DO IMPROVEMENTS IN ENVIRONMENTAL PERFORMANCE LEAD TO JOB LOSS?

BY

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THESIS

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ABSTRACT

One dominant argument against environmental regulations is that the regulations will increase costs to facilities, causing the facilities to lay-off their workers. However, there are several ways facilities can respond to regulatory and community pressures to increase environmental performance. The facility could reduce its emissions of toxic chemicals by preventing pollution at the beginning of the process, controlling pollution by recycling or treating chemicals, or controlling pollution using end of pipe techniques. Furthermore, these responses can affect employment in different ways, depending on whether abatement activities require more or less labor and their effect on the scale of output. The purpose of this study is to examine the impact of facilities' voluntary reductions in toxic emissions on their level of employment by estimating the level pollution control and employment as a simultaneous decision made by facilities. I compare the different methods facilities use to reduce their emissions and how these methods affect facility-level employment. I apply a 3SLS model to panel data from the EPA's Toxic Release Inventory and a unique facility-level dataset, which includes facility-level characteristic data on over 10,000 establishments across the United States over 15 years, from 1995 to 2011. My results show that reductions in toxic releases had a statistically significant negative impact on employment. However, if the facility reduces emissions using prevent pollution methods through reducing emissions per unit of sales, then the facility will reduce less employment than if the facility reduced pollution using end of pipe pollution control methods. These effects are similar if the facility is reducing regulated emission as well as non-regulated emissions.

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CHAPTER 1

INTRODUCTION

Command and control regulations are prevalent environmental policies, because they are relatively easy to implement and enforce; however, they tend to be more costly for firms than other types of regulations. Critics have argued that command and control regulations have adverse effects on employment, because they can be expected to increase costs for firms and lead the firms to lay-off their workers. However, empirical evidence on this effect has been mixed (which I will discuss in the next section). Recently, policy makers have implemented mandatory information disclosure policies to provide incentives for firms to voluntarily increase their environmental performance and allow the firms to utilize more flexible abatement techniques. Several studies have examined how firms respond to these regulations and what factors or pressures influence firm responsiveness. Voluntary approaches to pollution control are only likely to be undertaken if they are in the interest of the firm; thus, their impact on the firms' costs and employment may be different from that of command and control regulations. The purpose of this paper is to analyze the impact of facilities' voluntary reductions in pollution discharges—through mandatory information disclosure—on their level of employment.

Over the past two decades, the EPA has used information disclosure of toxic releases as a policy instrument to complement command and control regulations and provide incentives for facilities to voluntarily reduce their toxic releases. The Toxic Release Inventory (TRI)—which was established by the EPA in 1987—requires facilities that have more than ten full-time employees and produce or use chemicals above a threshold level to report their toxic emissions. The EPA then publically discloses the amount of reported chemicals. Most of these toxic

chemicals are not directly regulated by environmental regulations. However, previous studies show that a facility's public disclosure of TRI releases can lead to pressures from regulators, investors, consumers and other stakeholders to reduce emissions (Khanna 2001; Doshi et al. 2013).

Previous studies have analyzed the effects of command and control regulations on employment; however, these analyses might have overestimated the costs of regulations to facilities, since command and control regulations tend to be more costly than other regulations, which allow for more flexibility in the abatement techniques. My analysis extends previous studies by examining how voluntary pollution control affects employment.

This analysis also differs from previous studies by examining why facilities might reduce their pollution, the methods that the facilities might use to reduce their emissions, and how these methods affect employment. I incorporate internal facility-level characteristics as well as external pressures that facilities might face, which could lead them to reduce their emissions. I examine the levels of toxic emissions discharged, emissions per unit of sales, and waste management techniques to determine whether facilities reduce their emissions by controlling pollution at the end of the production process, preventing pollution at the source by increasing efficiency, or controlling pollution by recycling chemicals or treating the releases on and offsite. Some of these techniques for reducing pollution might be less costly to the facilities than others; therefore I analyze how each of these activities affects the facilities' employment. Lastly, I compare regulated chemical emissions and non-regulated emissions in order to see if reductions in emissions regulated by the Clean Air Act (CAA) have a different impact on a facility's employment than emissions that are not regulated.

I conduct this research by using a panel data set of 10,824 facilities that reported to the TRI during the 1995-2011 period. I use the facilities' level of discharges of toxic chemicals and their waste management levels as measures of their environmental performance, and I use a 3-stage least squares model to allow facilities' levels of pollution control and employment to be simultaneously determined. Lastly, in order to identify the system of equations, I use the level of pollution emitted by the sibling facilities as an instrumental variable, which determines a facility's pollution, but is not expected to affect its employment.

My overall results show that improvements in environmental performance through reductions in toxic releases lead to a statistically significant reduction in employment. A reduction in pollution intensity through a reduction in emissions per unit of sales also decreases employment; however, for a given reduction in emissions, a reduction in pollution by using pollution prevention techniques reduces employment less than reducing pollution through end-of-pipe methods. If the facilities choose to reduce pollution by increasing waste management, then they tend to reduce their employment. Lastly, facilities that reduce their regulated toxic emissions and regulated emissions per unit of sales tend to reduce employment; however, reducing emissions through increasing efficiency results in less adverse effects on employment. These effects of reducing regulated emissions on employment are very similar to the employment effects of reducing regulated and non-regulated emissions.

CHAPTER 2

PREVIOUS LITERATURE

Several studies have examined motivating factors that lead facilities to voluntarily reduce their toxic releases. These studies have shown that even though toxic emissions are not directly regulated through the TRI, public disclosure of toxic emissions can increase stakeholders' awareness of high-emitting facilities, which can lead to different pressures for the facilities to reduce their chemical releases (Bi and Khanna 2012). Arora and Cason (1998) and Bi and Khanna (2012) found that facilities' community characteristics such as household income had a significant effect on facilities' toxic releases. Other studies have found facilities that participate in voluntary pollution prevention programs (Bi and Khanna 2012; Harrington et al. 2014) or have active environmental management systems (Anton et al. 2004) are more likely to reduce their toxic emissions. Lastly, Doshi et al. (2013) found that facility characteristics such as private ownership and proximity to headquarters significantly reduced toxic releases.

Another body of literature examined the positive outcomes of reducing toxic releases in order to further understand why facilities voluntarily improve their environmental performance. Studies have found that facilities that reduce their toxic emissions have fewer inspections (Innes and Sam 2008) and are monitored for compliance less frequently (Maxwell and Decker 2006). These studies show that facilities are not only pressured to reduce their emissions, but they also might choose to voluntarily abate their pollution discharges because they can benefit from better relations with regulators.

One study analyzed the negative outcomes of reducing toxic releases by comparing toxic emissions of manufacturing facilities that shut down and facilities that continued operations

(Kassinis and Vafeas 2009). Kassinis and Vafeas (2009) found that facilities that had shut down tended to reduce their emissions more—prior to going out of business—than facilities that continued operations. Studies have examined the impacts of toxic releases on number of inspections, frequency of monitoring, and facilities shutting down; however, as far as I am aware, there have been no studies that analyzed how toxic releases affect employment.

Several studies have sought to measure the effects of command and control regulations on changes in employment (Berman and Bui 2001; Morgenstern et al. 2002; Walker 2011; Golombek and Raknerud 1997; Cole and Elliot 2007). However, these empirical studies have shown mixed results. Early studies such as Golombek and Raknerud (1997) and Morgenstern et al. (2002) examined only three or four industries and found overall insignificant effects of environmental performance and regulations on employment. Golombek and Raknerud (1997) looked at the correlation between Norwegian environmental regulations and employment. They found that there were no significant effects in the chemical industries; however, in the iron and steel industry and the pulp and paper industry, they found a significantly positive correlation between higher employment and stricter environmental regulations. Morgenstern et al. (2002) used industry-level data to examine how firms' environmental spending affects the change in employment, and they found small and insignificant affects. However, Morgenstern et al. (2002) did not treat environmental spending as endogenous; therefore, there might be endogeneity bias and it could be difficult to infer causality.

Later studies analyzed the effects of command and control regulations on employment, while aiming to control for the endogeneity of firms' environmental performance and labor in several different ways; however, the results were also inconclusive. Berman and Bui (2001) analyzed how local regulations around the Los Angeles area affect employment at manufacturing

plants. They controlled for the possible endogeneity of regulations by selecting comparison groups from counties in Louisiana and Texas and counties surrounding the LA area that were comprised of facilities in similar industries but had no local regulations. Although there was a large decrease in employment during the sample period, Berman and Bui (2001) did not find significant evidence that local environmental regulations were the cause of the labor reduction. Instead, Berman and Bui (2001) found that the local regulations might have resulted in a small increase in employment. The unexpected results could be attributed to the limited number of industries included in the study. That is, since Berman and Bui (2001) are only analyzing the manufacturing industry, the local regulations that apply to the facility also apply to all of its competitors; as a result, the demand for the facility's goods might not be affected. Next, Walker (2011) analyzed how environmental regulation—measured by county attainment status—affected the employment growth rate in facilities across the United States, and used a change in the requirements of the CAA as an exogenous shock. Walker (2011) found that facilities located in counties that had switched their regulatory status from attainment to non-attainment—which leads to stricter air pollution regulations—had a significantly lower employment growth rate. However, since the shock occurred to all counties across the U.S. and there was no variation in the change in regulation, it is difficult to tease out the changes in county attainment status associated with the amendment to the CAA. Lastly, Cole and Elliot (2007) used a three-stage least squares (3SLS) model to estimate industry-level abatement expenditure and employment simultaneously. They found that abatement expenditure had no significant effect on employment for industries in the UK. However, these results could be due to the small sample size; the data was comprised of only 27 industries over 5 years.

Studies that analyze the effects of command and control regulation on firm location have also shown mixed results (for a review of some of these studies, see Jeppesen and Folmer 2001). It is important to consider these analyses when examining employment effects on regulations, because if a firm chooses to relocate due to increased regulations, employment in the area would change. Early studies found that environmental regulations do not significantly affect the location of new firms (Bartik 1988; McConnell and Schwab 1990; Levinson 1996). However, these studies did not control for endogeneity between regulations and firm location. List et al. (2003) extended previous studies by comparing results from a parametric model and a propensity score matching model, which controlled for endogeneity. When List et al. (2003) used the parametric model and did not control for endogeneity, the results were insignificant; in contrast, List et al. (2003) found that in the propensity score matching model, new firms were significantly less likely to locate to non-attainment counties. These results from List et al. (2003) highlight the importance of controlling for endogeneity.

In this study, I control for the endogeneity of toxic emissions using a 3SLS model similar to Cole and Elliot (2007). This analysis extends Cole and Elliot (2007) and other previous studies in several ways. First, I utilize a large facility-level data set that includes over 10,000 facilities in 61 industries over a 17-year time period. This allows me to conduct detailed analysis on the change in facility-level employment.

In addition to the unique data set, the analysis differs from previous studies by using multiple measures for voluntary environmental performance and regulatory stringency. Previous studies have focused on analyzing plant- or industry-specific responses to command and control regulations. These regulations require facilities to install end-of-pipe controls such as smoke stacks or scrubbers. Since these methods catch pollution after it is generated and do not alter the

facilities' production process, they often impose costs on facilities. In contrast, facilities that adopt voluntary environmental management have a greater flexibility in choosing their methods for reducing pollution, and the facilities will only choose the abatement methods that have the potential to increase their profits. Therefore, we anticipate that the effects of voluntary environmental performance on facilities' employment will be different than the effects of command and control regulations. I use amount toxic chemical discharges a proxy for voluntary environmental performance, and I use waste management and toxic emissions per unit of sales to analyze the effects of different methods of pollution control. I also include variables for the stringency of enforcement of command and control regulations to control for spillover effects on facilities' voluntary environmental performance. Lastly, I compare facility-specific responses to voluntary environmental management and command and control regulations by analyzing whether reductions in regulated emissions have a different affect on employment than un-regulated emissions.

Finally, I extend previous literature by controlling for external pressures such as community and headquarter pressures. As mentioned above, Doshi et al. (2013) and Arora and Cason (1998) found that facilities change their toxic emissions in response to community characteristics and pressures. Similarly, Kassinis and Vafeas (2009) and Greenwood et al. (2010) found that facilities change their employment or shut down in response to external pressures such as populations with higher income or proximity headquarters. Greenwood et al. (2010) explained that facilities that are located near their headquarters face greater community pressures, because they are more likely to receive negative media attention, if they do not perform in a socially responsible manner. Therefore, we expect that facilities might respond to these external pressures by changing their employment.

CHAPTER 3

CONCEPTUAL FRAMEWORK

We consider a profit maximizing, polluting facility whose level of labor and pollution discharges are determined simultaneously. The facility could choose to produce or use more chemicals than the TRI threshold level and thus would be required to report its toxic emissions to the EPA. The EPA publically discloses the facility's level of emissions and waste management activities. However, the EPA does not require the facility to reduce its emissions, so any reductions in emissions are due to the facility's voluntary abatement activities. Since reductions are voluntary, they must be beneficial to the facility and increase the facility's profits—or have the potential to increase profits either by reducing costs, increasing demand (market share) or allowing facility to charge a higher price.

Studies have found that public disclosure of toxic emissions can lead to several external pressures for facilities to reduce their chemical releases, even though the emissions might not be directly regulated (Doshi et al. 2013; for a review, see Khanna 2001). First, indirect regulatory pressures might influence a facility to improve its environmental performance. The facility might increase its abatement activities in order to preempt future regulations or avoid liability threats (Anton et al. 2004; Khanna and Damon 1999). The facility might reduce emissions to be on good standing with regulators in hopes that regulators will be more relaxed with future inspections and regulations. Also, the facility might reduce toxic emissions due to spillover effects from other environmental regulations. Next, the facility might face pressures from its investors, consumers, and the surrounding community to participate in environmental management (Arora and Cason 1996; Sam, Khanna, and Innes 2009). If the facility reduces emissions, it could benefit from

greater reputational benefits and better relationship with its investors or community. Lastly, the facility might be motivated to reduce its emissions due to its internal characteristics. Facility characteristics could lead to a reduction in the cost of abatement or provide easier access to cleaner technology. Some of these characteristics that could lead to better environmental performance include: facility size, financial stability, relations with headquarters, and past environmental performance (Khanna 2001; Doshi et al. 2013).

Voluntary abatement activities allow for more flexibility in the abatement techniques compared to command and control regulations—which focus on controlling pollution at the end of the production process—and they are likely to result in less financial burden to the facility. Therefore, the facility could respond to external pressures in several ways. First, the facility could reduce its emissions of toxic chemicals by reducing production levels or output. Second, the facility could control pollution at the end of the process by installing smoke stacks or scrubbers. Third, the facility could control the pollution before it is generated through pollution prevention. It could prevent pollution by changing the production process, increasing efficiency, or substitute use of other non-toxic chemical inputs. Lastly, the facility could abate using waste management techniques by recycling the chemicals or treating the chemical waste after the waste is generated.

These pollution abatement efforts could directly or indirectly increase or decrease employment, depending on whether abatement activities require more or less labor and their effects on the facilities' output (Berman and Bui 2001; Morgenstern et al. 2002). First, the facility could directly decrease or increase employment by substituting pollution for another input. We consider the facility has three inputs: labor, capital, and pollution. In order to decrease pollution, the facility could increase employment, if labor and pollution are substitutes. On the

other hand, if labor and pollution are complements, then the facility could increase its capital in order to decrease pollution and labor. Therefore, this direct effect of substituting pollution for other inputs has an ambiguous effect on facilities' employment. Next, a reduction in pollution could indirectly affect the facility's employment through a change in its output from either a change in the demand or a change in the supply. When the facility reduces its pollution, the facility could differentiate its product as an environmentally friendly good, which could increase its demand; this would increase output and increase labor. Lastly, when the facility reduces its pollution, its costs could also decrease due to reduced liabilities or fines. If the facility's costs decrease, then the facility could increase its employment. Overall, the expected net impact of environmental performance on employment is ambiguous.

As mentioned earlier, the profit maximizing facility chooses the quantity of pollution control and employment based on its firm characteristics and the external pressures it faces, but also the facility's decision of one quantity will affect its decisions of the other quantity. This means that the level of pollution is endogenous. I control for this endogeneity bias by estimating two equations simultaneously. In one equation, I examine the extent to which regulatory pressures, community pressures, and firm characteristics determine whether or not a facility reports to the TRI and the level of its TRI emissions. In the second equation, I examine the extent to which TRI emissions affected employment. I will explain these two equations in the next section.

CHAPTER 4

EMPIRICAL FRAMEWORK

In order allow emissions and employment to be determined simultaneously, I implement a three-stage least squares (3SLS) model similar to that used in Cole and Elliot (2007). I estimate the reduced form equation of pollution control and the structural model of the employment as:

$$POLLUTION_{it} = \alpha_1 X_{1it} + \theta_1 SALES_{it-1} + \delta_1 REGS_{it-1} + \alpha_2 Z_t + \alpha_3 d_i + \alpha_4 \lambda_{it} + \varepsilon_{1it} \quad [1]$$

$$EMP_{it} = \beta_1 X_{2it} + \theta_2 SALES_{it-1} + \gamma_2 POLLUTION_{it} + \rho_2 TRI\ REPORT_{it} + \delta_2 REGS_{it-1} + \beta_2 Z_t + \beta_3 d_i + \varepsilon_{2it} \quad [2]$$

where EMP_{it} is the level of employment for *i*th facility at time *t,* and $POLLUTION_{it}$ is the amount of reported pollution or pollution control for *i*th facility at time *t*. I use several different measures for $POLLUTION_{it}$, including: amount of toxic releases, amount of waste management, toxic releases per unit of sales, amount of toxic releases that are regulated by the CAA, and CAA regulated releases per unit of sales. In addition to analyzing how reductions in pollution affects employment, these measures allow us to study how different pollution control methods affect employment.

The variable $SALES_{it-1}$ is the level of output produced, measured in level of sales, for facility *i* at time *t-1*. $REGS_{it-1}$ is a vector of measures of regulations and regulation outcomes, for facility *i* at time *t-1*. These measures include whether the facility was penalized for being out of compliance and whether the facility was in a non-attainment county. Since I expect *SALES* and *REGS* to be endogenous, I use the lagged values of facility *i*.

I use X_{1it} and X_{2it} to represent vectors of exogenous facility-specific variables that affect $POLLUTION_{it}$ and EMP_{it}, respectively. The factors that affect $POLLUTION_{it}$, which we will

discuss later, include: ownership of the firm, headquarter location, unemployment rate and household income in the area around the facility, whether the facility produces final goods, and the environmental voting record in the state where the facility is located. The variables that affect EMP_{it} include: ownership of the firm, headquarter location, and unemployment rate and household income in the area around the facility. I utilize industry-level fixed effects, where Z_t represents year dummies to capture time trend, and d_i represents time-invariant industry dummies generated from the 4-digit SIC code.

I represent the random error terms for equation [1] and [2] as ε_{1it} and ε_{2it}, respectively. Since I anticipate that facilities choose their level of employment and pollution simultaneously, I assume the error term of equation [1] is correlated with $POLLUTION_{it}$. In order to correct for this, I estimate the simultaneous equations using a 3SLS model. 3SLS requires each equation to have at least as many excluded variables as it has endogenous variables. The excluded variables must be correlated with the endogenous variable, but not correlated with the error term. Equation [2] includes one endogenous variable; therefore, in Equation [1] I use λ_{it} to represent a facility-specific variable that is expected to affect facilities' pollution control, but is not expected to affect facilities' employment. A Facility's ability to control pollution would depend on the technical feasibility and the ability of other facilities in the company to control pollution; however, I don't expect the technical feasibility to reduce emissions to affect the facility's employment, unless the employment is indirectly affected through a change in the facility's own emissions. Therefore, I use the total pollution reduction of sibling facilities to satisfy the identification requirement. In order to check the robustness of the siblings' pollution variable, I estimate the models using three other variables: the emissions or waste management methods used by sibling facilities per sibling facility, the total amount of pollution reduction of siblings

that are in the same industry as the facility, and the pollution reduction of the sibling facilities that are in the same industry as the facility per same-industry sibling facility.

Lastly, as we will discuss later, the data set includes facilities that report to the TRI for the entire sample period as well as facilities that have fallen below the TRI reporting threshold and thus report their emissions intermittently. In order to control for these missing observations, I include a missing data indicator variable, *TRI REPORT,* which takes the value of 1 if the facility reported zero or positive emissions, and 0 otherwise. Allison (2001) explains that this method is acceptable to use when the data does not exist. For example, in my case, I am examining facilities' voluntary environmental performance due to public disclosure of their toxic releases. The facilities that fall below the reporting threshold are not required to report their emissions; therefore, the data on how these facilities respond to public disclosure of emissions does not exist. The significance of the coefficient tells us that the missing data are not random. However, there is no intuitive meaning behind the value of the coefficient of *TRI REPORT*.

Next, I will discuss the external and internal pressures that the polluting facility might face that could cause it to voluntarily reduce its emissions and effect its employment. These pressures include regulatory pressures, community pressures, and firm characteristics. Table 1 provides all of the variables that I use and their descriptions.

4.1. Determinants of Toxic Emissions and Pollution Control

The profit-maximizing, polluting facility could be pressured to reduce its toxic emissions by stakeholders in the surrounding community, including: consumers and environmental activists (Arora and Cason 1998; Bi and Khanna 2012; Sam et al. 2002; Harrington et al.2008). If the polluting facility does not take the community's concerns under consideration, it could risk a bad

reputation, loss of sales, or even liability for damages. As a measure of community pressures, I use *Income per Capita* in the county where the facility is located. Arora and Cason (1998) found that facilities in areas with higher per capita income tend to have lower toxic emissions in future years. They explain that areas with higher income per capita often have a higher demand for environmental quality than areas with lower income per capita. Similarly, Bi and Khanna (2012) found that median household income had a significant effect on whether the facility participated in the 33/50 program. Therefore, we expect that facilities located in areas with higher income per capita will have higher pressures to abate their pollution discharges.

For another measure of community pressures, I use *Final Goods*, which is a dummy for whether the facility produced final goods or intermediate goods. I create the variable using 4-digit SIC codes, as classified by Harrington et al. (2008). Harrington et al. (2008) found that facilities that produce final goods are more likely to adopt total quality environmental management (TQEM). We anticipate that consumer and community pressures have more leverage on facilities that produce final goods than facilities that produce intermediate goods, and the facilities that produce final goods will show larger increases environmental performance.

As mentioned above, the EPA does not directly regulate toxic releases through the TRI; however, facilities might respond to indirect regulatory pressures to improve relations with regulators or to preempt future regulations (Khanna et al. 2009; Khanna 2001). I use a several measures to proxy for indirect regulatory pressures. First, I use *County Nonattainment Status* to control for spillover effects within facilities that comply with command and control regulations. Bi and Khanna (2012) found that the non-attainment had a significant effect on whether the facility participated in the 33/50 program. Therefore, although chemicals included in the TRI are not the same chemicals that are monitored for county-attainment status, we expect facilities that

are located in nonattainment counties to have larger waste management and greater reductions in toxic emissions.

The second proxy I use for indirect regulatory pressures is regulation outcomes such as the *Penalties* incurred by the facility. *Penalties* is a dummy variable that measures whether the facility is in compliance with air quality regulation, where the value equals 1 if the facility was penalized for being out of compliance, and 0 otherwise. Bi and Khanna (2012) found that the number of inspections for compliance incurred by the facility had a significantly positive effect on whether the facility participated in the 33/50 program. Therefore, we expect that if the facility was penalized in prior years, then it will decrease its toxic releases and use more methods of pollution control.

Lastly, I use *State LCV Scores*—the voting record for environmental bills from the League of Conservation Voters (LCV)—as a measure of regulation pressures that indirectly affects employment through toxic emissions. Levinson (1996) uses *State LCV Scores* as a component of one of the regulation indices to analyze their effects on firm location. These indices include: the Conservation Foundation Index, which was comprised of 19 components such as state processes for environmental impact statements and LCV scores; the FREE index or the Fund for Renewable Energy and the Environment index, which was constructed using the strength of environmental laws in each state; and the Green index, which was the total number of statutes in each state. Jeppesen and Folmer (2001) explain that when evaluating the effect of regulations on employment, indexes are not an ideal proxy for regulations, because these variables do not directly affect the facilities' costs. Therefore, in my analysis I use *State LCV Scores*—a component of the Conservation Foundation Index—only in determining toxic releases, and I expect that this proxy will only indirectly affect employment through toxic

releases. Bi and Khanna (2012) use the *State LCV Scores* to control for political climate while analyzing how the EPA's 33/50 program affects toxic emissions, and they found that it had a significantly negative effect on releases. Therefore, we anticipate that facilities located in areas with high *State LCV Scores* will have lower pollution and more pollution control.

In addition to community and regulatory pressures, firm characteristics play a key role in the facility's ability to reduce its emissions. I use the following variables to evaluate the effects of firm- and facility-level characteristics on toxic releases: sales, facility size, unemployment rate, whether the facility is publicly or privately owned, whether the facility is located in the same city as its corporate headquarters, and the level of pollution reduction from other facilities under the same parent firm. We expect that facilities with larger *Sales* have larger toxic releases. However, we also expect facilities with larger *Sales* have a greater ability to reduce their emissions, since they are more financially stable and have more resources to put towards improving environmental performance. Therefore, sales and facility size could have a positive or negative effect on toxic releases.

I use county-level *Unemployment Rate* as a measure of the stability of the surrounding economy. Arora and Cason (1998) found that unemployment rate had a significantly negative effect on toxic releases. Therefore, we expect that as the county *Unemployment Rate* increases, toxic releases and waste management in facilities will decrease due to the economic downturn.

I create an indicator variable, *Firm Ownership,* which takes the value of 1 if the facility is publically owned and 0 otherwise. Doshi et al. (2013) found that privately owned facilities have lower toxic releases than publically owned facilities; they explained that publically owned facilities might be under more pressure to increase financial performance rather than environmental performance. However, Doshi et al. (2013) also noted that publically owned

facilities might invest in more abatement activities in order to avoid the stock prices decreasing due to the facilities' large disclosures of toxic chemicals. Thus, it is ambiguous whether facilities that are publically traded have lower or higher emissions and pollution control.

Next, I construct the dummy *Headquarter Location* to take the value of 1 if the facility is located in the same city as its headquarters, and 0 otherwise. Doshi et al. (2013) found that facilities that are located in the same city as their headquarters demonstrate greater environmental performance than those facilities not located in the same city. The authors explained that facilities located near headquarters are under more pressure to keep good reputations. Therefore, I expect that facilities located near their headquarters would abate more pollution.

Lastly, I expect that a facility's emissions or pollution control methods will be affected by the type of technology and products it is producing; I proxy for these by including *Siblings' Pollution*. This variable is the total toxic emissions emitted or amount of waste management by all of the facility's sibling facilities—facilities that report to the same headquarters, as indicated by the headquarters' D-U-N-S number. Doshi et al. (2013) found that facilities with a near-by sibling facility that was in the same industry demonstrated greater environmental performance. Harrington et al (2008) used the percent of sibling facilities that adopt TQEM in order to control for peer pressure, and found that it had a significant positive effect on facilities adopting TQEM. We expect that facilities with siblings that undertake larger pollution control and have smaller amounts of pollution discharges will also have more pollution control and less pollution discharges. We expect that the *Sibling's Pollution* will affect the facility's emissions, but not its employment. Therefore, I exclude this variable from the employment model. I check the robustness of siblings' pollution by estimating the model with the three other variables. First, I

use the *Pollution per Sibling*, by taking the total amount of pollution emitted by the sibling facilities divided the number of siblings or the number of sibling that report to TRI. Second, I use *Same-Industry Sibling's Pollution*, which is the total amount of pollution reduction from the facilities that have the same headquarters as well as the same 4-digit SIC code. Lastly, I use *Same-Industry Pollution per Sibling,* which is the amount of pollution by the sibling facilities in the same industry divided by the number of same-industry sibling facilities.

After we analyze how external pressures and firm characteristics affect a facility's quantity of toxic emissions, then we will be able to get a deeper understanding how the quantity of toxic emissions affect the facility's employment. Next, we will discuss the factors that might affect the polluting facility's employment.

4.2. Determinants of Employment

As mentioned earlier, I use multiple measures of proxies for voluntary environmental performance in determining employment. First, I use a change in *Toxic Emissions* as the mirror image of abatement. Second, I use *Waste Management*, which is a measure of abatement activities such as: recycling chemicals or materials, treating waste, or energy recovery both on and offsite. Third, I use *Emissions per Unit of Sales* as a measure of efficiency in using toxic chemicals. Lastly, I use *CAA Regulated Emissions* and *CAA Regulated Emissions per Unit of Sales* in order to compare reductions in regulated emissions and voluntary reductions in unregulated emissions. Several studies have used firms' environmental spending or abatement costs as a proxy for abatement activities and regulation stringencies in order to analyze firms' responses to command and control regulations (Morgenstern et al. 2002; Cole and Elliot 2007; Levinson 1996). However, as mentioned in Section 2, previous results on how abatement

activities affect employment are mixed. Since we are analyzing the effects of voluntary pollution control, we expect that facilities will respond differently than with command and control regulations.

Levinson (1996) suggested using multiple measures for regulation stringency or facilities' abatement activities, because each proxy could be picking up distinct regulation characteristics; therefore, in addition to voluntary abatement activities, I use two other measures for regulations and regulation outcomes. First, I use *County Nonattainment Status* to measure whether or not the facility is affected by command and control regulations. As with the effects of abatement activities, the results are unclear on how *County Nonattainment Status* affects employment. Walker (2011) and List et al. (2003) found that facilities located in counties that had switched their regulatory status from attainment to non-attainment had significantly lower employment growth rate and lower new facility birth rate. However, McConnell and Schwab (1990) found that it had insignificant effects on new facilities' location.

Secondly, I use *Penalties* as a proxy for regulation outcomes. As stated earlier, *Penalties* is a measure of whether the facility was out of compliance for air regulations in the previous year. If the facility was penalized, then its costs would increase, and we would expect that it would reduce its employment. However, the facility could increase employment in order to increase its environmental performance, if more employment is needed for pollution control. Therefore, the effect of *Penalties* on employment is ambiguous.

As another determinant of employment, I use *Income per Capita* to measure community pressures and characteristics. Kassinis and Vafeas (2009) state that facilities located in higher income areas are more likely to shut down, because they face greater pressures to be socially responsible. However, facilities in higher income areas might face more pressure to increase

financial performance. Therefore, we expect that facilities located in areas with higher income per capita will have higher pressures to reduce their emissions and will have either lower or higher employment.

As with the pollution equation, I use *Unemployment Rate* as a measure of stability of the surrounding economy in determining employment. We expect that as the county unemployment rate increases, output would decrease due to a decrease in demand, which would result in a decrease in employment—if the facilities had localized demand. However, we also expect that as the unemployment rate increases, wages would decrease, and individual facilities would be able to hire more employees. Therefore, the effect of a change in unemployment rate on facility-level employment is ambiguous.

Lastly, I control for facility-level characteristics by using *Sales, Firm Ownership,* and *Headquarter Location.* I expect that facilities with larger *Sales* will have more employees. *Firm Ownership* could either be positive or negative depending on whether public facilities have more or less employees than private facilities. Greenwood et al. (2010) found facilities located near their headquarters tended not to destroy as many jobs as facilities that were more spread out in order to improve their reputation with the community. However, if facilities that are located near their headquarters experience more pressure from the community to be environmentally responsible, then the facilities could respond to the increase in cost by reducing employment. Since the effects of both *Ownership,* and *Headquarter Location* might be ambiguous, I estimate the equations with and without these variables and include both models in the results.

CHAPTER 5

DATA DESCRIPTION

This analysis focuses on U.S. facilities that report to the TRI and have continued their operations from 1995 to 2011 (U.S. Environmental Protection Agency 2011a). The EPA requires facilities with at least ten full-time employees to report all releases of toxic emissions as well as waste management activities, if the facility manufactures more than 25,000 lbs., processes more than 25,000 lbs., or uses more than 10,000 lbs. of a specific toxic chemical—from a list of over 500 chemicals—in one year. The EPA then publically discloses the reports. In 1995, 2000, 2001, and 2011, the EPA changed the TRI chemical requirements and the reporting thresholds to include more reportable chemicals (U.S. Environmental Protection Agency 2012b). Therefore, I only consider the releases from chemicals whose threshold requirements have remained unchanged throughout the sample period.

I constructed several dependent variables for equation [1] to analyze the effects of reductions in pollution or increases in pollution control on employment. First, I used the logarithm of the total amount of toxic chemicals released for each facility; these emissions include both onsite and offsite chemical releases and disposals in air, water, and land. Second, I divided the amount of toxic releases by the amount of annual sales in order to get the emissions per unit of sales. Next, I constructed a variable measure waste management; this variable includes the amount of treated chemicals, chemicals and materials that were recycled, or recovered energy on and offsite by the facility. Lastly, I examined the releases from regulated chemicals by taking the logarithm of the amount of releases emitted by the facility that are

regulated by the CAA and by taking the ratio of releases regulated by the CAA and amount of annual sales.

I utilize facility-specific characteristic data from the National Establishment Time-Series (NETS) database (Bi 2011). I used the facility TRI identifier to merge the TRI with the NETS database. These facility characteristics include: annual sales (in dollars), number of employees, facility ownership type, facility and headquarter location as well as SIC codes and Dun and Bradstreet (D&B) parent company identification numbers. I only use the facilities that had employment and sales data for all 17 years to create a balanced panel of 18,862 facilities across all 50 states. Of these facilities that have continued operations, I focus on 11,975 facilities that reported their toxic emissions to the TRI at least one year from 1995 to 2011. Of these, I excluded the facilities with total toxic releases in the top percentile, because these releases could have been caused by bygone catastrophic events instead of production processes. As a result, my sample included 10,824 facilities and 184,008 observations. I constructed variables for employment and sales by taking the logarithm of the values for each facility. I constructed the dummy variable *Headquarter Location* where the value equals 1 if the facility is located in the same city as its headquarters, or 0 otherwise. Lastly, I used the facilities' 4-digit SIC codes to construct industry-level fixed effects.

In order to get data on the inspections and penalties incurred by each of the facilities, I used the facility TRI identifier to merge the data with the EPA's AIRS Facility Subsystem database (U.S. Environmental Protection Agency 2012a). I constructed an indicator variable where the value equals 1 if the facility was penalized by the EPA's Air Facility System (AFS), and 0 otherwise.

Next, I used the county and state location of the facility to merge the data set with household income data (Bureau of Economic Analysis 2012), county-level unemployment data (U.S. Bureau of Labor Statistics 2011), county attainment status data (U.S. Environmental Protection Agency 2011b), and state-level data on environmental legislation (League of Conservation Voter 2011). I interpolated the household and economic data to create a balanced panel with all of the variables. I constructed an indicator variable for *County Nonattainment Status* where the value equals 1 if the county is out of attainment for at least one chemical, and 0 otherwise. Lastly, I constructed *State LCV Scores*, by combining U.S. Senate and House of Representative voting record for environmental bills from LCV.

The summary statistics are shown in Table 2, and Figures 1-3 show the trends in employment, sales, and toxic releases over time. The average number of employees for facilities that have continued operations for the entire sample period decreased by 15% between 1995 and 2011 (Figure 1), while the average amount of sales, measured in thousand dollars, increased by 15% (Figure 2). The average toxic releases for facilities in my sample decreased by 54.1% (Figure 3). The average emissions from regulated chemicals for the facilities in my sample dropped by 57.1%, while the un-regulated toxic releases only decreased by 36.5%. Lastly, the average emissions per thousand dollars of sales decreased by 45.7% and the average regulated emissions per thousand dollars of sales decreased by 52.4% between 1995 and 2011. However, the average level of waste management for facilities also decreased by 13.8%. This suggests that over time facilities are reducing pollution by using more pollution prevention methods and using less waste management techniques that control pollution at the end of the process.

CHAPTER 6

RESULTS

Table 3 presents the coefficients of the 3SLS model with *Toxic Emissions* as the dependent variable for equation [1]. The determinants of *Toxic Emissions* are the same for all of the models; the differences between the specifications are in the determinants of *Employment.* Column (2) includes only *Toxic Emissions*, lagged *Sales*, and exogenous variables such as *County Nonattainment Status*, *Income per Capita*, and *Unemployment Rate*. Column (4) includes lagged *Penalties* in the *Employment* equation as well as in the *Toxic Emissions* equation. Lastly, column (6) includes *Headquarter Location* and *Firm Ownership* in the *Employment* equation. The signs and significance of the coefficients remain consistent throughout the specifications in Table 3.

In the *Employment* equation (columns 2, 4, and 6), *Toxic Emissions* is positive and significant. This suggests that facilities with higher toxic releases have higher employment, and that with all other factors held constant facilities that lower their toxic releases have lower employment levels. Column 6 shows that a 1 percent reduction in toxic releases leads to a 7.3 percent reduction in employment. We are holding all facility characteristics such as sales constant, which means that this coefficient is only picking up the direct effect of reductions in pollution on labor. In other words, this negative effect on employment indicates that labor and pollution are complements; and therefore, in order to reduce pollution, the facility must reduce labor and increase other inputs such as capital. Due to data limitations, I am unable to analyze the indirect effects of environmental performance on employment through changes in output.

In the *Employment* equation, *Sales* is positive and significant, which means facilities with larger sales have more employees. *Firm Ownership* is positive and significant, which means that on average publically owned facilities have more employees than privately owned facilities. *County Nonattainment Status* is significant and positive in all of the *Employment* equations, which suggests that facilities in dirtier areas with more air pollution have more employees. *Penalties* is negative and significant, which means that facilities that were penalized for being out of compliance with air regulations in the previous year tend to reduce their employment. *Unemployment Rate* is either insignificant or significant and positive. This suggests that the facilities have non-localized demands; and thus, the facilities tend to hire more workers due to the decrease in wages, or they are not affected by the unemployment rate. Next, *Income per Capita* is negative and significant, which means facilities located in an area with high per capita income have lower employment. This is consistent with Kassinis and Vafeas (2009) who explained that facilities located in higher income areas are more likely to shut down. Facilities located in higher income areas are likely to face more pressures to be socially responsible, and this could result in increased costs to the facility. Lastly, *Headquarter Location* is negative and significant. This is suggests that facilities located in the same city as their headquarter have lower employment. This unexpected sign could be due to the limited variation across time, since it is rare for facilities in my sample to move to new locations.

Most of the signs of explanatory variables, in the *Toxic Emissions* equation (columns 1, 3, and 5) are intuitive and consistent with previous literature. *Sales* and *Siblings' Pollution* are positive and statistically significant. *County Nonattainment Status* and *State LCV Score* are negative and significant, which means that regulations indirectly pressure facilities to reduce their pollution. However, *Penalties* is positive and significant, which means facilities that were

penalized have larger amounts of toxic releases in the following year. The unexpected sign on *Penalties* could be attributed to two factors. First, regulators might target facilities that are larger and pollute more. Although I use the lagged value of the variable and I control for size using *Sales*, *Penalties* might still be highly correlated with facility size. Second, the penalties were imposed to the facility for non-compliance with regulated emissions; therefore, in an effort to be in compliance, facilities might have increased their toxic emissions—which are not regulated directly. *Firm Ownership* is positive and significant, which means facilities that are publically owned have more toxic releases than privately owned facilities. *Headquarter Location* is statistically significantly negative, which means facilities located near their headquarters have lower toxic releases. These coefficients of *Firm Ownership* and *Headquarter Location* are consistent with Doshi et al. (2013). *Unemployment Rate* is negative and significant, which is consistent with Arora and Cason (1998). Lastly, *Final Goods* and *Income per Capita* are both significant and negative, which suggests that community pressures lead facilities to reduce their toxic emissions. These results are similar to the results of Bi and Khanna (2012).

In the model examining total toxic releases, we find that, for a given level of sales, improving environmental performance by reducing toxic emissions does have an adverse effect on employment. However, this could be driven by the methods and technologies that facilities use in order to reduce pollution. Next, we examine how different abatement methods could affect facilities employment.

First, we will examine how pollution prevention through increased efficiency affects employment by analyzing *Emissions per Unit of Sales* (results in Table 4). In Table 4, *Emissions per Unit of Sales* is positive and significant. This means that a reduction in *Emissions per Unit of Sales* results in lower employment. In other words, facilities that are more pollution-intensive

tend to have more employment. The signs and significance of the other exogenous variables either remained unchanged or became insignificant.

In order to fully understand what the positive coefficient of *Emissions per Unit of Sales* means in terms of its affect on employment, we need to examine the numerical changes in the amount of toxic emissions in pounds, emissions per thousand dollars of sales, and employment, given a one percent reduction in toxic emissions. The results from these calculated levels are presented in Table 8. First, I calculated a one percent change in the average *Toxic Emissions* for the sample as 265.25 pounds. Next, I calculated the level change in *Emissions per Unit of Sales* from a one percent change in toxic emissions, when we hold sales constant, which equals 0.00694 pounds per thousand dollars of sales. This equals an 11.4% change in *Emissions per Unit of Sales.* Lastly, I evaluate how these changes in *Toxic Emissions* and *Emissions per Unit of Sales* affect the average number of employees. I calculate the changes in *Employment* from a one percent change in *Toxic Emissions*, by multiplying the average *Employment* of the sample by the coefficient of *Toxic Emissions* in column 6 of Table 3

I find that a one percent decrease in *Toxic Emissions* results in employment decreasing by 18 employees; however, when the one percent decrease in toxic release is conducted through reducing *Emissions per Unit of Sales* by using pollution prevention methods, then facility-level employment only decreases by 7 employees. This is consistent with expectations, since we would anticipate that pollution prevention methods would be less costly to facilities than end of process pollution control methods, and thus facilities might not reduce as many employees.

Next, I analyze how an increase in *Waste Management*–through recycling, treatment, or energy recovery—affects facilities' employment. I conduct this analysis by estimating two 3SLS models; the coefficients for the models are shown in Table 5. I only present the models that

include all the relevant variables. For the first model, I estimate equation [1] and [2] using *Waste Management* as the dependent variable in equation [1] and the endogenous variable in equation [2], and I use *Siblings' Waste Management* as the instrumental variable. The results from this model are shown in columns (1) and (2). The coefficient of *Waste Management* is statistically significantly negative in the employment model, which suggests that an increase in pollution control through waste management by one percent significantly decreases employment by 10.8 percent. The calculated results in Table 8 show that this one-percent decrease in waste management results in a reduction in the number of employees by about 26 people. The sign and significance of the explanatory variables *Sales, Siblings' Waste Management, Firm Ownership, Income per Capita, Unemployment Rate,* and *Headquarter Location* are similar to the results in Table 3. However, *County Nonattainment Status, State LCV Scores,* and *Final Good* become insignificant, and *Penalties* has a positive sign—which, as mentioned above, could be due to regulators targeting large, highly-polluting facilities.

For the second model, I estimate three equations by using both *Toxic Emissions* and *Waste Management* as separate dependent variables in equation [1] and as endogenous variables in equation [2]; these results are shown in columns (3), (4), and (5). In the *Employment* equation, *Toxic Emissions* is significantly positive and *Waste Management* is significantly negative. This means that both a decrease in toxic releases or an increase in waste management results in a decrease in employment, holding all else constant. As I mentioned earlier, *Waste Management* includes chemical, material, or energy wastes that were treated, recovered, or recycled after the wastes were generated. Therefore, these management techniques are likely be costly to the facilities, since they are implemented at the end of the production process and they do not increase efficiency.

Lastly, I use *CAA Regulated Emissions* and *CAA Regulated Emissions per Unit of Sales* as the dependent variables in equation [1] in order to analyze employment effects from reductions in regulated chemicals. The coefficients of these models are presented in Tables 6 and 7. In Table 6, *CAA Regulated Emissions* is positive and significant in the *Employment* equation, which means that reductions in regulated releases result in reductions in facilities employment. The coefficients of regulated emissions and the other explanatory variables are similar to the model that includes toxic releases of both regulated and non-regulated chemicals (in Table 3); therefore, there is no significant difference between the effects of a reduction in regulated chemicals the effects of a reduction in non-regulated chemicals on employment.

Finally, in Table 7, *CAA Regulated Emissions per Unit of Sales* is positive and significant. Similar to total *Emissions per Unit of Sales,* these results suggests that a decrease in the pollution intensity of the facility reduces employment. The signs and significance of the explanatory variables did not change from total *Emissions per Unit of Sales* model. In Table 8, the calculated changes in levels of regulated emissions, regulated emissions per unit of sales and employment show that a one percent decrease in *CAA Regulated Emissions* results in a reduction in employment by about 17 people. However, a one percent decrease in regulated emissions through a decrease in *Regulated Emissions per Unit of Sales* equals a reduction in employment of only 8 employees. These results are similar to reductions in total emissions and emission per unit of sales; however, a decrease in *Regulated Emissions per Unit of Sales* from a one percent decrease in regulated emissions reduces employment slightly more than a decrease in *Emissions per Unit of Sales* from a one percent decrease in total emissions. This could be due to the inflexible command and control regulation requirements. For example, the CAA might require

facilities to install end-of-pipe techniques to reduce releases, instead of allowing them to change their production process or increase efficiency.

Next, I use three other variables to check the robustness of using *Siblings' Pollution* as an instrumental variable in the *Employment* equation. I use each of the three variables separately in each model as an alternative instrumental variable, replacing *Siblings' Pollution*. The results from these models are shown in Tables 9-13; I only include the models with all the relevant variables. I use the *Pollution per Sibling* (shown in columns 1 and 2)*, Same-Industry Sibling's Pollution* (columns 3 and 4)*,* and *Same-Industry Pollution per Sibling* (columns 5 and 6)*.* All of the models, except the *Waste Management* models (in Table 11), are robust to the different variables; the coefficients remain consistent throughout the models and are similar to the original models with *Siblings' Pollution.* In Table 11, I use *Waste Management per Sibling* (columns 1 and 2)*, Same-Industry Sibling's Waste Management* (columns 3 and 4)*,* and *Same-Industry Waste Management per Sibling* (columns 5 and 6) as alternative instrumental variables. In these specifications, the coefficient of *Waste Management* is positive and significant. However, this could be due to the limited number of facilities that report waste management in the sample. *Toxic Emissions, Emissions per Unit of Sales, CAA Regulated Emissions,* and *Regulated Emissions per Unit of Sales* are positive and significant in all of the models (Tables 9, 10, 12, and 13, respectively).

Overall, these results show that reductions in toxic releases tend to result in a decrease in employment. However, this could be due to facilities using costly end-of-pipe pollution control techniques in order to reduce emissions. Furthermore, facilities might be choosing these costly methods of pollution reduction because they are required to use them by command and control regulations. When the facilities chose cheaper, more flexible methods of pollution control such

as pollution prevention at the source, then the affects of environmental performance on employment are not as adverse as when the facilities reduces pollution end of the process techniques.

CHAPTER 7

CONCLUSION

This study examines the effects of voluntary environmental performance on facility-level employment due to public disclosure of toxic releases. I utilize a unique facility-level data set of over 10,000 facilities across the United States, which enables me to conduct a detailed analysis on facilities' methods of environmental performance and how those methods affect facility-level employment. I use a 3SLS model to allow pollution and labor to be determined simultaneously by the facility. Also, I examine how external pressures might lead a facility to change its pollution and employment.

The results show that overall reductions in toxic releases have a negative impact on employment. However, I also find that the method of pollution reductions plays an important role in determining how facilities' employment changes. If the facility prevents pollution at the source by increasing efficiency or substituting non-toxic chemicals, then the facility decrease its employment less than if the facility controls pollution at the end of the process or by treating waste, recycling chemicals or materials, or recovering energy. This makes intuitive sense, since end of the pipe methods are often more costly than pollution prevention and do not change the production process to be more efficient. Lastly, reducing regulated chemicals has a negative effect on employment. This is likely due to the command and control regulations requiring costly pollution control methods.

There are several approaches that could by studied to further research on how environmental performance affects employment. First, future studies could examine both the direct affect and indirect affect of pollution reduction on employment. As I mentioned before, I

only analyze the direct effect of improvements in environmental performance on employment through substitution of inputs. Due to lack of data on the input or output price of the facilities' goods, I am unable to examine how environmental performance indirectly affects employment through changes in the supply or demand. However, this indirect affect could be significant. For example, if the facility is able to differentiate its product and charge a higher price for producing an environmentally friendly good, then the facility might be able to increase profits and increase employment. Second, in my analysis, due to the nature of the TRI data set, I examine total pollution reductions in pounds. However, in order to get an understanding of how changes in employment through reductions in pollution affect society, future studies could weight the total pollution reductions by the toxicity of pollutants. Future research could examine whether reductions in highly toxic pollutants have different affects on employment than weakly toxic pollutants; and the study could balance the adverse effects on employment with the beneficial effects on human health. Lastly, future studies could use a change in the reporting threshold as an exogenous shock to control for the endogeneity of pollution reductions. Due to data limitations, I am unable to examine the magnitude of the TRI threshold change for each specific chemical and exactly when the change occurred.

In conclusion, although regulators have been focused on implementing command and control regulations, these are costly to facilities and may have adverse effects on facilities' employment. My results show that if policy makers implemented more flexible regulations, instead of command and control regulations, then facilities would respond by reducing pollution, increasing efficiency, and would reduce employment less than under rigid regulations.

TABLES AND FIGURES

Table 1: Variable Description

Variable Name	Description
Employment (Logged)	Establishment Employment in a year t (logged)
Toxic Emissions (Logged)	Releases from core chemicals that remained from 1987 to present, in pounds (added 1 and logged)
Waste Management (Logged)	Amount of waste management from treating waste, recycling chemicals or materials, or energy recovery, in pounds (added 1 and logged)
Emissions per Unit of Sales (Logged)	Releases from core chemicals per 1,000 dollars of sales (added 1 and logged)
CAA Regulated Emissions (Logged)	Releases from core chemicals regulated by the CAA, in pounds (added 1 and logged)
CAA Regulated Emissions per unit of Sales (Logged)	Releases from core chemicals regulated by the CAA per 1,000 dollars of sales (added 1 and logged)
TRI Report	Reporting indicator (1= facility reported 0 emissions or positive TRI, 0= facility did not report emissions)
Sales (per thousand dollars, logged)	Establishment sales per 1,000 dollars in year t-1 (logged)
Siblings' Pollution	Releases from the facility's sibling facilities of core chemicals that remained from 1987 to present, in pounds
Siblings' Waste Management	Amount chemicals that were treated, recycled, or the amount of energy recovery from the facility's sibling facilities, in pounds
Pollution per Sibling	Amount core chemical releases from the facility's sibling facilities divided by the number of sibling facilities, in pounds per sibling
Same-Industry Siblings' Pollution	Amount of core chemical releases from the facility's sibling facilities that had the same 4-digit SIC code, in pounds
Same-Industry Pollution per Sibling	Amount of core chemical releases from the facility's sibling facilities that had the same 4-digit SIC code divided by the number of same-industry sibling facilities, in pounds per sibling
Waste Management per Sibling	Amount chemicals that were treated, recycled, or the amount of energy recovery from the facility's sibling facilities divided by the number of sibling facilities, in pounds per sibling
Same-Industry Siblings' Waste Management	Amount of chemicals that were treated, recycled, or the amount of energy recovery from the facility's sibling facilities that had the same 4-digit SIC code, in pounds
Same-Industry Waste Management per Sibling	Amount of chemicals that were treated, recycled, or the amount of energy recovery from the facility's sibling facilities that had the same 4-digit SIC code divided by the number of same-industry sibling facilities, in pounds per sibling
County Nonattainment Status	Nonattainment status indicator for the county in year t-1 (1= out of attainment for at least one criteria pollutant, 0= in attainment)
Penalties	Penalty indicator in AFS in year t-1 (1= penalized, 0= not penalized)
State LCV Scores	State voting record for environmental bills (from the Senate and House of Representatives)
Firm Ownership	Public/Private Indicator for the last year (1=Public, 0=Private or Government)
Final Goods	Final good indicator (1= produces final goods, 0= produces intermediate goods)
Income per Capita (Logged)	Personal per capita income for each county (logged)
Unemployment Rate	County unemployment rate in year t-1 (in percent)
Headquarter Location	Headquarter location indicator (1= facility located in the same city in the same city as headquarter, 0= facility located in different city)

Table 2: Summary Statistics (1995-2011)

	All Facilities	Facilities that report to TRI for the entire period	Facilities that report intermittently
Employment (Logged)	4.5795	4.9559	4.4424
	(1.3656)	(1.3714)	(1.3374)
Toxic Emissions (Logged)	4.8806	9.0384	3.3669
	(4.5725)	(2.6490)	(4.1689)
Waste Management (Logged)	4.8551	9.0944	3.3117
	(5.5462)	(5.1881)	(4.8203)
Emissions per unit of Sales (Logged)	0.4518	0.9118	0.2843
	(0.8758)	(1.1288)	(0.6909)
CAA Regulated Emissions (Logged)	4.3129	8.1540	2.9144
	(4.5925)	(3.6340)	(4.0786)
CAA Regulated Emissions per unit of Sales (Logged)	0.3996	0.8030	0.2527
	(0.8298)	(1.0827)	(0.6570)
Sales (per thousand dollars, logged)	9.4114	9.8520	9.2510
	(1.5213)	(1.5235)	(1.4884)
Siblings' Pollution (in pounds)	225020.80	355560.8	177493.4
	(7.77E+05)	(9.47E+05)	(6.99E+05)
Siblings' Waste Management (in pounds)	3774149.00	5892519	3002886
	(1.95E+07)	(2.42E+07)	(1.74E+07)
County Nonattainment Status	0.4619	0.4443	0.4683
	(0.4985)	(0.4969)	(0.4990)
Penalties	0.0187	0.0374	0.0118
	(0.1353)	(0.1897)	(0.1082)
State LCV Scores	95.4267	93.0625	96.2875
	(51.0125)	(50.0076)	(51.3466)
Firm Ownership	0.2583	0.3337	0.2309
	(0.4377)	(0.4715)	(0.4214)
Final Goods	0.1350	0.1522	0.1287
	(0.3417)	(0.3592)	(0.3349)
Income per Capita (Logged)	10.3221	10.3052	10.3283
	(0.2779)	(0.2670)	(0.2816)
Unemployment Rate (percent)	5.8051	5.8215	5.7992
	(2.4788)	(2.4100)	(2.5033)
Headquarter Location	0.4374	0.3541	0.4678
	(0.4961)	(0.4782)	(0.4990)
Number of Facilities	10824	2889	7935
Total Observations	184008	49113	134895

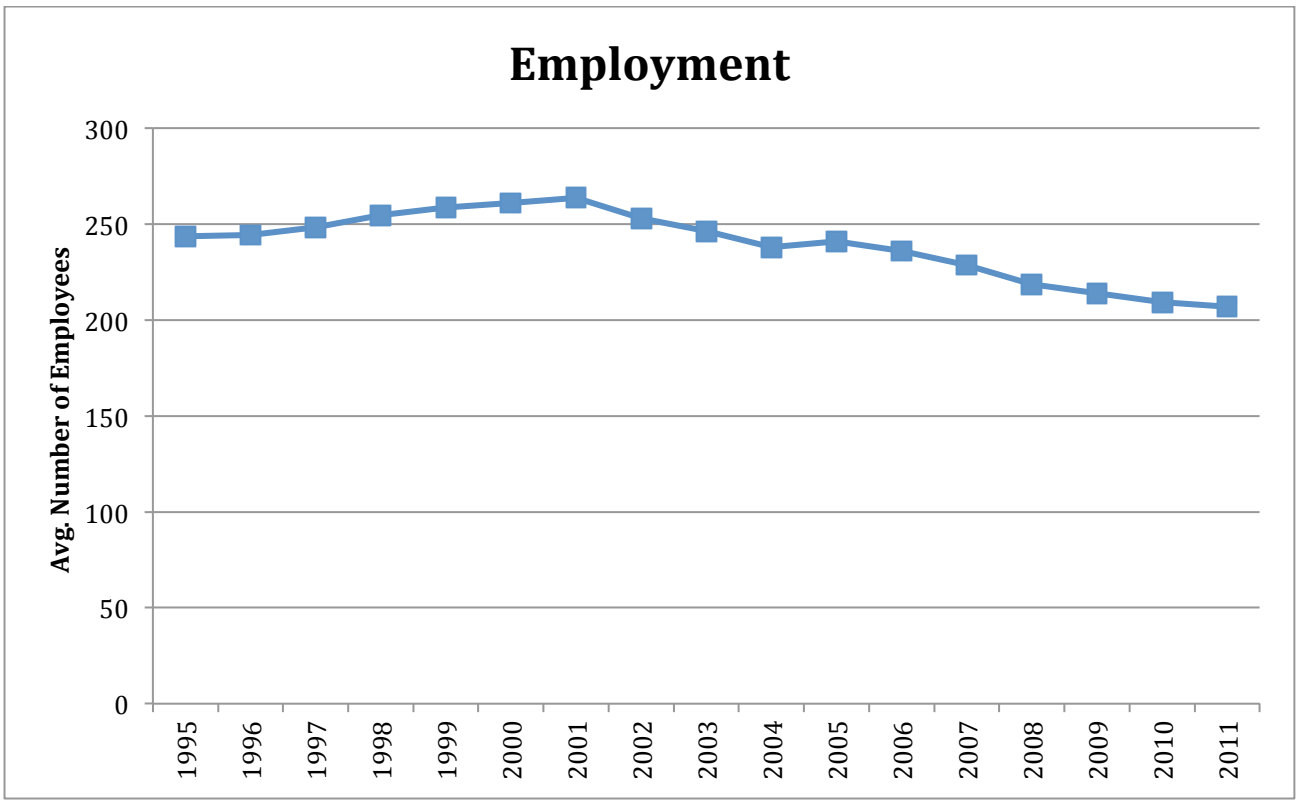

Figure 1. Average Employment, 1995-2011

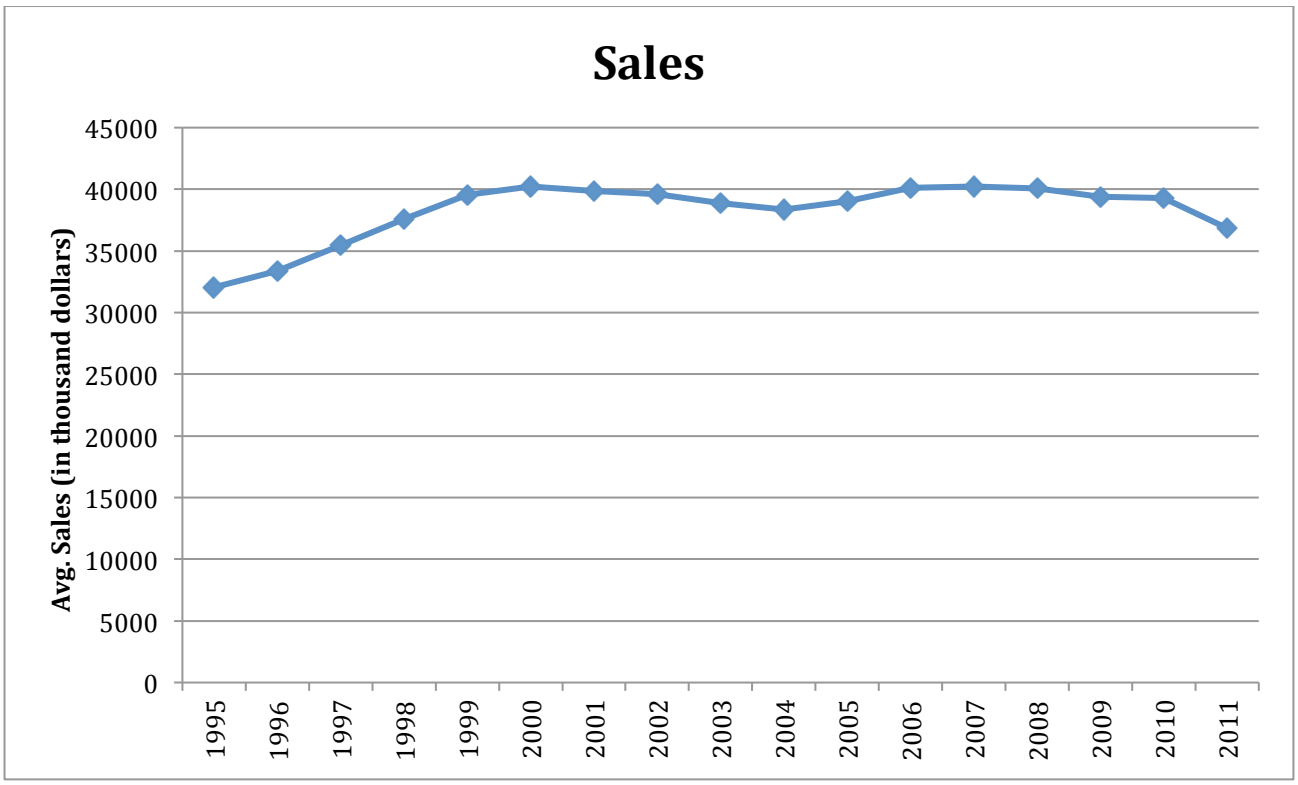

Figure 2. Average Sales, 1995-2011

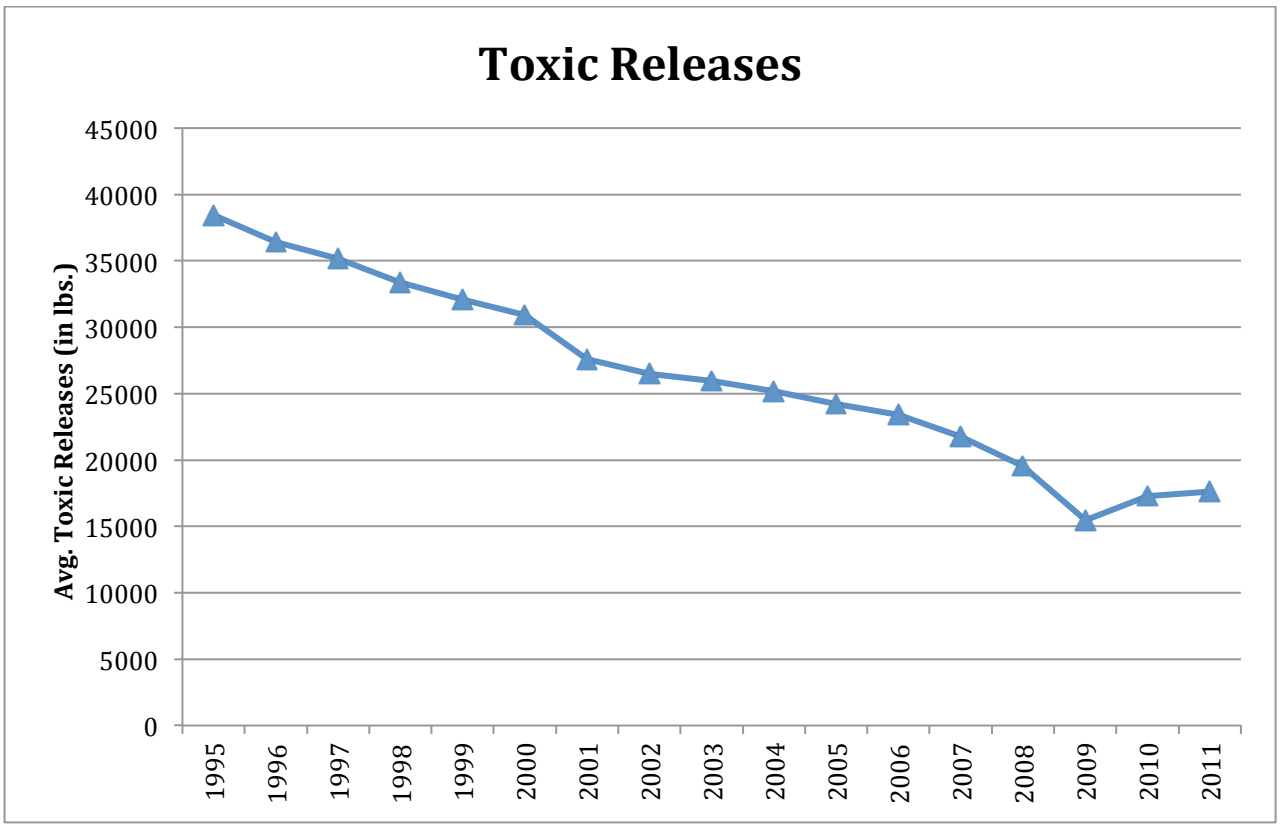

Figure 3. Average Toxic Releases, 1995-2011

Table 3: Estimates of Facility-Level Toxic Emissions and Employment (1995-2011)

VARIABLES	(1) Toxic Emissions (Logged)	(2) Employment (Logged)	(3) Toxic Emissions (Logged)	(4) Employment (Logged)	(5) Toxic Emissions (Logged)	(6) Employment (Logged)
Toxic Emissions (Logged)		0.0883***		0.115***		0.0733***
Formant so		(0.00494)		(0.00643)		(0.00688)
TRI Report		-0.199***		-0.301***		-0.200***
		(0.0339)		(0.0439)		(0.0469)
$Sales_{t-1}$ (per thousand dollars, logged)	0.625***	0.714***	0.626***	0.702***	0.631***	0.721***
	(0.00786)	(0.00204)	(0.00786)	(0.00244)	(0.00787)	(0.00239)
Siblings' Pollution	3.98e-07***		3.77e-07***		4.09e-07***	
	(1.44e-08)		(1.45e-08)		(1.48e-08)	
County Nonattainment $Status_{t-1}$	-0.166***	0.0174***	-0.170***	0.0231***	-0.169***	0.0168***
	(0.0247)	(0.00403)	(0.0247)	(0.00429)	(0.0247)	(0.00390)
$Penalties_{t-1}$	2.447***		2.607***	-0.138***	2.612***	-0.0481***
	(0.0714)		(0.0737)	(0.0155)	(0.0737)	(0.0149)
State LCV Scores	-0.00225***		-0.00210***		-0.00233***	
	(0.000215)		(0.000212)		(0.000220)	
Firm Ownership	0.274***		0.275***		0.209***	0.0377***
	(0.0260)		(0.0254)		(0.0273)	(0.00423)
Final Goods	-5.449**		-5.440**		-5.400**	
	(2.451)		(2.451)		(2.451)	
Income per Capita (Logged)	-1.141***	-0.0901***	-1.155***	-0.0619***	-1.156***	-0.0991***
	(0.0636)	(0.0105)	(0.0636)	(0.0114)	(0.0637)	(0.0104)
Unemployment $Rate_{t-1}$	-0.0765***	0.00124	-0.0774***	0.00270**	-0.0764***	9.80e-05
	(0.00684)	(0.00109)	(0.00684)	(0.00115)	(0.00685)	(0.00104)
Headquarter Location	-0.338***		-0.333***		-0.273***	-0.0386***
	(0.0233)		(0.0229)		(0.0244)	(0.00409)
Constant	11.54***	-2.191***	11.66***	-2.454***	11.58***	-2.047***
	(1.530)	(0.248)	(1.529)	(0.261)	(1.530)	(0.236)
Observations	173,184	173,184	173,184	173,184	173,184	173,184
AIC	1290640		1290596		1289911	
BIC	1303892		1303858		1303193	
R-squared	0.201	0.811	0.201	0.811	0.201	0.812

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Industry and year effects are included, but not reported.

Table 4: Estimates of Facility-Level Emissions per Unit of Sales and Employment (1995-2011)

VARIABLES	(1) Emissions per unit of Sales (Logged)	(2) Employment (Logged)	(3) Emissions per unit of Sales (Logged)	(4) Employment (Logged)	(5) Emissions per unit of Sales (Logged)	(6) Employment (Logged)
Emissions per unit of Sales (Logged)		0.434***		0.499***		0.267***
		(0.0187)		(0.0219)		(0.0238)
TRI Report		0.0396***		0.0181		0.0682***
		(0.0131)		(0.0152)		(0.0163)
$Sales_{t-1}$ (per thousand, logged)		0.763***		0.768***		0.754***
		(0.00286)		(0.00332)		(0.00365)
Siblings' Pollution	8.06e-08***		7.73e-08***		8.77e-08***	
	(2.69e-09)		(2.71e-09)		(2.83e-09)	
County Nonattainment $Status_{t-1}$	-0.0503***	0.0280***	-0.0510***	0.0327***	-0.0506***	0.0203***
	(0.00477)	(0.00427)	(0.00477)	(0.00443)	(0.00478)	(0.00410)
$Penalties_{t-1}$	0.349***		0.383***	-0.0873***	0.386***	-0.00611
	(0.0131)		(0.0142)	(0.0145)	(0.0142)	(0.0138)
State LCV Scores	-0.000709***		-0.000676***		-0.000789***	
	(3.94e-05)		(3.91e-05)		(4.16e-05)	
Firm Ownership	-0.00171		-3.31e-05		-0.0322***	0.0560***
	(0.00466)		(0.00458)		(0.00522)	(0.00425)
Final Goods	-0.208		-0.289		-0.284	
	(0.440)		(0.474)		(0.474)	
Income per Capita (Logged)	-0.0943***	-0.119***	-0.0971***	-0.110***	-0.0947***	-0.129***
	(0.0123)	(0.0104)	(0.0123)	(0.0107)	(0.0123)	(0.00979)
Unemployment $Rate_{t-1}$	-0.00418***	-0.000728	-0.00437***	-0.000380	-0.00385***	-0.00157
	(0.00132)	(0.00113)	(0.00132)	(0.00115)	(0.00132)	(0.00105)
Headquarter Location	-0.0644***		-0.0631***		-0.0466***	-0.0432***
	(0.00423)		(0.00418)		(0.00469)	(0.00424)
Constant	1.308***	-2.131***	1.334***	-2.283***	1.305***	-1.860***
	(0.295)	(0.259)	(0.295)	(0.266)	(0.295)	(0.244)
Observations	173,184	173,184	173,184	173,184	173,184	173,184
AIC	-310531.2		-310624		-311458.9	
BIC	-297289.5		-297372.2		-298187	
R-squared	0.170	0.812	0.170	0.812	0.170	0.813

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Industry and year effects are included, but not reported.

Table 5: Estimates of Facility-Level Waste Management and Employment (1995-2011)

VARIABLES	(1) Waste Management (Logged)	(2) Employment (Logged)	(3) Toxic Releases (Logged)	(4) Waste Management (Logged)	(5) Employment (Logged)
Toxic Emissions (Logged)					0.102***
					(0.0151)
Waste Management (Logged)		-0.108***			-0.0617***
		(0.0181)			(0.0165)
TRI Report		0.208*			-0.0532
		(0.120)			(0.0538)
$Sales_{t-1}$ (per thousand dollars, logged)	0.899***	0.845***	0.634***	0.899***	0.751***
	(0.00950)	(0.0105)	(0.00787)	(0.00950)	(0.00604)
Siblings' Pollution			2.65e-07***	2.65e-07***	
			(1.25e-08)		
Siblings' Waste Management	6.71e-09***			7.12e-09***	
	(6.40e-10)			(5.11e-10)	
County Nonattainment $Status_{t-1}$	-0.0173	0.00382	-0.169***	-0.00937	0.0227***
	(0.0298)	(0.00480)	(0.0247)	(0.0299)	(0.00493)
$Penalties_{t-1}$	2.405***	0.331***	2.609***	2.407***	0.00152
	(0.0890)	(0.0269)	(0.0737)	(0.0890)	(0.0162)
State LCV Scores	0.000345		-0.00223***	-0.000215	
	(0.000229)		(0.000224)	(0.000271)	
Firm Ownership	0.637***	0.125***	0.249***	0.633***	0.0669***
	(0.0329)	(0.0105)	(0.0272)	(0.0328)	(0.00795)
Final Goods	1.079		-5.591**	1.057	
	(2.960)		(2.275)	(2.960)	
Income per Capita (Logged)	-0.762***	-0.235***	-1.160***	-0.720***	-0.0927***
	(0.0763)	(0.0120)	(0.0638)	(0.0771)	(0.0134)
Unemployment $Rate_{t-1}$	-0.0798***	-0.0108***	-0.0772***	-0.0766***	-0.000679
	(0.00824)	(0.00132)	(0.00685)	(0.00828)	(0.00113)
Headquarter Location	-0.543***	-0.119***	-0.301***	-0.540***	-0.0606***
	(0.0292)	(0.00949)	(0.0243)	(0.0292)	(0.00605)
Constant	-1.518	-1.716***	11.60***	-1.919	-2.685***
	(1.845)	(0.336)	(1.530)	(1.848)	(0.339)
Observations	173,184	173,184	173,184	173,184	173,184
AIC	515492.1			1357661	
BIC	528764			1370943	
R-squared	0.212	0.664	0.200	0.212	0.750

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Industry and year effects are included, but not reported.

Table 6: Estimates of Facility-Level Regulated Emissions and Employment (1995-2011)

VARIABLES	(1) CAA Regulated Emissions (Logged)	(2) Employment (Logged)	(3) CAA Regulated Emissions (Logged)	(4) Employment (Logged)	(5) CAA Regulated Emissions (Logged)	(6) Employment (Logged)
CAA Regulated Emissions (Logged)		0.0814***		0.108***		0.0693***
		(0.00478)		(0.00637)		(0.00661)
TRI Report		-0.0766***		-0.148***		-0.105***
		(0.0289)		(0.0382)		(0.0396)
$Sales_{t-1}$ (per thousand dollars, logged)	0.569***	0.717***	0.569***	0.705***	0.575***	0.723***
	(0.00780)	(0.00196)	(0.00780)	(0.00235)	(0.00781)	(0.00225)
Siblings' Pollution	3.98e-07***		3.73e-07***		4.09e-07***	
	(1.42e-08)		(1.42e-08)		(1.47e-08)	
County Nonattainment $Status_{t-1}$	-0.195***	0.0193***	-0.199***	0.0261***	-0.199***	0.0188***
	(0.0245)	(0.00409)	(0.0245)	(0.00441)	(0.0246)	(0.00398)
$Penalties_{t-1}$	2.379***		2.559***	-0.142***	2.565***	-0.0509***
	(0.0703)		(0.0732)	(0.0160)	(0.0732)	(0.0151)
State LCV Scores	-0.00237***		-0.00219***		-0.00246***	
	(0.000210)		(0.000206)		(0.000217)	
Firm Ownership	0.251***		0.253***		0.175***	0.0386***
	(0.0253)		(0.0246)		(0.0271)	(0.00423)
Final Goods	-5.647**		-5.636**		-5.738**	
	(2.433)		(2.433)		(2.258)	
Income per Capita (Logged)	-1.163***	-0.0851***	-1.178***	-0.0529***	-1.181***	-0.0927***
	(0.0631)	(0.0108)	(0.0630)	(0.0119)	(0.0632)	(0.0108)
Unemployment $Rate_{t-1}$	-0.0782***	0.00203*	-0.0792***	0.00386***	-0.0781***	0.000860
	(0.00679)	(0.00111)	(0.00679)	(0.00118)	(0.00680)	(0.00106)
Headquarter Location	-0.333***		-0.328***		-0.255***	-0.0398***
	(0.0227)		(0.0221)		(0.0242)	(0.00407)
Constant	12.54***	-2.319***	12.68***	-2.644***	12.60***	-2.172***
	(1.518)	(0.251)	(1.518)	(0.268)	(1.519)	(0.240)
Observations	173,184	173,184	173,184	173,184	173,184	173,184
AIC	-118136.3		-118199		-118758.4	
BIC	-106793.3		-106846.6		-107387.2	
R-squared	0.217	0.811	0.217	0.811	0.217	0.812

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Industry and year effects are included, but not reported

Table 7: Estimates of Facility-Level Regulated Emissions per Unit of Sales and Employment (1995-2011)

VARIABLES	(1) Regulated Emissions per unit of Sales (Logged)	(2) Employment (Logged)	(3) Regulated Emissions per unit of Sales (Logged)	(4) Employment (Logged)	(5) Regulated Emissions per unit of Sales (Logged)	(6) Employment (Logged)
Regulated Emissions per unit of Sales (Logged)		0.485***		0.562***		0.304***
		(0.0219)		(0.0260)		(0.0267)
TRI Report		0.0408***		0.0184		0.0674***
		(0.0138)		(0.0161)		(0.0165)
$Sales_{t-1}$ (per thousand dollars, logged)		0.764***		0.769***		0.754***
		(0.00312)		(0.00366)		(0.00382)
Siblings' Pollution	7.33e-08***		6.98e-08***		8.05e-08***	
	(2.55e-09)		(2.58e-09)		(2.69e-09)	
County Nonattainment $Status_{t-1}$	-0.0545***	0.0321***	-0.0552***	0.0377***	-0.0551***	0.0233***
	(0.00452)	(0.00440)	(0.00452)	(0.00461)	(0.00452)	(0.00423)
$Penalties_{t-1}$	0.306***		0.337***	-0.0861***	0.341***	-0.00634
	(0.0123)		(0.0135)	(0.0149)	(0.0135)	(0.0139)
State LCV Scores	-0.000576***		-0.000546***		-0.000645***	
	(3.68e-05)		(3.64e-05)		(3.90e-05)	
Firm Ownership	-0.00181		-5.71e-05		-0.0324***	0.0569***
	(0.00436)		(0.00427)		(0.00494)	(0.00428)
Final Goods	-0.203		-0.200		-0.258	
	(0.416)		(0.416)		(0.449)	
Income per Capita (Logged)	-0.0955***	-0.117***	-0.0980***	-0.107***	-0.0977***	-0.126***
	(0.0116)	(0.0106)	(0.0116)	(0.0110)	(0.0116)	(0.00992)
Unemployment $Rate_{t-1}$	-0.00510***	-0.000234	-0.00527***	0.000212	-0.00486***	-0.00122
	(0.00125)	(0.00115)	(0.00125)	(0.00117)	(0.00125)	(0.00106)
Headquarter Location	-0.0475***		-0.0469***		-0.0263***	-0.0475***
	(0.00394)		(0.00388)		(0.00445)	(0.00411)
Constant	1.303***	-2.173***	1.326***	-2.339***	1.315***	-1.900***
	(0.279)	(0.264)	(0.279)	(0.272)	(0.279)	(0.247)
Observations	89,811	89,811	89,811	89,811	89,811	89,811
AIC	-121590.2		-121646.9		-122143.4	
BIC	-110237.8		-110285.1		-110762.8	
R-squared	0.206	0.811	0.206	0.811	0.206	0.812

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Industry and year effects are included, but not reported.

Table 8: Percent and Absolute Changes in Pollution and Employment

Avg. Employment:	239
Avg. Sales (per thousand dollars):	38,229
Avg. Toxic Emissions:	26,525
Avg. Emissions per unit of sales:	6.082
Avg. Regulated Emissions:	21,964.71
Avg. Regulated Emissions per unit of sales:	5.164

Changes due to a 1% decrease in *Toxic Emissions*[α]

	Percent	Level
Toxic Releases:	-1%	-265.25 lbs.
Emissions per unit of sales:	**-11.4%**	-0.00694 lbs./$1000 sales
Number of Employees:	-7.3%	**-18 employees**

Changes due to a 11.4% decrease in *Emissions per Unit of Sales*[α]

	Percent	Level
Number of Employees:	-3.05%	**-7 employees**

Changes due to a 1% decrease in *Waste Management*

	Percent	Level
Number of Employees:	10.8%	**26 employees**

Changes due to a 1% decrease in *CAA Regulated Emissions*[β]

	Percent	Level
Regulated Releases:	-1%	-219.65 lbs.
Regulated Emissions per unit of sales:	**-11.1%**	-0.00575 lbs./$1000 sales
Number of Employees:	-6.9%	**-17 employees**

Changes due to a 11.1% decrease in *Regulated Emissions per Unit of Sales*[β]

	Percent	Level
Number of Employees:	-3.382%	**-8 employees**

[α] The percent reductions calculated result from a 265.25 lbs reduction in toxic releases
[β] The percent reductions calculated result from a 219.65 lbs reduction in CAA regulated toxic releases

Table 9: Estimates of Facility-Level Toxic Emissions and Employment, Robustness Checks (1995-2011)

VARIABLES	(1) Toxic Emissions (Logged)	(2) Employment (Logged)	(3) Toxic Emissions (Logged)	(4) Employment (Logged)	(5) Toxic Emissions (Logged)	(6) Employment (Logged)
Toxic Emissions (Logged)		0.104***		0.0842***		0.105***
		(0.00634)		(0.00736)		(0.00699)
TRI Report		-0.306***		-0.227***		-0.305***
		(0.0433)		(0.0501)		(0.0477)
$Sales_{t-1}$ (per thousand dollars, logged)	0.625***	0.707***	0.632***	0.715***	0.628***	0.706***
	(0.00788)	(0.00229)	(0.00787)	(0.00253)	(0.00788)	(0.00246)
Pollution per Sibling	5.07e-06***					
	(1.67e-07)					
Same-Industry Siblings' Pollution			1.03e-06***			
			(3.78e-08)			
Same-Industry Pollution per Sibling						4.07e-06***
						(1.45e-07)
County Nonattainment $Status_{t-1}$	-0.166***	0.0221***	-0.173***	0.0187***	-0.170***	0.0223***
	(0.0247)	(0.00407)	(0.0247)	(0.00400)	(0.0247)	(0.00412)
$Penalties_{t-1}$	2.586***	-0.109***	2.586***	-0.0716***	2.575***	-0.112***
	(0.0737)	(0.0149)	(0.0737)	(0.0156)	(0.0737)	(0.0155)
State LCV Scores	-0.00212***		-0.00216***		-0.0021***	
	(0.000215)		(0.000218)		(0.000215)	
Firm Ownership	0.254***	0.0306***	0.249***	0.0348***	0.281***	0.0302***
	(0.0270)	(0.00443)	(0.0271)	(0.00434)	(0.0270)	(0.00447)
Final Goods	-5.365**		-5.585**		-5.575**	
	(2.450)		(2.275)		(2.275)	
Income per Capita (Logged)	-1.164***	-0.0690***	-1.151***	-0.0874***	-1.150***	-0.0674***
	(0.0636)	(0.0108)	(0.0637)	(0.0108)	(0.0636)	(0.0110)
Unemployment $Rate_{t-1}$	-0.0786***	0.00181*	-0.0786***	0.000812	-0.0793***	0.00192*
	(0.00684)	(0.00110)	(0.00685)	(0.00107)	(0.00684)	(0.00110)
Headquarter Location	-0.258***	-0.0292***	-0.321***	-0.0351***	-0.306***	-0.0288***
	(0.0244)	(0.00422)	(0.0242)	(0.00422)	(0.0242)	(0.00430)
Constant	11.71***	-2.336***	11.55***	-2.161***	11.56***	-2.352***
	(1.529)	(0.248)	(1.530)	(0.242)	(1.530)	(0.250)
Observations	173,184	173,184	173,184	173,184	173,184	173,184
AIC	1290640		1290596		1289911	
BIC	1303892		1303858		1303193	
R-squared	0.201	0.811	0.201	0.811	0.201	0.812

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Industry and year effects are included, but not reported.

Table 10: Estimates of Facility-Level Emissions per Unit of Sales and Employment, Robustness Checks (1995-2011)

VARIABLES	(1) Emissions per unit of Sales (Logged)	(2) Employment (Logged)	(3) Emissions per unit of Sales (Logged)	(4) Employment (Logged)	(5) Emissions per unit of Sales (Logged)	(6) Employment (Logged)
Emissions per unit of Sales (Logged)		0.386***		0.259***		0.376***
		(0.0215)		(0.0202)		(0.0230)
TRI Report		0.0458***		0.0708***		0.0516***
		(0.0149)		(0.0140)		(0.0158)
$Sales_{t-1}$ (per thousand, logged)		0.758***		0.753***		0.757***
		(0.00335)		(0.00316)		(0.00354)
Pollution per Sibling	1.14e-06***					
	(3.19e-08)					
Same-Industry Siblings' Pollution			2.79e-07***			
			(7.27e-09)			
Same-Industry Pollution per Sibling					9.35e-07***	
					(2.77e-08)	
County Nonattainment $Status_{t-1}$	-0.0502***	0.0276***	-0.0517***	0.0198***	-0.0510***	0.0269***
	(0.00477)	(0.00422)	(0.00477)	(0.00402)	(0.00477)	(0.00425)
$Penalties_{t-1}$	0.379***	-0.0489***	0.379***	-0.00308	0.377***	-0.0457***
	(0.0142)	(0.0139)	(0.0142)	(0.0132)	(0.0142)	(0.0141)
State LCV Scores	-0.00072***		-0.00076***		-0.00071***	
	(4.01e-05)		(4.14e-05)		(4.03e-05)	
Firm Ownership	-0.0237***	0.0558***	-0.0276***	0.0561***	-0.0176***	0.0559***
	(0.00517)	(0.00443)	(0.00518)	(0.00422)	(0.00516)	(0.00443)
Final Goods	-0.272		-0.286		-0.209	
	(0.473)		(0.473)		(0.439)	
Income per Capita (Logged)	-0.0984***	-0.113***	-0.0929***	-0.130***	-0.0948***	-0.114***
	(0.0123)	(0.0102)	(0.0123)	(0.00971)	(0.0123)	(0.0102)
Unemployment $Rate_{t-1}$	-0.00447***	-0.000795	-0.00433***	-0.00162	-0.00459***	-0.000823
	(0.00132)	(0.00110)	(0.00132)	(0.00105)	(0.00132)	(0.00110)
Headquarter Location	-0.0422***	-0.0349***	-0.0552***	-0.0438***	-0.0528***	-0.0357***
	(0.00470)	(0.00432)	(0.00466)	(0.00410)	(0.00467)	(0.00436)
Constant	1.333***	-2.092***	1.293***	-1.841***	1.305***	-2.071***
	(0.295)	(0.254)	(0.295)	(0.242)	(0.295)	(0.254)
Observations	173,184	173,184	173,184	173,184	173,184	173,184
AIC	-310531.2		-310624		-311458.9	
BIC	-297289.5		-297372.2		-298187	
R-squared	0.170	0.812	0.170	0.812	0.170	0.813

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Industry and year effects are included, but not reported.

Table 11: Estimates of Waste Management and Employment, Robustness Checks (1995-2011)

VARIABLES	(1) Waste Management (Logged)	(2) Employment (Logged)	(3) Waste Management (Logged)	(4) Employment (Logged)	(5) Waste Management (Logged)	(6) Employment (Logged)
Waste Management (Log)		0.0212*		0.0998***		0.143***
		(0.0125)		(0.0160)		(0.0167)
TRI Report		-0.0103		0.0600		-0.0612
		(0.0827)		(0.106)		(0.111)
$Sales_{t-1}$ (per thousand dollars, logged)	0.900***	0.739***	0.896***	0.665***	0.894***	0.632***
	(0.00950)	(0.00721)	(0.00950)	(0.00931)	(0.00951)	(0.00974)
Waste Management per Sibling	2.41e-08***					
	(2.30e-09)					
Same-Industry Siblings' Waste Management			7.86e-07***			
			(4.59e-08)			
Same-Industry Waste Management per Sibling					2.94e-06***	
					(1.76e-07)	
County Nonattainment $Status_{t-1}$	-0.00893	0.00376	-0.0106	0.00511	-0.00672	0.00475
	(0.0299)	(0.00360)	(0.0298)	(0.00510)	(0.0298)	(0.00577)
$Penalties_{t-1}$	2.404***	0.0583***	2.393***	-0.143***	2.386***	-0.225***
	(0.0890)	(0.0190)	(0.0890)	(0.0252)	(0.0890)	(0.0272)
State LCV Scores	-0.000146		-0.000352		-0.000368*	
	(0.000271)		(0.000222)		(0.000210)	
Firm Ownership	0.683***	0.0417***	0.633***	-0.0145	0.658***	-0.041***
	(0.0325)	(0.00741)	(0.0327)	(0.00982)	(0.0326)	(0.0105)
Final Goods	0.546		0.517		0.518	
	(2.747)		(2.746)		(2.746)	
Income per Capita (Logged)	-0.718***	-0.162***	-0.702***	-0.0973***	-0.695***	-0.0778***
	(0.0770)	(0.00903)	(0.0761)	(0.0128)	(0.0759)	(0.0145)
Unemployment $Rate_{t-1}$	-0.0770***	-0.0030***	-0.0762***	0.00385***	-0.0762***	0.00596***
	(0.00828)	(0.000991)	(0.00823)	(0.00140)	(0.00822)	(0.00159)
Headquarter Location	-0.550***	-0.0503***	-0.533***	-0.00526	-0.523***	0.0167*
	(0.0292)	(0.00667)	(0.0292)	(0.00884)	(0.0293)	(0.00948)
Constant	-1.944	-1.250***	-2.066	-1.182***	-2.115	-0.976**
	(1.848)	(0.248)	(1.844)	(0.345)	(1.843)	(0.386)
Observations	173,184	173,184	173,184	173,184	173,184	173,184
R-squared	0.201	0.811	0.201	0.811	0.201	0.812

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Industry and year effects are included, but not reported.

Table 12: Estimates of Facility-Level Regulated Emissions and Employment, Robustness Checks (1995-2011)

VARIABLES	(1) CAA Regulated Emissions (Logged)	(2) Employment (Logged)	(3) CAA Regulated Emissions (Logged)	(4) Employment (Logged)	(5) CAA Regulated Emissions (Logged)	(6) Employment (Logged)
CAA Regulated Emissions (Logged)		0.0987***		0.0826***		0.105***
		(0.00615)		(0.00756)		(0.00740)
TRI Report		-0.172***		-0.119***		-0.176***
		(0.0368)		(0.0452)		(0.0443)
$Sales_{t-1}$ (per thousand dollars, logged)	0.569***	0.709***	0.577***	0.716***	0.574***	0.706***
	(0.00782)	(0.00218)	(0.00781)	(0.00250)	(0.00782)	(0.00249)
Pollution per Sibling	5.11e-06***					
	(1.65e-07)					
Same-Industry Siblings' Pollution			9.79e-07***			
			(3.73e-08)			
Same-Industry Pollution per Sibling					3.84e-06***	
					(1.43e-07)	
County Nonattainment $Status_{t-1}$	-0.196***	0.0250***	-0.203***	0.0217***	-0.200***	0.0264***
	(0.0245)	(0.00417)	(0.0246)	(0.00416)	(0.0245)	(0.00433)
$Penalties_{t-1}$	2.539***	-0.114***	2.540***	-0.0822***	2.529***	-0.129***
	(0.0731)	(0.0152)	(0.0732)	(0.0164)	(0.0732)	(0.0166)
State LCV Scores	-0.0022***		-0.0023***		-0.0021***	
	(0.000211)		(0.000214)		(0.000210)	
Firm Ownership	0.219***	0.0319***	0.219***	0.0352***	0.249***	0.0302***
	(0.0268)	(0.00447)	(0.0269)	(0.00440)	(0.0268)	(0.00459)
Final Goods	-5.551**		-5.595**		-5.570**	
	(2.432)		(2.434)		(2.434)	
Income per Capita (Log)	-1.191***	-0.0595***	-1.178***	-0.0761***	-1.181***	-0.0514***
	(0.0631)	(0.0111)	(0.0632)	(0.0114)	(0.0631)	(0.0118)
Unemployment $Rate_{t-1}$	-0.0805***	0.00291***	-0.0805***	0.00195*	-0.0813***	0.00345***
	(0.00679)	(0.00112)	(0.00680)	(0.00110)	(0.00679)	(0.00115)
Headquarter Location	-0.239***	-0.0308***	-0.305***	-0.0355***	-0.291***	-0.0287***
	(0.0242)	(0.00424)	(0.0240)	(0.00429)	(0.0241)	(0.00444)
Constant	12.74***	-2.518***	12.58***	-2.346***	12.62***	-2.603***
	(1.518)	(0.253)	(1.519)	(0.250)	(1.519)	(0.261)
Observations	173,184	173,184	173,184	173,184	173,184	173,184
AIC	-118136.3		-118199		-118758.4	
BIC	-106793.3		-106846.6		-107387.2	
R-squared	0.217	0.811	0.217	0.811	0.217	0.812

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Industry and year effects are included, but not reported

Table 13: Estimates of Facility-Level Regulated Emissions per Unit of Sales and Employment, Robustness Checks (1995-2011)

VARIABLES	(1) Regulated Emissions per unit of Sales (Logged)	(2) Employment (Logged)	(3) Regulated Emissions per unit of Sales (Logged)	(4) Employment (Logged)	(5) Regulated Emissions per unit of Sales (Logged)	(6) Employment (Logged)
Regulated Emissions per unit of Sales (Log)		0.464***		0.302***		0.472***
		(0.0263)		(0.0238)		(0.0300)
TRI Report		0.0422***		0.0701***		0.0478***
		(0.0162)		(0.0147)		(0.0184)
$Sales_{t-1}$ (per thousand dollars, logged)		0.759***		0.753***		0.758***
		(0.00378)		(0.00344)		(0.00426)
Pollution per Sibling	9.58e-07***					
	(3.02e-08)					
Same-Industry Siblings' Pollution			2.43e-07***			
			(6.88e-09)			
Same-Industry Pollution per Sibling					7.45e-07***	
					(2.60e-08)	
County Nonattainment $Status_{t-1}$	-0.0548***	0.0335***	-0.0560***	0.0232***	-0.0556***	0.0340***
	(0.00452)	(0.00446)	(0.00452)	(0.00416)	(0.00452)	(0.00459)
$Penalties_{t-1}$	0.335***	-0.058***	0.335***	-0.00616	0.333***	-0.0612***
	(0.0135)	(0.0145)	(0.0135)	(0.0134)	(0.0135)	(0.0151)
State LCV Scores	-0.00057***		-0.00062***		-0.00056***	
	(3.73e-05)		(3.88e-05)		(3.73e-05)	
Firm Ownership	-0.0234***	0.0571***	-0.0272***	0.0571***	-0.0177***	0.0574***
	(0.00490)	(0.00456)	(0.00490)	(0.00428)	(0.00489)	(0.00462)
Final Goods	-0.204		-0.209		-0.202	
	(0.416)		(0.416)		(0.416)	
Income per Capita (Logged)	-0.102***	-0.105***	-0.0963***	-0.126***	-0.0994***	-0.104***
	(0.0116)	(0.0105)	(0.0116)	(0.00989)	(0.0116)	(0.0107)
Unemployment $Rate_{t-1}$	-0.00546***	-8.41e-05	-0.00529***	-0.00120	-0.00560***	3.67e-05
	(0.00125)	(0.00113)	(0.00125)	(0.00106)	(0.00125)	(0.00114)
Headquarter Location	-0.0239***	-0.0399***	-0.0346***	-0.048***	-0.0335***	-0.0396***
	(0.00445)	(0.00434)	(0.00441)	(0.00405)	(0.00443)	(0.00446)
Constant	1.348***	-2.201***	1.306***	-1.895***	1.331***	-2.212***
	(0.279)	(0.263)	(0.279)	(0.246)	(0.279)	(0.267)
Observations	89,811	89,811	89,811	89,811	89,811	89,811
R-squared	0.206	0.811	0.206	0.811	0.206	0.812

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Industry and year effects are included, but not reported.

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