Does Segment Disclosure Constrain Corporate Pollution?[*]

Chenxing Jing [a], Bin Xu [b], Luo Zuo [c, d, e]

[a] University of International Business and Economics, China

[b] University of Leeds, United Kingdom

[c] National University of Singapore, Singapore

[d] NUS Centre for Governance and Sustainability, Singapore

[e] NUS Sustainable and Green Finance Institute, Singapore

September 2024

Abstract

We examine whether corporate segment disclosure affects firm environmental performance. Using mandatory segment reporting in the United States as a shock, we find that mandatory disclosure of previously hidden segments that belong to pollutive industries reduces toxic pollution of firm plants. Consistent with the notion that segment disclosure enhances the monitoring of firm pollution by highlighting the materiality of pollutive segments and drawing stakeholders' attention to underlying environmental issues, the effect is stronger (insignificant) when the newly disclosed segments are more pollutive (non-pollutive). Disclosing firms reduce pollution by enhancing pollution prevention practices and increasing green innovation, which in turn reduces environmental violations. Overall, this study uncovers the role of mandatory financial disclosure in shaping non-financial corporate behavior.

Keywords: Segment Disclosure, Corporate Pollution, Materiality, Monitoring

JEL Classifications: G30, M41, Q53

[*] We appreciate the helpful comments of Gonul Colak, Guojun He, Kewei Hou, Vic Naiker, Enrico Onali, Nasser Spear, Siyang Tian, Xiaoxia Ye, Shafu Zhang, and seminar participants at the 2024 China International Conference in Finance, Heriot-Watt University, Hunan University, the University of Exeter, the University of International Business and Economics, the University of Melbourne, and the University of Sussex.

1. Introduction

Despite a vast literature in accounting and finance examines the real effects of corporate disclosure (Leuz and Wysocki, 2016; Roychowdhury et al., 2019; Kothari et al., 2023), it remains largely unexplored whether and how financial disclosure affects non-financial corporate behavior. One line of work shows that more transparent corporate segment disclosure leads to a better firm information environment and improved monitoring of firm behavior (e.g., Berger and Hann, 2003; Ettredge et al., 2005; Cho, 2015; Franco et al., 2016). Building on this literature, we exploit the idea that the information about a firm's operating segment(s) can highlight the underlying environmental issues and expose the firm to increased monitoring of its environmental performance. In particular, we aim to uncover the effect of mandatory disclosure of pollutive segments on corporate environmental policies.

Our focus on the role of segment information in the context of corporate environmental performance monitoring is motivated by the fact that heavy-polluting industries (e.g., chemical and allied products) are widely recognized by stakeholders and the disclosure of a *material* (and thus reportable) segment in such industries (i.e., pollutive segment) draws the stakeholders' attention to the underlying environmental issues of the firm. We propose a monitoring channel through which the disclosure of new segment information reduces corporate pollution. This channel suggests that more complete and transparent information about a firm's operating segments (the pollutive segments in particular) facilitates the monitoring of corporate environmental performance and thus reduces pollution. However, in the absence of an effective disclosure rule, a multisegment firm may not disclose all (or may intentionally hide some) of the operating segments to the public (Botosan and Stanford, 2005; Berger and Hann, 2007). If this is the case, there would be no financial information (e.g., segment sales) about the hidden segments and relatively limited narrative disclosure about segments' business activities in the annual reports. Such incomplete segment disclosure impedes stakeholders' awareness of the materiality of a firm's business segments, and consequently the firms with hidden pollutive segments are subject to limited public scrutiny.

However, the mandatory disclosure of pollutive segments in annual reports, widely disseminated among stakeholders, exposes the firm to greater external monitoring. The new financial and narrative information about pollutive segments not only raises the awareness of the materiality of such segments but also improves the understanding of the nature of business activities with high pollution potential. As a result, new segment information draws the attention of stakeholders to the firm's environmental issues (e.g., Hanlon et al., 2022; Kothari et al., 2023) and reduces information processing costs of stakeholders (Blankespoor, 2022). To the extent that segment disclosure facilitates the monitoring of firm environmental performance, we hypothesize that more transparent segment disclosure can reduce corporate pollution.

It is challenging to empirically identify the effect of segment disclosure on corporate pollution due to potential endogeneity problems. To examine the causal effect of segment disclosure on corporate environmental performance, we utilize the adoption of SFAS 131 (Statement of Financial Accounting Standards No. 131, "Disclosures about Segments of an Enterprise and Related Information") issued in 1997 as a shock that generates plausibly exogenous increases in the newly disclosed segments.[1] The SFAS 131 aims to improve the quality of segment disclosure by reducing managers' discretion in aggregating segments for external reporting. Under this new standard, a firm is required to report segments consistent with its internal organizational structure and how managers organize the business internally (Herrmann and Thomas, 2000; Cho, 2015).

In our main analysis, we examine corporate pollution at the plant level. We measure the environmental performance of each plant in our sample firms using the Toxic Release Inventory

[1] SFAS 131 supersedes SFAS 14 ("Financial Reporting for Segments of a Business Enterprise"), and is effective for firms with fiscal years beginning after December 15, 1997. The SFAS 131 adoption year is 1998 (1999) for firms with a December (non-December) year-end (Cho, 2015; Jayaraman and Wu, 2019).

(TRI) database compiled by the Environmental Protection Agency (EPA). The EPA tracks the amount of toxic chemicals released by the U.S. plants to the environment since 1987, with additional plant-specific information such as the location and the industry classification of each plant. As commonly used in the prior literature (e.g., Akey and Appel, 2021; Xu and Kim, 2022), our main pollution measure is the total toxic emissions released by a plant per year. Our sample is at the intersection of the TRI database consisting of polluting plants and Compustat database, and thus our analysis focuses on the public U.S. firms with polluting plants.

Utilizing the exogenous increase in segment disclosure induced by the adoption of SFAS 131 and the plant-level toxic pollution information, we conduct a difference-in-differences (DiD) analysis of the effect of the disclosure of pollutive segments on the toxic pollution of firm plants. The treatment group consists of the plants in firms that disclose only a single segment before SFAS 131 (i.e., they hide their diversification status) and disclose at least one previously hidden pollutive segment after SFAS 131 adoption. These treatment firms are labeled as single-to-multisegment firms because they appear as if operating in a single segment before SFAS 131 and reveal their diversification status after SFAS 131. The control group includes the plants in firms that disclose a single segment before and after the adoption of SFAS 131.

Our baseline analysis shows that there is a significant decrease in toxic pollution for treated firms as compared to control firms after SFAS 131 adoption. Specifically, we observe a 26.9% decrease in toxic pollution for plants of treated firms relative to those of control firms. The economic magnitude is comparable to prior studies of the effects of other shocks pertaining to parent company liability, financial constraints, CEO hometown identity, and shareholder activism on toxic pollution (Akey and Appel, 2021; Xu and Kim, 2022; Li et al., 2021; Chu and Zhao, 2019). We then perform a dynamic DiD analysis that examines the timing of the changes in toxic pollution surrounding the adoption of SFAS 131. We find that changes in toxic pollution of treated firms and control firms before the adoption of SFAS 131 are indistinguishable, supporting the parallel trend assumption, while the treatment effect is statistically significant and persistent throughout the entire three-year post-treatment period.[2]

Next, we examine the heterogeneous effect of the mandatory disclosure of segment information on corporate pollution. We conduct two related tests on the treatment effect of disclosing highly pollutive and the placebo effect of disclosing non-pollutive segments, respectively. First, we expect the treatment effect to be stronger if the newly disclosed segments are more indicative of potential environmental issues and therefore strengthen the monitoring of environmental performance to a greater extent. We find that segment disclosure has a greater impact on pollution reduction when the newly disclosed segments are more pollutive than the previously disclosed segments. This finding provides more nuanced evidence supporting the idea that the disclosure of new segments, especially when such segments belong to heavy polluting industries, highlights the underlying environmental issues and enhances the monitoring of environmental performance. Second, we examine the placebo effect of disclosing non-pollutive segments. In the placebo test, we rerun our baseline DiD model with a placebo treatment group that consists of single-to-multisegment firms that disclose new segments belonging to non-pollution-intensive industries. Such new disclosure is unlikely to increase environmental monitoring and would therefore not affect firm pollution. As expected, we do not find evidence that the placebo treatment firms exhibit significant changes in pollution relative to control firms. Taken together, our evidence on the heterogeneous effect of pollutive and non-pollutive segment disclosure substantiates the idea that segment disclosure matters for environmental governance.

[2] Our baseline evidence survives several robustness tests. Specifically, the negative effect of segment disclosure on toxic pollution holds when we use alternative estimation windows in our DiD analysis. The effect is robust to the inclusion of various additional fixed effects such as industry-year fixed effects and state-year fixed effects, which account for various unobserved heterogeneities. Moreover, our finding is robust to the exclusion of firms that are likely to be heavily affected by the dot-com bubble. We also find consistent evidence when we examine the effect of segment disclosure on toxic pollution at the firm level.

In addition, we perform further analyses that deepen our understanding of the environmental effect of segment disclosure. We first examine the effect of segment disclosure on how firms adapt environmental policies. We find that treatment firms significantly enhance pollution prevention practices and green innovation after disclosing pollutive segments to the public. In addition, consistent with the notion that segment information facilitates curbing corporate environmental misbehavior, we document that the likelihood of environmental violations decreases significantly after SFAS 131 adoption.

In the final part, we examine an alternative explanation that the disclosure of new segment information improves the quality of a firm's information environment and in turn enhances the firm's ability to finance pollution abatement activities. This financing channel is plausible considering that financial constraints are a key determinant of firm environmental performance (Xu and Kim, 2022) and that high-quality segment information can reduce information asymmetry and financing frictions (Kim and Verrecchia, 1994; Berger and Hann, 2003; Ettredge et al., 2005). If the financing channel is at play, the effect of segment disclosure on pollution reduction would be stronger for firms facing higher information asymmetry and financial constraints before the adoption of SFAS 131. However, we do not find evidence that the effect of segment disclosure on pollution is stronger for firms with higher information asymmetry. In addition, using the text-based measures of financial constraints (Hoberg and Maksimovic, 2015), we do not find evidence that the effect of segment disclosure on pollution is more pronounced for treatment firms that are financially constrained. This finding contradicts the prediction of the financing channel that new segment information leads to pollution reduction by reducing information costs and easing financing constraints.

Our study makes three main contributions. First, we enrich the literature on the effects of mandatory segment disclosure (e.g., Berger and Hann, 2003; Ettredge et al., 2005; Cho, 2015; Franco et al., 2016; Jayaraman and Wu, 2019) and complement the literature on the real effects of corporate disclosure in general (Leuz and Wysocki, 2016; Roychowdhury et al., 2019; Kothari et al., 2023). We exploit the idea that segment information (the disclosure of pollutive segments in particular) highlights underlying environmental issues and facilitates the monitoring of corporate environmental performance. One main takeaway from our study is that the disclosure of firm fundamental information, segment information in particular, has an environmental effect: more transparent segment disclosure curbs toxic pollution.

Second, we contribute to the emerging literature on the effects of mandatory disclosure on environmental and social outcomes (Christensen et al., 2021; Kothari et al., 2023). Christensen et al. (2017) find that mandatory disclosure of safety records in the financial reports of firms reduces injuries despite that the safety-related information is publicly available on a government website. Their study provides direct evidence on the real effects of including information on social responsibility in financial reports that "broadcast the information to a wide range of interested parties" (Christensen et al., 2017). Greenstone et al. (2023) show that corporate disclosure of greenhouse gas (GHG) emissions is essential to understanding the climate damages caused by each firm's emissions, highlighting the importance of mandatory disclosure of GHG emissions for tackling the climate challenge (Bolton et al., 2021). Relatedly, Tomar (2023) finds that mandatory GHG disclosure reduces the GHG emissions of the reporting facilities. Bonetti et al. (2023) document that mandatory disclosure of the chemical components used in hydraulic fracturing creates public pressure and improves local water quality. This strand of literature demonstrates that mandatory disclosure facilitates the internalization of the externalities of corporate environmental and social issues. We complement this literature by showing that segment disclosure curbs firm toxic pollution.

Third, our study contributes to a growing literature on the determinants of corporate environmental performance and policies. Existing literature finds that corporate environmental performance is shaped by financing conditions (Cohn and Deryugina, 2018; Levine et al., 2018;

Xu and Kim, 2022; Bartram et al., 2022), executive incentives (Li et al, 2021; Berrone and Gomez-Mejia, 2009; Flammer et al., 2019), the parent-subsidiary organizational form (Akey and Appel, 2021), ownership structure (Berrone et al., 2010; Shive and Forster, 2020), institutional investors (Dyck et al., 2019; Kim et al., 2019; Naaraayanan et al., 2021), private equity (Bellon, 2022), and financial analysts (Jing et al., 2023). Complementing this literature, our study reveals that high quality segment information matters for the monitoring of corporate environmental performance.

2. Institutional Background and Hypothesis Development

2.1. Institutional background on corporate segment disclosure

Corporate segment information is important for the monitoring of firm performance and behavior (e.g., Berger and Hann, 2003; Ettredge et al., 2005; Cho, 2015; Franco et al., 2016). However, managers have incentives to hide segment information or avoid disclosing disaggregated segment information (e.g., Botosan and Stanford, 2005; Berger and Hann, 2007; Bens et al., 2011). For example, managers may hide segments with poor performance to avoid strict external monitoring of the underlying agency problems. Managers may also withhold the information of segments that outperform their industry peers to prevent revealing valuable segment-specific proprietary information to competitors. To the extent that managers have incentives to withhold segment information, the quality of segment disclosure is questionable.

Under the first U.S. accounting standard on segment reporting issued in 1976, namely SFAS 14, managers are given the discretion to provide aggregated segment information that is not required to reflect a firm's internal organizational structure. As per SFAS 14, industry segments are defined based on the products and services provided to customers. This definition of segments has been criticized for not being linked to a firm's internal operating structure (e.g., Street et al., 2000). For instance, the American Institute of Certified Public Accountants (AICPA, 1994) expresses concerns about the quality of segment reporting under SFAS 14 that "many companies define industry segments too broadly for business reporting and thus report on too few industry segments."[3]

In response to such concerns, SFAS 131 (now codified as ASC 280) was issued in June 1997 to supersede SFAS 14 and became effective for fiscal years beginning after 15 December 1997. Under SFAS 131, segment reporting must be based on how operating activities are organized and assessed internally by the management. In other words, it becomes mandatory for firms to disclose more disaggregated segment information that corresponds to their internal organization structure. As a result, by mandating the disclosure of previously hidden segments under SFAS 14, the adoption of SFAS 131 is expected to improve the quality of segment disclosure. Indeed, empirical evidence suggests that the adoption of SFAS 131 leads to more detailed segment disclosure and an improved firm information environment.[4]

Existing literature focuses on the real effects of segment disclosure on corporate financial policies and outcomes, such as the efficiency of capital allocations among business segments (Cho, 2015), managerial learning and investment efficiency (Jayaraman and Wu, 2019), debt financing (Franco et al., 2016; Altieri, 2022), and competitive position (Zhou, 2022). This literature largely supports the notion that detailed segment information is valuable for outsiders who are keen to assess "the past performance and future risks and prospects of diversified companies" (APB, 1967). However, the real effect of segment disclosure on an important aspect of non-financial performance, corporate environmental performance, remains unexplored. The adoption of SFAS 131 leads to the disclosure of much more detailed segment information in the Notes to Financial Statements of the annual reports. Such information can

[3] According to the Association for Investment Management and Research (AIMR, 1993), "weakness in FAS 14 has been exploited by many enterprises ... we have seen one of the ten largest firms in the country report all its operations as being in a single, very broadly defined industry segment." Botosan et al. (2021) provide an overview of the history of segment reporting by U.S. public firms over the period 1976-2017.

[4] It is documented that SFAS 131 increases the number of reported segments (Herrmann and Thomas, 2000), improves the forecast accuracy of analysts (Berger and Hann, 2003) and the stock price informativeness (Ettredge et al., 2005), and reduces the uncertainty about credit risk among rating agencies (Akins, 2018).

help stakeholders better understand the nature of a company's operations, including activities that might have environmental implications. We detail our proposed environmental effect of segment disclosure in the next subsection.

2.2. Hypothesis development

Building upon the literature on the effects of mandatory segment disclosure under SFAS 131, this study aims to uncover the environmental externalities of segment disclosure by focusing on the disclosure of pollutive segments. We propose a monitoring channel through which segment disclosure improves corporate environmental performance. The monitoring channel is based on the idea that segment information, the disclosure of pollutive segments in particular, can facilitate environmental monitoring. In the absence of an effective mandatory disclosure rule, firms may hide segment information because voluntarily disclosing a pollutive segment may lead to penalties being imposed on the firm by stakeholders and regulators. With a potential *environmental motive* of hiding segment information, firms are likely to report more aggregated segment information due to environmental concerns. However, the mandatory disclosure of more disaggregated segment information exposes firms to increased environmental monitoring.

This idea is best illustrated using an example where a firm discloses a new pollutive segment due to a new mandatory disclosure rule (e.g., SFAS 131). After the new disclosure rule, the firm discloses in its annual report that it has a business segment belonging to a pollutive industry. Take Hawkins Inc as an example, the company discloses a single segment belonging to the Wholesale Trade - Nondurable Goods industry (SIC 51) under SFAS 14. After SFAS 131 adoption, the company discloses two segments, including *Industrial* segment (SIC 51: Wholesale Trade - Nondurable Goods) and a newly disclosed segment in a heavy-polluting manufacturing industry, namely *Water Treatment* (SIC 28: Chemicals and Allied Products).[5]

[5] It is worth noting that the company has three EPA-registered polluting plants, namely Hawkins Terminal I, Hawkins Inc, and Vertex Chemical Corp, all of which are in the Chemicals and Allied Products industry (SIC 28).

The segment sales of *Industrial* and *Water Treatment* segments account for respectively 69.85% and 30.15% of the firm's total annual sales in the adoption year of SFAS 131. The newly disclosed financial information (i.e., segment sales) points to the materiality of the pollutive segment. In addition, the disclosure of descriptive information about the company's operating segments sheds light on the nature of the business activities in each segment.[6] Both segment-level financial and narrative information attracts the attention of stakeholders and highlights the environmental issues, exposing the firm to greater public scrutiny. The greater exposure to environmental monitoring increases both the detection probability and the consequences of corporate environmental misbehavior, e.g., lower future cash flows and/or higher cost of capital (Christensen et al., 2017). As such, the firm is incentivized to improve its environmental performance.

One may argue that new segment information in the annual reports might not matter for environmental monitoring. Given that the EPA information about polluting plants and product-related information is publicly available for stakeholders, the disclosure of pollutive segments in annual reports is not necessary for environmental governance.[7] However, segment disclosure calls attention from stakeholders (with limited attention) to the polluting segments (Hanlon et al., 2022; Kothari et al., 2023).[8] This is because annual reports are widely disseminated among investors, financial analysts, and the media (Christensen et al., 2017), and, importantly, the pollutive segments newly disclosed under SFAS 131 are *material* (and thus reportable).[9] The

[6] As mentioned in the 10-K file of Hawkins Inc, SFAS 131 requires "disclosures of certain financial and descriptive information about a company's operating segments". Indeed, the adoption of SFAS 131 makes the detailed descriptions of operating activities in each material segment available in the Notes to Financial Statements of the 10-K file.

[7] Regarding product-related information, as required by the Regulation S-K (https://www.ecfr.gov/current/title-17/chapter-II/part-229), public firms need to describe the revenue-generating activities, products and/or services in the business description section (Item 1) of the 10-K filings. The information in Item 1 sheds light on the nature of business activities but not the materiality of each activity.

[8] The literature suggests that investors have limited attention (e.g., Merton, 1987; Barber and Odean, 2008; Hanlon et al., 2022; Kothari et al., 2023).

[9] A U.S. public firm is required to report the information about an operating segment that meets any of the materiality thresholds: (1) its revenue is 10% or more of the combined revenue of all operating segments, (2) the absolute amount of its profit or loss is 10% or more of the greater of (a) the combined profit of operating segments

disclosure of such sizable segments highlights the importance of previously hidden segments that stakeholders do not pay much attention to before SFAS 131. The resulting raised awareness of the materiality of the pollutive segments increases public scrutiny of both financial and non-financial (environmental) performance of the newly disclosed segments after SFAS 131.

Segment disclosure (of sales) can be particularly useful for assessing the pollution intensity, leading to enhanced monitoring of environmental performance. The Task Force on Climate-Related Financial Disclosures (TCFD) recommends scaling carbon emissions by revenue for comparison across companies (see https://www.fsb-tcfd.org). Given the premise that it may not be ideal to compel companies to decrease their production levels, it is argued that if consumers have a set demand for a certain product, it is more environmentally beneficial for the economy if companies with lower pollution intensity produce a greater portion of that product (Aswani et al., 2024). In our context, before segment disclosure, stakeholders might assess a firm's pollution intensity as total emissions divided by total revenue, while after segment disclosure, stakeholders might pay more attention to segment pollution intensity: segment's emissions divided by segment revenue. Suppose a firm's total toxic emissions is E and has two segments: one polluting segment (segment sales=A) and one non-polluting segment (segment sales=B). Before segment disclosure, pollution intensity is $E/(A+B)$; after segment disclosure, it is E/A, which is larger than the previous one.[10] Thus firms might be pressured to reduce emissions in polluting segments after the disclosure of segment sales.

---

or (b) the absolute amount of the combined loss of operating segments, (3) its assets are 10% or more of the combined assets of all operating segments.

[10] To illustrate, we recall the example of Hawkins Inc. The total pollution of the company is 1,977 pounds and the sales of the Industrial (SIC 51: Wholesale Trade - Nondurable Goods) and Water Treatment (SIC 28: Chemicals and Allied Products) segments are 66.68 and 28.78 million respectively in the adoption year of SFAS 131. Without the segment sales information, the pollution intensity is 1,977/95.46, where 95.46 is total annual sales. Considering that the Industrial segment belongs to a typical non-polluting industry while Water Treatment belongs to a typical heavy-polluting industry, the pollution intensity can be better calculated as total pollution scaled by the sales of the heavy-polluting segment (i.e., 1,977/28.78), which is much greater than 1,977/95.46. This example suggests that knowing the segment sales of a firm's heavy polluting segments can help stakeholders more accurately assess the pollution intensity of the firm's heavy-polluting segments, leading to greater public scrutiny.

In addition, stakeholders face costs in processing pollution-related information (e.g., Blankespoor, 2022). Segment disclosure reduces the information processing costs and thereby facilitates environmental governance. The availability of much more detailed segment information in the 10-K files (Notes to Financial Statements in particular) after SFAS 131 can lead to a better understanding of the nature and potential environmental externalities of operating activities in each segment. Narrative disclosures about a firm's pollutive segments can help information intermediaries and investors better assess the firm's future environmental risk and monitor how the firm's business model (including the activities of pollutive segments) evolves over time. Thus, segment disclosure serves as an important complement to other sources of pollution-related information, reducing information processing costs. Taken together, in the presence of limited attention and information processing costs, high-quality segment information matters for the monitoring of corporate environmental performance. We hypothesize that the disclosure of new pollutive segment(s) reduces firm pollution.

3. Data and Sample

3.1. Toxic pollution data

We obtain plant-level toxic pollution data from the Toxic Release Inventory (TRI) database established by the Environmental Protection Agency (EPA).[11] The TRI database has been widely used in the prior literature to measure corporate environmental performance.[12] TRI provides information on the release of 770 listed toxic chemicals for U.S. industrial plants. A plant is required to submit annual reporting forms for each chemical if it: (1) manufactures, processes, or uses one of over 700 chemicals listed by the TRI; (2) has over 10 full-time employees; and (3) operates in one of the approximately 400 industries (e.g., manufacturing,

[11] The Emergency Planning and Community Right-to-Know Act (EPCRA) was passed in 1986 in response to concerns regarding the environmental and safety hazards caused by the emission of toxic chemicals. The EPCRA requires firms to disclose the storage, use, and release of certain toxic chemicals. The TRI was established under Section 313 of EPCRA to track the industrial management of toxic chemicals.

[12] See, for example, Klassen and McLaughlin (1996), King and Lenox (2002), Currie and Schmieder (2009), Currie et al. (2015), Akey and Appel (2021), Xu and Kim (2022), and Hsu et al. (2023).

mining) identified at the six-digit North American Industry Classification System (NAICS) level.[13] Each report includes the information on plant name, industry, location, reporting year, the quantity of a specific toxic chemical released into the environment, and parent company name. Appendix A shows an example of how a particular chemical released into the air, water, and land, respectively, by a plant is presented in the TRI database.[14] In this example, Section 1 of the form reports the toxic chemical identity, Methanol, and Section 5 shows the quantity of this chemical entering each environmental medium onsite, including fugitive air emissions (5,120 pounds) and stack air emissions (1,833 pounds), while emissions released into water and land are zero, and Section 6 presents the quantity of the chemical transferred to off-site locations (3,612 pounds).

Using the chemical-plant level toxic emission data in the TRI database, we construct a plant-level measure of toxic pollution by aggregating the emissions of all chemicals for each plant-year (e.g., Kim et al., 2019; Naaraayanan et al., 2021; Xu and Kim, 2022; Jing et al., 2023). The main pollution measure in our empirical analysis is *POLLUTION*, defined as the natural logarithm of the sum of onsite and offsite toxic emissions. Onsite pollution is the quantity of onsite emissions released into air, water, and ground. Offsite pollution is the quantity of toxic emissions transferred offsite for further disposal. Specifically, air emissions consist of stack air emissions (e.g., through a vent or duct) and fugitive emissions (e.g., evaporative losses). Water emissions consist of the releases to streams and other surface water bodies. Ground emissions include the disposal of waste into underground injection wells, landfills, surface impoundments, and spills and leaks released to land.

[13] See the TRI-listed chemicals at: https://www.epa.gov/toxics-release-inventory-tri-program/tri-listed-chemicals.
[14] Toxic chemical release information reported by facilities is available at: https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-and-tools. Stakeholders are able to find the pollution information of the facilities belonging to a parent company by searching based on the name of parent company.

3.2. Sample construction

Our sample construction begins with U.S. public firms with business segment information in the Compustat database during the five years around the adoption of the SFAS 131. We identify those firms as either treated firms or control firms using the firm's restated segment data upon the adoption of SFAS 131 (Berger and Hann, 2003, 2007; Cho, 2015; Jayaraman and Wu, 2019). In particular, a firm is classified as a treated firm if it discloses a single segment in the last year under SFAS 14, while disclosing multiple (two or more) restated segments and at least one of the newly disclosed segments are known for being pollutive. We define a segment as being pollutive if the four-digit SIC industry of the segment belongs to a list of industries covered by the EPA's TRI database over the period 1987-1997.[15] A firm is classified as a control firm if it discloses a single segment under both SFAS 14 and SFAS 131.

We exclude financial (SIC 6000-6999) and utility (SIC 4900-4999) firms. We then follow the convention (Berger and Ofek, 1995; Cho, 2015) and remove firms if the sum of segment sales (assets) is beyond 1% (25%) of their total sales (total assets) to ensure the segment data is reliable. Finally, following prior studies (Berger and Hann, 2003, 2007), we exclude firms if the difference between the sums of segment sales, from old segment disclosure and the restated segment disclosure in the first 10-K file under SFAS 131 respectively, is over 1%, so that firms experiencing confounding events (e.g., acquisition, divestiture) are dropped.

We obtain financial variables from Compustat and stock price data from CRSP, which are merged with toxic pollution data from the TRI database.[16] Following previous literature (e.g., Akey and Appel, 2021; Xu and Kim, 2022; Jing et al., 2023), our analysis focuses on EPA-registered plants with toxic emissions. We require all plants in our sample to have non-

[15] The TRI database starts from 1987 and 1997 is the year before the adoption of SFAS 131. We assume that an industry that is covered by the TRI database over this period has a high potential to pollute the environment.

[16] Following previous studies (e.g., Akey and Appel, 2019, 2021; Xu and Kim, 2022), we merge the TRI database with Compustat based on both fuzzy matching and manual checks. We first apply a fuzzy string-matching algorithm to match the two databases using company names, and then check the accuracy of matching based on company address, website, and the DUNS number.

missing data for at least the year before SFAS 131 adoption (year *t*–1) and the adoption year of SFAS 131 (year *t*). We winsorize all continuous variables at the 1st and 99th percentiles. Our final sample consists of 3,217 plant-year observations (1,865 treated plant-year observations and 1,352 control plant-year observations) from 710 plants (295 treated plants and 415 control plants) and 180 unique public firms (71 treated firms and 109 control firms) using a five-year window (*t*–2, *t*–1, *t*, *t*+1, *t*+2) centered on the adoption of SFAS 131 in year *t*.[17]

3.3. Descriptive statistics

Panel A of Table 1 reports summary statistics for the pollution variables at the plant level and financial variables at the firm level. On average, plants in our sample release 218 thousand pounds of toxic chemicals each year. Regarding the firm-level variables, the average firm sales (*SIZE*) is 1,793 million U.S. dollars. The average leverage ratio is 0.256 and the average *ROA* is 0.167. Panel B of Table 1 reports the result of a univariate DiD test that compares the mean values of toxic pollution in the pre- and post-SFAS 131 periods for treated and control plants. We find a significant decrease (-0.244, *t*-stat. = -2.11) in toxic pollution for treated plants after SFAS 131 adoption, while there is a marginal insignificant increase (0.056, *t*-stat. = 0.62) of toxic pollution for control plants. The univariate DiD result shows that the average treatment effect of the SFAS 131 adoption on toxic pollution is negative and statistically significant (-0.30, *t*-stat. = -2.05) for the treated group relative to the control group. The univariate evidence is consistent with our hypothesis that firms are motivated to reduce toxic pollution after disclosing pollutive segments upon the adoption of SFAS 131.

[17] Our sample does not include plant-years when pollution is below the reporting threshold and a plant does not submit a detailed pollution reporting form, namely Form R (see the example in Appendix A). Our main results are robust to using a constant sample of plant-year observations with non-missing emission values for a plant throughout the sample window (see Panel D of Table 9).

4. Main Results

4.1. Baseline results

To isolate the effect of the mandatory disclosure of pollutive segments on toxic pollution, we use a difference-in-differences specification to examine the effect of the adoption of SFAS 131 on firm toxic pollution as follows.

$$POLLUTION_{i,t} = \alpha + \beta_1 TREAT \times POST_{i,t} + \delta X_{i,t-1} + PLANT_i + YEAR_t + \varepsilon_{i,t} \qquad (1)$$

where i denotes a plant and t denotes a year. $POLLUTION_{i,t}$ is the natural logarithm of the amount of toxic pollution of plant i in year t. *TREAT* is an indicator variable that equals one for plants in firms that disclose only a single segment before SFAS 131 (i.e., they hide their diversification status) and disclose their previously hidden pollutive segment(s) after SFAS 131 adoption, and zero for control plants.[18] *POST* is an indicator variable that equals one for the post-SFAS 131 period (t, t+1, t+2), and zero for the pre-SFAS 131 period (t–2, t–1). Our coefficient of interest is β_1 that captures the treatment effect of the disclosure of pollutive segments on toxic pollution of plants.

$X_{i,t-1}$ denotes a vector of control variables commonly used in prior studies on corporate environmental performance (e.g., Shive and Forster, 2020; Xu and Kim, 2022; Jing et al., 2023), including firm sales (*SIZE*), market-to-book ratio (*MTB*), leverage (*LEVERAGE*), tangibility (*TANGIBILITY*), and return on assets (*ROA*). Appendix B provides detailed variable definitions. $PLANT_i$ is plant fixed effect that accounts for any time-invariant plant-specific heterogeneity. $YEAR_t$ is event year fixed effect that accounts for time-varying aggregate trends that may affect plant environmental performance. Standard errors are clustered at the firm level.

[18] A segment is classified as being pollutive if it belongs to an industry with the four-digit SIC industry code that appears at least once in the TRI database from 1987 (the first year of TRI data) to 1997 (the year before the adoption of SFAS 131). A key difference between our empirical design and prior studies on the economic consequences of SFAS 131 is that we limit our treatment group to those having at least one newly disclosed pollutive segment. Firms disclosing non-pollutive segments only are used in the placebo test in Section 5.2.

Table 2 presents the treatment effect of the adoption of SFAS 131 on toxic pollution of plants. The dependent variable is *POLLUTION*, the natural logarithm of the amount of toxic pollution in a plant-year. We report the DiD estimation results without and with control variables in Columns (1) and (2), respectively. The coefficients on *TREAT×POST* are negative and statistically significant, suggesting that treated plants significantly reduce the release of toxic chemicals after disclosing pollutive segments. The effect is economically sizable. As shown in Column (1), treated plants reduce toxic pollution by 26.9% (i.e., $e^{-0.314}$–1), relative to control plants. Our results are consistent with the argument that the disclosure of segments with high pollution potential incentivizes the disclosing firms to reduce toxic pollution. The economic magnitude of 26.9% is comparable to studies examining various shocks pertaining to parent company liability, financial constraints, CEO hometown identity, and shareholder activism on pollution (Chu and Zhao, 2019; Akey and Appel, 2021; Li et al., 2021; Xu and Kim, 2022).[19] In our sample, this percentage translates into a reduction of 58.5 thousand pounds of toxic emissions per firm-year.

Next, we estimate a dynamic DiD model to explore the timing of the changes in pollution surrounding the adoption of SFAS 131 in Columns (3) and (4). Specifically, we replace *POST* in the baseline DiD model with indicators of one pre-treatment year and three post-treatment years (i.e., *PRE*(–1), *POST*(0), *POST*(+1), *POST*(+2)). The year *PRE*(–2) is the base year and thus is omitted in the regression. We interact *TREAT* with the above four indicator variables. Column (3) shows that the coefficient on *TREAT×PRE*(–1) is statistically insignificant, indicating no significant difference in pollution between treatment and control

[19] Specifically, Akey and Appel (2021) document that the treatment effect of the Bestfoods decision (i.e., the Supreme Court narrows the circumstances when parent companies are held liable for environmental liability of insolvent subsidiaries) on ground pollution of plants with publicly traded parents is 25.1%. Xu and Kim (2022) show that a plausibly exogenous increase in equity financing due to mutual fund flow-induced temporary price appreciations reduces toxic pollution of plants by 19.2%. Li et al. (2021) document a 40% drop in toxic pollution around CEO turnover events for plants that become hometown plants located near the incoming CEOs' hometowns. Chu and Zhao (2019) find that after being targeted by hedge fund activism toxic emissions decrease by 19.7% at the plant level and 32.6% at the firm level.

groups before the adoption of SFAS 131. In addition, the coefficients on *TREAT*×*POST*(0), *TREAT*×*POST*(+1), and *TREAT*×*POST*(+2) are –0.231, –0.308, and –0.408 respectively, and largely statistically significant. The magnitude and statistical significance of these coefficients gradually increase over the post-treatment period, consistent with the idea that it takes time for firms to reduce pollution.

To provide further support to the identifying assumption of parallel trends, we expand the estimation window to seven years (*t*–3 to *t*+3).[20] Figure 1 plots coefficients on event time indicators from a regression of total pollution on six event time indicators (years *t*–2, *t*–1, *t*, *t*+1, *t*+2, *t*+3), control variables in Equation (1), and plant fixed effects. We use year *t*–3 as the benchmark year and run the regressions separately for the treatment and control groups. The figure shows that the difference in pollution levels of treatment and control groups only starts to widen in the post-treatment period. Both the regression result and graphical evidence suggest that our DiD analysis does not violate the parallel trend assumption.[21]

4.2.Heterogeneous effect of mandatory segment disclosure

Next, to substantiate the idea that segment reporting matters for the monitoring of corporate environmental performance, we investigate the heterogeneous effect of segment disclosure. To the extent that the mandatory disclosure of pollutive segments facilitates public scrutiny of corporate pollution, we expect such disclosure to reduce pollution. In contrast, the mandatory disclosure of non-pollution segments would have no impact on corporate pollution. We test these two related questions in this section.

[20] Our baseline evidence is highly robust to different estimation windows (see Table 9).

[21] Given that SFAS 131 was issued by the Financial Accounting Standards Board (FASB) in June 1997 and was effective for fiscal years beginning after December 15, 1997 (Berger and Hann, 2003), it is likely that firms respond to the expected increase in environmental monitoring the year before the adoption of SFAS 131 (year *t*–1). However, we do not observe that firms take actions before the disclosure mandate in our dynamic DiD analysis.

4.2.1. The disclosure of new highly pollutive segments

First, we examine whether the treatment effect is stronger when the newly disclosed segments are more pollutive. Such segments are more indicative of potential environmental issues and is therefore more likely to attract stakeholders' attention. In Panel D of Table 3, we test whether the treatment effect is more pronounced when the newly disclosed segments are perceived to be more pollutive than the previously disclosed segments. We define "heavy polluting industries" as those having the same four-digit SIC codes as the TRI top 50 industries with the highest industry average toxic releases.[22] *TREAT_NEW_HIGHLY_POLLUTIVE_SEG* takes the value of one for plants of firms with an initial segment that is not in "heavy polluting industries" before SFAS 131 adoption, while disclosing at least one new highly pollutive segment that belongs to "heavy polluting industries" upon the adoption of SFAS 131, and zero otherwise. *TREAT_NON_NEW_HIGHLY_POLLUTIVE_SEG* takes the value of one for the remaining treated plants, and zero otherwise. Consistent with our expectation, the coefficient on *TREAT_NEW_HIGHLY_POLLUTIVE_SEG×POST* is statistically more significant and larger in magnitude than that on *TREAT_NON_NEW_HIGHLY_POLLUTIVE_SEG×POST* (*p*-value = 0.028). This evidence suggests that the treatment effect of segment disclosure on pollution reduction is stronger when the newly disclosed segments are more pollutive than the previously disclosed segments.

4.2.2. The disclosure of non-pollutive segments

Second, we perform a placebo test of the effect of the mandatory disclosure of non-pollutive segments. In this test, the treated group consists of plants of treated firms (i.e., single-segment to multiple-segment firms) but the newly disclosed segments do not belong to a pollutive industry. This is an important falsification test for the monitoring channel, because the disclosure of non-pollutive segments would not facilitate the monitoring of firm pollution,

[22] We calculate the industry average toxic releases in our sample over the period 1987-1997 because the TRI database is established in 1987 and 1997 is the year before the adoption of SFAS 131.

and therefore the effect of such disclosures on toxic pollution would be insignificant. The results are presented in Table 4. In the placebo test, we modify the baseline model by replacing *TREAT* with *PLACEBO* that equals one for plants in the placebo treatment group, and zero for control plants. Columns (1) and (2) report the static DiD results. In both columns, the coefficients on *PLACEBO*×*POST* are negative but statistically insignificant, suggesting no significant reduction in toxic pollution for placebo treated plants relative to control plants. Columns (3) and (4) report the dynamic DiD results. The coefficients on *PLACEBO*×*POST*(0), *PLACEBO*×*POST*(+1), and *PLACEBO*×*POST*(+2) are negative and statistically insignificant. The placebo test suggests that there is no significant difference in toxic pollution between placebo treatment group and control group. Taken together, our evidence from both cross-sectional analysis and placebo test favors the monitoring channel as the explanation of how the disclosure of pollutive segments reduces firm pollution.

5. Corporate Environmental Investments

To shed light on the mechanisms through which segment disclosure leads to better corporate environmental performance, we examine how firms improve their environmental performance by implementing various pollution prevention and reduction strategies.

5.1. Pollution abatement investment

First, we investigate the effect of segment disclosure on the investment in pollution abatement. Firms can cut toxic emissions by investing in pollution abatement technologies and practices (e.g., waste management systems) (Akey and Appel, 2021). However, given that pollution abatement is costly (Clarkson et al., 2004; Fernando et al., 2017), managers may avoid such investments if the probability of environmental misbehavior being detected is low (Hart and Zingales, 2017). To the extent that the disclosure of pollutive segments increases the detection probability, we expect treated firms to increase investments in pollution abatement.

We employ EPA's Pollution Prevention (P2) database to analyze pollution abatement activities. P2 database provides information about pollution prevention practices and is widely used in the pollution abatement literature (e.g., Akey and Appel, 2019, 2021; Muthulingam et al., 2022).[23] According to the EPA's Waste Management Hierarchy, the most environmentally preferred waste management strategy is source reduction that prevents pollution at the source.[24] Based on the P2 data over the period 1991-2012, Ranson et al. (2015) document that source reduction activities lead to a sharp (16% on average) decrease in toxic releases in the year a pollution prevention project is implemented, suggesting that source reduction activities have an immediate effect on pollution reduction.[25] We measure the source reduction activities by counting the number of P2 abatement practices (*ABATEMENT_PRACTICES*) at the plant level in Columns (1) and (2) of Table 4. As reported in Table 1, the average number of pollution prevention practices is 0.788. We use the OLS estimation in Column (1) and the Poisson estimation in Column (2). We find that treated plants significantly increase abatement practices after SFAS 131 adoption, relative to control plants. We then use an output-based measure of waste management activities, *WASTE* in Column (3). *WASTE* is the natural logarithm of the amount of production-related waste at the plant level. We find that treated plants produce less production waste, as compared to control plants.

5.2. Green innovation

In addition, we examine the environmental-related research and development activities (i.e., green patents) as a proxy for pollution abatement efforts (Flammer et al., 2019; Jing et al., 2023). We obtain detailed patent information from a database compiled by Kogan et al. (2017).

---

[23] The P2 database covers eight categories of pollution prevention activities including good operating practices, inventory control, spill and leak prevention, process modifications, surface preparation and finishing, cleaning and degreasing, product modifications, and raw material modifications.
[24] See the Waste Management Hierarchy at: https://www.epa.gov/p2/learn-about-pollution-prevention#p2.
[25] Specifically, according to Ranson et al. (2015), raw material modifications, cleaning and degreasing, and product modifications reduce toxic releases by 20%, 15%, and 13%, respectively, in the first year these pollution prevention strategies are implemented.

Following Carrion-Flores and Innes (2010), we identify "green" innovations as those with patent classifications related to solid waste prevention, water pollution, recycling, air pollution control, solid water disposal, and solid waste control. Since plant-level patent information is not available, we calculate the number of green patents at the firm level and set the value as zero for firms without green patent records. We compare the number of green patents in treated and control firms using a five-year window (*t*–2 to *t*+2) centered on the adoption of SFAS 131 in Table 5. OLS and Poisson estimators are used in Columns (1) and (2) respectively. In both columns, the number of green patents filed by treated firms significantly increases, as compared to control firms, after SFAS 131 adoption. Overall, our results show that, as a response to the disclosure of pollutive segments, the disclosing firms are motivated to increase investments in pollution abatement (i.e., pollution prevention practices and green innovation), and thereby reduce toxic pollution.

6. Additional Analysis and Robustness

In the final empirical section, we first examine how segment disclosure affects corporate environmental violations, and then test an alternative explanation (i.e., financing channel) that the relaxation of financial constraints due to better information environment after SFAS 131 adoption leads to pollution reduction. We end this section by performing a series of robustness tests.

6.1.Environmental violations

To provide corroborating evidence of the monitoring channel, we examine the effect of segment disclosure on corporate environmental violations. Pollution reduction is associated with a lower likelihood of government environmental enforcement (Xu and Kim, 2022). We expect that an important environmental effect of disclosing pollutive segments is the reduced legal enforcement activities facing firms. To test this conjecture, we construct a measure of environmental violations, *VIOLATOR*, that equals one if the number of EPA enforcement cases at the plant level is positive in a year, and zero otherwise.[26] In our sample, around 3% of the plant-year observations have at least one environmental violation. Table 6 reports the results. The dependent variable is *VIOLATOR* in Columns (1) and (2). We use OLS estimator in Column (1) and Probit estimator in Column (2). In both columns, the coefficients on *TREAT×POST* are significantly negative, suggesting that treated plants are less likely to have environmental violations relative to control plants after SFAS 131 adoption.

6.2. The financing channel

Next, we test an alternative explanation of our baseline evidence that the disclosure of new segment information enhances the firm's ability to finance pollution abatement activities (i.e., financing channel). The newly disclosed segments improve the quality of a firm's information environment and thus reduce the financing costs (Kim and Verrecchia, 1994; Berger and Hann, 2003; Ettredge et al., 2005). The relaxation of financial constraints enhances the firm's ability to invest in pollution abatement activities and ultimately improve environmental performance (Xu and Kim, 2022). If the financing channel is at work, we expect the effect of segment disclosure on toxic pollution to be stronger for treated firms with more information asymmetry and high financial constraints before SFAS 131 adoption. It is worth noting that the monitoring channel, in contrast, may not work for financially constrained firms because such firms have limited financial slack and are consequently unable to respond to external monitoring (Hong et al., 2012; Dimson et al., 2015). Therefore, examining how financial constraints moderate the effect of segment disclosure on corporate pollution can help disentangle the two channels.

To test the financing channel, we conduct cross-sectional analysis by partitioning the treated firms into two groups based on the level of information asymmetry and financial

[26] We obtain the EPA enforcement data from the Integrated Compliance Information System for Federal Civil Enforcement Case Data (ICIS FE&C) that provides plant-level information about EPA enforcement cases, including the nature and date of violations, pollutants involved, defendant names, and penalty amounts.

constraints respectively. In Panel A of online Appendix Table A1, we use three market-based measures of information asymmetry, including the bid-ask spread (*SPREAD*) (Amihud and Mendelson, 1986), Amihud's (2002) measure of illiquidity (*ILLIQUIDITY*), and the generalized probability of informed trading measure developed by Duarte et al. (2020) (*GPIN*). In Column (1) of Panel A, *TREAT_HIGH_SPREAD* (*TREAT_LOW_SPREAD*) takes the value of one for treated plants of firms with the *SPREAD* above (below) the sample median in the year before SFAS 131 adoption, and zero otherwise. Column (1) shows that the coefficients on *TREAT_HIGH_SPREAD×POST* and *TREAT_LOW_SPREAD×POST* are not statistically significantly different. We then replace *SPREAD* with *ILLIQUIDITY* and *GPIN* respectively in Columns (2) and (3) and find similar results. Therefore, there is no evidence to suggest that segment disclosure leads to pollution reduction by lowering information asymmetry.

In Panel B of online Appendix Table A1, we employ three text-based measures of financial constraints developed by Hoberg and Maksimovic (2015), denoted as *FC*, *FC_EQUITY,* and *FC_DEBT*. *FC* reflects the extent to which firms are likely to delay investments due to financial constraints, while *FC_EQUITY* and *FC_DEBT* measure the difficulties in issuing equity and debt respectively. In Column (1), *TREAT_CONSTRAINED* (*TREAT_UNCONSTRAINED*) takes the value of one for treated plants of firms with *FC* above (below) the sample median in the year before SFAS 131 adoption, and zero otherwise. We find that the coefficients on *TREAT_CONSTRAINED×POST* and *TREAT_UNCONSTRAINED×POST* are not statistically significantly different. This finding is robust to two additional measures of financial constraints, *FC_EQUITY* and *FC_DEBT*, used in Columns (2) and (3) respectively. These findings contradict the argument that segment disclosure reduces pollution by easing financial constraints, ruling out the financing channel.

6.3.Robustness tests

Finally, we conduct various robustness tests in online Appendix Table A2. First, we use different estimation windows. Panel A shows that our baseline evidence is highly robust to using a three-year (*t*–1 to *t*+1), seven-year (*t*–3 to *t*+3), or eleven-year (*t*–5 to *t*+5) estimation window centered on the SFAS 131 adoption. Second, we control for additional fixed effects to alleviate the concern that the results are driven by any unobservable time-variant industry or state specific factors in Panel B. In particular, in addition to plant fixed effects, we control for industry-year fixed effects in Column (1) and state-year fixed effects in Column (2).[27] In both columns, we find a significant negative effect of the adoption of SFAS 131 on toxic pollution.

Third, the promulgation of SFAS 131 may coincide with the peak of the dot-com bubble that is likely to influence corporate environmental performance by exacerbating financial constraints and limiting investment in pollution abatement (Xu and Kim, 2022). To address this concern, following Jayaraman and Wu (2019) and Campello and Graham (2013), we exclude firms likely affected by the dot-com bubble in Panel C. Column (1) discards firms in tech industries. Column (2) also excludes firms that have manufacturing links to tech industries (i.e., technology-related manufacturers and firms with supply chain links to tech industries). Column (3) further drops firms with marketing links to tech industries.[28] Results show that our findings are not driven by the dot-com bubble. Fourth, in Panel D we find consistent results when we use a constant sample of plant-year observations with non-missing emission values for a plant throughout the sample window.

Fifth, we examine the effect of the adoption of SFAS 131 on toxic pollution at the firm level in Panel E. The dependent variables in Columns (1) and (2) are *FIRM_POLLUTION* and *FIRM_POLLUTION/SALES* respectively. We define *FIRM_POLLUTION* as the natural

[27] Plant industry is defined by two-digit SIC codes of the plants. Plant state is the state where a plant locates.
[28] Tech industries are with SIC 481, 737. Technology-related manufacturers are with SIC 355, 357, 366-7, 369, 381-2, 384. Firms with supply chain links to tech industries are with SIC 227, 229, 348, 351, 361-2, 365, 371-2, 376, 379, 385-6. Firms with marketing links to tech industries are with SIC 232-4, 236, 273, 363, 394.

logarithm of the sum of toxic pollution of all plants of a firm in a year, and *FIRM_POLLUTION/SALES* as the natural logarithm of the sum of toxic pollution of all plants of a firm in a year divided by the firm's total sales (Shive and Forster, 2020). We include all the control variables in Equation (1), and firm and event year fixed effects. We find that the coefficients on *TREAT×POST* are negative and statistically significant in both columns, suggesting that treated firms significantly reduce toxic pollution relative to control firms after SFAS 131 adoption, consistent with our baseline evidence based on the plant-level analysis.

7. Conclusion

This study examines the environmental effect of mandatory corporate segment disclosure. Segment information matters for the external monitoring of corporate environmental performance because the information about a firm's operating segment(s) highlights the underlying environmental issues and exposes the firm to increased environmental scrutiny. By examining the adoption of SFAS 131 as a shock, we empirically test the effect of the mandatory disclosure of pollutive segments on firm toxic pollution.

We find that the newly disclosed information about pollutive segments decreases the amount of toxic pollution released by firm plants, consistent with the idea that more transparent corporate segment disclosure improves the monitoring of corporate environmental performance. Moreover, we find that the effect of segment disclosure on pollution reduction is more pronounced when the newly disclosed segments are more pollutive, while the disclosure of non-pollutive segments has no impact on corporate pollution, suggesting that the disclosure of pollutive segments matters for environmental governance. Further analysis reveals that firms reduce pollution by enhancing their pollution prevention practices and green innovation, which in turn reduces the likelihood of environmental violations.

Overall, this study demonstrates the environmental effect of corporate segment disclosure and highlights the importance of high-quality segment disclosure for environmental governance.

References

Accounting Principles Board (APB). 1967. *Statement of the Accounting Principles Board: Disclosure of Supplemental Information by Diversified Companies*. New York, NY: AICPA.

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

Akey, P. and Appel, I., 2019. Environmental externalities of activism. Available at SSRN 3508808.

Akins, B., 2018. Financial reporting quality and uncertainty about credit risk among ratings agencies. *The Accounting Review*, 93, 1-22.

Altieri, M., 2022. Agency costs of debt in conglomerate firms. *Journal of Financial and Quantitative Analysis*, 57, 3048-3080.

Amihud, Y., 2002. Illiquidity and stock returns: cross-section and time-series effects. *Journal of Financial Markets*, 5, 31-56.

Amihud, Y. and Mendelson, H., 1986. Liquidity and stock returns. *Financial Analysts Journal*, 42, 43-48.

Association for Investment Management and Research (AIMR). 1993. *Financial Reporting in the 1990s and Beyond: A Position Paper of the Association for Investment Management and Research*. Prepared by Peter H. Knutson. Charlottesville, VA: AIMR.

Aswani, J., Raghunandan, A. and Rajgopal, S., 2024. Are carbon emissions associated with stock returns?. *Review of Finance*, 28, 75-106.

Barber, B.M. and Odean, T., 2008. All that glitters: The effect of attention and news on the buying behavior of individual and institutional investors. *Review of Financial Studies*, 21, 785-818.

Bartram, S.M., Hou, K. and Kim, S., 2022. Real effects of climate policy: Financial constraints and spillovers. *Journal of Financial Economics*, 143, 668-696.

Bellon, A., 2022. Does private equity ownership make firms cleaner? The role of environmental liability risks. Available at SSRN 3604360.

Bens, D.A., Berger, P.G. and Monahan, S.J., 2011. Discretionary disclosure in financial reporting: An examination comparing internal firm data to externally reported segment data. *The Accounting Review*, 86, 417-449.

Berger, P.G. and Hann, R., 2003. The impact of SFAS No. 131 on information and monitoring. *Journal of Accounting Research*, 41, 163-223.

Berger, P.G. and Hann, R., 2007. Segment profitability and the proprietary and agency costs of disclosure. *The Accounting Review*, 82, 869-906.

Berger, P.G. and Ofek, E., 1995. Diversification's effect on firm value. *Journal of Financial Economics*, 37, 39-65.

Berrone, P., Cruz, C., Gomez-Mejia, L.R. and Larraza-Kintana, M., 2010. Socioemotional wealth and corporate responses to institutional pressures: Do family-controlled firms pollute less?. *Administrative Science Quarterly*, 55, 82-113.

Berrone, P. and Gomez-Mejia, L.R., 2009. Environmental performance and executive compensation: An integrated agency-institutional perspective. *Academy of Management Journal*, 52, 103-126.

Blankespoor, E., 2022. Understanding investor interaction with firm information: A discussion of Lee and Zhong (2022). *Journal of Accounting and Economics*, 74, 101523.

Bolton, P., Reichelstein, S., Kacperczyk, M.T., Leuz, C., Ormazabal, G. and Schoenmaker, D., 2021. Mandatory corporate carbon disclosures and the path to net zero. *Management and Business Review*, 1(3).

Bonetti, P., Leuz, C. and Michelon, G., 2023. Internalizing externalities: Disclosure regulation for hydraulic fracturing, drilling activity and water quality (No. w30842). National Bureau of Economic Research.

Botosan, C.A., Huffman, A. and Stanford, M.H., 2021. The state of segment reporting by US public entities: 1976–2017. *Accounting Horizons*, 35, 1-27.

Botosan, C.A. and Stanford, M., 2005. Managers' motives to withhold segment disclosures and the effect of SFAS No. 131 on analysts' information environment. *The Accounting Review*, 80, 751-772.

Campello, M. and Graham, J.R., 2013. Do stock prices influence corporate decisions? Evidence from the technology bubble. *Journal of Financial Economics*, 107, 89-110.

Carrión-Flores, C.E. and Innes, R., 2010. Environmental innovation and environmental performance. *Journal of Environmental Economics and Management*, 59, 27-42.

Cho, Y.J., 2015. Segment disclosure transparency and internal capital market efficiency: Evidence from SFAS No. 131. *Journal of Accounting Research*, 53, 669-723.

Christensen, H.B., Floyd, E., Liu, L.Y. and Maffett, M., 2017. The real effects of mandated information on social responsibility in financial reports: Evidence from mine-safety records. *Journal of Accounting and Economics*, 64, 284-304.

Christensen, H.B., Hail, L. and Leuz, C., 2021. Mandatory CSR and sustainability reporting: Economic analysis and literature review. *Review of Accounting Studies*, 26, 1176-1248.

Chu, Y. and Zhao, D., 2019. Green hedge fund activists. Available at SSRN 3499373.

Clarkson, P.M., Li, Y. and Richardson, G.D., 2004. The market valuation of environmental capital expenditures by pulp and paper companies. *The Accounting Review*, 79, 329-353.

Cohn, J. and Deryugina, T., 2018. Firm-level financial resources and environmental spills (No. w24516). National Bureau of Economic Research.

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

Currie, J. and Schmieder, J.F., 2009. Fetal exposures to toxic releases and infant health. *American Economic Review*, 99, 177-83.

Dimson, E., Karakaş, O. and Li, X., 2015. Active ownership. *Review of Financial Studies*, 28, 3225-3268.

Duarte, J., Hu, E. and Young, L., 2020. A comparison of some structural models of private information arrival. *Journal of Financial Economics*, 135, 795-815.

Dyck, A., Lins, K.V., Roth, L. and Wagner, H.F., 2019. Do institutional investors drive corporate social responsibility? International evidence. *Journal of Financial Economics*, 131, 693-714.

Ettredge, M.L., Kwon, S.Y., Smith, D.B. and Zarowin, P.A., 2005. The impact of SFAS No. 131 business segment data on the market's ability to anticipate future earnings. *The Accounting Review*, 80, 773-804.

Fernando, C.S., Sharfman, M.P. and Uysal, V.B., 2017. Corporate environmental policy and shareholder value: Following the smart money. *Journal of Financial and Quantitative Analysis*, 52, 2023-2051.

Flammer, C., Hong, B. and Minor, D., 2019. Corporate governance and the rise of integrating corporate social responsibility criteria in executive compensation: Effectiveness and implications for firm outcomes. *Strategic Management Journal*, 40, 1097-1122.

Franco, F., Urcan, O. and Vasvari, F.P., 2016. Corporate diversification and the cost of debt: The role of segment disclosures. *The Accounting Review*, 91, 1139-1165.

Greenstone, M., Leuz, C. and Breuer, P., 2023. Mandatory disclosure would reveal corporate carbon damages. *Science*, 381, 837-840.

Hanlon, M., Yeung, K. and Zuo, L., 2022. Behavioral economics of accounting: A review of archival research on individual decision makers. *Contemporary Accounting Research*, 39, 1150-1214.

Hart, O. and Zingales, L., 2017. Companies should maximize shareholder welfare not market value. *ECGI-Finance Working Paper*, (521).

Herrmann, D. and Thomas, W.B., 2000. An analysis of segment disclosures under SFAS No. 131 and SFAS No. 14. *Accounting Horizons*, 14, 287-302.

Hoberg, G. and Maksimovic, V., 2015. Redefining financial constraints: A text-based analysis. *Review of Financial Studies*, 28, 1312-1352.

Hong, H., Kubik, J.D. and Scheinkman, J.A., 2012. Financial constraints on corporate goodness (No. w18476). National Bureau of Economic Research.

Hsu, P.H., Li, K. and Tsou, C.Y., 2023. The pollution premium. *Journal of Finance*, 78, 1343-1392.

Jayaraman, S. and Wu, J.S., 2019. Is silence golden? Real effects of mandatory disclosure. *Review of Financial Studies*, 32, 2225-2259.

Jing, C., Keasey, K., Lim, I. and Xu, B., 2023. Analyst coverage and corporate environmental policies. *Journal of Financial and Quantitative Analysis*, Forthcoming.

Kim, I., Wan, H., Wang, B. and Yang, T., 2019. Institutional investors and corporate environmental, social, and governance policies: Evidence from toxics release data. *Management Science*, 65, 4901-4926.

Kim, O. and Verrecchia, R.E., 1994. Market liquidity and volume around earnings announcements. *Journal of Accounting and Economics*, 17, 41-67.

King, A. and Lenox, M., 2002. Exploring the locus of profitable pollution reduction. *Management Science*, 48, 289-299.

Klassen, R.D. and McLaughlin, C.P., 1996. The impact of environmental management on firm performance. *Management Science*, 42, 1199-1214.

Kogan, L., Papanikolaou, D., Seru, A. and Stoffman, N., 2017. Technological innovation, resource allocation, and growth. *Quarterly Journal of Economics*, 132, 665-712.

Kothari, S.P., Zhang, L. and Zuo, L., 2023. Disclosure regulation: past, present, and future. In: Hilary G., McLean, R.D. (Eds.), *Handbook of Financial Decision Making*. Edward Elgar Publishing, Cheltenham, United Kingdom, 215-234.

Levine, R., Lin, C., Wang, Z. and Xie, W., 2018. Bank liquidity, credit supply, and the environment (No. w24375). National Bureau of Economic Research.

Leuz, C. and Wysocki, P.D., 2016. The economics of disclosure and financial reporting regulation: Evidence and suggestions for future research. *Journal of Accounting Research*, 54, 525-622.

Li, W., Xu, Q. and Zhu, Q., 2021. CEO hometown favoritism in corporate environmental policies. Available at SSRN 3859116.

Merton, R., 1987. A simple model of capital market equilibrium with incomplete information. *Journal of Finance*, 42, 483-510.

Muthulingam, S., Dhanorkar, S. and Corbett, C.J., 2022. Does water scarcity affect environmental performance? Evidence from manufacturing facilities in Texas. *Management Science*, 68, 2785-2805.

Naaraayanan, S.L., Sachdeva, K. and Sharma, V., 2021. The real effects of environmental activist investing. Available at SSRN 3483692.

Ranson, M., Cox, B., Keenan, C. and Teitelbaum, D., 2015. The impact of pollution prevention on toxic environmental releases from US manufacturing facilities. *Environmental Science & Technology*, 49, 12951-12957.

Roychowdhury, S., Shroff, N. and Verdi, R.S., 2019. The effects of financial reporting and disclosure on corporate investment: A review. *Journal of Accounting and Economics*, 68, p.101246.

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

Street, D.L., Nichols, N.B. and Gray, S.J., 2000. Segment disclosures under SFAS No. 131: Has business segment reporting improved?. *Accounting Horizons*, 14, 259-285.

Tomar, S., 2023. Greenhouse gas disclosure and emissions benchmarking. *Journal of Accounting Research*, 61, 451-492.

Xu, Q. and Kim, T., 2022. Financial constraints and corporate environmental policies. *Review of Financial Studies*, 35, 576-635.

Zhou, Y., 2022. Proprietary costs and corporate lobbying against changes in mandatory disclosure. *Management Science*, 68, 8483-8505.

Appendix A. An example of the Toxic Release Inventory (TRI) reporting form

Facility name: Akzo Nobel Speciality Coatings Inc
Parent Company Name: Akzo Nobel Inc
Reporting year: 1997

PART II. CHEMICAL - SPECIFIC INFORMATION

DOCUMENT CONTROL NUMBER: 1397110025350

Note: 'NA' means Not Applicable

Section 1. Toxic Chemical Identity
1.1 CAS Number: 67-56-1 PFAS Indicator: NO
1.2 Toxic Chemical or Chemical Category Name: Methanol
1.3 Generic Chemical Name: NA
1.4 Distribution of Each Member of the Dioxin and Dioxin like Compounds Category

NA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
NO																	

Section 2. Mixture Component Identity
2.1 Supplier Provided Generic Chemical Name: NA

Section 3. Activities and Uses of the Toxic Chemical
3.1 Manufacture the Toxic Chemical:

Produce: NO	Import: NO	On-Site Use/Processing: NO
Sale/Distribution: NO	Byproduct: NO	Impurity: NO

3.2 Process the Toxic Chemical:

Reactant:NO
Formulation Component:YES
Article Component: NO
Repackaging: NO
Impurity: NO
Recycling:

3.3 Otherwise Use the Toxic Chemical:

Chemical Processing Aid: NO
Manufacturing Aid: NO
Ancillary or Other Use: NO

Section 4. Maximum Amount of the Toxic Chemical Onsite During the Calendar Year
Maximum Chemical Amount: 10000 to 99999

Section 5. Quantity of the Toxic Chemical Entering each Environmental Medium Onsite
5.1 Fugitive or Non-Point Air Emissions

NA	TOTAL RELEASE (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE
NO	5120	Pounds	E - Published Emission Factors

5.2 Stack or Point Air Emissions

NA	TOTAL RELEASE (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE
NO	1833	Pounds	E - Published Emission Factors

5.3 Discharges to Receiving Streams or Water Bodies

NA	STREAM/WATER BODY NAME	TOTAL RELEASE (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE	% FROM STORMWATER
NO	NA				

5.4-5.5 Disposal to Land Onsite
5.4.1 Underground Injection Onsite to Class I Wells.

NA	TOTAL RELEASE (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE
YES			

5.4.2 Underground Injection Onsite to Class II-V Wells.

NA	TOTAL RELEASE (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE
YES			

5.5 Disposal to Land Onsite
5.5.1A RCRA Subtitle C Landfills

NA	TOTAL RELEASE (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE
YES			

5.5.1B Other Landfills

NA	TOTAL RELEASE (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE
YES			

5.5.2 Land Treatment/Application Farming

NA	TOTAL RELEASE (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE
YES			

5.5.3 Surface Impoundment

NA	TOTAL RELEASE (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE
YES			

5.5.4 Other Disposal

NA	TOTAL RELEASE (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE
YES			

Section 6. Transfers of the Toxic Chemical in Wastes to Off-Site Locations
6.1 Discharges to Publicly Owned Treatment Works (POTWs)
6.1.A Total Quantity Transferred to POTWs and Basis of Estimate

6.1.A.	TOTAL TRANSFERS (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE
1	NO DATA		NO DATA

6.1.B POTW Locations

6.1.B.	POTW NAME	ADDRESS	CITY	STATE	COUNTY	ZIP CODE
1	NA					

6.2 Transfers to other Off-Site Locations

1 RCRA Number: WID000808824	Parent Company Controlled: NO
Name: HYDRITE CHEMICAL CO.	Address: 114 NORTH MAIN ST.
City: COTTAGE GROVE	State: WI
County:	Zip Code: 53527
Country Code (Non - US):	Province:

OFFSITE AMOUNT SEQUENCE	TOTAL TRANSFERS (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE	WASTE MANAGEMENT TYPE
1	1261	Pounds	M - Data Monitoring Or Measurements	M20 - Solvents/Organics Recovery

2 RCRA Number: ILD980613913	Parent Company Controlled: NO
Name: SAFETY-KLEEN CORP.	Address: 633 EAST 138TH ST.
City: DOLTON	State: IL
County:	Zip Code: 60419
Country Code (Non - US):	Province:

OFFSITE AMOUNT SEQUENCE	TOTAL TRANSFERS (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE	WASTE MANAGEMENT TYPE
1	730	Pounds	M - Data Monitoring Or Measurements	M50 - Incineration/Thermal Treatment

3 RCRA Number: MOD980962849	Parent Company Controlled: NO
Name: ESSEX WASTE MANAGEMENT	Address: 1483 SW 58TH HWY.
City: KINGSVILLE	State: MO
County:	Zip Code: 64061
Country Code (Non - US):	Province:

OFFSITE AMOUNT SEQUENCE	TOTAL TRANSFERS (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE	WASTE MANAGEMENT TYPE
1	185	Pounds	M - Data Monitoring Or Measurements	M50 - Incineration/Thermal Treatment

4 RCRA Number: TXD055135388	Parent Company Controlled: NO
Name: TREATMENT ONE	Address: 5743 CHESWOOD ST.
City: HOUSTON	State: TX
County:	Zip Code: 77087
Country Code (Non - US):	Province:

OFFSITE AMOUNT SEQUENCE	TOTAL TRANSFERS (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE	WASTE MANAGEMENT TYPE
1	13	Pounds	M - Data Monitoring Or Measurements	M50 - Incineration/Thermal Treatment

5 RCRA Number: WID023350192	Parent Company Controlled: NO
Name: MILWAUKEE SERVICE SOLVENT	Address: N59 WEST 14765 BOBOLINK
City: MENOMONEE FALLS	State: WI
County:	Zip Code: 53051
Country Code (Non - US):	Province:

OFFSITE AMOUNT SEQUENCE	TOTAL TRANSFERS (per year)	UNIT OF MEASURE	BASIS OF ESTIMATE	WASTE MANAGEMENT TYPE
1	1423	Pounds	M - Data Monitoring Or Measurements	M20 - Solvents/Organics Recovery

Source: https://enviro.epa.gov/enviro/tri_formr_partone_v2.get_thisone?rpt_year=1997&dcn_num=1397110025350&ban_flag=Y

Appendix B. Variable definitions

This table reports the definitions and data sources of variables employed in the paper.

Variable	Definition	Data Source
Pollution-related variables		
POLLUTION	Natural logarithm of the total quantity (in pounds) of toxic emissions at the plant level	TRI
AIR_POLLUTION	Natural logarithm of the total quantity (in pounds) of toxic emissions released onsite into the air at the plant level	TRI
ABATEMENT_PRACTICES	The number of pollution prevention practices at the plant level	EPA P2
WASTE	Natural logarithm of the total quantity (in pounds) of production-related waste at the plant level	TRI
VIOLATOR	Indicator variable that equals one if the number of EPA enforcement cases at the plant level is positive in a year, and zero otherwise	ICIS FE&C
Firm characteristics		
SIZE	Natural logarithm of sales	Compustat
MTB	Market value of equity scaled by the book value of equity	Compustat
LEVERAGE	The sum of current liabilities and long-term debt scaled by total assets	Compustat
TANGIBILITY	Gross property, plant, and equipment scaled by total assets	Compustat
ROA	Operating income scaled by total assets	Compustat
GREEN_INNOVATION	The number of green patents (missing values are recoded as zero)	Kogan et al. (2017)
Variables for additional analysis		
SPREAD	The yearly median of daily bid-ask spread defined as the difference between the daily bid and ask prices divided by the average of the bid and ask prices (Amihud and Mendelson, 1986)	CRSP
ILLIQUIDITY	The absolute value of daily stock return scaled by daily dollar volume, averaged over a firm's fiscal year (Amihud, 2002)	CRSP
GPIN	The generalized probability of informed trading measure (see Duarte et al. (2020))	Duarte et al. (2020)
FC	The text-based measure of financial constraints	Hoberg and Maksimovic (2015)
FC_EQUITY	The text-based measure of financial constraints in terms of issuing equity	Hoberg and Maksimovic (2015)
FC_DEBT	The text-based measure of financial constraints in terms of issuing debt	Hoberg and Maksimovic (2015)

Figure 1. Time trend in toxic pollution around the adoption of SFAS 131

This figure plots coefficients on event time indicators from a regression of total pollution (the natural logarithm of the total pollution) on six event time indicators (years *t*–2, *t*–1, *t*, *t*+1, *t*+2, *t*+3), control variables in Equation (1), and plant fixed effects. Year *t* represents the year of SFAS 131 adoption. Specifically, the adoption year is 1998 (1999) for firms with a December (non-December) year-end, and therefore our stacked sample consists of both December and non-December year-end cohorts. We use year *t*–3 as the benchmark year and run the regressions separately for the treatment and control groups.

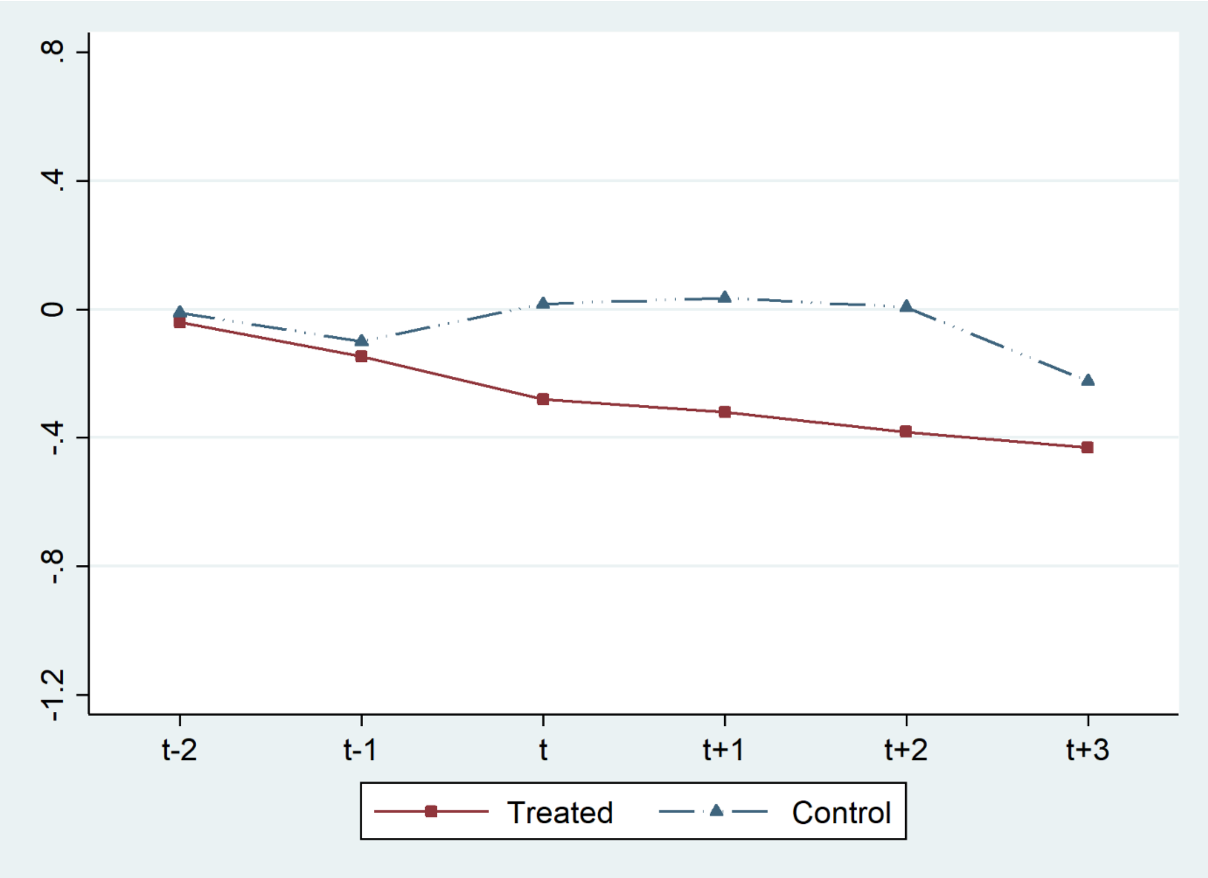

Table 1. Descriptive statistics

This table presents summary statistics of the variables used in our main analysis in Panel A and the results of univariate analysis in Panel B. The sample consists of 3,217 plant-year observations from 710 plants and 180 unique public firms using a five-year window (t–2, t–1, t, t+1, t+2) centered on the adoption of SFAS 131 in year t. All variables are defined in Appendix B. Panel B reports the results of a univariate analysis of the average toxic pollution (i.e., the natural logarithm of the amount of toxic pollution in a plant-year) before and after the adoption of SFAS 131 for treated and control plants. *TREAT* is a dummy variable that equals one if the firm is reported as a single-segment firm under SFAS 14 but as a multiple-segment firm (with at least one newly disclosed pollutive segment) after the adoption of SFAS 131, and zero otherwise. *POST* is a dummy variable that equals one for the years after the adoption of SFAS 131, and zero otherwise. The test for differences in the means is based on two-tailed t-statistic. ∗∗∗, ∗∗, and ∗ indicate significance levels at 1%, 5%, and 10%, respectively.

Panel A. Summary statistics

Variable	Obs.	Mean	SD	25th	50th	75th
Plant-level variables						
POLLUTION (raw value in 1000s)	3,217	217.519	1213.330	2.063	15.932	67.448
ABATEMENT_PRACTICES	3,217	0.788	1.904	0.000	0.000	1.000
WASTE (raw value in 1000s)	3,217	1402.456	6436.571	18.270	73.435	330.201
VIOLATOR	3,217	0.030	0.172	0.000	0.000	0.000
Firm-level variables						
SIZE (raw value in $million)	826	1793.447	3914.946	230.007	565.263	1382.673
MTB	826	2.685	3.573	1.257	1.987	2.957
LEVERAGE	826	0.256	0.180	0.117	0.246	0.367
TANGIBILITY	826	0.636	0.276	0.425	0.599	0.825
ROA	826	0.167	0.073	0.118	0.159	0.208

Panel B. Univariate analysis of average pollution before and after SFAS 131

	Mean			
	Before SFAS 131 (*POST*=0)	After SFAS 131 (*POST*=1)	Diff.	t-stat.
Treated plants (*TREAT*=1)	8.896	8.652	-0.244**	(-2.11)
Control plants (*TREAT*=0)	9.602	9.658	0.056	(0.62)
Diff.	-0.706**	-1.006***	Diff. in Diff. = -0.300**	
t-stat.	(-1.99)	(-2.88)	(-2.05)	

Table 2. The effect of the adoption of SFAS 131 on toxic pollution

This table reports the difference-in-differences (DiD) estimation results of the effect of the adoption of SFAS 131 on toxic pollution. Static DiD results are presented in Columns (1) and (2) and dynamic DiD results are presented in Columns (3) and (4). The dependent variable is *POLLUTION*, measured by the natural logarithm of the amount of toxic pollution in a plant-year. *TREAT* is a dummy variable that equals one if the firm is reported as a single-segment firm under SFAS 14 but as a multiple-segment firm (with at least one newly disclosed pollutive segment) after the adoption of SFAS 131, and zero otherwise. In Columns (1) and (2), *POST* is a dummy variable that equals one for the years after the adoption of SFAS 131, and zero otherwise. In Columns (3) and (4), we examine the timing of the changes in toxic pollution surrounding the adoption of SFAS 131, using a dynamic DiD estimation where we replace *POST* with indicators of one pre-treatment year and three post-treatment years (i.e., *PRE*(–1), *POST*(0), *POST*(+1), *POST*(+2)). We control for plant fixed effects (Plant FE) and event year fixed effects (Year FE). All variables are defined in Appendix B. Standard errors are clustered at the firm level. *t*-statistics are reported in parentheses. ∗∗∗, ∗∗, and ∗ indicate significance levels at 1%, 5%, and 10%, respectively.

	POLLUTION			
	(1)	(2)	(3)	(4)
TREAT*×*POST	**-0.314****	**-0.363*****		
	(-2.36)	**(-2.80)**		
***TREAT*×*PRE*(–1)**			**0.014**	**-0.019**
			(0.14)	**(-0.19)**
***TREAT*×*POST*(0)**			**-0.231**	**-0.287****
			(-1.65)	**(-2.08)**
***TREAT*×*POST*(+1)**			**-0.308***	**-0.387****
			(-1.77)	**(-2.27)**
***TREAT*×*POST*(+2)**			**-0.408****	**-0.492****
			(-2.04)	**(-2.55)**
SIZE		-0.152		-0.146
		(-0.89)		(-0.86)
MTB		0.007		0.009
		(0.49)		(0.60)
LEVERAGE		0.897**		0.921**
		(2.16)		(2.20)
TANGIBILITY		-0.040		-0.112
		(-0.08)		(-0.21)
ROA		0.183		0.194
		(0.20)		(0.21)
Plant FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	3,217	3,217	3,217	3,217
Adj. R^2	0.855	0.855	0.855	0.855

Table 3. The heterogeneous effect of segment disclosure

This table reports the difference-in-differences (DiD) estimation results of the heterogeneous effect of the disclosure of pollutive and non-pollutive segments, respectively, upon the adoption of SFAS 131 on toxic pollution. Panel A examines the relation between segment disclosure and toxic pollution conditional on whether the newly disclosed segments are perceived to be more pollutive than the previously disclosed segment. We define "heavy polluting industries" as those having the same four-digit SIC codes as the TRI top 50 industries with the highest industry average toxic releases in our sample. We split *TREAT* into *TREAT_NEW_HIGHLY_POLLUTIVE_SEG* and *TREAT_NON_NEW_HIGHLY_POLLUTIVE_SEG* depending on whether the newly disclosed segments after the adoption of SFAS 131 are more pollutive than the previously disclosed segments before the adoption of SFAS 131. *TREAT_NEW_HIGHLY_POLLUTIVE_SEG* takes the value of one for plants of firms with initial segment that is not in "heavy polluting industries" before SFAS 131 adoption, while disclosing at least one new highly pollutive segment that belongs to "heavy polluting industries" upon the adoption of SFAS 131. *TREAT_NON_NEW_HIGHLY_POLLUTIVE_SEG* takes the value of one for the remaining treated plants, and zero otherwise. *POST* is a dummy variable that equals one for the years after the adoption of SFAS 131, and zero otherwise. The dependent variable is *POLLUTION*, measured by the natural logarithm of the amount of toxic pollution in a plant-year. Panel B examines the placebo effect of the adoption of SFAS 131 on toxic pollution where the specifications are the same as those in Table 2 except that the treated group is replaced with placebo treated plants. Placebo treated plants (*PLACEBO*) are identified as the plants of firms that are reported as a single-segment firm under SFAS 14 but as a multiple-segment firm after the adoption of SFAS 131, while the newly disclosed segments do not belong to pollutive industries (i.e., not in the list of industries covered by the EPA's TRI database over the period 1987-1997). Static DiD results are presented in Columns (1) and (2) and dynamic DiD results are presented in Columns (3) and (4). *PLACEBO* is a dummy variable that equals one for plants in the placebo treatment group, and zero for plants in the control group. In Columns (1) and (2), *POST* is a dummy variable that equals one for the years after the adoption of SFAS 131, and zero otherwise. In Columns (3) and (4), we examine the timing of the changes in toxic pollution surrounding the adoption of SFAS 131, using a dynamic DiD estimation where we replace *POST* with indicators of one pre-treatment year and three post-treatment years (i.e., *PRE*(–1), *POST*(0), *POST*(+1), *POST*(+2)). The dependent variable is *POLLUTION*, measured by the natural logarithm of the amount of toxic pollution in a plant-year, in all columns. We control for plant fixed effects (Plant FE) and event year fixed effects (Year FE). All variables are defined in Appendix B. Standard errors are clustered at the firm level. *t*-statistics are reported in parentheses. ∗∗∗, ∗∗, and ∗ indicate significance levels at 1%, 5%, and 10%, respectively.

Panel A. The disclosure of new highly pollutive segments

	POLLUTION
	(1)
TREAT_NEW_HIGHLY_POLLUTIVE_SEG×POST	-0.708***
	(-3.76)
TREAT_NON_NEW_HIGHLY_POLLUTIVE_SEG×POST	-0.332**
	(-2.47)
Controls	Yes
Plant FE	Yes
Year FE	Yes
Equal sensitivity (*p*-value)	0.028**
N	3,217
Adj. R^2	0.855

Panel B. The disclosure of non-pollutive segments

	POLLUTION			
	(1)	(2)	(3)	(4)
PLACEBO*×*POST	**-0.123**	**-0.162**		
	(-0.61)	**(-0.84)**		
***PLACEBO*×*PRE*(–1)**			**0.146**	**0.090**
			(1.18)	**(0.79)**
***PLACEBO*×*POST*(0)**			**-0.075**	**-0.148**
			(-0.31)	**(-0.64)**
***PLACEBO*×*POST*(+1)**			**0.020**	**-0.063**
			(0.07)	**(-0.26)**
***PLACEBO*×*POST*(+2)**			**-0.080**	**-0.122**
			(-0.30)	**(-0.44)**
Controls	No	Yes	No	Yes
Plant FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	2,011	2,011	2,011	2,011
Adj. R^2	0.870	0.870	0.869	0.870

Table 4. Pollution abatement investment

This table reports the difference-in-differences (DiD) estimation results of the effect of the adoption of SFAS 131 on pollution prevention practices. The dependent variable is *ABATEMENT_PRACTICES* in Columns (1) and (2) and *WASTE* in Column (3). *ABATEMENT_PRACTICES* is the number of abatement practices in the EPA P2 database in a plant-year. *WASTE* is the natural logarithm of the amount of production-related waste in a plant-year. The results of OLS regressions are reported in Columns (1) and (3) and the result of Poisson regression is reported in Column (2). *TREAT* is a dummy variable that equals one if the firm is reported as a single-segment firm under SFAS 14 but as a multiple-segment firm (with at least one newly disclosed pollutive segment) after the adoption of SFAS 131, and zero otherwise. *POST* is a dummy variable that equals one for the years after the adoption of SFAS 131, and zero otherwise. We control for plant fixed effects (Plant FE) and event year fixed effects (Year FE). All variables are defined in Appendix B. Standard errors are clustered at the firm level. *t*-statistics are reported in parentheses. ∗∗∗, ∗∗, and ∗ indicate significance levels at 1%, 5%, and 10%, respectively.

	ABATEMENT_PRACTICES		*WASTE*
	OLS	POISSON	OLS
	(1)	(2)	(3)
TREAT×POST	**0.180****	**0.170***	**-0.268****
	(2.11)	**(1.85)**	**(-2.29)**
Controls	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	3,217	1,504	3,205
Adj. R^2	0.754		0.863
Pseudo R^2		0.414	

Table 5. Green innovation

This table reports the difference-in-differences (DiD) estimation results of the effect of the adoption of SFAS 131 on green innovation. The dependent variable is *GREEN_INNOVATION*, defined as the number of green patents in a firm-year (missing values are recoded as zero). The result of OLS regression is reported in Column (1) and the result of Poisson regression is reported in Column (2). *TREAT* is a dummy variable that equals one if the firm is reported as a single-segment firm under SFAS 14 but as a multiple-segment firm (with at least one newly disclosed pollutive segment) after the adoption of SFAS 131, and zero otherwise. *POST* is a dummy variable that equals one for the years after the adoption of SFAS 131, and zero otherwise. We control for firm fixed effects (Firm FE) and event year fixed effects (Year FE). All variables are defined in Appendix B. Standard errors are clustered at the firm level. *t*-statistics are reported in parentheses. ∗∗∗, ∗∗, and ∗ indicate significance levels at 1%, 5%, and 10%, respectively.

	GREEN_INNOVATION	
	OLS	POISSON
	(1)	(2)
TREAT×POST	**1.691***	**0.256****
	(1.84)	**(2.40)**
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	826	397
Adj. R^2	0.960	
Pseudo R^2		0.875

Table 6. Environmental violations

This table reports the difference-in-differences (DiD) estimation results of the effect of the adoption of SFAS 131 on environmental violations. The dependent variable is *VIOLATOR*. *VIOLATOR* is a dummy variable that equals one if the number of EPA enforcement cases at the plant level is positive in a year, and zero otherwise. The result of OLS regression is reported in Column (1) and the result of Probit regression is reported in Column (2). *TREAT* is a dummy variable that equals one if the firm is reported as a single-segment firm under SFAS 14 but as a multiple-segment firm (with at least one newly disclosed pollutive segment) after the adoption of SFAS 131, and zero otherwise. *POST* is a dummy variable that equals one for the years after the adoption of SFAS 131, and zero otherwise. We control for plant fixed effects (Plant FE) and event year fixed effects (Year FE). All variables are defined in Appendix B. Standard errors are clustered at the firm level. *t*-statistics are reported in parentheses. ∗∗∗, ∗∗, and ∗ indicate significance levels at 1%, 5%, and 10%, respectively.

	VIOLATOR	
	OLS	PROBIT
	(1)	(2)
TREAT×POST	**-0.031****	**-0.737***
	(-2.03)	**(-1.66)**
Controls	Yes	Yes
Plant FE	Yes	Yes
Year FE	Yes	Yes
N	3,217	403
Adj. R^2	0.047	
Pseudo R^2		0.110

Online Appendix for
Does Segment Disclosure Constrain Corporate Pollution?

Table A1. Financing channel

This table reports the difference-in-differences (DiD) estimation results of the effect of the adoption of SFAS 131 on toxic pollution conditional on information asymmetry and financial constraints. Panel A examines the relation between segment disclosure and toxic pollution conditional on the firm's information asymmetry, as measured by the bid-ask spread (*SPREAD*), Amihud's (2002) measure of illiquidity (*ILLIQUIDITY*), and the generalized probability of informed trading (GPIN) measure developed by Duarte et al. (2020) respectively. In Column (1) of Panel A, *TREAT_HIGH_SPREAD* (*TREAT_LOW_SPREAD*) takes the value of one for treated plants of firms with the *SPREAD* above (below) the sample median in the year before the adoption of SFAS 131, and zero otherwise. In Column (2) of Panel A, *TREAT_HIGH_ILLIQUIDITY* (*TREAT_LOW_ILLIQUIDITY*) takes the value of one for treated plants of firms with the *Illiquidity* above (below) the sample median in the year before the adoption of SFAS 131, and zero otherwise. In Column (3) of Panel A, *TREAT_HIGH_GPIN* (*TREAT_LOW_GPIN*) takes the value of one for treated plants of firms with the *GPIN* above (below) the sample median in the year before the adoption of SFAS 131, and zero otherwise. Panel B examines the relation between segment disclosure and toxic pollution conditional on financial constraints, as measured by three text-based measures of financial constraints developed by Hoberg and Maksimovic (2015), including the overall financial constraints (*FC*) and the constraints in issuing equity (*FC_EQUITY*) and debt (*FC_DEBT*). In Column (1) of Panel B, *TREAT_CONSTRAINED* (*TREAT_UNCONSTRAINED*) takes the value of one for treated plants of firms with *FC* above (below) the sample median in the year before the adoption of SFAS 131, and zero otherwise. In Column (2) of Panel B, *TREAT_CONSTRAINED_EQUITY* (*TREAT_UNCONSTRAINED_EQUITY*) takes the value of one for treated plants of firms with *FC_EQUITY* above (below) the sample median in the year before the adoption of SFAS 131, and zero otherwise. In Column (3) of Panel B, *TREAT_CONSTRAINED_DEBT* (*TREAT_UNCONSTRAINED_DEBT*) takes the value of one for treated plants of firms with *FC_DEBT* above (below) the sample median in the year before the adoption of SFAS 131, and zero otherwise. The dependent variable is *POLLUTION*, measured by the natural logarithm of the amount of toxic pollution in a plant-year. *POST* is a dummy variable that equals one for the years after the adoption of SFAS 131, and zero otherwise. We control for plant fixed effects (Plant FE) and event year fixed effects (Year FE). All variables are defined in Appendix B. Standard errors are clustered at the firm level. *t*-statistics are reported in parentheses. ∗∗∗, ∗∗, and ∗ indicate significance levels at 1%, 5%, and 10%, respectively.

Panel A. Information asymmetry

	POLLUTION		
	(1)	(2)	(3)
TREAT_HIGH_SPREAD×POST	-0.304**		
	(-2.08)		
TREAT_LOW_SPREAD×POST	-0.425**		
	(-2.40)		
TREAT_HIGH_ILLIQUIDITY×POST		-0.355**	
		(-2.39)	
TREAT_LOW_ILLIQUIDITY×POST		-0.371**	
		(-2.17)	
TREAT_HIGH_GPIN×POST			-0.565**
			(-2.19)
TREAT_LOW_GPIN×POST			-0.249**
			(-2.06)
Controls	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Equal sensitivity (*p*-value)	0.268	0.466	0.113

N	3,217	3,217	2,668
Adj. R^2	0.855	0.855	0.861

Panel B. Financial constraints

	POLLUTION		
	(1)	(2)	(3)
TREAT_CONSTRAINED×POST	-0.326*		
	(-1.75)		
TREAT_UNCONSTRAINED×POST	-0.642***		
	(-2.93)		
TREAT_CONSTRAINED_EQUITY×POST		-0.335*	
		(-1.70)	
TREAT_UNCONSTRAINED_EQUITY×POST		-0.614***	
		(-2.94)	
TREAT_CONSTRAINED_DEBT×POST			-0.627**
			(-2.54)
TREAT_UNCONSTRAINED_DEBT×POST			-0.365**
			(-2.43)
Controls	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Equal sensitivity (*p*-value)	0.113	0.140	0.156
N	2,703	2,703	2,703
Adj. R^2	0.857	0.857	0.857

Table A2. Robustness tests

This table conducts various robustness tests for our baseline results. Panel A uses different estimation windows. A three-year, seven-year, and eleven-year window centered on the adoption of SFAS 131 in Columns (1), (2), and (3) respectively. Panel B controls for additional fixed effects, namely plant industry-year interaction fixed effects in Column (1) and plant state-year interaction fixed effects in Column (2). Plant industry is the defined by two-digit SIC codes of the plants. Plant state is the state where a plant locates. Panel C excludes firms affected by the dot-com bubble. Column (1) excludes firms in tech industries. Column (2) also excludes firms that have manufacturing links to tech industries (i.e., technology-related manufacturers and firms with supply chain links to tech industries). Column (3) further drops firms with marketing links to tech industries. Panel D reruns the baseline regressions using a constant sample of plant-year observations with non-missing values throughout the five-year estimation window. Panel E examines the effect of the adoption of SFAS 131 on toxic pollution at the firm level. The dependent variable in Panels A-D is *POLLUTION*, defined as the natural logarithm of the amount of toxic pollution in a plant-year. The dependent variables in Columns (1) and (2) of Panel E are *FIRM_POLLUTION* and *FIRM_POLLUTION/SALES* respectively. *FIRM_POLLUTION* is the natural logarithm of the sum of toxic pollution of all plants of a firm in a year. *FIRM_POLLUTION/SALES* is the natural logarithm of the sum of toxic pollution of all plants of a firm in a year divided by the firm's total sales. *TREAT* is a dummy variable that equals one if the firm is reported as a single-segment firm under SFAS 14 but as a multiple-segment firm (with at least one newly disclosed pollutive segment) after the adoption of SFAS 131, and zero otherwise. *POST* is a dummy variable that equals one for the years after the adoption of SFAS 131, and zero otherwise. We control for plant fixed effects (Plant FE) in Panels A-D and firm fixed effects (Firm FE) in Panel E, and event year fixed effects (Year FE) in all panels. All variables are defined in Appendix B. Standard errors are clustered at the firm level. *t*-statistics are reported in parentheses. ∗∗∗, ∗∗, and ∗ indicate significance levels at 1%, 5%, and 10%, respectively.

Panel A. Different time windows

	POLLUTION		
	t–1 to *t*+1	*t*–3 to *t*+3	*t*–5 to *t*+5
	(1)	(2)	(3)
TREAT×POST	**-0.292****	**-0.314****	**-0.446****
	(-2.46)	**(-2.15)**	**(-2.33)**
Controls	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	2,036	4,333	6,301
Adj. R^2	0.882	0.825	0.767

Panel B. Additional fixed effects

	POLLUTION	
	(1)	(2)
TREAT×POST	**-0.386*****	**-0.423*****
	(-2.87)	**(-3.49)**
Controls	Yes	Yes
Plant FE	Yes	Yes
Industry-year FE	Yes	No
State-year FE	No	Yes
N	3,208	3,217
Adj. R^2	0.860	0.850

Panel C. Excluding firms affected by the dot-com bubble

	POLLUTION		
	Drop tech industries	Drop tech industries and firms with manufacturing links to tech industries	Drop tech industries and firms with manufacturing and marketing links to tech industries
	(1)	(2)	(3)
TREAT×POST	**-0.362******	**-0.354****	**-0.361****
	(-2.78)	**(-2.45)**	**(-2.49)**
Controls	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	3,199	2,610	2,581
Adj. R^2	0.857	0.857	0.856

Panel D. Constant sample

	POLLUTION			
	(1)	(2)	(3)	(4)
PLACEBO×POST	**-0.321****	**-0.359****		
	(-2.11)	**(-2.47)**		
***PLACEBO×PRE*(–1)**			**0.007**	**-0.014**
			(0.07)	**(-0.14)**
***PLACEBO×POST*(0)**			**-0.254***	**-0.301****
			(-1.69)	**(-2.04)**
***PLACEBO×POST*(+1)**			**-0.300**	**-0.364***
			(-1.56)	**(-1.98)**
***PLACEBO×POST*(+2)**			**-0.397***	**-0.444****
			(-1.93)	**(-2.24)**
Controls	No	Yes	No	Yes
Plant FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	2,465	2,465	2,465	2,465
Adj. R^2	0.852	0.853	0.852	0.852

Panel E. Firm-level analysis

	FIRM_POLLUTION	*FIRM_POLLUTION/SALES*
	(1)	(2)
TREAT×POST	**-0.391****	**-0.438*****
	(-2.25)	**(-2.69)**
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	826	826
Adj. R^2	0.907	0.904