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journal homepage: www.journals.elsevier.com/journal-of-accounting-and-economicsPublic environmental enforcement and private lender monitoring: Evidence from environmental covenants[☆]Stacey Choy^a, Shushu Jiang^b, Scott Liao^{a, *}, Emma Wang^c^a Rotman School of Management, University of Toronto, Canada^b NUS Business School, National University of Singapore, Singapore^c Charles H. Dyson School of Applied Economics and Management, Cornell University, United States

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1. Introduction

Public regulatory enforcement represents the primary force in compelling firms to internalize the negative externalities of environmental pollution (e.g., Greenstone, 2002; Stafford, 2003; Earnhart, 2004). However, such enforcement may not be sufficient to tackle the rapidly growing environmental challenges due to resource constraints or regulatory capture. As a result, there has been an increasing call for joint efforts between public and private sectors to address environmental issues.¹ Yet, how public and private environmental monitoring interact in reducing corporate pollution remains unclear. In this study, we fill this gap by examining whether and how public environmental enforcement affects private lenders' environmental monitoring efforts and the effectiveness of such monitoring in curbing corporate pollution. We focus on private lender monitoring due to the importance of sustainable finance in achieving green environment and the ability of lenders to affect borrowers' operations via loan covenants (Roberts and Sufi, 2009; Conley and Williams, 2011; Chava et al., 2019).

Lenders can use three major types of covenants to monitor their borrowers' environmental activities (environmental covenants, hereafter): 1) *disclosure* covenants require borrowers to disclose material environmental matters to lenders or discuss environmental matters with lenders upon lenders' request, 2) *action* covenants require borrowers to actively remedy or prevent environmental damages, and 3) *audit* covenants require borrowers to hire professionals to conduct environmental

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¹ For example, the United Nations Environment Programme calls for private businesses to partner with governments to solve environmental challenges. See <https://www.unep.org/about-un-environment/private-sector-engagement>.

audits. Disclosure and audit covenants are designed to help lenders obtain information to assess and address environmental risks in a timely fashion, whereas action covenants are designed to prevent violations of environmental laws and reduce liabilities in the event of violations.²

We argue that public environmental enforcement may incentivize lenders to monitor their borrowers' polluting activities by increasing the benefits of monitoring. First, borrowers' environmental liabilities and credit risks may increase with public enforcement intensity because stringent regulators are more likely to detect environmental violations and penalize borrowers. Hence, the benefit of lender monitoring in reducing borrowers' environmental liabilities increases with public enforcement intensity, especially in case of highly polluting borrowers. Second, public enforcement may increase lender environmental liabilities directly because lenders deemed as management may be held accountable for cleaning up contamination on real property used as loan collateral. Therefore, the benefit of lender monitoring in reducing their own exposure to environmental liabilities also increases with public enforcement intensity.³

We further expect public environmental enforcement to enhance the effectiveness of lender monitoring in reducing borrowers' polluting activities. Specifically, regulators' timely detection of borrowers' environmental violations can assist lenders in monitoring borrowers' compliance with environmental covenants (La Porta et al., 2006; Jackson and Roe, 2009). For example, regulators' public disclosure of environmental violations may prompt lenders to request that borrowers provide additional information, conduct audits on environmental activities, and perform immediate remedial actions to control pollution and minimize environmental liabilities.

We test our predictions using a sample of 2073 loan facilities from 1997 to 2016. To measure lender monitoring, we collect loan agreements from firms' 10-K, 10-Q, and 8-K filings and extract environmental covenants from the affirmative covenant section. We find that 41.8% of loans in our sample include at least one environmental covenant, suggesting that they are prevalent but not ubiquitous in loan contracts. Of those, 50.9% use only disclosure covenants, compared to 7.5% that use only action covenants; 28.5% of contracts bundle disclosure covenants with either action or audit covenants; and 13.1% include all three types of covenants. Following prior research (Konisky, 2007; Seltzer et al., 2022), we capture public environmental enforcement intensity, measured as the average number of environmental inspection and enforcement actions per manufacturing facility within a state in a given year. We use plant-chemical-level toxic release data from the Toxics Release Inventory (TRI) database maintained by the Environmental Protection Agency (EPA) to capture borrowers' polluting activities.

We first explore how public enforcement affects the use of environmental covenants in loan contracts. Consistent with the prediction that stringent public enforcement strengthens lenders' monitoring incentives, we find that borrowers facing higher regulatory intensity are more likely to have environmental covenants when they are more polluting or when their loans use real property collateral. Next, we examine whether stringent public enforcement enhances the effectiveness of lender monitoring in curbing borrowers' polluting activities. To address the selection bias in the use of environmental covenants, we conduct analyses based on a coarsened exact matched (CEM) sample, where we match loans with environmental covenants and those without using firm size, state enforcement intensity, membership in polluting industries, real property collateral, and loan initiation year (Iacus et al., 2012). We find that borrowers with environmental covenants experience a larger reduction in toxic chemical releases after loan initiation when exposed to higher versus lower enforcement intensity, suggesting that stringent public enforcement enhances the effectiveness of lender monitoring.

We further strengthen our inference on the effects of public enforcement on the effectiveness of private lender monitoring by exploiting two settings in which we can better identify variation in public enforcement that is unlikely driven by local confounding factors, such as economic conditions. First, we use counties' nonattainment status designation under the Clean Air Act (CAA) as a setting that increases county-level environmental enforcement. The federal EPA classifies each county as either an attainment or a nonattainment region every year based on its releases of pollutants regulated under the CAA's National Ambient Air Quality Standards. Polluting plants in nonattainment counties face stricter regulatory enforcement (Becker and Henderson, 2000; Greenstone, 2002). As county-level nonattainment status is mandated at the federal level, it is less likely to be affected by local factors. We find that environmental covenants are more effective in reducing borrowers' emissions of air pollutants regulated under the CAA for borrowers located in nonattainment counties compared to those located in attainment counties. Moreover, our falsification analyses find no significant difference in the effectiveness of environmental covenants in reducing emissions of the non-CAA regulated pollutants between the two groups, further ruling out potential omitted local factors.

In our second setting, we exploit variation in state environmental enforcement after close congressional elections, defined as elections with a margin of victory of the winning candidate of less than 5% (Akey, 2015; Heitz et al., 2021). In addition to systematic factors such as candidates' political and electoral experience (e.g., Lee, 2008), prior research suggests that close election outcomes are also partially attributable to random factors that could affect voter behaviors such as weather, natural disasters, outcomes of sporting events, and ballot order (e.g., Ho and Imai, 2008; Lee, 2008; Healy et al., 2010; Bassi, 2019).

² See Section 2.2.2 for examples of the three types of environmental covenants. Lenders may include environmental compliance covenants that require borrowers to comply with environmental laws. We do not examine such covenants because loan contracts usually include a general affirmative covenant requiring borrowers to comply with all laws.

³ Our prediction is not without tension. Lender monitoring may decrease if stringent public enforcement reduces lenders' monitoring benefits by improving borrowers' environmental performance and reducing financial and reputation risks borne by lenders (Greenstone, 2002; Shimshack and Ward, 2005; Shimshack, 2014; Lim, 2016; Blundell et al., 2020).

Therefore, this setting contains variation in states' partisan composition of congressional representatives that is unlikely to be correlated with local economic or cultural factors. Consistent with the notion that congressional members can systemically affect local enforcement (Scholz et al., 1991) and that Democrat congressional representatives tend to be more committed to addressing environmental issues than Republicans (Shipan and Lowry, 2001; Egan, 2013; Egan and Mullin, 2017; Ballew et al., 2019), we find that borrowers with environmental covenants and located in states where a Democrat won a recent close congressional election experience a significantly larger reduction in toxic chemical releases after loan initiation. Though neither setting is perfect in addressing endogeneity concerns, our findings collectively support the idea that stringent public enforcement enhances the effectiveness of private lender monitoring.

We conduct several supplemental analyses on mechanisms to corroborate our inferences. First, we show that the effects of public enforcement on enhancing lenders' environmental monitoring efforts and the effectiveness of lender monitoring are stronger when borrowers have higher bankruptcy risks. This finding suggests that lenders' concerns over credit risks are an important mechanism explaining the interplay between public enforcement and lender monitoring. Second, we provide evidence on emission-reduction channels. Specifically, we show that borrowers with environmental covenants are more likely to invest in pollution abatement involving product modifications when they are located in states with higher enforcement. This finding triangulates the result of pollution reduction in the presence of lender monitoring and stringent public enforcement. Third, we explore the bundling of environmental covenants and find that borrowers in higher enforcement states reduce more emissions when their loan contracts bundle disclosure covenants with audit or action covenants, or both. Last, we find that the effects of public enforcement on the effectiveness of environmental covenants are robust after controlling for financial and general covenants. We also fail to find evidence that financial or general covenants reduce borrowers' toxic releases or increase borrowers' abatement investments, regardless of public enforcement stringency. This finding further supports the unique role of environmental covenants in lenders' environmental monitoring.

This paper contributes to the literature in multiple ways. First, it extends the literature on the interaction between public enforcement and private monitoring in addressing environmental issues. Prior studies focus on the interplay between public and private environmental enforcement through citizen lawsuits, non-profit organizations, and industry self-regulation (Heyes and Rickman, 1999; Langpap, 2007; Langpap and Shimshack, 2010; Short and Toffel, 2010; Potoski and Prakash, 2013). We show that public enforcement also induces and facilitates private lender monitoring. Our results suggest that such monitoring is an important channel through which public enforcement compels firms to internalize environmental externalities. Our paper also adds to the broader literature on public enforcement of other regulations, such as SEC enforcement of securities laws, and its interaction with private monitoring (Djankov et al., 2003; La Porta et al., 2006; Jackson and Roe, 2009; Glaum et al., 2018; Hutton et al., 2022).

Second, this paper extends the emerging literature on the role of private lenders in sustainable finance by focusing on their monitoring mechanisms in loan covenants (Conley and Williams, 2011; Park, 2018; Dyck et al., 2019; Houston and Shan, 2022; Krueger et al., 2020; Gillan et al., 2021; Raghunandan and Rajgopal, 2022). Ohlrogge (2022) finds that firms' credit access is tightened after the court rules that the cleanup cost is not dischargeable in bankruptcy. He also provides qualitative evidence that lenders impose environmental audit covenants after this ruling to limit environmental risks. Amiram et al. (2023) argue that firms pay lower loan spreads by committing to mitigating ESG concerns, where commitment is captured by the use of environmental covenants in bank loans. Lee and Zakota (2022) also examine loan environmental covenants and find that lenders use environmental covenants to mitigate environmental risks. Different from these studies, we focus on the interplay between public environmental enforcement and private environmental monitoring and highlight that lender environmental monitoring is more effective in the presence of stronger public enforcement. We further expand the literature by providing a novel approach to capture lenders' environmental monitoring efforts.

Third, our study adds to the growing literature examining factors that affect corporate pollution, such as firm financial constraints (Kim and Xu, 2022) and parent company environmental liability exposure (Akey and Appel, 2021). In addition, we expand the literature on how stakeholders, such as shareholders (Dimson et al., 2015; Dyck et al., 2019; Akey and Appel, 2020; Krueger et al., 2020), customers (Schiller, 2018; Dai et al., 2021), and environmental activists (Naaraayanan et al., 2021), shape corporate environmental practices. Our paper advances this stream of literature by documenting that the private lenders' monitoring through environmental covenants, in the presence of strict public environmental enforcement, curbs corporate pollution.

2. Literature review and hypothesis development

2.1. Public environmental enforcement and environmental liabilities

Current U.S. environmental regulations adopt a "polluter pays" principle to compel firms to internalize environmental externalities. The EPA holds parties responsible for their pollution with legal liabilities, including obligations to pay penalties, perform environmental cleanup, and refrain from polluting in the future (Bledsoe and Hamilton, 2010). These liabilities are economically significant. Kim and Xu (2022) show that, from 1990 to 2014, about 57% of investigations by

environmental regulatory agencies resulted in legal liabilities, with an average of \$6.75 million per case. They also find that cleanup and compliance costs are the most significant environmental liabilities, amounting to about \$21 million and \$14 million, respectively. For extensive contamination or contamination sites located in highly populated areas, cleanup costs can reach hundreds of millions or even billions of dollars (Ohlrogge, 2022). Though environmental laws are mostly set at the federal level, enforcement is typically carried out by state and local authorities. Thus, differences in industrial composition, regulatory resources, political environment, and environmental preferences of the authorities can generate regional variations in regulatory enforcement (Konisky, 2007; Shimshack, 2014; Grooms, 2015; Innes and Mitra, 2015).

2.2. Lender monitoring of environmental activities

2.2.1. Lenders' financial and reputation risks in relation to borrowers' polluting activities

Borrowers' polluting activities may increase lenders' financial and reputational risks. Lenders are more likely to suffer financial losses when they or their borrowers are exposed to environmental liabilities. First, borrowers' environmental liabilities may increase their default risk. In the case of bankruptcy, such liabilities may dilute lenders' claims because some environmental claims, such as cleanup obligations, are not dischargeable (Ohlrogge, 2022). Second, lenders deemed as management may be liable for any contamination on real property that was pledged as collateral.⁴

Lenders also face higher financial risks when borrowers' polluting activities result in worse business prospects and lower creditworthiness. Recent research shows that environmental policies can propagate from customers to suppliers (Schiller, 2018; Dai et al., 2021). Polluting firms may lose market share if their customers demand more environmentally friendly suppliers. As a result, borrowers with poor environmental profiles may find it more challenging to survive in a market with a growing emphasis on sustainability. In addition to financial risks, financing polluting borrowers creates reputation risks for lenders. Public demand for responsible lending has grown rapidly in recent years. For example, there has been an increasing number of environmental-related proposals from social-minded investors and depositors requesting that banks adjust their lending portfolios to tackle climate change.⁵

2.2.2. Environmental covenants

To lower the financial and reputational risks arising from borrower pollution, lenders may use environmental covenants to monitor borrowers' polluting activities. We identify three major types of environmental covenants used in loan contracts: 1) *disclosure* covenants require borrowers to disclose material environmental matters to lenders or discuss such matters upon lenders' request, 2) *action* covenants require borrowers to avoid or remediate environmental damages, and 3) *audit* covenants require borrowers to hire professionals to conduct environmental audits. These covenants make polluting activities more costly for borrowers. For example, when lenders detect non-compliance with environmental covenants, they may renegotiate stricter loan terms, call back the loan, stop providing additional loans, or freeze the line of credit.⁶ Moreover, borrowers may face criminal charges for "knowing violations" if they continue polluting after lenders uncover environmental violations through these covenants. In Appendix A, we provide an example of a prototypical loan contract that includes all three environmental covenants.⁷

2.2.3. Effect of environmental enforcement on lender environmental monitoring

2.2.3.1. *Incidence of lender environmental monitoring.* Public environmental enforcement may increase the benefits of monitoring borrowers' polluting activities, thus increasing lenders' incentive to monitor. First, stringent environmental enforcement increases lenders' exposure to their own or borrowers' environmental liabilities, thereby incentivizing lender monitoring of borrowers. When public enforcement is stronger, polluting borrowers are more likely to face environmental liabilities, and lenders, especially those considered to be involved in management, also may face liabilities if any real property collateral is polluted. As a result, the benefits and incentives of monitoring may increase with public enforcement intensity for a high-polluting borrower and for loans collateralized by real property. The tension of this prediction is that public enforcement may improve borrowers' environmental profiles and in turn, decrease the benefits of environmental monitoring among lenders. If public enforcement effectively deters borrowers' polluting activities, lenders may be less concerned about environmental liabilities and their effect on borrower credit risk.

⁴ Although the 1996 Lender Liability Act exempts lenders from environmental liabilities when they are not the owner or operator of the real property, lenders may still be liable if their activities related to real property collateral constitute "participation in management."

⁵ For example, in 2019, a group of investors filed climate-focused resolutions requiring banks to reduce their financing of fuel companies. See. In the Dakota Access Pipeline protest, protestors boycotted banks that financed pipeline construction, pressuring them to halt lending to the project. Indeed, Homanen (2018) finds that these banks experienced significant decreases in deposit growth.

⁶ For example, in a loan agreement between Catchmark Timber Operating Partnership, LP, and its lenders, the lenders can terminate the loan in the event of non-performance of environmental covenants. See <https://www.sec.gov/Archives/edgar/data/1341141/000119312514457083/d843067dex101.htm>.

⁷ We calculate cosine similarity for environmental covenants among all loan contracts and present the loan contract with the highest cosine score as the prototypical example.

2.2.3.2. *Effectiveness of lender environmental monitoring.* We also expect lender environmental monitoring to be more effective in the presence of stringent public enforcement due to timely detection of environmental violations. Despite lenders' access to private information, obtaining information on non-compliance with environmental covenants could be difficult if borrowers do not truthfully disclose their environmental performance to their lenders. However, the EPA publicly discloses environmental violations within a few days of detection, which assists lenders in monitoring borrowers' compliance with environmental covenants (La Porta et al., 2006; Jackson and Roe, 2009). Public disclosure of violations allows lenders to request additional information based on the disclosure covenants and conduct inspections based on the audit covenants, which may further discipline borrowers' polluting activities and ensure compliance with environmental laws. Lenders may also require that borrowers take appropriate remedial and preventive actions based on the action covenants. We therefore expect stringent public enforcement to increase the effectiveness of lenders' monitoring.

3. Sample and data

3.1. Loan sample and environmental covenants

Our analyses focus on private loan agreements collected from SEC filings. We begin with a sample of loans issued between 1997 and 2016 in DealScan whose issuers can be matched to firms in Compustat.⁸ For matched loans, we then search 10-K, 10-Q, and 8-K SEC filings for loan agreements using an extended list of keywords adapted from Nini et al. (2009) and Beatty et al. (2019). To ensure accurate matching between loan agreements and DealScan loans, we retain only those credit agreements signed within 30 days of the loan initiation date (Jiang, 2023). When extracting environmental covenants from loan agreements, we first restrict our search to loan agreements that contain the keyword "environmental" or "hazard." We then search whether any text patterns identified as environmental covenants appear within 35,000 characters (i.e., a typical length of an affirmative covenant section) from the beginning of the affirmative covenant section.⁹ See Appendix B for lists of keywords. We also extract data on real property collateral from loan agreements because DealScan is incomplete regarding collateral type information.

3.2. State regulatory enforcement intensity

We obtain inspection and enforcement data from the Integrated Compliance Information System for Federal Civil Enforcement Case Data in the EPA's Enforcement and Compliance History Online database. We use data on inspections and administrative and judicial enforcement actions taken by the EPA under all environmental statutes.¹⁰ To measure state-level regulatory enforcement intensity, we normalize the total number of inspections and enforcement actions in a state by the total number of TRI-reporting facilities, following Seltzer et al. (2022). We exclude inspection or enforcement actions on focal borrowers when aggregating state-level enforcement intensity.

3.3. Borrowers' polluting activities

To measure changes in borrowers' polluting activities after loan initiation, we use data on total toxic releases obtained from TRI, which provides the most granular data on corporate pollution at the plant-chemical level and is widely used in research (Akey and Appel, 2021; Naaraayanan et al., 2021; Kim and Xu, 2022). Chemicals covered in TRI include those causing cancers and other chronic or significant adverse human health or environmental effects. Firms covered in TRI belong to manufacturing, metal mining, electric power generation, chemical manufacturing, and hazardous treatment industries.¹¹ Following prior research (Akey and Appel, 2021; Kim and Xu, 2022), we drop observations with zero ground, water, and air emissions. To compare firms borrowing from the same lead lender, we further restrict our sample to loans with one lead lender.¹² After mapping loan contracts to the TRI sample and removing observations with missing data, we have 2073 loan facilities in our sample.

⁸ We begin our sample period in 1997 because the Lender Liability Act, passed in 1996, affected lenders' potential environmental liability. We end the sample period in 2016 because we need three years of chemical releases to examine the consequence of environmental covenants.

⁹ Lenders' monitoring incentives may be affected by the presence of an insurance covenant. We do not consider the effect of insurance covenants because Nini (2020) finds that 98% of loan contracts contain insurance covenants.

¹⁰ Administrative cases take place before state or federal governing bodies, whereas judicial cases (e.g., breach of contract suits or other civil actions) generally occur in courts.

¹¹ The current TRI program requires industrial facilities that have at least 10 full-time employees, are in TRI-listed industries, use TRI-listed chemicals, and emit TRI-listed chemicals exceeding certain thresholds to report their chemical release data to TRI. The program's primary objective is to publish information about the industrial management of toxic chemicals. It also monitors facilities' compliance with reporting requirements and issues civil and potentially criminal penalties for misreporting. As a result, the probability of misreporting is relatively low.

¹² Our results continue to hold if we include loans with multiple lead lenders.

4. Research design and main results

4.1. Regulatory enforcement and the use of environmental covenants

To investigate how public environmental enforcement affects the use of environmental covenants, we estimate the following OLS model at the loan-facility level:

$$\begin{aligned}
 \text{EnvironmentCov}_{i,j,t} = & \beta_0 + \beta_1 \text{High Polluting Industry}_i \times \text{StateEnf}_{i,t-1} + \beta_2 \text{Real property Collateral}_{i,j,t} \times \text{StateEnf}_{i,t-1} \\
 & + \beta_3 \text{Non-Real property Collateral}_{i,j,t} \times \text{StateEnf}_{i,t-1} + \beta_4 \text{Real property Collateral}_{i,j,t} \\
 & + \beta_5 \text{Non-Real property Collateral}_{i,j,t} + \beta_6 \text{StateEnf}_{i,t-1} + \beta_7 \text{Log(Total Asset)}_{i,t-1} + \beta_8 \text{ROA}_{i,t-1} \\
 & + \beta_9 \text{Leverage}_{i,t-1} + \beta_{10} \text{Cash/Liabilities}_{i,t-1} + \beta_{11} \text{Tangible}_{i,t-1} + \beta_{12} \text{Tobin'sQ}_{i,t-1} \\
 & + \beta_{13} \text{Sd(Operating Cash Flow)}_{i,t-1} + \beta_{14} \text{AltmanZ}_{i,t-1} + \beta_{15} \text{Dividend}_{i,t-1} \\
 & + \beta_{16} \text{Institutional Ownership}_{i,t-1} + \beta_{17} \text{Log(Loan Size)}_{i,j,t} + \beta_{18} \text{Log(Maturity)}_{i,j,t} \\
 & + \beta_{19} \text{Revolver}_{i,j,t} + \beta_{20} \text{Log(N Lenders)}_{i,j,t} + \text{Industry FE} + \text{Year FE} + \text{Loan Purpose FE} \\
 & + \text{Lead Lender FE} + \text{State FE} + \varepsilon
 \end{aligned} \tag{1}$$

where i , j , and t indicate borrower, loan facility, and year, respectively. *EnvironmentCov* _{i,j,t} captures the existence of any environmental covenants in loan facility j of borrower firm i at time t . Similar to Seltzer et al. (2022), we use industry membership to capture the level of borrowers' polluting activity. We create a high-polluting industry indicator that equals one if the industry belongs to a top-5 polluting sector, as designated by the EPA (*High Polluting Industry EPA*), and zero otherwise. We also create our own list of high-polluting industries based on industry-level total toxic release intensity. Specifically, an industry is classified as highly polluting if its total releases scaled by sales are in the top quartile of all industries covered by TRI (*High Polluting Industry TRI*). Appendix C provides variable definitions, and Appendix D presents the list of high-polluting industries identified under these two methods.

We construct *State Enf* to capture borrowers' overall exposure to regulatory enforcement. Considering that a borrower may have plants in multiple states, we measure *State Enf* as the proportion of borrowers' plants located in states with high regulatory enforcement intensity (i.e., state regulatory enforcement intensity, as defined in Section 3.2, above the yearly median of all TRI reporting firms). *Real Property Collateral* equals one if a loan facility includes real property as collateral, and zero otherwise. *Non-Real Property Collateral* equals one if a loan facility includes collateral that is not real property, and zero otherwise.

We include two sets of control variables. The first set captures borrower characteristics before loan initiation. Specifically, we control for firm size (*Log(Total Assets)*), profitability (*ROA*), leverage ratio (*Leverage*), tangibility (*Tangible*), growth opportunities (*Tobin'sQ*), and volatility (*Sd(Operating Cash Flow)*). Prior research shows that firms are more likely to cut environmental investments when they have weaker financial conditions (Kim and Xu, 2022), which we capture using cash divided by total liabilities (*Cash/Liabilities*), Altman's Z score (*AltmanZ*), and dividend payout (*Dividend*). We also include *Institutional Ownership* to control for the influences of institutional investors on firms' environmental activities (e.g., Dimson et al., 2015; Dyck et al., 2019; Akey and Appel, 2021; Krueger et al., 2020). Our second set of controls captures loan characteristics, including loan size (*Log(Loan Size)*), loan maturity (*Log(Maturity)*), whether a loan is a revolver (*Revolver*), and the number of lenders in the syndicate (*Log(N lenders)*). Finally, we control for industry fixed effects using the Fama-French 48 industry classification, year fixed effects, loan purpose fixed effects, lead lender fixed effects, and state fixed effects. If a borrower has plants in multiple states, we include indicators for all of those states for the borrower in the model. Because of the multiple fixed effects, we use OLS as our main specification model. We also use the Probit model for robustness checks and find similar results. We cluster standard errors by industry because lenders' use of environmental covenants is likely correlated within an industry.

Panel A of Table 1 presents descriptive statistics of environmental covenants and our main variables. In our sample, 41.8% of the loans contain at least one environmental covenant. Among the three types of covenants, disclosure covenants are the most common (39%), followed by action (18%) and audit (8%) covenants (untabulated). We focus on the existence of any covenant in our main analysis and explore covenant bundling in a supplemental analysis. As for the other main variables in Model (1), 31% of the sample belongs to a high-polluting industry (based on the EPA definition), and 18% of loans include real property collateral. Panel B presents the average enforcement intensity and average use of environmental covenants in each state. States that rely heavily on mining, natural gas, and oil industries, such as Wyoming, have higher regulatory enforcement intensity. Panel C presents the industry distribution of the use of environmental covenants and shows that environmental covenants are most widely used in the precious metals, food products, textiles, and wholesale industries. Panel D shows correlations among the main variables. We note that the correlation between *High Polluting Industry EPA* and *Polluting Industry TRI* is 0.865, suggesting that these two industry classifications capture very similar constructs. Though we do not find a significantly positive association between our enforcement intensity (or polluting industries) measures and the use of

Table 1
Descriptive statistics for the determinant tests.

Panel A: Descriptive Statistics								
	N	Mean	Sd	Median	P25	P75	Min	Max
EnvironmentCov	2073	0.42	0.49	0.00	0.00	1.00	0.00	1.00
EnvironmentCovN	2073	0.65	0.89	0.00	0.00	1.00	0.00	3.00
State Enf	2073	0.48	0.34	0.50	0.23	0.70	0.00	1.00
High Polluting Industry EPA	2073	0.31	0.46	0.00	0.00	1.00	0.00	1.00
High Polluting Industry TRI	2073	0.38	0.48	0.00	0.00	1.00	0.00	1.00
Real Property Collateral	2073	0.18	0.38	0.00	0.00	0.00	0.00	1.00
Non-Real Property Collateral	2073	0.35	0.48	0.00	0.00	1.00	0.00	1.00
Log (Total Asset)	2073	7.86	1.45	7.84	6.83	8.87	4.25	11.39
ROA	2073	0.14	0.06	0.13	0.09	0.17	-0.01	0.34
Leverage	2073	0.60	0.18	0.62	0.49	0.73	0.17	1.06
Cash/Liabilities	2073	0.19	0.32	0.07	0.03	0.19	0.00	1.90
Tangible	2073	0.32	0.19	0.27	0.17	0.44	0.04	0.81
Tobin's Q	2073	1.45	0.60	1.28	1.04	1.65	0.73	3.84
Sd (Operating Cash Flow)	2073	0.04	0.03	0.03	0.02	0.05	0.01	0.13
AltmanZ	2073	2.98	1.94	2.61	1.75	3.79	0.27	11.69
Dividend	2073	0.70	0.46	1.00	0.00	1.00	0.00	1.00
Institutional Ownership	2073	0.73	0.22	0.77	0.60	0.88	0.05	1.15
Log (Loan Size)	2073	5.70	1.21	5.71	5.01	6.52	2.30	8.52
Log (Maturity)	2073	3.79	0.57	4.09	3.58	4.09	2.30	4.43
Revolver	2073	0.65	0.48	1.00	0.00	1.00	0.00	1.00
Log (N Lenders)	2073	2.10	0.88	2.20	1.61	2.77	0.00	3.71

Panel B: State Enforcement, Environmental Covenants, High Polluting Industries							
State	N TRI Facilities	State Enf (raw)	State Enf (deflated)	State Enf (median)	EnvironmentCov %	High Polluting Industry EPA %	High Polluting Industry TRI %
ALABAMA	554	185	0.34	0.31	0.52	0.42	0.52
ALASKA	31	185	5.52	6.34	0.40	0.50	0.50
ARIZONA	284	172	0.60	0.60	0.38	0.40	0.48
ARKANSAS	369	113	0.31	0.29	0.33	0.41	0.43
CALIFORNIA	1436	472	0.34	0.41	0.45	0.22	0.30
COLORADO	229	566	2.49	2.49	0.50	0.31	0.37
CONNECTICUT	339	197	0.60	0.59	0.51	0.35	0.41
DELAWARE	69	50	0.74	0.77	0.44	0.56	0.56
DISTRICT OF COLUMBIA	8	58	6.28	4.31	0.58	0.58	0.58
FLORIDA	651	246	0.38	0.39	0.47	0.23	0.39
GEORGIA	756	254	0.34	0.42	0.42	0.29	0.40
HAWAII	35	115	3.22	3.40	0.61	0.00	0.33
IDAHO	103	163	1.48	1.27	0.48	0.38	0.38
ILLINOIS	1210	285	0.24	0.27	0.45	0.32	0.43
INDIANA	992	164	0.17	0.17	0.41	0.24	0.34
IOWA	448	193	0.43	0.39	0.46	0.27	0.32
KANSAS	302	152	0.50	0.53	0.56	0.18	0.28
KENTUCKY	469	177	0.38	0.43	0.46	0.30	0.39
LOUISIANA	375	226	0.60	0.52	0.42	0.51	0.63
MAINE	97	157	1.70	2.01	0.54	0.12	0.12
MARYLAND	194	180	0.95	0.92	0.51	0.51	0.57
MASSACHUSETTS	519	269	0.54	0.48	0.43	0.28	0.37
MICHIGAN	872	226	0.27	0.23	0.41	0.32	0.36
MINNESOTA	507	117	0.23	0.26	0.48	0.12	0.24
MISSISSIPPI	328	97	0.30	0.29	0.45	0.23	0.36
MISSOURI	568	271	0.48	0.47	0.40	0.34	0.43
MONTANA	50	301	6.09	4.87	0.52	0.83	0.83
NEBRASKA	192	117	0.61	0.56	0.40	0.16	0.29
NEVADA	127	41	0.30	0.25	0.40	0.35	0.45
NEW HAMPSHIRE	142	132	0.93	0.95	0.53	0.16	0.19
NEW JERSEY	499	374	0.83	0.91	0.42	0.31	0.42
NEW MEXICO	76	193	2.46	2.28	0.56	0.35	0.35
NEW YORK	712	850	1.49	1.69	0.53	0.34	0.48
NORTH CAROLINA	826	210	0.26	0.26	0.39	0.31	0.41
NORTH DAKOTA	55	115	2.13	2.12	0.55	0.33	0.33
OHIO	1548	174	0.11	0.12	0.42	0.28	0.39
OKLAHOMA	357	541	1.51	1.39	0.50	0.16	0.23
OREGON	295	120	0.41	0.42	0.48	0.20	0.42
PENNSYLVANIA	1290	447	0.35	0.37	0.45	0.30	0.41
PUERTO RICO	140	348	2.58	2.45	0.31	0.13	0.25
RHODE ISLAND	121	93	0.89	0.88	0.48	0.33	0.43
SOUTH CAROLINA	527	106	0.20	0.21	0.43	0.32	0.39

(continued on next page)

Table 1 (continued)

Panel B: State Enforcement, Environmental Covenants, High Polluting Industries							
State	N TRI Facilities	State Enf (raw)	State Enf (deflated)	State Enf (median)	EnvironmentCov %	High Polluting Industry EPA %	High Polluting Industry TRI %
SOUTH DAKOTA	94	161	1.72	1.46	0.38	0.42	0.43
TENNESSEE	642	146	0.23	0.27	0.36	0.18	0.26
TEXAS	1583	701	0.45	0.39	0.41	0.33	0.42
UTAH	186	315	1.68	1.69	0.59	0.26	0.39
VERMONT	41	56	1.38	1.74	0.50	0.00	0.50
VIRGINIA	472	180	0.39	0.45	0.43	0.24	0.34
WASHINGTON	338	297	0.88	0.90	0.49	0.17	0.36
WEST VIRGINIA	190	159	0.84	0.92	0.44	0.55	0.72
WISCONSIN	916	118	0.13	0.13	0.49	0.22	0.35
WYOMING	50	269	5.41	5.09	0.46	0.42	0.48

Panel C: The Industry Distribution of Environmental Covenants		
Fama-French 48 Industry	EnvironmentCov = 1 (%)	N Loans
Precious Metals	80%	5
Food Products	66%	77
Textiles	58%	19
Wholesale	58%	95
Shipbuilding, Railroad Equipment	57%	7
Electrical Equipment	53%	93
Electronic Equipment	52%	121
Rubber and Plastic Products	52%	54
Shipping Containers	51%	41
Tobacco Products	50%	6
Steel Works Etc	50%	110
Non-Metallic and Industrial Metal Mining	50%	22
Business Services	50%	8
Transportation	50%	10
Computers	48%	21
Chemicals	47%	197
Recreation	47%	15
Automobiles and Trucks	45%	150
Aircraft	45%	49
Beer & Liquor	45%	29
Communication	42%	12
Almost Nothing	41%	41
Business Supplies	41%	104
Construction	40%	15
Measuring and Control Equipment	38%	37
Machinery	37%	153
Fabricated Products	37%	19
Construction Materials	34%	115
Consumer Goods	30%	73
Pharmaceutical Products	30%	37
Medical Equipment	29%	55
Petroleum and Natural Gas	27%	44
Coal	25%	16
Utilities	17%	209
Defense	13%	8
Printing and Publishing	0%	4
Retail	0%	2

Panel D: Correlation Matrix										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) EnvironmentCov	1	0.963***	0.025	-0.060***	-0.039*	0.334***	0.062***	-0.184***	-0.033	0
(2) EnvironmentCovN	0.855***	1	0.033	-0.037*	-0.013	0.345***	0.065***	-0.198***	-0.049**	0.001
(3) State Enf	0.031	0.049**	1	0.108***	0.115***	0.036*	-0.02	0.066***	0.014	0.01
(4) High Polluting Industry EPA	-0.060***	-0.001	0.114***	1	0.865***	-0.034	-0.058***	0.161***	-0.121***	0.184***
(5) High Polluting Industry TRI	-0.039*	0.024	0.116***	0.865***	1	-0.02	-0.053**	0.170***	-0.104***	0.211***
(6) Real Property Collateral	0.334***	0.323***	0.039*	-0.034	-0.02	1	-0.339***	-0.216***	-0.136***	0.053**
(7) Non-Real Property Collateral	0.062***	0.070***	-0.019	-0.058***	-0.053**	-0.339***	1	-0.194***	-0.167***	0.085***
(8) Log (Total Asset)	-0.189***	-0.192***	0.061***	0.170***	0.176***	-0.218***	-0.203***	1	-0.115***	0.353***
(9) ROA	-0.037*	-0.057***	0.01	-0.090***	-0.086***	-0.144***	-0.141***	-0.107***	1	-0.291***
(10) Leverage	0.004	0.01	-0.011	0.174***	0.200***	0.052**	0.074***	0.346***	-0.276***	1
(11) Cash/Liabilities	0.014	0.005	0.049**	-0.172***	-0.185***	0.027	-0.005	-0.131***	0.189***	-0.569***

Table 1 (continued)

Panel D: Correlation Matrix											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
(12) Tangible	-0.129***	-0.070***	0.118***	0.464***	0.484***	-0.024	-0.071***	0.188***	-0.121***	0.236***	
(13) Tobin's Q	-0.058***	-0.068***	0.025	-0.175***	-0.189***	-0.129***	-0.110***	-0.031	0.620***	-0.243***	
(14) Sd (Operating Cash Flow)	0.119***	0.153***	0.038*	-0.102***	-0.148***	0.108***	0.161***	-0.329***	0.082***	-0.136***	
(15) AltmanZ	-0.004	-0.023	0.016	-0.265***	-0.293***	-0.092***	-0.047**	-0.304***	0.586***	-0.666***	
(16) Dividend	-0.186***	-0.205***	-0.026	0.220***	0.202***	-0.223***	-0.196***	0.267***	0.067***	0.073***	
(17) Institutional Ownership	0.070***	0.070***	0.077***	-0.069***	-0.066***	0.011	0.011	0.198***	0.049**	-0.079***	
(18) Log (Loan Size)	-0.107***	-0.130***	0.058***	0.051**	0.048**	-0.178***	-0.241***	0.729***	0.124***	0.140***	
(19) Log (Maturity)	0.157***	0.145***	0.006	-0.067***	-0.032	0.150***	0.093***	-0.122***	0.017	-0.079***	
(20) Revolver	-0.058***	-0.061***	-0.02	-0.001	-0.013	-0.074***	-0.037*	-0.092***	-0.024	-0.138***	
(21) Log (N lenders)	-0.063***	-0.084***	0.03	0.029	0.023	-0.172***	-0.175***	0.493***	0.118***	0.121***	
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
(1)	0.035	-0.110***	-0.034	0.123***	-0.002	-0.186***	0.096***	-0.104***	0.149***	-0.058***	-0.075***
(2)	0.037*	-0.092***	-0.043*	0.144***	-0.017	-0.202***	0.100***	-0.122***	0.146***	-0.061***	-0.092***
(3)	0.03	0.105***	0.016	0.026	-0.016	-0.024	0.080***	0.054**	0.012	-0.023	0.027
(4)	-0.278***	0.468***	-0.190***	-0.144***	-0.304***	0.220***	-0.099***	0.050**	-0.053**	-0.001	0.03
(5)	-0.261***	0.495***	-0.183***	-0.195***	-0.328***	0.202***	-0.098***	0.044**	-0.017	-0.013	0.025
(6)	-0.007	-0.002	-0.145***	0.122***	-0.119***	-0.223***	0.049**	-0.177***	0.142***	-0.074***	-0.182***
(7)	0.001	-0.064***	-0.096***	0.168***	-0.080***	-0.196***	0.029	-0.239***	0.072***	-0.037*	-0.190***
(8)	-0.074***	0.123***	-0.053**	-0.386***	-0.353***	0.260***	0.126***	0.724***	-0.048**	-0.104***	0.508***
(9)	0.183***	-0.121***	0.618***	0.036	0.631***	0.073***	0.056**	0.124***	0.064***	-0.036	0.124***
(10)	-0.481***	0.249***	-0.240***	-0.128***	-0.666***	0.066***	-0.108***	0.144***	-0.042*	-0.145***	0.115***
(11)	1	-0.389***	0.328***	0.189***	0.474***	-0.120***	0.300***	-0.007	0.112***	0.069***	-0.075***
(12)	-0.261***	1	-0.321***	-0.073***	-0.366***	0.179***	-0.284***	-0.023	-0.099***	0.039*	-0.005
(13)	0.312***	-0.278***	1	0.061**	0.665***	0.008	0.154***	0.121***	-0.009	-0.052**	0.082***
(14)	0.182***	-0.073***	0.119***	1	0.234***	-0.199***	-0.070***	-0.308***	-0.011	0.002	-0.235***
(15)	0.597***	-0.345***	0.686***	0.223***	1	0.004	0.127***	-0.080***	0.026	0.069***	-0.041*
(16)	-0.123***	0.180***	-0.011	-0.195***	-0.035	1	-0.103***	0.227***	-0.081***	0.036	0.208***
(17)	0.165***	-0.242***	0.092***	-0.105***	0.094***	-0.072***	1	0.218***	0.219***	0.012	0.127***
(18)	-0.045**	0.023	0.111***	-0.260***	-0.088***	0.224***	0.278***	1	0.133***	0.009	0.615***
(19)	0.050**	-0.077***	-0.091***	0.022	0.022	-0.126***	0.187***	0.029	1	0.139***	0.091***
(20)	0	0.033	-0.063***	0.004	0.043**	0.036	0.001	0.019	0.358***	1	0.053**
(21)	-0.128***	0.022	0.051**	-0.200***	-0.074***	0.196***	0.180***	0.609***	0.085***	0.068***	1

Table 1 Panel A presents the descriptive statistics of borrower and loan characteristics for the determinant analysis. The unit observation is at the loan facility level. Table 1 Panel B presents descriptive statistics of regulatory enforcement intensity (*State Enf*), environmental covenants (*EnvironmentCov*), and membership in high-polluting industries (*High Polluting Industry*) by each state. Table 1 Panel C presents the industry distribution of environmental covenants. Table 1 Panel D presents a correlation matrix. The lower panel shows the Pearson correlation, while the upper panel shows the Spearman correlation. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. The definition of variables can be found in Appendix C.

environmental covenants, we do find a positive and significant association between real property collateral and environmental covenants.

Table 2 presents the results of the OLS estimation for the determinants of environmental covenants. Column 1 reports results using *High Polluting Industry EPA*, and column 2 reports results using *High Polluting Industry TRI*. In column 1, the coefficient on the interaction term between *High Polluting Industry* and *State Enf* is positive and significant. For borrowers in a high-polluting industry, a one standard deviation increase in regulatory enforcement intensity is associated with a 10 percentage points increase in the probability of having environmental covenants in loan contracts (a 24% increase conditional on the sample mean). We further find a positive and significant coefficient on the interaction term between *Real Property Collateral* and *State Enf*. On average, a one standard deviation increase in regulatory enforcement intensity increases the probability of loan contracts with real property collateral having environmental covenants by 7 percentage points (a 17% increase conditional on the sample mean). In comparison, the interaction between *Non-Real Property Collateral* and *State Enf* is insignificant. Results are similar in column 2 where we use *High Polluting Industry TRI* to capture borrowers' polluting activities.¹³ Consistent with the notion that public enforcement strengthens lenders' environmental monitoring incentives, our findings suggest that lenders are more likely to use environmental covenants to mitigate potential environmental liabilities when borrowers face stricter regulatory enforcement.

4.2. Regulatory enforcement and the consequences of environmental covenants

Next, we test whether environmental covenants are more effective in reducing borrowers' total toxic emissions when borrowers are exposed to higher regulatory enforcement intensity. Specifically, we estimate the following OLS model at the plant-chemical level:

¹³ Results are similar if we conduct the analyses at the loan package level (untabulated).

Table 2
The determinants of environmental covenants.

Dependent Variable =	EnvironmentCov	
High Polluting Industry =	High Polluting Industry EPA (1)	High Polluting Industry TRI (2)
High Polluting Industry \times State Enf (β_1)	0.295*** (3.61)	0.266*** (3.12)
Real Property Collateral \times State Enf (β_2)	0.214* (1.95)	0.216* (1.93)
Non-Real Property Collateral \times State Enf (β_3)	-0.076 (-0.69)	-0.071 (-0.64)
Real Property Collateral	0.274*** (3.27)	0.272*** (3.23)
Non-Real Property Collateral	0.093 (1.22)	0.091 (1.19)
State Enf	-0.148 (-1.62)	-0.147 (-1.54)
Log (Total Asset)	-0.050*** (-2.74)	-0.052*** (-2.87)
ROA	-0.138 (-0.38)	-0.118 (-0.33)
Leverage	0.150 (1.08)	0.146 (1.04)
Cash/Liabilities	-0.043 (-0.73)	-0.045 (-0.74)
Tangible	-0.162 (-1.56)	-0.176 (-1.67)
Tobin's Q	-0.075* (-1.87)	-0.075* (-1.88)
Sd (Operating Cash Flow)	1.036 (1.22)	1.079 (1.26)
AltmanZ	0.021 (1.53)	0.021 (1.48)
Dividend	-0.039 (-1.05)	-0.037 (-0.98)
Institutional Ownership	0.184* (1.80)	0.183* (1.77)
Log (Loan Size)	0.010 (0.67)	0.011 (0.77)
Log (Maturity)	0.063** (2.09)	0.064** (2.11)
Revolver	-0.057** (-2.51)	-0.058** (-2.55)
Log (N Lenders)	0.049* (1.75)	0.050* (1.78)
Constant	0.231 (1.10)	0.237 (1.12)
Coefficient differences (p-value)		
$\beta_2 = \beta_3$	0.0232	0.0245
Industry FE	YES	YES
Year FE	YES	YES
Loan Purpose FE	YES	YES
Bank FE	YES	YES
State FE	YES	YES
Observations	2073	2073
Adjusted R-squared	0.323	0.321

This table presents results from the OLS estimation of the following model (Model 1):

$$EnvironmentCov_{i,j,t} = \beta_0 + \beta_1 High\ Polluting\ Industry_i \times State\ Enf_{i,t-1} + \beta_2 Real\ Property\ Collateral_{i,j,t} \times State\ Enf_{i,t-1} + \beta_3 Non-Real\ Property\ Collateral_{i,j,t} \times State\ Enf_{i,t-1} + \beta_4 Real\ Property\ Collateral_{i,j,t} + \beta_5 Non-Real\ Property\ Collateral_{i,j,t} + \beta_6 State\ Enf_{i,t-1} + Controls + Fixed\ Effects + \varepsilon$$

The unit observation is at the loan facility level. *EnvironmentCov* equals one if a loan facility has environmental covenants included in its loan agreement and zero otherwise. In Column (1), *High Polluting Industry EPA* equals one if the borrower belongs to one of the top 5 polluting industry sectors identified by the U.S. EPA. In Column (2), *High Polluting Industry TRI* equals one if the borrower belongs to an industry with industry emission intensity in the top quartile of all industries covered by the TRI databases throughout the sample period. *Real Property Collateral* equals one if a loan facility has real property collateral and zero otherwise. *Non-Real Property Collateral* equals one if a loan facility has collateral that is not real property and zero otherwise. *State Enf* is the proportion of a borrower's plants located in states with high environmental regulation intensity. Detailed definitions of the control variables can be found in [Appendix C](#). Industry, Year, Loan Purpose, Lead Lender, and State FEs are included. Standard errors are clustered by industry. T-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

$$\begin{aligned} \text{Log}(1 + \text{Toxic Release}_{c,p,i,j,t}) = & \beta_0 + \beta_1 \text{EnvironmentCov}_{i,j,t^*} \times \text{Post}_{i,j,t} \times \text{State Enf}_{i,p,t} + \beta_2 \text{EnvironmentCov}_{i,j,t^*} \times \text{Post}_{i,j,t} \\ & + \beta_3 \text{EnvironmentCov}_{i,j,t^*} \times \text{State Enf}_{i,p,t} + \beta_4 \text{Post}_{i,j,t} \times \text{State Enf}_{i,p,t} \\ & + \beta_5 \text{EnvironmentCov}_{i,j,t^*} + \beta_6 \text{Post}_{i,j,t} + \beta_7 \text{State Enf}_{i,p,t} + \text{Controls} + \text{Plant} \\ & - \text{Chemical FE} + \text{Chemical} - \text{Year FE} + \text{State FE} + e \end{aligned} \tag{2}$$

where c, p, i, j, t^*, t indicates chemical, plant, borrower, loan facility, year of loan initiation, and year of chemical releases, respectively. *Toxic Release* is the amount of total releases scaled by sales in the previous year.¹⁴ *Post* is an indicator that equals one in the three years after loan initiation, and zero otherwise. *State Enf_{i,p,t}* is the regulatory enforcement intensity faced by plant p of borrower i in year t . β_1 captures the effect of regulatory enforcement intensity on the effectiveness of environmental covenants in reducing borrowers' toxic chemical releases. We include the same set of controls as in Model (1). Moreover, we control for time-invariant heterogeneity at the plant-chemical level, time-varying heterogeneity at the chemical level, and time-invariant heterogeneity at the state level by adding plant-chemical, chemical-year, and state fixed effects, respectively. Standard errors are clustered by industry.¹⁵ To balance the time needed to achieve emission reduction as a result of lender monitoring and the loss of loan sample required for a long window, we restrict our sample to three years before and three years after loan initiation and require that a plant report to TRI in both the pre-and post-periods for a given chemical. Our findings continue to hold when using five years before and five years after loan initiation as our sample period (see Online Appendix Table A1 and Figure A1).

Table 3 Panel A presents the descriptive statistics for the main variables at the plant-chemical level. As shown, 38% of plant-chemical level observations are associated with borrowers whose loans include environmental covenants. The plants in our sample, on average, release 60,802 pounds of toxic emissions for each chemical (untabulated). In Panel B of Table 3, column 1 shows the regression results of Model (2) based on OLS estimations. The coefficient on $\text{EnvironmentCov}_{i,j,t^*} \times \text{Post}_{i,j,t} \times \text{State Enf}_{i,t}$ (i.e., β_1) is significant at the 1% level, suggesting that plants located in states with higher regulatory enforcement intensity experience a significant larger decline in toxic chemical emissions after loan initiation. The effect of regulatory enforcement intensity on the effectiveness of environmental covenants in reducing borrowers' total toxic releases is economically significant. In states at the third quartile of enforcement intensity (0.62), the percentage reduction in toxic release for borrowers with environmental covenants after loan initiations is 2.1% (calculated as $(e^{-0.045 \times 0.62 + 0.007} - 1)$) compared to those without environmental covenants. In states at the first quartile of enforcement intensity (0.2), the percentage reduction is only 0.2% (calculated as $(e^{-0.045 \times 0.2 + 0.007} - 1)$). Our findings suggest that state environmental enforcement improves the effectiveness of lender monitoring through environmental covenants in reducing borrowers' polluting activities.

Table 3
The outcomes of environmental covenants.

	All Sample			CEM Unweighted Sample			CEM Weighted Sample		
	N	Mean	Sd	N	Mean	Sd	N	Mean	Sd
EnvironmentCov	384,896	0.38	0.49	208,711	0.50	0.50	208,711	0.46	0.50
EnvironmentCovN	384,896	0.66	0.97	208,711	0.89	1.07	208,711	0.83	1.06
Post	384,896	0.44	0.50	208,711	0.44	0.50	208,711	0.44	0.50
State Enf	384,896	0.61	0.75	208,711	0.64	0.77	208,711	0.62	0.76
Log (1+Toxic Release)	384,896	1.01	1.36	208,711	0.99	1.37	208,711	0.92	1.34
Democrat Win	44,241	0.52	0.50	32,117	0.49	0.50	32,117	0.48	0.50
Democrat Majority	44,241	0.43	0.50	32,117	0.42	0.49	32,117	0.43	0.49
Nonattainment	113,592	0.51	0.50	64,071	0.53	0.50	64,071	0.55	0.50
Log (1 + Air Toxic Release)	113,592	0.64	1.11	64,071	0.55	1.01	64,071	0.51	0.97
I(Product)	384,896	0.00	0.07	208,711	0.00	0.07	208,711	0.00	0.06
I(Raw Material)	384,896	0.01	0.09	208,711	0.01	0.10	208,711	0.01	0.09
I(Cleaning and Degreasing)	384,896	0.00	0.07	208,711	0.01	0.08	208,711	0.01	0.08
I(Surface)	384,896	0.01	0.08	208,711	0.01	0.09	208,711	0.01	0.07
I(Operating)	384,896	0.04	0.20	208,711	0.04	0.19	208,711	0.04	0.19
I(Process)	384,896	0.02	0.15	208,711	0.02	0.15	208,711	0.02	0.14
High Polluting Industry EPA	384,896	0.50	0.50	208,711	0.37	0.48	208,711	0.40	0.49
Real Property Collateral	384,896	0.10	0.30	208,711	0.04	0.20	208,711	0.05	0.22
Non-Real Property Collateral	384,896	0.26	0.44	208,711	0.34	0.47	208,711	0.31	0.46

(continued on next page)

¹⁴ Results are similar if we do not take the log transformation of *Toxic Release*. Results are also robust if we use the cost of goods sold or total assets as a scaler. Furthermore, following Akey and Appel (2021), we construct a normalized production level and do not observe any significant changes in borrowers' production levels around loan origination, suggesting that reductions in total releases are not driven by decreased production.

¹⁵ In robustness tests (untabulated), we find that our main results still hold if we include industry-year fixed effects, if we cluster standard errors by borrower or state, or if we adopt two-way clustering by state and borrower.

Table 3 (continued)

Panel A: Descriptive Statistics for the Outcome Tests									
	All Sample			CEM Unweighted Sample			CEM Weighted Sample		
	N	Mean	Sd	N	Mean	Sd	N	Mean	Sd
Log (Total Asset)	384,896	9.07	1.44	208,711	8.90	1.39	208,711	8.95	1.33
ROA	384,896	0.13	0.06	208,711	0.14	0.06	208,711	0.14	0.05
Leverage	384,896	0.64	0.13	208,711	0.63	0.13	208,711	0.63	0.13
Cash/Liabilities	384,896	0.11	0.13	208,711	0.12	0.13	208,711	0.13	0.13
Tangible	384,896	0.43	0.18	208,711	0.41	0.19	208,711	0.40	0.18
Tobin's Q	384,896	1.34	0.47	208,711	1.35	0.43	208,711	1.40	0.47
Sd (Operating Cash Flow)	384,896	0.03	0.02	208,711	0.03	0.02	208,711	0.03	0.02
AltmanZ	384,896	2.44	1.39	208,711	2.61	1.31	208,711	2.74	1.29
Dividend	384,896	0.84	0.37	208,711	0.80	0.40	208,711	0.81	0.39
Institutional Ownership	384,896	0.74	0.18	208,711	0.76	0.17	208,711	0.75	0.17
Log (Loan Size)	384,896	6.38	1.11	208,711	6.36	1.11	208,711	6.43	1.07
Log (Maturity)	384,896	3.77	0.59	208,711	3.82	0.54	208,711	3.81	0.56
Revolver	384,896	0.66	0.47	208,711	0.67	0.47	208,711	0.70	0.46
Log (N Lenders)	384,896	2.44	0.79	208,711	2.35	0.79	208,711	2.38	0.77
Financial Covenant (indicator)	384,896	0.80	0.40	208,711	0.84	0.37	208,711	0.81	0.39
General Covenant (indicator)	384,896	0.82	0.38	208,711	0.87	0.34	208,711	0.85	0.36
Financial Covenant (number)	384,896	1.29	0.94	208,711	1.37	0.94	208,711	1.28	0.91
General Covenants (number)	384,896	1.61	1.70	208,711	1.66	1.68	208,711	1.53	1.62

Panel B: Toxic Release, State Enf, and EnvironmentCov			
Dependent Variable =	Log (1+Toxic Release)		
Sample	All	CEM Unweighted	CEM Weighted
	(1)	(2)	(3)
EnvironmentCov × Post × State Enf	-0.045*** (-2.900)	-0.049** (-2.434)	-0.048** (-2.337)
EnvironmentCov × Post	0.007 (0.460)	0.012 (0.613)	0.001 (0.061)
EnvironmentCov × State Enf	0.014 (1.332)	-0.003 (-0.182)	0.005 (0.374)
Post × State Enf	0.005* (1.701)	0.006 (0.857)	0.005 (0.764)
EnvironmentCov	0.043** (2.324)	0.032 (1.359)	0.025 (1.314)
Post	-0.011 (-1.045)	0.002 (0.128)	0.009 (0.729)
State Enf	-0.031*** (-2.924)	-0.030** (-2.280)	-0.030* (-1.997)
High Polluting Industry EPA	0.051 (1.498)	0.079*** (3.031)	0.152*** (4.009)
Real Property Collateral	-0.033 (-1.270)	0.008 (0.210)	0.028 (0.784)
Non-Real Property Collateral	-0.012 (-0.813)	-0.016 (-0.754)	-0.002 (-0.090)
Log (Total Asset)	-0.236*** (-7.847)	-0.234*** (-7.151)	-0.222*** (-6.491)
ROA	0.753*** (5.902)	0.739*** (4.541)	0.688*** (4.018)
Leverage	-0.138 (-1.355)	-0.024 (-0.184)	-0.019 (-0.150)
Cash/Liabilities	0.022 (0.514)	0.011 (0.202)	-0.001 (-0.024)
Tangible	-0.054 (-0.492)	-0.102 (-1.494)	-0.098 (-1.288)
Tobin's Q	-0.007 (-0.276)	0.004 (0.135)	0.018 (0.453)
Sd (Operating Cash Flow)	0.375 (1.055)	0.429 (1.475)	0.528* (1.702)
AltmanZ	-0.077*** (-4.871)	-0.066*** (-3.830)	-0.065*** (-3.507)
Dividend	0.011 (0.368)	-0.013 (-0.424)	-0.004 (-0.125)
Institutional Ownership	0.001 (0.019)	0.036 (0.462)	0.041 (0.498)
Revolver	0.010 (1.584)	0.011** (2.229)	0.012** (2.219)
Log (Loan Size)	-0.002	-0.008*	-0.010**

Table 3 (continued)

Panel B: Toxic Release, State Enf, and EnvironmentCov			
Dependent Variable =	Log (1+Toxic Release)		
Sample	All	CEM Unweighted	CEM Weighted
	(1)	(2)	(3)
Log (Maturity)	(-0.496) 0.001 (0.223)	(-2.019) -0.003 (-0.477)	(-2.139) -0.007 (-1.619)
Log (N Lenders)	-0.008 (-1.210)	-0.005 (-0.937)	-0.003 (-0.494)
Plant-Chemical FE	YES	YES	YES
Chemical-Year FE	YES	YES	YES
State FE	YES	YES	YES
Observations	384,896	208,711	208,711
Adjusted R-squared	0.910	0.910	0.912

Panel A reports descriptive statistics for the outcome tests. The unit observation is at the plant-chemical-year level. The variable definition can be found in Appendix C.

Panel B presents OLS estimates of the following model (Model 2):

$$\text{Log}(1+\text{Toxic Release}_{c,p,i,t}) = \beta_0 + \beta_1 \text{EnvironmentCov}_{i,t^*} \times \text{Post}_{i,t} \times \text{State Enf}_{i,p,t} + \beta_2 \text{EnvironmentCov}_{i,t^*} \times \text{Post}_{i,t} + \beta_3 \text{EnvironmentCov}_{i,t} \times \text{State Enf}_{i,p,t} + \beta_4 \text{Post}_{i,t} \times \text{State Enf}_{i,p,t} + \beta_5 \text{EnvironmentCov}_{i,t^*} + \beta_6 \text{Post}_{i,t} + \beta_7 \text{State Enf}_{i,p,t} + \text{Controls} + \text{Plant-Chemical FE} + \text{Chemical-Year FE} + \text{State FE} + \varepsilon$$

The unit of observation is at the Plant-Chemical-Year level. Column 1 (2 and 3) uses the sample before matching (after matching using CEM). The dependent variables are the log of one plus total releases scaled by sales. EnvironmentCov equals one if a loan facility has environmental covenants and zero otherwise. Post is an indicator variable equal to one for years after the loan initiation. State Enf is the total inspections and enforcement actions deflated by the total number of facilities in a state (excluding the borrower's own inspection and enforcement). The definition of the control variables can be found in Appendix C. Standard errors are clustered at the industry level. T-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

This finding could be explained by self-selection. For example, when facing high regulatory intensity, polluting borrowers may invest more in environmental abatements to avoid environmental violations, and these borrowers may be more likely to accept environmental covenants in loan contracts. To mitigate such self-selection concern, we conduct our outcome analyses based on a coarsened exact matched (CEM) sample, which allows us to ensure an ex-ante covariate balance between loans with and those without environmental covenants. To the extent that observable and unobservable factors are correlated, matching on observables helps mitigate the non-randomness from both observables and unobservables (Iacus et al., 2012; Christensen et al., 2017). Based on the previously mentioned determinants of lender monitoring, we match loans with environmental covenants with those without based on the quintiles of state enforcement intensity, the High Polluting Industry EPA indicator, real property collateral indicator, year of loan initiation, and quintiles of firm size. Our matched sample includes 1165 loans, among which 495 have environmental covenants and 670 do not.¹⁶ We further weight loans without environmental covenants (i.e., the control group) to adjust for the different proportions of the control group within each stratum.

Panel A of Table 3 presents descriptive statistics for the CEM samples. Panel B, columns 2 and 3 present results with the unweighted and weighted CEM samples, respectively. We find a negative and significant β_1 in both columns, and the coefficients are similar between the unweighted and weighted CEM samples, suggesting the composition of the control group does not affect our findings. These coefficients are also similar to the OLS estimation using the unmatched sample. These findings mitigate the concern that self-selection of environmental covenants explains the effectiveness of environmental covenants in reducing toxic emissions.

Using the CEM samples, we further investigate the coefficient dynamics on $\text{EnvironmentCov} \times \text{Post} \times \text{State Enf}$ by replacing Post with indicators for each year in the three years before and after loan initiation. Panels A and B of Fig. 1 show the coefficient dynamics in the unweighted and weighted CEM samples, respectively. We find that the coefficient on the triple interaction variable is close to zero and exhibits no trend before loan initiation in either the unweighted or weighted samples, consistent with the parallel trend assumption. The coefficient turns negative and significant only for the years after loan initiation, which further alleviates the concern of self-selection.

4.3. Endogeneity of regulatory enforcement intensity

Another endogeneity concern in our analyses is that the state-level regulatory enforcement measure may confound other state-level factors that explain polluting activities (e.g., local economic conditions). We adopt several approaches to address this endogeneity concern in addition to the high-order fixed effects, such as the chemical-year

¹⁶ The sample size drops from 384,896 to 208,711 (i.e., 46% decline) when using this CEM matched sample due to the decline in common support. Matching on firm size and the loan initiation years contributes most to the decline in common support. This decline in sample size due to a lack of common support is not uncommon in prior research (e.g., Cen et al., 2018; Hills et al., 2021). Our results continue to hold when we only use any 4 out of the 5 criteria to match the sample, where the decline in the number of observations is less significant, ranging from 7.5% to 31%.

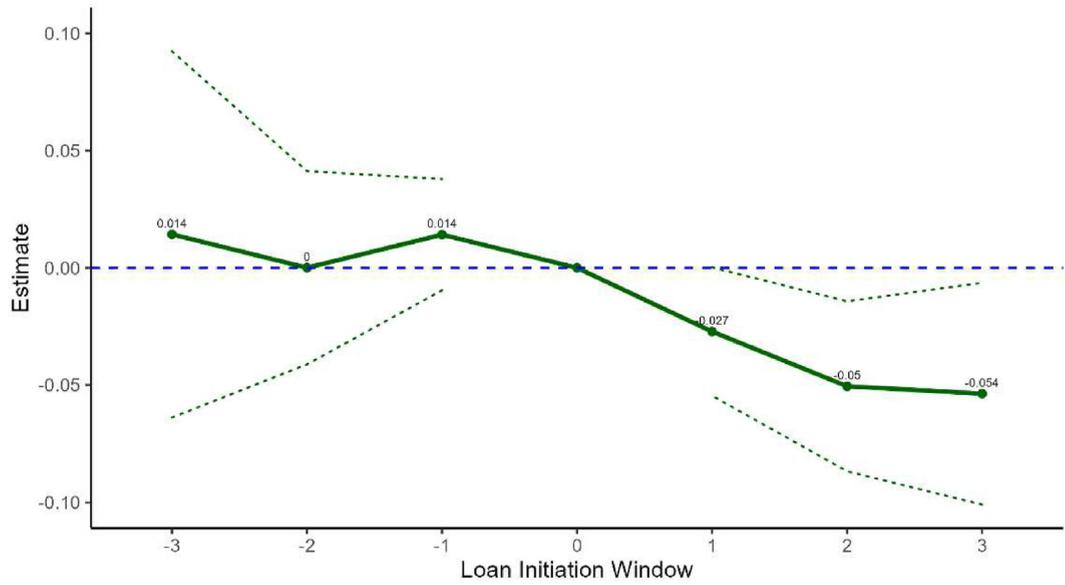
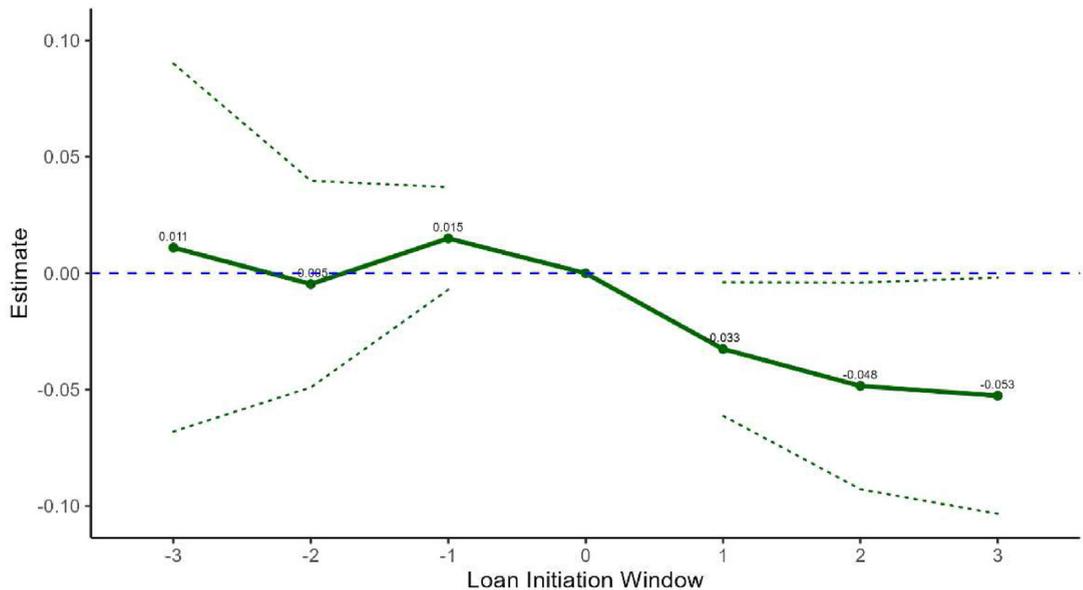
Panel A: CEM Unweighted Sample**Panel B: CEM Weighted Sample**

Figure 1. Coefficient Dynamics. This table shows the coefficient dynamics for total releases around the origination of loans having *EnvironmentCov*, based on the CEM sample. We use the baseline regression specification (2) but replace *Post* with indicators for each year around the loan origination. The unit of observation is at the plant-chemical level. Loan initiation window k on the x-axis is year k around loan initiation, where the negative (positive) integer k indicates years prior (post) to the loan initiation. Solid (dashed) lines indicate estimated coefficients (95% confidence intervals).

fixed effect included in Model (2). First, we explicitly control for the state pollution level and state gross domestic product (GDP) in the analyses. Our results are robust to these additional state-level controls (see Online Appendix Table A2). Next, we employ two settings to better identify changes in regulatory enforcement intensity. To address concerns of both self-selection into environmental covenants and confounding state-level factors, we use the weighted CEM sample for both settings. Results are similar when we use the unweighted CEM sample or the unmatched sample (untabulated).

4.3.1. Nonattainment status to identify air regulatory enforcement intensity

We first exploit the nonattainment designation under the Clean Air Act (CAA) to identify variation in local environmental enforcement. Under the CAA, the federal EPA assigns nonattainment status to any county where regulated pollutants exceed the federal thresholds designated in the National Ambient Air Quality Standards. Polluting plants in nonattainment counties face more stringent environmental regulations and enforcement than those in attainment counties (Becker and Henderson, 2000; Greenstone, 2002).¹⁷ As nonattainment status is mandated at the federal level, it is less likely to be correlated with local economic conditions and public sentiment.¹⁸ In Online Appendix Table A3, we provide a list of states that have ever been designated as nonattainment. In Online Appendix Figure A3, we plot the change in CAA enforcement in each state after a nonattainment designation.

We collect data on the nonattainment status of U.S. counties from the EPA's Green Book. We treat a county as a nonattainment county if the whole county is classified as nonattainment for any pollutant regulated by the National Ambient Air Quality Standards in a particular year.¹⁹ In Table 4, Panel A, we first validate and find that counties have higher CAA enforcement intensity after receiving the nonattainment designation. Next, we investigate whether the effectiveness of environmental covenants in reducing borrowers' pollution is stronger for plants in nonattainment counties.²⁰ We report the findings in Table 4, Panel B. In column 1, the use of environmental covenants is significantly associated with a larger reduction in emissions of CAA-regulated air pollutants in the post-loan origination periods when borrowers' plants are located in nonattainment counties compared to those in attainment counties. To further identify the effects of CAA enforcement on CAA-regulated pollutants and to rule out omitted variables that may explain enforcement of all environmental statutes, we conduct a falsification analysis on whether CAA nonattainment status affects air emissions not regulated by CAA. We re-estimate the same regression using emissions of air pollutants not regulated under the CAA (column 2) as dependent variables. We find insignificant results for non-CAA chemical releases, mitigating the potential omitted variables concern.

4.3.2. Close elections to identify regulatory enforcement intensity

We next exploit close congressional elections to identify variation in state environmental enforcement. To the extent that close congressional election outcomes are partially attributable to random factors that affect voter behaviors (Eggers et al., 2015), this setting introduces variation in states' partisan composition of congressional representatives that may affect environmental enforcement, and this variation is unlikely to be correlated with local economic or cultural factors (Helland, 1998; Lee, 2008; Akey, 2015; Innes and Mitra, 2015; Heitz et al., 2021). Random components that could affect voter turnout or voter preferences include weather and natural disasters such as floods and droughts (e.g., Achen and Bartels, 2016; Bassi, 2019), outcomes of sporting events (e.g., Healy et al., 2010; Busby et al., 2017), and ballot order (Ho and Imai, 2008). Moreover, prior studies and anecdotal evidence suggest that congressional representatives can influence regulatory enforcement in their home states by introducing bills and resolutions, offering amendments, securing funding and federal appropriations, and affecting enforcement actions and investigations in home states (Scholz et al., 1991).²¹ Furthermore, compared to Republicans, Democrats tend to be more committed to promoting environmental regulation and increasing government spending (Shipan and Lowry, 2001; Egan 2013; Egan and Mullin, 2017; Ballew et al., 2019). Thus, we expect that Democratic congressional representatives who win in close elections are more likely to strengthen environmental enforcement in their home states.

We collect election data on U.S. Senate and House Elections from the MIT Election Data and Science Lab and restrict our analyses to general elections where the winner is either Republican or Democrat. Following prior research (Akey, 2015; Heitz et al., 2021), we define close elections as those where the winning candidate's margin of victory is less than 5%. We construct two state-year level indicator variables to capture an increase in regulatory enforcement. Specifically, *Democrat Win* equals one if Democratic candidates win at least one close election in a state, and *Democrat Majority* equals one if Democratic candidates win more than half of the close elections in a state. In Online Appendix Table A4, we list the distribution of Democratic wins for states with close elections. In Online Appendix Figure A4, we plot the change in enforcement level after Democrats win close elections.

¹⁷ Specifically, states with nonattainment counties are required to develop plant-specific regulations, set emission limits to curb emission for every major source of pollution, adopt the "lowest achievable emission rates" (LAER) standard, and invest in the cleanest abatement technology.

¹⁸ While this setting may not rule out local pollution as an omitted variable, Greenstone (2002) argues that "scientific evidence suggests that during the years under study many counties were designated nonattainment due to pollution that was related to weather patterns— a factor which is unlikely to be related to local manufacturing sector activity."

¹⁹ We are not aware of any readily available database that allows the mapping of TRI chemicals to each of the six National Ambient Air Quality Standards pollutant categories regulated by the CAA. In addition, pollutants covered by the TRI could be subject to more than one CAA standard. For example, carbon monoxide is monitored under both 1-h and 8-h standards, and each standard designates nonattainment status based on the values computed using different criteria and thresholds. As a result, we do not use a regression discontinuity design to further sharpen identification.

²⁰ We validate that before loan initiation, there is no significant difference in chemical emissions in nonattainment counties between firms whose loans have and those do not have environmental covenants (Figure A2 in Online Appendix). Our finding of reduced chemical releases after loan initiation for this sample thus is not likely driven by self-selection.

²¹ For example, Michigan Congressman Daniel Kildee introduced the National Opportunity for Lead Exposure Accountability and Deterrence Act of 2017, which requires the EPA to enhance the national primary drinking water regulations for lead and copper. He also introduced the Flint Registry Reauthorization Act to compile a voluntary registry of individuals exposed to lead contamination in the local drinking water system in Flint. In another example, after the oil pipeline leak in Orange County, CA, in 2021, district Congresswoman Katie Porter monitored the investigation and held a congressional hearing in Irvine to give local residents an opportunity to speak with lawmakers and seek information.

Table 4
CAA nonattainment status and environmental covenants.

Panel A: Nonattainment Status and CAA Enforcement		
Dependent Variable =	CAA Enf	
	(1)	
Nonattainment	0.054*** (3.452)	
County FE	YES	
Year FE	YES	
Observations	68,491	
Adjusted R-squared	0.337	
Panel B: Nonattainment Status, Environmental Covenants, and Toxic Releases		
Dependent Variable =	Log (1 + Air Toxic Release)	
Sample	CEM Weighted Sample	
Chemical =	CAA	Non-CAA
	(1)	(2)
EnvironmentCov × Post × Nonattainment (β_1)	-0.075* (-1.932)	0.022 (0.727)
EnvironmentCov × Post	0.044 (1.472)	-0.008 (-0.522)
EnvironmentCov × Nonattainment	0.007 (0.170)	0.011 (0.361)
Post × Nonattainment	0.023 (0.817)	-0.008 (-0.320)
EnvironmentCov	-0.074 (-1.340)	-0.104*** (-3.547)
Post	-0.019 (-0.738)	0.023 (1.176)
Nonattainment	0.115* (1.786)	-0.014 (-0.390)
Cross-sample coefficient differences (p-value)		
β_1	0.058	
Controls	YES	YES
County FE	YES	YES
Chemical-Year FE	YES	YES
State-Year FE	YES	YES
Observations	64,071	44,399
Adjusted R-squared	0.594	0.668

Panel A presents the results of regressing Clean Air Act (CAA) enforcement intensity on nonattainment status after controlling county and year-fixed effects. The unit of observation is at the county-year level. *Nonattainment* equals one if a county is designated as nonattainment status for a given year by EPA and zero otherwise. *CAA Enf* is the log of one plus the aggregate number of CAA enforcement and inspections conducted in a county for a given year. Panel B presents OLS estimates of Model 2, where *State Enf* is replaced with an indicator for prior year nonattainment status (*Nonattainment*). The unit of observation is at the Plant-Chemical-Year level. The dependent variables are the log of one plus air toxic emissions scaled by sales. In Column (1), the sample is restricted to the chemicals regulated under CAA, whereas in Columns (2), the samples include chemicals that are not regulated under CAA. *EnvironmentCov* equals one if a loan facility has environmental covenants and zero otherwise. *Post* is an indicator variable equal to one for years after the loan initiation. The definition of the control variables can be found in Appendix C. Standard errors are clustered at the industry level. T-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

In Table 5, Panel A, we first validate that states with at least one or a majority of Democrat winners in close elections have higher state environmental enforcement intensity in the year after the election, compared to states where Republicans win close elections. In Table 5, Panel B, we show that after loan initiation, borrowers with environmental covenants experience a larger reduction in total toxic emissions when their plants are located in close-election states with at least one or a majority of congressional seats won by Democratic candidates, respectively.²² Overall, these findings suggest that the effects of public enforcement on lenders' monitoring are unlikely driven by omitted, time-varying, state-level variables. Together, these analyses support our main arguments that public enforcement reinforces private monitoring in reducing borrowers' polluting behavior.

²² Considering that some states may have consecutive close elections and our outcome tests cover a three-year window before and after loan initiation, we exclude states with consecutive close elections in the post-loan initiation periods. Moreover, firms located in states with Democratic wins and with environmental covenants do not show a difference in emission reductions before loan initiation, compared to those without environmental covenants (see Figure A2 in Online Appendix). We do not employ a Regression Discontinuity design because there may be multiple congressional close elections in an election cycle within a state.

Table 5
Close elections and environmental covenants.

Panel A: Close Election Validation Tests		
Dependent Variable =	State Enf_{t+1}	
	(1)	(2)
Democrat Win	0.0322* (1.878)	
Democrat Majority		0.0305** (2.054)
State FE + Year FE	YES	YES
Observations	346	346
Adjusted R-squared	0.809	0.809
Panel B: Close Election Outcome Tests		
Dependent Variable =	Log (1+Toxic Release)	
Sample	CEM Weighted Sample	
Close Election =	Democrat Win (1)	Democrat Majority (2)
EnvironmentCov × Post × Close Election	-0.128** (-2.492)	-0.110** (-2.249)
EnvironmentCov × Post	0.003 (0.071)	-0.012 (-0.309)
EnvironmentCov × Close Election	0.035* (1.806)	0.026 (1.327)
Post × Close Election	0.040 (0.894)	0.024 (0.611)
EnvironmentCov	0.008 (0.357)	0.014 (0.582)
Post	-0.008 (-0.400)	0.000 (0.019)
Close Election	-0.040 (-0.910)	-0.025 (-0.685)
Controls	YES	YES
Plant-Chemical FE	YES	YES
Chemical-Year FE	YES	YES
State FE	YES	YES
Observations	32,117	32,117
Adjusted R-squared	0.928	0.928

Panel A presents the results of regressing one-year-ahead enforcement intensity on an indicator for democrat-win close elections after controlling for state and year-fixed effects. The unit of observation is at the state-year level. $State\ Enf_{t+1}$ is the log of one plus the aggregate number of environmental inspections and enforcements per facility in the state in the year after close elections. In Column (1), *Democrat Win* equals one if Democratic candidates win at least one of the seats in close congressional elections in the state. In Column (2), *Democrat Majority* equals one if Democratic candidates win more than half of the seats in close congressional elections in the state in year t . Standard errors are clustered at the state level. Panel B presents OLS estimates of Model 2 (outcome test), where $State\ Enf$ is replaced with *Democrat Win* (column 1) or *Democrat Majority* (column 2). The sample is restricted to the states that have close elections a year prior to the loan origination but do not have consecutive close elections in the post-loan initiation periods. The dependent variables are the log of one plus total releases scaled by sales. *EnvironmentCov* equals one if a loan facility has environmental covenants and zero otherwise. *Post* is an indicator variable equal to one for years after the loan initiation. The definition of the control variables can be found in Appendix C. T-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

5. Supplementary analyses

5.1. Cross-sectional analyses on borrowers' bankruptcy risk

Considering that environmental liabilities are more concerning to lenders when borrowers are close to bankruptcy, we expect the effect of public enforcement on lender monitoring to be stronger when borrowers have higher bankruptcy risk. We test this prediction by partitioning our sample based on borrowers' bankruptcy risk, measured using Altman's Z Score. Specifically, we consider a borrower to be of high (low) bankruptcy risk if its Altman's Z Score is below (above) the lowest quintile of the sample.²³ Table 6, Panels A and B present the determinant and outcome results of the bankruptcy subsamples.

²³ We further find that borrowers have lower Altman's Z scores in the year of their environmental violations (see Online Appendix Table A5), suggesting that environmental liabilities deteriorate borrowers' creditworthiness.

Table 6
Subsample analyses – bankruptcy risks.

Panel A: Subsample Analyses of Determinant Tests		
Dependent Variable =	EnvironmentCov	
Subsample	Altman Z \leq Lowest Quintile	Altman Z $>$ Lowest Quintile
	(1)	(2)
High Polluting Industry EPA \times State Enf (β_1)	0.810*** (6.13)	0.257** (2.66)
Real Property Collateral \times State Enf (β_2)	0.726** (2.57)	0.196 (1.45)
Non-Real Property Collateral \times State Enf (β_3)	-0.071 (-1.23)	-0.094 (-0.66)
Real Property Collateral	0.163 (1.02)	0.269*** (2.85)
Non-Real Property Collateral	0.106 (1.36)	0.097 (1.07)
State Enf	-0.678*** (-4.85)	-0.109 (-1.15)
Constant	0.355 (0.59)	0.035 (0.14)
Cross-sample coefficient differences (p-value)		
β_1	0.000	
β_2	0.036	
β_3	0.886	
Controls	YES	YES
Industry FE	YES	YES
Year FE	YES	YES
Loan Purpose FE	YES	YES
Bank FE	YES	YES
State FE	YES	YES
Observations	417	1637
Adjusted R-squared	0.725	0.314
Panel B: Subsample Analyses of Outcome Tests		
Dependent Variable =	Log (1+Toxic Release)	
Sample	CEM Weighted Sample	
Subsample	Altman Z \leq Lowest Quintile	Altman Z $>$ Lowest Quintile
	(1)	(2)
EnvironmentCov \times Post \times State Enf (β_1)	-0.093*** (-2.81)	-0.024 (-1.19)
EnvironmentCov \times Post	0.055 (1.19)	-0.019 (-1.43)
EnvironmentCov \times State Enf	0.008 (0.307)	0.013 (0.973)
Post \times State Enf	0.024 (1.09)	0.006 (1.01)
EnvironmentCov	-0.012 (-0.388)	0.019 (0.593)
Post	-0.007 (-0.210)	0.017 (1.65)
State Enf	-0.057** (-2.39)	-0.007 (-0.598)
Cross-sample coefficient differences (p-value)		
β_1	0.078	
Controls	YES	YES
Plant-Chemical FE	YES	YES
Chemical-Year FE	YES	YES
State FE	YES	YES
Observations	54,960	153,751
Adjusted R-squared	0.936	0.906

Panel A presents OLS estimates of Model 1 (determinant test) using the subsamples partitioned based on the quintile value of *AltmanZ*. *EnvironmentCov* equals one if a loan facility has environmental covenants included in its loan agreement and zero otherwise. *High Polluting Industry EPA* equals one if the borrower belongs to one of the top 5 polluting industry sectors identified by the U.S. EPA. *Real Property Collateral* equals one if a loan facility has real property collateral and zero otherwise. *Non-Real Property Collateral* equals one if a loan facility has collateral that is not real property and zero otherwise. *State Enf* is the proportion of a borrower's plants located in states with high environmental regulation intensity. Standard errors are clustered by industry. Panel B presents OLS estimation of Model 2 (outcome test) using the subsamples partitioned based on the quintile value of *AltmanZ*. The unit of observation is at the Plant-Chemical-Year level. The dependent variables are the log of one plus total releases scaled by sales. *Post* is an indicator variable equal to one for years after the loan initiation. *State Enf* is the total inspections and enforcement actions deflated by the total number of facilities in a state (excluding the borrower's own inspection and enforcement). The definition of the control variables can be found in Appendix C. Standard errors are clustered at the industry level. T-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Consistent with our expectation, we find that public enforcement has a stronger effect in both inducing lender monitoring and enhancing lender monitoring effectiveness for borrowers with higher bankruptcy risk. These findings support the argument that credit risk is an important channel through which lenders incorporate public enforcement activity into their monitoring decisions.

5.2. Sources and mechanisms of emission reductions

To triangulate our findings and shed light on the mechanisms through which borrowers reduce their emissions, we examine borrowers' investment in abatement activities after loan initiation using the EPA's Pollution Prevention (P2) database. We focus on six activities that can reduce hazardous emissions: raw material modification, cleaning and degreasing, product modification, surface preparation and finishing, good operating practices, and process modifications (Akey and Appel, 2021). As shown in Table 7, borrowers whose loans contain environmental covenants are more likely to invest in product modifications to reduce pollution when they are located in states with higher regulatory enforcement intensity. This finding suggests that the interplay between public enforcement and private monitoring can increase firms' pollution abatement activities.

5.3. Bundling of environmental covenants

In our main analyses, we examine the effects of environmental covenants based on whether a loan includes any environmental covenants. In this supplemental analysis, we examine whether bundling of the three types of covenants affects our

Table 7
The effects of environmental covenants on abatement investments.

Dependent Variable =	I(Product)	I(Raw Material)	I(Cleaning and Degreasing)	I(Surface)	I(Operating)	I(Process)
Sample	CEM Weighted Sample					
	(1)	(2)	(3)	(4)	(5)	(6)
EnvironmentCov × Post × State Enf	0.002* (1.945)	-0.002 (-1.008)	0.004 (1.171)	-0.000 (-0.501)	-0.009 (-0.797)	-0.009 (-1.170)
EnvironmentCov × Post	-0.001 (-0.734)	0.000 (0.097)	-0.001 (-0.433)	0.001 (0.756)	0.007 (0.923)	0.002 (0.353)
EnvironmentCov × State Enf	0.001 (1.218)	0.000 (0.012)	-0.002 (-0.848)	-0.001 (-0.939)	0.001 (0.230)	0.005 (1.494)
Post × State Enf	-0.001 (-1.654)	0.001 (1.231)	-0.003 (-0.878)	-0.001 (-0.942)	-0.004 (-1.152)	0.003 (1.121)
EnvironmentCov	-0.000 (-0.388)	0.003 (0.812)	-0.001 (-0.345)	0.002* (1.971)	-0.002 (-0.329)	-0.002 (-0.674)
Post	0.001 (0.702)	-0.000 (-0.377)	0.000 (0.022)	0.001 (0.552)	0.001 (0.195)	0.001 (0.172)
State Enf	-0.001 (-0.803)	0.001 (0.560)	0.002 (0.765)	-0.003 (-1.682)	0.015*** (2.000)	-0.003 (-1.367)
Controls	YES	YES	YES	YES	YES	YES
Plant-Chemical FE	YES	YES	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
Observations	208,711	208,711	208,711	208,711	208,711	208,711
Adjusted R-squared	0.399	0.360	0.435	0.440	0.560	0.459

This table provides OLS estimates from the following equation:

$$I(\text{Abatement Initiatives}_{c,p,i,j,t}) = \beta_0 + \beta_1 \text{EnvironmentCov}_{i,j,t} \times \text{Post}_{i,j,t} \times \text{State Enf}_{i,p,t} + \beta_2 \text{EnvironmentCov}_{i,j,t} \times \text{Post}_{i,j,t} + \beta_3 \text{EnvironmentCov}_{i,j,t} \times \text{State Enf}_{i,p,t} + \beta_4 \text{Post}_{i,j,t} \times \text{State Enf}_{i,p,t} + \beta_5 \text{EnvironmentCov}_{i,j,t} + \beta_6 \text{Post}_{i,j,t} + \beta_7 \text{State Enf}_{i,p,t} + \text{Controls} + \text{Fixed Effects} + \varepsilon$$

The unit of observation is at the Plant-Chemical-Year level. The dependent variable is an indicator variable for each category of abatement initiatives undertaken to reduce the use of a certain chemical. *EnvironmentCov* equals one if a loan facility has environmental covenants and zero otherwise. *Post* is an indicator variable equal to one for years after the loan initiation. *State Enf* is the total inspections and enforcement actions deflated by the total number of facilities in a state (excluding the borrowers' own inspection and enforcement). Standard errors are clustered at the industry level. T-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

inference and shed light on the effectiveness of covenant designs. Appendix E presents descriptive statistics of bundled environmental covenants: 24% of our samples have only one environmental covenant ($EnvironmentCovN = 1$), and 17% have bundled covenants, with disclosure covenants bundled together with either an action or audit covenant ($EnvironmentCovN = 2$) or both covenants ($EnvironmentCovN = 3$). In Table 8, we find that the effects of environmental covenants in reducing emissions in the presence of strict public enforcement are driven by the use of at least two types of environmental covenants. In particular, effective covenant designs involve bundling disclosure covenants with either action or audit covenants or both. These findings further suggest that the effectiveness of lenders' environmental monitoring increases with environmental covenant intensity in the presence of strict public enforcement.

5.4. Effects of financial and general covenants

To corroborate our findings on the role of environmental covenants in lenders' environmental monitoring, we test the effectiveness of these covenants controlling for financial and general covenants. In Table 9, based on the incidence of covenants in column 1 and the number of covenants in column 2, we continue to find that environmental covenants effectively reduce borrowers' emissions in the presence of more stringent regulatory enforcement. Moreover, we do not find evidence suggesting that the use of either general or financial covenants is associated with reduced pollution after loan

Table 8
Bundled environmental covenants.

Dependent Variable =	Log (1+Toxic Release)
Sample	CEM Weighted Sample
	(1)
EnvironmentCovN = 1 × Post × State Enf	0.004 (0.310)
EnvironmentCovN = 2 × Post × State Enf	-0.072* (-1.755)
EnvironmentCovN = 3 × Post × State Enf	-0.094*** (-3.051)
EnvironmentCovN = 1 × Post	-0.009 (-0.454)
EnvironmentCovN = 2 × Post	0.020 (0.606)
EnvironmentCovN = 3 × Post	-0.005 (-0.135)
EnvironmentCovN = 1 × State Enf	-0.003 (-0.238)
EnvironmentCovN = 2 × State Enf	-0.021 (-0.499)
EnvironmentCovN = 3 × State Enf	0.027 (0.659)
Post × State Enf	0.005 (0.698)
EnvironmentCovN = 1	0.017 (0.729)
EnvironmentCovN = 2	0.041 (1.151)
EnvironmentCovN = 3	-0.028 (-0.557)
Post	0.010 (0.752)
State Enf	-0.028 (-1.545)
Controls	YES
Plant-Chemical FE	YES
Chemical-Year FE	YES
State	YES
Observations	208,711
Adjusted R-squared	0.913

This table presents OLS estimates of Model 2 (outcome test), where $EnvironmentCov$ is replaced with indicators for the number of bundled environmental covenants. The dependent variables are the log of one plus total releases scaled by sales. $EnvironmentCovN = k$ equals one if a loan facility has k environmental covenants and zero otherwise. $Post$ is an indicator variable equal to one for years after the loan initiation. $State\ Enf$ is the total inspections and enforcement actions deflated by the total number of facilities in a state (excluding the borrower's own inspection and enforcement). The definition of the control variables can be found in Appendix C. Standard errors are clustered at the industry level. T-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9
The effects of financial covenants and general covenants.

Dependent Variable =	Log (1+Toxic Release)	
	CEM Weighted Sample	
Sample		
Covenant	Incidence	Number
	(1)	(2)
EnvironmentCov × Post × State Enf (β_1)	-0.052** (-2.504)	-0.031*** (-3.337)
General Covenant × Post × State Enf (β_2)	-0.031 (-0.801)	-0.004 (-0.419)
Financial Covenant × Post × State Enf (β_3)	-0.015 (-0.352)	-0.006 (-0.565)
EnvironmentCov × Post	0.003 (0.158)	0.003 (0.340)
General Covenant × Post	0.014 (0.683)	-0.014*** (-2.864)
Financial Covenant × Post	0.001 (0.040)	0.013* (1.861)
EnvironmentCov × State Enf	0.005 (0.375)	0.001 (0.210)
General Covenant × State Enf	0.013 (0.564)	-0.002 (-0.267)
Financial Covenant × State Enf	-0.016 (-0.736)	-0.003 (-0.233)
Post × State Enf	0.048 (1.659)	0.029** (2.309)
EnvironmentCov	0.024 (1.290)	0.011 (1.255)
General Covenant	-0.003 (-0.304)	0.011** (2.067)
Financial Covenant	0.001 (0.071)	-0.013 (-1.285)
Post	-0.005 (-0.243)	0.011 (0.733)
State Enf	-0.027 (-1.520)	-0.016 (-1.200)
H0: $\beta_1 \geq \beta_2$	0.28	0.05
H0: $\beta_1 \geq \beta_3$	0.23	0.05
Controls	YES	YES
Plant-Chemical FE	YES	YES
Chemical-Year FE	YES	YES
State FE	YES	YES
Observations	208,711	208,711
Adjusted R-squared	0.912	0.913

This table provides OLS estimates of Model 2 (outcome test), where we additionally include interactions among *Post*, *State Enf*, and *General Covenant* or *Financial Covenant*. The unit of observation is at the Plant-Chemical-Year level. The dependent variables are the log of one plus total releases scaled by sales. In Column (1), *EnvironmentCov* (*General Covenant* or *Financial Covenant*) equals one if a loan facility has an environmental covenant (general or financial covenants) and zero otherwise. In Column (2), *EnvironmentCov* (*General Covenant* or *Financial Covenant*) is the number of environmental covenants (general or financial covenants) included in the loan facility. *Post* equals one for years after the loan initiation. *State Enf* is the total inspections and enforcement actions deflated by the total number of facilities in a state (excluding the borrower's own inspection and enforcement). Standard errors are clustered at the industry level. T-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

initiation, regardless of regulatory enforcement intensity. Further, though the coefficient on the incidence of financial or general covenants is not significantly different from that of environmental covenants (column 1), the coefficient on the number of financial or general covenants is significantly lower than that on the number of environmental covenants (column 2). Moreover, we fail to find evidence suggesting that general or financial covenants increase borrowers' abatement activities (untabulated). These results suggest the unique role of environmental covenants in addressing environmental risks.

6. Conclusion

Motivated by the call for joint efforts between governments and private sectors to achieve environmental goals, our study provides novel evidence on the interplay between public enforcement and private monitoring in addressing corporate pollution. We capture private lender monitoring by the use of environmental covenants in loan contracts, a direct mechanism through which lenders can monitor environmental risks among borrowers. We predict and find that when highly polluting

borrowers and borrowers using real collateral are located in states with higher regulatory enforcement intensity, lenders are more likely to use environmental covenants to mitigate environmental liabilities. These findings suggest that stringent public enforcement strengthens lenders' environmental monitoring incentives.

To shed light on the impact of public enforcement on lenders' monitoring effectiveness, we examine whether the effects of environmental covenants on borrowers' polluting activities vary with regulatory enforcement intensity. We argue that public enforcement facilitates lenders' monitoring by providing timely detection and disclosure of environmental violations. We predict and find that environmental covenants are more effective in reducing borrowers' toxic releases when borrowers face stronger regulatory enforcement. These findings, along with a higher likelihood of borrower investments in abatement technologies in the presence of stronger regulatory enforcement, suggest that public enforcement strengthens lenders' monitoring of borrowers' environmental activities, which in turn motivates borrowers to adopt more environmentally friendly practices.

Our study adds to the debate on the roles of governments and private sectors in tackling corporate pollution. Our findings support the notion that public enforcement and private monitoring complement each other in curbing corporate pollution. Our evidence that lender monitoring more effectively curbs corporate pollution in the presence of more stringent public enforcement suggests that governmental oversight is still crucial to induce firms to internalize environmental externalities through the channel of private monitoring. Our study also contributes to the environmental, social, and governance (ESG) literature by documenting the use of environmental covenants to monitor borrowers' polluting activities and the influence of public enforcement on the effectiveness of these covenants.

Appendix A. An Example of Environmental Covenants

The following excerpt is from the loan agreement filed on February 12, 2010, between Geokinetics Holdings USA and its lenders that includes all three types (action, disclosure, and audit) of environmental covenants.

See https://www.sec.gov/Archives/edgar/data/314606/000110465910007439/a10-3821_1ex10d1.htm.

Section 6.04 Environmental Matters.

- (a) Comply, cause each of its Subsidiaries to comply and use commercially reasonable efforts to cause all lessees and other Persons operating or occupying its properties to comply, in all material respects, with all applicable Environmental Laws and Environmental Permits; obtain and renew, and cause each of its Subsidiaries to obtain and renew, all Environmental Permits necessary for its operations and properties; and conduct, and cause each of its Subsidiaries to conduct, any investigation, study, sampling and testing, and undertake any cleanup, removal, remedial or other action reasonably required to remove and clean up all releases or threatened releases of Hazardous Materials from any of its properties, as required under, and in accordance with the requirements of all Environmental Laws; provided, however, that neither the Borrower nor any of its Subsidiaries shall be required to undertake any such cleanup, removal, remedial or other action to the extent that its obligation to do so is being contested in good faith and by proper proceedings and appropriate reserves are being maintained with respect to such circumstances.
- (b) In the event any assessments requested by the Administrative Agent identify any material non-compliance with Environmental Law relating to the sites specified in such reports (the "Specified Sites") that could reasonably be expected to result in any Environmental Liabilities in excess of the Threshold Amount with respect to the Specified Sites as reasonably determined by the Lenders, the Borrower shall (i) provide the Lenders with a plan to remedy such non-compliance (a "Specified Remediation Plan"), (ii) shall implement any changes or additions to such Specified Remediation Plan as may be reasonably requested by the Lenders and (iii) shall implement such Specified Remediation Plan or cure any such non-compliance within 180 days of such Specified Remediation Plan being approved by the Lenders or within such other time as the Lenders may agree.
- (c) Environmental Reporting Requirements. Promptly after a Responsible Officer obtains knowledge thereof, notify the Administrative Agent of or, as soon as practicable after receipt thereof, deliver to the Administrative Agent, for prompt further distribution to each Lender, material documents concerning:
 - (i) any Environmental Action against or of any non-compliance by any Loan Party or any of its Subsidiaries with any Environmental Law or Environmental Permit that would (1) reasonably be expected to result in a material liability or (2) cause any Mortgaged Properties to be subject to any additional restrictions on ownership, occupancy, use or transferability under any Environmental Law;
 - (ii) (1) any occurrence of any release or threatened release of Hazardous Materials required to be reported to any Governmental Authority under applicable Environmental Law, (2) any remedial actions taken by any Loan Party or its Subsidiaries in respect of any such release or threatened release that could reasonably be expected to result in an Environmental Action or (3) the Loan Parties' discovery of any occurrence of or condition on any real property adjoining or in the vicinity of any site or facility that would be reasonably expected to cause such site or facility or any part thereof to be subject to any restrictions on the ownership, occupancy, transferability or use thereof under any Environmental Laws, in each case where such event or occurrence would reasonably be expected to have a Material Adverse Effect;

- (iii) copies of any and all material written communications with respect to (1) any Environmental Action, (2) any release or threatened release or non-compliance with any Environmental Law required to be reported to any Governmental Authority and (3) any request for information from a Governmental Authority that suggests such Governmental Authority is investigating the potential responsibility of the Borrower or any of its Subsidiaries as a potentially responsible party, in each case where such event or occurrence would reasonably be expected to have a Material Adverse Effect;
- (iv) (1) any Permitted Acquisition that could reasonably be expected to (A) expose the Borrower or any of its Subsidiaries to, or result in, material Environmental Actions or (B) affect the ability of the Borrower and its Subsidiaries to maintain in full force and effect all Governmental Authorizations and Environmental Permits required for the continued operations of their respective businesses and (2) any action proposed to be taken by the Borrower or any of its Subsidiaries to modify current operations in a manner that would reasonably be expected to subject the Borrower and its Subsidiaries to any material additional obligations or requirements under Environmental Laws;
- (v) copies of all environmental reports, audits or analyses (whether produced by the Borrower or its Subsidiaries or any third party or Governmental Authority) in respect of any sites owned, leased or operated by the Borrower and its Subsidiaries to the extent requested by the Administrative Agent or any Lender upon a request to the Administrative Agent;
- (vi) upon a good faith belief that a release of Hazardous Materials or a violation of Environmental Law reasonably likely to result in a fine or penalty in excess of the Threshold Amount has occurred and within 60 days after such request and at the expense of the Borrower, any additional environmental site assessment reports for any of its or its Subsidiaries' properties described in such request prepared by an environmental consulting firm acceptable to the Administrative Agent, indicating the presence or absence of such Hazardous Materials and the estimated cost of any compliance, removal or remedial action in connection with any such Hazardous Materials on such properties; without limiting the generality of the foregoing, if the Administrative Agent reasonably determines at any time that a material risk exists that any such report will not be provided within the time referred to above, the Administrative Agent may retain an environmental consulting firm to prepare such report at the expense of the Borrower, and the Borrower hereby grants and agrees to cause any Subsidiary that owns any property described in such request to grant at the time of such request to the Administrative Agent, the Lenders, such firm and any agents or representatives thereof an irrevocable non-exclusive license, subject to the rights of tenants, to enter onto their respective properties to undertake such an assessment; and
- (vii) any such other documents and information as the Administrative Agent may reasonably request from time to time.

Appendix B. Keywords list

Part I: Keywords for the search of credit agreements.

“CREDIT AGREEMENT”, “LOAN AGREEMENT”, “CREDIT FACILITY”, “LOAN AND SECURITY AGREEMENT”, “LOAN & SECURITY AGREEMENT”, “CREDIT AND GUARANTEE AGREEMENT”, “CREDIT & GUARANTEE AGREEMENT”, “CREDIT AND GUARANTY AGREEMENT”, “CREDIT & GUARANTY AGREEMENT”, “LOAN AND GUARANTEE AGREEMENT”, “LOAN & GUARANTEE AGREEMENT”, “LOAN AND GUARANTY AGREEMENT”, “LOAN & GUARANTY AGREEMENT”, “CREDIT AND SECURITY AGREEMENT”, “CREDIT & SECURITY AGREEMENT”, “LOAN AND SECURITY AGREEMENT”, “LOAN & SECURITY AGREEMENT”, “REVOLVING CREDIT”, “FINANCING AND SECURITY AGREEMENT”, “FINANCING & SECURITY AGREEMENT”, and “FACILITY AGREEMENT”.

The word list is in capital letters because the title of a credit agreement typically starts with capital letters.

Part II: Keywords for the search of environmental covenants.

Affirmative covenants: “affirmative covenants”, “positive covenants”, “company covenants”, “covenants of the borrower”, “environmental covenants”, “reporting covenants”, “general covenants”.

Environmental action covenants: “conduct/take/complete/implement/+ w/250 + remed/clean/remov/abate/dispose/eliminate/corrective + w/250+ environmental/hazard”.

Environmental disclosure covenants: “advise/notify/report/disclose/deliver/notice + w/500 + environmental/hazard”.

Environmental audit covenants: “conduct/provide/retain/hire/furnish + w/250 + environmental + w/250 + consultant/audit/engineering/consulting/advisor”.

The word lists in part II are case insensitive. Note that “+ w/n” means searching within n characters. For example, “advise + w/500+ environmental” locates a text where “environmental” appears within 500 characters after “advise”.

Part III: Keywords to search real property collateral.

Real property collateral: “collateral + w/100 + real + w/30 + property”, “real + w/30 + property + w/30 + collateral”.

Appendix C. Variable Definitions

Variable	Definition (Data sources in parentheses)
Environmental Covenant Variables	
<i>EnvironmentCov</i>	Equals one if a loan contract includes at least one environmental covenant and zero otherwise. (SEC filings)
<i>EnvironmentCovN</i>	The number of environmental covenants included in a loan agreement. (SEC filings)
Other Loan-level Variables	
<i>Real Property Collateral</i>	Equals one if a loan agreement includes real property collateral, and zero otherwise. (SEC filings)
<i>Non-Real Property Collateral</i>	Equals one if a loan facility reports collateral in DealScan and its loan agreement does not include real property collateral and zero otherwise. (DealScan, SEC filings)
<i>Log (Loan Size)</i>	The natural logarithm of loan facility amount (in millions). (DealScan)
<i>Log (Maturity)</i>	The natural logarithm of loan maturity. (DealScan)
<i>Log (N Lenders)</i>	The natural logarithm of the number of lenders. (DealScan)
<i>Financial Covenant</i>	Indicator for financial covenants or the number of financial covenants included in a loan facility. (DealScan)
<i>General Covenant</i>	Indicator for general covenants or the number of general covenants included in a loan facility. (DealScan)
Environmental Performance Variables	
<i>High Polluting Industry EPA</i>	Equals one if a borrower belongs to one of the top 5 polluting industry sectors identified by the U.S. EPA (see Appendix D).
<i>High Polluting Industry TRI</i>	Equals one if a borrower belongs to an industry with industry emission intensity (i.e., total releases scaled by sales) in the top quartile of all industries covered by TRI. (TRI)
<i>Log(1 + Toxic Release)</i>	The natural logarithm of one plus total emission of the toxic chemical scaled by sales in the previous year. (TRI)
<i>I(Abatement Initiatives)</i>	Equals one if a plant undertakes a certain category of pollution prevention efforts, which include product modification, raw material modification, cleaning and degreasing, surface preparation and finishing, good operating practices, and process modification. (TRI P2)
Firm-level Variables	
<i>Log (Total Asset)</i>	The natural logarithm of total assets (in millions). (Compustat)
<i>ROA</i>	Operating income before depreciation scaled by the average of the total assets at the beginning and the ending period. (Compustat)
<i>Leverage</i>	Total liabilities divided by total assets. (Compustat)
<i>Cash/Liabilities</i>	Cash divided by total liabilities. (Compustat)
<i>Tangible</i>	Total property, plant, and equipment divided by total assets. (Compustat)
<i>Tobin's Q</i>	The book value of total liabilities plus the market value of equity, divided by total assets. (Compustat, CRSP)
<i>Sd(Operating Cash Flow)</i>	The standard deviation of operating cash flows in the past five years. (Compustat)
<i>AltmanZ</i>	Altman's Z score = $3.3 \times (\text{Earnings before Interest and Taxes/Total Assets}) + 0.99 \times (\text{Sales/Total Assets}) + 0.6 \times (\text{Market Value of Equity/Total Liabilities}) + 1.2 \times (\text{Working Capital/Total Assets}) + 1.4 \times (\text{Retained Earnings/Total Assets})$. (Compustat, CRSP)
<i>Dividend</i>	Equals one if a firm issues a dividend and zero otherwise. (Compustat)
<i>Institutional Ownership</i>	Percentage of shares owned by institutional investors. (Thomson Reuters)
State-level Variables	
<i>State Enf (Determinant)</i>	Proportion of borrower's plants located in states with high regulatory enforcement intensity (i.e., the aggregate number of environmental inspections and enforcements in the state deflated by the total number of TRI-reporting facilities in the state exceeds the yearly median. We exclude the inspections and enforcements on the borrower from the nominator and the borrower's plants in the state from the denominator. (EPA Enforcement and Compliance History Online database)
<i>State Enf (Outcome)</i>	Aggregate number of inspections and enforcement in the state (excluding inspections and enforcements related to borrowers' plants in the state) deflated by the total number of TRI-reporting facilities (excluding the borrowers' plants) in the state. (EPA Enforcement and Compliance History Online database)
<i>Democrat Win</i>	Equals one if Democratic candidates win at least one seat in close congressional elections in the state, and zero otherwise (MIT Election Data and Science Lab).
<i>Democrat Majority</i>	Equals one if Democratic candidates win more than half of the seats available in close congressional elections in the state, and zero otherwise. (MIT Election Data and Science Lab).
County-level Variables	
<i>Nonattainment</i>	Equals one if the county is currently designated as nonattainment status, and zero otherwise. (EPA Green Book)

Appendix D. List of High-Polluting Industries

We use two methods to define a high-polluting industry. First, we classify an industry as highly polluting if it is identified by the EPA as a top-5 polluting sector (*High Polluting Industry EPA*). Specifically, we obtain the EPA's list of polluting industry sectors by total disposal or other releases for 2019 (https://www.epa.gov/sites/default/files/2021-01/documents/2019_tri_national_analysis_complete_report.pdf) and map these to Fama-French 48 industries. Second, we classify an industry as highly polluting if its average total releases scaled by sales are higher than the top quartile of all industries covered by TRI (*High Polluting Industry TRI*). [Table D1](#) lists high-polluting industries under both definitions.

Table D1

List of Polluting Industries

FF48 Industries	High Polluting Industry EPA	High Polluting Industry TRI
Utilities	YES	YES
Business Supplies	YES	YES
Precious Metals	YES	YES
Non-Metallic and Industrial Metal Mining	YES	YES
Steel Works Etc	YES	YES
Almost Nothing	NO	YES
Shipping Containers	NO	YES
Chemicals	YES	YES
Rubber and Plastic Products	NO	YES

Appendix E. Bundling of Environmental Covenants

Table E1 presents the percentage of bundles for different combinations of three environmental covenants in the sample of loan facilities with at least one environmental covenant (column 1) and the aggregate loan facility sample (column 2). $EnvironmentCovN = k$ equals one if a loan facility has k environmental covenants, and zero otherwise.

Table E1

List of Polluting Industries

	% EnvironmentCov (1)	% Total Sample (2)
EnvironmentCovN = 1	58.4	24.4
Disclosure	50.9	21.3
Action	7.5	3.1
EnvironmentCovN = 2	28.5	11.9
Disclosure + Action	22.3	9.3
Disclosure + Audit	6.2	2.6
EnvironmentCovN = 3	13.1	5.5
Disclosure + Action + Audit	13.1	5.5
<i>Sum</i>	100	41.8

Appendix F. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jacceco.2023.101621>.

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