Environmental Liabilities, Creditors, and Corporate Pollution: Evidence from the Apex Oil Ruling*

Jianqiang Chen   Pei-Fang Hsieh   Po-Hsuan Hsu   Ross Levine

March 2022

Abstract

We evaluate the impact of the 2008 Apex Oil court decision that made the creditors of some corporations financially liable for the environmental damages caused by specific pollutants. *Apex* reduced the circumstances under which environmental liabilities were dischargeable in Chapter 11, which generated financial incentives for the creditors of firms near bankruptcy to pressure their firms to reduce emissions of those pollutants. We discover that *Apex* lowered bond prices, widened loan spreads, and reduced corporate pollution among firms that (a) release the specific chemicals covered by *Apex* and (b) are close to Chapter 11 and hence likely to be affected by changes to the dischargeability of environmental liabilities. Further tests suggest that creditors rapidly responded to *Apex* and successfully induced firms to reduce pollution.

* Chen, College of Technology Management, National Tsing Hua University, email: cjq456jq@gapp.nthu.edu.tw; Hsieh, College of Technology Management, National Tsing Hua University, email: pfhsieh@mx.nthu.edu.tw; Hsu, College of Technology Management, National Tsing Hua University, email: pohsuanhsu@mx.nthu.edu.tw; Levine, Haas School of Business, University of California, Berkeley, email: rosslevine@berkeley.edu. We thank the valuable comments from Dyaran Bansraj, Taehyun Kim, Jongsub Lee, Kyoungwon Seo, Francesc Rodriguez Tous, and seminar participants at City University of London, National Taiwan University and Seoul National University. We also thank Wan-Chien Chiu for her assistance in processing bank loan data.

1. Introduction

Corporate pollution harms public health and the environment. As documented by Levine et al (2021), research shows that more than half of U.S. rivers, lakes, and waterways cannot support healthy aquatic life due to toxic emissions, the tap water of tens of millions of U.S. residents contains toxic chemical concentrations that exceed the levels established by the Clean Water Act, and commonly found pollutants increase rates of cancer, reproductive and neurodevelopment disorders, and premature death (Environmental Protection Agency (EPA), 2013; Landrigan et al., 2018). In addition, the EPA (2014-2016) shows that industrial pollution accounts for most U.S. land and water pollution. This research raises concerns that corporate decision-makers do not fully internalize the social costs of their choices concerning toxic releases, and U.S. environmental regulations and regulators do not fully counteract the incentives created by such externalities. Although extensive research examines how environmental regulations influence pollution, little work studies the ramifications of court decisions that change legal liability for firms' environmental damages.

In this paper, we evaluate the impact of a court decision that made the creditors of some corporations more liable for the environmental damage caused by their corporations. We focus on the dischargeability of environmental obligations under Chapter 11 bankruptcy. Chapter 11 allows financially distressed firms to reduce (i.e., "discharge") claims, such as debts. In a series of landmark cases (e.g., *Ohio v. Kovacs* (1985) and *U.S. v. Whizco* (1988)), the courts ruled that obligations to clean up polluted sites were financial "claims," making those environment obligations dischargeable in Chapter 11 like other debts. The ramifications were profound: environmental cleanup liabilities could be shifted from the corporation and its creditors to taxpayers in bankruptcy, leaving more corporate resources available to satisfy the claims of debtholders. Among financially distressed firms close to bankruptcy, therefore, the dischargeability of environmental liabilities reduced the financial incentives of creditors to limit their firms' toxic releases.

In a pivotal and surprising decision—the 2008 Apex Oil decision, the courts materially reduced the circumstances under which environmental liabilities could be discharged in Chapter 11 bankruptcy. In *Apex*, the Department of Justice and EPA brought an action under the Resource Conservation and Recovery Act (RCRA). They sought injunctive relief requiring the corporate successor of Apex Oil to clean up a site that Apex Oil contaminated before filing for Chapter 11. On July 28, 2008, the U.S. District Court for the Southern District of Illinois ordered Apex Oil Company Inc. (the successor) to clean up the contamination, holding that the environmental obligations under RCRA were not obligations to pay; they were obligations to clean up the site. Consequently, the environmental obligations under RCRA were not "claims" as defined by Chapter 11 and hence not dischargeable. While Apex Oil appealed the decision to the Seventh Circuit and the Supreme Court, the lower court ruling stood, meaning legal liability for RCRA-covered environmental damages shifted after *Apex* as those liabilities were no longer dischargeable in Chapter 11.

Changes in the legal liability for RCRA-covered environmental damages among firms in Chapter 11 suggest potentially large effects of *Apex* on creditors and pollution. *Apex* only applied to environmental cleanup obligations covered by the RCRA. Furthermore, *Apex* was primarily relevant to firms close to bankruptcy because it reduced the dischargeability of environmental cleanup obligations in bankruptcy; it did not change environmental obligations outside of bankruptcy. Thus, for firms in Chapter 11 with RCRA-covered liabilities, *Apex* left fewer resources available for creditors: corporate resources were first used to satisfy environmental obligations and only then to settle creditor claims as documented by Hayes (2016) and Ohlrogge (2020). After *Apex*, therefore, the creditors of firms close to bankruptcy that release RCRA-pollutants had stronger incentives to pressure their firms to curtail RCRA-emissions because any resultant cleanup costs would no longer be dischargeable in bankruptcy.

To evaluate the impact of *Ape*x on corporate creditors and pollution, we assess the hypotheses that among firms close to bankruptcy, *Apex* (a) adversely affected bondholder wealth,

(b) increased the interest rates charged by creditors, and (c) reduced corporate releases of RCRA-pollutants among firms that were heavy emitters of RCRA-covered chemicals before the 2008 decision. To conduct these tests, we first match data on U.S. public firms from the Compustat/CRSP database with information on the release of toxic chemicals by the facilities of those firms from the EPA's toxic release inventory (TRI) database. This matching procedure yields a chemical-facility-year panel dataset with almost 165,000 observations. We then conduct difference-in-differences (DID) analyses, where we differentiate facilities that were heavy emitters of RCRA-toxic pollutants before *Apex* from those that were not. Suppose the 2008 decision influenced firms by reducing the dischargeability of RCRA-pollution liabilities in Chapter 11. In that case, the impact of *Apex* on creditors and pollution should be larger among relatively heavy emitters of RCRA-pollutants. Furthermore, we conduct the DID estimation in two subsamples: firms with comparatively high and low default probabilities in 2007 pre-*Apex*. As stressed above, *Apex* only reduces the dischargeability of RCRA-related environmental liabilities in Chapter 11 bankruptcy. Thus, *Apex* should primarily influence the creditors of RCRA-polluting firms close to bankruptcy.

Our results are consistent with this view of how *Apex* influenced corporate pollution decisions. We find that after *Apex*, (a) corporate releases of RCRA-pollutants fell among firms that were heavy emitters of RCRA-pollutants, and (b) the drop in RCRA-pollutants is larger among firms closer to bankruptcy. Furthermore, we conduct a placebo test by examining the release of *non*-RCRA-regulated chemicals. If the 2008 decision shapes corporate behavior by altering the dischargeability of environmental obligations in Chapter 11, it should only affect RCRA-pollutants. That is what we find: there is no change in *non*-RCRA-chemical releases after *Apex*. The results of reduced RCRA-pollutants hold when conditioning on facility, chemical-year, and firm-year fixed effects and state-specific time trends. The results are robust to using several different approaches to (a) defining "heavy" emitters of RCRA-pollutants during the pre-*Apex* period and (b) gauging the closeness of firms to bankruptcy pre-*Apex*. Furthermore, the data do not violate the parallel trends assumption, consistent with the view that *Apex* induced creditors of treated firms to pressure management to reduce the release of RCRA-pollutants. Moreover, we find no evidence that *Apex* reduced pollution by lowering production or shifting the location of facilities (Greenstone, 2002; Akey and Appel, 2021).

We next directly assess the relationship between *Apex* and corporate creditors. Examining the *Apex*-creditor nexus is crucial because the proposed mechanism through which *Apex* spurs firms to reduce pollution is by altering the financial incentives of creditors and inducing them to pressure firms to emit less. Thus, we evaluate the reactions of bond returns, interest rates, and loan spreads to the Apex decision.

For bond returns, we examine cumulative abnormal returns (CARs) on corporate bonds around the 2008 Apex decision using transaction-level data from the WRDS Bond Returns database. We use the change in the flat price plus accrued interest to define bonds' monthly returns. Using an event window of one or two months around the Apex decision, we evaluate the response of CARs to *Apex*. We find a significant decrease in the CARs of bonds issued by heavy RCRA-polluters with high default probabilities but no change in the CARs of bonds issued by heavy RCRA-polluters with low default probabilities. In conjunction with the earlier findings on pollution, these results are consistent with the view that *Apex* reduced the dischargeability of RCRA-cleanup liabilities in Chapter 11, spurring bondholders to pressure firms to reduce RCRA-chemical releases.

We find similar results when analyzing interest rates. We measure a corporation's total interest rate as total interest expenses divided by total liabilities. Using a similar DID specification to the one used when examining RCRA-chemical releases and controlling for an array of time-varying firm traits, we study the change in interest rates after *Apex*. We continue to differentiate by whether firms are heavy (or non-heavy) RCRA-polluters and whether they are close to bankruptcy or not. We discover a significant increase in interest rates after *Apex* among heavy-RCRA-polluters close to bankruptcy. The findings indicate that debtholders are aware of the enhanced risk and potential loss due to the Apex Oil ruling decision. As a result, they raise the interest rates for lending to RCRA-polluting firms more exposed to bankruptcy risk.

Finally, we find consistent results using interest rate spreads on newly-issued bank loans. Saunders and Allen (2010), James and Kizilaslan (2014), and others note that bank loan spreads reflect banks' perception of the likelihood of default and the loss given default (LGD). When banks perceive higher expected LGD, they raise loan spreads. Therefore, if *Apex* increases LGD for heavy RCRA-polluters, bank loan spreads will widen following the Apex Oil decision. We use data on bank loan spreads (relative to LIBOR) from the DealScan database to test this argument. Using the same DID strategy, we assess the response of loan spreads to *Ape*x. Consistent with the *Apex*-creditor channel, we find that bank loan spreads for heavy RCRA-polluters closer to bankruptcy widened appreciably following *Ape*x but not for other firms. This result suggests that banks readily responded to the increase in specific borrowers' environmental liabilities due to the Apex Oil ruling by boosting interest rate spreads on their loans.

Our study relates to but is distinct from Ohlrogge (2020). He documents a reduction in chemical releases among public firms in the 7th Circuit, which is the legal jurisdiction of the original Apex Oil ruling. Our study differs as follows. First and foremost, we focus on the impact of *Apex* on creditors. Examining creditors is critical to our goal of evaluating a particular mechanism through which *Apex* spurred firms to reduce pollution: by altering the financial incentives of creditors. Second, we examine all public firms (with the requisite data), not only firms in the 7th Circuit. As we show, the rest of the country quickly applied *Apex*, and using the complete set of firms increases the sample from 55 7th Circuit firms to over 700 firms. Third, we employ a different methodology. We differentiate firms by their proximity to default and whether they release RCRA-pollutants. This methodology improves our ability to identify the impact of a change in legal liability for environmental damages on creditors and corporate pollution.

We also contribute to research on finance and the environment. Our work is different from prior studies that focus on shareholders' and managers' interest in environmental issues (Fowlie, 2010; Shive and Forster, 2020; Akey and Appel, 2021) or governments' concerns about economic growth and employment (Jaffe et al., 1995; Jaffe and Palmer, 1997; Greenstone, 2002; Greenstone, List, and Syverson, 2012). We explore how changes in legal liability for environmental damages can alter the incentives of creditors concerning corporate pollution. Our analyses complement recent studies highlighting bondholders' and banks' preferences for firms with better environmental performance (Flammer, 2021; Gao, Li, and Ma, 2021; Kacperczyk and Peydro, 2021). Rather than focusing on general environmental risk and reputational concerns, we examine a specific mechanism running from the reassignment of legal liability over environmental obligations to the financial incentives of creditors. Finally, we note that our work adds to the literature on law, finance, and economics by assessing the impact of the Apex court decision on securities prices and industrial pollution.

2. Dischargeability and the Case of Apex Oil

Under Chapter 11, a financially distressed company (the debtor) files for protection from its creditors with a federal bankruptcy court. Existing shareholders and managers often remain in control of the business while seeking to restructure the firm's obligations and operations to make it successful, subject to the oversight and jurisdiction of the court. Chapter 11 provides debtors with the ability to reduce—"discharge"—claims that arose before the distressed firm filed for bankruptcy. To the extent that the courts define pre-Chapter 11 environmental obligations as claims, firms can discharge those environmental liabilities through Chapter 11. Discharging environment claims can have material financial ramifications on the debtor as the burden of addressing environmental damages or other liabilities shifts from the debtor to taxpayers, leaving more resources available to satisfy the claims of other creditors (Hayes, 2016). Thus, whether courts define environmental obligations as dischargeable claims is a first-order consideration for some investors.

In defining dischargeable claims, the U.S. Bankruptcy Code stipulates that a claim can be (1) a "right to payment" 11 U.S.C. § 101(5)(A) or (2) a "right to an equitable remedy for breach of performance" but only "if such a breach gives rise to a right to payment" 11 U.S.C. § 101(5)(B). Most financial instruments clearly represent rights to payment and are hence dischargeable in Chapter 11. However, the courts have faced greater challenges in defining the circumstances under which pre-Chapter 11 environmental obligations give rise to a "right to payment" and hence make it a dischargeable claim.

Consider the landmark 1985 Supreme Court case of *Ohio v. Kovacs* concerning the dischargeability of environmental obligations. The State of Ohio obtained an injunction ordering Kovacs to clean up a hazardous waste disposal site. When Kovacs did not comply, the State directed a receiver to take Kovacs's assets to implement the injunction. Kovacs filed for bankruptcy, and the bankruptcy court stayed the execution, precluding Ohio from obtaining those assets. Ohio filed a complaint with the Bankruptcy Court arguing that the environmental obligation was not dischargeable because it was not a right to payment; it was an obligation to clean up a hazardous waste disposal site. However, the Bankruptcy Court, District Court, Court of Appeals, and Supreme Court ruled that in *Ohio v. Kovacs*, the environmental obligation "gives rise to a right to payment." The Supreme Court argued that it was clear from the details of the case that Ohio wanted money from Kovacs to defray the cleanup costs. Consequently, the obligation to clean up the hazardous waste disposal site had been converted into an obligation to pay money, making it dischargeable in bankruptcy. Subsequent cases focused on whether the environmental obligation was ultimately a monetary claim and hence dischargeable, e.g., *In re Chateaugay Corp*. and *In re Torwico Elecs.*, Inc. In fact, in *U.S. v. Whizco, Inc*. (1988), the Sixth District Court ruled that if a cleanup order would force a defendant to spend money, the environmental obligation was a claim and hence dischargeable.

In a significant and surprising decision, the courts altered and clarified the circumstances under which they would consider pre-Chapter 11 environmental obligations as dischargeable.

Apex Oil Co. filed for Chapter 11 in late 1987 and re-incorporated in 1989. In 2004, the Department of Justice and Environmental Protection Agency (EPA) brought an action under the Resource Conservation and Recovery Act (RCRA).[1] The action sought injunctive relief requiring the corporate successor to clean up a contaminated site due to Apex Oil's operations before filing for Chapter 11. Critically, the government used the RCRA §7003, 42 U.S.C. §6973(a) to compel Apex Oil Company Inc. (the reorganized entity) to clean up the site. The RCRA does *not* entitle the plaintiff to demand payment instead of cleaning up the site; it only allows the government to sue for an injunction to compel a cleanup. As summarized by Ohlrogge (2020), Apex Oil argued that it could not clean up the site and would have to pay about $150 million to other firms to comply with the EPA cleanup injunction. They stressed that their situation was similar to that in *U.S. v. Whizco, Inc*, where courts decided that such an obligation was a "claim" and hence dischargeable in bankruptcy.

On July 28, 2008, Chief Judge David R. Herndon of the U.S. District Court for the Southern District of Illinois ordered Apex Oil to clean up the contamination, holding that its environmental obligations were not dischargeable. The court rejected the application of the reasoning in *Whizco* to the RCRA context because, under RCRA, the cleanup obligation does *not* give rise to a right of payment. Apex Oil appealed to the Seventh Circuit, which rejected Apex Oil's argument in August 2009. It held that the obligation to perform a mandatory cleanup injunction under the RCRA was not a claim and hence not discharged in Apex Oil's bankruptcy. The Seventh Circuit further concluded that the fact that it would cost Apex Oil money to have the site cleaned up did not make it a "right to payment." Apex Oil appealed the ruling to the Supreme Court. In 2010, the Supreme Court declined to review and let stand the Seventh Circuit decision. The consequence of the Supreme Court's decision not to review *Apex* is that environmental cleanup injunctions brought under RCRA are generally not dischargeable in bankruptcy.

[1] Before the Apex Oil case, federal and state governments tried using other laws (such as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Surface Mining Control and Reclamation Act (SMCRA) of 1977) but failed to impose environmental liabilities on polluting companies.

The District Court Apex decision in 2008 was a significant turning point. While recognizing that the Seventh Circuit's rejection of the appeal in 2009 and the Supreme Court decision to not review the case in 2010 also shaped markets, Ohlrogge (2020) explains that the 2008 decision surprised and altered the behaviors of practitioners, triggering many law and environmental consulting firms to alert their client firms about the ramifications of the District Court decision. Furthermore, *Apex* shaped subsequent court decisions and legal scholarship on environmental liabilities (e.g., Fil, 2009; Rdzanek, 2010; Gardner and Pusha III, 2014; Light, 2019).

3. Data

The EPA's Toxic Release Inventory (TRI) database contains facility-level information on toxic emissions.[2] The EPA requires that any facility in particular industries using TRI-listed chemicals above specified thresholds and employing ten or more full-time equivalent workers reports its emissions of each TRI-listed toxic chemical. The publicly available database provides information at the facility-chemical-year level. Thus, a facility may report several chemicals over time, and firms often have multiple facilities in the TRI database.

We link the TRI database to publicly listed firms in Compustat. For each TRI facility, we use its parent company name. When the company name is missing in the TRI database, we use the facility name. Then, we calculate the similarity scores between these names and firm names in Compustat using the Damerau–Levenshtein distance.[3] We focus on the sample period 2003-2013. We omit 2008 from the analyses because the District Court decision was made on July 28, 2008. After matching, we have around 165,000 facility-chemical-year observations, covering 6,790 unique facilities owned by 721 unique public firms in our sample period. In a robustness check, we also aggregate all facilities' toxic releases to the firm level and form a firm-chemical-year panel to address potential within-chemical transfers between facilities.

[2] See https://www.epa.gov/toxics-release-inventory-tri-program/tri-basic-data-files-calendar-years-1987-2018.
[3] We also make a few manual matches, e.g., 'IBM CORP' vs. 'INTERNATIONAL BUSINESS MACHS COR'.

Panel A in Table 1 reports the summary statistics of RCRA-regulated toxic releases in our facility-chemical-year samples.[4] Panel A shows that air releases, water releases and land releases account for 18.38%, 10.56%, and 71.06% of all toxic releases under RCRA, respectively. Non-air toxic releases (i.e., water and land releases) under the RCRA thus account for 81.62% of all RCRA toxic releases. Our main analyses focus on non-air toxic releases, which we label "Toxic Releases" in the empirical analysis. Besides these specific toxic releases, the TRI database includes other pollutants that were stored, recycled, or treated within facilities. Panel A of Table 1 provides summary statistics on toxic releases, including the sum of total releases (air, water, and land releases), wastes recycling, energy recovery, and waste treatment of all RCRA chemicals produced in a facility in a year. The average number of employees hired in a facility is 480. Table 1 also reports each facility's parent firm's characteristics, including R&D Intensity (R&D expenditures/total assets), CAPX/AT (capital expenditure/total assets), XAD/AT (advertising expenditures/total assets), ROA, leverage, tangibility, Tobin's Q, Ln AT (the natural logarithm of the book value of total assets), Labor/Capital (labor/capital intensity), and firm age. Appendix A provides more detailed variable definitions.

[Insert Table 1 here]

We address two concerns with the TRI database. First, firms self-report toxic emissions, potentially leading to measurement errors (e.g., De Marchi and Hamilton 2006; Currie et al. 2015). We do the following to ameliorate measurement error concerns. First, we focus on non-air toxic emissions. It is more difficult for regulators to verify the accuracy of toxic air emissions because they dissipate, and the nature of the dissipation depends on wind and rain.[5] Second, we focus on public firms because they tend to be larger and subject to greater oversight, limiting measurement

[4] Following Ohlrogge (2020), we use the EPA's Substance Registry Services website to identify RCRA-regulated toxic chemicals (https://ofmpub.epa.gov/sor_internet/registry/substreg/LandingPage.do). Using 'RCRA' as a keyword, we search the website and find the RCRA chemical lists and corresponding Chemical Abstract Service (CAS) compound IDs. Using these IDs, we retrieve RCRA-regulated toxic releases in the TRI database.

[5] Since similar concerns might be raised concerning water pollution, we confirm that the paper's results hold when only examining land releases of toxic pollutants. See the Table IA1 in the Internet Appendix.

errors and misreporting. Consistent with this view, Brehm and Hamilton (1996) and Akey and Appel (2021) find that smaller firms violate EPA rules more frequently than larger firms. Third, we focus on pollutants covered by the RCRA. Examining RCRA-regulated compounds is a natural feature of our study because the Apex ruling only made environmental obligations covered by the RCRA non-dischargeable obligations. Examining RCRA-regulated compounds also helps address measurement concerns. Compared to other toxic chemicals covered by the TRI, RCRA compounds are more toxic and therefore subject to stricter mandatory reporting requirements and monitoring.

While implementing these strategies to mitigate measurement error concerns, we also note that several studies suggest that the TRI database is not subject to significant measurement errors. In obtaining and surveilling the TRI data, the EPA focuses on ensuring that firms comply with reporting mandates. It does not use TRI data to levy penalties concerning emissions, which reduces incentives for firms to underreport emissions (Greenstone, 2003). Indeed, Xu and Kim (2022) show that misreporting leads to fines and even criminal liability, and Bui and Mayer (2003) discover little evidence of material, systematic measurement error in the TRI data.[6]

A second concern with the TRI database is that the EPA changed industry and chemical coverage, as discussed in Currie et al. (2015) and the EPA (2019). This concern is less relevant for our sample period, because the EPA made few changes during the 2003-2013 period. The EPA did not change industry coverage and changed only 17 chemicals covered by the TRI out of 690.[7] We did the following to address remaining concerns about chemical coverage. First, we condition on chemical-year fixed effects. Second, we show that the results are robust to (i) filling-in zeros for missing RCRA chemicals or (ii) restricting the sample to facility-chemical observations in which a facility reports the chemical in all sample years.

[6] See https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-quality.
[7] See https://19january2017snapshot.epa.gov/toxics-release-inventory-tri-program/tri-listed-chemicals_.html

4.Baseline Results

4.1 RCRA toxic releases

This section evaluates the response of facilities' emissions of RCRA-regulated toxic pollutants to *Apex*. In conducting the evaluation, we differentiate between heavy polluters and non-heavy polluters. *Apex* is more likely to influence heavy polluters since the expected value of any future injunctions to address environmental obligations will be greater among heavy polluters than those with negligible toxic releases. To differentiate between heavy and non-heavy polluters, we classify those facilities with total RCRA production wastes during the pre-*Apex* period greater than their corresponding industry (NAICS 3-digital code) median as heavy polluters.[8] We classify other facilities as non-heavy polluters.

Our difference-in-differences regression is as follows:

$$ln(1 + Toxic\ Releases_{ict}) = \beta(Apex_t \times Heavy\ Polluters_i) + \alpha State_i \times t + \gamma Facility_i + \delta_1 I_{ct} + \delta_2 I_{kt} + \varepsilon, \quad (1)$$

where i indexes facilities, c indexes chemicals released in non-air forms, k indexes parental company, and t indexes years. $Toxic\ Releases_{ict}$ denotes the amount of non-air RCRA toxic chemical *c* released by facility i in year *t*. $Apex_t$ equals one during the years after 2008 and zero otherwise (we find robust results when we define $Apex_t$ as years after 2009). $Heavy\ Polluters_i$ equals one if the facility was a heavy polluter during the pre-Apex period and zero otherwise. More specifically, $Heavy\ Polluters_i$ equals one if facility i's total RCRA production wastes were larger than the industry (NAICS 3-digital code) median during the pre-Apex (2005-2007) period and zero otherwise. The regression controls for linear state-specific time trends ($State_i \times t$) to

[8] As shown in Table 1, total RCRA production wastes consist of total pollution releases (air, water, and land releases) of all chemicals covered by the RCRA. In Internet Appendix Table IA2, we define heavy polluters as facilities with total RCRA releases (air, water, and land releases) greater than their corresponding industry median and find consistent results. In robustness tests, we define heavy polluters as facilities in the top 70th percentile polluters in their respective industries. That is, instead of using the median, we set Heavy Polluters equal to one if total RCRA production wastes are in the top 70th percentile of the corresponding industry and zero for the bottom 30th percentile. As shown in Table IA3 of the Internet Appendix, all the results hold.

control for any trends in state-level environmental policies or other factors shaping pollution.[9] We also include plant fixed effects ($Facility_i$) to control for time-invariant heterogeneity at the facility level (Greenstone, List, and Syverson, 2012). Following Akey and Appel (2021), we add chemical-year fixed effects (I_{ct}) to control for time-varying heterogeneity at the chemical-year level. Adding chemical-year fixed effects allows us to exploit within-chemical-time variation to isolate the impact of the Apex ruling on toxic emissions. This within-chemical-time variation is important because, as Chatterji, Levine, and Toffel (2009) and Di Giuli (2013) mention, researchers lack accepted methods for comparing the environmental impact of each chemical. In some specifications, we also include parent-year fixed effects (I_{kt}) to control for time-varying heterogeneity at the parent (i.e., firm) level. We cluster heteroskedasticity robust standard errors at the facility level to correct for estimation errors related to facility identity.[10]

This specification allows us to test a key implication of the *Apex*-creditor-pollution view: *Apex* should reduce pollution more among firms closer to Chapter 11 because RCRA-related environmental obligations are no longer dischargeable through Chapter 11. To evaluate this implication, we estimate Equation (1) using two subsamples. The "High Default Probability" sample includes facilities belonging to parent firms with default probabilities above their corresponding industry medians. "Low Default Probability" facilities belong to firms with default probabilities below the medians of their respective industries. To compute the default probability of each parent firm in 2007, we use the methodology developed by Campbell et al. (2008), which uses a reduced-form econometric model to predict corporate failures. As shown in the Internet Appendix (Table IA5), the results are robust to using Merton's (1974) distance to default model.

We discover that toxic emissions drop significantly after *Apex* among heavy polluting facilities in firms with comparatively high default probabilities. As shown in Table 2, $Apex_t \times Heavy\ Polluters_i$ enters with a negative and statistically significant coefficient in the

[9] The results hold when excluding these trends.
[10] The results hold when clustering standard errors by state or firm, as shown in Table IA4 of the Internet Appendix.

specifications excluding parent-year fixed effects (column (1)). The estimated coefficient in column (1) for the high default probability subsample is -0.2166, suggesting that the Apex decision was associated with a 19.48% reduction in toxic releases relative to the subsample's mean.[11] For the low default probability subsample (column (2)), $Apex_t \times Heavy\ Polluters_i$ enters with a statistically insignificant coefficient of -0.0649. When we compare the estimated coefficient on $Apex_t \times Heavy\ Polluters_i$ across the two subsamples using Fisher's permutation test (e.g., Cleary (1999) and Efron and Tibshirani (1993)), the difference is statistically significant (as shown in the bottom of Table 2).

[Insert Table 2 here]

The results hold when also conditioning on parent-year fixed effects, as shown in columns (3) and (4). The reductions of toxic releases of facilities with high and low default probabilities are 21.31% and 0.75%, respectively, relative to the subsample's mean. The estimated coefficient on $Apex_t \times Heavy\ Polluters_i$ in column (3) is statistically significant at the 1% level, while it is insignificant in column (4). When we compare the coefficients on $Apex_t \times Heavy\ Polluters_i$ across these two columns, the difference is statistically significant, as shown in the bottom row of Table 2. Among high-pollution facilities in firms closer to bankruptcy, we find that toxic emissions drop appreciably after *Apex*. These findings are consistent with the view that *Apex* increased the costs to firm owners and creditors of polluting and potentially boosting environmental liabilities because such obligations were no longer dischargeable in bankruptcy. Furthermore, we were concerned that *Apex* might have reduced pollution by lowering production at a facility rather than by reducing the amount pollution per output (Greenstone, 2002; Akey and Appel, 2021). However, we find no evidence that employment falls following the Apex decision among heavy emitters of RCRA-pollutants as shown in Table IA6 in the Internet Appendix.

[11] Since Ln(1+ Toxic Releases + Δ Toxic Releases) = X + ΔX where ΔX = -0.2166×1, Δ Toxic Releases = (1+ Mean Toxic Releases)×[exp(ΔX) – 1]. The Mean of Toxic Releases is 36190 pounds from Table 1 Panel B.

The causal interpretation of the difference-in-differences approach relies on the assumption of parallel trends, which requires that the relative pollution outcomes of heavy and non-heavy polluters in the high default probability subsample would not have changed in the absence of *Apex*. To test the parallel trends assumption, we examine the estimated difference in toxic releases between heavy and non-heavy polluting facilities in each year among high-default probability firms. In particular, we estimate the following regressions:

$$ln(1 + Toxic\ Releases_{ict}) = \sum_{t=2004}^{2013} \beta_t (I_t \times Heavy\ Polluters_i) + \alpha State_i \times t + \gamma Facility_i + \delta_1 I_{ct} + \delta_2 I_{kt} + \varepsilon, \quad (2)$$

where i indexes facilities, k indexes parental company, c indexes chemicals, and t indexes years. I_t denotes an indicator variable for year *t* (except the base year of 2003). The conditioning variables are the same as those in Equation (1).

Figure 1 plots the estimated coefficients on $I_t \times Heavy\ Polluters_i$ after estimating Equation (2) and the 95% confidence interval for each year relative to the base year of 2003 for high-default probability firms. The results are consistent with the parallel trends assumption. The difference in toxic releases between heavy and non-heavy polluters is insignificantly different from zero before *Apex*. After the ruling, the difference in toxic releases between heavy and non-heavy polluters drops appreciably among facilities in high default probability firms. It is noteworthy that toxic releases by heavy polluters drop significantly relative to non-heavy polluters after 2009 and remain low throughout the rest of the sample period.

[Insert Figure 1 here]

4.2 Placebo test: Chemical compounds not covered by the RCRA

We conduct a placebo test to identify the impact of *Apex* on toxic emissions more precisely. For the placebo test, we examine the release of chemical compounds *not* regulated by RCRA. *Apex* only made environmental obligations covered by the RCRA non-dischargeable. Thus, if *Apex* induced firms to pollute less by reshaping their expectations of whether they can discharge environmental obligations in bankruptcy, *Apex* should only have affected the release of chemical compounds covered by RCRA. Consistent with this view, we find that *Apex* did not affect the release of toxic chemicals not covered by the RCRA. As reported in Table 3, the estimated coefficients on $Apex_t \times Heavy\ Polluters_i$ are insignificant in both the high- and low-default probability subsamples.

[Insert Table 3 here]

5. Creditors' Interests and Incentives

This section explores one potential mechanism through which *Apex* reduced pollution: increasing the expected financial costs to creditors of firms near bankruptcy with RCRA-related cleanup obligations. The *Apex*-creditor view holds that *Apex* increased the costs to creditors of firms in Chapter 11 with RCRA-related environmental cleanup obligations because those obligations were no longer dischargeable in bankruptcy (Hayes, 2016). As a result, creditors of firms close to bankruptcy would have stronger incentives after *Apex* to pressure the managers of those firms to cut RCRA-related pollution. To evaluate this *Apex*-creditor mechanism, we study how bond returns, interest rates, and loan spreads responded to the Apex ruling.[12]

5.1 Bondholder wealth

We first investigate how *Apex* influenced bondholders by examining the impact of *Apex* on the cumulative abnormal returns (CARs) of bonds during the days surrounding the July 28, 2008 District Court decision.[13] To compute CARs, we collect corporate bond transactions and price data from the WRDS Bond Returns database. We use the change in the flat price plus accrued interest to define bonds' monthly return. For firms with multiple bonds, we calculate the equally-weighted and value-weighted monthly bond returns based on the respective market values of those bonds. Then, we compute monthly bond CARs adjusted by Lin et al.'s (2011) six factors: the Fama and

[12] We require that firms have at least five years of pre- and post-*Apex* financial data for these firm-level tests.
[13] We use this date given the analyses in Ohlrogge (2020), who shows that law firms and lawyers responded immediately to the decision. See: https://www.justice.gov/archive/opa/pr/2008/July/08-enrd-670.html.

French (1993) three factors, Elton et al.'s (2001) default and term premia, and a liquidity risk premium factor. Specifically, we estimate the following six-factor model for each bond's expected monthly returns:

$$R_{it} - R_f = \alpha_i + \beta_{1i}\left[R_M - R_f\right] + \beta_{2i}SMB_t + \beta_{3i}HML_t + \beta_{4i}Term_t + \beta_{5i}Def_t + \beta_{6i}Liq_t + u_{it}, \quad (3)$$

where $R_M - R_f$ is stock market excess return, SMB_t is the size premium, HML_t is the book-to-market factor, $Term_t$ is the term risk premium, Def_t is the default risk premium, Liq_t is the risk premium of liquidity. We estimate the model over twelve months (-14, -3) with a two-month gap before the event date. Finally, we calculate the CAR of each firm's bond(s) for (-1, 1) and (-2, 2) windows surrounding the Apex decision based on the difference between actual bond return and expected bond return estimated by the six-factor model.

We find evidence consistent with the *Apex*-creditor view that *Apex* increased the expected costs to creditors of firms close to bankruptcy with RCRA-related environmental cleanup obligations. Specifically, we regress each firm's CAR on the $Heavy\ Polluters_i$ indicator and report the results in Table 4. Specifically, $Heavy\ Polluters_i$ equals one if firm *i*'s total RCRA production wastes were larger than the industry (SIC 2-digital code) median during the pre-Apex (2005-2007) period and zero otherwise. We find a significant decrease in the bond CARs of heavy polluters with high default probabilities for the (−1, 1) and (−2, 2) event windows. However, there is no change in the CARs of heavy polluters with low default probabilities. The results are robust to using either value- or equally-weighted CARs, as shown in Panels A and B of Table 4, respectively.

[Insert Table 4 here]

We calculate the impact of *Apex* on bondholder wealth using the Table 4 estimates to illustrate the size of *Apex*'s impact on bondholders. Consider the estimates based on the (−1, 1) and (−2, 2) windows in columns (1) and (3) for high default probability firms. These estimates indicate that bondholders of an average heavy polluter with a high default probability, on average, suffer a total loss of $135 million during the 3-month event window and a total loss of $266 million during the 5-month event window.[14]

5.2 The total interest rate

We also evaluate the *Apex*-creditor mechanism by examining how the Apex Oil ruling impacted firms' interest expenses. If the creditors of heavy RCRA polluters with high default probabilities are aware of the potential losses due to *Apex*, they would likely raise interest rates to compensate for the increased exposure. Thus, we estimate the following difference-in-differences regression for firms' total interest rate expenses using a firm-year panel:

$$Total\ interest\ rate_{it} = \beta(Apex_t \times Heavy\ Polluters_i) + \gamma Control_{it} + \delta_1 I_i + \delta_2 I_t + \varepsilon, \quad (4)$$

where i indexes firms and t represents years. The dependent variable, $Total\ interest\ rate_{it}$, equals total interest expenses divided by total liabilities for firm *i*. $Heavy\ Polluters_i$ is defined above. $Control_{it}$ denotes an extensive list of control variables including R&D Intensity, capital expenditure/total assets, advertising expenditures/total assets, ROA, leverage, tangibility, Tobin's Q, the natural logarithm of the book value of total assets, capital intensity (labor/capital), and firm age. Appendix A provides variable definitions. Thus, β is the coefficient of interest and represents the difference-in-differences estimate of how firms' total interest rate responded to changes in their exposure to the Apex Oil ruling. We report standard errors clustered at the firm level.

Consistent with the *Apex*-creditor mechanism, total interest rates rise significantly after *Apex* among heavy polluters with high default probabilities but not firms with low default probabilities. As shown in Table 5, this pattern holds when controlling for an extensive list of firm characteristics. Taking the estimates from column (3), the total interest rate of heavy polluters with high default probabilities rises by 39 basis points following *Apex*. This estimate implies that an

[14] We calculate bondholder wealth loss by multiplying the average bond market value by the abnormal return coefficients. The average bond market value of each firm before the (−1, 1) and (−2, 2) event windows of high default heavy polluters were about $3 billion.

average heavy polluter with a high default probability pays, on average, $52.30 million more in annual interest payments after the ruling, where average interest payments among such firms before Apex (2007) was $466.80 million.[15] Our results suggest that financial markets distinguish the impact of Apex across firms and raise interest rates for relevant firms, heavy RCRA polluters subject to greater bankruptcy risk.

[Insert Table 5 here]

5.3 The bank loan spread

As a final test of the *Apex*-creditor view, we study bank loan spreads. Bank loan spreads reflect banks' perception of the likelihood of default and the loss given default (LGD) (Saunders and Allen, 2010; James and Kizilaslan, 2014). When banks perceive higher expected LGD, they raise loan spreads and increase expected borrowing costs. Thus, after *Apex*, we expect that banks will expect greater LGD among heavy polluters, increasing bank loan spreads to such borrowers. To test this argument, we use DealScan's bank loan spread database. A firm's bank loan spread equals the natural logarithm of the number of basis points above LIBOR that banks charge the firm on loans in a year. We aggregate bank loans into firm-year observations by weighting each loan granted to a firm in a year by loan size. We use the Equation (4) regression framework, where the dependent variable is the bank loan spread.

Consistent with the findings on bond CARs and total interest rates, we find that *Apex* boosts bank loan spreads. Table 6 shows that heavy polluters' loan spreads increase significantly after *Apex* among high default probability firms but not in the low default probability subsample. These results suggest that banks identified which firms *Apex* would impact the most and increased loan spreads among those firms.

[Insert Table 6 here]

[15] We obtain the number of interest charges by multiplying interest rate change by the firms' average total liabilities in the year 2007 ($13.4 billion).

6. Conclusion

The 2008 Apex Oil decision reduced the circumstances under which environmental liabilities were dischargeable in Chapter 11. *Apex* established that RCRA-covered environmental cleanup obligations could not be discharged through bankruptcy. *Apex* only applied to environmental cleanup obligations caused by RCRA-pollutants and firms in Chapter 11. Among firms in Chapter 11 with RCRA-covered liabilities, *Apex* left fewer resources to settle creditor claims because corporate resources would first settle environmental obligations. By redefining property rights on environmental liabilities, *Apex* altered the incentives of the creditors of some firms. Specifically, creditors of RCRA-polluters close to Chapter 11 had stronger financial incentives to pressure their firms to reduce emissions of RCRA-pollutants following *Apex* because the resultant cleanup costs would no longer be dischargeable in bankruptcy.

We discovered that *Ape*x had significant effects on corporate creditors and pollution. Bond and bank interest rates rise appreciably following *Apex* among heavy RCRA-polluters closer to Chapter 11. However, we find no change in bond and bank interest rates among non-heavy RCRA-polluters or firms with low default probabilities. Furthermore, we show that after *Ape*x, corporate releases of RCRA-pollutants fell among heavy RCRA-polluters, and the drop was larger among firms closer to bankruptcy. We find no change in the releases of *non*-RCRA-pollutants. The results are consistent with the view that *Apex* adversely affected the creditors of RCRA-polluters closer to bankruptcy. These creditors responded by inducing their firms to reduce the emissions of chemicals for which the creditors would now be indirectly liable in Chapter 11 bankruptcy. The results advertise the large effects of the assignment of environmental liabilities on creditors and corporate pollution.

References

Akey, P. and Appel, I., 2021. The limits of limited liability: Evidence from industrial pollution. The Journal of Finance, 76(1), pp.5-55.

Brehm, J. and Hamilton, J.T., 1996. Noncompliance in environmental reporting: Are violators ignorant, or evasive, of the law? American Journal of Political Science, pp.444-477.

Bui, L.T. and Mayer, C.J., 2003. Regulation and capitalization of environmental amenities: evidence from the toxic release inventory in Massachusetts. Review of Economics and statistics, 85(3), pp.693-708.

Campbell, J.Y., Hilscher, J. and Szilagyi, J., 2008. In search of distress risk. The Journal of Finance, 63(6), pp.2899-2939.

Chatterji, A.K., Levine, D.I. and Toffel, M.W., 2009. How well do social ratings actually measure corporate social responsibility? Journal of Economics & Management Strategy, 18(1), pp.125-169.

Cleary, S., 1999. The relationship between firm investment and financial status. The Journal of Finance, 54(2), pp.673-692.

Currie, J., Davis, L., Greenstone, M. and Walker, R., 2015. Environmental health risks and housing values: evidence from 1,600 toxic plant openings and closings. American Economic Review, 105(2), pp.678-709.

De Marchi, S. and Hamilton, J.T., 2006. Assessing the accuracy of self-reported data: an evaluation of the toxics release inventory. Journal of Risk and uncertainty, 32(1), pp.57-76.

Di Giuli, A., 2013. Pollution and firm value. Available at SSRN 2227034.

Efron, B. and Tibshirani, R.J., 1993. An introduction to the bootstrap. Monographs on statistics and applied probability, 57, pp. 202.

Elton, E.J., Gruber, M.J., Agrawal, D. and Mann, C., 2001. Explaining the rate spread on corporate bonds. The Journal of Finance, 56(1), pp.247-277.

Environmental Protection Agency, 2013. *National Rivers and Streams Assessment 2008–2009: A Collaborative Survey*.

Environmental Protection Agency, 2014-2016. *TRI National Analysis*.

Environmental Protection Agency, 2018. *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2016*.

Environmental Protection Agency, 2019. Factors to Consider When Using Toxics Release Inventory Data.

Fama, E.F. and French, K.R., 1993. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics, 33(1), pp.3-56.

Fil, R., 2009. Resource Conservation and Recovery Act vs. Chapter 11: When Is a" Discharge" Not Discharged? American Bankruptcy Institute Journal, 28(9), p.26.

Flammer, C., 2021. Corporate green bonds. Journal of Financial Economics, 142, pp.499-516.

Fowlie, M., 2010. Emissions trading, electricity restructuring, and investment in pollution abatement. American Economic Review, 100(3), pp.837-69.

Gao, H., Li, K., and Ma, Y., 2021. Stakeholder orientation and the cost of debt: Evidence from state-level adoption of constituency statutes. Journal of Financial and Quantitative Analysis 56(6), pp.1908-1944.

Gardner, R.W. and Pusha III, R., 2014. The west virginia chemical spill and environmental liabilities in a post-apex world. American Bankruptcy Institute Journal, 33(4), p.38.

Greenstone, M., 2002. The impacts of environmental regulations on industrial activity: Evidence from the 1970 and 1977 clean air act amendments and the census of manufactures. Journal of Political Economy, 110(6), pp.1175-1219.

Greenstone, M., 2003. Estimating regulation-induced substitution: The effect of the Clean Air Act on water and ground pollution. American Economic Review, 93(2), pp.442-448.

Greenstone, M., List, J.A. and Syverson, C., 2012. The effects of environmental regulation on the competitiveness of US manufacturing (No. w18392). National Bureau of Economic Research.

Hayes, D.W., 2016. Environmental liabilities in § 363 Sales and the Priority of environmental claims. National Conference of Bankruptcy Judges American Bankruptcy Institute Conference Roundtable. https://ncbjmeeting.org/2016/

Jaffe, A.B. and Palmer, K., 1997. Environmental regulation and innovation: a panel data study. Review of Economics and Statistics, 79(4), pp.610-619.

Jaffe, A.B., Peterson, S.R., Portney, P.R. and Stavins, R.N., 1995. Environmental regulation and the competitiveness of US manufacturing: what does the evidence tell us? Journal of Economic Literature, 33(1), pp.132-163.

James, C. and Kizilaslan, A., 2014. Asset specificity, industry-driven recovery risk, and loan pricing. Journal of Financial and Quantitative Analysis, 49(3), pp.599-631.

Kacperczyk, M. T. and Peydro, J., 2021. Carbon emissions and the bank-lending channel. Working paper.

Landrigan, P.J., Fuller, R., Acosta, N.J., Adeyi, O., Arnold, R., Baldé, A.B., Bertollini, R., Bose-O'Reilly, S., Boufford, J.I., Breysse, P.N. and Chiles, T., 2018. The Lancet Commission on pollution and health. The lancet, 391(10119), pp.462-512.

Levine, R., Lin, C., Wang, Z. and Xie, W., 2021. Bank Liquidity, Credit Supply, and the Environment. NBER Working Paper No. w24375, Available at SSRN: https://ssrn.com/abstract=3134272

Light, S.E., 2019. The law of the corporation as environmental law. Stan. L. Rev., 71, p.137.

Lin, H., Wang, J. and Wu, C., 2011. Liquidity risk and expected corporate bond returns. Journal of Financial Economics, 99(3), pp.628-650.

Merton, R.C., 1974. On the pricing of corporate debt: The risk structure of interest rates. The Journal of finance, 29(2), pp.449-470.

Ohlrogge, M., 2020. Bankruptcy claim dischargeability and public externalities: Evidence from a natural experiment. Available at SSRN 3273486.

Rdzanek, D.E., 2010. Discharge of RCRA Injunctive Claims in Bankruptcy: The Seventh Circuit's Decision in United States v. Apex Oil Co., Inc. Seventh Circuit Review, 6(1), p.163.

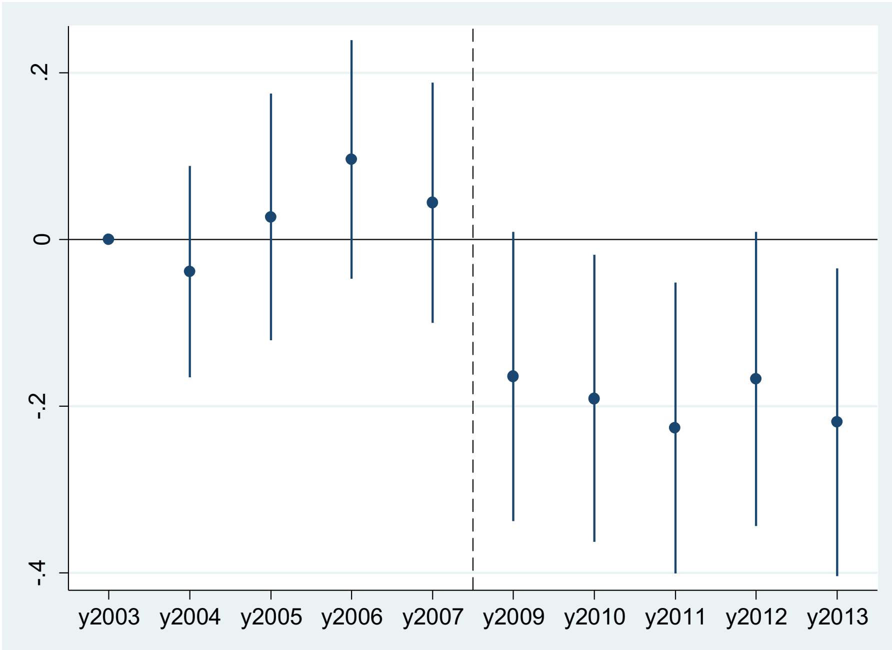
Saunders, A. and Allen, L., 2010. Credit risk management in and out of the financial crisis: new approaches to value at risk and other paradigms (Vol. 528). John Wiley & Sons.

Shive, S.A. and Forster, M.M., 2020. Corporate governance and pollution externalities of public and private firms. The Review of Financial Studies, 33(3), pp.1296-1330.

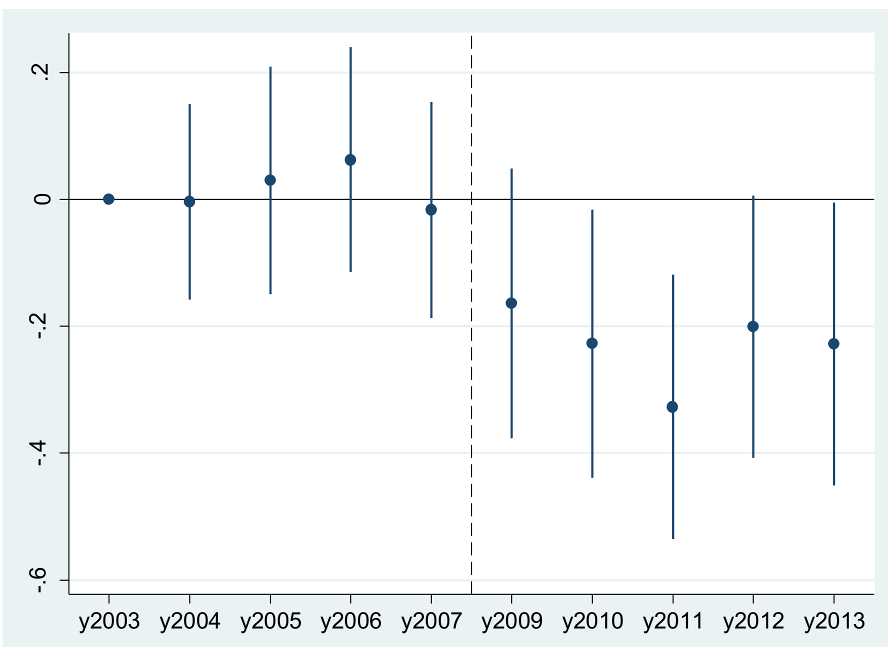
Xu, Q. and Kim, T., 2022. Financial constraints and corporate environmental policies. Available at SSRN 3028768. The Review of Financial Studies 35(2), pp.576-635.

Figure 1 Parallel trend plots of baselines

These plots depict the annual coefficients estimates from baseline models based on 2003. Vertical lines in the plots depict 95% confidence intervals for the coefficients. The model and sample descriptions can be referred to **Table 2.**



Panel A. Table 2 Column (1)



Panel B. Table 2 Column (3)

Table 1 Summary statistics

The table shows summary statistics for all samples, High and Low Default Prob. subsamples of facilities from 2003 to 2013 without the year 2008. Air Releases consist of fugitive air releases and stack air releases. Water Releases refer to surface water discharges. Land Releases refer to toxic chemicals disposed of in underground wells, landfills, and surface impoundments et al. Air, Water and Land releases make up the Total Releases. Toxic Releases consist of Water and Land Releases. Production Wastes consist of Total Releases, wastes recycling, energy recovery, and wastes treatment. The unit of them is pounds and reported in thousands (1000s). Ln(1+Toxic Releases) (Ln(1+Land Releases)) is natural logarithm of one plus the amount of Toxic Releases (Land Releases). Releases data are from TRI databases at the facility-chemical-year level and employment data is from the NETS database at the facility-year level. Facility parent firms' characteristics include R&D Intensity, capital expenditure/total assets, advertising expenditures/total assets, ROA, leverage, tangibility, Tobin's Q, the natural logarithm of the book value of total assets, labor/capital intensity, and firm age (their definitions are provided in Appendix A). High Default Prob. (Panel B) includes facilities belonging to firms with probability of failure (measured by Campbell et al., 2008) in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Default Prob. (Panel C). Over Total Releases (Over Production Wastes) means all types of releases over Total Releases (Production Wastes).

Panel A. All Samples

Variables	Obs	Mean	Median	SD	Over Total Releases	Over Production Wastes
Air Releases (1000 pounds)	163932	9.41	0.02	85.12	18.38%	3.76%
Water Releases (1000 pounds)	163932	5.41	0.00	176.93	10.56%	2.16%
Land Releases (1000 pounds)	163932	36.41	0.00	509.00	71.06%	14.56%
Toxic Releases (1000 pounds)	163932	41.82	0.00	538.70	81.62%	16.72%
Total Releases (1000 pounds)	163932	51.23	0.37	546.34	100.00%	20.49%
Production Wastes (1000 pounds)	163932	250.07	7.03	2649.48		100.00%
Ln(1+Toxic Releases)	163932	3.51	0.69	4.28		
Ln(1+Land Releases)	163932	3.21	0.00	4.20		
Employment (Facility)	17583	480.46	180.00	1062.81		
R&D Intensity (Firm)	163932	0.01	0.00	0.02		
CAPX/AT (Firm)	163932	0.05	0.04	0.03		
XAD/AT (Firm)	163932	0.00	0.00	0.01		
ROA (Firm)	163932	0.05	0.05	0.07		
Leverage (Firm)	163932	1.14	0.66	29.17		
Tangibility (Firm)	163932	0.37	0.35	0.19		
Tobin's Q (Firm)	163932	1.37	1.28	0.71		
Ln AT (Firm)	163932	9.10	9.12	1.84		
Labor/Capital (Firm)	163932	0.01	0.01	0.02		
Firm Age (Firm)	163932	35.83	42.00	15.59		

Panel B. The High Default Prob. Subsample

Variables	Obs	Mean	Median	SD	Over Total Releases	Over Production Wastes
Air Releases (1000 pounds)	71329	7.98	0.02	64.50	18.07%	3.24%
Water Releases (1000 pounds)	71329	6.25	0.00	132.63	14.15%	2.54%
Land Releases (1000 pounds)	71329	29.94	0.00	455.72	67.77%	12.15%

Toxic Releases (1000 pounds)	71329	36.19	0.00	474.50	81.93%	14.68%
Total Releases (1000 pounds)	71329	44.17	0.34	478.90	100.00%	17.92%
Production Wastes (1000 pounds)	71329	246.43	5.78	1938.76		100.00%
Ln(1+Toxic Releases)	71329	3.38	0.41	4.24		
Ln(1+Land Releases)	71329	3.10	0.00	4.15		
Employment (Facility)	8053	509.36	190.00	1027.73		
R&D Intensity (Firm)	71329	0.01	0.00	0.02		
CAPX/AT (Firm)	71329	0.05	0.04	0.03		
XAD/AT (Firm)	71329	0.01	0.00	0.01		
ROA (Firm)	71329	0.03	0.03	0.08		
Leverage (Firm)	71329	1.61	0.88	42.62		
Tangibility (Firm)	71329	0.38	0.34	0.19		
Tobin's Q (Firm)	71329	1.27	1.20	0.60		
Ln AT (Firm)	71329	8.73	8.72	1.84		
Labor/Capital (Firm)	71329	0.01	0.01	0.02		
Firm Age (Firm)	71329	32.17	38.00	16.69		
Panel C. The Low Default Prob. Subsample						
Air Releases (1000 pounds)	92603	10.52	0.02	98.08	18.56%	4.16%
Water Releases (1000 pounds)	92603	4.77	0.00	204.61	8.41%	1.88%
Land Releases (1000 pounds)	92603	41.39	0.00	546.47	73.03%	16.37%
Toxic Releases (1000 pounds)	92603	46.15	0.00	583.31	81.44%	18.25%
Total Releases (1000 pounds)	92603	56.67	0.39	593.02	100.00%	22.41%
Production Wastes (1000 pounds)	92603	252.87	8.21	3087.33		100.00%
Ln(1+Toxic Releases)	92603	3.61	1.10	4.31		
Ln(1+Land Releases)	92603	3.29	0.00	4.24		
Employment (Facility)	9530	456.04	170.00	1091.03		
R&D Intensity (Firm)	92603	0.01	0.00	0.02		
CAPX/AT (Firm)	92603	0.05	0.04	0.03		
XAD/AT (Firm)	92603	0.00	0.00	0.01		
ROA (Firm)	92603	0.06	0.06	0.05		
Leverage (Firm)	92603	0.79	0.57	10.33		
Tangibility (Firm)	92603	0.37	0.35	0.20		
Tobin's Q (Firm)	92603	1.44	1.35	0.78		
Ln AT (Firm)	92603	9.37	9.56	1.80		
Labor/Capital (Firm)	92603	0.01	0.01	0.01		
Firm Age (Firm)	92603	38.64	45.00	14.06		

Table 2 Baseline results

This table reports regression results evaluating how facilities' emission of RCRA-regulated toxic pollutants responded to the Apex decision. The dependent variable is Ln(1 + Toxic Releases$_{ict}$), where Toxic Releases$_{ict}$ equals the amount of non-air RCRA toxic chemical c released by facility i in year t. *Apex* equals one after the 2008 Apex District court decision, i.e., from 2009 onward, and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were larger than the industry (NAICS 3-digital code) median and zero otherwise. As indicated, regressions also control for Facility, Chemical-Year, and Parent-Year fixed effects and State Time Trends. Regressions (1) and (3) include the sample of High Default Probability firms, i.e., firms with above the median levels of Campbell et al. (2008) failure probabilities relative to other firms in their industries. Correspondingly, regressions (2) and (4) include Low Default Probability firms. The table also reports the results of tests of the hypothesis that the coefficient estimates on *Apex*Heavy Polluters* for the High-Low Default probability subsamples are equal. Appendix A provides detailed variable definitions. We report t-statistics based on robust standard errors clustered at the facility level in parentheses. Based on the estimated coefficient p-values (p), * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)
Apex*Heavy Polluters	-0.2166***	-0.0649	-0.2396***	-0.0075
	(-3.1337)	(-0.9657)	(-2.8112)	(-0.1064)
Constant	3.5951***	2.6838***	3.4573***	3.2463***
	(6.2471)	(4.6061)	(12.2792)	(4.6110)
Observations	70,875	91,746	70,232	91,324
R-squared	0.750	0.729	0.759	0.736
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES
High - Low Default Prob.	0.007***		0.000***	

Table 3 Placebo tests: non-RCRA releases

This table reports regression results evaluating how facilities' emission of non-RCRA-regulated toxic pollutants responded to the Apex decision. The dependent variable is Ln(1 + Non-RCRA Releases_{ict}), where Non-RCRA Releases_{ict} equals the amount of non-RCRA toxic chemical *c* released by facility i in year *t*. $Apex$ equals one after the 2008 Apex District court decision, i.e., from 2009 onward, and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were larger than the industry (NAICS 3-digital code) median and zero otherwise. As indicated, regressions also control for Facility, Chemical-Year, and Parent-Year fixed effects and State Time Trends. Regressions (1) and (3) include the sample of High Default Probability firms, i.e., firms with above the median levels of Campbell et al. (2008) failure probabilities relative to other firms in their industries. Correspondingly, regressions (2) and (4) include Low Default Probability firms. Appendix A provides detailed variable definitions. We report t-statistics based on robust standard errors clustered at the facility level in parentheses. Based on the estimated coefficient p-values (*p*), * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(1+Non-RCRA Releases)	Ln(1+Non-RCRA Releases)	Ln(1+Non-RCRA Releases)	Ln(1+Non-RCRA Releases)
Apex*Heavy Polluters	-0.0504	-0.0486	-0.1075	0.0716
	(-0.7066)	(-0.6436)	(-1.2308)	(0.8003)
Constant	1.4900***	1.2529***	1.7621***	1.2454***
	(8.0483)	(5.3299)	(8.0598)	(3.9994)
Observations	29,409	35,888	28,975	35,503
R-squared	0.658	0.645	0.671	0.657
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES

Table 4 Bondholders' wealth change

This table reports regression results evaluating how the cumulative abnormal returns CARs) on firms' bonds respond to *Apex*. The dependent variable is the CAR of each firm's bonds over either the (-1,1) or (-2,2) month event window surrounding the July 2008 District Court Apex decision. We compute monthly bond CARs using Lin et al.'s (2011) six factor model. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were larger than the industry (NAICS 3-digital code) median and zero otherwise. Regressions (1) and (3) include the sample of High Default Probability firms, i.e., firms with above the median levels of Campbell et al. (2008) failure probabilities relative to other firms in their industries. Correspondingly, regressions (2) and (4) include Low Default Probability firms. Panel A uses value-weighted bonds when computing CARs, while Panel B uses equally-weighted bonds. The table also reports the results of tests of the hypothesis that the coefficient estimates on *Heavy Polluters* for the High-Low Default probability subsamples are equal. Appendix A provides detailed variable definitions. We report t-statistics based on robust standard errors clustered at the firm level in parentheses. Based on the estimated coefficient p-values (p), * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

Panel A. Value weighted				
	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	CAR(-1,1)	CAR(-1,1)	CAR(-2,2)	CAR(-2,2)
Heavy Polluters	-0.0442***	0.0049	-0.0885**	0.0163
	(-3.0641)	(0.3920)	(-2.2997)	(0.4803)
Constant	0.0315***	-0.0034	0.0987***	0.0263
	(2.8888)	(-0.3164)	(3.0523)	(0.9858)
Observations	101	124	101	124
R-squared	0.087	0.001	0.054	0.002
High – Low Default Prob.	0.003***		0.031**	
Panel B. Equal weighted				
Heavy Polluters	-0.0456***	0.0072	-0.1030***	0.0336
	(-3.2222)	(0.5851)	(-2.7254)	(1.0487)
Constant	0.0310***	-0.0059	0.1083***	0.0114
	(2.8653)	(-0.5604)	(3.3989)	(0.4524)
Observations	101	124	101	124
R-squared	0.096	0.003	0.075	0.008
High – Low Default Prob.	0.000***		0.007***	

Table 5 Total interest rate

This table reports regression results evaluating how firms' total interest rate responded to *Apex*. The dependent variable is *Total interest rat*e, which equals total interest expenses divided by total liabilities. *Apex* equals one after the 2008 District court decision and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA wastes during the pre-Apex (2005-2007) period were larger than the industry median and zero otherwise. Regressions include firm and year fixed effects. Regressions (3) and (4) include: R&D Intensity, capital expenditure/total assets (CAPX/AT), advertising expenditures/total assets (XAD/AT), ROA, leverage, Tangibility, Tobin's Q, the natural logarithm of the book value of total assets (LN AT), capital intensity (Labor/Capital), and the age of the firm (Firm Age). Regressions (1) and (3) include the sample of High Default Probability firms. Regressions (2) and (4) include Low Default Probability firms. The table reports the results of tests of the hypothesis that the coefficient estimates on *Heavy Polluters* for the High-Low Default probability subsamples are equal. Appendix A provides variable definitions. Parentheses include t-statistics based on robust standard errors clustered at the firm level. Using estimated coefficient p-values (p), * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Total Interest Rate	Total Interest Rate	Total Interest Rate	Total Interest Rate
Apex*Heavy Polluters	0.0042**	0.0009	0.0039**	0.0011
	(2.2503)	(0.6313)	(2.1478)	(0.7467)
R&D Intensity			-0.0299	0.0008
			(-1.4666)	(0.0188)
CAPX/AT			-0.0788***	-0.0822***
			(-4.4978)	(-3.4747)
XAD/AT			-0.0331	0.0237
			(-0.7811)	(0.5332)
ROA			-0.0232***	-0.0194***
			(-2.9810)	(-2.7018)
Leverage			-0.0000*	0.0000*
			(-1.7720)	(1.8864)
Tangibility			0.0244***	0.0302***
			(3.1239)	(2.9944)
Tobin's Q			-0.0002	-0.0029**
			(-0.1999)	(-2.4488)
Ln AT			-0.0033*	-0.0016
			(-1.9290)	(-0.9123)
Labor/Capital			-0.0572***	-0.0081
			(-4.3847)	(-0.5628)
Firm Age			-0.0012	0.0003
			(-0.6648)	(0.8587)
Constant	0.0261***	0.0198***	0.0834	0.0243
	(64.9191)	(50.2202)	(1.5721)	(1.1494)
Observations	2,603	2,824	2,603	2,824
R-squared	0.644	0.591	0.665	0.623
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES

High - Low Default Prob.	0.065*	0.089*

Table 6 Bank loan spread

This table reports regression results evaluating how firms' bank loan spreads responded to *Apex*. The dependent variable is *Bank loan spread*, which equals the natural logarithm of the number of basis points above LIBOR that banks charge the firm. *Apex* equals one after the 2008 District court decision and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were larger than the industry median and zero otherwise. Regressions include firm and year fixed effects. Regressions (3) and (4) include: R&D Intensity, capital expenditure/total assets (CAPX/AT), advertising expenditures/total assets (XAD/AT), ROA, leverage, Tangibility, Tobin's Q, the natural logarithm of the book value of total assets (LN AT), capital intensity (Labor/Capital), and the age of the firm (Firm Age). Regressions (1) and (3) include High Default Probability firms. Regressions (2) and (4) include Low Default Probability firms. The table reports the results of tests of the hypothesis that the coefficient estimates on *Heavy Polluters* for the High-Low Default probability subsamples are equal. Appendix A provides variable definitions. Parentheses include t-statistics based on robust standard errors clustered at the firm level. Using estimated coefficient p-values (p), * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(Loan Spread)	Ln(Loan Spread)	Ln(Loan Spread)	Ln(Loan Spread)
Apex*Heavy Polluters	0.1673*	-0.0314	0.1707**	-0.0681
	(1.9498)	(-0.3572)	(2.1266)	(-0.8598)
R&D Intensity			-5.1368***	-2.5954**
			(-2.9020)	(-2.4467)
CAPX/AT			-2.2620***	0.3522
			(-2.6853)	(0.2866)
XAD/AT			6.7739**	-4.5992
			(2.2359)	(-1.3757)
ROA			-0.3968	-1.4517***
			(-1.3446)	(-3.6669)
Leverage			-0.0000	-0.0003
			(-0.1466)	(-1.2104)
Tangibility			-0.5458	-1.0247**
			(-1.4585)	(-2.3589)
Tobin's Q			-0.1341***	-0.1241***
			(-3.2030)	(-2.6335)
Ln AT			-0.1091	-0.2000***
			(-1.5828)	(-3.1730)
Labor/Capital			0.5686	5.7096***
			(0.2229)	(4.2530)
Firm Age			-0.0160	0.0269
			(-0.8535)	(1.0316)
Constant	4.9039***	4.4477***	6.7490***	5.8017***
	(247.9652)	(222.5948)	(7.5705)	(5.2694)
Observations	911	1,048	911	1,048
R-squared	0.801	0.833	0.815	0.850
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
High - Low Default Prob.	0.062*		0.021**	

Appendix A Variables Definition

Variables	Definition
Ln(1+Toxic Releases)	Natural logarithm of one plus the amount of facility total RCRA chemical releases excluding air-related releases.
Ln(1+Land Releases)	Natural logarithm of one plus the amount of facility total RCRA releases excluding air and water related releases.
Ln(1+Non-RCRA Releases)	Natural logarithm of one plus the amount of facility total non-RCRA chemical releases excluding air-related releases.
Ln(Facility Emp)	Natural logarithm of the employment of the facility.
CAR	Bond cumulated abnormal return. CARs are calculated using the 6-factor model (three factors plus term risk premium, default risk premium and the liquidity risk premium (Lin et al., 2011)). The event date is in July 2008, the District Court decision date of Apex. We estimate the model over one year which is (-14, -3) with two months gap before the event date.
Total Interest Rate	The total interest expense divided by total liabilities of a firm.
Ln(Loan Spread)	Natural logarithm of the basis point of firms' bank loan spread based on LIBOR. The data is from DealScan and all loans are aggregated into firm-year level data by weighting all loans granted to a firm in a given year based on loan size.
Apex	Apex equals one when year>=2009 and set to zero otherwise
Heavy Polluters	For facility-chemical level data, $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes were larger than the industry (NAICS 3-digital code) median during the pre-Apex (2005-2007) period and zero otherwise. For firm level data, $Heavy\ Polluters_i$ equals one if firm i's RCRA production wastes were larger than the industry (SIC 2-digital code) median during the pre-Apex (2005-2007) period and zero otherwise.
High/Low Default Prob.	For facility-chemical level data, High Default Prob. includes facilities belonging to firms with probability of failure (measured by Campbell et al., 2008) in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Default Prob. For firm level data, High Default Prob. includes firms with probabilities of failure (Campbell et al., 2008) at the end of December 2007 being larger than SIC 2-digital code industry median, and the Low Default Prob. includes all others. And in CARs part, we change the date December 2007 to June 2008.
High/Low Expected Default	For facility-chemical level data only, High Expected Default includes facilities belonging to firms with the expected default frequency of Merton's (1974) distance to default model in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Expected Default.
R&D Intensity	Research and development expenditures divided by total assets, set to zero if missing.
CAPX/AT	Capital expenditure scaled by the book value of total assets, set to zero if missing.

XAD/AT	Advertising expenditures divided by total assets, set to zero if missing.
ROA	Net income scaled by the book value of assets, set to zero if missing.
Leverage	The ratio of total debt to stockholder's equity, set to zero if missing.
Tangibility	Property, Plant and Equipment divided by total assets, set to zero if missing.
Tobin's Q	Total assets plus the market value of equity minus book value of equity divided by book value of total assets, set to zero if missing.
Ln AT	Natural logarithm of the book value of total assets (million-dollar), set to zero if missing.
Labor/Capital	The ratio of the number of employees over Property, Plant and Equipment, set to zero if missing.
Firm Age	Years on Compustat.

Internet Appendix for "Environmental Liabilities, Creditors, and Corporate Pollution: Evidence from the Apex Oil Ruling"

A. Robustness Tests

First, Table IA1 shows that the findings are robust to using the natural logarithm of one plus land toxic releases (rather than all non-air releases) as the dependent variable.

Second, we consider different ways of defining the treatment group. For example, In Table IA2, we define $Heavy\ Polluters_i$ to be one if a facility's total RCRA releases (i.e., the sum of air, water and land releases) are larger than the corresponding industry median before the Apex and zero otherwise. Table IA2 confirms the Table 2 results. In Table IA3, rather than using sample median, we define $Heavy\ Polluters_i$ to be one if a facility's total RCRA production wastes are in the top 70th percentile of the corresponding NAICS 3-digital industry and zero for facilities in the bottom 30th percentile. Table IA3 shows that the Table 2 results hold.

Third, we verify that the results are robust to alternative clustering assumptions based on the Table 2 analyses. Panel A of Table IA4 reports results with state clustering to accounts for correlation in the standard errors of facilities in the same state. Panel B clusters by firm. All results hold.

Fourth, we use a measure of default probabilities based on Merton's (1974) distance to default model. As shown in Table IA5, the results from Table 2 hold using this alternative measure.

Fifth, we slightly alter the event date. Although the District Court's decision was made in July 2008, the Seventh Circuit upheld this decision in August 2009. Thus, we re-estimate Equation (1) while defining $Apex_t$ as equal to one after 2009 and zero otherwise. As shown in Table IA7, the results hold.

Sixth, we were concerned that nonrandom, noncompliance with TRI reporting mandates around the Apex Oil decision could shape the findings. Consequently, we conducted the following two robustness tests. We begin by replacing a missing value with a zero when (a) a facility reports a missing value for an RCRA toxic chemical release in years t to t+2 and (b) that same facility reported a non-missing for that chemical in years t-1 and t+3. As shown in Table IA8, the results hold. Next, we limit the sample to facilities that report non-missing values for an RCRA chemical in all years during our sample period. Table IA9 shows the results hold, reducing concerns that measurement errors associated with changes in compliance around the Apex ruling drive our results.

Seventh, we were concerned that *Apex* could trigger within-chemical transfers between facilities of the same firm that could alter our findings. Thus, we aggregated all RCRA toxic releases of all facilities that belong to a firm to form a firm-chemical-year panel. We then implemented a similar difference-in-differences estimation to the Table 2 facility-chemical-year analyses using this firm-chemical-year panel. Table IA10 shows that the results hold.

Table IA1 Robustness tests with land releases

This table reports DID results of the land releases of facilities from 2003-2013 without the year 2008. This is facility-by-chemical-by-year level data. We drop non-RCRA chemicals observations. The dependent variable is Ln(1 + Land $Releases_{ict}$), where Land $Releases_{ict}$ equals the amount of facility total releases excluding air and water related releases in chemical c released by facility i in year t. $Apex$ equals one after the 2008 Apex District court decision, i.e., from 2009 onward, and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were larger than the industry (NAICS 3-digital code) median and zero otherwise. High Default Prob. includes facilities belonging to firms with probability of failure (measured by Campbell et al., 2008) in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Default Prob. All variables are defined in the Appendix A. Facility-clustered standard errors-based t statistics are reported in parentheses. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(1+Land Releases)	Ln(1+Land Releases)	Ln(1+Land Releases)	Ln(1+Land Releases)
Apex*Heavy Polluters	-0.1986***	-0.1191	-0.2282***	-0.0693
	(-2.7625)	(-1.6325)	(-2.6609)	(-0.9326)
Constant	3.2336***	2.3786***	3.1827***	3.0429***
	(5.7134)	(4.0017)	(11.6417)	(4.0681)
Observations	70,875	91,746	70,232	91,324
R-squared	0.756	0.733	0.766	0.741
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES
High - Low Default Prob.	0.097*		0.008***	

Table IA2 Robustness tests with a different definition of Heavy Polluters

This table reports the DID results of the Toxic Releases of facilities from 2003-2013 without the year 2008 with different definition of Heavy Polluters based on RCRA total releases. This is facility-by-chemical-by-year level data. We drop non-RCRA chemicals observations**.** The dependent variable is Ln(1 + Toxic Releases_{ict}), where Toxic Releases_{ict} equals the amount of non-air RCRA toxic chemical *c* released by facility i in year t. $Apex$ equals one after the 2008 Apex District court decision, i.e., from 2009 onward, and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA total releases (i.e., sum of air, water, and land releases) during the pre-Apex (2005-2007) period were larger than the industry (NAICS 3-digital code) median and zero otherwise. High Default Prob. includes facilities belonging to firms with probability of failure (measured by Campbell et al., 2008) in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Default Prob. All variables are defined in the Appendix A. t statistics are reported in parentheses. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)
Apex*Heavy Polluters	-0.2369***	-0.1120	-0.2707***	-0.1036
	(-3.3943)	(-1.5873)	(-3.2955)	(-1.3586)
Constant	3.5678***	2.7152***	3.4173***	3.3011***
	(6.2486)	(4.6881)	(12.5488)	(4.6948)
Observations	70,875	91,746	70,232	91,324
R-squared	0.750	0.729	0.759	0.736
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES
High - Low Default Prob.	0.019**		0.012**	

Table IA3 Robustness tests based on different percentile

This table reports DID results of the Toxic Releases of facilities from 2003-2013 without the year 2008 by using the top 70th percentile as treated facilities. This is facility-by-chemical-by-year level data. We drop non-RCRA chemicals observations**.** The dependent variable is Ln(1 + Toxic Releases_{ict}), where Toxic Releases_{ict} equals the amount of non-air RCRA toxic chemical *c* released by facility *i* in year *t*. *Apex* equals one after the 2008 Apex District court decision, i.e., from 2009 onward, and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were in the top 70th percentile in the industry (NAICS 3-digital code) and zero for facilities in the bottom 30th percentile. High Default Prob. includes facilities belonging to firms with probability of failure (measured by Campbell et al., 2008) in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Default Prob. All variables are defined in the Appendix A. Facility-cluster standard errors-based t statistics are reported in parentheses. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)
Apex*Heavy Polluters	-0.3527***	-0.0571	-0.3196**	0.1597
	(-2.9979)	(-0.4876)	(-2.1039)	(1.0573)
Constant	3.2106***	1.7374	2.0774***	2.8722***
	(19.7496)	(1.2672)	(3.9967)	(3.1088)
Observations	39,722	56,839	39,096	56,364
R-squared	0.760	0.733	0.773	0.741
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES
High - Low Default Prob.	0.001***		0.000***	

Table IA4 Robustness tests with different cluster levels

This table reports the DID results of the Toxic Releases of facilities from 2003-2013 without the year 2008 with standard error cluster at state level or firm level. This is facility-by-chemical-by-year level data. We drop non-RCRA chemicals observations**.** The dependent variable is Ln(1 + Toxic Releases$_{ict}$), where Toxic Releases$_{ict}$ equals the amount of non-air RCRA toxic chemical *c* released by facility *i* in year *t*. *Apex* equals one after the 2008 Apex District court decision, i.e., from 2009 onward, and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were larger than the industry (NAICS 3-digital code) median and zero otherwise. High Default Prob. includes facilities belonging to firms with probability of failure (measured by Campbell et al., 2008) in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Default Prob. All variables are defined in the Appendix A. t statistics are reported in parentheses. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

Panel A. Cluster at the state level				
	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)
Apex*Heavy Polluters	-0.2166***	-0.0649	-0.2396***	-0.0075
	(-3.0229)	(-1.0648)	(-2.9026)	(-0.1133)
Constant	3.5951***	2.6838***	3.4573***	3.2463***
	(84.9848)	(72.4997)	(30.1129)	(16.2615)
Observations	70,875	91,746	70,232	91,324
R-squared	0.750	0.729	0.759	0.736
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES
High - Low Default	0.007***		0.000***	

Panel B. Cluster at the firm level				
Apex*Heavy Polluters	-0.2166**	-0.0649	-0.2396**	-0.0075
	(-2.3875)	(-1.0474)	(-2.1341)	(-0.1165)
Constant	3.5951***	2.6838***	3.4573***	3.2463***
	(6.2115)	(6.1823)	(11.1659)	(4.4922)
Observations	70,875	91,746	70,232	91,324
R-squared	0.750	0.729	0.759	0.736
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES
High - Low Default	0.007***		0.000***	

Table IA5 Robustness tests based on Expected Default Frequency (EDF)

This table reports robust DID results of the Toxic Releases of facilities from 2003-2013 without the year 2008 based on Expected Default Frequency (EDF). This is facility-by-chemical-by-year level data. We drop non-RCRA chemicals observations**.** The dependent variable is Ln(1 + Toxic Releases_{ict}), where Toxic Releases_{ict} equals the amount of non-air RCRA toxic chemical *c* released by facility *i* in year *t*. $Apex$ equals one after the 2008 Apex District court decision, i.e., from 2009 onward, and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were larger than the industry (NAICS 3-digital code) median and zero otherwise. High Expected Default includes facilities belonging to firms with the expected default frequency of Merton's (1974) distance to default model in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Expected Default. All variables are defined in the Appendix A. Facility-clustered standard errors-based t statistics are reported in parentheses. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Expected Default	Low Expected Default	High Expected Default	Low Expected Default
Dependent var.	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)
Apex*Heavy Polluters	-0.1727**	0.0130	-0.1649*	0.0586
	(-2.3224)	(0.1765)	(-1.8840)	(0.6649)
Constant	2.6077***	2.6412***	3.2956***	2.5630***
	(6.1308)	(4.2063)	(9.0754)	(3.4051)
Observations	65,930	91,787	65,381	91,382
R-squared	0.752	0.729	0.762	0.734
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES
High – Low EDF	0.001***		0.002***	

Table IA6 Facility employment

This table reports the impact of Apex Oil ruling on facilities' employment from 2003-2013 without the year 2008. Ln(Facility Emp) is the natural logarithm of the employment of the facility. Apex equals one when year>=2009 and set to zero otherwise. Heavy Polluters equals one which represents the facility's RCRA production wastes from year 2005-2007 are larger than industry (NAICS 3-digital code) median before the Apex Oil ruling and set to zero otherwise. High Default Prob. includes facilities belonging to firms with probability of failure (measured by Campbell et al., 2008) in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Default Prob. All variables are defined in the Appendix A. Facility-clustered standard errors-based t statistics are reported in parentheses. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)
Subsample	High Default Prob.	Low Default Prob.
Dependent var.	Ln(Facility Emp)	Ln(Facility Emp)
Apex*Heavy Polluters	-0.0354	-0.1129
	(-0.4274)	(-1.6120)
Constant	5.1482***	6.4932***
	(19.0845)	(25.3211)
Observations	6,958	8,639
R-squared	0.911	0.900
State Time Trends	YES	YES
Facility FE	YES	YES
Parent-Year FE	YES	YES

Table IA7 Robustness tests: defining the treatment since 2009

This table reports DID results of the Toxic Releases of facilities from 2003-2013 without the year 2008. This is facility-by-chemical-by-year level data. We drop non-RCRA chemicals observations**.** The dependent variable is Ln(1 + Toxic Releases_{ict}), where $\text{Toxic Releases}_{ict}$ equals the amount of non-air RCRA toxic chemical c released by facility i in year t. $Apex$ equals one after the 2009 Apex Circuit Court decision, i.e., from 2010 onward, and zero before 2010. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were larger than the industry (NAICS 3-digital code) median and zero otherwise. High Default Prob. includes facilities belonging to firms with probability of failure (measured by Campbell et al., 2008) in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Default Prob. All variables are defined in the Appendix A. Facility-clustered standard errors-based t statistics are reported in parentheses. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)
Apex*Heavy Polluters	-0.1898***	-0.1126*	-0.2285***	-0.0440
	(-2.9947)	(-1.6787)	(-2.8791)	(-0.6267)
Constant	3.5805***	2.6874***	3.4431***	3.2575***
	(6.2188)	(4.5525)	(12.2349)	(4.6013)
Observations	70,875	91,746	70,232	91,324
R-squared	0.750	0.729	0.759	0.736
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES
High - Low Default Prob.	0.084*		0.001***	

Table IA8 Robustness tests of Toxic Releases missing data zero fill-in

This table reports robust DID results of the Toxic Releases of facilities from 2003-2013 without the year 2008 with missing data zero fill-in. We fill zero for a facility's missing value in a RCRA toxic chemical release between year t and t+2 when that facility reported any value in that RCRA chemical in t-1 and t+3. This is facility-by-chemical-by-year level data. We drop non-RCRA chemicals observations**.** The dependent variable is Ln(1 + Toxic $Releases_{ict}$), where Toxic $Releases_{ict}$ equals the amount of non-air RCRA toxic chemical c released by facility i in year t. $Apex$ equals one after the 2008 Apex District court decision, i.e., from 2009 onward, and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were larger than the industry (NAICS 3-digital code) median and zero otherwise. High Default Prob. includes facilities belonging to firms with probability of failure (measured by Campbell et al., 2008) in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Default Prob. All variables are defined in the Appendix A. Facility-clustered standard errors-based t statistics are reported in parentheses. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)
Apex*Heavy Polluters	-0.2486***	-0.0701	-0.1975**	0.0041
	(-3.3228)	(-1.0192)	(-2.3087)	(0.0575)
Constant	3.6319***	2.5998***	3.3597***	3.1424***
	(6.5153)	(4.9453)	(11.5431)	(5.1531)
Observations	71,745	93,894	71,094	93,471
R-squared	0.726	0.704	0.738	0.712
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES
High - Low Default Prob.	0.003***		0.004***	

Table IA9 Robustness tests of observations with continuous RCRA Toxic Releases during 2003 - 2013

This table reports robust DID results of the continuous Toxic Releases of facilities from 2003-2013 without the year 2008. The sample includes only facility-by-chemical observations that continuously report Toxic Releases during our sample period. This is facility-by-chemical-by-year level data. We drop non-RCRA chemicals observations**.** The dependent variable is Ln(1 + Toxic Releases$_{ict}$), where Toxic Releases$_{ict}$ equals the amount of non-air RCRA toxic chemical c released by facility i in year t. $Apex$ equals one after the 2008 Apex District court decision, i.e., from 2009 onward, and zero before 2009. $Heavy\ Polluters_i$ equals one if facility i's RCRA production wastes during the pre-Apex (2005-2007) period were larger than the industry (NAICS 3-digital code) median and zero otherwise. High Default Prob. includes facilities belonging to firms with probability of failure (measured by Campbell et al., 2008) in December 2007 being larger than industry (NAICS 3-digital code) median. All other facilities are assigned to the Low Default Prob. All variables are defined in the Appendix A. Facility-clustered standard errors-based t statistics are reported in parentheses. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)
Apex*Heavy Polluters	-0.2404**	-0.0141	-0.2686**	0.0150
	(-2.2873)	(-0.1510)	(-2.3509)	(0.1651)
Constant	4.4343***	3.6262***	4.1113***	4.6033***
	(8.4132)	(4.1762)	(14.4252)	(5.9872)
Observations	30,754	46,604	30,296	46,257
R-squared	0.820	0.774	0.829	0.782
State Time Trends	YES	YES	YES	YES
Facility FE	YES	YES	YES	YES
Chemical-Year FE	YES	YES	YES	YES
Parent-Year FE			YES	YES
High - Low Default Prob.	0.004***		0.001***	

Table IA10 Aggregated into firm chemical level

This table reports DID results of the Toxic Releases of firms from 2003-2013 without the year 2008 by aggregating data into firm-chemical-year level. This is firm-by-chemical-by-year level data. We drop non-RCRA chemicals observations. Ln(1+Toxic Releases) is the natural logarithm of one plus the amount of firm RCRA chemical releases excluding air-related releases. Apex equals one which represents the year>=2009. Heavy Polluters is an indicator variable that equals one when firm i's total RCRA production wastes in 2005-2007 are larger than SIC 2-digital code industry median and zero otherwise. High Default Prob. includes firms with probabilities of failure (Campbell et al., 2008) at the end of December 2007 being larger than SIC 2-digital code industry median, and the Low Default Prob. includes all others. All variables are defined in the Appendix A. Firm-clustered standard errors-based t statistics are reported in parentheses. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(1)	(2)	(3)	(4)
Subsample	High Default Prob.	Low Default Prob.	High Default Prob.	Low Default Prob.
Dependent var.	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)	Ln(1+Toxic Releases)
Apex*Heavy Polluters	-0.2476**	-0.0533	-0.2816***	-0.1273
	(-2.5846)	(-0.4748)	(-2.8334)	(-1.0490)
Constant	4.6534***	4.3710***	4.5257***	4.6812***
	(20.8480)	(13.1690)	(28.3584)	(13.9832)
Observations	20,746	27,080	20,261	26,420
R-squared	0.353	0.271	0.627	0.583
State Time Trends	YES	YES	YES	YES
Year FE	YES	YES		
Firm FE	YES	YES	YES	YES
Chemical-Year FE			YES	YES
High - Low Default Prob.	0.077*		0.126	