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RESEARCH ARTICLE

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Bureaucratic response to performance information: how mandatory information disclosure affects environmental inspections

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Abstract

Information disclosure has become a ubiquitous component of contemporary governance. This study examines how disclosure of information about the performance of regulated entities, which also implicates the performance of relevant government agencies, affects bureaucratic behaviors. In the context of the Clean Air Act (CAA)—the primary law that regulates air pollution in the United States—this study shows that regulators significantly increased CAA regulatory inspections on facilities that started to disclose relevant performance information to the public following the requirements of the Toxics Release Inventory (TRI), which is a major environmental information disclosure program in the United States. Additional analyses suggest the increase was because of the disclosure providing new information to regulators instead of mobilizing citizen actions. The findings suggest that performance information about regulated entities can alleviate information asymmetry between bureaucrats and regulated entities and increase the accountability of regulated entities as well as relevant government agencies.

Evidence for practice

- Disclosure of information about the performance of regulated entities also has an impact on the behaviors of regulators.
- Regulators increase their scrutiny on regulated entities that are required to disclose relevant information, and the increase is especially large on those that disclose worse performance records.
- The change in regulatory behaviors is likely due to information disclosure alleviating information asymmetry between regulators and regulated entities by providing new information to regulators.
- Regulators' response to information serves as an important mechanism for information disclosure policy to achieve its objectives.

Performance information is a mainstay of contemporary governance (Grimmelikhuijsen et al., 2013; Grimmelikhuijsen & Welch, 2012; Moynihan & Pandey, 2010). Public and private organizations have increasingly been required to track and measure their operation, services, and performance, and oftentimes, to disclose the collected information to the public, in order to achieve certain objectives. This approach—unlike conventional approaches that rely on financial incentives or enforcement of rules and standards—leverages the power of information to change the behaviors of consumers, citizens, companies, and government agencies as an alternative way to achieve specific goals. Scholars call this approach "targeted transparency" (Fung et al., 2007; Weil et al., 2013), and advocates believe that it has the potential to increase accountability, facilitate performance improvement, and

enhance the provision of goods and services, in both private and public sectors (Coglianese et al., 2003; Kosack & Fung, 2014; Piotrowski, 2008).

Echoing the development of performance information in public administration is a surge of scholarly interest in assessing its impact on bureaucratic behaviors and other outcomes to understand the extent to which performance information can actually fulfill its promise (Cucciniello et al., 2017; Gerrish, 2016; Kroll, 2015). The findings are mixed. While disclosure of performance information is effective at achieving certain outcomes such as improving financial management and reducing corruption, evidence on its role to cultivate accountability and improve performance in other areas is less certain, and its impact often varies across policy domains and forms of performance information (Cucciniello et al., 2017; de Fine Licht 2014).

Moreover, the majority of the existing research focuses on performance information about government agencies, that is, government as the object of transparency (Meijer, 2013). However, many public services are not solely and/or directly delivered by government agencies (Moynihan et al., 2011). For example, water utilities, following the regulations and measures developed by government agencies, are the direct provider of drinking water to households. While information about the service (e.g., water quality) reflects the performance of water utilities, it also implicates the performance of government as government agencies play critical roles in shaping the performance. This type of performance information is ubiquitous, ranging from quality of public education and drinking water safety to restaurant hygiene and industrial pollution. Yet, relatively little is known about how it affects bureaucratic behaviors (de Boer et al., 2018).

This study engages the question in the context of the Toxics Release Inventory (TRI) and the Clean Air Act (CAA). The TRI is a major mandatory environmental information disclosure program in the United States and requires industrial facilities that meet certain criteria to disclose information about their management of listed toxic chemicals to the public. The CAA is the primary law that regulates air pollution in the United States. Unlike the TRI, which does not place any requirement on regulated entities other than disclosure of information, the CAA is a command-and-control regulation in which regulators have the authority to conduct regulatory activities, such as inspections, to ensure regulated entities' compliance with various technological and emission standards. A significant number of CAA facilities are covered by the TRI. In addition, many of the TRI chemicals are also regulated by the CAA, which makes information in the TRI disclosure relevant to regulatory activities in the CAA. Because of the significant overlap in regulated entities and pollutants, this study investigates the impact of TRI disclosure on CAA regulatory inspections. With a difference-in-differences (DID) research design, it finds that regulators significantly increased CAA regulatory inspections on a group of facilities when these facilities started to disclose relevant information in the TRI. The increase was larger for facilities that disclosed worse performance records. However, I did not find a larger increase in communities with characteristics that are associated with stronger citizen actions (i.e., higher voter turnout, higher population density, and higher education level).

This study contributes to the understanding of mandatory information disclosure and the use of performance information. It demonstrates the potential of performance information to alleviate information asymmetry and increase government accountability, even when the information is not directly about government. It also provides evidence that regulatory response is an important mechanism for mandatory information disclosure policy to achieve its goals.

THEORETICAL FRAMEWORK

Transparency makes available information about performance of an actor and allows other actors to monitor the work and performance of the first actor (Grimmelikhuijsen & Welch, 2012; Meijer, 2013). It comes in many forms—the information could be about decision-making process, policy content, and policy outcomes (Grimmelikhuijsen & Welch, 2012). It also attempts to achieve a variety of objectives—from promoting participation, cultivating trust, and reducing corruption to increasing government accountability and improving qualities of public services (Cucciniello et al., 2017). Scholars have extensively studied the effects of different forms of transparency on both citizens and government agencies regarding a range of outcomes (for a recent review, see Cucciniello et al., 2017). With few exceptions (e.g., de Boer et al., 2018), most of the studies in the literature focus on government as the object of transparency. That is, the information directly measures the process, operations, or performance of government agencies. However, contemporary governance is complex. Many public services are not solely and directly delivered by government agencies, and many policy outcomes require efforts and responses from other actors (Moynihan et al., 2011). In a complex governance system, information about other actors' performance may implicate the performance of government agencies, especially when government agencies have the responsibility and power to influence the outcomes.

This research studies disclosure of such performance information. Specifically, it focuses on "targeted transparency," in which regulated entities are mandated to disclose factual information about their products, services, or operation to the public in order to achieve certain regulatory goals (Weil et al., 2013). It is different from general "sunshine" laws and open-government initiatives, which encourage government agencies to make existing datasets such as administrative records and government meeting records easily accessible to the public and often treat transparency as an end in

itself (Weil et al., 2013). It also differs from voluntary disclosure of selective (often favorable) information from entities such as nongovernmental organizations (Ebrahim, 2003; Tremblay-Boire & Prakash, 2015). Instead, "targeted transparency" is more focused and requires the disclosure of specific information in standardized formats with the goal of changing the behaviors of relevant stakeholders and the disclosing entities.

In "targeted transparency" that focuses on private entities, since government often shares the responsibility to improve the performance of regulated entities, the disclosed information also reflects the performance of government. This article examines whether and how disclosure of information about the performance of regulated entities may affect the behaviors of government agencies. Specifically, it investigates how mandatory disclosure of information about facilities' environmental performance affects regulators' inspection activities.

WHY INFORMATION DISCLOSURE MAY AFFECT BUREAUCRATIC BEHAVIORS

Regulators carefully balance conflicting political demands and statutory requirements in their implementation of policies and regulations (Scholz & Wei, 1986). They are influenced by organizational structure and culture (Konisky & Reenock, 2013), respond to task differences (Scholz & Wei, 1986), and react to demands from various political actors (Overman & Schillemans, 2022). Information disclosure is most likely to influence regulatory behaviors by changing (1) the perceived environmental performance of regulated entities and (2) the equilibrium of multiple political influences.

First, information disclosure may change regulators' perception of the performance of regulated entities (Hansen & Nielsen, 2022). Enforcement of regulation is in essence a principle–agent problem that is characterized by information asymmetry between regulators and regulated entities (Vaughan, 1990). In light of new information about the performance of regulated entities, regulators will adjust their enforcement strategies to maximize deterrence (Harrington, 1988). Prior research shows that regulators often become more stringent with entities with relatively worse performance (Helland, 1998). If disclosed information shows that regulated entities have worse performance than regulators' prior expectation, information disclosure will have a "shock and shame" effect and compel closer scrutiny of these entities from regulators (Anderson et al., 2019; Stephan, 2002). Obviously, information disclosure may also provide nothing new or even reveal better performance than the prior understanding of regulators. But the latter two scenarios are less likely. If regulated entities or agencies have favorable private information about their performance, they would have voluntarily disclosed or provided the information already (Marquis et al., 2016; Tremblay-Boire & Prakash, 2015). Since this effect of information disclosure arises from its direct impact on regulators by providing new information to them, I call it "direct mechanism."

Second, information disclosure may also indirectly affect behavior of regulators by mobilizing stakeholders and changing the politics surrounding relevant issues (Meier et al., 2022; Meijer, 2013; Moynihan & Soss, 2014). Government agencies operate in an environment that consists of a variety of stakeholders that include elected officials, interest groups, the media, and citizens. These stakeholders play critical roles in shaping the reputation of government agencies, and government agencies carefully balance stakeholder demands to cultivate and protect their reputation (Carpenter & Krause, 2012; Moynihan & Hawes, 2012).

The concern for reputation, to a large degree, dictates regulators' dealing of regulated entities (Bustos, 2021; Etienne, 2015; Lee, 2022). Performance information about regulated entities often implicates the performance of regulators, putting reputation of government agencies at stake. When their reputation is under threat, government agencies tend to increase their scrutiny of regulated entities with bad reputation to disassociate themselves from the criticized actors and shield themselves from hostile external audiences (Hood, 2010). For example, Hiatt and Park (2012) found that U.S. Department of Agriculture was less likely to approve applications of genetically modified products from firms with tainted reputation due to recent protests and boycotts. Maor and Sulitzeanu-Kenan (2013) found that U.S. Food and Drug Administration took enforcement actions faster when faced with negative media coverage. Gilad et al. (2015) demonstrated that Israel's banking regulator tended to shift blame to others in response to claims that regulations were too lenient. de Boer et al. (2018) showed that regulators in Netherland who perceived higher degree of performance information disclosure applied rules and regulations more rigidly to minimize potential criticism on ambiguous enforcement behaviors.

Following the above logic, to the extent that mandatory information disclosure mobilizes stakeholders, it is also expected to affect the behaviors of bureaucrats. In the case of information about pollution (the empirical context of this study), the information is primarily negative. It may draw negative reactions from the media (Campa, 2018), nonprofit organizations (Maxwell et al., 2000), and citizens (Li, 2021). In this context, when regulated entities experience enhanced scrutiny from other stakeholders following disclosure of performance information, regulators are expected to increase their own scrutiny/inspections on regulated entities.

Both the direct and indirect mechanisms suggest that regulators are expected to increase their scrutiny/inspections on regulated entities that are required to disclose performance information. I test this hypothesis in the main analysis. Following the main analysis, I examine heterogenous effects of information disclosure to explore the mechanisms of the impact.

EMPIRICAL CONTEXT

Toxics Release Inventory

The empirical context to test the hypothesis is the Toxics Release Inventory (TRI) and Clean Air Act (CAA). Established by the Emergency Planning and Community Right-to-Know Act of 1986, TRI is a major environmental information disclosure program in the United States. Under the TRI, for each listed toxic chemical, a facility must submit forms that detail its management of the chemical on an annual basis if it satisfies all three of the following conditions: (1) it is in a covered industry; (2) it employs 10 or more full-time equivalent employees; (3) it manufactures, processes, or uses the chemical in quantities above the threshold level. The forms include information such as the quantities of releases to different media (air, water, and land) and the quantities that have been recycled, treated, and used for energy recovery. The information submitted by facilities is compiled and made available to the public by the Environmental Protection Agency (EPA) through disk storage and on the Internet from the EPA and other environmental sources, such as the Right-To-Know Network (RTK-Net).

The TRI program collects, processes, and analyses TRI data on an annual cycle. Every year, facilities submit TRI forms for the previous calendar year to the EPA by July 1. A preliminary dataset is made available to the public shortly after the deadline. From July to October, the EPA conducts additional data quality checks, publishes the complete dataset, and begins analyzing the data. In January of the next year, the EPA publishes the TRI National Analysis. In addition to activities that occur at specific times of the year, the TRI program continually conducts data quality checks.

Since the inception of the TRI, reported toxic emissions have fallen dramatically. EPA's analysis (U.S. EPA, 2001) shows that total releases in the United States decreased by 45.5% between 1988 and 1999. Emissions further dropped by approximately 30% between 2001 and 2010 (U.S. EPA, 2012). For the calendar year of 2016, more than 21,000 facilities submitted TRI data to the EPA, reporting 27.80 billion pounds of TRI-listed chemicals as production-related waste. Of this total, 87% was recycled, combusted for energy recovery, or treated. Only 13% (3.88 billion pounds) was disposed of or otherwise released into the environment.

At its inception, the TRI covered only manufacturing industries (Standard Industry Classification (SIC) codes 20–39) and listed about 280 chemicals. The covered industries and listed chemicals both expanded over time. Most relevant to this study is the expansion of industry coverage in 1998. Specifically, starting for the 1998 calendar year, seven new industries were added to the coverage of the TRI. The seven industries were metal and coal mining, electric utilities that combust coal and/or oil, commercial hazardous waste treatment, solvent recovery, petroleum bulk terminals, and wholesale chemical distribution. Prior to 1998, all facilities in the seven industries did not disclose in the TRI. From 1998, because of TRI's size-based reporting criteria, larger facilities in these seven industries, those that employed more than 10 full-time employees and met the thresholds for listed chemicals, started to disclose in the TRI, and smaller facilities in the seven industries continued to not disclose in the TRI. This study exploits the variations created by the industry coverage expansion and size-based reporting criteria to identify the effects of TRI disclosure on CAA regulatory inspections.

Clean Air Act

The CAA is the primary law that regulates air pollution in the United States. Unlike the TRI, which imposes no pollution control requirements on covered facilities, the CAA is a command-and-control regulation that requires regulated entities to meet specific emissions and technology standards. It is jointly implemented by the federal EPA and states. While the EPA establishes and revises various air quality, emission, and technology standards, state regulators are required to develop enforceable state implementation plans and assume the primary responsibility of ensuring facilities' compliance with these standards through day-to-day activities such as permitting, inspections, and enforcement.

This study focuses on CAA inspection activities, which regulators use to determine the compliance status of a facility. They are a core component of the CAA as they identify problematic behaviors, which are crucial for enforcing sanctions, monitoring policy outcomes, and adjusting regulations (Etienne, 2015). They are also costly and signal regulatory attention and priority (Hanna & Oliva, 2010). Regulators primarily conduct three types of CAA inspection activities (also referred to as evaluations): full evaluations, partial evaluations, and investigations (U.S. EPA, 2016). These inspection activities can be conducted both on and off site and can include reviews of monitoring data (e.g., continuous emissions monitoring system (CEM) and continuous parameter monitoring reports); reviews of permit, facility records, and operating logs; visual inspections of facility and equipment; and stack tests; among others (U.S. EPA, 2016). Full and partial evaluations differ in the scope of activities. Investigations are rare and involve a more in-depth assessment of a particular issue usually based on issues discovered in full or partial evaluations (U.S. EPA, 2016).

The EPA sets inspection frequency targets based on types of facilities (U.S. EPA, 2016). However, these targets are not binding. The EPA guidelines allow states to take into consideration factors such as compliance history, location of facility, potential environmental impact, operational practices, use of control equipment, resources in the state's compliance monitoring program, and

participation in national enforcement initiatives to make inspection decisions. Inspection activities can also be triggered by citizen complaints, anonymous employee complaints and tips, or facility characteristics and behaviors that correlate with frequent violations or significant damages (U.S. EPA, 2016). The complexity of these considerations, coupled with limited regulatory resources, affords regulators high levels of discretion in determining when and on which facilities to conduct inspections (Shimshack, 2014).

Connections between the Clean Air Act and Toxics Release Inventory

CAA regulatory inspections may be influenced by the TRI disclosure because of the close connections between them. First, many of the facilities covered by the TRI are also regulated by the CAA. In 2016, among the more than 21,000 facilities that disclosed information in the TRI, around 12,700 of them were also under the jurisdiction of the CAA. Second, many of the TRI chemicals are regulated by the CAA as well. Greenstone (2003) found that lots of the TRI chemicals can be classified as volatile organic compounds, particulate matter, or lead, which are three of the six criteria pollutants that the CAA primarily focuses on. In addition, many TRI chemicals fall into the jurisdiction of the National Emission Standards for Hazardous Air Pollutants program of the CAA. Based on the TRI data for 2016, 37% of the TRI chemicals were regulated by the CAA, and these CAA-regulated chemicals represented 59% of the air emissions reported in the TRI. Conversely, scholarly have found that CAA inspections can lead to significant reduction in TRI emissions (Hanna & Oliva, 2010).

DATA

Sample

The sample includes CAA facilities in the newly covered industries by the TRI due to the 1998 expansion. I assign them to the treatment (TRI) or control (non-TRI) group based on whether and when they started to disclose relevant information in the TRI. Specifically, I first obtain a list of CAA facilities in the newly covered industries. Then, based on the TRI reporting records, I collect information on for what years and what chemicals these facilities disclosed information in the TRI and construct the treatment (TRI) and control (non-TRI) groups. The control (non-TRI) group consists of facilities that did not disclose information in the TRI throughout the analysis period of 1993–2001, and the treatment (TRI) group consists of facilities that did not disclose from 1993 to 1997 but started to report air emissions of CAA-regulated TRI chemicals from 1998 due to the rule change.

Variables

CAA inspections

The data on inspections are from the Air Facility System database. The database compiles CAA inspection activities on stationary sources and includes detailed information on these activities, including dates, types, facility identifiers, and facility location. I aggregate the number of inspections to facility-year level.

It is worth noting that the inspections recorded in the Air Facility System do not include the regulatory efforts to ensure the quality of disclosed TRI information. So, any change in the inspections on TRI facilities identified in this study is not due to the need to fulfill the implementation requirements of the TRI. The federal EPA does make efforts to ensure that the information in the TRI is accurate, and these efforts mainly involve quality calls to verify the accuracy of reported information, focusing on facilities that report the largest releases or experience large or abnormal changes in releases. But these quality calls are not a part of the Air Facility System database, which only records activities within the scope of the CAA. In the Appendix, I conduct a robustness check by only focusing on CAA inspections carried out by state regulators. Since the TRI program and its quality checks are implemented by the federal EPA, by excluding the small number of CAA inspections conducted by the federal EPA, the robustness check could further assuage the concern that the identified change in CAA inspections on TRI facilities may be a result of the required efforts to implement the TRI.

TRI disclosure

The information about whether and when a facility started to disclose information comes from the TRI database. During the study period, the TRI information for a calendar year was due to the EPA by July 1 of the next calendar year, and the information was available to the public roughly 10 months later after the submission due date, which makes public access to the TRI information about 16 months after the end of the relevant calendar year. Because of the lag in information access, while TRI facilities started to disclose information about their emissions that occurred in calendar year 1998, the information did not affect the CAA inspections in calendar year 1998, and I need to assign appropriate information disclosure schedule for CAA inspections. That is, I need to determine when in calendar year the TRI disclosure started to come into effect with regard to CAA inspections.

I assign TRI disclosure schedule to CAA inspections as follows. The TRI disclosure for a certain calendar year (TRI year) will treat the period after the public-access date of this TRI disclosure and before the public-access date of the TRI disclosure for the next calendar year. The main

TABLE 1 Illustration of TRI year definition.

TRI year	Calendar year (based on public access)	Calendar year (based on submission deadline)
1993	03/15/1995–06/15/1996	07/01/1994–07/01/1995
1994	06/15/1996–05/13/1997	07/01/1995–07/01/1996
1995	05/13/1997–12/15/1998	07/01/1996–07/01/1997
1996	12/15/1998–05/13/1999	07/01/1997–07/01/1998
1997	05/13/1999–05/11/2000	07/01/1998–07/01/1999
1998	05/11/2000–04/12/2001	07/01/1999–07/01/2000
1999	04/12/2001–05/23/2002	07/01/2000–07/01/2001
2000	05/23/2002–06/20/2003	07/01/2001–07/01/2002
2001	06/20/2003–06/23/2004	07/01/2002–07/01/2003

Source: The public-access dates and submission deadlines are provided by the EPA.

analysis will be based on the public-access rule. One problem is that regulators could potentially access the TRI information before the public-access date as facilities submit TRI forms to the EPA by an earlier date. As a sensitivity test, I also conduct analysis that follows a submission-deadline rule, following which the TRI disclosure for a calendar year (TRI year) will treat the period after the submission deadline of this TRI disclosure and before the submission deadline of the TRI disclosure for the next calendar year. Table 1 illustrates the definition of TRI year based on the two approaches.

Descriptive statistics

The sample includes 2634 CAA facilities (each facility is measured repeatedly each year). Among them, 1960 are non-TRI facilities and 694 are TRI facilities. Since the analysis leverages quasi-experimental variations and mainly uses fixed effects to control for potential confounders, relative few control variables are needed. Regarding the outcome variable, number of inspections, Figure 1 shows its trends for the TRI and non-TRI facilities over time. Before the industry expansion, TRI and non-TRI facilities had strong parallel trends, and the differences between them were relatively stable. After the rule change, inspections increased more for the TRI facilities than for non-TRI facilities. (The pattern is also shown in Table A1 in the Appendix.) But Figure 1 is a raw demonstration. It masks potential differential trends across states and industries. If the compositions of TRI facilities and non-TRI facilities are not perfectly identical regarding states and industries, Figure 1 might be misleading. I address these concerns in the regression.

METHODS

This study employs a difference-in-differences (DID) design that exploits TRI's industry expansion in 1998 and

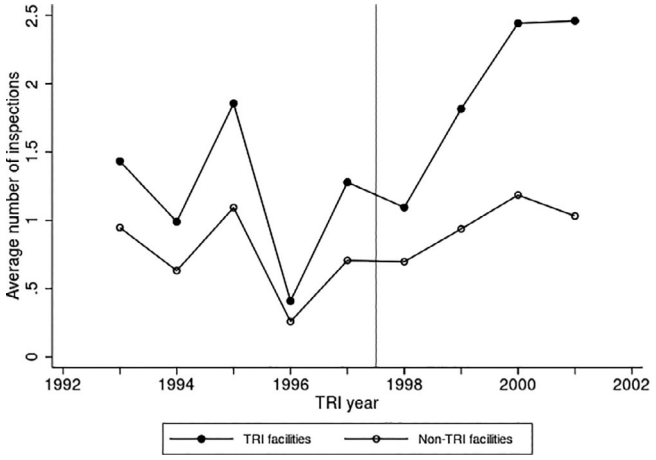

FIGURE 1 Trends of inspections for TRI and non-TRI facilities. The large year over year variations of inspections in this figure are partly due to the different length of TRI years as the intervals between public access to TRI information of different years tend to vary significantly, especially in the pre-rule change period. For example, TRI year 1995 is about 1.5 calendar years in length, while TRI year 1996 is only about 0.5 calendar year in length.

its size-based reporting requirements. Before the expansion, all facilities in the newly covered industries did not disclose in the TRI. After it, larger facilities in these industries (TRI facilities), those that met the size-based criteria, started to disclosure information in the TRI, and smaller facilities continued to not disclose in the TRI (non-TRI facilities).

The basic model compares the differences in CAA inspections between the TRI and non-TRI facilities, before and after the expansion. By assuming all other factors affect CAA inspections on the two groups of facilities in the same way over time, any change in the differences in inspections between the two groups before and after the expansion can be attributed to the expansion, which only affected the TRI facilities. As a part of the DID design, I include facility fixed effects and year fixed effects. I also include a large set of other fixed effects to further control for time variant factors that might affect TRI and non-TRI facilities differently. Specifically, I include county-year fixed effects and industry-year fixed effects (these more granular fixed effects will absorb the year fixed effects). The county-year fixed effects capture state and local political and economic factors and county-level environmental conditions, such as the National Ambient Air Quality Standards attainment status. The industry-year fixed effects capture factors such as industry-specific technological changes, market shocks, and regulatory initiatives. Specifically, I estimate the following model:

$$Y_{it} = \alpha + \beta * Post_t * TRI_i + \gamma_i + \delta_{ct} + \theta_{st} + \varepsilon_{it} \quad (1)$$

where Y_{it} is the number of CAA inspections on facility i in TRI year t. $Post_t$ is a dummy that equals one for the post-treatment period (1998 and after). TRI_i is a dummy

TABLE 2 Effects of TRI disclosure on CAA inspections.

	(1) Inspection	(2) Inspection	(3) Inspection	(4) Inspection	(5) Inspection
TRI * post	0.413*** (0.110)	0.470*** (0.110)	0.428*** (0.080)	0.564*** (0.083)	0.379*** (0.113)
1-year lagged violation dummy					0.046 (0.067)
Constant	0.963*** (0.010)	0.957*** (0.010)	0.947*** (0.008)	0.933*** (0.009)	0.980*** (0.012)
Facility fixed effects	X	X	X	X	X
State-year fixed effects			X	X	
County-year fixed effects	X	X			X
Industry-year fixed effects	X		X		X
N	20,620	20,620	26,340	26,340	18,558
R^2	0.605	0.598	0.492	0.482	0.624

Note: Industry is measured with two-digit SIC codes. All standard errors are clustered at facility level and in parentheses.
*$p < .10$; **$p < .05$; ***$p < .01$.

variable that equals one if facility *i* is a TRI facility. γ_i are facility fixed effects; δ_{ct} are county-year fixed effects; and θ_{st} are industry-year fixed effects.

Identification in the basic model requires that in the absence of the expansion, TRI facilities would have the same trend with non-TRI facilities. If TRI and non-TRI facilities were already having diverging trends regarding CAA inspections before the rule change, the DID model may wrongly attribute the continuation or reversion of the diverging trends to information disclosure. The possibility of the concern is high in the case of this study, as relevant stakeholders might have engaged in the decision-making process that led to the expansion of industry coverage. Thus, it is very important to examine if regulators had already changed their regulatory inspections on TRI facilities before the rule change. To do so, I extend the above basic DID analysis to an event study analysis. In practice, this means estimating Equation (1) with a full set of year effects interacted with the TRI status in lieu of $Post_t * TRI_i$. Plot of the coefficients for the year–TRI interactions allows the examination of the pretrends. If there was no difference in the trends of inspections on TRI and non-TRI facilities leading up to the expansion, the coefficients for the year–TRI interactions would move around zero before the expansion.

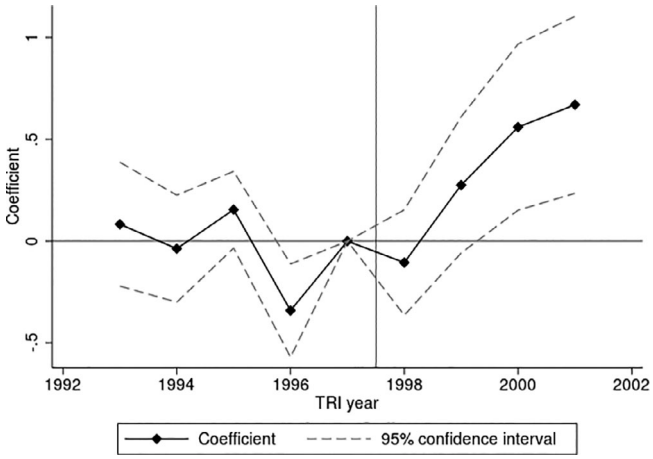

FIGURE 2 Event study coefficients.

RESULTS

Main analysis

Table 2 reports results from the main analysis. Each column of Table 2 represents estimates from a separate regression. Column (1) reports the estimates from the specification described in the methods section. Columns (2)–(4) report estimates from specifications with different (less restrictive) fixed effects compared with column (1). Column (5) has the same fixed effects as column (1) and also includes as a control a dummy variable that indicates whether or not a facility incurred violation of the CAA in the year before.

Estimates from different model specifications are similar, and I interpret the results based on column (1). Column (1) shows that on average, regulators increased the number of CAA inspections on a TRI facility by 0.413 per year when it started to disclose relevant information, which strongly supports the expectation laid out in the theoretical framework section. In the posttreatment period, a TRI facility on average received 1.953 inspections per year. The effect size of 0.413 represents a 27% increase (0.413/(1.953–0.413)).

To test if the increase in regulatory inspections was driven by pre-existing differential trends for TRI and non-TRI facilities, I show results from an event study approach. Particularly, I estimate a model similar to the specification in column (1) of Table 2, except that I replace $Post_t * TRI_i$ with a full set of year dummies interacted with TRI_i. I plot the coefficients for the year–TRI interactions in Figure 2, where I normalize the coefficient to 0 in 1997, the year prior to the expansion. The figure suggests that there was

little to no pretrend before the expansion, failing to reject the validity of the research design.

Heterogenous effects and exploration of mechanisms

The impact of information disclosure on inspections is unlikely to be the same across the board. In this subsection, I test several heterogenous treatment effects as a means to explore plausible mechanisms for the main treatment effect. In particular, I test whether the effects of information disclosure are greater for facilities (1) that disclose worse performance records, (2) in counties with stronger political activism, (3) in communities with higher population density, and (4) in communities with higher levels of education.

The heterogenous effects will shed light on the mechanisms of the treatment effect identified in the main analysis. For instance, if the treatment effect is a result of actions from citizens and nongovernmental organizations, we would expect a larger treatment effect in counties with stronger political activism. Similarly, since areas with higher population density and higher levels of education are more likely to be covered by the media (Campa, 2018), if the treatment effect arises from media coverage, we would expect a larger effect on facilities that are located in such communities.

I measure a facility's performance record with the amount of relevant toxic emissions that it reported to the TRI for 1998. Political and civic activism is measured by county-level voter turnout rate in the 2000 Presidential Election based on data from the National Neighborhood Data Archive. Population density and education level (percent of college graduate) are measured for the area of a 1-mile radius around a facility based on data from the 2000 Decennial Census. All four characteristics are dichotomized and operationalized with dummy variables. For a specific characteristic of a facility, the dummy variable equals 1 if the value of the relevant measurement is above the median level of all units in the dataset.

To estimate the heterogenous effects, I add interaction term $Post_t * TRI_i * Facility\ characteristic_i$ to the basic model. In this setup, coefficient on $Post_t * TRI_i$ measures the impact of information disclosure on the base group, and coefficient on $Post_t * TRI_i * Facility\ characteristic_i$ measures the additional impact on the group with certain characteristics. I run a separate regression for each characteristic and also combine all of them in a single model.

Table 3 reports estimates for the heterogenous effects. Columns (1)–(4) present results for each characteristic from a separate model, and column (5) presents results when all characteristics are estimated in a single model. Estimates for each characteristic from the combined model do not differ substantively from those based on separate models. So, I interpret the results based on separate models for each characteristic.

Column (1) shows that the increase of inspections was different for facilities with different performance records. While the results show that inspections increased for facilities that disclosed less worse performance records (the base category), the increase was small in magnitude ($\beta = 0.118$) and statistically insignificant. The increase on facilities with worse performance records, on the other hand, was much larger. The average number of inspections increased by 0.708 more on them, on top of the increase for the base category. The results could be due to the "direct mechanism" (that information disclosure affects regulatory actions by providing new information to regulators) as worse performance records may have a larger "shock and shame" effect, but they could also result from the "indirect mechanism" (that information disclosure affects regulatory actions through political pressure) as poor performance may also lead to stronger stakeholder actions.

However, other heterogenous effects are inconsistent with the prediction of "indirect mechanism." There is no discernable difference in the increase of inspections on facilities located in communities with different levels of education and population density, which are factors associated with media coverage and newspaper consumption (columns (3) and (4)) (Campa, 2018). Moreover, the increase of inspections is surprisingly much smaller in places with stronger political activism (column (2)). This may be due to celling effect. Environmental enforcement is already more stringent in places with strong political activism (Shimshack, 2014). Thus, regulators might find it less necessary to increase their scrutiny on these facilities, and the additional increase was relatively small. Regardless of the explanation, the results do not support the argument that political activism is a main driver of the increase in inspections following information disclosure. Other studies in the TRI context also have shown that citizens know little about TRI facilities and associated environmental risk in their communities (Atlas, 2007; Li & Konisky, 2022) and do not change their intention to act even when provided with local TRI information (Li, 2022), which corroborate the results from these heterogenous effects.

On the contrary, prior studies provide some evidence for the "direct mechanism." For example, EPA reports state that its Office of Enforcement and Compliance Assurance compares TRI information with other environmental information, such as air emissions data from the Air Facility System, to identify facilities that are potentially out of compliance with their permits (U.S. EPA, 2013). Kraft et al. (2011), through large-scale surveys, also found that both federal and state regulators used TRI information to assist regulation and enforcement, to understand facilities' environmental performance, and to set environmental regulatory priorities.

While much of the evidence underscores the role of the "direct mechanism" of information disclosure (providing new information to regulators), analyses in this study

TABLE 3 Heterogenous effects of TRI disclosure on CAA inspections.

	(1) Inspection	(2) Inspection	(3) Inspection	(4) Inspection	(5) Inspection
TRI * post	0.118 (0.110)	0.688*** (0.181)	0.460*** (0.153)	0.442*** (0.143)	0.325 (0.250)
TRI * post * larger emissions	0.708*** (0.242)				0.840*** (0.279)
TRI * post * higher turnout		−0.503** (0.218)			−0.617*** (0.219)
TRI * post * higher pop densi.			−0.072 (0.197)		0.169 (0.228)
TRI * post * more educated				−0.053 (0.178)	−0.065 (0.170)
Constant	0.963*** (0.010)	0.957*** (0.010)	0.947*** (0.008)	0.933*** (0.009)	0.980*** (0.012)
Facility fixed effects	X	X	X	X	X
County-year fixed effects	X	X	X	X	X
Industry-year fixed effects	X	X	X	X	X
N	20,620	20,620	20,620	20,620	20,620
R^2	0.606	0.605	0.605	0.605	0.606

Note: "Larger emissions," "higher turnout," "higher population density," and "more educated" are dummy variables that equal to 1 if a facility is located in a community with values of relevant measures higher/larger than the respective median values. Industry is measured with two-digit SIC codes. All standard errors are clustered at facility level and in parentheses.
*$p < .10$; **$p < .05$; ***$p < .01$.

cannot rule out the "indirect mechanism" as the study primarily uses political and demography characteristics as proxies for the "indirect mechanism." A more definite answer requires directly measuring TRI-related actions from citizens, nongovernmental organizations, and the media, and examine their relationship with regulators' behaviors.

Sensitivity test

In addition to the above analyses, I conduct a few sensitivity tests. First, I estimate the effects with Poisson fixed effects model as an alternative to the linear fixed effects model used in the main analysis. Second, I exclude inspections conducted by the federal EPA and focus on the effect of TRI disclosure on state CAA inspections. While all inspections included in the main analysis were within the scope of the CAA and were not a part of the implementation of the TRI program, focusing on state CAA inspections would further strengthen the case as the TRI is primarily administered by the federal EPA. Third, I conduct analysis following submission deadlines instead of public-access dates (See details in the data section). Results from all sensitivity tests are included in Table A2 in the Appendix, and they are substantively similar to the results from the main analysis.

DISCUSSION AND CONCLUSION

This study examines how relevant performance information from the TRI disclosure affects regulatory inspections in the CAA. Taking advantage of variations from TRI's expansion of industry coverage and its size-based disclosing requirements, this study finds that regulators significantly increased the number of CAA inspections on facilities that started to disclose relevant performance information.

This study makes several contributions to the understanding of transparency and disclosure of performance information. First, it provides evidence for the impact of performance information on bureaucratic behaviors. How performance information affects bureaucratic behaviors is among the biggest questions in performance management (Moynihan & Pandey, 2010). While the topic has received much attention from scholars (Cucciniello et al., 2017; Kroll, 2015), the evidence is inconclusive. Moreover, existing research predominantly focuses on the effect of performance information about government. But performance management regimes often extend beyond government: many public services are not directly delivered by government agencies, and many policy outcomes require cooperation of other stakeholders (Cheng & Li, 2022; Moynihan et al., 2011). This article finds that performance information on a third party, which implicates the performance of government agencies, also affects bureaucratic behaviors. The findings that regulators increase regulatory inputs and resources to target facilities that disclose performance information show that regulators have paid more attention to and have been more concerned about the environmental performance of these facilities, suggesting that performance information has the potential to increase government accountability. The conclusion is further strengthened by the results that regulators impose heavier scrutiny on facilities that disclose worse performance records.

Second, this study also contributes to the understanding of the efficacy and mechanisms of mandatory information disclosure policy. Information disclosure policy is

ubiquitous, but evidence on its effectiveness is mixed (Fung et al., 2007). Deciphering its efficacy requires understanding of how it affects behaviors of various stakeholders since it primarily attempts to use information to mobilize individual choice, market force, and participatory democracy to achieve certain regulatory goals. Existing research has extensively examined how citizens (Holbein, 2016; Li, 2022), consumers (Pope, 2009), investors (Lyon & Shimshack, 2015), and the media (Campa, 2018) respond to information disclosure programs. Scholars also have long held the contention that information disclosure policy affects the behaviors of regulators to increase pressure on targeted entities (Bennear & Olmstead, 2008). But direct and strong empirical evidence to validate the claim is scant. This study addresses the limitation by demonstrating that information disclosure indeed influences regulatory behaviors. By identifying regulatory response as a key mechanism for information disclosure policy to work, this article highlights the importance of considering the motivation and needs of regulators in the design of future information disclosure policy to better leverage this mechanism.

Third, the study also sheds light on why regulators respond to information about the performance of regulated entities. The findings support key tenets of principle–agent theory (i.e., information asymmetry) and its application to the relationship between regulators and regulated entities. Specifically, the study finds evidence for the direct mechanism, which suggests that regulators gained new knowledge from the mandatory information disclosure, suggesting that (1) information asymmetry is indeed a problem in environmental enforcement, and (2) mandatory information disclosure can mitigate it. On the contrary, the results are inconsistent with the bottom-up, indirect mechanism, which states that regulators would change their behaviors as a result of citizen actions instigated by new information. The muted indirect mechanism could either be because of (1) public apathy or lack of access to new information or (2) bureaucratic unresponsiveness to public demand. Future studies are needed to investigate the two reasons and necessary conditions to activate the indirect mechanism, which are also important for the next point in the discussion, about the generalizability of the findings of this study.

Fourth, information disclosure or transparency programs come in different forms (Fung et al., 2007), and their impacts often vary across policy domains (de Fine Licht 2014). However, the assumption of information asymmetry and the promotion of the democratic value of public participation are throughlines in such transparency and disclosure programs across policy domains. The information asymmetry issues in environmental enforcement that were demonstrated in this study have also been documented in areas such as health care (Ody-Brasier & Sharkey, 2019) and education (Holbein, 2016), and well-designed mandatory information disclosure programs would be expected to mitigate such issues. On the other hand, the muted indirect mechanism may or may not extend to other programs and policy areas. People are more likely to respond to easy-to-understand, vivid information or information that appeals to emotions (Loewenstein et al., 2014). The information disclosed in the TRI is relatively technical and does not correspond directly to more intuitive health indicators such as death rate and incidences of certain diseases. This could be a potential reason for the muted indirect mechanism in this study. But conditions may change in other programs and policy areas. For example, scholars have found that school rating systems motivated citizens to take political actions (Holbein, 2016). Future studies that unpack the indirect mechanism are needed to enhance our understanding of how citizens and bureaucrats respond to performance information.

There are also a few limitations that are worth noting in interpreting the results and developing future research. First, this study only focuses on inspections. While it is an important type of bureaucratic behavior, bureaucrats may change other types of behaviors as well. For example, they may increase aid to help facilities improve performance or they may deny permit for construction of new facilities. Future research could explore how performance information affects different types of bureaucratic behaviors. Second, this study does not provide definitive answer to the mechanisms of information disclosure's impact on bureaucratic behaviors. While it explored the mechanisms through heterogenous treatment effects, it did not directly measure actions from citizens, nongovernmental organizations, and the media in response to the disclosed TRI information. Future research could measure these responses directly and examine their relationship with regulatory behaviors to gain deeper insights into the mechanisms. Third, future research may also explore social equity implications of regulators' response to information disclosure. Minority communities often bear a disproportionately large share of environmental burden (Li et al., 2019) and receive fewer resources and less attention from public officials (Konisky & Reenock, 2018). As information disclosure becomes more prevalent, it is critical to understand if it will exacerbate or serve as an antidote to existing social and environmental inequalities.

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APPENDIX A

TABLE A1 Descriptive statistics.

Variable	Obs.	Mean	S.D.	Min.	Max.
# of inspection (annual)					
1993–1997 (before disclosure)					
TRI facilities	3370	1.193	1.695	0	22
Non-TRI facilities	9800	0.728	1.689	0	90
1998–2001 (post disclosure)					
TRI facilities	2696	1.953	3.155	0	37
Non-TRI facilities	7840	0.963	1.777	0	26

Note: Observation is at facility-year level.

TABLE A2 Sensitivity test.

	(1) Inspection (Poisson model)	(2) Inspection (Based on submission)	(3) State inspection
TRI * Post	0.147*** (0.051)	0.252*** (0.081)	0.379*** (0.102)
Constant	0.735*** (0.010)	0.922*** (0.008)	0.944*** (0.010)
N	16,089	19,410	20,620
R^2	0.390	0.567	0.608

Note: Table A2 reports results from sensitivity tests. Column (1) shows incidence rate ratio from a Poisson fixed effects model, and it suggests that inspections increased by about 15% following the disclosure of performance information. Column (2) shows estimates following submission-deadline schedule. The effect is smaller compared with the effect from the main analysis, which follows public-access schedule, but it is highly significant. Lastly, column (3) shows how TRI disclosure affects inspections carried out by state regulators, and the results are substantively similar as those from the main analysis.

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