Financial Constraints and Corporate Environmental Policies *

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Abstract

We show that financial constraints affect corporate environmental policies due to the significant abatement costs associated with hazardous waste management. Exploring three quasi-natural experiments in which firms' internal resources are likely exogenously impacted, we find that relaxation of financial constraints reduces U.S. public firms' toxic releases. The effects of financial constraints on toxic releases are amplified by weaker regulatory enforcement and external monitoring, and by managerial short-termism indexed with transient institutional investors or the incentive to meet earnings targets. Overall, our evidence highlights the real effects of financial constraints in the form of environmental pollution.

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"As man proceeds toward his announced goal of the conquest of nature, he is writing a depressing record of destruction–destruction of the earth he inhabits and destruction of the life that shares it with him."

Rachel Carson in *Silent Spring* (1962)

Introduction

In modern production processes, firms often generate byproducts that have adverse impacts on the environment and public health. In 2015 alone, U.S. firms produced 27.24 billion pounds of toxic chemicals from production-related processes. Researchers have documented costly adverse outcomes from exposure to pollutants and toxicants, such as issues ranging from infant mortality and neurodevelopment disorder to lower education completion, labor force participation, and earnings in later life (see Currie et al. (2014) for a review). Under the current U.S. regulatory regime, firms are required by laws to partially internalize the environmental costs by allocating resources for environmental protection. In addition, firms can go beyond the regulatory requirements in their environmental efforts, which serves as a form of private provision of public goods.[1]

In this paper, we examine how financial frictions affect corporate environmental policies. Environmental protection is exorbitantly expensive because it requires substantial inputs of energy, labor, contracted services, and raw materials in a process deeply integrated into every aspect of corporate decision-making.[2] The tension between environmental protection and a firm's bottom line lies in the fact that environmentally-friendly waste management methods are very costly for the firm, while the least costly methods such as direct disposal have detrimental environmental consequences and impose external costs to the public. When a firm is financially constrained, the wedge between the private benefits of financial stakeholders and the environmental benefits to the public from abatement

[1] Corporate social responsibility (CSR) is in essence corporate social or environmental behavior beyond legal requirements, which can be categorized as strategic, not-for-profit, or the result of moral hazard (Bénabou and Tirole (2010), Kitzmueller and Shimshack (2012)). The 2017 KPMG survey of corporate responsibility shows that three–quarters of N100 companies (a worldwide sample of 4,900 companies comprising the top 100 companies by revenue in each of the 49 countries researched) and 93% of G250 companies (the world's 250 largest companies by revenue based on the Fortune 500 ranking of 2016) publish their annual CSR reports.

[2] In 2005, the last year with official data, U.S. manufacturers spent over $26.57 billion on pollution abatement, which is about 1% of total U.S. manufacturing shipment value or above 20% of the manufacturing sector's total capital expenditure.

spending widens further. With limited internal resources, firms have strong incentives to preserve internal cash flows by undercutting abatement expenditures. Therefore, environmental protection is often sacrificed for the short-term benefit of financial stakeholders, resulting in further resource misallocation from society's point of view. In other words, financial constraints exert and exacerbate externalities in the form of environmental pollution.

Exploring the Toxics Release Inventory (TRI) establishment-level micro-data from the Environmental Protection Agency (EPA) from 1990 to 2014, we first show economically large and statistically significant correlations between the amount of toxic chemicals releases and two text-based financial constraint measures recently developed by Hoberg and Maksimovic (2014) and Bodnaruk, Loughran and McDonald (2015) for U.S. public firms. These text-based measures extract qualitative information about financial constraints from corporate disclosure documents and interpret this vast information using well-defined algorithms. Our results are robust to controls of firm characteristics related to common accounting-based financial constraint measures and to alternative categorizations of toxic releases under various EPA regulations. In terms of economic magnitude, a one-standard-deviation increase in the financial constraint measure is associated with a 2%-3% increase in total reported toxic release for an average establishment in the sample.

To establish the causal impact of financial constraints on firms' environmental policies, we explore three quasi-natural experiments to generate plausibly exogenous shocks to firms' financial resource availability. These three experiments include the American Jobs Creation Act (AJCA) passed in 2004 (Faulkender and Petersen (2012)), collateral value of firms' real estate assets (Chaney, Sraer and Thesmar (2012)), and mutual fund flow-induced price pressure (FIPP) (Coval and Stafford (2007), Edmans, Goldstein and Jiang (2012)). These experiments affect firms' cost of financing through cash flow windfalls from foreign income repatriation, higher debt capacity driven by collateral values, and additional equity issuance driven by short-term price appreciation, respectively. Given the exogenous nature of these shocks, they are unrelated to firm fundamentals and hence unlikely to be associated with firms' environmental policies other than through the cost of financing. We find consistent results across the three experiments that the relaxation of financial constraints reduces firms' discharges of toxic chemical.

After establishing the causality, we explore a number of cross-sectional variations on the inner workings of corporate environmental policies. We show that government regulation and external oversight play a significant role in reducing pollution. In fact, firms act accordingly to these regulatory and monitoring mechanisms when it comes to making pollution abatement decisions. In addition, our evidence highlights that managerial short-termism, driven by pressures from the capital markets, also helps shape corporate environmental policies. Overall, our sample of managers are opportunistic: they are keenly aware of the costs associated with environmental protection and strategically choose when and where to pollute.

In our first set of cross-sectional tests, we focus on variations in regulatory and monitoring environments. If a certain geographic region is designated as "nonattainment" by the EPA, environmental laws and regulations mandate enhanced monitoring and have costly ramifications. We first study firms' choice of overall pollution level according to regulatory strictness and show that establishments located in "nonattainment" counties release 20% less pollutants compared to their intra-firm peers located in "attainment" areas. Next we examine the heterogeneous sensitivity of toxic releases to financial constraints based on the attainment status of an establishment's location. When facing financial constraints, firms reduce abatement expenditures and pollute more in "attainment" areas with weak regulatory enforcement, but do not modify toxic releases in "nonattainment" areas. Similarly, "super-polluters," defined as establishments that release large quantities of pollutants, are often under the scrutiny of government agencies, environmental protection organizations, and news media. We find that small polluters are much more responsive to financial constraints, whereas "super polluters" display no sensitivity given the presence of external monitoring forces. Our results indicate the strategic choices firms make as to the level of the pollutants they exude to the environment with respect to regulatory and monitoring mechanisms, both in the extensive and intensive margins.

In our second set of cross-sectional tests, we examine managerial short-termism related to managerial decision horizons and compensation incentives. Reducing environmental pollution is a relatively long-term objective, compared to short-term decisions such as reducing production costs. When long-term objectives are in conflict with short-term ones, the investment horizon will affect resource allocations between these objectives and myopic firms or managers would favor short-term objectives. We test this idea through two dimensions. First, we infer managerial decision horizons by observing the portfolio composition of institutional investors, motivated by the strong correlation between these two (e.g., Bushee (2001), Gaspar, Massa and Matos (2005)). Our evidence shows that financial constraints significantly increase toxic releases when managerial and institutional investors' decision horizons are more short-term oriented. Second, we examine how toxic chemical releases respond to managerial incentives to meet earnings targets, which is one short-term objective predominantly emphasized in the prevailing compensation contract. The evidence points to a subset of firm-years where firm emit significantly more toxic releases when earnings fall short of analysts' forecasts, as they have tried "everything possible" including squeezing pollution abatement to reduce costs.

Our paper contributes to the literature on the real effects of financial constraints. Our evidence complements and extends earlier work focusing on investment and employment activities (e.g., Baker, Stein and Wurgler (2003), Almeida and Campello (2007), Campello, Graham and Harvey (2010), Chaney, Sraer and Thesmar (2012), Chodorow-Reich (2013)) by highlighting environmental pollution as the key outcome variable, which deserves a careful examination given its social impact. We demonstrate that firms carefully evaluate the private costs and benefits associated with the implementation of environmental policies, which deserves a careful examination given its social impact. As a result, financial constraints amplify the negative externalities of a firm's production decisions and impose additional costs to society.

Our paper also complements work on corporate social responsibility (CSR) from a few angles.[3] First, the vast majority of the CSR studies exploit firm-level variations using the Kinder, Lydenberg and Domini (KLD) ratings, where the measures are fairly persistent and might not precisely capture firms' ever-changing environmental performance (Chatterji, Levine and Toffel (2009)). In comparison, we focus on establishment-level toxic releases and utilize a set of well-defined and high-quality performance metrics in a large panel. The granular data allows us to exploit establishment-level variations to gauge the effect of important factors such as regulatory and monitoring mechanisms, which is essential for a better understanding of firms' environmental decisions.

[3] See Margolis, Elfenbein and Walsh (2009), Bénabou and Tirole (2010), and Kitzmueller and Shimshack (2012) for a comprehensive review of the literature.

Second, our paper relates to the discussion of how ownership structure and managerial incentives affect CSR activities (e.g., Dimson, Karakaş and Li (2015), Masulis and Reza (2015), Cheng, Hong and Shue (2016), Dyck et al. (2017), Fernando, Sharfman and Uysal (2017), Starks, Venkat and Zhu (2017), Akey and Appel (2018)). We show that managerial and institutional investors' short-termism magnifies the effects of financial constraints on firms' environmental footprints, highlighting the role of the capital market in pollution management. Our evidence is also consistent with previous studies that find that managers manipulate real activities to meet earnings benchmarks (Graham, Harvey and Rajgopal (2005), Roychowdhury (2006), Cohen, Mashruwala and Zach (2010), Almeida, Fos and Kronlund (2016)) with an emphasis on environmental abatement expenditures.

Last, we also contribute to the debate on firms "doing well by doing good" versus "doing good by doing well." The formal view juxtaposes corporate environmental policies and corporate financial performance. The idea is that when firms act as "responsible" partners with the environment and other non-financial stakeholders, their bottom lines benefit (e.g., Baron (2001), Edmans (2011), Eccles, Ioannou and Serafeim (2014), Dimson, Karakaş and Li (2015), Masulis and Reza (2015), Krüger (2015), Albuquerque, Durnev and Koskinen (2016), Dunn, Fitzgibbons and Pomorski (2017), Lins, Servaes and Tamayo (2017), Hoepner et al. (2018)). However, implementation of environmental protection is costly, and "doing good" may imply sacrificing shareholder value (Barber, Morse and Yasuda (2017)). We show that when the regulation and external non-stakeholder monitoring are weak, actions of "doing well" seems to dominate the motives of "doing good" (Hong, Kubik and Scheinkman (2012), Cohn and Wardlaw (2016)).

The rest of the paper is organized as follows. Section 1 describes institutional background, introduces data we use in this study, and provides some summary statistics. Our baseline correlation studies are presented in Section 2. In Section 3, we present three identification strategies to establish the causality of financial constraints on corporate environmental policies. A number of cross-sectional tests are discussed in Section 4. We conclude in Section 5.

1 Institutional Background and Data

1.1 Institutional Background

Born in the wake of elevated concern about environmental pollution, the EPA was founded in 1970 to consolidate a variety of federal research, monitoring, standard-setting, and enforcement activities into one agency. A number of laws serve as the EPA's foundation for protecting the environment and public health, with a few presidential Executive Orders (EOs) also playing a central role. Congress authorizes the EPA to develop and enact regulations, as well as explain the critical details necessary to implement environmental laws. Panel A in Figure 1 illustrates how different EPA rules regulate product used and produced in the manufacturing process. The EPA works with state and local authorities to ensure the compliance of environmental regulations, enforce penalties, and launch sanctions. If the EPA and state agencies uncover willful violations, civil or criminal trials and penalties are sought.

Panel B of Figure 1 presents the so-called "Waste Management Hierarchy," which intuitively outlines EPA's waste management guidelines. Source reduction refers to the process of maximizing or reducing the use of natural resources at the beginning of an industrial process, thereby eliminating the amount of waste produced by the process. Source reduction is the EPA's preferred method of waste management. Recycling refers to the series of activities through which discarded materials are collected, sorted, processed, and converted into raw materials and used in the production of new products.[4] Energy recovery is the process of generating energy from the combustion of wastes, including at waste-to-energy combustion facilities and landfill-gas-to-energy facilities.[5] Treatment means the use of various processes, such as incineration or oxidation, to alter the properties or composition of hazardous materials. Direct disposal or other releases is the least preferred methods of waste management.

Unfortunately, direct disposal is often the least costly method of waste management from a firm's perspective. The tension between environmental protection and a firm's bottom line lies precisely in the fact that the EPA-preferred waste management methods are more costly for a firm, while less

[4]The definition excludes the use of these materials as a fuel substitute or for energy production. (National Recycling Coalition, 1995)

[5]It is often associated with electricity generation, although it can also offset fossil fuels used at industrial sites.

preferred methods are more harmful to the environment. Consider a typical coal-fired plant. To minimize its environmental impact, it can use higher-grade (or cleaner) coal that reduces pollutants from the very beginning, which will significantly increase production costs.[6] A coal-fired plant can even switch to a natural gas-fired plant but this would require a substantial investment upfront. Indianapolis Power and Light (IPL), a subsidiary of American Energy Service (a publicly traded Fortune 500 company), is a good example of the high costs of waste management. IPL is consistently ranked on top of the nation's "super-polluter" list for toxic release and greenhouse gases (Public Integrity, 2016).[7] In its 10-K filing with the Security and Exchange Commission (SEC) for the fiscal year ending in December, 2016, IPL states the following:

> "On July 29, 2015, the IURC [Indiana Utility Regulatory Commission] issued a CPCN [Certificate of Public Convenience and Necessity], granting IPL authority to convert Unit 7 at the Harding Street Station from coal-fired to natural gas-fired at a cost of up to $70.9 million (the IURC later approved IPL's updated cost estimate for the Harding Street Station refuels including $64.3 million for Unit 7), and also to install and operate wastewater treatment technologies at Harding Street Station and Petersburg Generation Station in southern Indiana at a cost of up to $325.7 million." (IPL's 10-K, contents in brackets have been added by authors)

It is useful to put these numbers into perspective: by the end of fiscal year 2016, which is the latest information available, IPL's net income from operating activities was merely $324 million.

The above example may give the impression that environmental protection is all about fixed-asset investment. However, this could not be further from the truth. In Panel C of Figure 1, we present the cost categories of the abatement costs and expenditures according to the EPA Pollution Abatement Costs and Expenditures (PACE) survey for the manufacturing sector. Perhaps contrary to some conventional wisdom, depreciation of investment accounts for only 14% of abatement operating costs, and pollution abatement capital expenditures accounts for less than 5% of the total new capital expenditure. In contrast, expenditures associated with energy, contract work, labor, and materials and supplies make up the vast majority of the abatement costs.[8] This simple decomposition emphasizes

[6]Coal prices differ by rank and grade. According the U.S. Energy Information Administration, in 2015, the average annual sale price of coal per ton (2,000 pounds) ranged from $22.36 for lignite coal, to $51.57 for bituminous coal, and to $97.91 for anthracite coal. As one may expect, lignite and bituminous coal generate much more sulfur dioxide and smog than anthracite coal.

[7]The source of information is available from https://www.publicintegrity.org/2016/09/29/20248/americas-super-polluters.

[8]The source of data is PACE: 2005, published by the US Census Bureau, available from https://www.census.gov/prod/2008pubs/ma200-05.pdf.

that environmental policies are not only a sideshow of corporate capital investment. To the contrary, environmental policies run much deeper into every stage of operations for modern corporations. Understanding the impact of financial constraints on corporate environmental policies has its own importance, which deserves a careful investigation.

In some of our empirical tests, we use a county's attainment or nonattainment status as one of our identification strategies. Under the Clean Air Act Amendments of 1977 (1977 CAAA), each year every county is classified by the EPA as attainment or nonattainment of the national standards for criterion pollutants. The threshold for excessive pollution is applied uniformly across the United States.[9] In any given year, some counties generate pollution over these thresholds while others do not. Figure 2 presents the latest version (September 2017) of the nonattainment map from the EPA. The EPA has mandatory and discretionary sanctions for nonattainment areas. For example, the EPA can impose a mandatory sanction for highway funding through the Federal Highway Administration. Discretionary sanctions mandate that local plants emitting the pollutant must adopt "lowest achievable emission rates" (LAER) technologies, which requires the installation of the cleanest available technologies regardless of costs. Furthermore, if any new plants plan to locate in the nonattainment county, the EPA forces them to reduce their releases from another polluting source within the county. In contrast, for areas designated as "attainment," large polluters are only required to use the "best available control technology" (BACT), which is significantly less costly than LAER technology. In summary, a nonattainment status results in more stringent regulations to reduce toxic released without regard to cost (Becker and Henderson (2000), Walker (2013)).

1.2 Data

Our main source of data comes from the establishment-level TRI program administered by the EPA from 1990 to 2014. For any facility in the U.S., if it falls within a TRI-reportable industry sector, has ten or more employees, and the amount of manufactured or processed TRI-listed chemicals is above a certain quantity threshold, then it is required to report information about the release of the toxin. The EPA conducts an extensive quality analysis on the TRI reporting data and provides analytical support

[9] Ambient air pollution is measured by EPA pollution monitors that take hourly/daily readings. The choice and management of monitoring location is not subject to local authorities.

for enforcement efforts led by their Office of Enforcement and Compliance Assurance (OECA). The EPA first identifies TRI forms containing potential errors and contacts the facilities that submitted them. If errors are confirmed, the facilities then submit a corrected report. In addition, the Office of Inspector General is an independent office within the EPA that performs audits, evaluations, and investigations of the agency and its contractors to prevent and detect fraud, waste, and abuse.[10]

In our empirical exercises, we mainly focus on the total quantity of toxic releases. As a robustness check, we also consider toxic releases under the Clean Air Act (CAA), the Clean Water Act (CWA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as the "Superfund"), as well as the Occupational Safety and Health Act (OSHA). In comparison to firm-level or industry-level data, working with establishment-level data allows us to study corporate environmental policies at a fine granularity with a high precision. We remove the establishment with a total toxic release amount below 100 pounds or employee counts below 10 to make sure small polluters are not driving our results. We also remove establishments with fewer than three consecutive observations.

We extract facility information from the National Establishment Time-Series (NETS) database produced by Walls & Associates, which is a continuous annual compilation of different vintages of the Dun & Bradstreet (D&B) Million Dollar Directory database. The organizational structure of the NETS database shares many similarities with those of the Longitude Business Database (LDB) maintained by the U.S. Census Bureau.[11] Due to its production lag time, the most recent version of the NETS database, which is the version we use in this study, provides facility information between 1990 and 2014.

We draw firm-level accounting information from the Compustat database and stock market related information from the Center for Research in Security Prices (CRSP) database. We also use flow-induced price pressure (FIPP) from Lou (2012), the MSA-level Home Price Index (HPI) from the Federal Housing Finance Agency (FHFA), MSA-level local housing supply elasticity (Saiz (2010)),

[10]Section 325(c) authorizes civil and administrative penalties for noncompliance with TRI reporting requirements. Section 1101 of Title 18 of the U.S. Code makes it a criminal offense to falsify information given to the U.S. Government (including intentionally false records maintained for inspection).

[11]Please refer to Barnatchez, Crane and Decker (2017) for a detailed comparison between these two datasets. Notice that we exclude establishments with below 10 employees, which is the size class where NETS have large imputation rates as documented by Barnatchez, Crane and Decker (2017)

and the 30-year U.S. fixed mortgage rate to identify the causal link between firms' financial constraints and toxic releases. To measure the incentives of meeting earnings targets, we obtain earnings forecasts of sell-side analysts and realized earnings from the Institutional Brokerage Estimation System (I/B/E/S). Institutional holding data are obtained from Thomson Reuters' 13F filing database. To classify asset owners into different investment and holding horizons, we adopt the classification scheme in Bushee (2001). Lastly, to analyze the effect of AJCA, we hand-collect data from the firms' 10-K filings from 2001 to 2006 and determine whether the firm mentioned AJCA in their 10-K filings, whether the firm repatriated the foreign earnings under AJCA, and the amount of foreign earnings reported to be permanently reinvested overseas.

Linking these databases poses a challenge because there is no common and consistent linking keys among the EPA TRI report, NETS, and Compustat /CRSP databases. To establish linkage among these databases, we first link the EPA TRI report with the NETS database at the facility level, using a link file provided by the EPA with facility-level D&B numbers (also known as "DUNS number"). In the second step, we link the EPA TRI parent company information with Compustat /CRSP databases using a historical name matching algorithm. It is crucial to use historical name information, which is time-varying to plant opening, close, and ownership changes. We obtain the historical company name from CRSP, supplemented by the historical name and address information obtained from the 10K, 10-Q, and 8-K filings using the SEC Analytical Package provided by the Wharton Research Data Service (WRDS).

1.3 Measures of Financial Constraints

Financial constraints are difficult to measure (Farre-Mensa and Ljungqvist (2016)). In our empirical analysis, we made a conscious choice to avoid using accounting-based measures of financial constraints because they are highly correlated with the production level, which is a key factor in determining the total toxic release amount. Instead we mainly rely on two text-based financial constraint measures developed by Hoberg and Maksimovic (2014) and Bodnaruk, Loughran and McDonald (2015). In addition, we control for financial characteristics commonly used to construct the accounting-based financial constraint measures such as log(assets), Tobin's q, tangible, leverage, and cash/assets.

To construct the financial constraint measure, Bodnaruk, Loughran and McDonald (2015) first define a copula of words that describe financial constraints. Equipped with such a dictionary, they search the entire 10-K and use a simple "bag-of-words" approach to delineate the "tone" of management discussion and disclosure. In general, they classify a firm-year as more constrained if the list of "financial constraint" words occur more often. They validate their measure by its predictive power of events such as future dividend omissions, pension underfunding, and other related events generally described as syndromes of financial constraints. In contrast, many accounting-based financial constraint measures do not have any predictive power.

Hoberg and Maksimovic (2014) take a different approach. They focus on mandated disclosures regarding each firm's liquidity, as well as the discussion of the financing source each firm intends to use. Based on the disclosures in the Management's Discussion and Analysis (MD&A) section of the 10-K,[12] Hoberg and Maksimovic (2014) evaluate financial constraints by counting instances when a firm was constrained from raising capital. In our empirical analysis, we focus on the debt-market constraint measure, which describes a firm's intension to issue debt to solve their liquidity problems.

In summary, we recognize that none of the financial constraint metrics is perfect. We hope that these two measures capture some aspects of financial constraints in an intuitive manner.

1.4 Summary Statistics

Our final sample includes 8,294 establishments that belong to 1,544 U.S. public firms over the sample period from 1990 to 2014. 89,464 establishment-year observations are included. In Table 1, we present summary statistics for the firm-level observations in our sample (Panel A) and compare it to overall Compustat non-financial firms during the sample period (Panel B). Establishment-level summary statistics of the key variables are presented in Panel C. Compared to the overall Compustat universe during the same period, our median asset is $838.56 million while the Compustat median asset size is $191.27 million. Our firms also have more tangible assets (Compustat median tangible-to-assets ratio is 23% while our sample has 29%) and less cash (Compustat median cash/asset ratio

[12]Not every firm provides liquidity and capitalization resource subsection in MD&A section. Hoberg and Maksimovic (2014) show that these firms are generally healthy firms that have few liquidity issues to disclose.

is 9% while our sample median is only 4%). The differences are mainly driven by the fact that our sample overweights the manufacturing sector, as those are the firms included in the TRI program.

The average amount of toxic release by establishment differs by program definition. Toxics released according to the CERCLA, CAA and CWA include a somewhat wider spectrum of compounds than the toxic release defined by OSHA. The mean total toxic release per establishment per year is approximately 115 tons, and the average total toxic release per establishment per year based on the definitions of the CAA, CWA, and CERCLA range from 72 to 109 tons per year, while the OSHA definition of a toxic release is about 17.82 tons per year. The amount of toxic release is highly skewed because of some of the so-called "super-polluters." In our analysis, we use the natural logarithm of the toxic release amount defined by different programs to address the skewness in the data.

Figure 3 presents the time-series plot of aggregate toxic release of our sample establishments by year.[13] The total amount of toxic release declines over time. This is consistent with findings of earlier literature. Some important factors behind the decline in toxic release include more stringent environmental regulations and the higher pollution tax that firms are paying (Henderson (1996), Levinson (2009), Shapiro and Walker (2015)), migration of heavy polluting industries to other countries (Copeland and Taylor (2004)), and introduction of greener technologies (Levinson (2015)). Because of the above time-series attributes, we include year-related fixed effects in all of our specifications.

In Appendix Table A.2, we summarize total toxic releases using the Fama-French 48-industry classification. As one may expect, chemicals, construction materials, steel, machinery, and auto industries have the largest number of facilities discharging toxic chemicals, followed by the consumer products, food products, rubber and plastic petroleum, and public utility industries. Another feature of the data is that, for certain industries such as precious metal, metal mining, and utilities, the average emission per establishment is much higher than for other industries. These summary statistics

[13]There was a major expansion of reporting industries in 1998. Seven new industry sectors were required to report to TRI, including metal mining, coal mining, electric utilities, chemical wholesale distributors, petroleum bulk storage and terminals, hazardous waste management facilities, and solvent recovery facilities. In this figure, we removed a few new sectors added to the TRI program in 1998 to keep the number of sectors constant throughout the time period. However, in the subsequent empirical analysis, we include those sectors. There are a number of smaller expansions of reporting requirements between 2000 and 2014; however, most of the expansion is related to newly added carcinogenic toxins based on the National Toxicology Program (NTP) in their Report on Carcinogens (ROC). Using the gradual introduction of newly identified carcinogens as events that increase corporate liabilities, Gormley and Matsa (2011) explore managerial responses.

highlight the need to account for establishment or industry characteristics.

2 Baseline

In this section, we describe our baseline ordinary least squares (OLS) regression model that relates firms' toxic releases to financial constraint measures. The purpose of the correlation analysis is to establish some empirical regularities and benchmark cases. The baseline regression is as follows:

$$\begin{aligned} \textit{Toxic Release}_{i,t} &= \alpha + \beta \textit{Financial Constraints}_{c,t-1} + \gamma \textit{Firm Controls}_{c,t-1} \\ &+ \kappa \textit{Establishment Controls}_{i,t} + \textit{FEs} + \epsilon_{i,t} \end{aligned} \tag{2.1}$$

where i denotes each establishment, c denotes each firm, and t denotes year. Firm controls include *Log (Asset)*, *Tobin's q*, *Leverage*, *Tangibility*, and *Cash holding*, which are key inputs for commonly-used accounting-based financial constraint measures. We also include total capital investment to control for the impact of overall CAPEX on our outcome variables. Establishment-level controls include *Log (sales)* and *Log(employment)* to account for production amount at the establishment level. In Table 2, we present regression estimates of financial constraints on the total toxic release (measured by ton in logarithm) as our main outcome variable. The regressions for columns (1) to (3) include the financial constraint measure *Text FC*, which is the textual-based measures developed in Bodnaruk, Loughran and McDonald (2015).The regressions for columns (4) to (6) include the measure *HM Debt*, which is the debt-market constraint measure taken from Hoberg and Maksimovic (2014). We hypothesize the coefficient β to be positive – the more financially constrained firms are likely to release more toxins. All specifications include establishment fixed effects to account for time-invariant unobservable establishment attributes. Standard errors are clustered at the firm level.

The regression for column (1) in Table 2 also includes the year fixed effects. The key coefficient of 0.221 implies that a one-standard-deviation (0.20) increase in financial constraint (Bodnaruk, Loughran and McDonald (2015)) is associated with approximately a 0.44 increase in the log number of total toxic release, which corresponds to 2.5% of our sample mean (1.75). Similarly, column (4) of Panel A in Table 2 shows that a one-standard-deviation (0.06) increase in financial constraint

(Hoberg and Maksimovic (2014)) is associated with a 0.42 increase in the total toxic release, which corresponds to 2.4% of our sample mean.

We include industry-year (Fama-French 48-industry classification) fixed effects in regressions (2) and (5), and state-year fixed effects in regressions (3) and (6). This set of fixed effects effectively account for time-varying industry or state-wide characteristics such as state-level environmental regulations and enforcements. All of the point estimates across different regression specifications are of similar economic magnitudes, ranging from 1.8% (column (2)) to 2.2% (column (3)) of the sample mean.

As robustness checks, Appendix Table A.3 presents regression estimates of financial constraints on the amount of toxic chemical releases categorized under various EPA regulations with the same regression specifications. We include the emissions under the CAA and the CWA to examine the robustness across different disposal mechanisms. We also include emissions covered under the CERCLA, as well as the OSHA to demonstrate the robustness against emissions imposing the highest known threats to public health. The coefficients of the two text-based financial constraint measures remain quantitatively similar across different categories of toxic chemical emissions.

In addition, Appendix Table A.4 presents regression estimates of a dummy variable indicating an establishment's EPA compliance status, which takes the value of one if non-compliant and zero otherwise, on the two financial constraint measures. Coefficients across all specifications are close to zero and none of them is statistically significant at conventional levels. We believe that this non-result merits attention. One possible interpretation is that firms are reducing their CSR activities, which are by definition beyond legal requirements. While financial constraints adversely affect corporate environmental policies, they do not necessarily lead to non-compliance because visibly and publicly violating the EPA's compliance regulations is also costly. Noncompliance triggers significant monetary costs that may include fines, penalties, and mandatory recovery costs, as well as indirect costs such as reputational losses.[14] As a consequence, a firm will try to avoid being labeled as non-compliant even if it is financially constrained. Another possible explanation is that financially constrained firms

[14]In the full EPA TRI record, only 2.88% of observations have a noncompliance status. The average penalty dollar amount at both the state and federal level is $245 thousand, with the highest record being $40 million. The compliance action costs average as high as $36 million, with the highest being around $5 billion.

are more likely to manipulate the toxic release numbers reported to the EPA as firms reduce waste management spending. While both explanations may be driving the facts, our observation highlights the potential shortcomings of using an establishment's EPA compliance status as a sufficient statistic of corporate environmental policies in our context.

3 Identification: Three Experiments

Section 2 presents a positive correlation between firms' toxic releases and financial constraint measures. However, it remains challenging to identify the causal impact of firms' financial constraints on environmental policies. The key concern lies in the omitted variable issues. For example, there might be some firm-, industry-, or state-level unobservables that affect firms' financial health and their environmental decisions, which could bias the OLS coefficients in either direction. Alternatively, there is the reverse causality concern: poorer environmental performance is associated with worse financial performance (Margolis, Elfenbein and Walsh (2009)) and a higher cost of capital (Chava (2014)), which likely makes firms more financially constrained. In order to establish the causal link, we need to generate an exogenous shock to firms' financial constraints, while the shock should be unrelated to firms' toxic release decisions.

In this section, we exploit three quasi-natural experiments to generate an exogenous shock. In the first experiment, we make use of the 2004 American Jobs Creation Act (AJCA), which created a positive cashflow windfall by lowering the repatriation tax rate for firms that repatriated foreign earnings previously held by foreign subsidiaries. In the second experiment, we exploit the collateral value of firms' real estate assets, where higher collateral value reduces lending frictions and therefore facilitates financing through higher debt capacity. In the third experiment, we use mutual fund flow-induced price pressure (FIPP), where large inflows generate temporary price appreciation and induce seasoned equity issuance. These three shocks are completely independent of each other and generates exogenous shocks to firms' financial constraints through orthogonal channels. We study firms' toxic releases in response to these three shocks to generate causal inference of how financial constraints affect toxic releases.

3.1 Experiment 1: Tax Holidays

The 2004 AJCA provided a temporary tax break for firms by lowering the repatriation tax rate from 35% to 5.25% for multinational U.S. firms that had earnings held by foreign subsidiaries. It was implemented to boost domestic investment and employment by incentiving U.S. firms to bring back their stockpiles of cash "trapped" overseas because of the repatriation taxes due. The U.S. Department of the Treasury specified how the repatriated earnings could be spent, such as expenditures on plant and equipment, employment, and acquisitions. To qualify for the tax break, companies need to have "domestic reinvestment plans" that outline the uses of the repatriated funds. In a nutshell, the AJCA introduced a positive cashflow windfall for firms that repatriated foreign earnings, which is well-suited to capture the temporary and significant changes in internal financing cost for our sample firms.

Collecting data from 10-K statements between 2000 and 2007, we are able to identify 350 unique firms that repatriated foreign earnings under the AJCA, out of which 132 are matched to our EPA-Compustat-merged sample. We exploit a differences-in-differences (DID) analysis as in Faulkender and Petersen (2012). We classify firms into three categories: (1) firms with little or no likelihood of repatriating foreign earnings; (2) firms with a reasonable likelihood of repatriating foreign earnings that choose not to repatriate such earnings under the AJCA; and (3) firms with a reasonable likelihood of repatriating foreign earnings and choose to repatriate under the AJCA. To properly account for the heterogeneous ex ante likelihood of repatriation and the actual repatriation of foreign earnings, the empirical design explicitly considers both the predicted probability of repatriation and the residual from actual repatriation. Our focus is on the residual term, which identifies the differential reactions between the treatment (category 3) and the control firms (category 2).

Our goal is to examine whether repatriating income under the AJCA relaxes financial constraints for a subgroup of firms. Firms that were not constrained before the AJCA windows should have reached their desired level of environmental activities, therefore AJCA would only change the source of financing for abatement expenditures without affecting the level. In contrast, for financially constrained firms that previously underfunded their environmental activities, the AJCA significantly reduced the cost of internal capital. This exogenous shock allows constrained firms to fund environmental abatement activities that they otherwise would have foregone, resulting in a reduction of toxic releases.

Specifically, we first estimate the probability of foreign earnings repatriation and the residual based on firm characteristics prior to 2004 and present the results in Appendix Table A.5.[15] We then extract the estimated probability and the residual term, and examine the effect of foreign earnings repatriation on corporate environmental policies as follows:

$$\begin{aligned} \textit{Toxic Release}_{i,c,t} &= \alpha + \beta_1 \textit{Residual}_{c,t} * \textit{FP}_{c,t} + \beta_2 \textit{Pr(Repatriate)}_{c,t} \\ &\quad + \beta_3 \textit{Residual}_{c,t} + \beta_4 \textit{FP}_{c,t} + \gamma \textit{Controls} + FE + \epsilon_{i,t} \end{aligned} \tag{3.1}$$

where i denotes each EPA establishment, c denotes each firm, and t denotes year, and Firm Controls include *Log(assets)*, Tobin's q, *pre-investment Earnings*, *Leverage*, *Tangibility*, *Capital Investment*, and *Cash Holdings*. Establishment controls include the *Log(sales)* and *Log(employment)*. In this experiment, we follow Faulkender and Petersen (2012) and use *FP* to identify the financially constrained group, where *FP* is defined as the proportion of years during which a firm's investment expenditures exceed its internal cash flow during 2000 to 2003. We choose this measure for easy replication of their findings on the effect of the AJCA on domestic investment, therefore lending support to our empirical settings.

In Table 3, we present the regression estimates of Equation 3.1. Our main variable of interest is *Residual * FP*, which captures the effects of foreign earnings repatriation on financially constrained firms. The negative coefficient on *Residual * FP* suggests that the repatriating firms that were previously constrained (i.e., unable to fully fund abatement activities) significantly reduce toxic chemical releases after the repatriation. In terms of the economic magnitude, repatriation reduces toxic chemical releases by 13.6% for an average establishment own by financially constrained repatriating firms.[16]

To put these estimates in perspective, we further examine the effect of the AJCA on domestic investment, as in Faulkender and Petersen (2012), and present the results in columns (4) and (5)

[15] We find that firms with fewer investment opportunities, more unrepatriated foreign earnings, and larger tax breaks generated by the AJCA are more likely to repatriate, consistent with previous studies.

[16] The magnitude is calculated as (-0.515+0.152)/2.67 using coefficients in column(3) of Table 3, where 2.67 is the average log of total release for financially constrained repatriating firms during our AJCA sample period.

of Table 3 for our EPA-linked sample and the full Compustat sample, respectively. The dependent variable *Domestic Inv* is defined as the sum of domestic capital expenditure, domestic R&D, advertising expenses, and acquisitions scaled by assets.[17] We find that financially constrained firms disproportionately increased domestic investment relative to unconstrained firms after foreign earnings repatriation. The economic magnitudes we document are quantitatively similar to Faulkender and Petersen (2012), and help to validate our empirical settings.

3.2 Experiment 2: The Collateral Channel

In our second identification strategy, we exploit the collateral channel of firms' real estate assets, which represents a major part of their tangible assets. An increase in the value real estate assets reduces external financing frictions, and has been documented to generate more debt issuance and investment activities (Chaney, Sraer and Thesmar (2012)). We therefore use this setting to identify the effects of financial constraints on environmental policies. This experiment uses variations in a firm's real estate value driven by local real estate prices. Before 1993, Compustat provides detailed decomposition of property, plant, and equipment (PPE), which includes three major categories of real estate assets: building, land and improvement, and construction in progress. We retrieve the market value of these three categories for firms in 1993 and then inflate firms' real estate value using local MSA-level Housing Price Index (HPI) provided by the Federal Housing Finance Agency (FHFA) from 1993-2007.[18] Real estate value calculated this way has the advantage of not being affected by firms' decision of acquiring additional real estate assets after 1993, which helps us to obtain a cleaner identification.

There might be some concerns with respect to potential omitted variables associated with both HPI and firms' environmental decisions, which might contaminate the collateral channel that we try

[17]We use the Compustat segment file to compute the amount of domestic capital expenditure and domestic R&D.

[18]A few steps are involved in this process. First, the asset values provided by Compustat in 1993 are book values instead of market values. To generate market value in 1993, we first refer the average age of these assets by calculating the ratio of accumulated depreciation of buildings to the historic cost of buildings (assuming a 40-year depreciation schedule), and then approximate the historical cost using the CPI before 1975 and state-level HPI after 1975. Second, after getting the 1993 market value, we use headquarter MSA-level HPI as the price inflater to generate real estate value between 1993-2007. Chaney, Sraer and Thesmar (2012) collect information regarding the real estate assets using firms' 10-K filing and confirm that facilities do clusters with headquarters in the same MSA area, and a major portion of corporate real estate assets do locate in the headquarters.

to establish. To deal with these endogeneity concerns, we use the MSA-level HPI instrumented by the MSA-level supply elasticity (Saiz (2010)) interacted with 30-year mortgage rates in the U.S.(Mian and Sufi (2011), Chaney, Sraer and Thesmar (2012)). The intuition is that as housing demand increases due to changes in the mortgage rate, home prices are less sensitive to demand in elastically-supplied markets because these areas capitalize demand shocks into quantities rather than prices. Whereas in areas with a very inelastic supply, demand shocks translate into prices instead of quantity (e.g., areas like San Francisco or Boston). The first stage specification is as follows:

$$HPI_{i,t} = \alpha + \beta \ Elasticity_i \times Mortgage \ Rate_t + MSA \ FE + Year \ FE + \epsilon_{i,t} \tag{3.2}$$

In the second stage, we run the following regression specification:

$$Y_{k,j,i,t} = \alpha + \beta \times \widehat{RE \ Value}_{j,i,t} + \gamma HPI_{i,t} + \sum_n \kappa_n Init.Cond_j \times HPI_{i,t} + controls + \epsilon_{k,j,i,t} \tag{3.3}$$

where i denotes MSA, t denotes year, j denotes firm, and k denotes establishment. The regressions include MSA-level HPI to control for the direct impact of real estate prices on toxic releases. It also includes initial firm-level characteristics, which are the five quintiles of age, assets, and return on assets interacted with MSA-level HPI to control for the heterogeneous ownership decisions and their potential impact on the sensitivity that we measure. Establishment fixed effects are included in all specifications.

We present the first stage regression estimates in Appendix Table A.6 where the interaction terms are significantly positively related to MSA HPI. In Table 4 Panel A, we present the regression estimates for the second stage, with column (1) using real estate value inflated by HPI and columns (2)-(4) using real estate value inflated by the instrumented HPI. Across all four columns, higher real estate values lead to lower toxic release amount. The coefficient estimates show that a one-standard-deviation increase in real estate value leads to about 3%-4% drop in toxic releases relative to the sample mean. In columns (5)-(6), we examine the effect of real estate value changes on investment at the firm level as a comparison. We include the same controls as in Chaney, Sraer and Thesmar (2012) and find a similar effect on firms' investment behavior.

In Panel B of Table 4, we examine the heterogeneous impact with respect to firms' ex ante financial constraint level. The idea is that the increase in real estate value should be more beneficial for firms that are ex ante financially constrained. This set of tests addresses additional concerns that our instrument variable might be related to some higher order of demand factors that might affect firms' environmental policies (Davidoff et al. (2016)), as it would be hard to argue why these confounding factors would result in different impacts for constrained versus unconstrained firms. Panel B presents the results for these cross-sectional tests. We find that real estate value does not show a significant impact on the total release amount for the unconstrained group. The coefficient for the unconstrained group in column (3) is only 0.001 with a t-stat of almost zero, whereas for highly constrained firms in column (4) the coefficient is 0.087, which is statistically significant at the 1% level. The cross-sectional results further confirm the impact of financial constraints on firms' environmental policy through the collateral channel.

3.3 Experiment 3: Mutual Fund Flow-Induced Price Pressure

In our third experiment, we take advantage of one key observation from the mutual fund literature (Coval and Stafford (2007), Lou (2012)): when investors move capital to or away from mutual funds, the inflows and outflows force mutual fund managers to proportionally scale their existing stock positions up or down. Consequently, their trades induce price pressure that pushes stock prices up (down) with capital inflows (outflows). As the mutual fund flowed-induced price pressure (FIPP) slowly dissipates, there is subsequent return reversal. A common interpretation of the temporary price pressure is that it represents a source of "non-fundamental" shocks to the firm (Edmans, Goldstein and Jiang (2012), Hoberg and Maksimovic (2014)). Khan, Kogan and Serafeim (2012) examine the effects of temporary price pressure resulting from flow-driven trading and find that positive price pressure induces seasoned equity issuance. In other words, large inflow-induced price pressure generates exogenous positive variations of external financing due to equity market valuation, resulting in relatively relaxed financial constraints. We explore this setting to test the impact of financial constraints on corporate environmental policies.

Specifically, we construct a quarterly measure of FIPP as follows:

$$FIPP_{j,t} = \frac{\sum_i Shares_{i,j,t-1} \times PercFlow_{i,t}}{\sum_i Shares_{i,j,t-1}}, \tag{3.4}$$

where $Shares_{i,j,t-1}$ is the number of firm j's shares held by mutual fund i at the end of quarter $t-1$, and $PercFlow_{i,t}$ denotes the capital flow to mutual fund i in quarter t as a fraction of its total net assets at the end of quarter $t-1$. One key feature of our FIPP calculation is that instead of the actual transactions, we use the hypothetical trades based on mutual funds' previous quarter-end portfolio weights. The uninformed nature of the trading arises as it captures the change of a mutual fund's positions that are mechanically induced by fund flows, which is very different from the fund manager's discretionary trading potentially driven by information about the firm's fundamentals.

One may further argue that even the previous quarter-end positions of the fund may contain some fundamental information that is yet to be incorporated into prices. In Figure 4 Panel A, we present the cumulative abnormal returns (CAR) for firms that experience large capital inflow, defined as the top decile in year t month 0-12 (but not in year $t-1$), and trace the return for 24 months. We observe that the inflow-induced price appreciation persists and then completely reverses after 24 months. The price continuation and reversal patterns are more consistent with the temporary FIPP rather than slow information diffusion; in particular, the latter implies no return reversal pattern.

We apply a differences-in-differences (DID) analysis to examine the effects of FIPP. We pair each treatment (large inflow) establishment with a control establishment that is from the same industry and state, has a similar employee count, but does not experience large inflow shocks. The choice of control group helps to absorb industry, state, and size factors that might affect the outcome variables. We then trace both the treatment and control groups from three years before to three years after the inflow shocks. In the following DID specification, the coefficient of interest is β_3, which captures the differential changes of outcome variables between the treatment and control groups after the shock:

$$Y_{j,t} = \alpha + \beta_1 Post_{j,t} + \beta_2 Treated_{j,t} + \beta_3 Post{*}Treated_{j,t} + \gamma Controls + FE + \epsilon_{j,t} \tag{3.5}$$

We first conduct graphical and statistical inspection to examine the parallel pretrends between the treatment and control groups, which is the key identifying assumption for the DID analysis. In Figure

4 Panel B, we plot the coefficient estimates of a dynamic DID specification to formally examine the pretrend of toxic releases. Prior to the inflow pressure, the estimated difference between the treatment and control groups is statistically indifferent from zero, indicating parallel pretrends. However, as the FIPP unfolds for the treated group from year 0, which corresponds to the month 0-12 of the positive CAR period in Panel (A) of Figure 4, the treatment group displays a sharp drop in the total toxic release compared to the control group. The parallel pretrends and the sharp drop of treatment group's toxic release starting from the large inflow year suggests that the FIPP is liable for the movement.

Table 5 reports DID regression estimates of firms' net stock issuance and toxic releases based on Equation (3.5). Column (1) presents estimates of net stock issuance at the firm level, with the coefficient on the interaction term $Treated * Post$ being positive and statistically significant. Compared to the control group, treatment firms issue significantly more shares post large inflow shocks, confirming that managers seize the window of opportunity for equity issuance when the stock price temporarily appreciates relative to the fundamental (Khan, Kogan and Serafeim (2012)). Columns (2)-(4) present the DID results on toxic releases where treated establishments show significant reductions in toxic releases relative to the control establishments. In terms of the economic magnitude, the point estimates are between 0.14 and 0.19, which correspond to 5%-7% of the in-sample average (2.67). Overall, Table 5 illustrates that short-term price appreciations driven by FIPP are associated with additional equity issuance and a subsequent relaxation in financial constraints, which is accompanied by a lower toxic release amount.

4 Cross-sectional Analysis

In Section 3, we illustrate the causal impacts of financial constraint on firms' environmental policies. Import questions remain unanswered regarding the trade-off between financial performance and environmental protection. For example, how do financial frictions interact with regulatory enforcement? What role does the external capital market play in this decision process? In this section, we explore a few cross-sectional settings leading to the heterogeneous impacts of financial constraints on firms' corporate environmental policies: the regulatory and external monitoring environment, firms' investment horizons, and managerial incentives related to earnings management.

4.1 Regulatory and Monitoring Environment

As we discussed in Subsection 1.1, under the CAA, the EPA labels an area as "nonattainment" when the air quality of an area contains a specified amount of any of the common air pollutants for which the EPA has established a National Ambient Air Quality Standard. If an area is designated as "nonattainment," it triggers air quality planning and control requirements under which states must take corrective actions. The Lowest Achievable Emission Rate (LAER), (supposedly) without cost consideration, is required on major new or modified emission sources located in non-attainment areas. Additionally, any new emissions are required to be offset from an existing emission source within the same county. This set of environmental regulation generates cross-county variations in the strictness of the regulatory monitoring and enforcement.

Exploiting such an institutional setting, we investigates how financial constraints impact toxic releases by individual establishments located in regions with different regulatory monitoring and enforcement. We first examine how nonattainment status is related to the level of toxic releases. The regression specifications include year, firm, and establishment-level industry fixed effects, as well as firm-level and establishment-level controls. The results in columns (1) and (2) of Table 6 show that establishments in nonattainment counties on average release less than their intra-firm peers in attainment counties. The economic magnitude is major: the nonattainment dummy is associated with 20% less toxic releases relative to our sample mean. This evidence shows firms' strategic behavior with respect to waste management: within the same firm, establishments located in attaintment counties (weak regulation) devote significantly fewer resources to environmental protection compared to their peers in nonattaintment countries (strong regulation). The results are consistent with the literature documenting stringent environmental regulations contributing to the decreasing trend in U.S. manufacturing pollution (Becker (2005), Levinson (2009), Shapiro and Walker (2017)).

The results in columns (3) to (6) of Table 6 answer a different question: when firms are more financially constrained, how do establishments from counties with a different attainment status manage the toxic release in response? We separately estimate the impact of financial constraints on toxic release amounts, grouped by the contemporaneous attainment status of the county where the establishment is located. We find that facing financial constraints, establishments in attainment counties (weak regulation) generate larger toxic release amounts. The sensitivity on average is two to three times larger in attainment counties (weak regulation) and statistically significant, while the sensitivity measure is much smaller and not statistically significant in nonattainment countries (strong regulation).

This set of tests highlights firms' active management of toxic releases according to the local regulatory environment. In the long-run, firms can choose to relocate some of the establishments in response to regulatory changes (Henderson (1996), Becker and Henderson (2000)). From a short-term perspective, when facing financial constraints, firms shift resources away from locations with weak regulatory enforcement (i.e., attainment counties) to subsidize abatement expenditures at establishments facing stronger regulatory enforcement (i.e., non-attainment counties). It is important to recognize that short-term intra-firm resource adjustment is possible due to the abatement costs composition. Heavy equipment is not the only option for processing industrial waste and reducing toxic chemical releases. Instead, the vast majority of the abatement costs are variable costs, such as more expensive and cleaner input, which can be modified across locations fairly easily.

In addition to the non-attainment status, we explore the polluters' size as another gauge for regulatory and external monitoring strictness. Large polluters are typically the focus for EPA monitoring and enforcement activities, as they pose the largest threat to public health and the environment (Becker (2005)). In addition, large polluters also face higher public scrutiny of their environmental activity and performance. For example, a number of environmental protection advocacy groups, public concerns groups, and news media routinely scrutinize the so-called "super-polluters." In Table 7, we exam the impact of financial constraints on toxic release in two subsamples: (1) large polluters, or establishments in the top 30% of total toxic release amount in a year; and (2) small polluters, or establishments in the other 70% of total toxic release amount in a year. Our most robust finding from Table 7 is that financial constraints have a much larger and statistically significant impact on smaller polluters, whereas the effects on large polluters are small and statistically insignificant.

Overall, the results for nonattainment status and polluters' size deliver a similar message: firms are keenly aware of the external regulatory and monitoring environment when gauging the costs and benefits associated with environmental protection. As financial constraints increase the costs for abatement expenditures, firms shift resources to establishments where additional toxic releases might incur large regulatory or social penalties and reduce abatement spending in areas with looser environmental regulations.

4.2 Investment Horizon and Earnings Management

Next we study the role of investment horizon and managerial incentives in firms' environmental policies. In a standard multi-task principle-agent framework (Holmstrom and Milgrom (1991)), incentive pay will direct agents' effort allocation among different objectives. Monitoring and performance evaluation of long-term objectives, such as environmental efforts, are inherently difficult. In contrast, short-term objectives, such as the commonly-used financial performance matrix, are in general easily observable and measurable. When effort allocation between short-term and long-term objectives cannot be monitored precisely and if the marginal rate of returns of efforts to the long-term objectives is relatively low, the multi-task principle-agent framework predicts little managerial attention will be devoted to the long-term objective.

Applying this framework to our environmental policy setting results in two predictions: first, short-term oriented firms and managers are more likely to deprioritize environmental protection efforts when facing financial constraints; second, when environmental efforts are in conflict with some easily observable short-term objectives, such as an earnings target that is heavily emphasized by the prevailing managerial compensation contract, the short-term objective is likely to dominate.[19]

To explore whether managerial myopic preference matters for corporate environmental policies, we need a proxy for the managerial decision horizon. Researchers have documented a strong *correlation* between the investment horizons of institutional investors and the managerial decision horizon, although at this point it is not entirely clear whether such a correlation is driven by managerial in-

[19] Researchers have documented that firms exhibit a strong tendency to meet earnings targets. See Healy and Wahlen (1999), Dechow and Skinner (2000), and Fields, Lys and Vincent (2001) for a review.

centives to cater to outside investors, or outside investors' preference for managerial styles, or both. For example, Bushee (2001) shows that high levels of ownership by institutions with short-term investment horizons (i.e., "transient" institutions) are associated with overweighting of the near-term earnings component of value and underweighting of the long-term earnings component.[20] We follow this design and use holding by institutional investors, as well as the composition of their portfolios, to calculate each firm's average investment horizon and interpret it as a proxy for managerial decision horizons. We sort firm-year observations into two groups by investment horizons and examine the impact of financial constraints on establishments' toxic releases.

The evidence in Table 8 supports that shorterm-ism, by managers or driven by institutional investors, magnifies the effects of financial constraints on firms environmental policies. In Table 8, columns (1) and (2) sort firms into two groups based on the number of "transient" institutional investors, while columns (3) and (4) use the equally-weighted institutional investor's holding horizon measured by portfolio turnover rate, and columns (5) and (6) use value-weighted institutional investor's turnover rate. The sensitivity of toxic releases to financial constraint measures is approximately two to three times higher for establishments with shorter investment horizons, based on more transient holders (more transient investors in column(1) and higher turnover ratios in columns (3) and (5)). For groups with more transient investors, the coefficient on the Text FC measure is 0.482 in column (1) with statistical significance at the 1% level. In terms of economic magnitude, a one-standard-deviation increase in Text FC corresponds to a 5.5% increase in toxic releases relative to our sample mean. In contrast, the coefficient in column (2) for the low group is only 0.103 and statistically insignificant from zero. This comparison demonstrates that financial constraints have an economically sizable and statistically significant impact on toxic releases, particularly when the investment horizon or managerial decision horizon is short-term oriented.

We next examine how managerial decisions on toxic releases respond to the incentives of meeting earnings targets, which can be interpreted as a specific short-term objective. We hypothesize that firms that can meet or beat their earnings expectations are able to allocate additional resources to

[20] In the context of corporate control, Gaspar, Massa and Matos (2005) show that target firms with short-term shareholders are more likely to receive an acquisition bid, but get lower premiums. Chen, Harford and Li (2007) find that only concentrated holdings by independent long-term institutions (i.e., "dedicated" institutions in the language of Bushee (2001)) are related to post-merger performance and their presence makes withdrawal of bad bids more likely.

pollution abatement, while firms that miss their earnings targets will generate more toxic releases as they have allegedly tried "everything possible" to increase earnings performance, including reducing abatement costs. To address our hypothesis, we first calculate an earnings surprise as the difference between reported earnings and the analysts' consensus and define a dummy variable equal to 1 for firm-years that fell short of analysis consensus. Columns (1) to (3) in Table 9 present the results where we exploit within-firm cross-year variation by including establishment fixed effects. Establishments emit significantly more toxic releases in years when earnings are lower than analysis forecasts and the effect size is approximately 2.3% of the sample mean. Our earnings results confirm that earnings management and environmental protection are connected decisions, with an active trade-off margin operating between them. Managers favor meeting earnings targets over environmental protection, when these two objectives are in conflict. The results are also in line with survey evidence (Graham, Harvey and Rajgopal (2005)) and empirical research documenting that managers manipulate real activities in order to meet earnings benchmarks (Roychowdhury (2006), Cohen, Mashruwala and Zach (2010), Caskey and Ozel (2017)), even though such activities have a negative impact on firms' long-run performances (Bhojraj et al. (2009)).

5 Conclusion

Exploiting several novel establishment-level datasets, we provide evidence that financial constraints have direct impacts on corporate environmental policies. Treating toxic chemicals generated during the manufacturing process is costly and consumes significant financial resources. Firms reduce abatement expenditures when facing financial constraints because their costs for environmental protection increases correspondingly. In other words, as the gap between benefits and costs for abatement expenditure widens, firms start to cut corners and sacrifice environmental protection for short-term value preservation, resulting in, among other things, more toxic chemical releases. However, because the private benefit from pollution abatements in general is smaller than public benefits, the additional toxic chemicals generated imposes higher costs on the environment, society, and public health. Collaborative cross-sectional test results also illustrate that the documented impacts are amplified by regulatory enforcement, external monitoring, and managerial incentives shaped by capital market pressure. These results consistently point to the externalities of financial frictions in the form of environmental pollution.

Our paper generates a number of policy implications. Our evidence suggests that temporal variations of toxic releases are closely tied to firms' financial strength. When regulatory oversight and enforcement are resource constrained, our results suggest a non-random auditing policy that focuses on the scenarios where a violation of environmental protection is most likely to occur. Our results also highlight that financial frictions can magnify firms' negative environmental externalities. To offset the tendency of deprioritizing waste abatement, policy makers should promote environmental protection by providing designated subsidies for pollution control in a state-contingent manner. Lastly, our evidence suggests that under the prevailing compensation scheme that emphasizes financial performance, managers are unlikely to assign socially desirable resources for environmental protection. While progress has been made in terms of combining generic non-financial measures into the performance matrix, introducing a precise environmental performance measure is one necessary step towards a more environmentally-friendly manufacturing processes.

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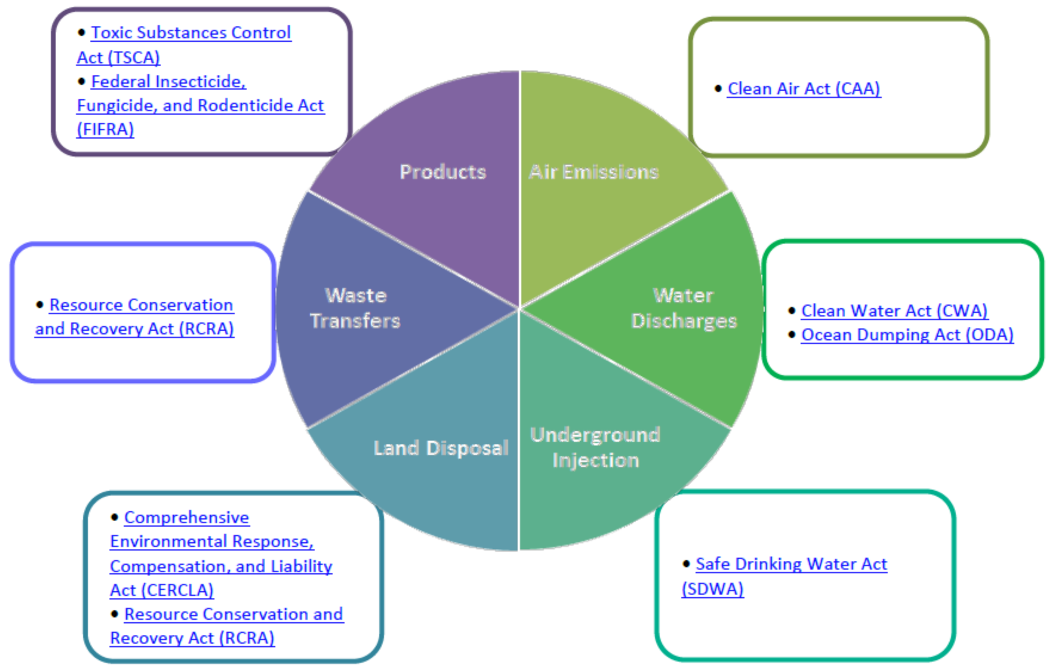
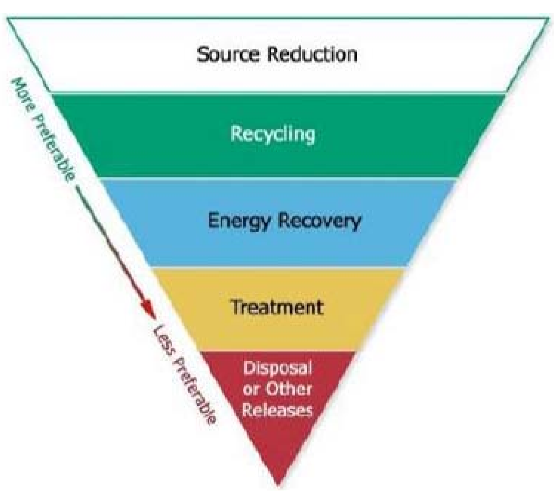
Figure 1: Environmental Protection Agency

Panel A illustrates Environmental Protection Agency (EPA) regulations that govern toxic releases in the United States. Panel B illustrates the EPA guideline for waste management with disposal or other releases being the least preferred method. Panel C presents abatement expenditure categories from the Pollution Abatement Costs and Expenditures (PACE) 2005 survey (last available) conducted by the U.S. Census Bureau for the manufacturing sector.

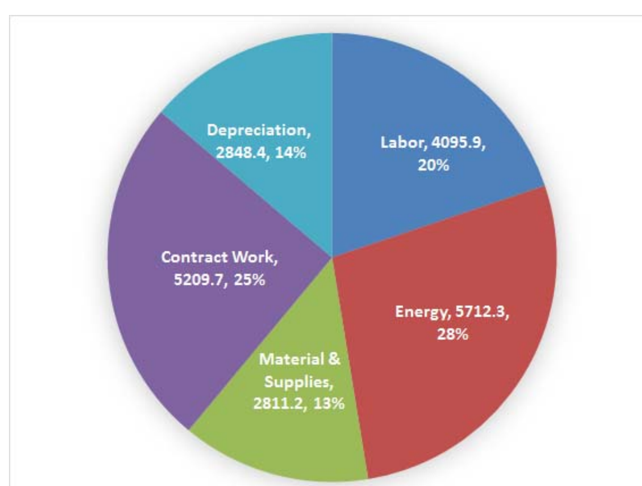
A. EPA's Role in Protecting Public Health



B. Waste Management Hierarchy



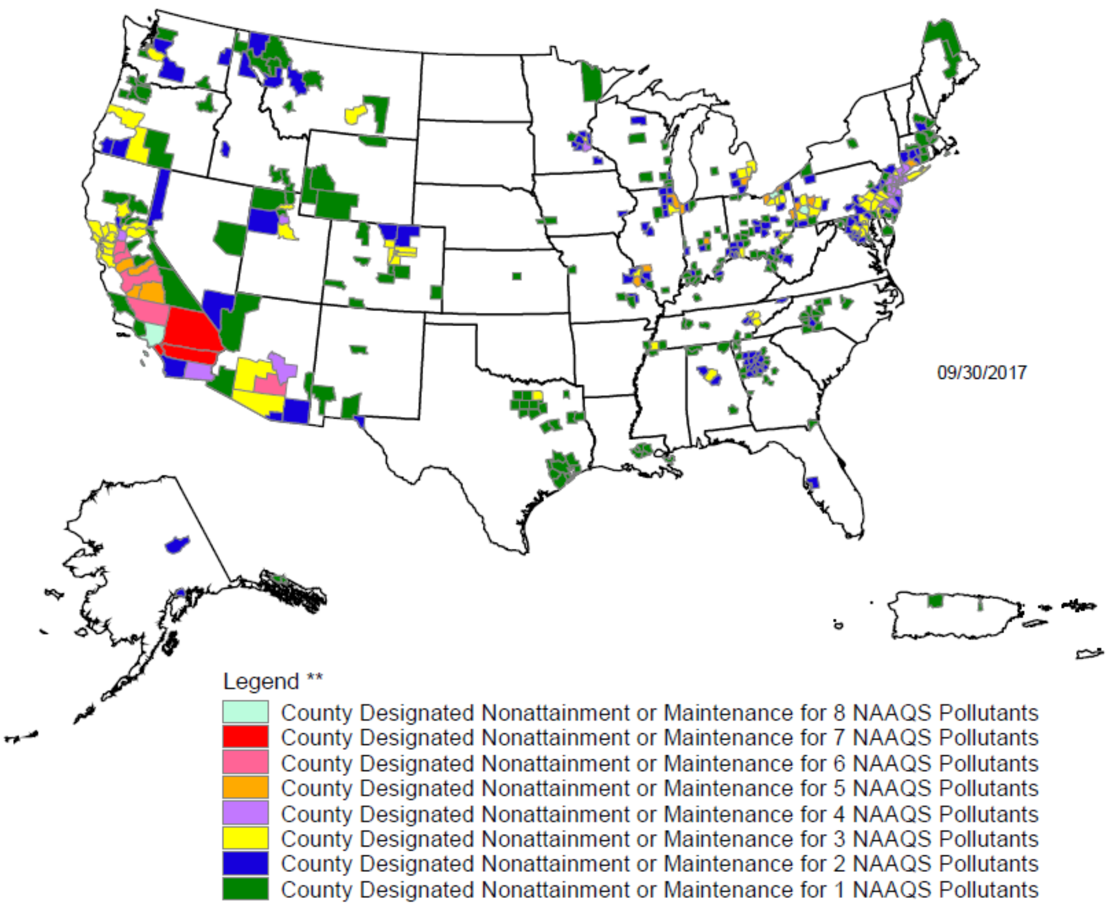
C. Abatement Costs and Expenditures ($Mils)



Source: United States Environmental Protection Agency

Figure 2: EPA Nonattainment Status

This figure displays a map of counties designated as "Nonattainment" for the National Ambient Air Quality Standards (NAAQS) pollutants as of September 2017. EPA publishes nonattainment status for each county in its Green Book publication each year.



Source: https://www.epa.gov/green-book

Figure 3: Aggregate Toxics Release

This figure presents the aggregate toxic releases for establishments held by U.S. public firms in our sample from 1990 to 2014. We include the total toxic release amount (in 000 tons) and toxic releases under the Clean Air Act (CAA) (in 000 tons) in the figure.

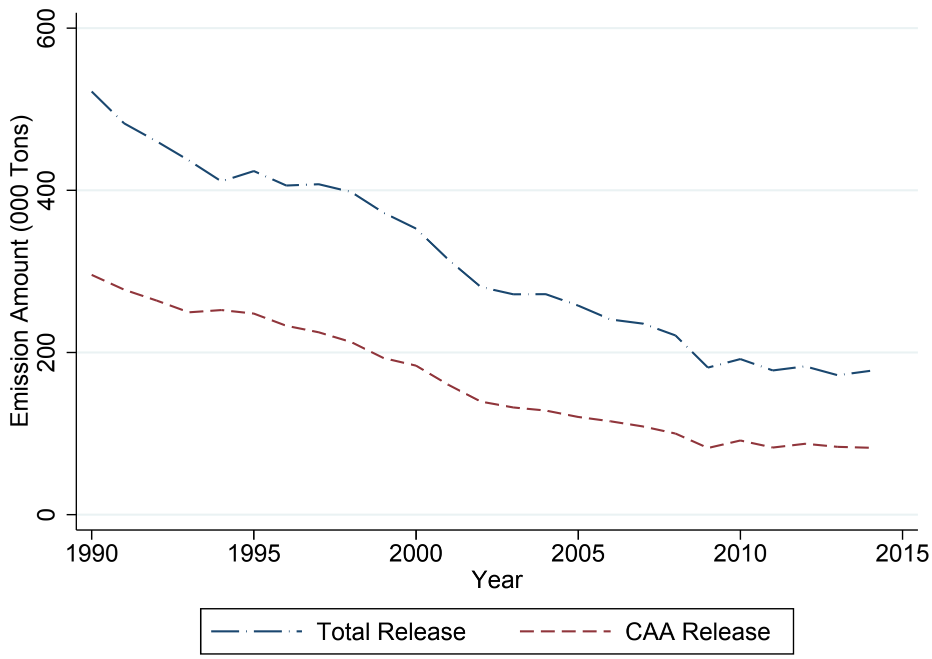
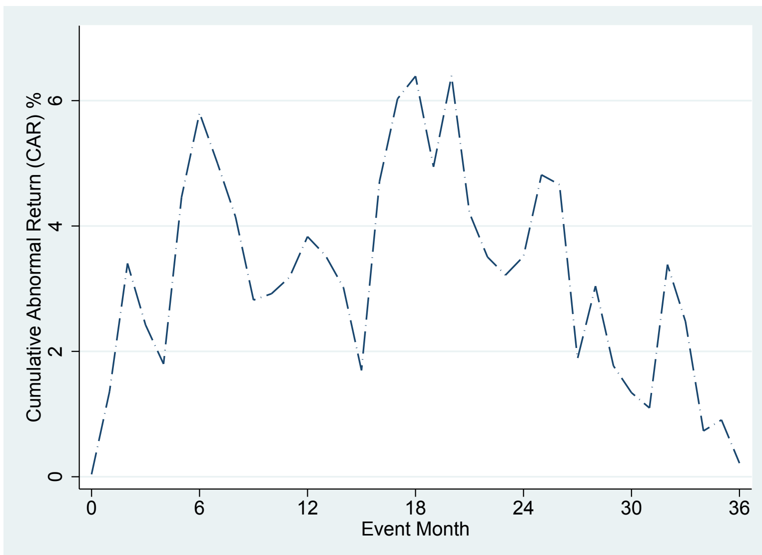


Figure 4: Flow-Induced Price Pressure

Panel A presents the cumulative abnormal return from month 0 to month 36 for sample firms that experience large flow-induced price pressure (FIPP), defined as the highest decile of FIPP in month (0-12). Panel B shows coefficient estimates β_k (with 95% confidence interval) of the dynamic differences-in-differences analysis for treatment and control establishments' total toxic releases. For every treatment establishment, the control establishment is defined as an establishment within the same industry and state, with similar employee amount, but did not experience large inflow shock. The omitted year, and thus benchmark, is year t-3. Firm-level controls include lagged log(assets), Tobin's q, Tangible, Leverage, Cash/Assets, and CAPEX/PPE. Establishment-level controls include contemporaneous *log(sales)* and log(employment). Standard errors are clustered at the firm level.

$$Y_{i,j,t} = \alpha + \sum_{k=t-2}^{t+2} \beta_k \cdot Treated_i \times 1[Year = k] + \sum_{k=t-2}^{t+3} \theta_k \times 1[Year = k] + \gamma \cdot X_{i,j,t} + \eta_i + \nu_t + \epsilon_{i,j,t}$$

Panel A: Cumulative Abnormal Return



Panel B: Diff-in-Diff Pretrend Dynamics

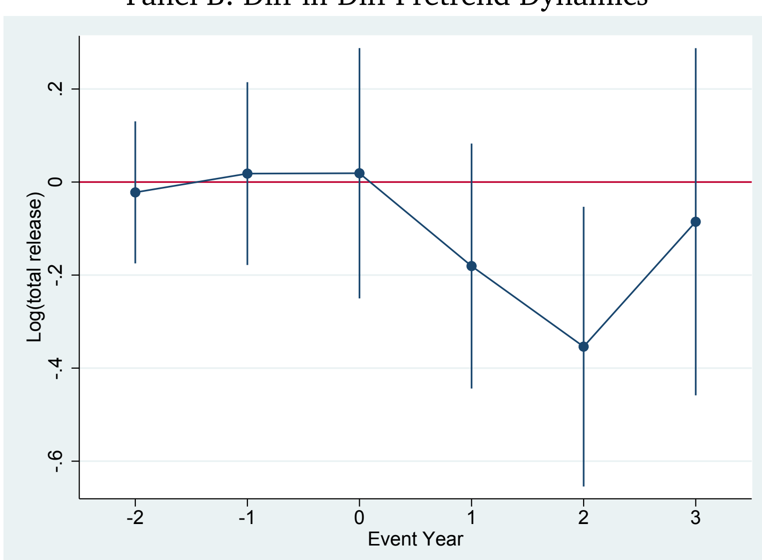


Table 1: Summary Statistics

Panel A presents firm-level summary statistics for our sample U.S. public firms during the 1990-2014 period. Panel B presents summary statistics for Compustat non-financial firms during 1990-2014. Panel C provides summary statistics for establishment-level data, including sales($Mil), employment, and toxic release amount (in tons and log of tons) under different EPA regulations, and noncomplicance status.

Panel A: Sample Firm Characteristics

	N	Mean	Median	SD	P25	P75
Assets(Mil)	18,155	6,148.28	871.79	26,249.97	262.35	3,226.08
Leverage	18,100	0.41	0.39	0.27	0.21	0.57
Cash/Assets	18,149	0.09	0.04	0.11	0.01	0.12
Tobin q	17,218	1.58	1.33	0.84	1.06	1.81
CAPEX/PPE	17,699	0.21	0.17	0.17	0.11	0.25
Tangible	18,146	0.33	0.29	0.18	0.19	0.43
Text FC	11,292	0.70	0.69	0.20	0.55	0.82
HM Debt	8,713	0.02	0.01	0.06	-0.02	0.05

Panel B: Compustat Firm Characteristics

	N	Mean	Median	SD	P25	P75
Assets - Total	154,083	3,097.42	191.27	16,185.57	48.69	977.30
Leverage	152,256	0.35	0.30	0.31	0.04	0.56
Cash/Assets	153,890	0.18	0.09	0.23	0.02	0.26
Tobin q	138,277	1.94	1.37	1.98	1.03	2.11
CAPEX/PPE	141,544	0.43	0.22	0.72	0.12	0.44
Tangible	153,801	0.32	0.23	0.26	0.09	0.49

Panel C: Establishment Characteristics

	N	Mean	Median	SD	P25	P75
Sales(Mil)	89,454	115.14	40.90	256.60	15.29	105.28
Employment	89,464	676.30	275.00	1,403.84	100.00	665.00
Total Release	87,292	119.32	8.42	351.14	0.85	52.19
CAA Release	74,984	71.85	5.93	193.21	0.49	37.30
CWA Release	80,517	87.60	6.36	254.93	0.59	39.22
CERCLA Release	84,165	109.62	7.56	313.38	0.72	47.43
OSHA Release	51,503	17.82	1.24	43.01	0.13	11.20
Log Total Release	87,292	1.75	2.13	3.20	-0.16	3.95
Log CAA Release	74,984	1.25	1.78	3.37	-0.71	3.62
Log CWA Release	80,517	1.44	1.85	3.22	-0.52	3.67
Log CERCLE Release	84,165	1.61	2.02	3.28	-0.33	3.86
Log Osha Release	51,503	-0.22	0.21	3.55	-2.08	2.42
Non Compliance	89,464	0.04	0.00	0.20	0.00	0.00

Table 2: Total Toxics Release

This table present the OLS estimates of the log number of total toxic releases on two text-based financial constraint measures: one from Bodnaruk, Loughran and McDonald (2015) and the other from from Hoberg and Maksimovic (2014). Firm-level controls include lagged log(assets), Tobin's q, Tangible, Leverage, Cash/Assets, and CAPEX/PPE. Establishment-level controls include contemporaneous log(sales) and log(employment). Establishment fixed effects are included in all specifications and standard errors are clustered at the firm level. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Text FC	0.221***	0.157**	0.192***			
	(3.07)	(2.40)	(2.78)			
HM Debt				0.686*	0.643**	0.648**
				(1.91)	(2.12)	(2.09)
Observations	51,364	51,312	51,106	36,514	36,463	36,374
Adj R-Squared	0.83	0.84	0.84	0.86	0.86	0.86
Establishment FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes			Yes		
Industry-Year FE		Yes			Yes	
State-Year FE			Yes			Yes

Table 3: Tax Holidays-AJCA

This table reports regression estimates of the effect of the AJCA. Columns (1) to (3) use the log number of total toxic releases at the establishment level as outcome variables. Residual is defined as the dummy variable Repatriation minus the Pr(Repatriate), where Pr(Repatriate) is estimated from the cross-sectional logit regression as in Appendix Table A.5. FP is defined as the proportion of years during which a firm had insufficient after-taxes earnings to fully finance capital expenditures in the four-year period prior to the AJCA (Faulkender and Petersen (2012)). Firm-level controls include lagged Log(Assets), Preinvestment Profits, Tobin's q, Tangible, Leverage, Cash/Assets, and CAPEX/PPE. Establishment-level controls include contemporaneous log(sales) and log(employment). In column (4) and (5), the dependent variable *Domestic Inv* is defined as the sum of domestic capital expenditure, domestic R&D, advertising expenses, and acquisitions scaled by assets. Column (4) reports results for the EPA sample and Column (5) reports results for the full Compustat sample, with firm-level Log(Assets), Tobin's q, and Preinvestment Profits as controls. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	Log(Total Release)			Dom Inv	
	(1)	(2)	(3)	(4)	(5)
Residual*FP	-0.568**	-0.719***	-0.515**	0.038***	0.027**
	(-2.21)	(-2.66)	(-2.13)	(2.59)	(2.23)
Pr(Repatriates)	-0.071	-0.044	-0.102	-0.020	-0.003
	(-0.28)	(-0.16)	(-0.41)	(-1.14)	(-0.36)
Residual	0.156	0.214**	0.152	-0.011*	-0.009**
	(1.49)	(2.04)	(1.46)	(-1.68)	(-2.21)
FP	-0.055	-0.197*	-0.077	-0.014**	-0.005*
	(-0.52)	(-1.79)	(-0.76)	(-2.44)	(-1.85)
Observations	21,881	21,866	21,760	3,364	36,412
Adj R-Squared	0.90	0.90	0.90	0.27	0.45
Controls	Yes	Yes	Yes	Yes	Yes
Establishment FE	Yes	Yes	Yes		
Firm FE				Yes	Yes
Year FE	Yes			Yes	Yes
Industry-Year FE		Yes			
State-Year FE			Yes		

Table 4: The Collateral Channel – Real Estate Shock

This table reports regression estimates of the log number of total toxic releases on firms' real estate value for our sample firms between 1993 and 2007. In Panel A, column (1) presents OLS estimates where firms' real estate value is calculated as the 1993 market value inflated by the MSA-level House Price Index (HPI). Columns (2)-(4) present regression estimates where MSA-level HPI is instrumented by the interaction term between MSA-level local housing supply elasticity and U.S. 30-year fixed mortgage rate. MSA-level HPI is included in the regressions to control for the direct impact of HPI. Firm level controls include lagged log(assets), Tobin's q, Tangible, Leverage, Cash/Assets, CAPEX/PPE and initial firm characteristics interacted with MSA-level HPI. Establishment-level controls include contemporaneous log(sales) and log(employment). Columns(5)-(6) present regression estimates using CAPEX/PPE as the LHS variable, with Cashflow/Assets and lagged Tobin's q as controls variables. Standard errors are clustered at the firm level. Panel B presents a subsample test results where the low group includes the bottom 30% of textual financial constraint measures each year and the high group includes the rest of the observations. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

A. Real Estate Value Shock

	Log(total release)				CAPEX/PPE	
	(1)	(2)	(3)	(4)	(5)	(6)
RE Value	-0.041**				0.019***	
	(-2.32)				(3.39)	
RE Value IV		-0.050***	-0.048***	-0.037**		0.021***
		(-2.82)	(-2.60)	(-2.14)		(3.12)
Observations	25,152	20,558	20,394	20,510	3,511	3,357
Adj R-Squared	0.82	0.83	0.83	0.84	0.45	0.46
Establishment FE	Yes	Yes	Yes	Yes		
Firm FE					Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes			Yes	Yes
State-Year FE			Yes			
Industry-Year FE				Yes		

B. Constrained vs. Unconstrained Firms

	(1)	(2)	(3)	(4)
	Low	High	Low	High
RE Value	-0.050	-0.083***		
	(-0.71)	(-2.67)		
RE Value IV			-0.001	-0.087***
			(-0.01)	(-2.74)
Observations	6,051	12,381	4,776	10,341
Adj R-Squared	0.84	0.83	0.83	0.83
Establishment FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 5: Flow Induced Price Pressure

This table reports regression estimates of firms' net stock issuance and the log number of total toxic releases on the flow-induced price pressure (FIPP). The inflow sample includes firm-years that experience buying pressure in the highest decile among firms in year t (but not in year t-1). Column (1) presents the net stock issuance at the firm level for the inflow sample. Columns (2)-(4) present the differences-in-differences analysis results of toxic releases by pairing the inflow (treatment) establishment with a control establishment that is from the same industry and state, has a similar employee count, but does not experience large inflow shocks. Firm-level controls include lagged log(assets), Tobin's q, Tangible, Leverage, Cash/Assets, and CAPEX/PPE. Establishment-level controls include contemporaneous log(sales) and log(employment). Standard errors are clustered at the firm level. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	Net Stock Issuance	Log(total release)		
	(1)	(2)	(3)	(4)
Inflow*Post	0.008**	-0.188**	-0.144*	-0.173**
	(2.01)	(-2.07)	(-1.82)	(-2.10)
Post	-0.002	0.077	0.030	0.135
	(-0.96)	(0.94)	(0.33)	(1.61)
Inflow	-0.010*	-0.132	-0.218	-0.205
	(-1.77)	(-0.65)	(-1.11)	(-1.14)
Observations	1,883	5,037	4,991	4,990
Adj R-Squared	0.39	0.92	0.93	0.93
Firm FE	Yes			
Establishment FE		Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes		
State-year FE			Yes	
Industry-year FE				Yes

Table 6: Nonattainment Status

In this table, we examine the relation between the log number of total toxic releases and the EPA nonattainment status of the county where an establishment resides. Firm-level controls include lagged log(assets), Tobin's q, Tangible, Leverage, Cash/Assets, and CAPEX/PPE. Establishment-level controls include contemporaneous log(sales) and log(employment). Columns (1)-(2) include firm, year, and establishment-level industry fixed effects. In columns (3)-(4), we split the sample according to the nonattainment status and include establishment fixed effects and year fixed effects. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	All		Nonattainment County			
	(1)	(2)	(3)	(4)	(5)	(6)
			Yes	No	Yes	No
Nonattainment	-0.367***	-0.337***				
	(-4.12)	(-4.00)				
Text FC			0.131	0.272***		
			(1.47)	(3.03)		
HM Debt					0.422	1.110**
					(1.04)	(2.28)
Observations	52,510	52,484	20,300	30,633	11,424	17,653
Adj R-Squared	0.41	0.46	0.87	0.84	0.89	0.87
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes				
Establishment FE			Yes	Yes	Yes	Yes
FF48 FE	Yes					
SIC4 FE		Yes				

Table 7: Large Polluters

In this table, we examine the heterogeneous impact of financial constraints on the log number of total toxic releases for large versus small polluters. Firm-level controls include lagged log(assets), Tobin's q, Tangible, Leverage, Cash/Assets, and CAPEX/PPE. Establishment-level controls include contemporaneous log(sales) and log(employment). We define an establishment as a large polluter if it belongs to the top 30% of total release amount. The regressions also include establishment fixed effects and year fixed effects. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	(1)	(2)	(3)	(4)
	Large	Small	Large	Small
Text FC	0.053	0.197**		
	(1.13)	(2.28)		
HM Debt			-0.036	0.781*
			(-0.19)	(1.85)
Observations	15,846	34,834	10,732	25,214
Adj R-Squared	0.86	0.72	0.88	0.77
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Establishment FE	Yes	Yes	Yes	Yes

Table 8: Institutional Holding Composition

This table reports regression estimates of the log number of total toxic releases on firms' institutional holding composition. Columns(1)-(2) present estimates with subsample split by the median number of transient holders. Columns(3)-(4) present estimates with subsample split by the equal-weighted turnover ratio of institutional holders. Columns(3)-(4) present estimates with subsample split by the value-weighted turnover ratio of institutional holders. Firm-level controls include lagged log(assets), Tobin's q, Tangible, Book leverage, Cash/Assets, and CAPEX/PPE. Establishment-level controls include contemporaneous log(sales) and log(employment). Establishment and year fixed effects are included in all regressions and standard errors are clustered at the firm level. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	N TRA Holders		EW Turnover		VW Turnover	
	(1)	(2)	(3)	(4)	(5)	(6)
	High	Low	High	Low	High	Low
Text FC	0.482***	0.103	0.403***	0.092	0.356***	0.124
	(3.78)	(1.07)	(2.99)	(1.02)	(3.11)	(1.14)
Observations	25,268	22,661	23,875	23,338	23,455	23,667
Adj R-Squared	0.83	0.82	0.83	0.84	0.82	0.84
Establishment FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: Toxics Release and Earnings Management

This table reports regression estimates of the log number of total toxic releases on a dummy variable indicating the reported earnings per share (EPS) is below the average analysis forecast in that firm-year. Firm-level controls include lagged log(assets), Tobin's q, Tangible, Book leverage, Cash/Assets, and CAPEX/PPE. Establishment-level controls include contemporaneous log(sales) and log(employment). Establishment fixed effects are included in all regressions and standard errors are clustered at firm level. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	(1)	(2)	(3)
Miss Earnings Forecast	0.046**	0.038**	0.043**
	(2.14)	(2.04)	(2.04)
Observations	73,822	73,777	73,276
Adj R-Squared	0.77	0.78	0.78
Establishment FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Year FE	Yes		
Industry-Year FE		Yes	
State-Year FE			Yes

A Appendix

Table A.1: Variable Definitions

Firm	
CAPEX/ PPE	Capital Expenditures/ L.PPENT
Cash/Assets	Cash and Short-term Investment/L.Assets
Cashflow/Assets	Operating income before depreciation and amortization + depreciation and amortization/L.Assets
Leverage	(Debt in Current Liabilities + Long-Term Debt)/ Assets
Tangible	PPENT/L.Assets
Tobin's q	(Total Asset + Common Shares Outstanding × Closing Price (Fiscal Year) − Common Equity − Deferred Taxes)/Asset
Text FC	Textual financial constraint measure by Bodnaruk, Loughran and McDonald (2015)
HM Debt	Debt focus financial constraint measured by Hoberg and Maksimovic (2014)
Dom Inv	(Domestic Capital Expenditure+Domestic R&D+Advertising expenses, and Acquisitions)/Assets
FP	The proportion of years during which a firm's investment expenditures exceeding its internal cash flow during
RE Value	1993 market value of real estate assets inflated by the MSA-level House Price Index (HPI)
N TRA Holders	Number of transient holders according to Bushee (2001) reported on 13-F filings
EW Turnover	Equal-weighted turnover ratio of institutional investors reported on 13-F filings
VW Turnover	Value-weighted turnover ratio of institutional investors reported on 13-F filings
Net Stock Issuance	(Sell of common and preferred stocks-purchases of common and preferred stocks)/L.Assets
Establishment	
log(employment)	Log number of employee at the establishment level
log(sales)	Log number of sales dollar amount (inflation adjusted) at the establishment level
Nonattainment	A dummy equals to one if an establishment resides in a county with nonattainment status
Non-compliant	A dummy equals to one if an establishment is in assigned as non-compliant by the EPA in a year

Table A.2: Summary Statistics by Industry

The table presents summary statistics of total toxic releases (tons) by industry (Fama-French 48). Industries with fewer than 50 observations have been dropped.

	Total Toxics Release					
	N	Mean	Median	SD	P25	P75
Agriculture	179	161.18	6.67	426.08	0.38	78.00
Food Products	3,953	82.33	13.66	209.21	4.14	65.00
Candy & Soda	204	15.56	9.26	24.13	0.44	19.10
Beer & Liquor	255	35.10	11.50	52.61	3.92	41.67
Tobacco Products	162	153.70	42.38	211.58	9.67	215.64
Recreation	595	59.30	37.71	76.29	5.60	87.00
Printing and Publishing	160	8.52	4.48	17.49	0.73	9.76
Consumer Goods	4,314	52.41	9.95	116.32	0.65	52.22
Apparel	374	23.00	10.21	32.54	1.81	28.50
Medical Equipment	1,077	33.73	6.01	118.25	0.55	21.28
Pharmaceutical Products	1,590	101.88	9.12	294.00	1.00	52.96
Chemicals	10,806	152.23	10.25	415.81	1.70	66.44
Rubber and Plastic Products	3,135	78.70	9.55	217.41	1.29	44.35
Textiles	1,121	51.73	8.60	150.91	1.61	37.72
Construction Materials	7,271	46.77	7.04	149.83	0.43	29.89
Construction	364	95.63	1.45	344.72	0.20	34.98
Steel Works Etc	7,119	208.82	8.66	540.37	0.73	71.69
Fabricated Products	2,689	25.57	3.87	80.53	0.35	21.62
Machinery	6,766	21.92	2.98	98.88	0.25	14.39
Electrical Equipment	3,335	35.31	3.60	139.81	0.23	21.12
Automobiles and Trucks	4,927	73.19	10.88	166.31	1.01	53.00
Aircraft	2,224	37.46	6.91	113.10	0.59	27.78
Shipbuilding, Railroad Equipment	650	43.47	20.20	71.85	4.67	51.47
Defense	466	37.80	6.30	126.26	0.59	31.81
Precious Metals	152	1,079.73	654.31	1,015.07	10.60	2,248.90
Non-Metallic and Industrial Metal Mining	363	586.05	39.67	848.03	2.55	1,014.77
Coal	62	242.26	68.17	363.19	24.10	284.00
Petroleum and Natural Gas	2,623	180.09	33.79	339.30	2.25	198.52
Utilities	2,773	746.93	430.55	771.09	108.06	1,219.48
Personal Services	314	55.28	1.01	257.38	0.13	12.98
Business Services	1,910	87.47	5.90	254.39	0.73	39.07
Computers	576	43.53	5.00	197.31	0.14	21.17
Electronic Equipment	3,342	12.81	1.55	44.21	0.13	7.72
Measuring and Control Equipment	1,116	14.22	1.37	48.12	0.13	7.50
Business Supplies	4,104	263.02	29.58	445.00	4.38	341.45
Shipping Containers	2,211	113.45	39.50	253.47	7.13	116.61
Transportation	247	88.08	3.89	249.68	1.16	24.97
Wholesale	2,512	67.93	2.23	244.89	0.55	17.20
Retail	745	54.31	4.86	155.53	0.72	23.24
Almost Nothing	395	362.62	16.22	691.44	1.08	259.53
Total	87,181	119.37	8.42	351.30	0.85	52.20

Table A.3: Toxics Release Under Various EPA Categories

This table present OLS estimates of the log number of firms' toxics release under the Clean Air Act(CAA), the Clean Water Act (CWA), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and the Occupational Safety and Health Act (OSHA) on two text-based financial constraints measures: one from Bodnaruk, Loughran and McDonald (2015) and the other from Hoberg and Maksimovic (2014). Firm-level controls include lagged log(assets), Tobin's q, Tangible, Book leverage, Cash/Assets, and CAPEX/PPE. Establishment-level controls include contemporaneous log(sales) and log(employment). Establishment fixed effects are included in all specifications and standard errors are clustered at the firm level. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	CAA	CWA	CERCLA	OSHA	CAA	CWA	CERCLA	OSHA
Text FC	0.253***	0.200***	0.195**	0.345***				
	(3.14)	(2.66)	(2.57)	(3.75)				
HM Debt					0.953**	0.594*	0.891**	0.738
					(2.12)	(1.89)	(2.38)	(1.20)
Observations	45,098	47,312	49,361	33,109	31,583	33,312	35,227	23,374
Adj R-Squared	0.83	0.84	0.84	0.81	0.86	0.87	0.87	0.83
Establishment FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A.4: Compliance Status of Toxics Release and Financial Constraint

This table presents OLS regression estimates of a dummy variable indicating establishment's EPA compliance status, which equals one for non-compliant and zero otherwise, on two text-based financial constraints measures: one from Bodnaruk, Loughran and McDonald (2015) and the other from Hoberg and Maksimovic (2014). Firm level controls include lagged log(assets), Tobin's q, Tangible, Leverage, Cash/Assets, and CAPEX/PPE. Establishment level controls include contemporaneous log(sales) and log(employment). Establishment fixed effects are included in all specifications and standard errors are clustered at the firm level. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Text FC	-0.003	0.002	-0.002			
	(-0.46)	(0.34)	(-0.27)			
HM Debt				0.002	0.012	0.013
				(0.07)	(0.38)	(0.41)
Observations	51,364	51,312	51,106	36,514	36,463	36,374
Adj R-Squared	0.16	0.17	0.17	0.16	0.16	0.16
Establishment FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes			Yes		
Industry-Year FE		Yes			Yes	
State-Year FE			Yes			Yes

Table A.5: Tax Holidays-AJCA: First Stage

The table shows the results for estimating the probability of repatriation using cross-sectional logit. In columns (1) and (2), the dependent variable is an indicator variable that takes the value of one when the firm repatriated foreign income under the AJCA in 2004 or later, and zero otherwise. The independent variables are based on values for the firm in 2003 or prior. Ordered logit model estimation results are shown in column (3). The dependent variable takes the value of two if the firm repatriated foreign earnings under the AJCA, one if it discussed repatriation of foreign earnings under the AJCA in their 10-Ks but did not repatriate, and zero otherwise. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	(1) Rep(Yes/No)	(2) Rep(Yes/No)	(3) Rep Consider
Log(Market Value of Assets)	0.378***	0.187***	0.185***
	(16.566)	(4.572)	(9.247)
Tobin's q	-0.088**	-0.083*	-0.059***
	(-2.467)	(-1.695)	(-2.580)
Preinvestment Earnings/BVA	2.829***	2.026***	1.009***
	(5.889)	(2.780)	(3.435)
Ln(1+ For Earnings (3 yrs))		0.065	0.003
		(1.449)	(0.084)
Foreign Earnings (3 yrs)>0 (1 if yes)		1.983***	1.799***
		(9.182)	(12.784)
Ln(1+Perm Reinvested Earn)		0.086	0.077
		(1.257)	(1.475)
Perm Reinvested Earn>0 (1 if yes)		0.127	0.720**
		(0.310)	(2.508)
Estimated Repatiation Tax/MVA		28.231	15.310
		(1.245)	(0.988)
Tax Loss Carryforward/MVA		-1.365***	-0.317**
		(-2.677)	(-2.289)
Observations	6032	5358	5358
R-Squared	0.13	0.27	0.19

Table A.6: The Collateral Channel – Real Estate Shock First Stage

This table reports the first stage regression estimates of MSA level HPI on the interaction between local housing supply elasticity and 30-year US fixed mortgage rate between 1993 to 2007 (Chaney, Sraer and Thesmar (2012)). Column (1) uses MSA-level local housing supply elasticity (Saiz (2010)) and Column (2) uses quartiles of the elasticity. MSA fixed effects and year fixed effects are included in all specifications and standard errors are clustered at the MSA level. Parentheses enclose t-statistics. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	MSA HPI	
	(1)	(2)
MSA Supply Elasticity * Mortgage rate	0.027***	
	(6.11)	
1 Quartile Elasticity * Mortgage Rate		-0.062***
		(-7.75)
2 Quartile Elasticity * Mortgage Rate		-0.046***
		(-5.87)
3 Quartile Elasticity * Mortgage Rate		-0.014**
		(-2.19)
Observations	1,246	1,246
Adj R-Squared	0.94	0.94
Year FE	Yes	Yes
MSA FE	Yes	Yes