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JEL Classification: G12, G21, G23, G30, D62

Keywords: Carbon Emissions, bank lending, Real effects, environmental performance, greenwashing

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November 30, 2021

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1. Introduction

The battle against global warming is at the forefront of social and policy debates. A fundamental element to mitigate the climate problem is the reduction of carbon emissions, especially those of the private sector, a process that is often described as a transition from brown to green economy. For the process to succeed it requires a strong involvement of many economic players, from the public and private sectors, including the financial sector (see, Bolton, Hong, Kacperczyk, and Vives, 2021, or Giglio, Kelly, and Stroebel, 2021), both in terms of capital provision and disciplinary actions to facilitate environmental progress.

Of special importance in the transition is the banking sector, given its centrality in allocating resources to non-financial companies (NFCs), its ability to impose costs on non-compliant companies either through quantity or price adjustments, and its power to coordinate actions. Indeed, the banking sector has taken a central stage in various climate actions, with the Net-Zero Banking Alliance launched in April 2021 being one of the most prominent initiatives.[1] While the involvement of the banking sector is promising, it is an empirical question whether it actually brings in a meaningful change. Do banks enforce emission reduction, by actively cutting credit to brown firms and (possibly) channeling credit towards green firms or by providing credit to brown firms for investment to reduce carbon emissions? Or are banks' actions a form of cheap talk without any real change? Answering these questions is paramount as has been highlighted by policy makers, including, among others, the then Bank of England's Governor, Carney (2015), and the European Central Bank's President, Lagarde (2019).

[1] As of November 2021, the Alliance includes 95 members from 39 countries, representing 43% of global banking assets.

In this paper, we shed light on these issues by looking at the sample of global firms that rely on bank credit and exhibit a rich cross-sectional variation in their carbon emission levels. In particular, we study how firm-level carbon emissions affect bank lending and, through this channel, real, financial, and environmental outcomes. As an empirical identification strategy of banks' willingness to reduce brown lending, we exploit a cross-sectional variation among banks in their commitments, through the Science Based Targets Initiative (SBTi),[2] to a well-defined path of reductions in carbon emissions, in line with the Paris Agreement goals. The extent to which such commitments result in a more environmentally friendly distribution of credit across firms is ex ante unclear. In the absence of sharp penalties and tight rules on lending to brown firms, commitments might be a tool for greenwashing, resulting in small or nil implications for the allocation of credit. Importantly, the commitments are also shocks to firms with prior credit from these banks. Even if bank commitments change their lending behavior, it is not clear whether firms could not secure their funding through other financial intermediaries and instruments, and hence continue polluting and investing. As such, we also analyze the credit supply mechanism via firm and loan-level data.

In our first test, we examine whether firms associated with banks that decide to make commitments experience different financing outcomes, conditional on their level of scope-1 emissions.[3] We analyze staggered commitments to the SBTi-targets by financial institutions with large exposures in the syndicated loan market (these banks participate in 60% of the loans). Our

[2] Even though SBTi is not the only initiative to coordinate climate actions, it is one of the most powerful ones, with the endorsement of several politically and socially important figures, such as Michael Bloomberg, Mark Carney, or Angela Merkel.

[3] Scope-1 greenhouse gas (GHG) emissions occur from sources that are controlled or owned by a firm. In our sample of firms, a standard deviation of the cross-section of scope-1 emissions equals 15.8 million tons of CO2e. The average level of scope-1 emissions is close to 3.4 million tons of CO2e. In turn, scope-2 emissions relate to the purchase of electricity (and steam and heat), and scope-3 emissions originate within the value chain in which a company operates. Details on the precise definitions of emissions are provided in the Greenhouse Gas Protocol.

data cover the 2013-2018 period, consistent with the fact that these bank-level commitments happen not earlier than in mid-2015. Our setting lends itself to estimating a triple difference-in-differences regression model, in which we compare outcomes across firms: i) before and after bank commitments; ii) depending on whether firms have, or do not have, a (previously) established credit relationship with a committed bank; iii) conditional on whether a firm is relatively green, or brown, based on its prior level of greenhouse gas (GHG) emissions.

Our results provide strong and robust evidence that committed banks affect firms' credit outcomes, conditional on the level of their emissions. The effect is present in both low-emission (green) firms, which are allocated relatively more credit, and in high-emission (brown) firms, which experience a reduction in total credit. Specifically, after a bank commits to carbon emissions reduction, firms with higher ex-ante scope-1 emissions and with ex-ante lending relationships with the committed bank (thereafter, committed firms) experience a relative reduction in total debt, compared to firms with the same levels of emissions but without ex-ante lending connections to the committed bank. The effect is economically significant with the difference in total debt of 6.4 percentage points (pp) per one-standard-deviation change in emissions. In turn, we do not find significant evidence on total debt based on the variation in levels of scope-2 and scope-3 emissions. The distinction in results between the two types of emissions likely reflects the fact that scope-1 emissions are easier to track and attribute to specific firm actions; hence, creditors find it easier to screen on such metrics. In sum, our results indicate that committed firms are cut financing and they cannot fully substitute their financing with borrowing from other lenders.

We provide further evidence on the source of the financing effect using several additional tests. We first divide firms' total debt into bank debt and non-bank debt and find that the effects for total debt are entirely driven by adjustments in bank debt, which suggests that the differences in leverage are a direct consequence of bank decisions rather than they are an outcome of an indirect channel in which banks affect the financial decisions of other market participants. We also find that banks are particularly responsive to firms with clear brown or green label, that is, firms located in the tails of the cross-sectional distribution of emissions (while the economic effects are mild for other firms). The results survive a battery of robustness tests typical for the difference-in-differences setting. Specifically, we find that firms in both the treatment and control groups follow similar trends prior to commitment episodes. Also, within non-committed firms, effects on bank lending are insignificant in the periods around the commitment events. For committed firms, effects are only significant after their banks commit. We further find that both sets of companies are similar along several firm-level observables. Finally, the results satisfy the test of selection on unobservables based on Oster (2019) and Altonji et al. (2005), that is, in the process of sequentially controlling for a large number of observables and different sets of fixed effects (e.g., firm observable controls, firm-fixed effects, time, industry-time or region-time fixed effects) that massively increase the debt regression R-squared, estimated effects remain very similar.

In our subsequent tests, we shed more light on the underlying economic mechanism driving bank financing decisions. We consider two possible hypotheses. In the first one, risk-averse banks cut credit to high-emission firms and channel credit to low-emission firms if they recognize that financial risk associated with their operations positively correlates with their emission activity. An alternative hypothesis is that committing banks make their credit decisions strictly based on their preferences for green versus brown assets. To distinguish between the two hypotheses, we conduct three tests. First, we control in our regressions for measures of credit risk based on the degree of firm leverage and its underlying stock return volatility. Our effect retains its economic significance after controlling for financial risk, even though financial risk also matters for credit allocation.[4] Quantitatively, after controlling for the risk channel, committed firms with a one-standard-deviation higher scope-1 emissions experience credit cut by 5.1 pp (as compared to uncommitted firms), whereas the overall effect without controlling for firm risk is 6.4 pp.[5]

Second, we look at relative changes in debt maturity choices. If bank behavior was an outcome of *preferences* for green vs. brown, one should expect loan maturity changes to be insignificant given that financial risk via climate risk (physical or transition induced) is mostly related to medium and long-term events. Our results indicate no significant change in maturity choices, the result that is more consistent with the preference hypothesis.

Third, we analyze loan-level data including firm-time fixed effects that control for business risk fully. This loan-level analysis provides a more nuanced view of the bank-lending channel and allows us to separate effects that are driven by syndicated loans only from those that are possibly driven by other lending arrangements. At a broad level, we can absorb firm-year-quarter fixed effects in our regressions and thus we can study lending decisions from committed vs. non-committed banks to the same firm at the same time, going in the direction of isolating a credit supply force. Here, we analyze the extensive and intensive margins of lending. We find that adjustment through syndicate loans happens along the extensive margin: compared to other banks, committed banks trim their participation in loans to firms with high emissions. At the same time, we do not find a significant result on the intensive margin: committed banks extend their syndicated loans as an in-or-out decision and do not partially cut the quantity of credit within a

[4] Formally, our proxy for firm risk is rolling stock-return volatility (lagged by one quarter), multiplied by firm financial leverage (debt over total assets). In the regression model, we interact such firm risk measure with an indicator for whether a firm is committed and with a *post* indicator for whether a firm's lender has committed or not.
[5] At the same time, committed firms with a one-standard-deviation higher risk experience a reduction in bank debt by 5.7 pp relative to equally risky uncommitted firms.

loan that they participate in. This result further supports the preference story along the lines of the divestment channel we observe in capital markets (e.g., Hong and Kacperczyk, 2009). We also analyze interest expenses, a proxy for loan prices, as another key margin through which credit supply could operate. Our results suggest that brown firms related to committed banks are penalized by higher prices, consistent with a credit supply channel. Overall, the results on the lending front suggest that committing banks do impose restrictions on polluting firms and relocate funding towards greener firms, and that other financing sources, such as uncommitted banks and non-bank debt, are not perfect substitutes for the affected firms.

While the increased restrictions to access credit may adversely affect polluting firms, the question is whether such firms' corporate decisions reflect the market force. To answer this question, we investigate firm-level real effects, including environmental and operational outcomes. In the first set of tests, we evaluate the impact of credit pressure on firm leverage, total assets, and investment decisions. Our estimates suggest that brown, committed firms undergo a process of deleveraging, characterized by shrinking leverage and asset size. A one-standard-deviation increase in ex-ante scope-1 emissions leads to a reduction in *CAPEX* of brown firms by 4.3 pp and in total assets by roughly 2 pp. The real effects are non-linear in that we observe a strong cut in lending and investment to brownest firms and a strong increase in credit and investments to greenest firms, with mild effects in between these extremes.

The above results suggest that firms do respond to bank pressure. However, the ultimate question is whether they adjust their environmental performance consistent with the committed banks' preference. On the one hand, committed firms have significant incentives to become relatively greener, as this grants easier access to bank financing; on the other hand, the tightening of credit standards due to SBTi commitments might limit their ability to invest in green technology or it may be costly to do so. Also, firms may want to reduce their investment/assets in segments/projects that are not necessarily brown if the brown sectors have higher profit margins.

Our findings on this front paint a mixed picture. Indeed, we find that committed firms with higher emissions significantly improve their environmental *E*-scores, although by just 10 pp as a response to a one-standard-deviation higher scope-1 emissions. Interestingly, effects are insignificant for the non-environmental ESG metrics. When we decompose the *E*-score into its subcomponents, we do not find any evidence of significant changes in environmental expenditures and, crucially, in overall ex-post scope-1 emissions–that is, choices involving hard metrics. Further, in the year after the shock, affected firms do not make any additional commitments regarding their own plans to reduce emissions in the future.[6]

Instead, what drives the improvement in environmental (ESG) performance is better communication. Since such communication efforts do not lead to any changes in real emissions or plans to reduce them, they are consistent with a form of greenwashing by the affected companies. Our results suggest that committed banks perceive these efforts as non-credible given that we still observe a significant credit pressure. Further, we observe that the lending pressure on effected firms does not change materially even if firms commit to future emission reductions.

[6] Given that after bank commitments, firms previously borrowing from these banks have lower total assets, but their carbon emissions do not change, if anything, affected firms may be even divesting green assets. At the same time, there could be some adjustments that may not be captured in our next year's scope-1 measure. For example, these firms could reduce (future) medium-term carbon emissions by increasing intangible assets, such as R&D in green technologies, the object that is not captured in CAPEX. In addition, it may take years to reduce carbon emissions for a brown firm. Nonetheless, we find no significant difference in SBTi commitments for on non-financial firms. All in all, our evidence points to no adjustments in hard data related to carbon emissions by the more affected firms.

Overall, our results suggest that banks affect carbon emissions via credit reallocation (from brown to green firms) rather than via providing loans to brown firms for the investment necessary to reduce carbon emissions.

Contribution to the literature. Our paper contributes to the recent and flourishing literature on climate change and finance.[7] By now, there is a relatively large evidence that investors ask for a premium to hold stocks of firms highly exposed to climate risk (e.g., because of high level of carbon emissions, as in Bolton and Kacperczyk, 2021abc), especially during periods in which climate risk is perceived to be higher (Engle et al., 2020; Choi, Gao, and Jiang, 2020). Similarly, corporate bonds issued by firms highly exposed to climate risk are found to generate lower future *ex-post* returns, amplified by perceptions of increased climate risk (Huynh and Xia, 2020; 2021). Our paper contributes to the literature by showing the bank-lending channel for carbon risk.

The literature on the implications of climate change for banking is rather sparse. Few papers analyze how loan pricing responds to firm exposure to carbon risk through carbon emissions (Delis, de Greiff, and Ongena, 2019; Degryse et al., 2021; Ehlers, Packer, and de Greiff, 2021). Gingingler and Moreau (2019) and Nguyen and Phan (2020) show that greater exposure to climate risk is associated with a reduction in corporate financial leverage. Using loan-level data, Reghezza et al. (2021) show that bank lending gets reduced after the Paris Agreement. We make several contributions to this literature. First, unlike the other papers, we consider the full bank-lending channel related to carbon risk in that we not only focus on the allocation of credit across firms with different levels of exposure to climate risk through carbon emissions but, importantly, we document that committed banks cut credit supply to firms that pollute relatively more, with

[7] For a review of this literature, see Giglio et al. (2021).

significant firm-level real effects (e.g., firm investment, total assets) and environmental effects. Despite the real and financial effects, we find no improvement in hard firm-level environmental scores for brown firms, but only evidence consistent with firm greenwashing. Second, we show that corporate deleveraging is due to bank-lending channel, prompted by a change in banks' preferences towards lending to green-*vs*-brown firms, rather than by a financial risk factor. Third, we are the first to show explicitly the role of bank environmental commitments in their lending activity and its transmission to the real sector, including their impact on carbon emissions. Finally, we show that banks affect carbon emissions via credit reallocation (from brown to green firms) rather than by improving brown firms' provision of capital for green investments.

The rest of the paper is organized as follows. Section 2 presents our data and Section 3 describes our empirical strategy. We present our findings in Section 4 and in Section 5 we briefly conclude.

2. Data

Our main analysis covers a sample of international firms for the period 2013-2018. The data we use result from merging the following sets: syndicated lending relationships from Thomson Reuters Dealscan; firm-level GHG emissions from S&P Global Trucost; and firm-level information (e.g., firm output, investment, leverage, or return volatility) from Compustat Global. Information from Compustat Global is matched with Dealscan following the methodologies in Chava and Roberts (2008) for non-financial companies (NFCs) and Schwert (2018) for lenders. We match Trucost data with the rest using ISIN. The combined data is a sample of 2112 firms, of which 631 firms have their headquarters located in the US, 348 in the European Union, 192 in the UK, and the remaining 941 firms are located elsewhere. We also use firm-level information from

Capital IQ on firm-level bank vs. nonbank finance, from MSCI on ESG ratings, and on firm-level environmental expenditure from Refinitiv. We report all summary statistics in Table 1.

In our empirical strategy, we utilize the data on bank commitments, following the Science Based Targets initiative (SBTi).[8] For some tests, we also identify NFCs which directly commit to SBTi. The SBTi is a joint initiative by Carbon Disclosing Project (CDP), the UN Global Compact, the World Wide Fund for Nature (WWF) (formerly named the World Wildlife Fund), and the World Resources Institute (WRI), whose purpose is to define and promote net-zero targets in line with the climate science. The overall goal of the initiative is to induce companies to commit to decarbonization pathways to increase the chance that global emissions can be reduced to a level that limits average temperature rise below 1.5°C. In the context of banks, that means greening their asset portfolios. The SBTi now comprises just over 1000 companies in 60 countries, with a combined value of $20.5 trillion.[9] The SBTi commitments vary both in the choice of base year for emissions and the horizon of interim targets. To join the SBTi, a company must first sign a commitment letter stating that it will work to set a science-based emission reduction target. It then has 24 months to develop and submit a target for validation. Once the target has been validated it is disclosed.

Our sample includes 59 banks that belong to 11 bank holding groups that either committed or stated a target for emission reductions.[10] These committed banks participate in approximately 60% of the loans. In general, banks commit in a staggered fashion. The first wave of commitments occurs in June of 2015 with other important rounds of commitments in November 2015 and April

[8] Bolton and Kacperczyk (2021d) provide more details on the origins of SBTi and the drivers of participation therein.
[9] See "From Ambition to Impact: Science Based Targets Initiative Annual Progress Report 2020."
[10] The list of lenders committed to SBTi comprises: ING; Westpac Banking; Bancolombia SA; BNP Paribas; Société Générale; HSBC; BBVA; Standard Chartered; YES Bank; ABN Amro; Commercial International Bank Egypt.

2016. We label each lender in Dealscan as committed, or not, depending on whether it eventually joins the SBTi, while also keeping track of the bank-specific commitment date. Formally, for each lender in our sample, we define two indicator variables: $Post_{b,t}$ is equal to one if bank *b* has committed by quarter *t*, and zero otherwise, and $Committed_b = max_b(Post_{b,t})$, which is equal to one if bank *b* ever commits to SBTi.

An important step in our analysis is establishing which firms are connected, through prior credit intakes, to banks which are committed to green targets. For each NFC in our sample, we compile a list of lenders in Dealscan the firm has (ex ante) borrowed from. For instance, the generic couple of firm *f* and bank *b* is defined as connected in quarter *t* if firm *f* has ever borrowed from bank *b* up to *t*, and defined as unconnected, otherwise. A firm is labelled as committed if at least one of its lenders is committed. Formally, let B_f be the set of connected lenders of firm *f*. Then, $Post_{f,t} = max_{Bf}(Post_{b,t})$ takes a value of one from the date of the first commitment of firm *f*'s previous lenders, and zero before. Committed firms are those whose lenders eventually commit, that is, those for which the indicator variable $Committed_f$ equals one.

Summary statistics in Table 1 suggest that 76% of the NFCs in our sample are connected to committed banks. This large share reflects the fact that committed banks are very active institutions in the syndicated loan market. To explore additional variation in lending arrangements, we define other variables to capture the strength of such relationship. First, we identify lead banks (or lead arrangers) in the syndicate (along the lines of Ivashina, 2009). Such institutions exert a prominent role in the issuance of syndicated loans; for example, they are primarily responsible for loan pricing, typically due to pre-existing stronger relationships with the borrower relative to the other banks in the syndicate. The resulting variable $LeadCommitted_f$ implies that the committed relationship involves at least one such lead bank for the firm; 56% of firms in our sample have a lead-arranger committed to SBTi. Second, for our connection indicator, and its lead-bank counterpart, we construct an intensive-margin proxy, namely, the share of lenders ($\%Committed_f$) and the share of lead-arrangers (*%LeadCommitted*), out of the total number of firms' lenders committed to SBTi. On average, 15% and 12% of the total number of lenders involve committed banks and committed lead-banks, respectively. Note, however, that we also exploit the time variation, that is, before and after a bank commits, and not only the cross-sectional variation.

For our analysis of emissions, we access yearly firm-level GHG emissions. We mostly focus on scope-1 emissions, that is, direct greenhouse gas emissions that occur from sources that are controlled or owned by a firm. As the first bank commitment happens in mid-2015 and our aim is to rely on ex-ante measures of firm pollution, we start by building a GHG-exposure variable, given by the average firm-level scope-1 emissions over the period 2013-2014, expressed in tons of emissions and denoted as $S1_f$. Indeed, our sample features a highly heterogenous and skewed distribution for $S1_f$, as presented in Table 1. The average firm produces roughly 3.56 million tons of emissions per year. Moreover, a cross-sectional standard deviation of $S1_f$ equals 13.8 million tons. To deal with such a highly non-linear distribution of scope-1 emissions, for practical purposes, we take the natural logarithm of $S1_{f,pre}$, obtaining the relatively more normally distributed variable, $Log\text{-}S1_f$. Eventually, to facilitate a better interpretation of our coefficients, we demean $Log\text{-}S1_f$ and the resulting demeaned variable is indicated as $\overline{Log\text{-}S1_f}$; its distribution is summarized in Table 1.[11]

[11] Note that the mean of $Log\text{-}S1_{f,pre}$ is not exactly zero. This is due to the fact that when demeaning, we subtract the mean based on the firm-level distribution (that is, one observation per firm) instead of the in-sample distribution. The two distributions differ slightly because a small number of firms eventually exit our sample before 2018.

For some of our empirical tests we use financial variables. The mean outstanding total debt in our sample of firms corresponds to $1276 million, with notable differences across firms: for instance, a firm in the 4th quartile of the debt distribution has a volume of total debt which is more than two times bigger than the one in the 1st quartile. On average, total debt amounts to roughly 30% of total assets, as is evident from the summary statistics for firm leverage (defined as total debt over total assets). In addition, we gather information on total bank debt, which, on average, equals 40% of total debt; the remaining fraction is predominantly market-financed debt. Throughout our analysis, we apply different firm-level controls, also fixed at their 2013-2014 mean values, including a proxy for firm revenue growth and firm size (log of total assets). Moreover, we proxy for firm-level default risk using a rolling-window stock-return volatility multiplied by firm financial leverage (debt over total assets). Firms exhibit a significant heterogeneity in their risk, with an average risk level of roughly 10.5 pp and an associated standard deviation of 8.6 pp. We also study other financial variables, in particular leverage and equity, summarized in Table 1.

For the analysis of real effects, we define the following variables. Capital expenditure (*CAPEX*) is expressed in log terms and measured at a quarterly frequency. This variable displays a large extent of variation. For instance, a firm in the 4th quartile of *CAPEX* has values 9 times larger than a firm in the 1st quartile. We also use ESG scores and its environmental subcomponent. Both variables take on values ranging from 0 (worst) to 10 (best). For both variables, the average firm has a score close to 5 points, with a standard deviation of close to 2 points. In practice, the ESG score is computed as a weighted average of its three main subcomponents, which, in turn, are obtained as a weighted average of further (sub)subcomponents. For the *E* subcomponent, we additionally gather information on the underlying factors: climate change (resulting from firm performance in terms of, for example, carbon emissions, energy efficiency), natural resources (capturing firm contribution to water stress, biodiversity and land use, and the sourcing of raw material), pollution and waste (proxying for, for example, firms' toxic emissions and waste, product packaging), and environmental opportunities (assessing firms' awareness and ability to exploit future opportunities in clean technologies, energy, and buildings). We also gather information on firm-level annual environmental expenditures. These represent a very small, close to 1%, fraction of total assets.

Finally, to better dissect whether the adjustment in credit driven by bank commitments is supply-driven, we study syndicated loan issuance at the firm-bank-year-quarter level. Our analysis is either at the extensive, intensive, or at both margins of lending. In particular, on the extensive margin, for a given firm in a given quarter, the set of (potential) lenders includes all banks involved in previous loan syndicates with that firm, in addition to any new lenders for the new loan issued in that quarter. We investigate whether a bank lends to that firm in that quarter (an indicator variable). On the intensive margin, we analyze credit volume granted by each lender that lends to the firm in that quarter. Finally, we combine the extensive and intensive margins, in that we analyze scenario in which some banks do not provide loans (value equal to zero), while other banks provide positive credit volume.

3. Empirical Strategy

Our empirical strategy exploits the fact that some banks commit to SBTi. We use these commitments in two ways: to answer the question whether they lead to material changes in bank lending strategies or are a manifestation of greenwashing, and also as a tool for empirical identification. By comparing changes in banks' commitments, we can trace changes in lending to brown/green firms, and thus identify a bank lending (credit supply) channel. From a different perspective, we can think of banks' commitments as shocks to firms that ex ante borrowed from these banks and we can analyze their impact on various corporate outcomes. Specifically, our main empirical specifications study the implications of these commitments for different firm-level outcome variables, $y_{f,t}$, such as debt (total debt, bank debt, and non-bank debt), real effects (e.g., total assets and CAPEX), and environmental effects (e.g., environmental score, carbon emissions, and environmental spending). Formally, we estimate the following triple difference-in-differences model:

$$y_{f,t}=\beta_1\overline{\text{Log-S1}}_f+\beta_2\text{Committed}_f+\beta_3\widetilde{\text{Post}}_t+\beta_4\overline{\text{Log-S1}}_f\text{Committed}_f+$$
$$\beta_5\widetilde{\text{Post}}_t*\overline{\text{Log-S1}}_f+\beta_6\text{Post}_{f,t}*\text{Committed}_f+\beta_7\text{Post}_{f,t}*\text{Committed}_f*\overline{\text{Log-S1}}_f+$$
$$\theta_1\text{Controls}_f+\text{FE}+e_{f,t} \qquad (1)$$

In the above equation, $\widetilde{\text{Post}}_t$ is an indicator variable equal to one from 2015Q2, the first date in which banks commit to SBTi, onwards. We include this variable to control for secular changes in firm outcomes occurring, for example, due to the Paris Agreement ratified in December 2015. Results are very similar if we set a post-Paris indicator variable to one for 2015:Q4 and after. Moreover, through the coefficient β_5 we also control for the possibility that firms with greater levels of scope-1 emissions may have recorded lower profitability (or higher risk) after the Paris Agreement, thereby experiencing different dynamics in both debt and investment.

Given that $\overline{Log\text{-}S1_f}$ describes a demeaned exposure to climate risk through scope-1 emissions, the coefficient β_6 pins down the effect of being connected to a committed bank for a firm with an average level of scope-1 emissions. The sign of this coefficient is ex ante uncertain. On one hand, if bank commitments to green targets eventually result in cutting credit to firms with high (above average) scope-1 emissions, we should expect the coefficient β_7 to be negative, at least in the debt regressions. On the other hand, these bank commitments could be greenwashing, and hence β_7 would be zero.

Other factors, beyond exposure to climate risk through GHG emissions, may also affect the evolution of debt, investment, and other left-hand side variables. We try to control for them through a vector of firm-level controls, which includes predetermined revenue growth and log assets size.[12] Both variables are fully interacted with $Committed_f$ and the *post* dummies. Additionally, *FE* represents a vector of fixed effects, which, in the most robust version of the model, is time and firm specific: the former absorb any variation which is common across all firms; the latter take care of within-firm time-invariant (observed and unobserved) heterogeneity.[13] For robustness, we also control for industry-time and region-time fixed effects (and in the loan-level data for firm-time fixed effects). $e_{f,t}$ represent error terms, which we cluster at the firm level, in line with the fact that the key coefficient of interest is identified by firm-level heterogeneity (Cameron and Miller, 2015) and the data are oriented at the firm-time level.

Equation (1) represents a triple difference-in-differences model with staggered treatment across firms. The key identification assumption for consistently estimating β_7 is that, absent bank commitment, connected and unconnected firms with comparable levels of scope-1 emissions would have experienced parallel dynamics in their bank debt. Put differently, consistently estimating β_7 requires an augmented version of the parallel trend assumption to hold. The

[12] In the Appendix, we show that size is the only firm observable which is different between committed and non-committed firms. Once we control for size, carbon emissions, sales growth, debt, risk, and leverage are not different; see Appendix, Table 1. We also analyze the Oster (2019)'s test on selection of unobservables. See the Results Section.
[13] Under the version of the model with firm and time-fixed effects, the coefficients β_1, β_2, β_3, and β_4 in equation (1) are not identified. Note that firm-level emissions are measured before any commitment and are not time varying.

challenge with respect to a standard difference-in-differences model with common time treatment is that, given staggered commitment across banks, there is not a single time period in which the treatment effect should materialize, thereby complicating the usual pre-*vs*-post comparisons.[14] In our setting, there are in fact two dates when banks commit, 2015Q2 and 2016Q2. Hence, to inspect the parallel-trend assumption, we take the following approach. We estimate the equation below, separately for committed and uncommitted firms:

$$y_{f,t} = \sum_{t \neq 2015Q1} \beta_t \overline{\text{Log-S1}_f} + \sum_{t \neq 2015Q1} \gamma_t \text{Controls}_f + \Gamma_t + \Gamma_f + u_{f,t} \quad (2)$$

For uncommitted firms, β_t should be generally insignificant. In turn, for committed firms, that is, those connected (through syndicated loans) with committed banks, β_t may be negative after 2015Q1, with a potential effect also showing up in 2016Q2. $Controls_f$ include, as in equation (1), average revenue growth and asset size over the 2013-2014 period. Γ_t and Γ_f represent time and firm-fixed effects, respectively.

To further investigate the credit-supply mechanism, we conduct several additional tests. First, we use the Oster (2019)'s test for the selection on unobservables. Second, we divide firm total debt into bank debt and non-bank debt. Third, we analyze the average loan rates that firms pay. Fourth, we conduct a loan-level analysis with firm-time fixed effects in which we examine the lending volume of committed banks vs. other banks to the same firm in the same quarter for a given level of firm emissions. These results are discussed in Section 4.

[14] For a formal explanation, see Goodman-Bacon (2021).

4. Results

In this section, we provide our empirical findings. We first report several results related to bank debt, both at the firm and individual loan levels. Next, we show the results for the real corporate decisions, including the investment and leverage choices. Finally, we present the results for environmental outcomes related to firm activities.

4.1. Firm-level Debt: Baseline Results

Table 2 reports findings for the estimation of equation (1), with (log) total debt as the dependent variable. We present results under progressively saturated versions of the model. In column 1, we do not include firm controls or fixed effects. In column 2, we augment the model with firm controls (fully interacted with both the post and firm-level commitment indicators). In columns 3 and 4, we add, one at a time, time-fixed effects–that control for changes in firm debt which are common across all firms in our sample–and firm-fixed effects, which take care of firm-level time-invariant heterogeneity. Finally, in column 5, we integrate firm controls, time, and firm-fixed effects. Across all specifications, the key coefficient of interest, β_7, describing the ex-post relative total debt dynamics for committed firms with above average scope-1 emissions, is negative (close to -0.025) and statistically significant at conventional levels (e.g., at the 1% level in the most saturated regression model, in column 5).

To assess the economic magnitude of the described effects, we take as a reference point the most robust version of the model, in column 5. Following a lender's commitment, firms with a one-standard-deviation higher log-level of scope-1 emissions experience a relative decline in total debt by 6.4 pp, as compared to other firms without ex-ante lending relationships with committed banks. Notably, the described economic effect does not depend substantially on controls and fixed effects. Indeed, the magnitudes of the coefficients vary across columns in a tight [6.4, 8.6] pp interval.

Next, in Table 3, we verify whether the adjustments in total debt are driven by bank debt or non-bank debt. We posit that the relative decline in debt for firms with higher carbon emissions is due to bank commitments. Hence, under our hypothesis, we should expect greater reductions in bank debt than in non-bank debt. An additional possibility is that banks also affect the financial decisions of other market participants and hence we should also observe adjustments in the level of non-bank debt. Our results suggest that the decrease in total debt is entirely driven by bank debt, that is, mostly a consequence of the direct channel, in which banks are the main force of debt adjustment. We discuss these results below in more detail.

Since we can only dissect the fraction of debt financed by banks for a subset of the companies in our sample (from Capital IQ), we start by successfully replicating the baseline analysis for total firm debt of such firms in column 1. The results from estimating the regression model over this subsample of firms are qualitatively and quantitatively comparable to those in Table 3 for the larger sample of NFCs. In column 2, we estimate the same most robust version of equation (1) with bank debt as the dependent variable. Relative to unconnected firms, connected firms experience a reduction in bank debt if their scope-1 emissions are relatively larger. From an economic perspective, the decline amounts to 12.2 pp as a result of a one-standard-deviation increase in scope-1 emissions. In contrast, in column 3, we do not observe any statistically or economically significant adjustment for non-bank debt.

4.2. Firm-level Debt: Robustness and Further Tests

In this section, we provide further robustness to our difference-in-differences model. First, to understand whether the key identification assumption on parallel trends holds, we estimate equation (2) with bank-debt as a dependent variable. We plot the time-varying coefficients in Figure 1. For treated (connected) firms, presented on the right-hand side of the figure, we observe an insignificant effect of scope-1 emissions on bank debt before the first commitment date (2015Q2) and a negative effect thereafter, which is reassuringly more pronounced also in 2016Q2, that is, the quarter in which the second round of commitments takes place. In contrast, for the (unconnected) firms in the control group, we observe no significant impact of scope-1 emissions on credit, neither before, nor after 2015q2.

In another test, we examine the differences between treated and control group based on a host of observables. We present the results from the balance test in Appendix, Table 1. Our results indicate no significant differences across the two samples, when matched on most observables. The only visible difference is that in log(assets). Firms that are part of the treatment group are on average larger than those of the control group. After controlling for size, carbon emissions, sales growth, debt, risk, and leverage are not different across the two samples.

We also test whether our estimates are potentially driven by selection on unobservables. Indeed, as we have argued in the balance table, connected and unconnected firms differ on total assets.[15] As such, differences in asset size may be symptomatic of differences along other dimensions that are not observed. However, given that the main coefficient in Table 2 is stable in different versions of the model this concern is likely irrelevant. This is particularly true as progressive saturation of the model with observable controls and different fixed effects implies an increase in the regression R-squared by 60 pp moving from column 1 to 5 (Altonji et al., 2005).

[15] Note that in some columns when we control for time-varying firm size in levels and in interactions with commitment, estimated effects are very similar.

We formally verify this statement following the test in Oster (2019). Here, we assume that unobservables correlate with the treatment in the same way as observables (and firm and time-fixed effects) do and fix an upper-bound for the ideal R-squared after controlling for all unobservables to one. Under these assumptions, the upper-bound for our coefficient of interest β_7 is -0.02013, which is strictly smaller than zero. The coefficient also preserves its economic significance.

In the Appendix, Table 3, we also check whether our results hold using different proxies for firms' connections to committed banks. Our baseline findings, reported in column 1 of Table 3, are based on the definition of connection using the extensive margin, that is, a firm is connected to any bank that commits through ex-ante loans. In column 2, we substitute this measure with the one based on the intensive margin, namely the share of committed banks relative to the number of total lenders a firm is ex-ante indebted to. In this alternative specification, the main coefficient of interest remains statistically and economically significant. A one-standard-deviation increase in scope-1 emissions is associated with a reduction in credit by 4.4 pp for firms with one-standard-deviation higher share of committed lenders (17.8%). Next, in column 3, we condition extensive-margin connections on the committed lender being a lead arranger. The coefficient remains negative (though its magnitude decreases by half) and it is statistically insignificant at conventional levels. This lower coefficient may indicate that lead banks have other margins to impose discipline on firms, e.g., via monitoring. Nevertheless, in column 4, when we replace the extensive-margin connection to committed lead arrangers with the share of committed lead arrangers the results again become statistically significant, though the economic effect is slightly smaller (3.4 pp cut for firms with a one-standard-deviation greater scope-1 emissions and with a one-standard-deviation higher share of committed lead arrangers). The last two findings suggest that while committed lead arrangers may shield their borrowers from larger credit cuts (e.g., Bolton et al. 2016), being connected to them becomes binding if committed lead arrangers have a sufficient weight in a firm's loan portfolio.

In the Appendix, Table 4, we analyze other measures of emissions. In column 1, we take the log level of scope-1, our benchmark model corresponding to column 5 of Table 2. In columns 2 and 3, we use the levels of scope-2 and scope-3, and in column 4, we use scope-1 intensity. We do not find significant evidence on total debt based on the variation in levels of scope-2 and scope-3 emissions. The distinction in results between the two types of emissions is consistent with the fact that scope-1 emissions are easier to track and attribute to specific firm actions and hence, creditors find it easier to screen on such metrics. In turn, the results for scope-1 emission intensity are very similar to those based on levels of emissions.

In Table 4, Panel A, we control for industry-time fixed effects, either 1-digit or 3-digit SIC codes, as well as region-time fixed effects. Column 1 shows the benchmark result from Table 2, column 2 includes sector-time fixed effects, column 3 (3-digit) industry-time fixed effects,[16] and column 4 region-time fixed effects.[17] Results in columns 2 and 3 are statistically and economically significant. However, we observe a reduction of one-third in the estimated coefficient, which implies that the credit reallocation from brown to green is partly across industries (even in the same period) and partly within the same industry in the same period.

[16] These industry-time fixed effects also control for time-varying shocks to some industries, such as the oil industry. Our results (not reported) are robust to including these controls and also to excluding some key industries, such as the oil industry.

[17] In our tests, regions largely correspond to continents. In the firm-level sample, we do not have enough variation in the data across countries in the same period. However, in loan-level sample, we can control for firm-time fixed effects, which allows us to absorb country or even a smaller location-time fixed effects.

In our subsequent tests, we shed more light on the underlying economic mechanism driving bank financing decisions. We consider two possible hypotheses. First, risk-averse banks cut credit to high-emission firms and channel credit to low-emission firms if they recognize that financial risk associated with their operations positively correlates with their emission activity. An alternative hypothesis is that committing banks make their credit decisions strictly based on their preferences for green versus brown assets. To distinguish between the two hypotheses, we conduct three tests: (i) we directly control for business risk, also interacted with commitments; (ii) we analyze loan maturity (financial risk stemming from physical risk and policy transition risk due to climate change is more important for the long- and medium-term); (iii) we analyze loan-level data and control for firm-time effects, which controls for all unobservable time-varying firm fundamentals, including any unobserved risk.

A relevant question is whether the described adjustments conditional on firm-level scope-1 emissions are driven by committed banks being more responsive to differences in risk among firms with different levels of emissions. In the context of lending, the primary source of firm-level risk of concern to lenders would be default risk. To distinguish between the two forces, in column 5 of Table 4, Panel A, we analyze the impact of scope-1 emissions on total debt controlling for a proxy of firm-level default risk, defined as a (lagged) product of stock returns volatility and firm leverage. Our results indicate that relatively riskier firms connected to committed banks indeed experience a relative decline in their total debt (by 5.7 pp in response to a one-standard-deviation increase in default risk), as compared to unconnected firms. Quantitatively, after controlling for the risk channel, committed firms with a one-standard-deviation higher scope-1 emissions experience a credit cut of 5.1 pp (relative to uncommitted firms), whereas the overall effect without controlling for firm risk is 6.4 pp.

In Table 4, Panel B, we study relative changes in debt maturity choices. If bank behavior was an outcome of *preferences* for green versus brown, one should expect loan maturity changes to be insignificant given that financial risk via climate risk (physical or transition) is mostly related to medium and long-term events. Columns 1 to 4 analyze log maturity and columns 5 to 8 analyze short-term loans (lower than the median). Our results indicate no significant change in maturity choices, the result that is more consistent with the preference hypothesis.

4.3. Loan-level Estimates

In this section, we report the results based on loan-level sample. In Table 5, we analyze the interaction between the post and commitment indicators and firm scope-1 emissions. In all columns, we control for firm-year-quarter fixed effects, which proxy for firm-level time-varying unobserved shocks, including demand. This test is especially important to establish whether the credit adjustment is supply driven.[18] In other words, we can analyze lending from committed vs. non-committed banks to the same firm at the same time.

We analyze both the extensive and intensive margins of lending. We find that the adjustment happens mostly along the extensive margin. Compared to other banks, committed banks reduce their participation in loans to firms with higher scope-1 emissions. At the same time, we do not find a significant result on the intensive margin, that is, committed banks extend their syndicated loans as an in-or-out decision and do not partially cut the quantity of credit within a loan that they participate in. This result further supports the preference story along the lines of the divestment channel.

[18] As the estimated coefficient increases in absolute value with controls, the Oster (2019) test also implies a significant lower bound.

The estimated coefficients for the combined intensive and extensive margins (column 4) imply that a one-standard-deviation increase in carbon emissions results in a reduction of the combined loan margins by 8 p.p. by committed banks, which is 17% of the mean and 5% of the standard deviation. For the extensive margin alone (column 6), a one-standard-deviation increase in scope-1 emissions results in a reduction of the probability of loan participation by 12% of the mean and 4% of the standard deviation.

The results are robust. In Table 5, in addition to firm-time fixed effects, we control for bank observables or bank fixed effects, or firm-level controls interacted with bank commitments, and in Appendix, Table 2, we control for bank-time fixed effects or for loan variables such as bank as prior lead arranger or relationship length. Finally, we also find similar results using OLS with log values or using a Poisson model.

We also look at loan prices as another margin through which credit supply could operate. Our dependent variable is total interest expenses on debt. Results are shown in Table 6. A one-standard-deviation in scope-1 implies an increase in debt interest expenses by 2% of the mean or 4% of the standard deviation of expenses. Our combined results suggest that brown firms related to committed banks are penalized by both lower volume and higher prices, consistent with a credit supply channel.

Overall, the results on the lending front suggest that committed banks do impose restrictions on polluting firms and relocate funding towards greener firms, and that other lending options, both from uncommitted banks and debt markets, are not perfect substitutes for the affected firms.

4.4. Real Effects: Deleveraging and Investment

One of our main questions is whether the reduction in bank lending triggers any firm real adjustments. In particular, do banks affect real investment decisions through their impact on financing choices, and does this discipline lead to a subsequent reduction in firm emissions, consistent with the banks' commitment preferences?

To shed more light on these questions, we first analyze the general implications of the changing financing spectrum. We begin by investigating potential effects on firm deleveraging. We report the results in Table 7. For ease of comparison, in columns 1 and 2, we repeat the analysis using bank debt and total debt as dependent variables. In column 3, we use firm leverage as a dependent variable, defined as total debt over total assets. We find that committed firms with relatively higher scope-1 emissions experience a significant decrease in leverage. The magnitude of the adjustment is, nonetheless, quite small. A one-standard-deviation increase in scope-1 emissions implies a relative reduction in leverage for connected firms (as compared to unconnected ones) by just 60 basis points. This effect is small when compared to both the unconditional mean leverage in the sample (equal to 30%) and to the decrease in the numerator, that is, total debt, associated to the same variation in scope-1 emissions (6.4 pp).

This result motivates our investigation of total assets as a separate dependent variable. We find that bank commitment is associated with a significant shrinkage in total assets for companies with high levels of scope-1 carbon emissions. Connected firms with a one-standard-deviation higher scope-1 emissions reduce the overall size of their balance sheets by roughly 2 pp.[19] When

[19] A back of the envelope calculation suggests that the overall decline in leverage is roughly in line with the described magnitudes of the adjustment in the numerator (total debt) and denominator (total assets). Note, in fact, that, as for any ratio, we can write the first derivative of leverage with respect to $log\text{-}S1_f$ as the first derivative of the numerator

we decompose firm assets into their equity portion, we do not observe any significant variation in firm equity associated with bank commitment, as reported in column 5. This result implies that firms do not substitute debt finance with equity funding perhaps, because equity finance is also relatively more expensive, consistent with evidence presented in Bolton and Kacperczyk (2021ab). Instead, our findings show that bank commitments are associated with deleveraging by firms with relatively higher carbon emissions.

Another dimension of firm behavior we consider is firm investment, measured by (log) *CAPEX*. In column 6, we observe a significant cut in firm investments. Connected firms with a one-standard-deviation higher scope-1 emissions reduce their *CAPEX* by 4.3 pp (as compared to unconnected NFCs). Overall, while the investment result is consistent with the deleveraging effect in that lower asset base requires less investment, it may also imply that tightened credit standards reduce the ability of high-emission firms to finance investments needed to improve their green technology.

In Table 8, we further examine whether the real effects exhibit any nonlinearities with respect to carbon emissions. This test is motivated by the fact that the original (non-log-transformed) distribution of scope-1 emissions is highly skewed to the right, as highlighted in the data section. Formally, we split firms according to quintiles of the distribution of ex-ante scope-1 emissions and replace such quintile dummies with the $\overline{Log\text{-}S1_f}$ exposure variable.

We find that, in relative terms, greenest firms experience an increase of 15% in total debt, compared to firms with low emission levels (brownest 40% of firms). The results in columns 2

(debt) minus the first derivative of the denominator (assets), multiplied by leverage itself. This corresponds to (-0.064 + 0.02) *leverage. For a firm with average leverage close to 30%, this translates in a 40-bps decline in leverage.

and 3 further indicate that this effect can be entirely explained by the adjustment in bank debt. The effect for bank debt is particularly striking as the difference between highest and lowest-emission quintiles is a staggering 50%. Effects are mild for the remaining firms. Finally, like for the debt effects, we also find nonlinearities in *CAPEX* associated with bank commitments, with 17.8% higher firm investment levels for the greenest as compared to other firms.

4.5. Environmental Performance: Emissions, ESG Metrics, and Expenditures

The underlying premise of bank commitments is their disciplinary effect on emission production. A simple adjustment cost mechanism would imply that banks that redirect lending towards greener companies should incentivize brown firms' adoption of cleaner technologies. In this section, we examine whether the brown companies indeed adjust their operations and technologies to become relatively greener.

To evaluate this mechanism, we consider a host of regression models in which the dependent variables measure firms' environmental performance along various dimensions. We present the initial findings from this analysis in Table 9. As a first test, we examine whether connected firms reduce their scope-1 emissions. Our dependent variable is one-year-ahead scope-1 emissions measured on an annual basis. While the results suggest that the average connected firm reduces its scope-1 emissions by a significant 35 pp, we do not find any additional marginal effect for firms with relatively higher scope-1 emissions, which is the key margin. Despite firm-level real and financial effects associated with bank commitments for browner firms, we do not find any reduction in carbon emissions, which represent hard data (and choice).

Next, we consider a broadly defined ESG score as a dependent variable. The results in column 2 also show no relevant treatment effect, that is, connected firms with higher emissions do not seem to improve their ESG metrics. However, when we look specifically at the *E* component of the ESG score, which tracks environmental performance at the firm level, in column 3, we find some statistical differences. Connected firms with a one-standard-deviation higher scope-1 emissions improve their *E*-scores by roughly 10 pp (as compared to firms with similar levels of emissions but without connections to committed banks). Still, the result is relatively small economically, given that the *E*-score varies between 0 and 10. In contrast, we do not observe any significant adjustment in environmental expenditures, neither when they are measured in logs (column 4), not when they are scaled by total assets (column 5). This variable, however, is available for only a very small subset of firms and hence our results here should be interpreted with caution. In column 6, we further study whether affected firms increase their usage of renewable energy. We find no significant result. Finally, since adjustment of environmental performance may be a slow process, we study whether affected firms at least express their willingness to commit to future emission reduction, using again SBTi commitments as a relevant proxy. Again, we do not find any statistically significant incidence in this type of efforts.

Given that after bank commitments, firms previously borrowing from these banks have lower total assets, but their carbon emissions do not change, if anything, affected firms may be even divesting green assets. At the same time, there could be some adjustments that may not be captured in our next year's scope-1 emission measure. For example, these firms could reduce (future) medium-term carbon emissions by increasing intangible assets, such as R&D in green technologies, the object that is not captured by *CAPEX*. In addition, it may take years to reduce carbon emissions for a brown firm. Nonetheless, we find no significant difference in SBTi commitments for non-financial firms. All in all, our evidence points to no adjustments in hard data related to carbon emissions by the more affected firms.

As a final step of our analysis, we dig deeper into more granular drivers of the improvement in the *E*-factor. The results are presented in Table 10. For ease of interpretation, we begin by reporting, in columns 1—4, the results related to the overall ESG score and to the *E* (environmental score), *S* (social score), and *G* (governance score), respectively. Interestingly, only the *E*-factor displays a significant change (improvement) for affected firms.

In the subsequent tests, we use different subcomponents of the *E-score*, defined by MSCI, as our left-hand-side variable. We do not find any improvement for affected firms in terms of their climate change mitigation efforts (column 5), waste reduction through a revision of product packaging policies (column 7), or carbon emissions (column 9). If anything, firms also perform worse in terms of their usage of natural resources (column 6). The only small improvement observed in the *E*-factor results from a mixed improvement in the awareness of affected firms about environmental future opportunities (e.g., related to clean technology). Whether this effect reflects a changed corporate perspective on environmental problem or is a manifestation of greenwashing is difficult to confirm using our data. However, given that the there is no change in hard environmental data and only an improvement in future opportunities (via one subcomponent of ESG), our evidence is more consistent with greenwashing by affected firms. Combined with the significant reduction in bank debt, our results suggest that the latter may be a more likely explanation of firm policies, which the banks in fact do not find credible.[20]

[20] In the Appendix, Table 5, we do not find any significant effects related to firms' commitments to future emissions reductions.

5. Conclusions

One of the most relevant questions in the current debate on climate policies is whether financial sector can provide discipline to spur improvement in environmental performance of the corporate sector. We analyze this problem in the context of the commercial banking sector. We study this question using global data for the period of 2013-2018 and bank commitments as a form of changes in attitudes to green finance, which in turn implies shocks to firms with previous credit from these banks.

We find that firms with higher scope-1 emission levels previously borrowing from banks making commitments subsequently receive less total bank credit. Effects are driven entirely by bank debt and are insignificant before the bank commitments. They are also not driven by selection on unobservables. The economic mechanism at work is bank credit supply, and results are consistent with bank preferences for green rather than differential response to an increased firm risk. Moreover, the reduction in bank lending to brown firms triggers the reduction in these firms' total debt, leverage, total assets, and real investments. The effects are non-linear, with a strong increase (cut) in lending and investments for green (brown) firms, and mild effects for other firms. Crucially, despite the real and financial effects, we find no improvement in hard firm-level environmental scores for brown firms (including subsequent reduction in carbon emissions or firm commitments to future (medium-term) reductions in carbon emissions), but only evidence consistent with firms' greenwashing.

The results suggest that banks affect carbon emissions via credit reallocation (from brown to green firms) rather than via providing loans to brown firms for the investment necessary to reduce carbon emissions.

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Figure 1. Bank Debt: Parallel Trends

This figure plots the coefficients from the time-varying version of the baseline bank debt regression where bank debt is the dependent variable, and the variable of interest is emissions interacted with commitment. 2015Q1 is the omitted base level and is one period before any bank commits to reducing emissions, indicated by the dashed red line. The left panel shows the results for firms that had never borrowed from a bank that commits until period t and the right panel shows firms that had borrowed from at least one bank that commits. The regressions include firm and time fixed effects and controls for predetermined total assets and revenue growth averaged over 2013 and 2014 interacted with the date indicators.

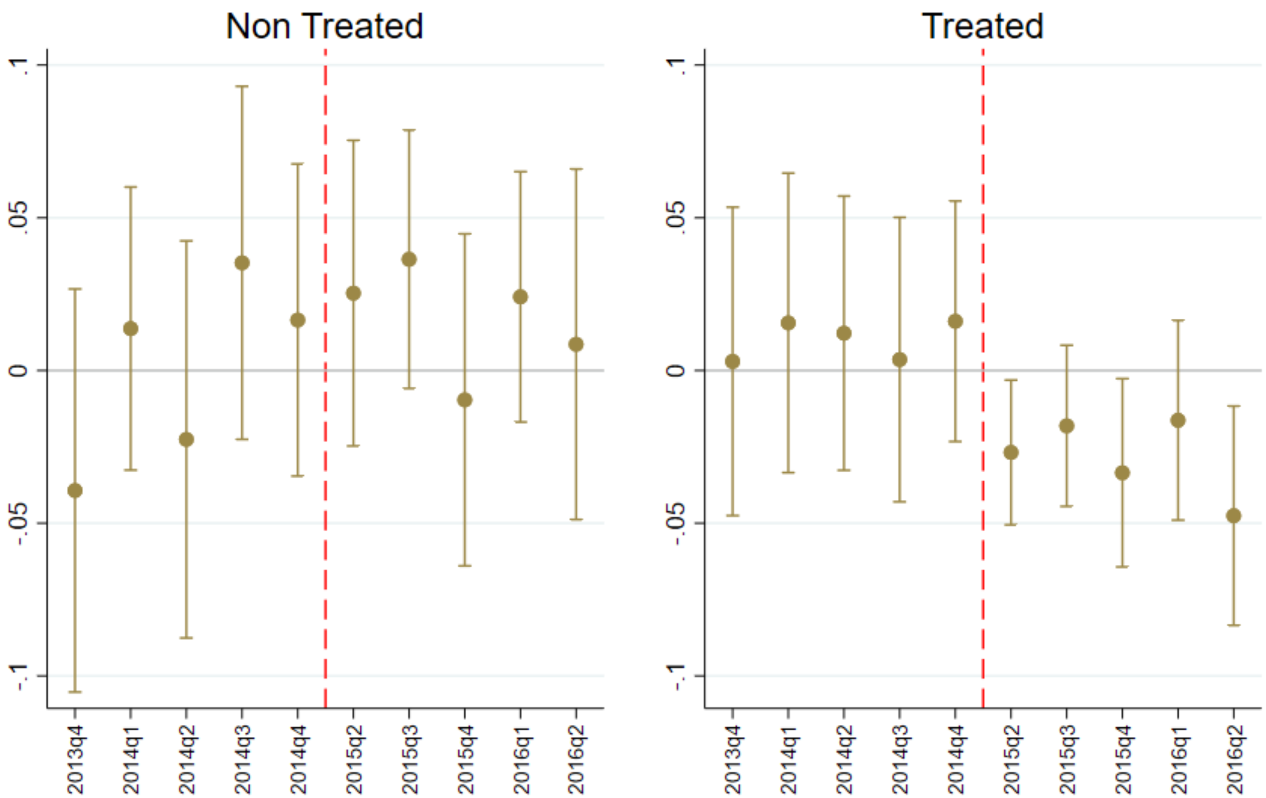

Table 1: Summary Statistics

This table reports summary statistics for the variables used in the firm and loan level analysis. The sample period is 2013-2018. Ex ante variables are averaged over 2013 and 2014.

VARIABLES		(1) N	(2) mean	(3) sd	(4) p25	(5) p50	(6) p75
Firm Level Variables							
Log-$S1_{ft}$	Log (Scope-1 Emissions tonnes)	8,691	11.78	2.538	10.03	11.55	13.42
Log-$S1_f$	Log-S1 (ex-ante)	2,112	11.78	2.538	10.04	11.54	13.39
$\overline{\text{Log-S1}}_f$	Log-S1 (ex-ante, demeaned)	2,112	0	2.538	-1.737	-0.238	1.608
$Committed_f$	Firm indicator if a firm ever has a lender that commits	41,450	0.769	0.421	1	1	1
$Post_{f,t}$ * $Committed_f$	Time indicator after a firm has at least 1 prior lender committing	41,450	0.383	0.486	0	0	1
Lead $Post_{f,t}$ * $Committed_f$	Time indicator after a firm has at least one bank who was a prior lead lender commit	41,450	0.266	0.442	0	0	1
$Committed_f$ (% committed)	% of a firm's prior lenders who have committed	41,450	0.150	0.178	0	0.107	0.200
$Committed_f$ (lead committed)	Firm indicator if a firm ever has a prior lead lender that commits	41,450	0.562	0.496	0	1	1
$Committed_f$ (% lead committed)	% of a firm's prior lead lenders who have committed (ex-ante	41,450	0.128	0.184	0	0.0625	0.194
% $Post_{f,t}$ * $Committed_f$	Interaction of $Committed_f$ (% committed) and $Post_{f,t}$	41,450	0.0785	0.148	0	0	0.118
% Lead $Post_{f,t}$ * $Committed_f$	Interaction of $Committed_f$ (% lead committed) and $Post_{f,t}$	41,450	0.0638	0.145	0	0	0.0339
Total Debt	Log(Total Debt)	41,450	7.152	1.543	6.230	7.369	8.387
Bank Debt	Log(Bank Debt +1)	32,844	5.367	2.468	4.581	6.041	7.232
Non-Bank Debt	Log(Non-Bank Debt +1)	32,844	5.503	2.885	4.047	6.488	7.818
Leverage	Total Debt / Total Assets	41,450	0.304	0.155	0.202	0.307	0.375
Assets	Log(Total Assets)	41,450	8.534	1.169	7.747	8.623	9.598
Equity	Log(Total Equity)	40,318	7.471	1.157	6.757	7.600	8.496
Risk	Leverage * Prior 12 month equity volatility	37,641	10.55	8.606	5.218	7.845	12.23
Revenue growth (ex-ante)	% growth in revenue	2,112	0.0540	0.233	-0.0496	0.0202	0.0905
Assets (ex-ante)	Log(Total Assets)	2,112	8.384	1.205	7.582	8.455	9.444
Capital Expenditures	Log(Capital Expenditure)	38,120	3.723	1.550	2.762	3.932	5.148
Interest Expense	Interest Expense / Total Debt, winsorized 2.5% both tails	36,951	0.0123	0.00775	0.00833	0.0106	0.0141
ESG Score	MSCI Environmental Social and Governance score	31,687	4.730	1.163	4	4.700	5.500
Env Score	MSCI Environmental sub-score	31,687	5.149	2.209	3.500	4.900	6.500
Soc Score	MSCI Social sub-score	31,687	4.482	1.758	3.400	4.500	5.600
Gov Score	MSCI Governance sub-score	31,685	5.585	2.085	4.100	5.500	7
Climate Score	MSCI Climate Change sub-sub-score	29,269	6.411	2.881	4.400	6.700	9

Natural Resource Score	MSCI Natural Resource sub-sub-score	24,623	4.992	2.486	3.300	4.700	6.500
Waste Mgmt Score	MSCI Waste Management sub-sub-score	24,016	5.498	2.577	3.600	5.500	7.600
Env Opp Score	MSCI Environmental Opportunity sub-sub-score	13,420	4.579	1.561	3.400	4.400	5.700
Carbon Score	MSCI Carbon sub-sub-score	26,614	6.929	2.706	5.300	7.200	9.500
Env Exp_{t+1}	Next year Log(Environmental Expenditures + 1)	1,962	4.082	2.954	1.902	3.621	5.720
Renewable Use	Indicator if a firm uses renewables	35,112	0.506	0.500	0	1	1
Firm Commitments	Time indicator if a firm commits	41,450	0.00914	0.0952	0	0	0
Maturity	Log(Maturity)	945	3.726	.7156	3.583	4.064	4.094
Loan Level Variables							
Extensive + Intensive	Log(Loan Amount +1)	60,907	0.465	1.375	0	0	0
Extensive	Indicator if lender makes a loan to a firm in a quarter	60,907	0.118	0.322	0	0	0
Intensive	Log(Loan Amount)	7,170	3.951	1.512	3.266	4.070	4.823
$ Extensive + Intensive	Loan Amount	60,907	10.85	43.64	0	0	0
$Post_{bt}$ * $Committed_b$	Time indicator after a lender commits	60,907	0.0320	0.176	0	0	0
$Committed_b$	Lender indicator if a lender ever commits	60,907	0.110	0.313	0	0	0
Bank Assets (ex ante)	Log(Total Assets)	44,346	11.61	0.700	11.57	11.96	11.96
Bank Tier 1 (ex ante)	Bank tier 1 capital ratio	35,436	13.28	3.134	11.55	12.92	13.71
Bank Prior Leader	Indicator if the lender was a prior lead lender to the firm	60,907	0.352	0.477	0	0	1
Relation Length (quarters)	Time since first loan in a firm-lender pair	60,907	46.79	25.25	27	48	66

Table 2: The Effects of Bank Commitment on Total Firm Debt

This table shows a firm-level analysis of debt based on how lender commitments to reducing emissions impacts firm-level total debt differentially depending on their level of emissions. A firm is defined as having a committed lender if at least one lender with whom they have a prior credit relationship has committed to reducing emissions. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Columns (1)-(5) progressively add controls and more stringent fixed effects. The sample period is 2013-2018. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1

	(1)	(2)	(3)	(4)	(5)
VARIABLES		Total Debt			
$Post_{f,t}$ * $Committed_f$ * $\overline{Log\text{-}S1}_f$	-0.027786*	-0.032313**	-0.031327**	-0.025477***	-0.024014***
	(0.016655)	(0.012946)	(0.012985)	(0.008177)	(0.008188)
$Post_{f,t}$ * $Committed_f$	0.313085***	0.094554	0.059311	0.176433	0.117986
	(0.037466)	(0.277427)	(0.278606)	(0.222047)	(0.222679)
$\widetilde{Post}_t$ * $\overline{Log\text{-}S1}_f$	-0.022071*	0.000900	0.000007	-0.003347	-0.004936
	(0.012501)	(0.010758)	(0.010765)	(0.008102)	(0.008120)
$Committed_f$* $\overline{Log\text{-}S1}_f$	-0.052864**	-0.016541	-0.016881		
	(0.025963)	(0.018809)	(0.018819)		
$\widetilde{Post}_t$	-0.039191	0.729832***		0.445915**	
	(0.027807)	(0.256963)		(0.191540)	
$Committed_f$	0.355131***	-1.027485**	-1.018895**		
	(0.061938)	(0.410459)	(0.410318)		
$\overline{Log\text{-}S1}_f$	0.362887***	0.051541***	0.051905***		
	(0.021640)	(0.016522)	(0.016528)		
Observations	41,450	41,450	41,450	41,450	41,450
R-squared	0.306596	0.704369	0.705459	0.904226	0.905337
Econ effect 1sd	-.074	-.086	-.083	-.068	-.064
Firm Controls	No	Yes	Yes	Yes	Yes
Time FE	No	No	Yes	No	Yes
Firm FE	No	No	No	Yes	Yes

Table 3: The Effects of Bank Commitment on Firm-Level Bank Debt and Non-Bank Debt

This table shows how lender commitments to reducing emissions impacts firms' debt types (bank and non-bank debt) differentially depending on their level of emissions. A firm is defined as having a committed lender if at least one lender with whom they have a prior credit relationship has committed to reducing emissions. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1

VARIABLES	(1) Total Debt	(2) Bank Debt	(3) Non-Bank Debt
$Post_{f,t}$ * $Committed_f$ * $\overline{\text{Log-S1}}_f$	-0.021475***	-0.045625*	-0.004968
	(0.007257)	(0.023655)	(0.021828)
$Post_{f,t}$ * $Committed_f$	0.184968	-0.155845	0.206685
	(0.239169)	(0.475702)	(0.493342)
$\widetilde{Post}_t$ * $\overline{\text{Log-S1}}_f$	-0.007374	-0.004587	-0.012032
	(0.006602)	(0.018698)	(0.020001)
Observations	32,828	32,828	32,828
R-squared	0.912666	0.745594	0.801383
Econ effect 1sd	-.057	-.122	-.013
Firm Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Table 4: The Effects of Bank Commitment on Total Firm Debt and Maturity

Panel A: Robustness

This table examines the robustness of the firm-level debt results. In each column we introduce a new control to check for robustness. Column (1) is the baseline result. Column (2) introduces sector-year fixed effects. Column (3) uses the more granular 3-digit industry-year fixed effects. Column (4) uses region-time fixed effects. Column (5) includes firm risk, defined as stock volatility times leverage. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1

	(1)	(2)	(3)	(4)	(5)
VARIABLES			Total Debt		
$Post_{f,t}$ * $Committed_f$ * $\overline{Log\text{-}S1}_f$	-0.023982***	-0.016405*	-0.016573*	-0.023580***	-0.019126**
	(0.008183)	(0.008462)	(0.008610)	(0.008247)	(0.007570)
$Post_{f,t}$ * $Committed_f$	0.116980	0.121669	0.007793	0.140263	0.293816
	(0.221643)	(0.221639)	(0.217682)	(0.226561)	(0.202523)
$\widetilde{Post}_t$ * $\overline{Log\text{-}S1}_f$	-0.004884	-0.003280	0.012940	-0.000845	-0.001397
	(0.008114)	(0.008859)	(0.009426)	(0.008199)	(0.007459)
$Risk_{ft}$					0.047628***
					(0.004470)
$Post_{f,t}$ * $Committed_f$ * $Risk_{ft}$					-0.006661***
					(0.002120)
$\widetilde{Post}_t$ * $Risk_{ft}$					-0.011362***
					(0.001873)
$Committed_f$ * $Risk_{ft}$					-0.003380
					(0.005163)
Observations	41,470	40,863	41,459	41,276	37,647
R-squared	0.905459	0.905587	0.916341	0.906732	0.921322
Econ effect 1sd	-.064	-.044	-.044	-.063	-.051
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Sector-Year FE	No	Yes	-	No	No
Industry3-Year FE	No	No	Yes	No	No
Region-Time FE	No	No	No	Yes	No

Panel B: Firm-Level Loan Maturity

This table examines the effect of bank commitment to reducing emissions on firm-level loan maturity depending on firm emissions. The regression is estimated at the firm level on an unbalanced panel aggregated from syndicated loans. If a firm has multiple loans in a quarter, they are averaged. Columns (1)-(4) use log maturity as the dependent variable. Columns (5)-(8) use an indicator for if the maturity is below the median as the dependent variable. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Bank controls are ex ante log assets and the tier 1 capital ratio averaged across banks. Lower-level interactions are included but not shown. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES		Maturity				I(Short Maturity)		
$Post_{f,t}$ * $Committed_f$ * $\overline{Log\text{-}S1}_f$	-0.006624	0.009306	0.007087	-0.012562	0.002052	-0.003128	-0.005693	-0.008958
	(0.019116)	(0.021724)	(0.020640)	(0.033537)	(0.013083)	(0.014832)	(0.014917)	(0.023021)
Observations	945	945	904	414	945	945	904	414
R-squared	0.031225	0.075936	0.120797	0.724850	0.016339	0.032653	0.042461	0.658657
Firm Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Bank Controls	No	No	Yes	Yes	No	No	Yes	Yes
Firm FE	No	No	No	Yes	No	No	No	Yes
Time FE	No	No	No	Yes	No	No	No	Yes

Table 5: The Effects of Bank Commitment in Loan-level Estimates

This table shows how lender commitments to reducing emissions impacts their lending to firms differentially depending on the firm's level of emissions. The data is at the borrower-lender-year-quarter level. If a lender has previously participated in a loan to the firm, but does not in the current period, they are coded as zero lending for columns (1) to (4) and column (6). From columns (1) to (5) if a lender provides a loan to the firm, the value is the log of the credit volume plus one until column (4) and the log of the credit volume in column (5). Therefore, columns (1)-(4) examine the extensive and intensive margins of lending together, while column (5) only the intensive and column (6) only the extensive margin. Firm controls are interacted with bank commitment. Lower-level interactions are included but not shown. Standard errors are double clustered at the firm and bank level. ***p<.01, **p<.05, *p<.1

VARIABLES	(1) Intensive+ Extensive	(2) Intensive + Extensive	(3) Intensive + Extensive	(4) Intensive + Extensive	(5) Intensive	(6) Extensive
$Post_{b,t}$ * $Committed_b$ * $\overline{\text{Log-S1}}_f$	-0.01587*	-0.03024**	-0.02383*	-0.03081**	0.03370	-0.00545*
	(0.009080)	(0.013973)	(0.013194)	(0.013670)	(0.021987)	(0.003045)
Observations	60,907	60,907	35,189	60,907	6,964	60,907
R-squared	0.408496	0.408769	0.513039	0.473526	0.893348	0.476230
Econ effect 1sd	-.041	-.079	-.062	-.08	.088	-.014
Firm Controls	No	Yes	Yes	Yes	Yes	Yes
Bank Controls	No	No	Yes	-	-	-
Firm-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	No	No	No	Yes	Yes	Yes

Table 6: The Effects of Bank Commitment on Firm Interest Expenses (Firm-Level Estimates)

This table shows how lender commitments to reducing emissions impacts firm-level interest expenses depending on their level of emissions. In Column (1) a firm is defined as having a committed lender if at least one lender with whom they have a prior credit relationship has committed to reducing emissions. In Column (2) the measure of commitment is the % of a firms' lenders who commit. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1.

	(1)	(2)
VARIABLES	Interest Expense	
Commit Measure	I(Any Bank Commits)	%Committed Banks
$Post_{f,t}$ * $Committed_f$ * $\overline{\text{Log-S1}}_f$	0.000108	0.000688**
	(0.000068)	(0.000343)
$Post_{f,t}$ * $Committed_f$	-0.000903	0.003365
	(0.001814)	(0.006071)
$\widetilde{Post}_t$ * $\overline{\text{Log-S1}}_f$	0.000016	0.000009
	(0.000067)	(0.000060)
Observations	36,946	36,946
R-squared	0.545207	0.545991
Firm Controls	Yes	Yes
Firm FE	Yes	Yes
Time FE	Yes	Yes

Table 7: Real and Financial Effects

This table shows the impact of lender commitment to reducing emissions on firm-level debt, leverage, total assets, equity, and investment (CAPEX) depending on their level of emissions. A firm is defined as having a committed lender if at least one lender with whom they have a prior credit relationship has committed to reducing emissions. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1

VARIABLES	(1) Bank Debt	(2) Total Debt	(3) Leverage	(4) Assets	(5) Equity	(6) CAPEX
$Post_{f,t}$ * $Committed_f$ * $\overline{\text{Log-S1}}_f$	-0.054523**	-0.026864***	-0.002433**	-0.008075**	0.000146	-0.016037**
	(0.025261)	(0.008708)	(0.001200)	(0.003967)	(0.006007)	(0.007983)
$Post_{f,t}$ * $Committed_f$	-0.223237	0.097761	0.031714	0.136436	0.096496	-0.051115
	(0.477445)	(0.222258)	(0.026243)	(0.086296)	(0.125774)	(0.175929)
$\widetilde{Post}_t$ * $\overline{\text{Log-S1}}_f$	0.000260	-0.005666	-0.000241	-0.007750**	-0.006699	-0.019751**
	(0.018432)	(0.008522)	(0.001068)	(0.003475)	(0.005088)	(0.007890)
Observations	32,828	41,450	41,450	41,450	40,316	38,126
R-squared	0.745613	0.905367	0.827560	0.972200	0.926749	0.889583
Econ effect 1sd	-.138	-.068	-.006	-.02	0	-.043
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: Non-Linearities in Carbon Emissions

This table shows how lender commitments to reducing emissions impact firm-level debt and investment (CAPEX) depending on their level of emissions. The level of emissions is not in logs as in the other tables, but we allow non-linear dependence. Exposure to committed lender is interacted with an indicator for each quintile of ex ante log emissions, with the quintile 1 being the lowest, and quintile 5 the highest. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1.

	(1)	(2)	(3)	(4)
VARIABLES	Total Debt	Bank Debt	Nonbank Debt	CAPEX
$Committed_f$ * $Quintile\ 1_f$	0.150820**	0.505329**	0.036395	0.178181**
	(0.061139)	(0.197246)	(0.183552)	(0.069618)
$Committed_f$* $Quintile\ 2_f$	0.194643***	0.227657	0.290353*	0.070268
	(0.054918)	(0.164739)	(0.159334)	(0.059301)
$Committed_f$* $Quintile\ 3_f$	0.120123**	0.017554	0.214505	0.073163
	(0.048630)	(0.165089)	(0.142174)	(0.055692)
$Committed_f$* $Quintile\ 4_f$	0.014759	-0.088734	0.235740	0.014622
	(0.045461)	(0.147861)	(0.150060)	(0.055104)
$Committed_f$	-0.323926	-0.895440	0.012571	-0.482784**
	(0.289626)	(0.557178)	(0.606215)	(0.243027)
$\widetilde{Post_t}$ * $Quintile\ 1_f$	0.046879	-0.111447	0.098056	0.141844**
	(0.052845)	(0.138589)	(0.164320)	(0.068936)
$\widetilde{Post_t}$ * $Quintile\ 2_f$	-0.001317	0.063011	-0.091805	0.115954*
	(0.045334)	(0.121357)	(0.142556)	(0.059550)
$\widetilde{Post_t}$ * $Quintile\ 3_f$	0.000610	-0.043587	-0.071566	0.073699
	(0.042093)	(0.117489)	(0.129613)	(0.055573)
$\widetilde{Post_t}$ * $Quintile\ 4_f$	-0.033589	0.047326	-0.245880*	-0.068779
	(0.030052)	(0.115088)	(0.129831)	(0.052202)
Observations	32,838	32,838	32,838	30,351
R-squared	0.913986	0.747286	0.802422	0.881757
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Size Quintile-Time FE	Yes	Yes	Yes	Yes

Table 9: Environmental Outcomes: Scope-1 Emissions, ESG Score, and Environmental Expenditures

This table shows how lender commitments to reducing emissions is associated to firm-level pollution, ESG scores, and environmental activities, including environmental expenditures, renewable use and firm commitments to carbon reduction, depending on their level of emissions. For the ESG and Environmental scores, higher is considered “better” from an ESG perspective. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1

VARIABLES	(1) Log-S1_{t+1}	(2) ESG Score	(3) Env Score	(4) Env Exp_{t+1}	(5) $\text{Env Exp}_{t+1}\text{/TA}$	(6) Renewable	(7) Committed
$\text{Post}_{f,t}$ * Committed_f * $\overline{\text{Log-S1}}_f$	-0.000267	0.008959	0.036235**	-0.016145	-0.039195	0.000500	-0.000342
	(0.012214)	(0.010368)	(0.018379)	(0.032979)	(0.096206)	(0.004630)	(0.001249)
$\text{Post}_{f,t}$ * Committed_f	-0.355541*	-0.031557	0.424572	-0.002870	0.562182	0.064190	-0.072430***
	(0.200091)	(0.210578)	(0.433195)	(0.599974)	(1.126328)	(0.083559)	(0.025429)
$\widetilde{\text{Post}}_t$ * $\overline{\text{Log-S1}}_f$	-0.030971***	0.044174***	0.014001	-0.037427	-0.094248*	-0.008940**	-0.002145**
	(0.011287)	(0.010677)	(0.016804)	(0.025164)	(0.056671)	(0.003942)	(0.000960)
Observations	8,633	31,668	31,668	1,911	1,911	35,112	41,450
R-squared	0.969906	0.845531	0.856806	0.966963	0.736150	0.842053	0.355540
Econ effect 1sd	-.001	.024	.097	-.043	-.104	.001	-.001
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 10: ESG Score Subcomponents

This table shows how lender commitments to reducing emissions is associated to firm-level ESG score sub-components depending on their level of emissions. For these scores, higher is considered "better" from an ESG perspective. See Table 1 and the main text for details on these scores. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1

VARIABLES	(1) ESG	(2) Env	(3) Soc	(4) Gov	(5) Climate	(6) Natural Res	(7) Waste	(8) Env Opps	(9) Carbon
$Post_{f,t}$ * $Committed_f$ * $\overline{Log\text{-}S1}_f$	0.008959	0.036235**	0.013780	0.007442	0.028564	-0.042912*	-0.010501	0.073176***	-0.010249
	(0.010368)	(0.018379)	(0.019152)	(0.024213)	(0.027702)	(0.025179)	(0.019920)	(0.022019)	(0.026165)
$Post_{f,t}$ * $Committed_f$	-0.031557	0.424572	-0.303427	-0.394068	0.483688	-0.333657	-0.755065	0.713411	0.798631
	(0.210578)	(0.433195)	(0.357121)	(0.499908)	(0.644104)	(0.588016)	(0.498163)	(0.504627)	(0.596354)
$\widetilde{Post}_t$ * $\overline{Log\text{-}S1}_f$	0.044174***	0.014001	-0.033116	-0.039935	-0.027283	-0.130389***	-0.173053***	0.047196**	-0.051186**
	(0.010677)	(0.016804)	(0.020170)	(0.027676)	(0.024921)	(0.025832)	(0.020335)	(0.021049)	(0.024795)
Observations	31,668	31,668	31,668	31,666	29,247	24,570	23,933	13,413	26,582
R-squared	0.845531	0.856806	0.760652	0.596703	0.859468	0.800882	0.851921	0.802693	0.877359
Econ effect 1sd	.024	.097	.037	.02	.076	-.114	-.028	.195	-.027
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Appendix

Appendix Table A1: Balance Table

The value displayed for t-tests and normalized differences are the differences in the means across the groups. Variables are ex ante averages over 2013-2014. Variables are residualized against total assets (except total assets itself). Normalized differences are significant if the value is higher than 0.25 in absolute value (see Imbens and Wooldridge, 2009). ***p<.01, **p<.05, *p<.1

	Not Committed		Committed		t-test Difference	Normalized difference
Variable	**N**	**Mean/SE**	**N**	**Mean/SE**	**(1)-(2)**	**(1)-(2)**
Log-S1	632	0.102	1481	-0.043	0.145	0.069
		[0.078]		[0.056]		
Total Debt	607	-0.022	1459	0.009	-0.031	-0.036
		[0.037]		[0.022]		
Total Assets	632	7.955	1481	8.566	-0.612***	-0.507
		[0.050]		[0.030]		
Revenue Growth	632	-0.002	1481	0.001	-0.003	-0.014
		[0.013]		[0.005]		
Leverage	617	-0.006	1467	0.002	-0.008	-0.054
		[0.006]		[0.004]		
Risk	564	0.383	1372	-0.157	0.540	0.072
		[0.327]		[0.201]		

Appendix Table A2: Loan Level Analysis: Robustness

This table analyzes the robustness of the main loan level results. The data is at the borrower-lender-year-quarter level and the tables follows Table 5. Columns (1)-(4) examine the extensive and intensive margins of lending together. Column (1) adds more stringent Bank-Time fixed effects. Column (2) employs a Poisson model. Column (3) adds an indicator control for whether a lender was a prior lead lender for that firm. Column (4) controls for the length of the firm-bank relationship. Firm controls are interacted with bank commitment. Standard errors are double clustered at the firm and bank level. ***p<.01, **p<.05, *p<.1

VARIABLES	(1) Intensive + Extensive	(2) Credit volume	(3) Intensive + Extensive	(4) Intensive + Extensive
$Post_{b,t}$ * $Committed_b$ * $\overline{\text{Log-S1}}_f$	-0.028547*	-0.034030*	-0.033784**	-0.026919*
	(0.014554)	(0.020246)	(0.013806)	(0.014145)
Observations	58,695	15,733	60,907	60,907
R-squared	0.509431		0.481341	0.478280
Robustness	Bank-Time FE	Poisson	Prior Leader	Relation Length
Firm Controls	Yes	Yes	Yes	Yes
Firm-Time FE	Yes	Yes	Yes	Yes
Bank FE	-	Yes	Yes	Yes

Appendix Table A3: Alternative Proxies of Commitment

This table examines alternative proxies for firm exposure to committed lenders. Column (1) uses an indicator for if any bank the firm has a prior relationship with has committed and it is our benchmark case. Column (2) uses the number of banks that have committed as a fraction of the total number of banks a firm has a prior relationship with. Column (3) uses an indicator if any lead bank has committed in which the firm has a prior relationship. Column (4) uses the fraction of lead banks (in which the firm has a prior relationship) that have committed. Each of these variables is interacted with ex ante log emissions demeaned. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1

	(1)	(2)	(3)	(4)
VARIABLES		Total Debt		
Commit Measure	I(Any Bank Commits)	%Committed Banks	I(Lead Commits)	%Committed Lead
$Post_{f,t}$ *$Committed_f$ * $\overline{\text{Log-S1}}_f$	-0.024014***	-0.093725***	-0.010178	-0.071809**
	(0.008188)	(0.033102)	(0.009093)	(0.032792)
$Post_{f,t}$*$Committed_f$	0.117986	-1.305176**	0.216759	-0.840769
	(0.222679)	(0.537944)	(0.254531)	(0.548636)
$\widetilde{Post_t}$ * $\overline{\text{Log-S1}}_f$	-0.004936	-0.009875	-0.015379**	-0.013942**
	(0.008120)	(0.007086)	(0.007352)	(0.006615)
Observations	41,450	41,450	41,450	41,450
R-squared	0.905337	0.905210	0.905180	0.905157
Econ effect 1sd	-.064	-.044	-.027	-.034
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Appendix Table A4: Other Emission Measures (Scope 1, 2, and 3)

This table examines the impact of lender commitment to reducing emissions on firm-level debt, depending on different measures of emissions. Column (1) uses log scope 1 emissions. Column (2) uses log scope 2 emissions. Column (3) uses log scope 3 emissions. Column (4) uses scope 1 emission intensity, defined as scope 1 emissions divided by revenues. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1.

	(1)	(2)	(3)	(4)
VARIABLES		Total Debt		
$Post_{f,t}$ * $Committed_f$ * $\overline{Trucost}_f$	-0.026864***	0.004164	0.006114	-0.000053***
	(0.008708)	(0.012297)	(0.015950)	(0.000017)
$Post_{f,t}$ * $Committed_f$	0.097761	0.436027*	0.445743*	0.348506*
	(0.222258)	(0.232712)	(0.252866)	(0.207165)
$\widetilde{Post}_t$ * $\overline{Trucost}_f$	-0.005666	0.004653	-0.016389	-0.000007
	(0.008522)	(0.010575)	(0.014169)	(0.000014)
Observations	41,450	41,450	41,450	41,450
R-squared	0.905367	0.905083	0.905092	0.905176
Trucost	Log-S1	Log-S2	Log-S3	S1 Intensity
Econ effect 1sd	-.068	.008	.01	-.036
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Appendix Table A5: Non-Financial Company Commitments

Panel A: Environmental Outcomes

This table examines the impact of the interaction of firm and lender commitments to reduce emissions on firm-level pollution and other environmental activities depending on their level of emissions. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1

VARIABLES	(1) ESG	(2) Env Score	(3) Soc Score	(4) Gov Score	(5) Climate Score	(6) Natural Resource Score	(7) Waste Mgmt Score	(8) Env Opps Score	(9) Carbon Score	(10) Log-S1$_{t+1}$	(11) Env Exp$_{t+1}$	(12) Renewable Use
$Post_{f,t}$ * $Committed_f$ * $\overline{Log\text{-}S1}_f$ * NFC $Commits_{ft}$	0.077415*	0.162491***	0.149070**	-0.164942	-0.071937	0.059896	0.069563	-0.001939	-0.049510	-0.059389	-0.075601	0.013239
	(0.046538)	(0.058991)	(0.072960)	(0.112842)	(0.085226)	(0.096550)	(0.114109)	(0.062014)	(0.070730)	(0.044378)	(0.275797)	(0.014628)
$Post_{f,t}$ * $Committed_f$ * $\overline{Log\text{-}S1}_f$	0.005480	0.030360	0.011951	0.014420	0.024359	-0.04778*	-0.019568	0.071070***	-0.023032	-0.005888	-0.006152	0.000382
	(0.011040)	(0.019484)	(0.020409)	(0.025571)	(0.029436)	(0.027124)	(0.021476)	(0.024107)	(0.028015)	(0.011500)	(0.029223)	(0.004780)
$Post_{f,t}$ * $Committed_f$ * NFC $Commits_{ft}$	0.025359	0.000455	0.014165	0.032933	-0.000017	0.253389	0.066450	-0.144951	-0.192165	0.088303	0.979365	-0.036627
	(0.119193)	(0.197837)	(0.211349)	(0.294579)	(0.237332)	(0.331316)	(0.225667)	(0.179437)	(0.149628)	(0.102099)	(0.923205)	(0.037266)
$\widetilde{Post}_t$ * $\overline{Log\text{-}S1}_f$	0.044837***	0.010860	-0.028231	-0.043523	-0.027989	-0.1448***	-0.1858***	0.040715*	-0.0587**	-0.0262**	-0.040581	-0.0107**
	(0.011505)	(0.018187)	(0.021413)	(0.029714)	(0.026824)	(0.027806)	(0.022449)	(0.022823)	(0.026893)	(0.010373)	(0.027183)	(0.004264)
$\widetilde{Post}_t$ * NFC $Commits_{ft}$	-0.004358	-0.082207	0.079963	-0.283937	0.071493	0.001052	0.010725	0.004949	-0.199622	0.035330	-0.424028*	-0.013216
	(0.107030)	(0.166238)	(0.168206)	(0.351351)	(0.206000)	(0.305094)	(0.227698)	(0.181614)	(0.122633)	(0.066401)	(0.247298)	(0.027121)
Observations	31,668	31,668	31,668	31,666	29,247	24,570	23,933	13,413	26,582	8,633	1,911	35,112
R-squared	0.845540	0.856936	0.760936	0.597186	0.859490	0.801312	0.852168	0.801695	0.877742	0.970299	0.967274	0.842172
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Real and Financial Effects

This table examines the impact of the interaction of firm and lender commitments to reduce emissions on firm-level debt, leverage, total assets, equity and investment (CAPEX), depending on their level of emissions. Firm controls are ex ante log total assets and revenue growth interacted with Post, Committed, and Post*Committed. Standard errors are clustered at the firm level. ***p<.01, **p<.05, *p<.1

VARIABLES	(1) Bank Debt	(2) Total Debt	(3) Leverage	(4) Log Assets	(5) Equity	(6) CAPEX
$Post_{f,t}$ * $Committed_f$ * $\overline{\text{Log-S1}}_f$ * NFC $Commits_{ft}$	0.075145	-0.067294*	-0.006884	-0.015255	0.006958	-0.043266
	(0.101113)	(0.036300)	(0.004272)	(0.011756)	(0.013386)	(0.027603)
$Post_{f,t}$ * $Committed_f$ * $\overline{\text{Log-S1}}_f$	-0.047805**	-0.021840***	-0.001890*	-0.006347*	-0.000064	-0.014816*
	(0.023897)	(0.008334)	(0.001145)	(0.003696)	(0.005574)	(0.008033)
$Post_{f,t}$ * $Committed_f$ * NFC $Commits_{ft}$	-0.016927	0.078443	0.009003	0.035951	0.049264	0.029218
	(0.203284)	(0.112216)	(0.014268)	(0.030155)	(0.050984)	(0.058382)
$\widetilde{Post}_t$ * $\overline{\text{Log-S1}}_f$	-0.006870	-0.004374	-0.000347	-0.007095**	-0.005926	-0.019216**
	(0.018738)	(0.008152)	(0.001038)	(0.003256)	(0.004688)	(0.007927)
$\widetilde{Post}_t$ * NFC $Commits_{ft}$	-0.370139**	0.031455	-0.004850	-0.001908	-0.046413	0.056650
	(0.148490)	(0.074857)	(0.010559)	(0.019106)	(0.045626)	(0.048235)
Observations	32,838	41,470	41,470	41,470	40,336	38,126
R-squared	0.745783	0.905537	0.827615	0.972301	0.926909	0.889620
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes