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Bank lending to fossil fuel firms

Abstract

How do banks react to firms' climate risks? Using almost 80,000 global syndicated loans originated from 2001 to 2021, we study bank lending to fossil fuel firms vis-à-vis other firms. We find that loans to fossil fuel firms are at least 7% more costly compared to other firms, and even more so toward the end of our sample. However, loan amounts to fossil fuel firms are approximately 22% larger, implying heavy financing of brown activities. We show that the pricing effects are even stronger for banks with higher reliance on ESG considerations, consistent with the shifts driven by the supply side (bank behaviour). Overall, our findings corroborate the view that banks price in climate risks but continue to heavily lend to polluting firms in the medium term (with an average maturity of four and one quarter years).

Keywords: Fossil fuel lending, Syndicated loans, Bank lending, Oil and gas sector, ESG ratings

JEL classification: G20; G21; G32; Q40; Q43

1. Introduction

Banks have a pivotal role in addressing climate change risks, but lending to polluting firms remains robust. A report by the European Central Bank (ECB) and the European Systemic Risk Board (ESRB) (2023) shows that banks continue to lend disproportionately more to high-emitting sectors (75% higher than the shares of these sectors in economic activity). Without a shift of financing toward greener activities, including both innovative production technologies by existing polluting firms and greenfield investments, the green transition will be substantially delayed and climate-related risk can cause financial instability.

In this paper, we analyze the terms of bank lending, especially loan pricing, to fossil fuel firms vis-à-vis other firms. This research is important as the first step to identify how banks (i) view fossil fuel firms compared to other firms, (ii) price the climate risks that the production of these firms carry, (iii) alter their lending policy over time, and (iv) change their lending policy over ESG considerations. Several policy makers, international organizations, and the media highlight the importance of these issues and the supply-side behaviour of banks given the emergence of climate change at the center of public discourse.¹

Theoretically, banks should price the excess environmental risk carried by fossil fuel firms in the lending terms they offer to these firms. As the debate on climate change, the restrictive policies, and the associated risks may intensify over time, we expect that banks price in this risk more intensively. However, consistent with anecdotal evidence on this matter,² we also expect that banks continue to finance the activities of fossil fuel firms, especially given that these loans have a medium-term maturity (about four to five years), policy has not become

¹ See, e.g., ECB, 2024 at <https://www.ecb.europa.eu/ecb/climate/html/index.en.html>; U.S. banking regulators in a report by FDIC, 2023 at <https://greencentralbanking.com/2023/10/26/us-regulators-climate-related-financial-risk-guidelines-fdic-occ-fed/>; World Bank, 2024 at <https://www.worldbank.org/en/topic/climatechange>; several media articles (e.g., <https://www.ft.com/content/bbe1bae2-3deb-11ea-a01a-bae547046735>).

² See the Guardian, 2023 at <https://www.theguardian.com/environment/2023/jan/17/banks-still-investing-heavily-in-fossil-fuels-despite-net-zero-pledges-study> or Forbes, 2024 at <https://www.forbes.com/sites/feliciajackson/2024/05/13/banks-back-fossil-fuels-with-71-trillion/>.

extremely stringent despite the results of the Paris Agreement in 2015, and these firms continue to be highly profitable and sound on average, even before the emergence of the pandemic. This also places the role of ESG considerations of banks at the center of our analysis. We expect that banks with substantial ESG considerations charge even higher lending rates and limit loan amounts to fossil fuel firms more than other banks.

We answer our research questions using data from the syndicated loan market. This market is ideal for two key reasons. First, fossil fuel firms are large and require large credit volumes to sustain their operations. Syndicated loans are large loans of all types and purposes granted to numerous large companies of different industries, located in several countries with various levels of climate restrictions. The banks originating the syndicated loans are the key banks providing credit to large firms, including fossil fuel firms. This creates substantial heterogeneity in our fully representative sample to pinpoint answers to our research questions. Second, the structure of the syndicated loans with multiple banks (lead banks and participants) lending to a single firm, and each firm receiving loans across several years, is ideal to separate the supply-side model of banks from the demand-side model of firms. This allows identifying the business model of each lead bank (the setter of the lending terms) against fossil fuel firms in both a static (in each year) and a dynamic (over time) framework.

Our sample spans the period from 2001 to 2021 and includes approximately 80,000 observations (loan facilities), granted by more than 280 lead banks to approximately 7,500 firms. Our identification strategy considers the effect of a binary variable (equal to one for fossil fuel firms and zero for the rest of the firms) on loan spreads (the lending rate over the risk-free rate) and comes in two steps. First, consistent with identifying a loan supply equation, we consider both the loan price and the loan amount as outcome variables. A positive coefficient on the fossil fuel indicator on both variables is consistent with a positively-sloped loan supply equation, as opposed to a loan demand equation, which would imply opposite coefficient for a

negative slope. This comes in addition to the nature of our sample, which allows many control variables and fixed effects.

Second, consistent with our arguments on the role of the banks' ESG model, we expect that the loan pricing to fossil fuel firms will be more costly by banks with higher ESG scores. Thus, we identify shifts in the loan supply curve from observing a significant interaction between the fossil fuel dummy and the banks' ESG score, whereas the equivalent interaction with the firms' ESG score would indicate a strong demand-side effect. Overall, considering the above empirical implications, our results are consistent with a strong movement in loan spreads stemming primarily from the supply side, although the credit-demand mechanism is also operative under certain conditions.

Our baseline results show that loans to fossil fuel firms have on average, higher spreads by 13.5 basis points (or equal to 7.3% higher than the average loan in the sample). This implies additional interest payments by fossil fuel borrowers of approximately USD 5.6 million for the average loan size and maturity. In fact, from 2012 onward, the increase in loan spreads to fossil fuel firms intensifies in most years, reaching values of 20 basis points or higher. Consistent with the identification of a loan supply equation, we also find significantly larger loan amounts to fossil fuel firms, approximately by 22.3%. Thus, banks price climate risk via higher lending rates but continue to provide robust credit flows to fossil fuel firms. Among the other loan characteristics, we find a shorter loan maturity for fossil fuel firms, in line with the premise that banks avoid long-term exposure to these borrowers, potentially fearing increasing regulatory stringency.

We further conduct additional analyses to capture possible heterogeneities in our results by distinguishing between upstream and downstream borrowers, as these show different sensitivity to crude oil prices and the overall level of uncertainty (see Suenaga and Smith, 2011; Kumar and Rabinovitch, 2013; Blomkvist, Dimic and Vulcanovic, 2023). We indeed find that

the cost of loan financing is higher for fossil fuel borrowers operating in the upstream sector relative to downstream borrowers, unless upstream producers possess market power; we thus pinpoint the relevance of an additional demand-side effect on loan spreads, which operates through firm competition.

This prompts us to consider alternative demand-side explanations of our findings. Given this, we examine the heterogeneity of our results with respect to a number of firm fundamentals. Although the competition effect is generally still present, other characteristics, such as the minimization of uncertainty regarding borrowers' solvency through the existence of previous lending relationships, the access to alternative financing sources, and the investment in research and development (R&D) do not emerge as potential factors explaining the higher cost of credit for fossil fuel borrowers.

Given the relatively moderate explanatory ability of demand-side mechanisms, we shift our attention to regulatory initiatives. In this regard, we find that loans to fossil fuel borrowers are priced less competitively in the period following the Paris Agreement, as well as after the adoption of the European Green Deal; this provides an indication of lenders' first-order response to more stringent regulation.

A key identification mechanism but also driver of our findings is the lead banks' ESG score. Interacting the fossil fuel dummy with the lenders' ESG score, we find that loans granted by lenders with a high ESG score carry an even higher price. Specifically, a one standard deviation increase in the lender's ESG score increases the loan spread to fossil fuel firms by between 30.2% and 48.2%, depending on the ESG measure and specification employed. The equivalent demand-side specification with the borrowers' (instead of the lenders') ESG rating in the interaction term with the fossil fuel indicator produces non-statistically significant estimates. This is an important finding, corroborating the view that we identify a loan supply

equation and pinpointing the banks' ESG rating as an important mechanism driving our baseline findings.

The above mechanism is further supported by the examination of mandatory disclosure of companies' ESG activities as an exogenous shock to lenders' ESG demand (as in Wang, 2023). While the adoption of mandatory ESG disclosure in the lenders' countries causes lenders with better performance on ESG to charge a premium on loans to fossil fuel firms, the adoption in the borrowers' countries does not affect loan spreads, thereby confirming the importance of supply-side forces over demand-side. The shift in banks' lending behaviour after the adoption of mandatory ESG disclosure in the lenders' countries is further evident in that better-ESG lenders limit their long-term exposure to fossil fuel borrowers by providing loans with shorter maturity. This creates the need for banks to adjust their lending in favour of green borrowers, thereby avoiding increasing regulatory stringency.

Finally, we examine the motivation of banks to continue extending credit to fossil fuel firms, albeit in less competitive loan terms. We find that banks with greater share of syndicated loans to fossil fuel firms in their portfolio (in terms of amount and number of loans) generally achieve higher future profitability relative to banks with limited loan exposure to similar firms. This highlights banks' profit-maximizing efforts as an important driver of their decision to supply loan financing to these firms.

Placement in the literature and contribution. Our paper contributes to a large emerging literature on the pricing of climate risks by financial markets. The study closer to our objectives is Ehlers, Packer and De Greiff (2022), Degryse, Goncharenko, Theunisz and Vadasz (2023) and Delis, De Greiff and Ongena (2023), who examine the effect on loan pricing of the probability that fossil fuel reserves become stranded. Their findings show that this probability is not priced until the Paris Agreement, while banks charge a "carbon premium" on loans to

carbon-intensive borrowers from that time onward (Reghezza, Altunbas, Marques-Ibanez, d'Acri and Spaggiari, 2022, document a similar effect of the Paris Agreement). On the same line, Beyene, Delis, De Greiff and Ongena (2021) consider bond to loan substitution due to the risk of stranded fossil fuel reserves.

Takahashi and Shino (2023) focus on Japanese firms and find less lending to fossil fuel firms (opposite to what we document in western countries). Chava (2014) shows that lenders take into account the environmental concerns of firms leading to higher cost of equity and debt capital for firms, while Nguyen, Ongena and Sila (2022) focus on residential mortgage markets and show that lenders charge higher interest rates for mortgages on properties exposed to a greater risk of sea level rise.

A different, yet important area of focus examines the potential conflict of interests of banks as a key reason for their continuous financing of polluting activities. For example, Laeven and Popov (2023) document an increase in cross-border lending in response to higher climate policy stringency in home countries: following an exogenous increase in the price of carbon in the domestic market, banks reduce their fossil lending at home and increase it abroad.

Our study is different from the above in that it considers more generally and globally the loan supply decisions of banks to fossil fuel firms and the dynamics of these decisions over time along with their ESG considerations. Most importantly, it identifies the lenders of fossil fuel borrowers and examines under which conditions their loan supply decisions are subject to lenders' risk-return considerations. In this context, we document that banks continue to provide large credit volumes to brown operations for revenue-generating purposes, despite efforts mostly from lenders with high ESG considerations to further increase lending rates and decrease loan maturities; these act as risk-mitigating tools and are partially caused by the adoption of mandatory ESG disclosure requirements in the lenders' countries and the resulting public pressure that this entails.

Several other recent studies examine the interconnection between finance and climate change. Bolton and Kacperczyk (2023) find higher stock returns associated with higher levels and growth rates of carbon emissions in all sectors and most countries, with results being stronger for firms located in countries with lower economic development, larger energy sectors, and less inclusive political systems. Görden, Jacob, Nerlinger, Riordan, Rohleder and Wilkens, (2020) construct a carbon risk factor using global stock return differences between brown and green firms. Other international studies focus on ESG market effects (e.g., Dyck, Lins, Roth and Wagner, 2019; Gibson Brandon, Glossner, Krueger, Matos and Steffen, 2022). Besides the international studies, single country studies also examine market pricing of carbon risk (Chava, 2014; Ilhan, Sautner and Vilkov, 2018; Engle, Giglio, Kelly, Lee and Stroebel, 2020; Monasterolo and De Angelis, 2020; Hsu, Li and Tsou, 2023; Miguel, Pedraza and Ruiz-Ortega, 2024).

Further, several studies focus on market effects of adverse climate events (e.g., Bansal, Kiku and Ochoa, 2016; Hong, Wang and Yang, 2021; 2023). Compared to these market studies, our analysis focuses on banks, which are strategic creditors of firm investments and their ongoing operations (along with corporate bond markets). Thus, banks are potentially those that motivate the continuing brown operations, especially in light of the fact that most of the green investments are financed by venture capital (see, e.g., Mrkajic, Murtinu and Scalera, 2019; Dong, Li, Lv and Yu, 2021; Gambacorta, Polizzi, Reghezza and Scannella, 2023; Van den Heuvel and Popp, 2023).

Finally, our study is related to the emerging literature on ESG and bank lending. In this respect, our findings complement those of Houston and Shan (2022) and Shin (2023), who document that lenders' ESG profiles affect borrowers' ESG practices and performance through the loan renewal channel. From a similar perspective, banks with higher ESG engagement exhibit superior financial performance and reduced fragility during crises (Cornett, Erhemjants

and Tehranian, 2016; Chiaramonte, Dreassi, Girardone and Piserà, 2022; Danisman and Tarazi, 2024).

Recently, there is a growing focus on exploiting the greater level of cross-firm and industry data availability and scope offered by ESG disclosure scores (Liang and Renneboog, 2017). To this end, banks' climate-related disclosure commitment is associated with a notable improvement in the corporate environmental performance of their borrowers, especially for polluting borrowers (Hasan, Lee, Qiu and Saunders, 2023). The counterargument is that the lack of standardization, transparency and enforcement for ESG disclosures often leads to a discrepancy between these disclosures and bank lending decisions, suggesting that banks may employ ESG metrics to cover up continued lending to brown sectors (Christensen, Hail and Leuz, 2019; Grewal and Serafeim, 2020; Giannetti, Jasova, Loumioti and Mendicino, 2023; Wang, 2023). We contribute to this debate by identifying a supply-side mechanism, through which environmental disclosures are incorporated into bank lending choices.

Structure of the paper. Our paper proceeds along the following lines. Section 2 provides the details of our dataset and discusses the empirical model. Section 3 provides the baseline results, along with several robustness tests. Section 4 provides the mechanisms driving these results, with an emphasis on banks' ESG considerations. Section 5 concludes the paper.

2. Data and empirical model

We obtain data from various sources. We collect all syndicated loans (at the facility level) over the period 2001 to 2021 from the Refinitiv LPC DealScan database. DealScan contains the most comprehensive historical loan-deal information on the global syndicated loan market. We exclude all loans for which there is no conventional pricing (there is no loan spread data) and this removes some very specialized credit lines. We match the loan facilities with bank-year

and firm-year accounting characteristics from Compustat and macroeconomic and institutional (country-year) variables from several sources. Finally, we obtain information on companies' (lenders and borrowers) environmental, social, and governance (ESG) score from RepRisk. The number of observations for our baseline specifications ranges from 79,590 to 79,614, depending on the controls and the set of fixed effects used. Our preferred specification includes 79,614 facilities, granted by 286 lead lenders headquartered in 21 countries to 7,502 borrowers headquartered in 77 countries.³ We provide variable definitions and sources in Table A1 of the Internet Appendix and basic summary statistics in Table 1. Moreover, Table A2 presents the lenders' countries in our sample and the number of observations in our baseline regression.

[Insert Table 1 about here]

2.1. Empirical model and key variables

The baseline form of our empirical model is:

$$Cost\ of\ credit_{lt} = a_0 + a_1 Fossil\ fuel\ firm_{kt} + a_2 Controls_{kt} + u_{lt} \quad (1)$$

where $Cost\ of\ credit_{lt}$ measures the cost of loan facility l originated at time t . The most widely used measure is the all-in spread drawn ($AISD$), denoting the spread over LIBOR, although the recent literature (e.g., Berg, Saunders, Steffen and Streit, 2017) also highlights the importance of fees and all-in spread undrawn ($AISU$). $Fossil\ fuel\ firm$ is a binary variable equal to one if the borrower is an oil and gas company or a coal company, and zero otherwise. The vector a_0

³ Consistent with relevant studies on the syndicated loan market we only include information on lead lenders (see, e.g., Cai, Eidam, Saunders and Steffen, 2018; Santos and Winton, 2019; Delis, Hasan and Ongena, 2020). Lead lenders (arrangers) usually negotiate the key terms of the loan, hold a large stake in the loan and are responsible for pricing decisions and the key loan characteristics. Moreover, they are liable to participant banks (those invited to participate in the loan by buying a share) for the pricing of all relevant risks, and the effective screening and monitoring of borrowers (Sufi, 2007; Ivashina, 2009; Delis, De Greiff and Ongena, 2023). Despite the presence of any moral hazard issues in the syndicate's formation, lead lenders have additional reputational incentives to price loans accurately and bear any relevant reputational costs in case of mispricing (Sufi, 2007; Ivashina, 2009, Beyene, De Greiff, Delis and Ongena, 2021).

denotes different types of fixed effects, *Controls* is a vector of control variables of dimension k , and u is a stochastic disturbance.

Put simply, our identification strategy provides a direct comparison across two borrower types: fossil fuel firms and non-fossil fuel firms. The main coefficient of interest is α_1 , which shows the different cost of credit faced by fossil fuel borrowers relative to the rest. We expect α_1 to be positive and statistically significant if the nature of these borrowers matters for the determination of loan spreads and thus, increases the cost of credit for fossil fuel firms. In fact, Figure 1 depicts the coefficient on the interaction of our *Fossil fuel firm* indicator with a time (year) indicator from the regression for *AISD* according to the model specification of equation (1). We observe a consistently positive coefficient, reflecting the higher cost of credit faced by fossil fuel borrowers, which becomes even more evident after 2016.

[Insert Figure 1 about here]

In robustness tests, we replace the fossil fuel firm indicator with an alternative proxy for climate risk, namely the borrower's exposure to climate change by Sautner, Van Lent, Vilkov and Zhang (2023), calculated from transcripts of company quarterly earnings calls. This proxy captures the proportions of these earnings calls devoted to discussing climate change; as such, it reflects the investors' current attention to certain climate topics considered to be relevant for their investment decisions (see Sautner, Van Lent, Vilkov and Zhang, 2023).

2.2. Control variables and fixed effects

We use several control variables at the loan, lender, borrower, and country pair-level. Following the relevant literature (Ivashina, 2009; Almeida, Cunha, Ferreira and Restrepo, 2017; Hasan, Hoi, Wu and Zhang, 2017; Kim, 2019; Delis, Hasan and Ongena, 2020), we control for loan characteristics such as the log of the loan amount, loan maturity (in months), the number of lenders in the syndicate, dummies for the use of collateral, performance-pricing provisions, and

covenants. We also use loan type and purpose fixed effects; these are important as loan facilities include credit lines and term loans, which have fundamental differences in their contractual arrangements and pricing (Berg, Saunders and Steffen, 2016) and their purpose (e.g., corporate purposes, working capital, takeovers or acquisitions, debt repayment, etc.).⁴

We also control for the bank's total assets and bank's profitability (*Bank size* and *Bank ROA* respectively). To control for specific supply-side channels, we use variables reflecting the willingness and capacity of banks to supply loans. Thus, we introduce *Bank capital* (the ratio of bank capital over total assets), which is the most widely used measure of bank agency problems (see, e.g., Holmstrom and Tirole 1997; Dell'Ariccia, Laeven and Marquez, 2014; Delis, Iosifidi and Papadopoulos, 2022). We also include firm-year variables with the aim to specifically control for demand-side channels that might affect loan conditions. These variables include size (*Firm size*), leverage (*Firm debt*) and return on assets (*Firm ROA*). We also employ the ratio of tangible assets to total assets (*Firm tangibility*) and a measure of company valuation (*Firm Tobin's Q*).

To capture companies' tangible ESG impact instead of their public ESG image, we use the RepRisk dataset, following Houston and Shan (2022). RepRisk is an event-based dataset that provides ESG ratings formulated on negative ESG news since January 2007. Unlike the popular KLD dataset, RepRisk does not cover positive ESG information as those are often self-reported for branding and marketing purposes (see Li and Wu, 2020; Houston and Shan, 2022). On the regulatory front, we control for the introduction of a carbon tax in the lender's country, since this is associated with an increase in domestic banks' lending to fossil fuel borrowers in foreign countries (Laeven and Popov, 2023). Finally, we control for economic development

⁴ We identify the lender's and the borrower's country as the country in which the lender and the borrower are located, respectively. Where a loan is provided by the parent bank's foreign affiliate or subsidiary, the lender's country is set as the country of the affiliate/subsidiary. Similarly, for firms receiving loans through their foreign subsidiaries, we set the borrower's country as the country of the affiliate/subsidiary. For example, although Citibank (the parent bank) is headquartered in the US, for loans provided by Citibank International Plc, we set the lender's country as the UK.

and macroeconomic conditions in each country pair, by using the difference in the GDP growth rate and in the GDP per capita between the lender's and borrower's country (*GDP growth* and *GDP per capita* respectively). We provide detailed descriptions of these variables in Table A1.

Moreover, we use year and lender fixed effects. These complement our lender-level characteristics and allow us to control for possible time-invariant lender-specific explanations of our findings (e.g., credit risk and performance), that are not isolated by our control variables. We also control for changes in the macroeconomic environment in the lenders' and borrowers' countries, employing lender's country and borrower's country fixed effects, respectively. These saturate the effect of *Fossil fuel firm* on loan spreads from other country (socioeconomic and political) effects on bank lending;⁵ they additionally control for changes in monetary policy conditions.

In even more stringent specifications, we employ lender's country \times year fixed effects. These control for time-varying macroeconomic explanations of our findings. The regression still yields results on the main coefficient of interest because there are multiple loan facilities from lenders headquartered in the same country within each year. Similarly, through the use of borrower's country \times year fixed effects we isolate any within-year macroeconomic conditions in the borrower's country. Again, the regression is identified, since there are multiple loan facilities to borrowers headquartered in the same country in a given year. Our last set of fixed effects includes those at the quarter-level, which eliminates any undesired variation beyond the quarterly frequency not absorbed by our remaining fixed effects.

2.3 Summary statistics

⁵ These are country factors affecting all banks and firms within a country. Several studies examine such macro effects on international bank lending (e.g., Delis, Hasan and Ongena, 2020; and references therein), and in this study these effects are fully controlled for via the country fixed effects.

Table 1 reports key descriptive statistics. The number of loan facilities in our baseline specification is 79,614. The average *AISD* in our sample is 183.97 basis points, while the average loan amount is USD 942.00 million, and the average maturity is 52.72 months (4.39 years). The total number of loans granted to fossil fuel firms is 7,582 and these constitute approximately 9.5% of the full sample.

In Panels A and B of Table 2 we report summary statistics and the mean comparison test for key loan features and firm accounting characteristics for loans to fossil fuel firms vs. all other loans in our sample. We find that, on average, *AISD* is 12.64 basis points higher for loans to non-fossil fuel firms compared to fossil fuel firms (a difference also observed for the *AISU*). This difference is statistically significant at the 1% level. This stands in contrast to our baseline findings, confirming that univariate tests may hide unobserved cross-sectional and temporal heterogeneities of all borrowers at all periods, that can only be captured with multivariate fixed effect regression models. It further indicates that the pricing of loans to fossil fuel firms may be subject to supply-side forces related to banks' lending behavior.

We also observe that loans to fossil-fuel firms are generally larger, less likely to be secured with collateral, and have a shorter maturity. Finally, fossil fuel borrowers, although generally larger, they are less profitable and valued less relative to the rest. It is evident that loans to the two borrower groups exhibit notable differences. Given this, proper identification rests on the comparison of two different states: loans to fossil fuel firms vs. loans to non-fossil fuel firms, as well as separating supply-side and demand-side drivers of loan pricing.

[Insert Tables 1 and 2 about here]

Moreover, to control for the possibility that potential differences in the observable (and unobservable) characteristics between fossil fuel and non-fossil fuel firms might affect our results, we employ a matched sample in alternative specifications. Specifically, we match the fossil fuel firms and the other firms according to their fundamentals. In this framework, the set

of counterfactuals is restricted to the matched controls (non-fossil fuel firms), meaning that in the absence of the fossil fuel firm indicator, the two borrower groups should behave similarly: this alleviates any concerns that the higher borrowing costs of the fossil fuel borrowers are not attributed to their fossil fuel status.

3. Empirical results

3.1. Baseline results

Table 3 reports our baseline results with standard errors clustered by borrower. In line with our discussion in Section 2, we consider different fixed effects in our model specifications. Column (1) includes the simplest set of fixed effects, namely year, lender, and loan type and purpose fixed effects, while in column (2), we introduce lender's country and borrower's country fixed effects. We further add lender's country \times year fixed effects in column (3) to control for within-year macroeconomic and political developments in the lender's country, while the employment of borrower's \times year fixed effects in column (4) serves the same purpose for the borrower's country. Our more stringent specification is that of column (5), where we introduce quarter effects, which control for any remaining variations at the quarterly level.

[Insert Table 3 about here]

Across all specifications, the coefficient on *Fossil fuel firm* is positive and statistically significant; indicating the higher cost of credit for loans granted to these firms relative to their non-fossil fuel counterparts (also in line with our priors discussed in Section 2). We use column (2) as our baseline specification, since the given set of fixed effects captures the impact of the fossil fuel indicator on loan spreads, without being overburden with fixed effects. The main coefficient of interest α_1 shows that the *AISD* on loans to fossil fuel borrowers is on average 13.47 basis points (bps) higher relative to other loans. This is a large and economically significant effect, equal to a 7.3% ($= 13.47 \text{ bps} \div 183.97 \text{ bps}$) increase for the average loan in

our sample. Given that the average loan size is \$942.00 million, fossil fuel borrowers pay on average approximately USD 1.269 million ($= \$942.00 \text{ million} \times 13.47 \text{ basis points}$) more per year in interest payments. Considering that the average time to maturity is 4.39 years, this represents approximately USD 5.581 million in extra interest expenses over the loan's duration. Hence, we can infer that fossil fuel borrowers are faced with a substantially higher cost of loans compared to non-fossil fuel ones.

Further, in column (6), we replicate our baseline specification (column 2), by replacing *AISD* with *Loan amount* as dependent variable. This allows us to examine the effect on the quantity of loans. We observe a positive and statistically significant coefficient (at the 1% level) on *Fossil fuel firm*: specifically, these borrowers receive loans that are on average 22.3% ($= \exp(0.201) - 1) \times 1.00$) larger relative to other borrowers, implying heavy financing of brown activities. Thus, although banks price climate risk via higher lending rates, they continue to provide robust credit flows to fossil fuel firms.

However, fossil fuel borrowers may be more capital intensive relative to other firms, which may explain the fact that they receive larger loans.⁶ Hence, in column (7), we estimate lender-year regressions, where we employ as dependent variable the number of loans extended by the given lender in the year (*Number of loans*) and regress it on the lender's number of loans to fossil fuel borrowers (*Fossil fuel loans*) and various controls at the lender- and macro-level. The positive and statistically significant coefficient on *Fossil fuel loans* confirms that banks with exposure to fossil fuel borrowers increase their lending supply.

Overall, the size and magnitude of the estimated coefficients on the control variables in Table 3 are generally in line with expectations and the earlier works of Bae and Goyal (2009), Ivashina (2009), Cai, Eidam, Saunders and Steffen (2018) and Delis, Hasan and Ongena (2020).

⁶ A typical feature of the oil and gas sector is the presence of capital intensive companies; this often applies to the syndicated loan market, where we generally observe a positive relationship between firm size, firm capital intensity and/or tangibility and the amount of loan financing, either in the context of fossil fuel firms or non-fossil fuel firms (see Haselmann and Wachtel, 2011; Ehlers, Packer and De Greiff, 2022; Bogmans, Pescatori and Prifti, 2024).

Specifically, loan spreads increase with collateral, while decrease with loan amount, the number of lenders in the syndicate, and when performance provisions are included in the contract.⁷ Non surprisingly, large, more profitable and firms with high market valuation are associated with lower *AISD*, and more leveraged ones with higher loan rates. Bank characteristics generally appear immaterial for loan spreads (except for lender's size), while an increase in volatility (VIX index) and the imposition of a carbon tax raise spreads.

3.2. Additional results

Our results are also robust to several robustness tests, the results of which we report and discuss in the Appendix. Specifically, we estimate regressions with different sets of control variables (at the lender-, borrower- and country-level), different standard error clustering, a matched sample of fossil fuel and non-fossil fuel firms across different firm characteristics, and different weights based on the number of loans between given lender-borrower pairs and country-pairs. Moreover, we control for the simultaneous setting of loan level characteristics by estimating seemingly unrelated regressions. Finally, we employ the borrower's exposure to climate change as an alternative proxy for climate risk, replacing our fossil fuel firm indicator (see Sautner, Van Lent, Vilkov and Zhang, 2023).

3.3. Different loan types

An important feature of our sample is the extensive geographical representation of lenders and borrowers in DealScan. However, existing studies point to contractual differences in the pricing between US and European syndicated loans (see Berg, Saunders, Steffen and Streitz, 2017), as well as between loans from US lenders and non-US lenders (see Giannetti and Ongena, 2012).

⁷ The imposition of collateral is often associated with higher loan spreads, because it is generally included in loan contracts for riskier borrowers (see, e.g., Ivashina, 2009; Amiram, Beaver, Landsman and Zhao, 2017).

Given this, a natural question is whether loans to fossil fuels firms are priced uniformly regardless of the lender's or borrower's origin.

To examine this, in column (1) of Table 4 we interact *Fossil fuel firm* with an indicator for US loans, whereas in column (2) we consider its interaction with an indicator for European loans.⁸ Either column confirms the higher cost of credit for fossil fuel borrowers, which ranges between 13.3 and 18.7 basis points. Nonetheless, we do not observe any differences in *AISD* based on the origin of the loans (the non-statistically significant coefficients in both interaction terms).

Moreover, estimates from column (3) show that there is no additional premium on loans granted from US lenders vs. loans granted from non-US lenders. Finally, we assess whether lenders' home bias in favour of domestic borrowers (as in Haselmann and Wachtel, 2011) is further evident in loans to fossil fuel borrowers. To this end, in column (4) we distinguish between loans where both counterparties are headquartered in the same country (domestic loans) and loans where counterparties operate in different countries (foreign loans). Although we confirm the higher spread on fossil fuel loans, there is no evidence of preferential treatment of domestic fossil fuel borrowers at the expense of foreign fossil fuel borrowers.

[Insert Table 4 about here]

3.4. *Upstream vs. downstream borrowers*

To further identify patterns in the pricing of loans to fossil fuel firms, we examine upstream borrowers vis-à-vis downstream borrowers. Upstream companies generally differ from other companies in the oil and gas sector due to their sensitivity to crude oil prices (see Kumar and Rabinovitch, 2013; Blomkvist, Dimic and Vulcanovic, 2023). Upstream producers engage in exploration and production and sell their output on the physical market; as such, their operations

⁸ In all specifications including double or triple interactions, we include the full interaction of all terms; however, for expositional brevity, we only report the coefficients on the terms of interest.

and cash flows are more sensitive to fluctuations in energy prices.⁹ In contrast, downstream refiners focus on refining and marketing, and gain from the differences between wholesale prices and retail prices (Suenaga and Smith, 2011); this allows them to transfer part of the price variation to their customers, making them more resilient to uncertainty. Therefore, we expect that the cost of loan financing is lower for downstream companies relative to upstream.

To examine this premise, in Table 5 we interact *Fossil fuel firm* with indicators for upstream and downstream borrowers (columns 1 and 2 respectively). In either specification, the coefficient on the main term of *Fossil fuel firm* is positive and statistically significant and even exceeds our baseline estimates. Moreover, although the coefficient on the interaction with *Upstream* is below conventional levels of statistical significance (column 1), that on the interaction with *Downstream* comes with a negative and statistically significant sign (column 2). This indicates that downstream borrowers are able to recover approximately 9.0 basis points from the initial spread increase relative to upstream borrowers.

[Insert Table 5 about here]

In theory, upstream firms should also be able to transfer part of the variation in energy prices to their customers, namely downstream firms; this however presupposes that upstream firms have a competitive advantage over their competitors. For instance, larger firms might possess market power making an increase in loan spreads by banks less likely. Given this, we construct indicators for upstream fossil fuel firms with values of size and level of sales above and below the sample mean (*High firm size* and *High firm sales*, respectively).

We then interact each of these indicators with *Fossil fuel firm* \times *Upstream fossil fuel firm* in columns (3) and (4) of Table 5. Estimates from either column reveal that larger upstream fossil fuel firms with a high market share are able to reverse almost fully the generic increase in *AISD* on loans to upstream producers. Therefore, we pinpoint the role of firm size for loan

⁹ The counterargument is that upstream producers possess market power, which often encourages oligopolistic behaviour (Huppmann and Holz, 2012).

price setting, as most of the increase to upstream fossil fuel borrowers is concentrated in firms with less market power. This highlights an additional demand-side effect on loan spreads, which operates through firm competition.

3.5. Other loan terms

An extension of our empirical analysis relates to the response of the remaining loan terms, as these are frequently employed as complements to the loan spread. To this end, we sequentially estimate our baseline specification with each of the remaining loan terms as dependent variables (and including *AISD* in our set of control variables). In column (1) of Table 6, we examine the role of loan fees, since we expect that fossil fuel borrowers are further faced with increasing cost of loans through higher fees. However, data on fees is generally limited since several loans (especially outside the U.S.) are term loans that have limited fees. Nevertheless, in column (1), we replicate our baseline specification with *AISU* as the dependent variable; estimates point to a positive and statistically significant effect of *Fossil fuel firm* on *AISU*. Thus, it seems that the characteristic nature of fossil fuel firms is further priced in the undrawn portion of the loan.

[Insert Table 6 about here]

In column (2), we examine the effect on the maturity of loans. We find that fossil fuel borrowers obtain loans of shorter maturity which is on average 3.1% or 1.7 months less relative to their non-fossil fuel counterparts. This appears to be in line with the premise that banks avoid long-term exposure to the fossil fuel firms due to increasing regulatory stringency. Turning to the remaining columns, we observe that there are no additional security requirements for fossil fuel firms, either in the form of collateral and covenants (columns 3 and 5 respectively), or by sharing risk among a greater number of lenders in the syndicate (column 4).

Results from this exercise complement our baseline findings, revealing that the higher cost of credit on loans to fossil fuel borrowers extends to the maturity but not the security of loanable funds, providing these borrowers with continuous access to syndicated loan financing.

3.6. Regulatory interventions and banking crises

In this section we examine potential differences in the pricing of loans to fossil fuel firms before and after certain regulatory initiatives. The first of these, refers to the 2015 Paris Agreement. While the risk of fossil fuel reserves was initially considered to be of a relatively long-term nature, the 2015 Paris climate agreement made evident that the policy initiatives to address climate change should be accelerated. Therefore, we expect that lenders price less competitively loans to fossil fuel firms after this agreement. We test this in Table 7, where we initially focus on the subsample of loans before and after 2016 (i.e., before and after the year where Paris Agreement was effective).

[Insert Table 7 about here]

Estimates from column (1) show that the positive and statistically significant coefficient on *Fossil fuel firm* is equal to 7.9 bps in the pre-Paris Agreement period, while it surges to 20.6 bps in the post-agreement period (column 2). Further, specification (3) includes the interaction of *Fossil fuel firm* with an indicator for the post-agreement period: the coefficient on the main term of our fossil fuel firm indicator is statistically significant, amounting to 8.4 basis points. Importantly, an increase of an almost equal magnitude (8.5 bps) is attributed to the post-agreement period, based on the positive and statistically significant coefficient on the double interaction with *Paris Agreement*.

Further, in columns (4) to (6) we compare the period before and after the European Parliament voted in support of the European Green Deal (January 15, 2020), which aims at making the European Union climate neutral by 2050. Many Euro Area banks have considerable

loan exposure to firms operating in energy-intensive sectors, since these loans are an important source of interest income (European Central Bank, 2024). The evolving regulatory environment increases the scrutiny of stakeholders as to banks' exposures to climate change; hence, banks face elevated litigation and reputation risks due to these exposures, especially if borrowers do not transit towards low-carbon production operations (Martini, Sautner, Steffen and Theunisz, 2024). Given the above, we expect transition risk to be priced in the financial institutions' loans that are subject to this regulation.¹⁰

To examine this premise, we construct an indicator that is equal to one for the post-voting period and if the lender is headquartered in EU (columns 4 and 5) or the borrower is headquartered in the EU (column 6). Estimates from all three columns confirm the higher cost of credit after the voting of the deal (the positive and statistically significant coefficients on the double interaction terms), which is over and above the generic increase on loans to fossil fuel borrowers (the coefficient on the main term of *Fossil fuel firm*). However, this increase is less pronounced for loans directed to US borrowers, as reflected in column (5) and the negative and statistically significant coefficient on *Fossil fuel firm × EU Green Deal (Lender's country) × US borrower*. This reveals that the aggravating effect of the regulation is mainly concentrated in loans to European borrowers.

Finally, in the next specification we control for the evolution of banking crises. During these crises, banks experience negative shocks due to actual or anticipated losses and liquidity problems, which further affect their loan supply. To examine whether these negative shocks to bank net wealth differentially impact loans to fossil fuel borrowers, we interact *Fossil fuel firm* with an indicator about whether the lender's country experiences a systemic banking crisis.

¹⁰ Due to this regulation, banks across all Euro Area countries are gradually incorporating climate-related risks in their risk assessments, further directing funds to more sustainable investments (European Banking Authority, 2023). This indicates that at first, the effect of the regulation is relatively homogeneous across the Euro Area.

Estimates from column (7) confirm the generic spread increase for fossil fuel borrowers, which is independent of the emergence of a banking crisis in the banks' home country.

4. Mechanisms

4.1 Borrowers' fundamentals

We initially examine potential demand-side explanations of our findings and identify certain firm traits that may drive our results. To this end, Table 8 includes the interaction of *Fossil fuel firm* with various firm characteristics, reflecting size, the existence of lending relationships, access to alternative financing sources, and investment in R&D.

We first consider the role of firm size, also given the findings in Section 3.4, where the increase in the spreads of loans to upstream fossil fuel borrowers is reversed for the largest producers; we further examine this for the full sample of fossil fuel borrowers, since in theory large firms might seek credit elsewhere more easily, thereby avoiding a potential loan spread increase. Although specification (1) reveals that large fossil fuel firms are not able to offset the higher spread, this is overturned in column (2), where we differentiate between firms with size above and below our sample mean. Specifically, the coefficient on *Fossil fuel firm* \times *High firm size* is negative and weakly statistically significant: this provides moderate evidence of a demand-side mechanism that operates through the competition of the largest fossil fuel firms in our sample.

[Insert Table 8 about here]

Next, we consider measures reflecting the superior information that banks may possess regarding the riskiness of fossil fuel firms. These measures reflect the existence and magnitude of a prior lending relationship between the lender and the borrower during the previous 5-year period (see Bharath, Dahiya, Saunders and Srinivasan, 2011).¹¹ Prior lending relationships

¹¹ From a different perspective, the number of borrowers that receive credit from at least two banks in the same year amounts to 2,435 and are associated with 11,254 loans, representing approximately 14.6% of our sample.

allow lenders to acquire valuable information about the borrowing firm's operations and credit risk. As such, we hypothesize that fossil fuel borrowers with prior lending ties with their banks are able to offset the generic loan spread increase due to their fossil fuel firm status. However, our estimates in columns (3) and (4) reject this premise, since we find no differences in loan spreads between relationship and first-time fossil fuel borrowers.

We subsequently examine the existence of alternative financing sources by measuring borrowers' access and reliance on the bond market. Typically, high-disclosure firms exhibit a greater propensity to raise funds in public debt markets (see Bharath, Sunder and Sunder, 2008; Dhaliwal, Khurana and Pereira, 2011). Moreover, the bond market may serve as a substitute for bank financing, particularly for fossil fuel firms, enabling them to avoid an increase in their loan spreads (see Beyene, De Greiff, Delis and Ongena, 2021).

Given the above, in the next two columns of Table 8, we employ an indicator of whether the borrower has at least one bond outstanding in the year and the ratio of bond-to-loan financing (columns 5 and 6, respectively). In either specification the main term of *Fossil fuel firm* enters with a positive and statistically significant coefficient, verifying the higher *AISD* for fossil fuel firms; this exists over and above the borrower's access to bond financing (the non-statistically significant coefficients on both interaction terms).

Finally, in the remaining columns of Table 8 we test for potential differences in the price of loans between more and less innovative fossil fuel firms based on their spending on research and development. Arguably, fossil fuel borrowers participating in innovative projects may receive preferential loan rates from lenders relative to non-innovative borrowers, although the relatively high risk of these projects may also be priced in the loan contracts. To examine the direction of the effect – if any – we interact our fossil fuel indicator with the borrower's R&D expense and an indicator for a borrower being above the sample mean in terms of R&D expense (columns 7 and 8, respectively). While estimates from either specification confirm the higher

cost of credit of fossil fuel firms, they do not provide evidence that this is contingent on their investment in R&D (the non-statistically significant coefficients on either interaction term).

4.2. ESG considerations

Banks increasingly integrate ESG criteria into their loan supply considerations; in fact, lenders are concerned about their own reputation and social capital, and often fear that this may be diminished by lending to borrowers with low performance on ESG aspects. Due to the potential hit in their reputation because of dealings with poor-ESG borrowers, these lenders may find it difficult to engage future business in other areas (Homanen, 2018; Houston and Shan, 2022). Moreover, banks are also the subject of public pressure and increased regulatory scrutiny. This provides them with a strong incentive to reduce negative reputational incidents relating to their own operations, as well as those of their borrowers. Given this, we hypothesize that lenders with better ESG-related ratings can charge an additional premium on loans to fossil fuel borrowers. This test, besides revealing how banks change their lending policy over ESG considerations, it further enables us to separate the supply-side model of banks from the demand-side model of firms.

We examine this in column (1) of Table 9, where we employ the interaction of our fossil fuel firm indicator with the lender's ESG score, based on the RepRisk index (RRI). To make interpretation easier, we modify the original index from RepRisk by multiplying it with (-1) , so a higher score means a stronger ESG performance. According to our estimates, loans to fossil fuel borrowers are 8.7 basis points more expensive relative to loans to other borrowers (the coefficient on the main term of *Fossil fuel firm*). Importantly, loans carry an additional premium when they are granted from banks with better performance on ESG criteria: a one standard deviation increase in *Lender's ESG* (equal to 17.49) raises *AISD* by 4.2 basis points for loans to fossil fuel firms (the coefficient on *Fossil fuel firm* \times *Lender's ESG*).

These results are confirmed and even magnified in column (2), where we consider the lender's ESG adjusted for the ESG score of all lenders in the banking sector: specifically, a one standard deviation increase in lender's ESG score is associated with a 4.0 bps higher spread, on top of the generic increase of 13.2 bps attributed to the fossil fuel firm indicator (the coefficients on *Fossil fuel firm* \times *Lender's ESG (adjusted)* and *Fossil fuel firm* respectively). On the other hand, the borrower's ESG is not material for lenders' loan pricing decisions, as the coefficient on the interaction including *Borrower's ESG* is below conventional levels of statistical significance (column 3). We further confirm this in column (4), where we include both lender's and borrower's ESG score in the same regression.

[Insert Table 9 about here]

We further examine the impact of mandatory ESG disclosure regulations, which require companies to disclose information about the ESG impacts of their operating, investing, and financing activities (see Wang, 2023). As the purpose of these regulations is to encourage companies to increase their ESG engagement, they impose public pressure on banks, inducing them to improve their ESG performance by diverting their lending to green firms instead of fossil fuel ones (see Grewal, Riedl and Serafeim, 2019). Specifically, the adoption of mandatory ESG disclosures in the lender's country might influence lenders' ESG ratings and improve the screening process of lenders (Danisman and Tarazi, 2024; Gehrig, Iannino and Unger, 2024). In our context, they might induce lenders to select better borrowers (in order to improve their own ESG characteristics) and/or provide more expensive financing to borrowers with worse ESG performance.¹²

We examine the above in columns (5) and (6) of Table 9, where we interact *Fossil fuel firm* with an indicator about the adoption of mandatory ESG disclosure in the lender's country (column 5) and the borrower's country (column 6) from Krueger, Sautner, Tang and Zhong

¹² Although the EU Green Deal and the mandatory ESG disclosure have ultimately similar purposes, they differ significantly with respect to their implementation dates and the countries concerned in our sample.

(2024).¹³ Estimates from column (5) confirm the higher cost of credit for fossil fuel firms on loans from lenders with higher ESG scores (the positive and statistically significant coefficients on *Fossil fuel firm* \times *Lender's ESG adjusted*).

Importantly, this cost is magnified if the lender's country requires the mandatory disclosure of companies' ESG activities (including the lenders' ESG activities); this is reflected in the positive and statistically significant coefficient on *Fossil fuel firm* \times *Lender's ESG adjusted* \times *ESG disclosure (Lender's country)*. Arguably, the requirement to disclose their ESG scores, causes lenders with better performance on ESG to charge a premium on loans to fossil fuel borrowers. Hence, better-ESG banks exhibit a stronger response to regulation, since they are less likely to engage in greenwashing, relative to banks with worse ESG performance, which offer significantly lower loan spreads to high-ESG borrowers to improve their ESG reputations (see Kim, Kumar, Lee and Oh, 2022; Huang, Bui, Hsu and Lin, 2024). On the other hand, the adoption of mandatory ESG disclosure in the borrower's country does not appear to influence lenders' loan pricing considerations (the non-statistically significant coefficient on the triple interaction term in column 6), revealing the limited potency of demand-side forces.

In the next two columns we replicate the estimations of specifications (5) and (6) with *Loan maturity* as dependent variable. Results from either column confirm the consistently negative effect of the fossil fuel firm indicator on the maturity of loans (the negative and statistically significant coefficient on the main term of *Fossil fuel firm*). Moreover, this effect is contingent on the lender's ESG score and it is magnified in the period after the mandatory disclosure of ESG activities in the lender's country (based on the coefficients on *Fossil fuel*

¹³ The dataset of ESG disclosure mandates is compiled through the collection of information on countries' ESG regulations. This information refers to data on countries' policies relating to the voluntary or mandatory reporting of ESG-related information. The information is derived from governments, stock exchanges, and the media in order to cross-check the accuracy of the information. In most of the cases, countries adopt mandatory disclosure all at once, i.e., the disclosure of all components of ESG activities (E, S, and G). In some cases, the disclosure of a specific component (e.g., E) precedes or supersedes the implementation of the other(s). For a detailed information on the compilation of the dataset, see Krueger, Sautner, Tang and Zhong (2024).

firm × *Lender's ESG adjusted* and *Fossil fuel firm* × *Lender's ESG adjusted* × *ESG disclosure* (*Lender's country*) respectively).

Finally, we conduct additional estimations, where we replicate the analysis of Table 9 by i) using ESG scores from Refinitiv¹⁴ and ii) replacing the ESG score from RepRisk with its environmental component and further considering the adoption of mandatory environmental disclosure (E disclosure). Estimates from these alternative specifications are presented in Tables A10 and A11, respectively in the Appendix. They reveal that the lender's ESG scores (E scores) exert an aggravating and easing effect respectively, on the spreads and maturity of loans to fossil fuel borrowers, which is magnified with the adoption of mandatory ESG disclosures (E disclosures) in the lender's country.

Altogether, results from this exercise confirm that lenders incorporate ESG criteria into their lending considerations. To this end, better-ESG lenders are not willing to engage with fossil fuel borrowers, unless they are compensated in the form of higher loan spread or they limit their long-term exposure to these borrowers by providing loans with shorter maturity. This pinpoints the banks' ESG rating as an important mechanism driving our baseline findings. The respective mechanism is further supported by the adoption of mandatory ESG disclosure in the lenders' countries, which creates the need for banks to adjust their lending in favour of green borrowers, thereby avoiding increasing regulatory stringency. This in turn is consistent with a shift in the loan supply curve related to banks' lending behaviour, that prevails over a demand-side effect.

4.3. Lenders' subsequent ESG score

Given the above findings about lenders' sensitivity regarding their ESG scores, we now evaluate the extent to which lenders adjust their loan portfolio to improve their ESG score after

¹⁴ By construction, higher values in ESG scores from Refinitiv mean stronger ESG performance.

extending loans to fossil fuel borrowers. Existing evidence shows that banking relationships promote ESG policies (see Houston and Shan, 2022). Moreover, negative news coverage of companies' climate-related actions affects lenders' reputational concerns, which consequently cause banks to undertake actions that influence their ESG profile (see Hrazdil, Anginer, Li and Zhang, 2024). It follows that the degree of banks' loan exposure to carbon-intensive companies exerts an impact on their ESG score.¹⁵

In this regard, banks are more likely to grant loans to borrowers with ESG profiles similar to their own, or when this is not possible, engage in practices to positively influence their borrower's, as well as their own subsequent ESG performance (Houston and Shan, 2022; Shin, 2023). Thus, it is possible that lenders alter their mix of loans in order to improve their ESG score as a response to extending loans to fossil fuel borrowers.

In Table 10, we estimate lender-year-level regressions to examine the subsequent lending behaviour of lenders that have outstanding loans to fossil fuel firms. Specifically, we assess whether these lenders adjust their lending towards better-ESG borrowers, as well as whether they increase their own ESG score. To accomplish this, we create an indicator for lenders that granted loans to at least one fossil fuel borrower in the previous year; the resulting variable (*Loan to fossil fuel firm*) takes the value of one for lenders to fossil fuel borrowers, and the value of zero otherwise.

[Insert Table 10 about here]

In column (1) we employ as dependent variable the average ESG score of borrowers on all loans by a given lender in the current year (*Average borrower ESG*), with higher values reflecting better performance on ESG. We observe that the coefficient on *Loan to fossil fuel firm* is positive but only weakly statistically significant, providing a moderate indication that

¹⁵ Existing studies document an essential link between banks' carbon risk exposure and their ESG activities (see Chih, Chih and Chen (2010), Cornett, Erhemjants and Tehranian (2016), Dimitras, Mitsi and Zopounidis (2024) with respect to bank loans, and Bedendo, Nocera and Siming (2023) with respect to bank bond issues).

lenders adjust their lending towards borrowers with better ESG ratings. The next specification employs as dependent variable the change in the lender's ESG score over a 2-year window, extending from the year before when lender granted at least one loan to a fossil fuel borrower to the year after (*Change in lender's ESG*). We notice that lenders of fossil fuel borrowers improve their ESG score in the following year, suggesting that lenders care about improving their own ESG score. Importantly, estimates from column (3) show that the difference between the lender's ESG score and the average ESG score of borrowers on all lender loans over the same 2-year window decreases, an indication that lenders positively influence the borrower's subsequent ESG performance (a finding in line with Houston and Shan, 2022).¹⁶

Overall, findings from this exercise complement those of Section 4.2, confirming lenders' concerns about the impact of their lending practices on their ESG score. Moreover, they uncover an additional aspect of lender-borrower relationships, where lenders to fossil fuel companies subsequently adjust their loan portfolios towards better-ESG borrowers.

4.4. Lenders' portfolio considerations

Our next exercise concerns the identification of lenders that are more likely to engage with fossil fuel borrowers. We hypothesize that lenders accustomed to doing business with these borrowers would be more willing to extend loan financing, even at the expense of higher loan spreads. To test the above premise, we initially conduct loan-level regressions with *AISD* as dependent variable to assess whether lenders with prior experience in lending to fossil fuel firms indeed charge higher loan rates. We create a measure of fossil fuel loan share, by calculating the total amount of loans to fossil fuel borrowers in the lender's portfolio as share of the lender's

¹⁶ The vast majority of lenders in our sample are bank lenders; nevertheless, we further estimate the regressions in columns (2) and (3) by controlling for potential differences between bank and non-bank lenders, through the use of the corresponding indicator as control variable or through the relevant fixed effects.

total amount of loans to all borrowers (*Fossil fuel loan share*). We then interact this with our fossil fuel firm indicator.

Based on our estimates from column (1) in Table 11, lenders with high proportion of loans to fossil fuel borrowers in their portfolio charge a premium on loans to these borrowers; importantly this is over and above the generic spread increase for loans to fossil fuel firms (the positive and statistically significant coefficients on *Fossil fuel firm* \times *Fossil fuel loan share* and *Fossil fuel firm* respectively). We obtain similar results in column (2), where we consider the number of fossil fuel loans to total loans.

[Insert Table 11 about here]

Next, we resort to lender-year-level regressions to estimate the probability that lenders with a high share of loans to fossil fuel borrowers in the previous year are more likely to provide at least one loan to such borrowers in the following year. We employ as dependent variable a binary variable that is equal to one if in the current year the lender granted at least one loan to a fossil fuel firm, and equal to zero otherwise. We then regress this on our measures of lender's fossil fuel loan share (*Fossil fuel loan share* and *Fossil fuel loan share (number)* in columns 3 and 4 respectively). Results from either specification suggest that a higher proportion of loans to fossil fuel firms (in terms of amount and/or number of loans) in the lender's portfolio increases the probability that the lender provides loan financing to fossil fuel borrowers.

We conclude that lenders with good knowledge of fossil fuel borrowers (reflected by higher shares of loans to this industry in their portfolio) are more likely to provide syndicated loan financing. This complements the analysis in Sections 4.2 and 4.3, giving rise to arguments that banks might not substantially value their corporate clients' ESG activities relative to public debt holders (see Krueger, Sautner and Starks, 2020; Bauer, Ruof and Smeets, 2021). However, this revenue-generating tactic comes at the expense of higher loan spreads, serving as an

indication that lenders' loan supply decisions regarding fossil fuel borrowers are subject to lenders' risk-return considerations.

4.5. Future performance of lenders to fossil fuel firms

Having analyzed the mechanisms through which banks provide loan financing to fossil fuel firms, a natural question arising is why banks continue to extend credit to these firms, even at the form of a higher loan spread. We expect this practice of lenders to be primarily stemming from profit-generation considerations. In fact, carbon-intensive projects have generally higher profit margins, making them difficult to divest, particularly since banks are often reluctant to explicitly commit to the decarbonization of their loan portfolio, as this entails certain cost-benefit tradeoffs (Kacperczyk and Peydró, 2022; Reghezza, Altunbas, Marques-Ibanez, d'Acri and Spaggiari, 2022).

We examine this premise in columns (5) and (6) of Table 11, where we estimate lender-year regressions and employing as dependent variable a forward measure of bank profitability. Specifically, we condition the average value of bank's return on assets in the 2-year ahead period on the bank's fossil fuel loan share and a number of relevant control variables. Results from both columns reveal that greater proportion of loans to fossil fuel firms (in terms of amount and number of loans, respectively) in the lender's portfolio is associated with an increase in bank's forward return on assets relative to banks with limited loan exposure to these firms.

The above findings designate banks' profitability considerations as an important driver of their willingness to continue providing syndicated loan financing (albeit in less competitive terms) to fossil fuel firms.

5. Conclusions

In this paper, we examine how large banks lend to large fossil fuel firms during the period 2001 to 2021, using a large sample of global syndicated loans. Our key findings are that banks price in the climate risks of fossil fuel firms (in the form of higher credit cost and shorter maturity) but their loans are considerably larger. Overall, banks continue to provide large credit volumes to brown operations, despite efforts mostly from banks with high ESG considerations to further increase lending rates and decrease loan maturities.

These efforts are partially caused by the adoption of mandatory ESG disclosure requirements in the lenders' countries, and the resulting public pressure on banks to improve their ESG performance by diverting their lending to green firms at the expense of fossil fuel firms. However, banks with greater loan exposure to fossil fuel firms are generally associated with higher future profitability relative to banks with limited exposure, highlighting profit-maximizing considerations as an important driver of banks' willingness to continue extending credit to these firms, albeit in less competitive loan terms.

Our results are aligned with increased stringency in the regulatory policy that has recently been imposed by banks, especially in Europe and the United States. However, these regulations do not seem to achieve any objective of curtailing lending to fossil fuel companies, which is increasing. On that line, our results seem to favor a more direct intervention in credit flows and/or the purpose of loan provision. We leave a more direct examination of these issues to future research.

References

- Almeida, H., Cunha, I., Ferreira, M. A. and Restrepo, F. (2017). The real effects of credit ratings: The sovereign ceiling channel. *The Journal of Finance* 72, 249-290.
- Amiram, D., Beaver, W. H., Landsman, W. R. and Zhao, J. (2017). The effects of credit default swap trading on information asymmetry in syndicated loans. *Journal of Financial Economics*, 126(2), 364–382.
- Bae, K.H. and Goyal, V.K. (2009). Creditor rights, enforcement, and bank loans. *The Journal of Finance* 64, 823-860.
- Bansal, R., Kiku, D. and Ochoa, M. (2016). Price of long-run temperature shifts in capital markets (No. w22529). National Bureau of Economic Research.
- Bauer, R., T. Ruof, and P. Smeets (2021). Get Real! Individuals Prefer More Sustainable Investments. *The Review of Financial Studies* 34 (8), 3976–4043.
- Bedendo, M., Nocera, G. and Siming, L. (2023). Greening the financial sector: Evidence from bank green bonds. *Journal of Business Ethics*, 188(2), 259-279.
- Berg, T., Saunders, A. and Steffen, S. (2016). The total cost of corporate borrowing in the loan market: Don't ignore the fees. *The Journal of Finance* 71, 1357-1392.
- Berg, T., Saunders, A., Steffen, S. and Streit, D. (2017). Mind the gap: The difference between US and European loan rates. *The Review of Financial Studies* 30, 948-987.
- Beyene, W., De Greiff, K., Delis, M. D. and Ongena, S. (2021). Too-big-to-strand? Bond versus bank financing in the transition to a low-carbon economy.
- Bharath, S.T., Dahiya, S., Saunders, A. and Srinivasan, A. (2011). Lending relationships and loan contract terms. *The Review of Financial Studies* 24, 1141-1203.
- Bharath, S. T., Sunder, J. and Sunder, S. V. (2008). Accounting quality and debt contracting. *The Accounting Review*, 83(1), 1-28.
- Blomkvist, M., Dimic, N. and Vulcanovic, M. (2023). Oil price uncertainty and IPOs. *The Energy Journal*, 44(6).
- Bogmans, C., Pescatori, A. and Prifti, E. (2024). The impact of climate policy on oil and gas investment: Evidence from firm-level data. *European Economic Review*, 165, 104750.
- Bolton, P. and Kacperczyk, M. (2023). Global pricing of carbon-transition risk. *The Journal of Finance*, 78(6), 3677-3754.
- Cai, J., Eidam, F., Saunders, A. and Steffen, S. (2018). Syndication, interconnectedness, and systemic risk. *Journal of Financial Stability*, 34, 105-120.
- Chava, S. (2014). Environmental externalities and cost of capital. *Management Science*, 60(9), 2223-2247.
- Chiaromonte, L., Dreassi, A., Girardone, C. and Piserà, S. (2022). Do ESG strategies enhance bank stability during financial turmoil? Evidence from Europe. *The European Journal of Finance*, 28(12), 1173-1211.
- Chih, H. L., Chih, H. H. and Chen, T. Y. (2010). On the determinants of corporate social responsibility: International evidence on the financial industry. *Journal of Business Ethics*, 93, 115-135.
- Christensen, H. B., Hail, L. and Leuz, C. (2019). Adoption of CSR and sustainability reporting standards: Economic analysis and review (Vol. 623, pp. 1-121). Cambridge, MA, USA: National Bureau of Economic Research.
- Cornett, M. M., Erhemjamts, O. and Tehranian, H. (2016). Greed or good deeds: An examination of the relation between corporate social responsibility and the financial performance of US commercial banks around the financial crisis. *Journal of Banking and Finance*, 70, 137-159.
- Danisman, G. O. and Tarazi, A. (2024). ESG activity and bank lending during financial crises. *Journal of Financial Stability*, 70, 101206.

- Degryse, H., Goncharenko, R., Theunisz, C. and Vadasz, T. (2023). When green meets green. *Journal of Corporate Finance*, 78, 102355.
- Delis, M. D., De Greiff, K. and Ongena, S. (2023). Being stranded with fossil fuel reserves? Climate policy risk and the pricing of bank loans.
- Delis, M.D., Hasan, I. and Ongena, S. (2020). Democracy and credit. *Journal of Financial Economics*, 136, 571-596.
- Delis, M. D., Iosifidi, M. and Papadopoulos, P. (2022). Blessing or curse? Government funding of deposit insurance and corporate lending. *Journal of Financial Stability*, 61, 101022.
- Dell’Ariccia, G., Laeven, L. and Marquez, R. (2014). Real interest rates, leverage, and bank risk-taking. *Journal of Economic Theory*, 149, 65-99.
- Dhaliwal, D. S., Khurana, I. K. and Pereira, R. (2011). Firm disclosure policy and the choice between private and public debt. *Contemporary Accounting Research*, 28(1), 293-330.
- Dimitras, A. I., Mitsi, C. C. and Zopounidis, C. (2024). Does firm carbon risk matter to banks? Evidence from the US syndicated loan market. *Journal of Environmental Management*, 368, 122249.
- Dong, W., Li, Y., Lv, X. and Yu, C. (2021). How does venture capital spur the innovation of environmentally friendly firms? Evidence from China. *Energy Economics*, 103, 105582.
- Dyck, A., Lins, K. V., Roth, L. and Wagner, H. F. (2019). Do institutional investors drive corporate social responsibility? International evidence. *Journal of Financial Economics*, 131(3), 693-714.
- European Banking Authority (2023). Opinion of the European Banking Authority on green loans and mortgages.
- Ehlers, T., Packer, F. and De Geiff, K. (2022). The pricing of carbon risk in syndicated loans: Which risks are priced and why?. *Journal of Banking and Finance*, 136, 106180.
- Engle, R. F., Giglio, S., Kelly, B., Lee, H. and Stroebel, J. (2020). Hedging climate change news. *The Review of Financial Studies*, 33(3), 1184-1216.
- European Central Bank (2024). Risks from misalignment of banks’ financing with the EU climate objectives. Assessment of the alignment of the European banking sector.
- European Central Bank and European Systemic Risk Board (2023). Towards macroprudential frameworks for managing climate risk. Available at: <https://www.esrb.europa.eu/pub/pdf/reports/esrb.report202312~d7881028b8.en.pdf>
- Gambacorta, L., Polizzi, S., Reghezza, A. and Scannella, E. (2023). Do banks practice what they preach? Brown lending and environmental disclosure in the euro area. ECB Working Paper No. 2023/2872.
- Gehrig, T., Iannino, M. C. and Unger, S. (2024). Social responsibility and bank resiliency. *Journal of Financial Stability*, 70, 101191.
- Giannetti, M., Jasova, M., Loumiotis, M. and Mendicino, C. (2023). The Disconnect Between Environmental Disclosures and Lending Activities.
- Giannetti, M. and Ongena, S. (2012). “Lending by example”: Direct and indirect effects of foreign banks in emerging markets. *Journal of International Economics*, 86(1), 167-180.
- Gibson Brandon, R., Glossner, S., Krueger, P., Matos, P. and Steffen, T. (2022). Do responsible investors invest responsibly?. *Review of Finance*, 26(6), 1389-1432
- Görgen, M., Jacob, A., Nerlinger, M., Riordan, R., Rohleder, M. and Wilkens, M. (2020). Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2930897
- Grewal, J., Riedl, E. J. and Serafeim, G. (2019). Market reaction to mandatory nonfinancial disclosure. *Management Science*, 65(7), 3061-3084.
- Grewal, J. and Serafeim, G. (2020). Research on corporate sustainability: Review and directions for future research. *Foundations and Trends® in Accounting*, 14(2), 73-127.

- Hasan, I., Hoi, C. K., Wu, Q. and Zhang, H. (2017). Social capital and debt contracting: Evidence from bank loans and public bonds. *Journal of Financial and Quantitative Analysis*, 52(3), 1017-1047.
- Hasan, I., Lee, H., Qiu, B. and Saunders, A. (2023). Climate-related disclosure commitment of the lenders, credit rationing, and borrower environmental performance. *Bank of Finland Research Discussion Paper*, (7).
- Haselmann, R. and Wachtel, P. (2011). Foreign banks in syndicated loan markets. *Journal of Banking and Finance*, 35(10), 2679-2689.
- Holmstrom, B. and Tirole, J. (1997). Financial intermediation, loanable funds, and the real sector. *The Quarterly Journal of Economics*, 112(3), 663-691.
- Homanen, M. (2018). Depositors disciplining banks: The impact of scandals. *Chicago Booth Research Paper*, (28).
- Hong, H., Wang, N. and Yang, J. (2021). Implications of stochastic transmission rates for managing pandemic risks. *The Review of Financial Studies*, 34(11), 5224-5265.
- Hong, H., Wang, N. and Yang, J. (2023). Mitigating disaster risks in the age of climate change. *Econometrica*, 91(5), 1763-1802.
- Houston, J. F. and Shan, H. (2022). Corporate ESG Profiles and Banking Relationships. *The Review of Financial Studies*, 35(7), 3373-3417.
- Hrazdil, K., Anginer, D., Li, J. and Zhang, R. (2024). Climate reputation and bank loan contracting. *Journal of Business Ethics*, 192(4), 875-896.
- Hsu, P. H., Li, K. and Tsou, C. Y. (2023). The pollution premium. *The Journal of Finance*, 78(3), 1343-1392.
- Huang, K. J., Bui, D. G., Hsu, Y. T. and Lin, C. Y. (2024). The ESG washing in banks: Evidence from the syndicated loan market. *Journal of International Money and Finance*, 142.
- Huppmann, D. and Holz, F. (2012). Crude oil market power—a shift in recent years?. *The Energy Journal*, 33(4).
- Ilhan, E., Sautner, Z. and Vilkov, G. (2021). Carbon tail risk. *The Review of Financial Studies*, 34(3), 1540-1571.
- Ivashina, V. (2009). Asymmetric information effects on loan spreads. *Journal of Financial Economics*, 92(2), 300-319.
- Kacperczyk, M. T. and Peydró, J. L. (2022). Carbon emissions and the bank-lending channel. Available at SSRN 3915486.
- Kim, O. S. (2019). Does Political Uncertainty Increase External Financing Costs? Measuring the Electoral Premium in Syndicated Lending. *Journal of Financial and Quantitative Analysis*, 1-54.
- Kim, S., Kumar, N., Lee, J. and Oh, J. (2022). ESG lending. In *Proceedings of Paris December 2021 Finance Meeting EUROFIDAI-ESSEC*, European Corporate Governance Institute—Finance Working Paper (No. 817).
- Krueger, P., Sautner, Z. and Starks, L. T. (2020). The importance of climate risks for institutional investors. *The Review of Financial Studies*, 33(3), 1067-1111.
- Krueger, P., Sautner, Z., Tang, D. Y. and Zhong, R. (2024). The effects of mandatory ESG disclosure around the world. *Journal of Accounting Research*.
- Kumar, P. and Rabinovitch, R. (2013). CEO entrenchment and corporate hedging: Evidence from the oil and gas industry. *Journal of Financial and Quantitative Analysis*, 48(3), 887-917.
- Laeven, L. and Popov, A. (2023). Carbon taxes and the geography of fossil lending. *Journal of International Economics*, 144, 103797.
- Laeven, M. L. and Valencia, M. F. (2018). Systemic banking crises revisited. *International Monetary Fund*.

- Li, J. and Wu, D. A. (2020). Do corporate social responsibility engagements lead to real environmental, social, and governance impact? *Management Science*, 66(9), 2564-2588.
- Liang, H. and Renneboog, L. (2017). On the foundations of corporate social responsibility. *The Journal of Finance*, 72(2), 853-910.
- Martini, F., Sautner, Z., Steffen, S. and Theunisz, C. (2024). Climate transition risks of banks. *Swiss Finance Institute Research Paper*, (23-66).
- Miguel, F., Pedraza, A. and Ruiz-Ortega, C. (2024). Climate-change regulations: Bank lending and real effects. *Journal of Financial Stability*, 70, 101212.
- Monasterolo, I. and De Angelis, L. (2020). Blind to carbon risk? An analysis of stock market reaction to the Paris Agreement. *Ecological Economics*, 170, 106571.
- Mrkajic, B., Murtinu, S. and Scalera, V. G. (2019). Is green the new gold? Venture capital and green entrepreneurship. *Small Business Economics*, 52, 929–950.
- Nguyen, D. D., Ongena, S., Qi, S. and Sila, V. (2022). Climate change risk and the cost of mortgage credit. *Review of Finance*, 26(6), 1509-1549.
- Reghezza, A., Altunbas, Y., Marques-Ibanez, D., d’Acri, C. R. and Spaggiari, M. (2022). Do banks fuel climate change?. *Journal of Financial Stability*, 62, 101049.
- Santos, J. A. and Winton, A. (2019). Bank capital, borrower power, and loan rates. *The Review of Financial Studies*, 32(11), 4501-4541.
- Sautner, Z., Van Lent, L., Vilkov, G. and Zhang, R. (2023). Pricing climate change exposure. *Management Science*, 69(12), 7540-7561.
- Shin, D. D. (2023). ESG Shifts in Lending and the Cost of Bank Loans. In *ESG Shifts in Lending and the Cost of Bank Loans: Shin, David (Dongheon)*.
- Suenaga, H. and Smith, A. (2011). Volatility dynamics and seasonality in energy prices: implications for crack-spread price risk. *The Energy Journal*, 32(3).
- Sufi, A. (2007). Information Asymmetry and Financing Arrangements: Evidence from Syndicated Loans. *The Journal of Finance* 62, 629-668.
- Takahashi, K. and Shino, J. (2023). Greenhouse gas emissions and bank lending. Basel: Bank for International Settlements, Monetary and Economic Department.
- Van den Heuvel, M. and Popp, D. (2023). The role of venture capital and governments in clean energy: Lessons from the first cleantech bubble. *Energy Economics*, 124, 106877.
- Wang, L. L. (2023). Transmission effects of ESG disclosure regulations through bank lending networks. *Journal of Accounting Research*, 61(3), 935-978.

Figure 1. The coefficient on *Fossil fuel firm* across time

The figure reports the coefficient on the interaction of *Fossil fuel firm* with a time (year) indicator from the regression for *AISD* according to the model in equation (1). The coefficient on *Fossil fuel firm* \times *Year* is depicted on the Y-axis and the corresponding year is depicted on the X-axis.

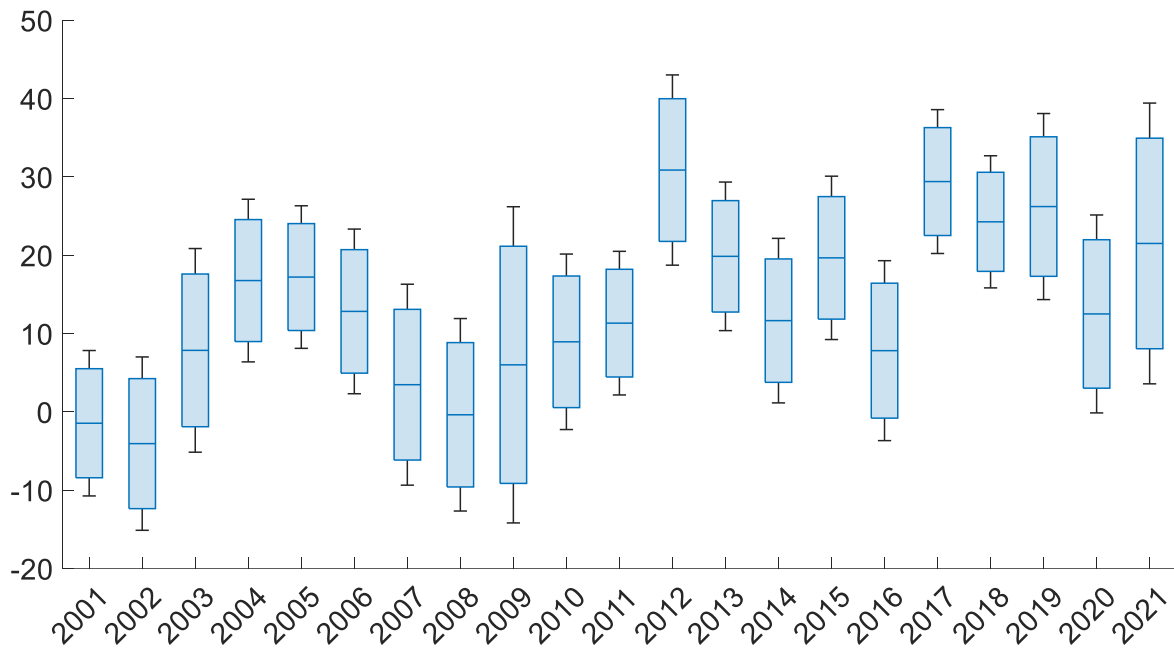


Table 1. Summary statistics

The table reports summary statistics (number of observations, mean, standard deviation, minimum and maximum values) for all variables used in the estimations of the main text. All variables are defined in Table A1.

	Obs.	Mean	Std. dev.	Min.	Max.
AISD	79,614	183.97	126.71	1.00	1,105.00
AISU	35,577	27.58	21.31	0.35	250.00
Loan amount (ln)	79,614	19.61	2.17	15.45	24.62
Loan amount (USD million)	79,614	942,000,000.00	1,790,000,000.00	5,128,600.00	49,000,000,000.00
Maturity (ln)	79,614	3.83	0.61	0.00	6.59
Collateral	79,614	0.39	0.49	0.00	1.00
Number of lenders	79,614	13.02	9.71	1.00	68.00
Performance provisions	79,614	0.27	0.45	0.00	1.00
Total covenants	79,614	0.39	0.49	0.00	1.00
Number of loans (lender-year)	932	86.81	221.23	1.00	2,114.00
Fossil fuel loans (lender-year)	932	6.05	15.52	0.00	138.00
Lending relationship	79,614	0.47	0.50	0.00	1.00
Lending relationship (amount)	79,614	0.15	0.25	0.00	1.00
Bank size	79,614	14.01	0.88	10.14	15.14
Bank ROA	79,614	0.01	0.00	-0.01	0.02
Bank capital	79,614	0.14	0.02	0.10	0.22
Firm size	79,614	8.90	2.06	3.42	16.50
Firm ROA	79,614	0.08	0.05	-0.12	0.25
Firm debt	79,614	0.34	0.18	0.00	0.92
Firm tangibility	79,614	0.30	0.25	0.00	0.90
Firm Tobin's Q	79,614	109.33	65.24	11.80	449.50
Firm R&D	79,614	0.01	0.03	0.00	0.48
Bond financing	79,025	0.37	0.48	0.00	1.00
Bond financing (amount)	79,025	0.03	0.02	0.08	0.79
GDP	79,614	-27.89	1,131.62	-23,159.92	23,159.92
GDP per capita	79,614	1.25	12.94	-141.81	94.61
Oil price	79,614	66.21	24.18	20.40	123.95
VIX	79,614	17.86	6.44	10.31	58.59
Lender's ESG	26,468	17.12	17.49	0.00	64.00
Lender's ESG adjusted	26,468	-1.37	16.83	-24.51	47.53
Borrower's ESG	5,971	13.55	13.78	0.00	64.67
Lender's ESG (Refinitiv)	22,862	27.81	24.91	0.00	87.78
Borrower's ESG (Refinitiv)	10,962	54.64	17.97	1.38	93.13

Table 2. Summary statistics for fossil fuel firms vs. non- fossil fuel firms

The table reports summary statistics for key loan terms and firm accounting characteristics distinguishing between fossil fuel firms and non-fossil fuel firms. All variables are defined in Table A1. Panel A reports the mean value of terms on all loan facilities to fossil fuel firms and to non-fossil fuel firms and the results from the mean-comparison test for differences in the mean between observations for the two groups. Panel B reports the mean value of firm accounting characteristics for the group of fossil fuel firms and for the group of non-fossil fuel firms, and the results from the mean-comparison test for differences in the mean between observations for the two groups. The number of loans granted to fossil fuel firms is 7,582 and the number of loans granted to non-fossil fuel firms is 72,032. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Loan terms for fossil fuel firms vs. non-fossil fuel firms

	Fossil fuel	Non-fossil fuel	Mean-comparison test	
			Mean diff.	Std. error
AISD	172.53	185.17	-12.64***	1.42
AISU	28.10	27.52	0.58	0.40
Loan amount	20.06	19.56	0.50***	0.02
Maturity	3.78	3.83	-0.05***	0.01
Collateral	0.29	0.40	-0.12***	0.01
Number of lenders	14.25	12.90	1.35***	0.11
Performance provisions	0.27	0.27	0.00	0.01
General covenants	0.39	0.39	0.00	0.01

Panel B: Accounting characteristics for fossil fuel firms vs. non-fossil fuel firms

	Fossil fuel	Non-fossil fuel	Mean-comparison test	
			Mean diff.	Std. error
Firm size	9.49	8.84	0.65***	0.03
Firm ROA	0.07	0.08	-0.01***	0.00
Firm debt	0.32	0.34	-0.02***	0.00
Firm tangibility	0.59	0.27	0.32***	0.00
Firm Tobin's Q	98.32	110.49	-12.17***	0.67

Table 3. Baseline results: different fixed effects

The table reports coefficients and t-statistics [in brackets]. The dependent variable is in the second row of the table and all variables are defined in Table A1. Estimation method is OLS. In specifications (1)-(5) the dependent variable is *AISD*. Specification (6) replicates the estimations in specification (2) by replacing *AISD* with *Loan amount* as dependent variable. In specification (7) the estimation is conducted at the lender-year level and the dependent variable is *Number of loans*, i.e., the number of loans granted by the given lender in the year, while the main explanatory variable is *Fossil fuel loans*, i.e., the number of loans to fossil fuel borrowers granted by the given lender in the year. In specifications (1) to (6) standard errors are clustered by borrower and in specification (7) by lender. Each specification includes a different set of fixed effects, as given in the lower part of the table. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) AISD	(2) AISD	(3) AISD	(4) AISD	(5) AISD	(6) Loan amount	(7) Number of loans
Fossil fuel firm	13.472*** [3.643]	13.472*** [3.643]	12.801*** [3.543]	11.706*** [3.303]	12.256*** [3.495]	0.201*** [3.259]	
Fossil fuel loans							12.060*** [9.353]
AISD						-0.002*** [-15.567]	
Loan amount	-11.499*** [-14.015]	-11.499*** [-14.015]	-11.270*** [-14.254]	-10.651*** [-13.398]	-12.373*** [-15.655]		
Maturity	6.091*** [2.659]	6.091*** [2.659]	7.396*** [3.244]	8.037*** [3.500]	9.795*** [4.347]	0.250*** [7.962]	
Collateral	51.883*** [23.573]	51.883*** [23.573]	51.241*** [23.812]	49.882*** [23.013]	48.773*** [22.792]	-0.039 [-1.201]	
Number of lenders	-0.741*** [-6.759]	-0.741*** [-6.759]	-0.778*** [-7.224]	-0.722*** [-6.635]	-0.649*** [-6.174]	0.040*** [14.750]	
Performance provisions	-11.082*** [-5.752]	-11.082*** [-5.752]	-12.114*** [-6.364]	-13.038*** [-6.759]	-13.316*** [-6.923]	0.097*** [3.418]	
General covenants	-1.280 [-0.626]	-1.280 [-0.626]	-1.798 [-0.889]	-3.452* [-1.693]	-3.922* [-1.952]	-0.015 [-0.403]	
Bank size	-14.545*** [-4.696]	-14.545*** [-4.696]	-12.347*** [-3.301]	-14.716*** [-3.924]	-12.715*** [-3.465]	0.153*** [3.536]	-45.974** [-2.146]
Bank ROA	-577.272*** [-3.327]	-577.272*** [-3.327]	194.188 [1.026]	28.625 [0.153]	44.147 [0.238]	1.221 [0.511]	-241.241 [-0.129]
Bank capital	68.086 [1.484]	68.086 [1.484]	-19.947 [-0.363]	6.994 [0.130]	22.448 [0.433]	-1.632*** [-2.723]	-384.954 [-1.354]
Firm size	-9.677*** [-13.767]	-9.677*** [-13.767]	-9.633*** [-14.165]	-10.302*** [-14.337]	-9.720*** [-13.553]	0.259*** [25.022]	
Firm ROA	-280.240*** [-14.292]	-280.240*** [-14.292]	-286.915*** [-14.883]	-305.861*** [-16.132]	-306.211*** [-16.287]	0.975*** [3.203]	
Firm leverage	92.489***	92.489***	90.873***	90.657***	90.206***	0.380***	

Firm tangibility	[15.819]	[15.819]	[15.601]	[15.397]	[15.663]	[4.605]	
	-7.989*	-7.989*	-7.282*	-9.439**	-9.988**	0.126**	
Firm Tobin's Q	[-1.788]	[-1.788]	[-1.666]	[-2.191]	[-2.358]	[1.992]	
	-0.106***	-0.106***	-0.086***	-0.080***	-0.078***	0.001***	
GDP	[-6.408]	[-6.408]	[-5.127]	[-4.716]	[-4.763]	[2.671]	
	-0.001	-0.001			0.001	-0.000	-0.003
GDP per capita	[-0.779]	[-0.779]			[0.666]	[-0.674]	[-1.275]
	-0.114	-0.114			-0.141	-0.013***	-0.253
Oil price	[-1.077]	[-1.077]			[-1.054]	[-7.724]	[-1.295]
	-0.165	-0.165			3.486	0.003*	-0.206
VIX	[-1.565]	[-1.565]			[1.134]	[1.842]	[-0.531]
	0.483**	0.483**			8.052	0.020***	0.232
Carbon tax	[2.473]	[2.473]			[1.109]	[5.474]	[0.376]
	9.415***	9.415***				0.043	5.213
	[3.808]	[3.808]				[1.441]	[0.313]
Observations	79,614	79,614	79,590	79,546	79,546	79,614	932
Adj. R-squared	0.546	0.546	0.553	0.564	0.569	0.735	0.924
Year effects	Y	Y	N	N	N	Y	Y
Lender effects	Y	Y	Y	Y	Y	Y	Y
Loan type and purpose effects	Y	Y	Y	Y	Y	Y	N
Lender's country effects	N	Y	N	N	N	Y	Y
Borrower's country effects	N	Y	Y	N	N	Y	Y
Lender's country × year effects	N	N	Y	Y	Y	N	N
Borrower's country × year effects	N	N	N	Y	Y	N	N
Quarter effects	N	N	N	N	Y	N	N

Table 4. Different loan and borrower types

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Different specifications include different loan types based on the origin of the lender and borrower. In specification (1) *Fossil fuel firm* is interacted with *US loan*, i.e., a binary variable equal to one if both the lender and borrower are headquartered in the U.S., and zero otherwise. In specification (2) *Fossil fuel firm* is interacted with *European loan*, i.e., a binary variable equal to one if both the lender and borrower are headquartered in Europe, and zero otherwise. In specification (3) *Fossil fuel firm* is interacted with *US lender*, i.e., a binary variable equal to one if the lender is headquartered in the U.S., and zero otherwise. In specification (4) *Fossil fuel firm* is interacted with *Domestic loan*, i.e., a binary variable equal to one if both the lender and borrower are headquartered in the same country, and zero otherwise. Each specification includes a different set of fixed effects, as given in the lower part of the table. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
Fossil fuel firm	18.736***	13.254***	17.686***	17.985***
	[3.186]	[4.007]	[3.199]	[3.211]
Fossil fuel firm × US loan	-10.588			
	[-1.682]			
Fossil fuel firm × European loan		-4.740		
		[-0.296]		
Fossil fuel firm × US lender			-7.458	
			[-1.439]	
Fossil fuel firm × Domestic loan				-8.305
				[-1.501]
Observations	79,614	79,614	79,614	79,614
Adj. R-squared	0.546	0.547	0.546	0.546
Controls	Y	Y	Y	Y
Year effects	Y	Y	Y	Y
Lender effects	Y	Y	Y	Y
Loan type and purpose effects	Y	Y	Y	Y
Lender's country effects	N	Y	N	Y
Borrower's country effects	N	Y	Y	Y

Table 5. Upstream vs downstream fossil fuel firms

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Different specifications include different indicators for identifying upstream and downstream fossil fuel borrowers. In specification (1) *Fossil fuel firm* is interacted with *Upstream fossil fuel firm*, i.e., a binary variable equal to one if the borrower is an upstream fossil fuel company (excluding coal companies), and zero otherwise. In specification (2) *Fossil fuel firm* is interacted with *Downstream fossil fuel firm*, i.e., a binary variable equal to one if the borrower is a downstream fossil fuel company (excluding coal companies), and zero otherwise. In specification (3) *Upstream fossil fuel firm* is interacted with *High firm size*, i.e., a binary variable equal to one if the borrower's size (log of total assets) is above the sample mean, and zero otherwise. In specification (4) *Upstream fossil fuel firm* is interacted with *High firm sales*, i.e., a binary variable equal to one if the borrower's sales (ratio of sales to total assets) is above the sample mean, and zero otherwise. All specifications include year, lender, lender's country, borrower's country, and loan type and purpose, and lender's country fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
Fossil fuel firm	14.439***	20.551***	4.701	4.777
	[2.921]	[4.598]	[0.974]	[0.989]
Fossil fuel firm × Upstream fossil fuel firm	12.431		26.113***	22.726***
	[1.054]		[3.686]	[3.238]
Fossil fuel firm × Downstream fossil fuel firm		-8.978**		
		[-2.195]		
Fossil fuel firm × Upstream fossil fuel firm × High firm size			-30.671***	
			[-4.050]	
Fossil fuel firm × Upstream fossil fuel firm × High firm sales				-22.621***
				[-2.766]
Observations	79,614	79,614	78,157	78,157
Adj. R-squared	0.560	0.560	0.565	0.564
Controls	Y	Y	Y	Y
Fixed effects	Y	Y	Y	Y

Table 6. Other loan characteristics

The table reports coefficients and t-statistics [in brackets]. The dependent variable is in the second row of the table and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Different specifications include alternative loan characteristics as dependent variable. All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
	AISU	Maturity	Collateral	Number of lenders	General covenants
Fossil fuel firm	1.373** [1.979]	-0.031** [-2.327]	-0.011 [-0.588]	0.628 [1.396]	0.016 [0.908]
AISD	0.163*** [33.771]	0.000** [2.300]	0.001*** [22.371]	-0.003*** [-4.203]	-0.000** [-2.084]
Loan amount	0.071 [0.483]	0.023*** [7.266]	-0.003 [-0.759]	1.583*** [15.986]	0.005 [1.114]
Maturity	1.960*** [3.069]		0.070*** [8.196]	0.513* [1.689]	0.001 [0.166]
Collateral	3.241*** [7.273]	0.065*** [8.348]		-0.562** [-2.224]	0.154*** [11.499]
Number of lenders	0.013 [0.430]	0.001 [1.645]	-0.001** [-2.298]		0.003*** [3.445]
Performance provisions	-0.509 [-1.366]	0.011 [1.437]	0.034*** [3.448]	2.615*** [10.687]	0.345*** [31.175]
General covenants	0.245 [0.687]	0.001 [0.166]	0.146*** [11.469]	1.053*** [3.925]	
Bank size	-0.982 [-1.633]	0.021 [1.550]	-0.006 [-0.486]	-0.362 [-1.181]	0.026* [1.815]
Bank ROA	25.116 [0.707]	1.409* [1.948]	-0.425 [-0.582]	-40.477*** [-2.623]	0.309 [0.421]
Bank capital	-4.384 [-0.442]	0.029 [0.160]	0.166 [0.901]	-1.949 [-0.433]	-0.194 [-0.995]
Firm size	-0.516*** [-3.788]	-0.013*** [-4.533]	-0.029*** [-8.655]	1.199*** [10.359]	-0.024*** [-6.197]
Firm ROA	-3.623 [-1.143]	0.432*** [6.321]	-0.484*** [-5.761]	0.648 [0.365]	0.099 [1.065]
Firm leverage	3.044*** [3.056]	-0.002 [-0.109]	0.266*** [9.998]	2.590*** [3.519]	-0.060* [-1.862]
Firm tangibility	-1.482** [-2.027]	0.034** [2.226]	-0.124*** [-5.617]	-1.132** [-2.328]	0.004 [0.143]
Firm Tobin's Q	-0.013*** [-4.768]	0.000 [0.958]	-0.000*** [-4.197]	-0.004** [-2.348]	0.000*** [4.132]
GDP	-0.000 [-1.091]	0.000 [1.494]	-0.000 [-0.840]	-0.000 [-0.035]	0.000 [0.498]
GDP per capita	0.039 [0.352]	0.003* [1.771]	-0.003** [-2.093]	-0.056 [-1.012]	-0.001 [-0.629]
Oil price	-0.004 [-0.224]	-0.000 [-0.073]	0.000 [0.558]	0.004 [0.332]	-0.001** [-2.430]
VIX	0.020 [0.455]	-0.003*** [-3.533]	-0.001 [-0.875]	-0.080*** [-3.696]	-0.001 [-1.568]
Carbon tax	1.846*** [3.373]	-0.038*** [-4.178]	-0.006 [-0.681]	0.033 [0.124]	0.016* [1.698]
Observations	35,532	79,614	79,614	79,614	79,614
Adj. R-squared	0.672	0.660	0.434	0.454	0.401
Fixed effects	Y	Y	Y	Y	Y

Table 7. Regulatory interventions and banking crises

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Different specifications include the consideration of certain regulatory policies and banking crises. Specification (1) replicates the baseline specification (column 2 of Table 3) for the period before the Paris Agreement (all years before 2016). Specification (2) replicates the baseline specification (column 2 of Table 3) for the period after the Paris Agreement (all years from 2016 onward). In specification (3) *Fossil fuel firm* is interacted with *Paris Agreement*, i.e., a binary variable equal to one for the period following the Paris Agreement (2016 onward), and zero otherwise. In specification (4) *Fossil fuel firm* is interacted with *EU Green Deal (Lender's country)*, i.e., a binary variable equal to one for the period after the voting of the European Green Deal (from January 15, 2020, onward) in the lender's country, and zero otherwise (the variable refers to lenders headquartered in EU countries). In specification (5) *Fossil fuel firm* is interacted with *EU Green Deal (Lender's country)* and *US borrower*, i.e., a binary variable equal to one if the borrower is headquartered in the U.S., and zero otherwise. In specification (6) *Fossil fuel firm* is interacted with *EU Green Deal (Borrower's country)*, i.e., a binary variable equal to one for the period after the voting of the European Green Deal (from January 15, 2020, onward) in the borrower's country, and zero otherwise (the variable refers to borrowers headquartered in EU countries). In specification (7) *Fossil fuel firm* is interacted with *Banking crisis*, i.e., a binary variable equal to one if the lender's country experiences a systemic banking crisis, and zero otherwise. All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pre-Paris	Post-Paris	Full sample	Full sample	Full sample	Full sample	Full sample
Fossil fuel firm	7.936**	20.606***	8.435**	10.235***	10.249***	10.064***	12.306***
	[2.058]	[3.657]	[2.181]	[2.886]	[2.890]	[2.841]	[3.413]
Fossil fuel firm × × Paris Agreement			8.473*				
			[1.879]				
Fossil fuel firm × × EU Green Deal (Lender's country)				13.600**	25.609***		
				[2.323]	[4.554]		
Fossil fuel firm × × EU Green Deal (Lender's country) × × US borrower					-27.110***		
					[-4.585]		
Fossil fuel firm × × EU Green Deal (Borrower's country)						23.881***	
						[3.875]	
Fossil fuel firm × × Banking crisis							-16.731
							[-1.398]
Observations	57,961	21,625	79,614	79,614	79,614	79,614	79,614
Adj. R-squared	0.582	0.542	0.560	0.560	0.560	0.560	0.524
Controls	Y	Y	Y	Y	Y	Y	Y
Fixed effects	Y	Y	Y	Y	Y	Y	Y

Table 8. Borrowers' characteristics

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Different specifications include the interactions of the fossil fuel firm indicator with various borrower-level accounting characteristics. In specification (1) *Fossil fuel firm* is interacted with *Firm size*, i.e., the log of total firm's assets. In specification (2) *Fossil fuel firm* is interacted with *High firm size*, i.e., a binary variable equal to one if the borrower's *Firm size* is above the sample mean, and zero otherwise. In specification (3) *Fossil fuel firm* is interacted with *Lending relationship*, i.e., a binary variable equal to one for a prior lending relationship between the lender and the borrower during the previous 5-year period, and zero otherwise. In specification (4) *Fossil fuel firm* is interacted with *Lending relationship amount*, i.e., the ratio of the amount of prior loans between the lender and the borrower during the previous 5-year period to the total number of loans received by the borrower during the same period. In specification (5) *Fossil fuel firm* is interacted with *Bond financing*, i.e., a binary variable equal to one if the borrower has an outstanding bond during the year, and zero otherwise. In specification (6) *Fossil fuel firm* is interacted with *Bond financing amount*, i.e., the total amount of bond financing for the borrower during the year. In specification (7) *Fossil fuel firm* is interacted with *Firm R&D*, i.e., the borrower's ratio of R&D expenses to total assets. In specification (8) *Fossil fuel firm* is interacted with *High firm R&D*, i.e., a binary variable equal to one if the borrower's R&D expenses (*Firm R&D*) is above the sample mean, and zero otherwise. All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fossil fuel firm	25.274** [1.978]	14.977*** [3.398]	12.919*** [3.230]	10.834*** [2.661]	9.441* [1.810]	9.879*** [2.646]	9.921*** [2.725]	10.175*** [2.790]
Fossil fuel firm × Firm size	-1.588 [-1.134]							
Fossil fuel firm × High firm size		-10.111* [-1.664]						
Fossil fuel firm × Lending relationship			-5.040 [-1.458]					
Fossil fuel firm × Lending relationship amount				-2.012 [-0.284]				
Fossil fuel firm × Bond financing					2.123 [0.340]			
Fossil fuel firm × Bond financing amount						23.191 [0.989]		
Fossil fuel firm × Firm R&D							73.568 [1.275]	
Fossil fuel firm × High firm R&D								11.904 [0.970]
Observations	79,614	79,614	79,614	79,614	79,025	79,025	79,164	79,614
Adj. R-squared	0.560	0.560	0.560	0.560	0.560	0.560	0.560	0.560
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Fixed effects	Y	Y	Y	Y	Y	Y	Y	Y

Table 9. ESG considerations

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Different specifications include the interactions of the fossil fuel firm indicator with variables reflecting the lenders' and borrowers' environmental, social, and governance (ESG) score and the adoption of mandatory ESG disclosure in the lenders' and borrowers' countries. In specification (1) *Fossil fuel firm* is interacted with *Lender's ESG*, i.e., the lender's ESG score (higher values reflect better performance on ESG). In specification (2) *Fossil fuel firm* is interacted with *Lender's ESG adjusted*, i.e., the difference between the lender's ESG score and the ESG score of the lender's industry. In specification (3) *Fossil fuel firm* is interacted with *Borrower's ESG*, i.e., the borrower's ESG score (higher values reflect better performance on ESG). In specification (4) *Fossil fuel firm* is interacted with *Lender's ESG adjusted* and *Borrower's ESG*. In specification (5) *Fossil fuel firm* and *Lender's ESG adjusted* are interacted with *ESG disclosure (Lender's country)*, i.e., a binary variable equal to one for the year onward in which mandatory disclosure of companies' ESG activities is in effect in the lender's country, and zero otherwise. In specification (6) *Fossil fuel firm* and *Lender's ESG adjusted* are interacted with *ESG disclosure (Borrower's country)*, i.e., a binary variable equal to one for the year onward in which mandatory disclosure of companies' ESG activities is in effect in the borrower's country, and zero otherwise. Specifications (7) and (8) replicate the estimations in specifications (5) and (6) with *Loan maturity* as dependent variable. All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) AISD	(2) AISD	(3) AISD	(4) AISD	(5) AISD	(6) AISD	(7) Loan maturity	(8) Loan maturity
Fossil fuel firm	8.734** [2.485]	13.207*** [2.896]	15.194** [2.465]	19.727** [2.241]	13.115*** [2.872]	13.244*** [2.913]	-0.027* [-1.897]	-0.027* [-1.881]
Fossil fuel firm × Lender's ESG	0.240** [2.101]							
Fossil fuel firm × Lender's ESG adjusted		0.237** [2.228]		0.428** [2.219]	0.235** [2.203]	0.224** [2.113]	-0.001* [-1.940]	-0.001* [-1.923]
Fossil fuel firm × Borrower's ESG			0.271 [0.418]	-0.330 [-0.785]				
Fossil fuel firm × Lender's ESG adjusted × × ESG disclosure (Lender's country)					2.401** [2.357]		-0.002* [-1.937]	
Fossil fuel firm × Lender's ESG adjusted × × ESG disclosure (Borrower's country)						0.306 [0.468]		0.002 [0.551]
Observations	24,670	24,670	5,952	2,822	24,670	24,670	24,662	24,662
Adj. R-squared	0.512	0.512	0.614	0.609	0.512	0.512	0.638	0.638
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Fixed effects	Y	Y	Y	Y	Y	Y	Y	Y

Table 10. Lenders' subsequent ESG score

The table reports coefficients and t-statistics [in brackets]. The dependent variable is in the second row of the table and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by lender. Different specifications include lender-year-level regressions to examine the lending behaviour of lenders to fossil fuel firms. In specification (1) the dependent variable is *Average borrower ESG*, the average ESG score of borrowers on all lender loans in the current year, adjusted for the ESG score of the borrowers' industries (higher values reflect better performance on ESG). The independent variables include *Loan to fossil fuel firm*, i.e., a binary variable equal to one if in the previous year the lender granted at least one loan to a fossil fuel firm, and zero otherwise, the average terms on all lender loans in the current year, the lender's accounting characteristics, the average borrowers' accounting characteristics on all lender loans, the lender's country macroeconomic characteristics, global volatility and carbon pricing controls (annual average values of WTI and VIX, indicator about carbon tax in the lender's country). Specification (2) replicates the estimation in specification (1) with *Change in lender's ESG* as dependent variable, i.e., the change in the lender's ESG score over a 2-year window, from one year before to one year after the lender granted at least one loan to a fossil fuel firm (adjusted for the ESG score in the lender's industry). Specification (3) replicates the estimation in specification (1) with *ESG difference* as dependent variable, i.e., the difference between the lender's ESG score and the average ESG score of borrowers on all lender loans over a 2-year window, from one year before to one year after the lender granted at least one loan to a fossil fuel firm (adjusted for the ESG score in the lender's industry and the ESG score in the borrower's industry). All specifications include year and lender fixed effects. Specifications (2) and (3) further include lender's industry fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) Average borrower ESG	(2) Change in lender's ESG	(3) ESG difference
Loan to fossil fuel firm	1.443*	11.330*	-2.166*
	[1.661]	[1.885]	[-1.871]
AISD	0.001	0.002	-0.011
	[0.222]	[0.049]	[-0.471]
Loan amount	-0.241	-4.068	-0.499
	[-0.738]	[-0.961]	[-0.478]
Maturity	-1.340	17.995	-0.660
	[-1.340]	[1.449]	[-0.096]
Collateral	-0.018	-17.912	6.879
	[-0.012]	[-0.946]	[1.012]
Number of lenders	0.258***	-0.056	-0.527
	[3.752]	[-0.082]	[-1.433]
Performance provisions	1.687	3.425	18.152*
	[0.698]	[0.229]	[1.698]
General covenants	-2.690	21.132	-14.326
	[-1.281]	[1.194]	[-1.582]
Bank size	0.957	2.439	1.209
	[0.958]	[0.328]	[0.285]
Bank ROA	69.372	-444.840	-1.406
	[0.818]	[-1.012]	[-0.004]
Bank capital	26.901**	43.687	-84.156*
	[2.017]	[0.725]	[-1.922]
Firm size	0.166	1.464	1.901
	[0.551]	[0.728]	[1.501]
Firm ROA	7.237	-77.725	9.781
	[0.570]	[-1.008]	[0.164]
Firm leverage	2.066	-5.474	9.303
	[0.568]	[-0.296]	[0.555]
Firm tangibility	-0.475	22.373	-2.186
	[-0.180]	[1.118]	[-0.143]
Firm Tobin's Q	0.000	-0.026	0.068
	[0.013]	[-0.371]	[1.527]
Observations	877	832	255
Adj. R-squared	0.229	0.043	0.728
Controls	Y	Y	Y
Fixed effects	Y	Y	Y

Table 11. Lenders' portfolio considerations and future performance

The table reports coefficients and t-statistics [in brackets]. The dependent variable is in the second row of the table and all variables are defined in Table A1. Estimation method is OLS. Different specifications include measures of lenders' loan portfolio to examine the lending behaviour and future performance of lenders. Specification (1) estimates a loan-level regression, where the dependent variable is *AISD* and *Fossil fuel firm* is interacted with *Fossil fuel loan share*, i.e., the ratio of the total amount of loans to fossil fuel firms by the lender in the previous year to the total amount of lender's loans. Specification (2) replicates the estimation in specification (1) with main independent variable *Fossil fuel loan share (number)*, i.e., the ratio of the total number of loans to fossil fuel firms by the lender in the previous year to the total number of lender's loans. Specification (3) estimates a lender-year-level regression, where the dependent variable is *Lending to fossil fuel firms*, i.e., a binary variable equal to one if in the current year the lender granted at least one loan to a fossil fuel firm, and zero otherwise. In specification (3) the independent variables include, *Fossil fuel loan share*, the average terms on all lender loans in the current year, the lender's accounting characteristics, the average borrowers' accounting characteristics on all lender loans, the lender's country macroeconomic characteristics, and global volatility and carbon pricing controls (annual average values of WTI and VIX, indicator about carbon tax in the lender's country). Specification (4) replicates the estimation in specification (3) with *Loan to fossil fuel firm (number)* as main independent variable. Specifications (5) and (6) replicate the estimations in specifications (3) and (4) with *Forward Bank ROA* as dependent variable (i.e., the average return on total bank assets in the forward 2-year period); the variable is converted to percentage form to enable the interpretation of coefficients. In specifications (1) and (2) standard errors are clustered by borrower and in specifications (3) to (6) by lender. Specifications (1) and (2) include year, lender, loan type and purpose, and lender's country fixed effects and specifications (3) to (6) include year and lender fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) AISD	(2) AISD	(3) Lending to fossil fuel firms	(4) Lending to fossil fuel firms	(5) Forward Bank ROA	(6) Forward Bank ROA
Fossil fuel firm	12.621*** [3.390]	12.657*** [3.418]				
Fossil fuel loan share	-9.714** [-2.119]		0.510*** [8.059]		0.047* [2.073]	
Fossil fuel loan share (number)		-11.206** [-2.087]		0.578*** [7.945]		0.032** [2.372]
Fossil fuel firm × Fossil fuel loan share	28.896*** [2.945]					
Fossil fuel firm × Fossil fuel loan share (number)		32.737*** [2.891]				
Observations	79,614	79,614	2,660	2,606	1,980	1,927
Adj. R-squared	0.546	0.546	0.499	0.504	0.737	0.740
Controls	Y	Y	Y	Y	Y	Y
Fixed effects	Y	Y	Y	Y	Y	Y

Internet Appendix

Bank lending to fossil fuel firms

Abstract

This Appendix is intended for online use only. The first section includes the definitions of variables employed and additional information on the sample. The second section includes the discussion of additional results and robustness checks. The third section reports estimates from specifications with (i) different controls and (ii) different clustering of standard errors, (iii) estimates from weighted regressions, (iv) results from alternative estimation methods and (v) alternative climate risk measures, (vi) robustness checks for loan maturity and (vii) results from specifications with alternative ESG measures.

Table A1. Variable definitions and sources

Variable	Description	Source
<i>A. Dependent variables in main and alternative specifications</i>		
AISD	All-in spread drawn, defined as the sum of the spread over LIBOR plus any facility fee for each dollar drawn from the loan.	DealScan
AISU	All-in spread undrawn, defined as the sum of the facility fees and the commitment fees. Facility fees are fees paid on the entire committed amount, regardless of usage. Commitment fees are fees paid on the unused amount of loan commitments.	DealScan
Loan amount	Log of the loan facility amount in USD.	DealScan
Maturity	Log of the loan duration in months.	DealScan
Number of loans	The number of loans granted by the lender in the year.	DealScan
Average borrower ESG	The average ESG score of borrowers on all lender loans in the current year (higher values reflect better performance on ESG). The variable is adjusted for the ESG score in the borrowers' industries by subtracting the average ESG score of the borrowers' industries. The variable is based on the variable <i>Borrower's ESG</i> , which is described in more detail below.	RepRisk
Change in lender's ESG	The change in the lender's ESG score over a 2-year window, from one year before to one year after the lender granted at least one loan to a fossil fuel firm. The variable is adjusted for the ESG score in the lender's industry by subtracting the ESG score of the lender's industry. The variable is based on the variable <i>Lender's ESG</i> , which is described in more detail below.	RepRisk
ESG difference	The difference between the lender's ESG score and the average ESG score of borrowers on all lender loans over a 2-year window, from one year before to one year after the lender granted at least one loan to a fossil fuel firm. The variable is adjusted for the ESG score in the lender's industry and the ESG score in the borrower's industry. The variable is based on the variables <i>Lender's ESG</i> and <i>Borrower's ESG</i> , which are described in more detail below.	RepRisk
<i>B. Main explanatory variables: Fossil fuel firm indicator and ESG scores</i>		
Fossil fuel firm	A binary variable equal to one if the borrower is an oil and gas company or a coal company, and zero otherwise. The classification of a company as fossil fuel firm is based on company SIC code and includes companies that engage in operations such as crude petroleum and natural gas, drilling oil and gas wells, oil and gas field exploration services, oil and gas field services. All remaining borrowers not classified as fossil fuel firms, are included in the control group of non-fossil fuel firms. The variable <i>Upstream fossil fuel firm</i> is a binary variable equal to one if the borrower is an upstream fossil fuel company (excluding coal companies), and zero otherwise. Similarly, the variable <i>Downstream fossil fuel firm</i> is a binary variable equal to one if the borrower is a downstream fossil fuel company (excluding coal companies), and zero otherwise.	Compustat
Fossil fuel loans	The number of loans to fossil fuel borrowers granted by the lender in the year.	DealScan
Loan to fossil fuel firm	A binary variable equal to one if in the previous year the lender granted at least one loan to a fossil fuel firm, and zero otherwise.	RepRisk
Climate change exposure	The borrower's exposure to climate change from Sautner, Van Lent, Vilkov and Zhang (2023). The variable is calculated from transcripts of company quarterly earnings calls and identifies the attention paid by earnings call participants to companies' climate change exposures. The variable is standardized before being employed in the regressions.	Sautner, Van Lent, Vilkov and Zhang (2023)
Lender's ESG	The lender's RepRisk index (RRI) in the year before the loan origination. The RRI is calculated by employing a proprietary algorithm that quantifies a company's reputational risk exposure to ESG issues. RepRisk does not cover positive ESG information, as those are often self-reported for branding and marketing purposes. By construction, a higher value of the RRI indicates a greater history of negative events, i.e., a worse ESG profile. To make interpretation easier, we modify the original index from RepRisk by multiplying it with (-1), so a higher score means a stronger ESG performance. The variable <i>Lender's ESG adjusted</i> is the difference between the lender's ESG score and the ESG score of the lender's industry. The variable <i>Borrower's ESG</i> is the borrower's ESG score (higher values reflect better performance on ESG). The variables <i>Lender's E score</i> , <i>Lender's E score adjusted</i>	RepRisk

Lender's ESG (Refinitiv)	and <i>Borrower's E score adjusted</i> are the equivalent variables for the environmental component of the lender's or borrower's ESG score. The lender's ESG score in the year before the loan origination from Refinitiv. The ESG scores are designed to transparently and objectively measure a company's relative ESG performance, commitment and effectiveness across 10 main themes (emissions, environmental product innovation, human rights, shareholders, etc.) based on publicly reported data. The ESG score assumes values between 0 and 100: by construction, a higher value indicates better relative ESG performance and sufficient degree of transparency in reporting material ESG data publicly. The variable <i>Borrower's ESG (Refinitiv)</i> is the borrower's ESG score (higher values reflect better performance on ESG).	Refinitiv
<i>C. Explanatory variables: Loan characteristics</i>		
Collateral	A binary variable equal to one if the loan is secured with collateral, and zero otherwise.	DealScan
Number of lenders	The number of banks involved in the syndicated loan.	DealScan
Number of leads	The number of lead banks involved in the syndicated loan.	DealScan
Performance provisions	A binary variable equal to one if the loan has performance pricing provisions, and zero otherwise.	DealScan
General covenants	A binary variable equal to one if the loan has covenants, and zero otherwise.	DealScan
US loan	A binary variable equal to one if both the lender and borrower are headquartered in the U.S., and zero otherwise.	DealScan
European loan	A binary variable equal to one if both the lender and borrower are headquartered in Europe, and zero otherwise.	DealScan
US lender	A binary variable equal to one if the lender is headquartered in the U.S., and zero otherwise.	DealScan
Domestic loan	A binary variable equal to one if both the lender and borrower are headquartered in the same country, and zero otherwise.	DealScan
<i>D. Explanatory variables: Lender characteristics</i>		
Bank size	The log of total bank assets.	Compustat
Bank ROA	The return on total bank assets.	Compustat
Bank capital	The ratio of bank capital to total assets.	Compustat
Bank NPLs	The ratio of bank non-performing loans to total assets.	Compustat
<i>E. Explanatory variables: Borrower characteristics</i>		
Firm size	The log of total firm assets.	Compustat
Firm ROA	The return on total firm assets.	Compustat
Firm debt	The firm debt to total assets ratio.	Compustat
Firm tangibility	The ratio of firm tangible assets to total assets.	Compustat
Firm Tobin's Q	The firm's Tobin's Q.	Compustat
Firm R&D	The firm's ratio of R&D expenses to total assets.	Compustat
Firm ROE	The return on firm equity.	Compustat
Firm EBITDA	The log of firm EBITDA.	Compustat
Lending relationship	A binary variable equal to one for a prior loan facility between the lender and the borrower in the 5-year period before the loan facility's origination year, and zero otherwise.	DealScan
Lending relationship amount	The ratio of the amount of prior loan facilities between the lender and the borrower in the 5-year period before the loan facility's origination year to the total amount of loans received by the borrower during the same period.	DealScan
Bond financing	A binary variable equal to one if the borrower has an outstanding bond during the year, and zero otherwise.	SDC
Bond financing amount	The ratio of the total amount of bond financing (in USD) for the borrower during the year to total assets.	SDC
<i>F. Explanatory variables: Lender's country characteristics</i>		
GDP	The difference in annual GDP (in billion USD) between the lender's country and the borrower's country.	WDI

GDP per capita	The difference in annual GDP per capita (in thousand USD) in constant prices between the lender's country and the borrower's country.	WDI
Polity	The Polity score in the lender's country. The polity score is the average of freedom house and the combined polity score. The freedom house is the average of the political rights index and the civil liberties index. The combined polity score is computed by subtracting the autocracy score (an eleven point autocracy scale) from the democracy score (an eleven point democracy score). The resulting unified polity scale for Polity ranges from 10 (most democratic) to 0 (least democratic).	The Quality of Government Institute
Debt-to-GDP	The ratio of public debt to GDP (%) in the lender's country.	WDI
Inflation	The difference in the inflation rate between the lender's country and the borrower's country.	WDI
Trade balance	The trade balance between the lender's country and the borrower's country.	WDI

G. Explanatory variables: Global volatility measures

Oil price	The crude oil price of West Texas Intermediate (WTI).	St. Louis Fed
VIX	The Chicago Board of Exchange (CBOE) Volatility Index (VIX Index). The VIX index measures the implied volatility of options on the S&P 500.	Bloomberg; CBOE

H. Explanatory variables: Carbon pricing, regulatory measures and banking crises

Carbon tax	A binary variable equal to one for the year onward in which carbon taxes were first imposed in the lender's country or the lender's country joined an Emissions Trading Scheme. The variable <i>Carbon tax (Borrower's country)</i> is the equivalent variable for the borrower's country.	Laeven and Popov (2023)
Paris Agreement	A binary variable equal to one for the period following the signing of the Paris Agreement (from 2016 onward), and zero otherwise.	Own estimations
Green Deal	A binary variable equal to one for the period after the voting of the European Green Deal (from January 15, 2020, onward), and zero otherwise. The variable <i>EU Green Deal (Lender's country)</i> refers to the lender's country and concerns only lenders headquartered in EU countries. The variable <i>EU Green Deal (Borrower's country)</i> refers to the borrower's country and concerns only borrowers headquartered in EU countries.	Own estimations
ESG disclosure	A binary variable equal to one for the year onward in which mandatory disclosure of companies' ESG activities is in effect in the corresponding country, and zero otherwise. The variable <i>ESG disclosure (Lender's country)</i> refers to the adoption of mandatory disclosure in the lender's country. The variable <i>ESG disclosure (Borrower's country)</i> is the equivalent variable for the borrower's country. The variables <i>E disclosure (Lender's country)</i> and <i>E disclosure (Borrower's country)</i> are the equivalent variables for the adoption of mandatory disclosure of companies' environmental activities (the environmental component of ESG). The list of countries and the corresponding year of the adoption of mandatory disclosures are included in Krueger, Sautner, Tang and Zhong (2024).	Krueger, Sautner, Tang and Zhong (2024)
Banking crisis	A binary variable equal to one if the lender's country experiences a systemic banking crisis in the current year, and zero otherwise.	Laeven and Valencia (2018)

Table A2. List of lenders' countries

The table presents the lenders' countries in our sample and the number of observations included in the baseline regressions.

Country	Observations
Australia	394
Austria	203
Belgium	221
Canada	272
China	139
Denmark	248
France	3,147
Germany	4,327
Greece	64
Italy	888
Japan	6,262
Luxembourg	44
Netherlands	1,623
Norway	436
Portugal	67
Singapore	936
Spain	973
Sweden	481
Switzerland	77
United Kingdom	12,374
United States of America	46,438
Total	79,614

Additional sensitivity tests

This section includes the discussion of additional results and robustness checks. In columns (1) to (3) of Table A3, we estimate our baseline specification for *AISD* (column 2 of Table 3) by including various additional control variables. These refer to measures of lenders' non-performing loans to total assets (NPLs), certain profitability indicators for the borrowing firms (ROE, EBITDA) and measures of the existence and magnitude of the lending relationship between the given lender-borrower pair during the past 5-year period. We also employ various institutional and macroeconomic variables reflecting the level of democratic development in the lender's country, the ratio of public debt to GDP, the difference in inflation rate and the trade balance between the country of the lender and borrower, as well as an indicator about the implementation of carbon tax in the borrower's country. Across all specifications, the coefficient on *Fossil fuel firm* is consistently positive and statistically significant. Further, in columns (4) to (6) we replicate the estimations of specifications (1) to (3) respectively, by replacing *AISD* with *Loan amount*.

In Table A4, we confirm the insensitivity of our inferences to the type of standard error clustering. In this respect, we initially cluster standard errors by borrower *and* year (column 1), lender *and* year (column 2), lender's country *and* year (column 3), borrower *and* lender (column 4), and borrower *and* lender *and* year (column 5). All specifications provide estimates that are almost similar to that from our baseline regression.

To further remove potential cross-sectional heterogeneity between the fossil fuel and non-fossil fuel firms, we employ a subsample of firms with similar fundamentals. This should control for potential differences in the observable and unobservable characteristics between fossil fuel firms and their non-fossil peers, as well as any differences in the loan characteristics between the two groups.

We report results from this exercise in Table A5, where we replicate our baseline specification (column 2 of Table 3) by matching the two borrower groups across a range of firm characteristics (size, profitability, leverage). Across these specifications, the coefficient on *Fossil fuel firm* is consistently positive and statistically significant. In fact, the coefficients are very similar to our baseline estimates, validating the higher cost of credit faced by fossil fuel firms relative to other very similar non-fossil fuel firms.

Thus far, our OLS estimations have assumed that all loans enter the model with equal weights. Normally, the different fixed effects in Table 3 provide a safeguard against cross-country variation. We nevertheless acknowledge that the empirical specification might leave the analysis open to the criticism that countries receiving fewer loans might affect our results disproportionately. To this end, in Table A6 we re-estimate our preferred model specification using weighted least squares and several different weights; these are based on the number of loans between each lender-borrower pair, between the borrower and the lender's country, and between the lender's and borrower's countries. The results are almost identical to our baseline.

In Table A7 we run a seemingly unrelated regression (SUR) model that accounts for the simultaneous setting of the price and non-price loan terms by the lenders at the time of loan origination. In this setting we estimate a system of regressions where, in addition to *AISD*, a number of different loan terms, namely *Loan amount*, *Maturity*, *Collateral*, and *Number of lenders* are regressed on the same set of regressors in our baseline equation (including the *AISD*). The results from this exercise confirm the robustness of our baseline OLS estimates; in fact, the results of our baseline models appear to be considerably conservative compared to those under the SUR framework.¹⁷

Next, in Table A8 we estimate our baseline specification by using an alternative proxy for climate risk. This proxy refers to the borrower's exposure to climate change, calculated from

¹⁷ For expositional purposes, we only report estimates from the regressions where the dependent variable is *AISD*. The estimates from the other equations in the model are available on request.

transcripts of quarterly earnings calls (see Sautner, Van Lent, Vilkov and Zhang, 2023). We standardize this variable and employ it in the regressions for *AISD*, *Loan amount* and *Number of loans*. Results from column (1) confirm the aggravating effect of climate change exposure on the pricing of loans: a one standard deviation in borrower’s climate exposure (equal to 1.00) raises AISD by 8.2 basis points.¹⁸ Moreover, as column (2) reveals, greater company exposure to climate change is associated with larger loan amounts.

In columns (3) and (4) we interact *Fossil fuel firm* with *Climate change exposure* in the regressions for *AISD* and *Loan amount*, respectively. Either column confirms the positive and statistically significant coefficient on *Fossil fuel firm*. However, the coefficient on the main term of *Climate change exposure*, albeit positive, is weakly statistically significant, revealing that its effect is absorbed by the fossil fuel firm indicator; this points to the limited potency of demand-side forces. Furthermore, the coefficient on *Fossil fuel firm* \times *Climate change exposure* is either weakly significant (column 3) or non-significant (column 4), suggesting that climate change exposure is not material for loan terms when we compare firms within the same (fossil fuel) sector. Finally, results from column (5) show that a rise in borrower’s exposure to climate change leads to an increase in the number of loans from lenders to exposed borrowers.

In Table A9 we confirm our findings about the shorter maturities on loans to fossil fuel firms by replicating the robustness tests of columns (1) to (3) of Table A3 and replacing *AISD* with *Loan maturity* as dependent variable. Estimates from all specifications verify the easing effect of the fossil fuel indicator on loan maturity, which is independent of the control variables used. Finally, in Table A10 we employ an alternative measure of lender’s and borrower’s ESG performance, namely the ESG score from Refinitiv. We use this to replicate the specifications of Table 9 for the regressions for *AISD* and *Loan maturity*. By construction, higher values in

¹⁸ We further employ the components of climate change exposure; these are obtained from its decomposition into opportunity, regulatory and physical shocks (for a detailed discussion of this approach, see Sautner, Van Lent, Vilkov and Zhang, 2023).

ESG scores from Refinitiv indicate stronger performance on ESG issues. Estimates from Table A10 confirm the aggravating effect of the lender's ESG score on loan spreads and the easing effect on loan maturity; moreover, these effects are reinforced with the adoption of mandatory ESG disclosure in the lender's country. We obtain similar results in Table A11, where we replace the ESG score from RepRisk with its environmental component (E score) and further replace the mandatory ESG disclosure indicator with an indicator on mandatory environmental disclosure (E disclosure).

Table A3. Different controls

The table reports coefficients and t-statistics [in brackets]. The dependent variable is in the second row of the table and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Each specification includes a different set of control variables, in addition to those included in the baseline regression (column 2 of Table 3). All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	AISD	AISD	AISD	Loan amount	Loan Amount	Loan amount
Fossil fuel firm	17.953*** [4.055]	12.887*** [3.530]	11.513*** [2.865]	0.252*** [3.635]	0.200*** [3.528]	0.202*** [3.798]
Bank NPLs	166.822 [1.115]			-1.542 [-0.818]		
Firm ROE	-36.129*** [-4.584]			-0.133 [-1.481]		
Firm EBITDA	-4.124 [-1.116]			0.212*** [4.807]		
Lending relationship	-8.350*** [-5.251]			0.049** [2.317]		
Lending relationship (amount)		-3.512 [-1.518]			-0.058* [-1.811]	
Polity		38.801*** [5.895]			0.060 [0.784]	
Debt-to-GDP		-0.046 [-0.407]			-0.004*** [-3.197]	
Inflation			-2.825*** [-3.118]			0.023** [2.017]
Trade balance			-0.000 [-0.209]			-0.000 [-1.037]
Carbon tax (Borrower's country)			1.007 [1.192]			0.413 [1.209]
Observations	49,976	56,919	54,441	49,976	56,919	54,441
Adj. R-squared	0.562	0.554	0.570	0.459	0.533	0.545
Controls	Y	Y	Y	Y	Y	Y
Fixed effects	Y	Y	Y	Y	Y	Y

Table A4. Different clustering of standard errors

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. Estimation method is OLS. The penultimate part of the table denotes the type of standard error clustering (B&Y refers to Borrower *and* Year, L & Y refers to Lender *and* Year, LC & Y refers to Lender's country *and* Year, BC & Y refers to Borrower's country *and* Year, and B & L & Y refers to Borrower *and* Lender *and* Year). All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Fossil fuel firm	13.472*** [3.703]	13.472*** [4.380]	13.472*** [6.871]	13.472*** [4.300]	13.472*** [3.438]
Loan amount	-11.499*** [-8.547]	-11.499*** [-8.210]	-11.499*** [-11.253]	-11.499*** [-7.679]	-11.499*** [-7.989]
Maturity	6.091 [1.469]	6.091 [1.419]	6.091 [1.437]	6.091 [1.397]	6.091 [1.388]
Collateral	51.883*** [13.090]	51.883*** [12.521]	51.883*** [14.209]	51.883*** [18.370]	51.883*** [12.127]
Number of lenders	-0.741*** [-6.313]	-0.741*** [-5.655]	-0.741*** [-5.724]	-0.741*** [-7.111]	-0.741*** [-5.284]
Performance provisions	-11.082*** [-4.575]	-11.082*** [-4.104]	-11.082*** [-3.545]	-11.082*** [-3.160]	-11.082*** [-4.000]
General covenants	-1.280 [-0.486]	-1.280 [-0.490]	-1.280 [-0.491]	-1.280 [-0.368]	-1.280 [-0.461]
Bank size	-14.545*** [-3.260]	-14.545** [-2.753]	-14.545* [-1.935]	-14.545*** [-3.232]	-14.545** [-2.750]
Bank ROA	-577.272** [-2.775]	-577.272 [-1.422]	-577.272* [-1.948]	-577.272** [-2.392]	-577.272 [-1.426]
Bank capital	68.086 [0.815]	68.086 [0.651]	68.086 [0.624]	68.086 [0.735]	68.086 [0.648]
Firm size	-9.677*** [-9.905]	-9.677*** [-10.646]	-9.677*** [-12.079]	-9.677*** [-9.654]	-9.677*** [-9.860]
Firm ROA	-280.240*** [-13.480]	-280.240*** [-11.305]	-280.240*** [-11.356]	-280.240*** [-7.133]	-280.240*** [-10.539]
Firm leverage	92.489*** [11.975]	92.489*** [13.315]	92.489*** [12.868]	92.489*** [14.597]	92.489*** [12.040]
Firm tangibility	-7.989 [-1.721]	-7.989* [-1.885]	-7.989 [-1.328]	-7.989 [-1.143]	-7.989 [-1.578]
Firm Tobin's Q	-0.106*** [-5.116]	-0.106*** [-5.516]	-0.106*** [-7.157]	-0.106*** [-5.671]	-0.106*** [-5.082]
GDP	-0.001*** [-5.074]	-0.001* [-1.936]	-0.001 [-1.104]	-0.001 [-0.872]	-0.001** [-2.086]
GDP per capita	-0.114 [-1.013]	-0.114 [-1.293]	-0.114 [-1.115]	-0.114 [-0.664]	-0.114 [-1.018]
Oil price	-0.165 [-1.002]	-0.165 [-1.019]	-0.165 [-1.190]	-0.165 [-1.721]	-0.165 [-1.021]
VIX	0.483 [1.099]	0.483 [1.101]	0.483 [1.502]	0.483 [1.541]	0.483 [1.107]
Carbon tax	9.415** [2.834]	9.415*** [2.870]	9.415** [2.366]	9.415* [2.040]	9.415** [2.776]
Observations	79,614	79,614	79,614	79,614	79,614
Adj. R-squared	0.546	0.546	0.546	0.546	0.546
Fixed effects	Y	Y	Y	Y	Y
Clustering	B & Y	L & Y	LC & Y	BC & Y	B & L & Y

Table A5. Matched samples

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. The estimation method is OLS with standard errors clustered by borrower. Each specification includes a different matched sample based on borrower characteristics. Specification (1) estimates the baseline specification (column 2 of Table 3) by limiting the sample to borrowers with similar values of *Firm size* (within one standard deviation of the sample mean). Specification (2) replicates specification (1) by limiting the sample to borrowers with similar values of *Firm size* and *Firm ROA*. Specification (3) replicates specification (1) by limiting the sample to borrowers with similar values of *Firm size*, *Firm ROA* and *Firm debt*. All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	Matched sample		
	(1) Size	(2) Size, ROA	(3) Size, ROA, Debt
Fossil fuel firm	12.878*** [3.124]	12.572*** [3.037]	12.029*** [2.825]
Loan amount	-9.741*** [-10.365]	-10.302*** [-10.747]	-8.897*** [-8.349]
Maturity	-0.021 [-0.007]	2.447 [0.738]	4.019 [1.063]
Collateral	52.045*** [19.105]	47.343*** [15.836]	48.674*** [13.673]
Number of lenders	-0.607*** [-4.622]	-0.659*** [-4.723]	-0.629*** [-4.176]
Performance provisions	-11.066*** [-5.290]	-6.620*** [-2.721]	-4.115 [-1.449]
General covenants	0.402 [0.175]	0.718 [0.283]	1.364 [0.465]
Bank size	-10.638*** [-2.889]	-9.741** [-2.465]	-10.784** [-2.553]
Bank ROA	-736.864*** [-3.498]	-736.455*** [-3.197]	-626.917** [-2.515]
Bank capital	-30.367 [-0.567]	-10.170 [-0.174]	43.215 [0.672]
Firm size	-11.002*** [-8.884]	-10.712*** [-7.683]	-9.642*** [-6.188]
Firm ROA	-293.312*** [-11.407]	-246.349*** [-5.254]	-244.159*** [-4.773]
Firm leverage	93.030*** [12.826]	106.760*** [12.318]	85.815*** [5.173]
Firm tangibility	-7.350 [-1.439]	-17.839*** [-3.400]	-20.085*** [-3.573]
Firm Tobin's Q	-0.107*** [-5.367]	-0.122*** [-4.800]	-0.078*** [-2.705]
GDP	-0.000 [-0.250]	-0.000 [-0.448]	0.002** [2.420]
GDP per capita	-0.027 [-0.220]	0.066 [0.453]	0.088 [0.569]
Oil price	-0.105 [-0.820]	-0.129 [-0.922]	-0.197 [-1.189]
VIX	0.612** [2.477]	0.501* [1.722]	0.710** [2.245]
Carbon tax	7.977*** [2.957]	6.862** [2.382]	9.215*** [2.907]
Observations	55,539	42,068	30,585
Adj. R-squared	0.432	0.450	0.453
Fixed effects	Y	Y	Y

Table A6. Weighted regressions

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Each specification includes a different weight. In specification (1), we weight by the number of loans between the lender and the borrower to the total number of loans in our sample. In specification (2), we weight by the number of loans between the borrower and the lender's country to the total number of loans in our sample. In specification (3), we weight by the number of loans between the lender's country and the borrower's country to the total number of loans in our sample. All specifications include borrower's accounting controls, lender's accounting controls, lender's country macroeconomic controls, and global volatility and carbon pricing controls. All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)
Fossil fuel firm	13.776*** [3.716]	13.826*** [3.759]	13.445*** [3.631]
Loan amount	-10.677*** [-12.622]	-11.293*** [-13.377]	-11.447*** [-13.962]
Maturity	5.650** [2.461]	5.979*** [2.605]	6.009*** [2.626]
Collateral	50.916*** [22.874]	51.549*** [23.395]	51.826*** [23.554]
Number of lenders	-0.854*** [-7.767]	-0.818*** [-7.319]	-0.723*** [-6.596]
Performance provisions	-10.867*** [-5.621]	-10.946*** [-5.670]	-11.158*** [-5.792]
General covenants	-1.324 [-0.648]	-1.266 [-0.621]	-1.711 [-0.836]
Observations	79,614	79,614	79,614
Adj. R-squared	0.547	0.546	0.546
Controls	Y	Y	Y
Fixed effects	Y	Y	Y

Table A7. Seemingly unrelated regressions

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Different specifications include a system of regression equations to control for the simultaneous determination of loan terms in each loan facility (only the estimates from the regression where the dependent variable is *AISD* are reported). In each regression, the set of regressors is the same as in the regression for *AISD* (including *AISD* and excluding the variable that acts as regressand in the respective equation). In specification (1), two regression equations are estimated, where the dependent variable is *AISD* and *Loan amount* respectively. In specification (2), three regression equations are estimated, where the dependent variable is *AISD*, *Loan amount* and *Maturity* respectively. In specification (3), four regression equations are estimated, where the dependent variable is *AISD*, *Loan amount*, *Maturity* and *Collateral* respectively. In specification (4), five regression equations are estimated, where the dependent variable is *AISD*, *Loan amount*, *Maturity*, *Collateral* and *Number of lenders* respectively. All specifications include borrower's accounting controls, lender's accounting controls, lender's country macroeconomic controls, and global volatility and carbon pricing controls. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
Fossil fuel firm	14.871*** (11.203)	15.273*** (11.506)	15.584*** (11.740)	16.142*** (12.161)
Loan amount	-10.758*** (-59.431)	-10.829*** (-59.824)	-11.448*** (-63.254)	-10.043*** (-55.510)
Maturity	7.971*** (12.636)	15.186*** (24.093)	6.971*** (11.076)	5.732*** (9.107)
Collateral	88.762*** (108.517)	87.278*** (106.706)	153.649*** (199.368)	151.412*** (196.478)
Number of lenders	-1.418*** (-33.145)	-1.393*** (-32.560)	-1.119*** (-26.164)	-2.675*** (-63.107)
Performance provisions	-17.348*** (-18.696)	-17.255*** (-18.596)	-15.901*** (-17.137)	-11.285*** (-12.164)
General covenants	-8.124*** (-9.285)	-8.200*** (-9.373)	-19.007*** (-21.753)	-18.769*** (-21.482)
Observations	79,614	79,614	79,614	79,614
Adj. R-squared	0.360	0.359	0.307	0.304
Controls	Y	Y	Y	Y
Fixed effects	Y	Y	Y	Y

Table A8. Alternative climate risk proxy

The table reports coefficients and t-statistics [in brackets]. The dependent variable is in the second row of the table and all variables are defined in Table A1. Estimation method is OLS. Different specifications include an alternative proxy for climate change risk by Sautner, Van Lent, Vilkov and Zhang (2023). Specification (1) replicates the baseline specification (column 2 of Table 3) by replacing *Fossil fuel firm* with *Climate change exposure*, i.e., the borrower's exposure to climate change. Specification (2) replicates the estimation in specification (1) with *Loan amount* as dependent variable. Specifications (3) and (4) replicate the estimations in specifications (1) and (2) respectively, by interacting *Climate change exposure* with *Fossil fuel firm*. Specification (5) replicates the estimation in specification (1) with *Number of loans* as dependent variable, while *Climate change exposure* refers to the average exposure of borrowers on all loans by the lender in the year. In specifications (1) to (4) standard errors are clustered by borrower and in specification (5) by lender. Specifications (1) to (4) include borrower's accounting controls, lender's accounting controls, lender's country macroeconomic controls, and global volatility and carbon pricing controls. Specification (5) includes lender's accounting controls, lender's country macroeconomic controls, and global volatility and carbon pricing controls. Specifications (1) to (4) include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. Specification (5) includes year, lender, lender's country, and borrower's country fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
	AISD	Loan amount	AISD	Loan amount	Number of loans
Climate change exposure	8.188*** [6.747]	0.056*** [3.111]	6.740* [2.040]	0.040* [2.010]	4.645** [2.390]
Fossil fuel firm			12.175** [2.487]	0.259*** [4.544]	
Fossil fuel firm × Climate change exposure			11.737* [1.851]	0.061 [1.287]	
AISD		-0.002*** [-13.666]		-0.002*** [-13.802]	
Loan amount	-11.995*** [-11.830]		-12.136*** [-11.955]		
Maturity	7.438** [2.455]	0.208*** [4.770]	7.694** [2.546]	0.212*** [4.865]	
Collateral	44.769*** [17.647]	-0.027 [-0.710]	44.647*** [17.661]	-0.026 [-0.670]	
Number of lenders	-0.790*** [-5.836]	0.036*** [10.403]	-0.780*** [-5.816]	0.036*** [10.492]	
Performance provisions	-10.389*** [-4.340]	0.055 [1.615]	-10.410*** [-4.376]	0.056* [1.657]	
General covenants	-1.603 [-0.681]	0.028 [0.653]	-1.732 [-0.734]	0.025 [0.583]	
Observations	53,688	53,688	53,688	53,688	423
Adj. R-squared	0.552	0.761	0.553	0.762	0.594
Controls	Y	Y	Y	Y	Y
Fixed effects	Y	Y	Y	Y	Y

Table A9. Different controls in the regressions for loan maturity

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *Loan maturity* and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Different specifications replicate the estimations of Table A3 with *Loan maturity* as dependent variable. Each specification includes a different set of control variables, in addition to those included in the baseline regression (column 2 of Table 3). All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)
Fossil fuel firm	-0.021** [-2.275]	-0.023** [-2.150]	-0.018** [-2.344]
Bank NPLs	1.388** [2.301]		
Firm ROE	0.059*** [2.828]		
Firm EBITDA	0.030** [2.434]		
Lending relationship	-0.029*** [-5.422]		
Lending relationship (amount)		-0.053*** [-6.041]	
Polity		-0.112*** [-3.763]	
Debt-to-GDP		0.001 [1.567]	
Inflation			0.003 [0.453]
Trade balance			-0.000 [-1.040]
Carbon tax (Borrower's country)			-0.072*** [-2.649]
Observations	49,969	56,912	54,437
Adj. R-squared	0.641	0.670	0.664
Controls	Y	Y	Y
Fixed effects	Y	Y	Y

Table A10. The effect of lenders' and borrowers' ESG: Alternative ESG measures

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Different specifications replicate the estimations of Table 9 by employing alternative ESG measures. In specification (1) *Fossil fuel firm* is interacted with *Lender's ESG (Refinitiv)*, i.e., the lender's ESG score from Refinitiv (higher values reflect better performance on ESG). In specification (2) *Fossil fuel firm* is interacted with *Borrower's ESG (Refinitiv)*, i.e., the borrower's ESG score from Refinitiv (higher values reflect better performance on ESG). In specification (3) *Fossil fuel firm* and *Lender's ESG (Refinitiv)* are interacted with *ESG disclosure (Lender's country)*, i.e., a binary variable equal to one for the year and after mandatory disclosure of companies' ESG activities is in effect in the lender's country, and zero otherwise. In specification (4) *Fossil fuel firm* and *Lender's ESG (Refinitiv)* are interacted with *ESG disclosure (Borrower's country)*, i.e., a binary variable equal to one for the year and after mandatory disclosure of companies' ESG activities is in effect in the borrower's country, and zero otherwise. Specifications (5) and (6) replicate the estimations in specifications (3) and (4) with *Loan maturity* as dependent variable. All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) AISD	(2) AISD	(3) AISD	(4) AISD	(5) Loan maturity	(6) Loan maturity
Fossil fuel firm	8.470*** [2.486]	23.819*** [2.713]	7.877** [2.375]	23.928*** [2.711]	-0.023** [-2.122]	-0.025** [-2.114]
Fossil fuel firm × Lender's ESG (Refinitiv)	0.220** [2.063]		0.210** [1.972]		-0.001** [-2.391]	-0.001* [-2.096]
Fossil fuel firm × Borrower's ESG (Refinitiv)		0.192 [0.318]		0.196 [0.321]		
Fossil fuel firm × Lender's ESG (Refinitiv) × × ESG disclosure (Lender's country)			0.127** [2.421]		-0.002* [-2.091]	
Fossil fuel firm × Lender's ESG (Refinitiv) × × ESG disclosure (Borrower's country)				0.032 [0.160]		0.003 [1.339]
Observations	22,862	10,962	22,862	10,962	22,862	10,962
Adj. R-squared	0.545	0.535	0.545	0.535	0.652	0.672
Controls	Y	Y	Y	Y	Y	Y
Fixed effects	Y	Y	Y	Y	Y	Y

Table A11. The effect of lenders' and borrowers' ESG. Environmental measures

The table reports coefficients and t-statistics [in brackets]. The dependent variable is *AISD* and all variables are defined in Table A1. Estimation method is OLS with standard errors clustered by borrower. Different specifications replicate the estimations of Table 9 by employing the environmental component of the ESG score and the mandatory adoption of environmental disclosure. In specification (1) *Fossil fuel firm* is interacted with *Lender's E score*, i.e., the environmental component of the lender's ESG score (higher values reflect better performance on ESG). In specification (2) *Fossil fuel firm* is interacted with *Lender's E score adjusted*, i.e., the difference between the environmental components of the lender's ESG score and the ESG score of the lender's industry. In specification (3) *Fossil fuel firm* is interacted with *Borrower's E score*, i.e., the environmental component of the borrower's ESG score (higher values reflect better performance on ESG). In specification (4) *Fossil fuel firm* and *Lender's E score adjusted* are interacted with *E disclosure (Lender's country)*, i.e., a binary variable equal to one for the year onward in which mandatory disclosure of companies' environmental activities (the environmental component of ESG) is in effect in the lender's country, and zero otherwise. In specification (5) *Fossil fuel firm* and *Lender's E score adjusted* are interacted with *E disclosure (Borrower's country)*, i.e., a binary variable equal to one for the year onward in which mandatory disclosure of companies' environmental activities (the environmental component of ESG) is in effect in the borrower's country, and zero otherwise. Specifications (6) and (7) replicate the estimations in specifications (4) and (5) with *Loan maturity* as dependent variable. All specifications include year, lender, lender's country, borrower's country, and loan type and purpose fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) AISD	(2) AISD	(3) AISD	(4) AISD	(5) AISD	(6) Loan maturity	(7) Loan maturity
Fossil fuel firm	8.889** [2.344]	11.057*** [2.737]	15.771*** [2.788]	12.773*** [2.778]	13.541*** [3.112]	-0.025* [-1.997]	-0.027* [-1.994]
Fossil fuel firm × Lender's E score	0.225** [2.122]						
Fossil fuel firm × Lender's E score adjusted		0.211** [2.119]		0.228** [2.339]	0.217** [2.299]	-0.001* [-1.992]	-0.001* [-1.877]
Fossil fuel firm × Borrower's E score			0.311 [0.788]				
Fossil fuel firm × Lender's E score adjusted × × E disclosure (Lender's country)				2.125** [2.371]		-0.002* [-2.007]	
Fossil fuel firm × Lender's E score adjusted × × E disclosure (Borrower's country)					0.358 [0.789]		0.001 [0.812]
Observations	24,670	24,670	5,952	24,670	24,670	24,662	24,662
Adj. R-squared	0.510	0.510	0.612	0.510	0.510	0.635	0.635
Controls	Y	Y	Y	Y	Y	Y	Y
Fixed effects	Y	Y	Y	Y	Y	Y	Y