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Climate-related Disclosure Commitment of the Lenders, Credit Rationing, and Borrower Environmental Performance[†]

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Abstract

Using lenders becoming members of the Task Force on Climate-Related Financial Disclosures (TCFD) as a plausible exogeneous shock, we examine whether and how lenders' commitment to transparent climate-related disclosures affects borrower firms' environmental performance. We find that client firms of TCFD-member lenders, relative to control firms, significantly improve their environmental performance after the TCFD launch. The effects are stronger for polluting firms. Moreover, TCFD-member lenders influence their borrowers' environmental performance via charging higher loan spread and reducing the number and amount of new loans issued to polluting firms. Finally, polluting clients of TCFD-member lenders experience tightened financial constraints subsequently.

JEL Classification: G21; G30; Q54
Keywords: Climate-related Disclosure Commitment; Credit Rationing; Borrower Environmental Performance

I. Introduction

Wildfire, flooding and other natural disasters caused by the climate changes have posed significant threats to human beings and the global economy. For example, it is estimated that, with a temperature increase of 1.5 °C, human losses from flooding could rise by 70–83% and flood damage by 160–240% (Dottori et al., 2018). The financial sector has been cast in the spotlight as the main financier of the fossil fuel sector that are the main contributor to global warming: the aggregate amount of investments made by the 60 largest commercial and investment banks into the industry was estimated as more than USD $3.8 trillion between 2016 and 2020.[1] The strong demand from the investors, the insurers, and other stakeholders around the world on more transparent climate-related disclosures has led to the establishment of the Financial Stability Board's (FSB) Task Force on Climate-Related Financial Disclosures (TCFD) in December 2015. The primary aim for this initiative is that more transparent climate-related disclosures will lead to more socially responsible investments and more efficient allocation of financing from the financial sector, which will ultimately help address the polluting behavior in the real sector and contribute to the transition to low-carbon economy.[2] Despite the growing public attention, there is no empirical evidence on the environmental impact of the financial institutions' commitment to transparent climate-related disclosures. Our study aims to fill this void in the literature.

In 2017, the TCFD released its comprehensive climate-related disclosure recommendations, which are structured around four areas of financial sector organizations: governance, strategy, risk management, and metrics and targets. The recommended climate-related disclosures will help investors, insurers, and others better understand how the reporting

[1] See https://priceofoil.org/2021/03/24/banking-on-climate-chaos-2021/.

[2] See https://www.fsb-tcfd.org/about/.

organizations assess climate-related risks and opportunities, enabling these stakeholders to make informed decisions. By becoming a TCFD member who helps develop the climate-related disclosure frameworks and takes the leadership role in promoting transparency in climate-related information, a financial institution has clearly demonstrated a high level of commitment to the recommended climate-related disclosures. Using a borrower firm's relationship bank becoming a TCFD member as a plausible exogeneous shock to the firm, we investigate whether and how lenders' climate-related disclosure commitment affects the borrower firms' environmental performance using a difference-in-differences (DiD) framework. Our comprehensive empirical analysis yields the following key findings.

First, we find that treated firms (i.e., firms whose relationship banks become TCFD members), relative to control firms, are, on average, *less* likely to be subjected to the enforcement actions from the US Environmental Protection Agency (EPA) after their relationship banks become the TCFD members (i.e., the treatment). This treatment effect on the EPA enforcement likelihood is both statistically and economically significant. Given that the unconditional EPA enforcement likelihood is 9 percent per year, the documented treatment effect amounts to approximately one third of the unconditional EPA enforcement likelihood. The finding is robust to controlling for a variety of firm characteristics as well as firm fixed effects and year fixed effects. The DiD regression results are also qualitatively similar when we alternatively use the number of EPA enforcement actions as the dependent variable.

Importantly, the results from our dynamic DiD regressions show that the dampening effects on the EPA enforcement likelihood and the number of enforcement actions occur only after the onset of the treatment and the effects persist into the future years after the treatment. That is, the parallel-trends assumption underpinning our DiD research design is satisfied and thus the

treatment effect of lenders' climate-related disclosure commitment on the EPA enforcement actions against borrower firms is likely causal. Collectively, our findings suggest that lenders' commitment to transparent climate-related disclosures results in a significant reduction in borrower firms' polluting behavior.

Second, we show that our results are robust to using alternative measures of the environmental performance. Based on the data from the Toxics Release Inventory (TRI) program provided by EPA, we find that treated firms, on average, produce 25% lower amount of total toxic releases per year relative to control firms (i.e., firms whose relationship banks are not the members of the TCFD) after their relationship banks commit to transparent climate-related disclosures by becoming the members of the TCFD. Based on the data from Kinder, Lydenberg, and Domini Research & Analytics database (KLD), we find that treated firms also have a significantly higher environmental scores relative to control firms after the launch of the TCFD. Both findings are robust to controlling for various firm characteristics, firm fixed effects and year fixed effects. Results from dynamic DiD regressions further show that the reduction in toxic releases and improvement in environmental scores occur only after the onset of the treatment and persist into the future years. This finding not only validates the parallel-trends assumption underlying the DiD research design but also confirms the likely causal effects of lenders' climate-related disclosure commitment on reducing borrower firms' pollution and improving their environmental performance.

Third, we partition our full sample into subsamples of polluters and non-polluters. We classify borrower firms as polluters if they have been subject to any EPA enforcement in the years prior to the TCFD establishment. We find that the treatment effects of lenders' climate-related disclosure commitment on borrower firms' environmental performance (e.g., EPA enforcement

actions, total toxic releases and environmental score) mainly concentrate in the polluter subsample. These results suggest that lenders' commitment to transparent climate-related disclosures is particularly effective in improving the environmental performance of polluting borrowers.

Fourth, we investigate the channel(s) through which lenders' climate-related disclosure commitment can curb borrower firms' polluting behavior. We conjecture that the lenders who are committed to transparent climate-related disclosures can influence the borrowers' environmental performance via two channels: 1) charging higher loan spread and reducing the number and amount of new loans issued to polluting firms (the credit-rationing channel) and 2) increasing the strength of lender monitoring on polluting firm's environmental performance (the monitoring channel). Using a sample of syndicated loans granted to publicly US companies, we find that polluting borrowers on average experience a 5% to 6% higher loan spread when the lead arranger is a TCFD member compared with the spread of the loans arranged by non-TCFD-member lenders after the TCFD establishment. By contrast, such a treatment effect on loan spread does not exist for the loans extended to the non-polluting firms. These findings are robust to the inclusion of loan- and firm-level control variables and different fixed effects including firm-bank fixed effects.

Furthermore, we do not find any significant TCFD treatment effect on non-price loan terms such as loan maturity and the usage of covenants and collaterals for either polluting borrowers or non-polluting borrowers. Since shorter loan maturity are known to be associated with increased monitoring incentives of lenders (Barclay and Smith, 1995; Gustafson, Ivanov, Meisenzahl, 2021; Park, 2000; Rajan and Winton, 1995), and covenants and collaterals are associated with ex-post monitoring of lenders (e.g., Rajan and Winton, 1995; Roberts and Sufi, 2009; Nini, Smith, and Sufi, 2012; and Ozelge and Saunders, 2012), these results indicate that lenders' climate-related disclosure commitment influences borrowers' environmental performance through credit rationing

rather than active monitoring. Taken together, our empirical evidence suggests that lenders' climate-related disclosure commitment influences polluters' environmental performance mainly through the credit-rationing channel.

To provide more concrete evidence on the credit-rationing channel, we further construct a firm-bank-pair panel dataset and investigate the aggregate syndicated loan flows for each firm-bank pair around the TCFD establishment for polluting borrowers and non-polluting borrowers separately. To focus on the loan-supply-side effect, we control for time-varying, firm-specific loan demand and the endogenous borrower-lender matching by including the firm-period fixed effects and the firm-bank fixed effects, respectively. Consistent with credit rationing, we find that after the TCFD establishment, the likelihood of new loan issuance, the total number of new loans, and the total dollar amount of new loans are all significantly lower for the treated borrowers only in the subsample of polluting firms. Again, we do not find any significant effect for the subsample of non-polluting borrowers. Moreover, our additional analysis on bank loan portfolios reveals that the TCFD-member banks significantly reduce their loan allocations to polluting firms in their loan portfolios after the TCFD establishment. These results clearly indicate that credit rationing is the primary mechanism through which lenders' commitment to transparent climate-related disclosures affects polluting borrowers' environmental performance.

Fifth, we find that treated firms experience significantly tightened financial constraints relative to control firms in the subsample of polluting firms, while we do not find similar effect in the subsample of non-polluting borrowers. These findings suggest that the TCFD-member banks' credit rationing on their polluting borrowers has posed a significant financial impact on these firms,

thereby forcing them to improve their environmental performance.[3]

Our study makes the following contributions to the literature. First, to the best of our knowledge, this study is the first study that examines whether and how lenders' climate-related disclosure commitment can affect borrower firms' environmental performance. Thus, it fills an important gap in the banking and disclosure literature especially given that the financial sector has been blamed for financing fossil fuels that caused global warming and is currently under strong demand from various stakeholders to improve their climate-related disclosures and capital allocation. We find that a lender's commitment to transparent climate-related disclosures indeed causes its clients to reduce their polluting behavior and improve their environmental records. Moreover, we show that the channel of this effect is via credit rationing rather than lender monitoring.

In this regard, our findings compliment the findings of Houston and Shan (2022), who show that lenders' environmental, social and governance (ESG) profiles (ratings) can influence their borrowers' ESG ratings via loan renewal channel. However, different from Houston and Shan's study, the focus of our study is on the effects of *lenders' commitment to transparent climate-related disclosures* on borrowers' EPA enforcement likelihood, polluting behavior and environmental performance. Hence, our study also contributes to the literature that shows the important influence of lenders on borrowers' corporate policies and performance (see, e.g., Chava and Roberts, 2008; Roberts and Sufi, 2009; and Nini, Smith, and Sufi, 2012).

Second, our study is related to the burgeoning literature on corporate social responsibility (CSR) disclosures. While the studies in this literature examine various topics including the

[3] A borrower firm of a TCFD-member bank could potentially switch to a non-TCFD-member bank for financing. However, the extant literature suggests that such relationship-bank switching can be quite costly due to the holdup problem (e.g., James, 1987; Vale, 1993; Petersen and Rajan, 1994; Boot, 2000; and Kim, Kliger, and Vale, 2003). Our robustness results show that such switching behavior does not affect our findings qualitatively.

determinants of the CSR reporting and the information effects of the disclosures, there is scant evidence on the real effect of the CSR disclosures (Christensen, Hail, and Leuz, 2021). For example, Ameli et al. (2020) and Ameli, Kothari, and Grubb (2021) argue that enhancing financial sector's climate-related disclosures through the TCFD recommendations alone may not be sufficient to cause financing to move away from carbon-intensive assets. We contribute to this growing literature on CSR disclosures by documenting new empirical evidence that the lenders' commitment to transparent climate-related disclosure policies does generate the intended benefits of improved allocation of bank financing and a reduction in borrowers' polluting behavior.

The rest of the paper proceeds as follows. Section 2 describes the institutional background of the TCFD. Section 3 discusses the sample construction and variable measurement. Section 4 discusses the empirical strategy and results. Section 5 concludes. Appendix A provides the detailed definitions of the variables used in the study and their data sources.

II. Institutional Background

Under the perception that enhancing the transparency in climate-related disclosures will enable stakeholders to make informed decisions, encourage the shift of financial capital allocation from carbon-intensive assets to low-carbon assets and thus help achieve the longer-term "well below 2°C" goal of the Paris Agreement, the Financial Stability Board (FSB) established the Task Force on Climate-Related Financial Disclosure (TCFD) in December 2015. The TCFD is chaired by Michael R. Bloomberg, with the aim of developing a climate-related financial risk disclosure framework. The initial 22 members of the TCFD were selected by the FSB and announced on January 21st, 2016.[4] The additional 9 TCFD members were added in May 2016, taking the total

[4] See https://assets.bbhub.io/company/sites/60/2016/01/20160121-TCFD-members-press-release.pdf.

membership to 31.[5] The list of lenders from the Thomson Reuters Loan Pricing Corporation DealScan database for whom the parent firm is a member of the expanded membership list of the TCFD in 2016 is as follows: JPMorgan Chase; Barclays; HSBC; UBS AG; Industrial and Commercia Bank of China; AXA Group SA; Banco Bradesco SA; Blackrock Inc; Canada Pension Plan Investment Board; Swiss Re.

In June 2017, the TCFD released its final report outlining its comprehensive climate-related disclosure recommendations.[6] The TCFD structured its climate-related disclosure recommendations around four thematic areas that represent core elements of how organizations operate: *governance*, *strategy*, *risk management*, and *metrics and targets*. The four overarching recommendations are supported by key climate-related recommended disclosures that form the framework with information that will help investors, insurers and others better understand how the reporting organization assesses climate-related risks and opportunities, thereby enabling these stakeholders to make informed decisions.

With regard to governance, the TCFD recommends a reporting organization to disclose the organization's governance around climate-related risks and opportunities, including a) describing the board's oversight of climate-related risks and opportunities, and b) describing management's role in assessing and managing climate-related risks and opportunities.

With regard to strategy, the TCFD recommends an organization to disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material. This includes a) describing the climate-related risks and opportunities the organization has identified over the short, medium,

[5] See https://www.fsb.org/2016/05/fsb-names-additional-members-of-the-task-force-on-climate-related-financial-disclosures/#footnote-1.

[6] See https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf.

and long term, b) describing the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning, and c) describing the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.

With regard to risk management, the TCFD recommends an organization to disclose how the organization identifies, assesses, and manages climate-related risks. This includes a) describing the organization's processes for identifying and assessing climate-related risks, b) describing the organization's processes for managing climate-related risks, and c) describing how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management.

With regard to metrics and targets, the TCFD recommends a reporting organization to disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material. This includes a) disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process, b) disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks,[7] and c) describe the targets used by the reporting organization to manage climate-related risks and opportunities and performance against targets.

Committing to the TCFD climate-related disclosure framework will signficantly enhance the transparency on a reporting organization's climate-related financial risk exposures to outside stakeholders, enabling these stakeholders to make more informed investment, insurance and other decisions. After the release of the TCFD's climate-related disclosure recommendations, most of

[7] Scope 1 emissions are direct emissions from owned or controlled sources of the reporting organization. Scope 2 emissions are indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting organization. Scope 3 emissions are all other indirect emissions that occur in the reporting organization's value chain.

the financial institutions became supporters of the initiative by the end of 2020 (i.e., the end of our sample period), which indicates that financial institutions generally believe that the TCFD's climate-related disclosure recommendations provide a useful framework to increase transparency on climate-related risks and opportunities.[8] However, by becoming a TCFD member who helps develop the climate-related disclosure frameworks and takes the leadership role in promoting transparency in climate-related information, a financial institution has clearly demonstrated a high level of commitment to the recommended climate-related disclosures.

For example, JPMorgan Chase, a TCFD-member lender, published a voluntary report in 2019 which details how the firm manages climate-related risks and opportunities according to the TCFD disclosure recommendations.[9] In its Environmental Social & Governance Report in 2020, JPMorgan Chase also discloses its financed emissions in each of its sector portfolios and its 2030 Paris-agreement-aligned targets for the sectors.[10] By contrast, non-TCFD-member lenders have not disclosed the data on their financed emissions by the end of 2020. Our empirical evidence also reveals that after the TCFD establishment, the TCFD-member lenders clearly integrate borrower firms' climate-related risks and opportunities into their lending decisions and increase their loan spreads and reduce their loan supply for polluting borrower firms.

We conjecture that *lenders' commitment to transparent climate-related disclosures will help promote responsible lending and shift financing away from polluting borrowers, thereby improving the environmental performance of borrower firms*.

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[8] Most of the firms that became supporters of the TCFD by the end of 2020 are financial firms and utility firms (see https://www.fsb-tcfd.org/support-tcfd/), which have been excluded from our sample of borrower firms to ensure we have a clean sample for empirical analysis.

[9] See https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/documents/jpmc-cr-climate-report-2019.pdf.

[10] See https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/documents/jpmc-esg-report-2020.pdf.

III. Data and Sample

A. Variable measurement

Our main environmental performance variables are based on the historical record of the EPA's enforcement actions. We obtain detailed facility-level enforcement cases from ICIS-FE&C data on federal administrative and judicial cases. We then supplement the data with the information from various datasets provided by the EPA that contains federal and state enforcement cases under various environmental regulations: 1) ICIS-Air data (Clean Air Act); 2) ICIS-NPDES data (Clean Water Act); 3) RCRAInfo data (Resource Conservation and Recovery Act); and 4) SDWA data (Safe Drinking Water Act). We identify as "enforcement year" the year during which the documents related to formal or judicial cases were signed. For informal cases, we use the year during which the handler received notification. For cases with missing information, we rely on the settlement date.[11]

To construct firm-level environment performance measures, we obtain the information on facilities registered with the EPA from Facility Registry Service (FRS) dataset. FRS provides comprehensive data on facility-level information including name, address, industry code, etc. Using the facility names, we hand-match the FRS dataset with Compustat data and find that there are 6,637 Compustat firms that have matching facility information in the EPA's FRS database. Using the hand-matched data, we construct two measures of corporate polluting behavior: 1) *EPA enforcement*, an indicator variable that equals one if the firm is the target of an EPA enforcement action in a given year and 2) *Number of EPA enforcements*, the aggregate number of enforcement actions against the firm in a given year.

[11] Our results are robust to using the enforcement action measures based solely on the case initiation date.

Further, we use two alternative measures of firm-level environmental performance. First, we rely on facility-level toxic releases under the Toxics Release Inventory (TRI) program provided by the EPA. Following the passage of the Emergency Planning and Community Right-to-Know Act (EPCRA), the TRI program has been established in 1986 to collect facility-level information on toxic releases that are detrimental to human health and environment. The TRI program currently covers 770 chemicals that can cause any of the following: 1) cancer or other chronic human health effects, 2) significant adverse acute human health effects, and 3) significant adverse environmental effects. The mandatory reporting requirement to TRI program is limited to facilities that meet the following conditions: 1) facilities in covered industry sector, 2) facilities with 10 or more full-time employees, and 3) facilities with usage of TRI-listed chemicals more than the established threshold. Accordingly, we limit our sample to the firms with facilities that are under the TRI mandatory reporting program when we use toxic releases as the measure of corporate environmental performance.

To measure firm-level toxic releases, we hand-match the TRI toxic releases database with Compustat data. For the facilities with missing parent company name, we use the above-mentioned matching data between FRS and Compustat (by name, using "parent company" from TRI). For each matched Compustat firm, we calculate aggregate releases for each toxic chemicals in each year. To calculate the aggregate toxic releases for each firm-year, we include only the toxic chemicals that have been reported by the firm in both the pre-treatment and post-treatment periods.

Second, we rely on corporate environmental performance index provided by the MSCI ESG KLD database (KLD). The KLD database has been extensively used in numerous research that focus on CSR-related topics (e.g., Hong and Kostovetsky, 2012; Deng, Kang, and Low, 2013; and Lins, Servaes, and Tamayo, 2017). The KLD database provides comprehensive information

on the environmental, social, and governance performance of the listed companies in the US, covering various dimensions including community, diversity, employee relations, environment, human rights, product, alcohol, gambling, firearms, military, nuclear, tobacco, and corporate governance. Since our interest is in corporate environmental performance, we restrict our attention to the relevant dimension. We first calculate a "strengths" ("concerns") score for each firm-year by counting the number of strengths (concerns). Since the maximum numbers of strengths and concerns vary over time, we follow Lins, Servaes, and Tamayo (2017) to scale the strengths (concerns) score with the maximum number of strengths (concerns) possible for each year. *Environment score* is then constructed by subtracting the scaled concerns score from the scaled strengths score. Since the KLD database focuses on Russell 3000 firms, we limit our sample to the firms covered by KLD when using *Environmental score* as the environmental performance measure.

Lastly, we obtain accounting information from Compustat and construct the following firm-level control variables: *Firm size* (log of total assets), *Profitability* (EBITDA divided by sales), *Tobin's Q* (book value of total assets minus book value of equity plus market value of equity, all divided by total assets), *Leverage* (total debt divided by total assets), *Altman Z-score*, and *Firm age*. Appendix A provides the detailed definitions of the variables. All continuous variables are winsorized at the 1% level to limit the influence of outliers.

B. Sample construction

To construct our borrower firm sample, we begin with all Compustat firms over the period 2012-2020 (i.e., four years before and four years after the TCFD establishment). To be included in our sample, we restrict our sample to those firms having access to the syndicated loan market.

Specifically, we obtain the syndicated loan data from the Thomson Reuters Loan Pricing Corporation DealScan database (DealScan) and drop firms that have not borrowed any loan during the pre-event period (i.e., the years between 2012-2015). Also, we exclude financial firms (Standard Industrial Classification (SIC) codes 6000-6999) and utility firms (SIC codes 4900-4999) from our borrower firm sample, since such firms are heavily regulated and subject to many regulatory shocks. Lastly, our sample is restricted to firms with non-missing controls, leaving us with an unbalanced panel of 2,305 unique borrower firms and 14,974 firm-year observations.

Panel A of Table 1 presents the summary statistics of the key variables for our main sample. Out of 14,974 firm-year observations, about 9.0% of them have been affected by either formal or informal enforcement actions by the EPA. On average, 0.34 enforcement action has been undertaken per firm-year. The average firm size is 12.5 billion US dollars. We also find that the mean *Profitability*, *Tobin's Q*, *Leverage*, and *Altman Z-score* are 0.14, 1.84, 0.32, and 1.94, respectively. We further find that the sample firms are, on average, 25.61 years old. Lastly, we find that approximately 29% of all firm-year observations in our sample are classified as involving polluters (i.e., the observations of firms that have been subjected to any EPA enforcement in the years prior to the treatment of their relationship lenders becoming TCFD members).

(Insert Table 1 about here)

IV. Results

A. Empirical strategy

To examine the effect of lenders' climate-related disclosure commitment on the environmental performance of borrower firms, we exploit the TCFD establishment as an exogeneous shock to borrower firms in a DiD framework. The underlying idea is that lenders'

leadership in this global initiative of transparent climate-related financial disclosures will promote their own responsible lending, which will in turn affect their borrowers' environmental performance. Under this premise, we examine the potential treatment effect of lenders becoming members of the TCFD on their borrower firms (the treated firms) relative to those borrower firms that are not clients of the TCFD-member lenders (the control firms).

To classify our sample firms into the treatment and control firms, we obtain the information on all new loan facilities granted to our sample of borrower firms during the pre-treatment period (2012-2015). We assign to the treatment (control) group the sample firms that have received a loan arranged by a TCFD-member lender (a non-TCFD-member lender) during the pre-treatment period. In those cases where multiple lenders have arranged loan agreements to a borrower firm during the pre-treatment period, we classify the firm into the treatment or control group based on the identity of the lender that has arranged the highest number of loans for the firm in the pre-treatment period.[12]

To identify the lead arranger in loan deals, we follow Ivashina (2009) and define the administrative agent as the lead arranger bank. For the loan facilities without an administrative agent, we follow Bharath et al. (2011) and rely on the lead arranger credit to identify the lead arranger banks. For the loan facilities with missing information on both the administrative agent and the lead arranger credit, we identify the banks with either the agent credit or the banks in sole lender deals as the lead arranger banks.[13] When there are multiple lead banks in a loan facility (less

[12] In Columns 1-4 of Appendix B, we rerun our baseline analysis for a subsample excluding the firms that have received multiple loans or received any loan lead-arranged by multiple lenders during the pre-treatment period. The results remain qualitatively unchanged.

[13] Using this methodology, we successfully identify the lead bank in more than 95% of the loan facilities.

than 5% of the cases), we define a loan as a TCFD-member arranged loan if any of the lead arrangers is a TCFD-member lender.

We use the following DiD regression specification to study the treatment effect of lenders' climate-related disclosure commitment on the environmental performance of borrower firms.

$$Y_{i,t} = \alpha_1 \, Treated_i \times Post_t + \alpha_2 \, X_{i,t} + \eta_i + \delta_t + \varepsilon_{i,t} \quad (1)$$

For the dependent variable $Y_{i,t}$, we use various proxies of borrower firms' environmental performance as discussed earlier. Our main variable of interest is the interaction term between the indicator variable, *Treated*, that equals one for the treated firms (i.e., firms that have been clients of TCFD-member lenders during the pre-treatment period) and equals zero otherwise, and the indicator variable, *Post*, that equals one for the post-TCFD-establishment years (i.e., years between 2017-2020) and equals zero otherwise. We identify 2016 as the TCFD-establishment event year since the initial 22 members of the TCFD were announced on January 2016 and the additional 9 TCFD members were added in May 2016. We exclude the event year 2016 from the sample so that our *Post* indicator can be clearly defined. $X_{i,t}$ is a vector of firm characteristics, including *Firm size, Profitability, Tobin's Q, Leverage, Altman's Z score, and Firm Age*. We also include firm fixed effects (η_i) and year fixed effects (δ_t) to control for all time-invariant firm-level characteristics and all firm-invariant time trends, respectively. In all regression specifications, we double cluster standard errors at both the firm and bank levels.

B. The treatment effect on the environmental performance of borrower firms

1. The treatment effect on the EPA enforcement actions

We begin our empirical analysis by examining the treatment effect of lenders' commitment to transparent climate-related disclosures on the environmental performance of borrower firms. Table 2 reports the DID estimation results using Equation (1). In our baseline specification in Column 1, we use the indicator variable, *EPA enforcement*, that equals one if the borrower firm is enforced by the EPA in year *t* as the measure of corporate environmental performance. In Column 2, we replace this indicator variable with the natural logarithm of one plus the number of EPA enforcement actions against the firm in year *t*.

We first estimate Equation (1) without including the firm-characteristics controls (but with firm fixed effects and year fixed effects). Column 1 of Table 2 shows that the coefficient estimate on the interaction, *Treated*×*Post*, is negative and statistically significant at the 1% level. This result suggests that treated firms exhibit a significant reduction in the EPA enforcement likelihood after the TCFD establishment in comparison with the control firms. The effect is economically significant as well. Based on the coefficient estimate of *Treated*×*Post*, the likelihood of EPA enforcement for the treated firms is on average reduced by about 3 percentage points more after the TCFD establishment relative to the control firms, which corresponds to a 33% decline (as the unconditional mean likelihood of EPA enforcement is 0.09 as shown in Table 1). Column 2 shows that the results remain qualitatively similar if we instead use the logarithm of one plus the number of EPA enforcements as the corporate environmental performance measure. Columns 3 and 4 show that the results remain qualitatively unchanged when we further include a variety of firm characteristics as control variables.

(Insert Table 2 about here)

2. The dynamic effect on the EPA enforcement actions

To examine whether the documented treatment effect of lenders' climate-related disclosure commitment on the EPA enforcement actions against borrower firms is driven by potential nonparallel EPA enforcement trends between the treated firms and control firms prior to the TCFD establishment, we employ a dynamic DiD regression framework by reintroducing the observations in 2016 to the sample and replacing the *Post* indicator in Equation (1) with a series of year indicators indicating different years in the sample, with the first year of the sample (i.e., 2012) being used as the reference year. Table 3 reports the dynamic DiD regression results.

Across different regression specifications with and without firm-characteristics controls, we find that the coefficient estimates on the interaction terms between *Treated* and the year indicators are all insignificantly different from zero before the establishment of TCFD. This finding suggests that environmental performance as proxied by the EPA enforcement actions is not significantly different between the treated and control firms prior to the TCFD establishment. Furthermore, the results show that the effect of lenders' climate-related disclosure commitment on treated firms' environmental performance starts to occur only in the event year (i.e., 2016, as indicated by *T+0*) and persists into the future years, with the magnitude of the effect increasing over time. We further visualize the coefficient estimates on the interaction terms between *Treated* and the year indicators from Column (1) of Table 3 in Figure 1, which clearly shows that there is no treatment effect before the event year *T+0* and the effect only occurs after the onset of the treatment. Thus, the parallel-trends assumption for the efficacy of the DiD approach is satisfied and the documented effect of lenders' climate-related disclosure commitment on the EPA enforcement actions against borrower firms is likely causal.

(Insert Table 3 about here)

3. The treatment effect on toxic releases and environment score

Next, we repeat the DiD regression analyses in Table 2 with alternative proxies for corporate environmental performance. First, we focus on the aggregate firm-level toxic chemical releases. This analysis restricts the sample to the borrower firms reporting to the TRI program administered by the EPA. The TRI mandatory reporting requirement is restricted to the facilities meeting the following three criteria: 1) the facility is included in a TRI-covered industry, 2) the facility has 10 or more full-time employee equivalents, and 3) the facility deals with TRI-listed chemicals in quantities greater than the yearly threshold. The availability of toxic release data limits our DiD regression analysis to an unbalanced panel of 439 unique borrower firms.

Second, we rely on the environmental ratings provided by KLD, a database used extensively in the CSR-related literature. The KLD database covers about 3,000 largest publicly listed companies (Russell 3000) in the US. The KLD-ratings data is only available up to 2018. This leaves us with the unbalanced panel of 1,727 unique sample firms. Table 4 reports the estimation results.

In Column 1, we use the natural logarithm of aggregate firm-level toxic chemical releases, *Total releases (Log)*, as the dependent variable. The result shows that the total amount of toxic releases from treated firms significantly drops by 25% (i.e., exp(-0.29)-1) on average relative to control firms after the TCFD establishment. The economic magnitude is sizeable. The aggregate amount of toxic chemicals disposed by treated firms drop by approximately 188 tons per year relative to control firms during the post-treatment period.[14] In column 2, we rerun the DiD

[14] -188 tons= -25%×750.62, where 750.62 is the mean *Total releases* in Table 1.

regression analysis with *Environment score* as the dependent variable. The result, again, is consistent with our main findings. The coefficient estimate on the interaction term *Treated×Post* is significantly positive, indicating that treated firms also improve their environmental ratings relative to control firms after the treatment.[15] Overall, the results in this section continue to show superior environmental performance changes for the treated firms relative to the control firms after the TCFD establishment.

(Insert Table 4 about here)

To verify the parallel-trends assumption, we similarly include the observations in 2016 and estimate the dynamic DiD specifications by replacing *Post* with a series of year indicators. As shown in Table 5, we fail to find any significant difference in environmental performance between the treated and control firms prior to the TCFD establishment. Furthermore, we find significantly lower total toxic releases from treated firms relative to control firms after the event year, which persists from year 1 to year 4 (i.e., from 2017 to 2020) as shown in columns 1 and 3 of Table 5. In columns 2 and 4, we also find that the treated firms exhibit a significantly improvement in *Environment score* relative to the control firms only after the TCFD establishment and not before (we cannot estimate the coefficient estimates of the indicators *T+3* and *T+4* as the KLD data is unavailable beyond 2018).[16]

(Insert Table 5 about here)

[15] As a placebo test, we further use the social and governance ratings of the sample firms from KLD as the dependent variable. We do not find any effect of lenders' climate-related disclosure commitment on borrower firms' social and governance ratings. This finding is expected since the financial institutions' commitment to transparent climate-related disclosures should mainly affect borrower firms' environmental performance rather than their social and governance performance.

[16] Some treated firms may switch lenders and borrow from non-TCFD-member lenders after the launch of the TCFD. In Columns 5-8 of Appendix B, we rerun our baseline analysis for a subsample excluding those treated firms that have been granted any loan arranged by the non-TCFD-member lenders during the post-event period (2017-2020). The results remain qualitatively unchanged, suggesting that such switching behavior is unlikely to affect our findings.

4. The effect on corporate environment performance for polluters vs. non-polluters

We next explore how the treatment effect of lenders' climate-related disclosure commitment on corporate environmental performance varies in polluting borrower firms versus non-polluting borrowers. We conjecture that lenders' commitment to transparent climate-related financial disclosures will encourage their responsible lending, which should have stronger effect on improving environmental performance for polluting firms than for non-polluting borrowers. To test this conjecture, we classify borrower firms into polluters or non-polluters based on the historical EPA enforcement actions in the years prior to the TCFD establishment. Those borrower firms that have been subject to any judicial, formal, or informal EPA enforcement in the years prior to the TCFD establishment are classified as polluters. The other borrower firms are classified as non-polluters. We then rerun our baseline DiD analyses using the polluter and non-polluter subsamples, respectively.

Table 6 presents the subsample DiD regression results. Consistent with our conjecture, Column 1 shows that the effect of lenders' climate-related disclosure commitment on the EPA enforcement likelihood is more pronounced for polluting borrower firms. For the subsample of polluters, the results show that the likelihood of EPA enforcement is approximately 6 percentage points lower for treated firms relative to control firms after the TCFD-establishment treatment, which is both economically and statistically significant. However, we fail to find any significant difference in the likelihood of EPA enforcement in the non-polluter subsample. The result from the Chow test strongly rejects the null hypothesis that the DiD-term coefficients are the same between the two subsamples.

The results are qualitatively similar when we use *Number of EPA enforcements (Log)*, *Total releases (Log)* or *Environmental score* as the environmental performance measure instead, as shown in Columns 2-4, albeit the DiD-term coefficient difference between the two subsamples is statistically insignificant when *Total releases (Log)* is the dependent variable (likely because of the smaller sample sizes when we require available data on toxic chemical releases). Taken together, these results clearly suggest that lenders' commitment to transparent climate-related financial disclosures has the strongest effect on improving the environmental performance of polluting borrower firms.

(Insert Table 6 about here)

C. Mechanism

Our results so far show a robust and positive impact of lenders' climate-related disclosure commitment on corporate environmental performance of borrower firms. In this section, we explore the possible underlying mechanism.

There are two potential mechanisms through which lenders' commitment to transparent climate-related disclosures can affect environmental performance of borrowers. On one hand, motivated by their commitment to transparent climate-related financial disclosures, the TCFD-member lenders may exert intense monitoring on borrower firms' environmental performance. The theoretical literature highlights that banks have a comparative advantage in monitoring (Diamond, 1984; Fama, 1985; Diamond, 1991). Furthermore, empirical studies provide evidence on the effectiveness of bank monitoring (e.g., Kaplan and Stein, 1993; Datta, Iskandar-Datta, and Patel, 1999; Guo, Hotchkiss, and Song, 2011). Increased monitoring from the TCFD-member

banks on the polluting behavior of borrowers can result in an improvement in corporate environmental performance of borrowers.

On the other hand, the TCFD-member lenders may integrate borrower firms' climate-related risks and opportunities into their lending decisions and thus increase their loan spreads and ration credit to borrowers with poor environmental performance. The theoretical models of Diamond (1989, 1991) demonstrate the disciplinary effect of lenders' credit rationing on borrower firms by showing that the risk of future credit rationing mitigates the adverse selection problem. Ambrose, Conklin, and Yoshida (2016) document empirical evidence in support of the theoretical predictions. By rationing future credit to polluting borrowers, the TCFD-member lenders can positively influence the environmental performance of these firms.

To explore the mechanism through which lenders' climate-related disclosure commitment affects environmental performance of borrower firms, we thus study the potential effects of lenders' climate-related disclosure commitment on loan terms and loan supply in this section.

1. The effect on price and non-price loan terms

If credit rationing is the underlying economic mechanism through which lenders' climate-related disclosure commitment affects corporate environmental performance of borrowers, we expect higher loan spreads for the treated polluting borrowers (relative to the control polluting borrowers) after the TCFD establishment due to the drop in loan supply (De Marco, 2019). On the other hand, if the underlying mechanism is increased bank monitoring, we should not expect any positive impact on loan spreads since tighter lender monitoring is associated with lower loan spreads (e.g., Gustafson, Ivanov, and Meisenzahl, 2022).

To examine the effect on loan spread, we obtain detailed loan contract information for all loans granted to the Compustat firms between 2012 and 2020 from Dealscan. We restrict our sample to the loan deals for which the pricing (spread over the benchmark rate), size, and the maturity date information is available. We further exclude loans granted to financial and utility firms (SIC codes 6000-6999 and 4900-4999). Finally, we restrict our sample to the loans with non-missing firm-level control variables, leaving us with a sample of 7,830 loan facilities.

The summary statistics are reported in Panel B of Table 1. Out of the 7,830 loans, about 38.0% are granted to the polluters. The average firm size is 11.6 billion US dollars, which is slightly smaller than that of our main sample. We also find that the average *Profitability* (EBITDA divided by sales), *Tobin's Q*, *Leverage*, *Altman Z-score*, *firm age* are 0.18, 1.85, 0.33, 2.27, and 27, respectively. The average loan has a loan spread of about 233 basis points over benchmark rate, is approximately 692 million US dollars, has a maturity of about 55.6 months, and has about 9 members in the syndicate. About 53% (50%) of the loans have collateral (covenants).

We classify our loan sample into loans granted to polluters and non-polluters following the definition used in Table 6. We then estimate the following loan-level DiD regression specification separately for these subsamples of loans:

$$Spread\ (Log)_{i,j,t} = \alpha_1\, TCFD\ arranged_{i,j} \times Post_t + \alpha_2\, X_{i,t} + \eta_i + \gamma_j + \delta_t + \varepsilon_{i,j,t} \qquad (2)$$

In Equation (2), *i* stands for firm *i*, *j* stands for lead arranger *j*, and *t* stands for year *t*. The dependent variable, *Spread (Log)*, is the natural logarithm of all-in-drawn spread of the loan. Our variable of interest is the interaction term between the indicator variable, *TCFD arranged*, that equals one if the loan is arranged by a TCFD-member bank and equals zero otherwise, and the indicator variable, *Post*, that that equals one for the post-TCFD-establishment years (i.e., years between

2017-2020) and equals zero otherwise. $X_{i,t}$ is a vector of firm characteristics, including *Firm size*, *Profitability, Tobin's Q, Leverage, Altman Z score*, and *Firm Age*. We also include firm fixed effects (η_i), bank fixed effects (γ_j), and year fixed effects (δ_t). The standard errors are double clustered at both the firm and bank levels. Table 7 reports the DiD estimation results.

In Column 1 of Table 7, the coefficient estimate of *TCFD arranged* × *Post* is positive and statistically significant at the 5% level for the polluter loan subsample, suggesting a significantly positive effect of lenders' climate-related disclosure commitment on the spreads of new loans issued to polluting borrowers. This effect is also economically meaningful, as the loan spread for the treated polluting borrowers on average increases by about 14 bp relative to the control polluting borrowers after the TCFD establishment.[17] On the other hand, we do not find any discernible impact on the loan spreads for non-polluters. A possible concern is that the endogenous matching between the lender and the borrower might lead to a bias of our coefficient estimate on the DiD term. As suggested in Adelino and Ferreira (2016), we further control for bank-firm paired fixed effects in Column 2 of Table 7 to alleviate the concern. This allows us to focus on the loan spread variation within the same bank-firm pairs before and after the TCFD establishment. Column 2 shows that our findings are robust to controlling for the bank-firm paired fixed effects. The Chow-test results also reject the null hypothesis that the DiD-term coefficients are the same between the two loan subsamples.

Taken together, these findings support credit rationing as the mechanism through which lenders' climate-related disclosure commitment affects the environmental performance of polluting borrowers.

[17] 14bp = 0.06×232.99, where 0.06 is coefficient estimate of the DiD term in Column 1 of Table 7 and 232.99 is the mean *Spread* in Table 1.

(Insert Table 7 about here)

In addition to the analysis on loan pricing, we further investigate the impact of lenders' climate-related disclosure commitment on non-price loan terms. The extant literature suggests various non-price loan terms that are associated with the strength of lenders' monitoring. For example, studies find that a short loan maturity increases lenders' monitoring incentives (Barclay and Smith, 1995; Gustafson, Ivanov, Meisenzahl, 2021; Park, 2000; Rajan and Winton, 1995). Extant research also shows positive associations between collateral usage and lenders' monitoring (Cerqueiro, Ongena, and Roszbach, 2016; Ono and Uesugi, 2009; Manove, Padilla, and Pagano, 2001) and between covenant usage and lenders' monitoring (Roberts and Sufi, 2009; Nini, Smith, and Sufi, 2012; Ozelge and Saunders, 2012). To test whether lenders' monitoring is the underlying mechanism of our findings, we use *Loan size*, *Maturity*, *Collateral*, *Number of lenders*, and *Covenant* as the dependent variable in Equation (2), respectively. The DiD regression results, presented in Table 8, suggest that there is no relationship between lenders' climate-related disclosure commitment and non-price loan terms for both (polluter and non-polluter) loan subsamples. Thus, the empirical evidence does not support monitoring as the mechanism through which TCFD-member lenders influence the environmental performance of borrowers.

(Insert Table 8 about here)

2. Bank loan flows

In the last section, we find evidence consistent with credit rationing being the mechanism through which lenders' climate-related disclosure commitment affects polluting borrowers. To provide more concrete evidence on credit rationing, we further investigate bank loan flows.

First, we examine the effect of lenders' climate-related disclosure commitment on the break-up of lending relationships between lenders and borrowers. To test this, we employ an approach similar to the one used in Saidi and Zaldokas (2021) by aggregating the syndicated loan flows for each firm-bank pair in the pre-treatment (2012-2015) and post-treatment (2017-2020) periods. We restrict our sample to the borrower firms that have borrowed any syndicated loan during the pre-treatment year. We further require that the firm-bank pair to have at least one lending agreement in either the pre-treatment or post-treatment period. Then, we estimate the following firm-bank-pair-level DiD regression specification for the polluters and non-polluters (as previously defined) separately:

$$Y_{i,j,t} = \alpha_1 \, TCFD\ member_{i,j} \times Post_t + \alpha_4 X_{i,t} + \eta_{i,j} + \gamma_{i,t} + \varepsilon_{i,j,t} \quad (3)$$

In Equation (3), *i* stands for firm *i*, *j* stands for lead arranger *j*, and *t* stands for period *t*. To examine the effect on bank loan flows, we use the following three measures as the dependent variable, respectively: 1) *Loans in pre- or post-period (Y/N)*, 2) natural logarithm of one plus *Number of loans in pre- or post-period*, and 3) natural logarithm of one plus *Amount of loans in pre- or post-period*. These three variables capture whether there is at least one new loan, the number of loans, and the amount of loans for a given borrower-lender-pair in each period, respectively. Our main variable of interest is the interaction term between the indicator variable, *TCFD member*, that equals one for the firm-bank pair where the lead-arranger bank is a TCFD member and equals zero otherwise, and the indicator variable, *Post*, that equals one for the post-TCFD-establishment period (i.e., years between 2017-2020) and equals zero otherwise. We also include firm-bank pair fixed effects ($\eta_{i,j}$) to focus on within-pair loan flows and firm-period fixed

effects to control for time-varying, firm-specific loan demand ($\gamma_{i,t}$). The standard errors are double clustered at both the firm and bank levels.

Table 9 reports the results. Columns 1-3 of Table 9 show that all three coefficient estimates on the interaction term between *TCFD member* and *Post* are negative and statistically significant at the 5% level for the polluter subsample. By contrast, none of the coefficient estimates on the interaction term is statistically different from zero for the non-polluters. The results clearly suggest that the lending relationships are more likely to break after the TCFD establishment only for the subsample of treated polluting borrowers. The results from the Chow test also reject the null hypothesis that the DiD-term coefficients are the same between the subsamples in two out of the three cases. The findings are consistent with TCFD-member lenders' credit rationing on these polluting firms.

(Insert Table 9 about here)

Second, we examine the aggregate loan supply to polluters at the lender level. Motivated by Ivashina and Scharfstein (2010), we calculate the average yearly amount of loans granted to polluters (scaled by the total amount of loans) for the pre- and post-treatment periods. We then construct two measures that capture the changes in aggregate loan supply to polluters. The first measure is the changes in yearly mean amount of loans granted to polluters in which the lender has either participated or arranged (*ΔYearly mean amount of loans in million granted to polluters pre vs. post TCFD*). The second measure is the changes in yearly mean amount of loans the lender has arranged for polluters (*ΔYearly mean amount of loans in million arranged for polluters pre vs. post TCFD*).

To examine the effect of lenders' climate-related disclosure commitment on their aggregate loan supply to polluters, we estimate the following regression specification:

$$Y_j = \alpha_1 + \alpha_2 \, TCFD\ member_j + \varepsilon_j \quad (4)$$

Where the dependent variable Y_j is one of the two loan-supply-change measures discussed earlier (i.e., *ΔYearly mean amount of loans in million granted to polluters pre vs. post TCFD* and *ΔYearly mean amount of loans in million arranged for polluters pre vs. post TCFD*). The main variable of interest is the indicator variable *TCFD member*, which identifies the TCFD-member lenders. The results are reported in Table 10.

The coefficient estimates of *TCFD member* are significantly negative at the 5% level in both columns of Table 10, indicating that TCFD-member lenders, relative to non-TCFD-member lenders, significantly reduce their loan supply to polluting firms by 5% of the total amount of annual lending after the TCFD establishment. Considering that the annual amount of loans granted to polluters is on average 13% of the total amount of annual lending, the magnitude of drop suggests the TCFD-member banks on average reduce their aggregate loan supply to polluters by a remarkable 38% after the TCFD establishment.

(Insert Table 10 about here)

Overall, our bank-firm level and bank-level analyses on bank loan flow and loan supply provide concrete empirical evidence confirming that TCFD-member lenders' credit rationing on polluting borrowers is the primary mechanism through which lenders' climate-related disclosure commitment affects the environmental performance of these firms.

D. Financial constraints of borrower firms

Finally, we investigate whether the polluting borrowers of TCFD-member banks experience tighter financial constraints relative to other polluting firms after the TCFD establishment. Given the evidence of TCFD-member lenders' credit rationing on polluting firms,

we expect to observe tightened financial constraints for the polluting borrowers of TCFD-member banks in the post-TCFD-establishment period.

Following Bartram, Hou, and Kim (2021), we construct a composite indicator of financial constraints based on six measures commonly used in the literature: the Kaplan-Zingales index (Kaplan and Zingales, 1997; Lamont, Pok and Saa-Requejo, 2001), the Hadlock and Pierce index (Hadlock and Pierce, 2010; Cornaggia et al, 2015), the Whited and Wu index (Whited and Wu, 2006; Fahlenbarch and Stulz, 2009), firm size, payout ratio, and credit ratings (Almeida, Campello, and Weisbach, 2004). Firms are identified as financially constrained if the Kaplan-Zingales index, the Hadlock and Pierce index, and the Whited and Wu index is above sample median. For firm size (log of total assets) and payout ratio, firms are categorized as constrained if they are below the sample median. For credit ratings, we classify a firm as constrained if the firm does not have either short-term or long-term credit rating. Based on these six measures, we then construct a composite indicator variable, *Financially constrained*, which equals one if the firm is classified as constrained by a majority of the above measures and equals zero otherwise. We then estimate Equation (1) using this composite indicator as the dependent variable for the polluters and non-polluters separately. Standard errors are double clustered at both the firm and bank levels. Table 11 reports the results.

As can be seen in Table 11, the coefficient estimates of the interaction term between *Treated* and *Post* are positive and significant for the subsample of polluters, while they are insignificantly different from zero for the non-polluters. The Chow-test results also reject the null hypothesis that the coefficients on the DiD term are the same between the two subsamples. This finding is consistent with tightened financial constraints for the polluting borrowers of TCFD-

member lenders due to the limited access to credit in the post-TCFD-establishment period driven by lenders' climate-related disclosure commitment.

(Insert Table 11 about here)

In Appendix C, we further investigate whether treated polluting firms experience a change in operating performance (*Profitability* and *Sales growth*) and firm value (*Tobin's Q*) relative to control polluting firms after the TCFD establishment. Given that we find treated polluting borrowers' environmental performance improves, while their financial constraints tighten, after the establishment of the TCFD, the overall effect of lenders' commitment to climate-related disclosure on operating performance and firm value is unclear ex ante. The DiD regression results in Appendix C show that treated firms' operating performance does not change relative to control firms after the TCFD establishment. However, we find that lenders' climate-related disclosure commitment has a net positive effect on the firm value of treated polluting borrowers, which is consistent with the findings of Dowell, Hart, and Yeung (2000) and Matsumura, Prakash, and Vera- Muñoz (2014) that improved corporate environmental performance leads to higher firm value.

V. Conclusion

The financial sector has been cast in the spotlight as the main financier of the fossil fuel sector that drives climate change. Investors, insurers, and other stake holders around the world are demanding the financial sector to take actions and help save the planet. While the role of the financial sector in addressing climate change is considered crucial (Wall Street Journal, 2021), the empirical evidence on financial institutions' environmental actions and their effectiveness in improving corporate environmental performance in the real sector is scant in the extant academic

literature. This study offers the first empirical evidence on the real effect of lenders' climate-related disclosure commitment via becoming members of the TCFD on the environmental performance of their borrower firms.

We find that lenders' climate-related disclosure commitment has led to a significant improvement in the corporate environmental performance of their borrowers, especially for the polluting borrowers. Moreover, we find that the effect of lenders' climate-related disclosure commitment on the corporate environmental performance of borrower firms is channeled through credit rationing, as we document a significant increase in the cost of borrowing and a tougher access to credit for polluting borrowers. Finally, we find that polluting borrowers of the TCFD-member lenders are more likely to be subject to financial constraints after the TCFD launch. Taken together, our empirical findings suggest that lenders' commitment to transparent climate-related disclosures can be an important driver of sustainable business environments—it does improve the allocation of bank financing and lead to a reduction in borrowers' polluting behavior.

From a policy perspective, our results are particularly relevant given the recent changes in the climate-related disclosure requirement in financial markets. For example, the EU has adopted the Sustainable Finance Disclosure Regulation which came into effect in 2021.[18] The findings of the study may be of interest to investors, academics and regulators.

[18] See https://www.eurosif.org/policies/sfdr.

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Figure 1

This figure reports the coefficient estimates of the interaction between *Treated* and year dummies from the regression reported in column 1 of Table 5.

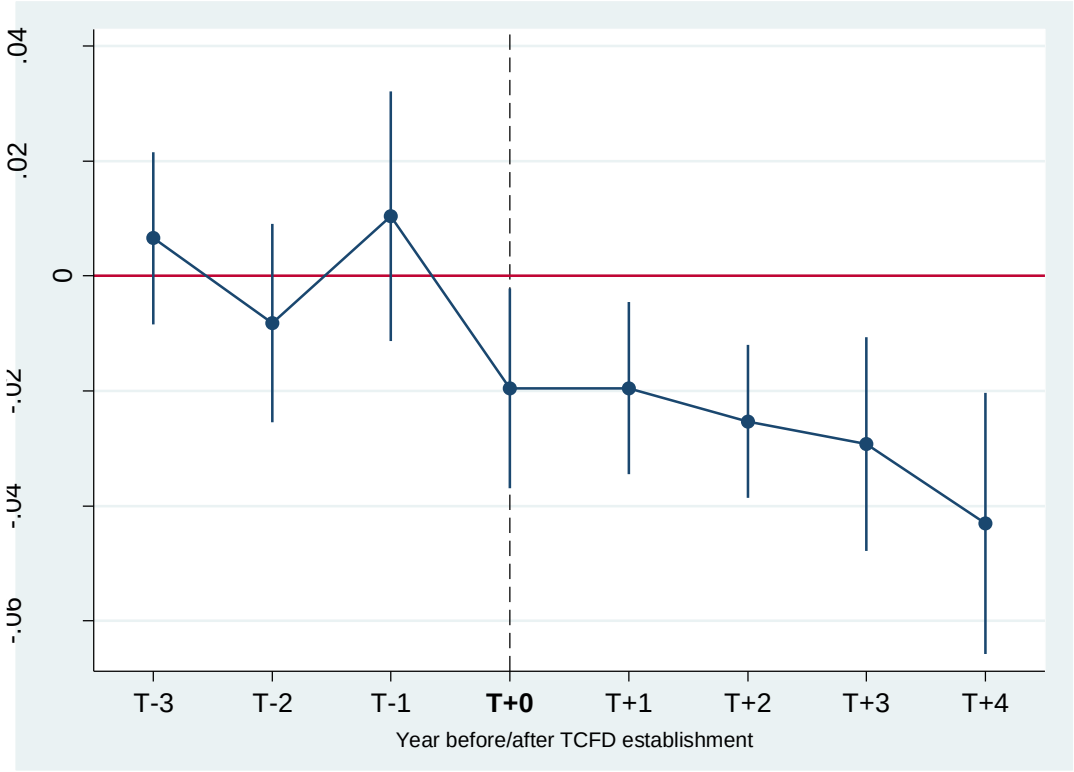

Table 1. Descriptive statistics

This table presents the summary statistics of the variables listed in Appendix A for the firm-year sample and the loan sample from 2012 to 2020.

	N	Mean	25th %	Median	75th %	Std
Panel A: Main sample						
Polluting behaviour						
Number of EPA enforcements	15,057	0.34	0.00	0.00	0.00	2.24
Number of EPA enforcements (Log)	15,057	0.11	0.00	0.00	0.00	0.37
EPA enforcement (Y/N)	15,057	0.09	0.00	0.00	0.00	0.29
Environment score	7,143	0.07	0.00	0.00	0.17	0.17
Total releases (in tons)	3,308	750.62	1.20	33.86	310.50	2271.25
Total releases (Log)	3,308	9.31	7.09	10.43	12.65	4.60
Borrower Characteristics						
Total assets (in $ millions)	15,057	12523.28	799.52	2351.17	8247.72	36280.56
Profitability	15,057	0.14	0.08	0.15	0.24	0.30
Tobin's Q	15,057	1.84	1.12	1.48	2.10	1.18
Leverage	15,057	0.32	0.17	0.29	0.43	0.21
Altman Z	15,057	1.94	0.96	1.95	3.03	2.00
Firm age	15,057	25.61	12.00	21.00	34.00	17.86
Sales growth	15,057	25.61	12.00	21.00	34.00	17.86
Polluter (Y/N)	15,057	0.29	0.00	0.00	1.00	0.45
Panel B: Loan sample						
Borrower Characteristics						
Total assets (in $ millions)	8,205	11648.55	1024.66	2783.33	8034.9	32311.99
Profitability	8,205	0.18	0.09	0.15	0.24	0.14
Tobin's Q	8,205	1.85	1.23	1.56	2.12	0.98
Leverage	8,205	0.33	0.19	0.31	0.46	0.21
Altman Z	8,205	2.27	1.21	2.12	3.15	1.58
Firm age	8,205	27.05	12	22	40	19.02
Polluter (Y/N)	8,205	0.38	0	0	1	0.48
Loan characteristics						
Spread	8,205	232.99	137.50	175.00	275.00	150.46
Loan size (in $ millions)	8,205	691.94	142.00	350.00	850.00	909.16
Maturity (in months)	8,205	55.62	54.00	60.00	60.00	18.45
Collateral (Y/N)	8,205	0.53	0.00	1.00	1.00	0.50
Number of lenders	8,205	8.65	4.00	7.00	12.00	6.39
Covenants (Y/N)	8,205	0.50	0.00	1.00	1.00	0.50
Relationship (Y/N)	8,205	0.60	0.00	1.00	1.00	0.49

Table 2. Regressions of EPA enforcements: Main test

This table reports the results from firm-level difference-in-differences regression analyses. The dependent variable in Columns 1 and 3 is *EPA enforcement*. The dependent variable in Columns 2 and 4 is *Number of EPA enforcements* (Log). In Columns 3 and 4, we further control for firm characteristics by including *Firm size* (Log), *Profitability*, *Tobin's Q*, *Leverage*, *Altman Z*, and *Firm age* (Log). All regressions include firm fixed effects and year fixed effects. *t*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. All variables are defined in Appendix A. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	EPA enforcement	*Number of EPA enforcements* (Log)	*EPA enforcement*	*Number of EPA enforcements* (Log)
TCFD client × Post TCFD	-0.03***	-0.04***	-0.03***	-0.04***
	(7.18)	(8.92)	(6.25)	(7.44)
Firm size (Log)			0.01**	0.01***
			(2.13)	(2.97)
Profitability			-0.002	-0.005
			(0.56)	(0.95)
Tobin's Q			0.004	0.004
			(1.64)	(1.50)
Leverage			-0.02	-0.02*
			(1.57)	(1.66)
Altman Z			-0.003	-0.002
			(1.48)	(0.85)
Firm age (Log)			0.01	0.04***
			(0.71)	(2.87)
Firm, year FE	Yes	Yes	Yes	Yes
Observations	15,057	15,057	15,057	15,057
Adjusted R^2	0.5262	0.6205	0.5261	0.6207

Table 3. Regressions of EPA enforcements: Dynamic DiD effects

This table reports the results from firm-level dynamic difference-in-differences regression analyses. The dependent variable in Columns 1 and 3 is *EPA enforcement*. The dependent variable in Columns 2 and 4 is *Number of EPA enforcements* (Log). All coefficients are measured relative to year 2012. In Columns 3 and 4, we further control for (unreported) firm characteristics as in Table 3. All regressions include firm fixed effects and year fixed effects. *t*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. All variables are defined in Appendix A. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	EPA enforcement	*Number of EPA enforcements* (Log)	*EPA enforcement*	*Number of EPA enforcements* (Log)
TCFD client × T-3	0.01	-0.01	0.01	-0.01
	(0.86)	(0.74)	(0.87)	(0.73)
TCFD client × T-2	-0.01	-0.01	-0.01	-0.01
	(0.95)	(1.31)	(0.94)	(1.27)
TCFD client × T-1	0.01	0.002	0.01	0.003
	(0.89)	(0.14)	(0.95)	(0.25)
TCFD client × T+0	-0.02**	-0.02**	-0.02**	-0.02**
	(2.25)	(2.49)	(2.22)	(2.42)
TCFD client × T+1	-0.02**	-0.04***	-0.02**	-0.04***
	(2.60)	(3.78)	(2.56)	(3.69)
TCFD client × T+2	-0.03***	-0.04***	-0.03***	-0.04***
	(4.14)	(4.96)	(3.76)	(4.57)
TCFD client × T+3	-0.03***	-0.04***	-0.03***	-0.04***
	(3.16)	(4.31)	(3.10)	(4.03)
TCFD client × T+4	-0.04***	-0.06***	-0.04***	-0.06***
	(3.68)	(4.41)	(3.75)	(4.41)
Firm characteristics	No	No	Yes	Yes
Firm, Year FE	Yes	Yes	Yes	Yes
Observations	17,000	17,000	17,000	17,000
Adjusted R^2	0.5312	0.6249	0.5311	0.6249

Table 4. Regressions of KLD environment score and toxic releases: Main test

This table reports the results from firm-level difference-in-differences regression analyses. The dependent variable in Columns 1 and 3 is *Total releases* (Log). The dependent variable in Columns 2 and 4 is *Environment score*. In Columns 3 and 4, we further control for firm characteristics as in Table 3. All regressions include firm fixed effects and year fixed effects. *t*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. All variables are defined in Appendix A. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Total releases (Log)	Environment score	Total releases (Log)	Environment score
TCFD client × Post TCFD	-0.29**	0.01***	-0.32**	0.01***
	(2.08)	(3.56)	(2.23)	(3.44)
Firm size (Log)			0.10	-0.03***
			(0.63)	(6.58)
Profitability			-0.48	0.01
			(0.42)	(0.45)
Tobin's Q			-0.15	-0.01
			(0.98)	(1.59)
Leverage			0.23	0.04*
			(0.27)	(1.78)
Altman Z			0.17	-0.0001
			(1.03)	(0.03)
Firm age (Log)			-0.84	-0.01
			(1.25)	(0.68)
Firm, year FE	Yes	Yes	Yes	Yes
Observations	3,308	7,143	3,308	7,143
Adjusted R^2	0.8390	0.6899	0.8391	0.6920

Table 5. Regressions of KLD environment score and toxic releases: Dynamic DiD effects

This table reports the results from firm-level dynamic difference-in-differences regression analyses. The dependent variable in Columns 1 and 3 is *Total releases* (Log). The dependent variable in Columns 2 and 4 is *Environment score*. All coefficients are measured relative to year 2012. In Columns 3 and 4, we further control for (unreported) firm characteristics as in Table 3. All regressions include firm fixed effects and year fixed effects. *t*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. All variables are defined in Appendix A. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Total releases (Log)	Environment score	Total releases (Log)	Environment score
TCFD client × T-3	-0.06	0.004	-0.05	0.004
	(0.98)	(0.63)	(0.88)	(0.62)
TCFD client × T-2	-0.11	-0.003	-0.11	-0.004
	(0.95)	(0.53)	(0.99)	(0.61)
TCFD client × T-1	-0.21	0.002	-0.21	0.001
	(1.21)	(0.16)	(1.27)	(0.08)
TCFD client × T-0	-0.04	0.01*	-0.04	0.01*
	(0.30)	(1.96)	(0.39)	(1.85)
TCFD client × T+1	-0.32**	0.02**	-0.33**	0.02**
	(2.46)	(2.25)	(2.53)	(2.34)
TCFD client × T+2	-0.31**	0.02***	-0.33**	0.01***
	(2.03)	(2.99)	(2.21)	(2.73)
TCFD client × T+3	-0.26		-0.29	
	(1.52)		(1.67)	
TCFD client × T+4	-0.73**		-0.75**	
	(2.08)		(2.06)	
Firm characteristics	No	No	Yes	Yes
Firm, year FE	Yes	Yes	Yes	Yes
Observations	3,729	8,206	3,729	8,206
Adjusted R^2	0.8476	0.6998	0.8476	0.7017

Table 6. Regressions of EPA enforcements using subsamples

This table reports the results from firm-level difference-in-differences regression analyses using the polluter and non-polluter subsamples. The dependent variables in columns 1 to 4 are *EPA enforcement, Number of EPA enforcements* (Log), *Total releases* (Log), and *Environment score,* respectively. We control for (unreported) firm characteristics as in Table 3. All regressions include firm fixed effects and year fixed effects. *t*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. All variables are defined in Appendix A. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. '*F*-statistic of difference' and '*P*-value of difference' reports the *F*-statistic and *P*-value of the chow test testing the null hypothesis that the coefficients on the *TCFD client* × *Post TCFD* term are the same between the two subsamples.

	EPA enforcement	*Number of EPA enforcements* (Log)	*Total releases* (Log)	*Environment score*
Subsample (polluters)				
TCFD client × *Post TCFD*	-0.06***	-0.08***	-0.36**	0.03***
	(4.49)	(5.65)	(2.62)	(5.60)
Observations	4,357	4,357	2,389	2,659
Adjusted R^2	0.3963	0.5387	0.8204	0.6670
Subsample (non-polluters)				
TCFD client × *Post TCFD*	0.001	0.001	-0.17	-0.003
	(0.70)	(1.03)	(0.42)	(0.49)
Observations	10,700	10,700	919	4,484
Adjusted R^2	0.0381	0.0231	0.8726	0.7092
Firm, year FE	Yes	Yes	Yes	Yes
F-statistic of difference	25.02	38.53	0.20	18.30
P-value of difference	0.0000	0.0000	0.6534	0.0000

Table 7. Regressions of loan spreads

This table reports the results from loan-level difference-in-differences regression analyses using the polluter and non-polluter subsamples. The dependent variable is *Spread* (Log). In Columns 1, the regressions include firm fixed effects and bank fixed effects. In Columns 2, we control for firm-bank-pair fixed effects. All regressions include fixed effects for year, loan type, and loan purpose. *t*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. All variables are defined in Appendix A. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. '*F*-statistic of difference' and '*P*-value of difference' reports the *F*-statistic and *P*-value of the chow test testing the null hypothesis that the coefficients on the *TCFD arranged*× *Post TCFD* term are the same between the two subsamples.

	Spread (Log)	*Spread* (Log)
Subsample (polluters)		
TCFD arranged× *Post TCFD*	0.08**	0.08***
	(2.29)	(3.54)
Observations	3,077	3,077
Adjusted R^2	0.7630	0.7977
Subsample (non-polluters)		
TCFD arranged× *Post TCFD*	0.01	-0.003
	(0.35)	(0.07)
Observations	5,128	5,128
Adjusted R^2	0.7640	0.7654
Firm, bank FE	Yes	No
Firm- bank FE	No	Yes
Year, loan type, loan purpose FE	Yes	Yes
F-statistic of difference	2.74	3.69
P-value of difference	0.0997	0.0567

Table 8. Regressions of non-price loan terms

This table reports the results from loan-level difference-in-differences regression analyses using the polluter and non-polluter subsamples. The dependent variables in columns 1 to 5 are *Loan size* (Log), *Maturity* (Log), *Collateral*, *Number of lenders* (Log), and *Covenant*, respectively. All regressions include fixed effects for firm, bank, year, loan type, and loan purpose. *t*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. '*F*-statistic of difference' and '*P*-value of difference' reports the *F*-statistic and *P*-value of the chow test testing the null hypothesis that the coefficients on the *TCFD arranged× Post TCFD* term are the same between the two subsamples.

	Loan size (Log)	*Maturity* (Log)	*Collateral*	*Number of lenders* (Log)	*Covenant*
Subsample (polluters)					
TCFD arranged× Post TCFD	0.11	0.03	-0.03	-0.01	-0.05
	(1.07)	(1.21)	(0.84)	(0.18)	(0.85)
Observations	3,077	3,077	3,077	3,077	3,077
Adjusted R^2	0.6217	0.7149	0.7096	0.5837	0.5204
Subsample (non-polluters)					
TCFD arranged× Post TCFD	0.01	0.03	-0.01	-0.06	-0.02
	(0.08)	(1.12)	(0.37)	(1.11)	(0.29)
Observations	5,128	5,128	5,128	5,128	5,128
Adjusted R^2	0.6191	0.6397	0.6744	0.6026	0.5719
Firm. bank, year, loan type, loan purpose FE	Yes	Yes	Yes	Yes	Yes
F-statistic of difference	0.41	0.02	1.67	0.01	1.00
P-value of difference	0.5232	0.8874	0.1977	0.9296	0.3179

Table 9. Regressions of bank loan flows pre vs. post the TCFD establishment

This table reports the results from firm-bank-pair-level difference-in-differences regression analyses using the polluter and non-polluter subsamples. The dependent variables in columns 1 to 3 are *Loans in pre- or post-treatment period (Y/N)*, *Number of loans in pre- or post-treatment period*, and natural algorithm of one plus *Amount of loans in pre- or post-treatment period*, respectively. All regressions include firm-bank-pair fixed effects and firm-year fixed effects. *t*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. '*F*-statistic of difference' and '*P*-value of difference' reports the *F*-statistic and *P*-value of the chow test testing the null hypothesis that the coefficients on the *TCFD arranged*× *Post TCFD* term are the same between the two subsamples.

	Loans in pre- or post-period (Y/N)	*Number of loans in pre- or post-period* (Log)	*Amount of loans in pre- or post-period* (Log)
Subsample (polluters)			
TCFD client × *Post TCFD*	-0.15**	-0.19**	-4.12**
	(2.11)	(2.42)	(2.31)
Observations	2,082	2,082	2,082
Subsample (non-polluters)			
TCFD client × *Post TCFD*	-0.01	-0.01	-0.29
	(0.11)	(0.22)	(0.19)
Observations	6,988	6,988	6,988
Firm-bank FE	Yes	Yes	Yes
Firm-period FE	Yes	Yes	Yes
F-statistic of difference	2.50	4.16	2.74
P-value of difference	0.1149	0.0423	0.0991

Table 10. Regressions of aggregate loan supply to polluters pre vs. post the TCFD establishment

This table reports the results from bank-level regression analyses. In Column 1, the dependent variable is *Δ Yearly mean number of loans granted to polluters – pre- vs. post- treatment period*. In Column 2, the dependent variable is *Δ Yearly mean number of loans (arranged) granted to polluters – pre- vs. post- treatment period*. *t*-statistics are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Δ Yearly mean amount of loans in million granted to polluters - pre vs. post TCFD	*Δ Yearly mean amount of loans in million (arranged) granted to polluters - pre vs. post TCFD*
TCFD member (Y/N)	-0.05**	-0.05**
	(1.98)	(2.02)
Intercept	Yes	Yes
Observations	462	462
Adjusted R^2	0.0063	0.0067

Table 11. Regressions of financial constraints

This table reports the results from firm-level difference-in-differences regression analyses using the polluter and non-polluter subsamples. The dependent variable is *Financial constraint*. In Columns 2, we control for firm characteristics by including *Firm size* (Log), *Profitability*, *Tobin's Q*, *Leverage*, *Altman Z*, and *Firm age* (Log). All regressions include firm fixed effects and year fixed effects. *t*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. All variables are defined in Appendix A. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. '*F*-statistic of difference' and '*P*-value of difference' reports the *F*-statistic and *P*-value of the chow test testing the null hypothesis that the coefficients on the *TCFD arranged*× *Post TCFD* are the same between the two subsamples.

	Financial constraint	*Financial constraint*
Subsample (polluters)		
Treated × *Post*	0.10***	0.08***
	(3.61)	(3.98)
Observations	4,085	4,085
Adjusted R^2	0.5761	0.6173
Subsample (non-polluters)		
Treated × *Post*	-0.004	0.01
	(0.49)	(0.53)
Observations	10,210	10,210
Adjusted R^2	0.6396	0.6592
Firm characteristics	No	Yes
Firm, year FE	Yes	Yes
F-statistic of difference	15.20	14.33
P-value of difference	0.0001	0.0002

Appendix A. Variable Definitions

Variable Name	Definition	Source
Task Force on Climate-related Financial Disclosures (TCFD)		
Treated	An indicator variable that equals one if the firm has been granted a loan lead-arranged by the TCFD member in the pre-TCFD launch period (between 2012 and 2015) and zero otherwise.	Compustat, Dealscan
Post	An indicator variable that equals one if the observation year is in the post-TCFD launch period (between 2017 and 2020) and zero otherwise.	Compustat, Dealscan
TCFD arranged	An indicator variable that equals one if the loan is lead-arranged by the TCFD member and zero otherwise.	Compustat, Dealscan
TCFD member	An indicator variable that equals one for the firm-bank pair where the bank is a TCFD member and zero otherwise.	Compustat, Dealscan
Environmental performance		
Number of EPA enforcements	Number of EPA enforcement actions (Judicial, formal, and informal) against the firm in the given year.	EPA
EPA enforcement	An indicator variable that equals one if the firm is subject to EPA enforcement actions (Judicial, formal, and informal) in the given year and zero otherwise.	EPA
Environment score	Number of environment strengths divided by maximum possible strengths - number of environment concerns divided by maximum possible concerns.	Kinder, Lydenberg, and Domini Research & Analytics (KLD)
Total releases	Aggregate amount of toxic releases (in tons).	EPA TRI program
Firm characteristics		
Firm size	Log of book value of assets of the firms (in $ millions).	Compustat
Profitability	Ratio of earnings before interest, taxes, depreciation, and amortization to sales from the year preceding loan initiation.	Compustat
Tobin's Q	Ratio of (book value of assets − book value of equity + market value of equity) to book value of assets.	Compustat
Leverage	Ratio of book value of debt (total) to book value of assets.	Compustat

<Appendix A continued>

Variable Name	Definition	Source
Firm characteristics		
Altman Z	1.2 (Net working capital/Total assets) + 1.4 (Retained earnings/Total assets) + 3.3 (Earnings before interest and taxes/Total Assets) + 0.6 (Market value of equity/Book value of liabilities) + 1.0 (Sales/Total assets).	Compustat
Firm age	Number of years since the first appearance in the Compustat database.	Compustat
Financial constraints	An indicator variable that equals one if majority of the constraint indexes are above median and zero otherwise; the constraint measures include Kaplan-Zingales, Hadlock-Pierce, and Whited-Wu.	Compustat
Sales growth	Sales / lagged (one year) Sales - 1.	Compustat
Polluter	A binary variable that equals one if the firm has previously been subject to EPA enforcement actions (judicial, formal, and informal) in the years prior to the TCFD establishment and zero otherwise.	EPA
Loan		
Spread	Amount the borrower pays in basis points over LIBOR for each dollar drawn down.	Dealscan
Loan size	The total size of the facility committed (in $ millions).	Dealscan
Maturity	Time to maturity (in months) at issuance.	Dealscan
Collateral	An indicator variable that equals one if the facility is secured and zero otherwise.	Dealscan
Number of lenders	Number of participants (including lead arranger) in the facility.	Dealscan
Covenants	An indicator variable that equals one if the facility has any covenant and zero otherwise.	Dealscan
Relationship	An indicator variable that equals one if the borrower received a loan arranged by the lender in the past five years and zero otherwise. See Bharath, Dahiya, Saunders, and Srinivasan (2011).	Dealscan
Loans in pre- or post-period	An indicator variable that equals one if there is at least one loan between the lender-borrower pair in each (pre- or post-TCFD-establishment) period.	Dealscan
Number of loans in pre- or post-period	Total number of loans between the lender-borrower pair in each (pre- or post-TCFD-establishment) period.	Dealscan
Amount of loans in pre- or post-period	Total amount of loans between the lender-borrower pair in each (pre- or post-TCFD-establishment) period.	Dealscan

Appendix B. Robustness tests

This table reports the results from firm-level difference-in-differences regression analyses. The dependent variable in Columns 1 and 5 is *EPA enforcement*. The dependent variable in Columns 2 and 6 is *Number of EPA enforcements* (Log). The dependent variable in Columns 3 and 7 is *Total releases* (Log). The dependent variable in Columns 4 and 8 is *Environment score*. Columns 1-4 report the results using a subsample excluding firms that have been granted multiple loans or a loan with multiple lead arrangers during the pre-event period (2012-2015); Columns 5-8 report the results using a subsample excluding treated firms that have been granted any loan arranged by the non-TCFD-member banks during the post-event period (2017-2020). We control for (unreported) firm characteristics as in Table 3. All regressions include firm fixed effects and year fixed effects. *T*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. All variables are defined in Appendix A. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Excluding the sample of firms that received multiple loans or loans with multiple lead arrangers during the pre-event period				Excluding the sample of treated firms that have switched to (received any loan from) non-TCFD-member banks post-event			
	EPA enforcement	*Number of EPA enforcements* (Log)	*Total releases* (Log)	*Environment score*	*EPA enforcement*	*Number of EPA enforcements* (Log)	*Total releases* (Log)	*Environment score*
TCFD client × Post TCFD	-0.03***	-0.03***	-0.45**	0.02***	-0.03***	-0.03***	-0.30**	0.01*
	(4.88)	(6.24)	(2.25)	(5.63)	(5.00)	(6.91)	(2.02)	(1.83)
Firm characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm, year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,320	10,320	2,118	5,018	14,128	14,128	3,001	6,598
Adjusted R^2	0.4907	0.5776	0.8165	0.6694	0.5228	0.6099	0.8369	0.6958

Appendix C. Regressions of operating performance and firm value

This table reports the results from firm-level difference-in-differences regression analyses using the polluter and non-polluter subsamples. The dependent variables in Columns 1 to 3 are *Profitability*, *Sales growth*, and *Tobin's Q*, respectively. All regressions include firm fixed effects and year fixed effects. *t*-statistics are reported in parentheses and are calculated with standard errors double clustered at both the firm and bank levels. All variables are defined in Appendix A. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. '*F*-statistic of difference' and '*P*-value of difference' reports the *F*-statistic and *P*-value of the chow test testing the null hypothesis that the coefficients on the *TCFD client* × *Post TCFD* term are the same between the two subsamples.

	Profitability	*Sales growth*	*Tobin's Q*
Subsample (polluters)			
TCFD client × *Post TCFD*	0.02	0.005	0.13***
	(0.70)	(0.44)	(3.23)
Observations	4,357	4,357	4,357
Adjusted R^2	0.4103	0.2143	0.6922
Subsample (non-polluters)			
TCFD client × *Post TCFD*	-0.13	0.21	0.09
	(1.29)	(1.30)	(1.58)
Observations	10,700	10,700	10,700
Adjusted R^2	0.4165	-0.0218	0.3612
Firm characteristics	No	No	No
Firm, year FE	Yes	Yes	Yes
F-statistic of difference	1.87	1.64	0.28
P-value of difference	0.1734	0.2028	0.5984

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