Do State Pollution Rankings Affect Facility Emissions? Evidence From The U.S. Toxic Release Inventory

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"The day it became clear that disclosure was a powerful regulatory tool was June 30, 1988, when Richard J. Mahoney, then head of Monsanto (one of the biggest chemical manufacturers in the U.S.), made a dramatic claim. Mahoney said bluntly that he had been astounded by the magnitude of Monsanto's annual release of 374 million pounds of toxins. He vowed to cut the release of air emissions 90% worldwide by the end of 1992."[2]

Atlantic Monthly, April 2000

Abstract

The Toxic Release Inventory (TRI), which the United States Congress enacted in 1986, is the largest "Right to Know" program in the world. Each year over 20,000 facilities are required to report their emissions of hundreds of toxic chemicals to the government for dissemination to the public. This paper uses exogenous changes to pollution rankings within states, due to the expansion of the industries covered by the TRI in 1998, as a way to directly test the effect of pollution rankings on facility emissions. This is the first paper to examine specifically whether facility emissions are influenced by pollution rankings. The results indicate that firms do respond to pollution rankings and that the magnitude is significant. Facilities in industries originally covered by the TRI likely reduced their emissions by as much as hundreds of millions of pounds *less* than they would have had they not experienced drops in their rankings brought about by the introduction of the new highly polluting industries.

I. Introduction

In Coase's (1960) classic essay, *The Problem of Social Cost*, Coase argues that externalities[3] can best be mitigated by reducing transactions costs in order to enable affected parties to enter into bargains or contracts to their mutual advantage. Accurate information plays a pivotal role since the affected parties need to know the costs and benefits involved in any transactions before these can be initiated. Implicit in Coase's argument is that government may be able to help move society to a more efficient allocation of resources by facilitating the provision of information.

When a government mandates that private firms provide environmental data to the public this is known as a "Right to Know" program. In line with Coase's reasoning,

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[2] Between 1988 and 1992 TRI reported total emissions from Monsanto facilities dropped almost 94%.
[3] Which he generally refers to as "harmful effects."

these programs can decrease the asymmetric information between public and private entities, thereby "leveling the playing field" such that members of the public can more easily express their environmental preferences. For example, in the absence of such a government mandate, the public may be aware that certain firms in their state discharge toxic wastes (simply by observing smokestacks or water discharge pipes), but not know how much or of what type. Once this information is known, however, the public can exert pressure on those firms that pollute the most or pose the greatest risk. Prior to the establishment of such a "Right to Know" program, members of the public would have somehow had to collect this information on their own (perhaps through monitoring the nearby air and water), which would have entailed a huge and likely prohibitive transaction cost.

In 1986, on the heels of the 1984 Union Carbide chemical disaster in Bhopal, India, and the subsequent chemical plant accident in West Virginia, the U.S. Congress passed the Emergency Planning and Community Right to Know Act (EPCRA), which required all manufacturing facilities employing more than 10 people and using more than 10,000 pounds of any of 377 listed toxic chemicals to report their emissions and transfers[4] to the U.S. government annually for dissemination to the public[5]. This information is organized under the heading of the "Toxic Release Inventory" (TRI) and it represented the first nationally mandated public "Right to Know" program in U.S. history.

Since its first year in 1987, the TRI has been expanded to include over 650 chemicals as well as several additional industries that were initially exempt. These include all federal agencies as well as power and mining companies. From 1988 to 1997 total emissions reported under the TRI fell nearly 63% and from 1998 to 2001 they fell an additional 19% (it is not possible to compare aggregate emissions reductions across the entire time period because in 1998 seven new highly polluting industries were added to the TRI, dramatically changing the composition of the TRI database). The key question

[4] Transfers refer to waste that is produced on site and then moved to another site.
[5] It has been noted that in some years the rate of non-compliance has been quite large, up to 1/3 of all covered facilities. However, Brehm and Hamilton (1996) show that the majority of non-complying facilities are very small, comprise a small percentage of total emissions, and that often their non-compliance is the result of ignorance of the law rather than evasion.

for both policy-makers and academics is whether the publication of the TRI is at least partially responsible for this dramatic decrease in emissions.

Armed with the detailed data provided by the TRI, members of the public can exert pressure on firms to reduce their emissions through a number of channels[6], including:

1. Political Pressure: At the behest of environmental organizations or concerned citizens, politicians may try to enact legislation to curb firm emissions, and the threat alone may be sufficient to influence firm behavior.

2. "Green consumerism": Consumers, firms, and government and non-governmental agencies can exert pressure on companies by purchasing less products from highly polluting firms or by rewarding less polluting firms with increased business.

3. Future liability: Once pollution data is part of the public domain this creates a record for any future liabilities firms may face regarding environmental or human health claims.

4. Future Expansion: Firms that want to expand their business, especially in new locations, will find it more difficult to do so if their current operations are known to be highly polluting.

Since all of the emissions data reported under the TRI fall within legally defined limits set by the U.S. Environmental Protection Agency (EPA), any changes in firm emissions that can be traced to the dissemination of the TRI data *suggest* that the TRI has provided a public benefit. This stems directly from Coase's main argument, which is that lower transactions costs improve societal welfare since they allow parties to better express and bargain for their interests. In the case of the TRI, lower transaction costs due to public information may lead to informal "bargaining," whereby the public expresses its environmental preferences through the channels described above and rational profit-

[6] In this paper I do not attempt to quantify the extent to which these different channels may influence firm behavior; I am only presenting a concise summary of why rational firms may be influenced by the public disclosure of toxic release information.

maximizing firms weigh these costs against the costs of pollution abatement. If the costs imposed on firms through public pressure are greater than the costs of reducing pollution, firms will reduce their emissions.

"Top Polluter" lists, which make use of the TRI data to rank facilities based on their toxic emissions, have become popular in the television, print, and internet media as well as with environmental groups, since they focus attention on a small subset of the TRI facilities that emit the overwhelming share of toxics. Articles that site the "Top 10" worst polluters or the "Dirty Dozen" are commonplace and the internet's most popular environmental website, Scorecard[7], which receives hundreds of thousands of visits per week, uses the TRI data to rank the "Top 100" most polluting firms on a number of geospatial categories instantly with the click of a button. Firms that find themselves in these dubious "spotlights" will most likely face significant public pressure to decrease their emissions.

Although prior to the establishment of an environmental "Right-to-Know" program firms always have the opportunity to highlight their *positive* environmental performance (as a means to attract business or promote a positive image), there is evidence that the costs of poor environmental performance are much greater than the relative benefits of good performance (O'Rourke, forthcoming 2005). This is likely due to the theory of loss aversion (Kahneman and Tversky 1991), which states that people tend to value losses much more than commensurate gains. Behavioral economists have conducted numerous laboratory experiments in which they have uncovered evidence of loss aversion and they point to the many aspects of contemporary U.S. law that explicitly recognize it (Kahneman et al. 1991). For example, in court rulings losses are often treated more much seriously than foregone gains when assessing damages. This heightened sensitivity to losses translates over into the environmental domain (Shogren 2002); people often expend much greater effort chastising firms that are highly polluting rather than rewarding firms that are working to improve the environment. For this reason, "Top Polluter" lists have significant potential to stimulate activism since they highlight firms' negative environmental performance, which from a concerned citizen's standpoint represents a loss of environmental quality.

[7] According to Yahoo. Scorecard can be accessed at www.scorecard.org.

This paper examines whether firms alter their toxic emissions based on their state pollution rankings (state "Top Polluter" lists) for two principle reasons; one policy oriented and one econometric. From a policy standpoint, it is easier to make changes in state versus national environmental regulations, and therefore it is reasonable to assume that firms will be more responsive to how they are perceived by politicians, environmental groups, and citizens at the state level. In addition, public pressure due to environmental concerns is often localized since the people who live in the vicinity of highly polluting firms have a direct and immediate incentive to curb firm emissions. Finally, firms that are high on "Top Polluter" lists within a given state may not rank high nationally, and therefore the national rankings will not include many facilities that likely face significant pressure to reduce their emissions[8].

From an econometric standpoint, the major change in the TRI rules that occurred in 1998, when seven new highly polluting industries were added to the TRI database, provides a quasi-natural experiment that helps identify causality between changes in state pollution rankings and subsequent facility emissions. Existing TRI facilities in states that had many new entrants saw their pollution rankings drop considerably, while facilities in states without many of the new industries saw little to no change in their rankings. If state pollution rankings do matter then facilities in the former group had less incentives to reduce emissions after the rule change and likely reduced reduce emissions less than they would have had they not experienced the unexpected drop in their rankings.

The econometric results confirm that indeed state pollution rankings do affect facility emissions in the direction predicted; overall, facilities that had already been covered under the TRI through 1998 likely reduced their emissions by as much as 5,000-6,000 pounds less than they otherwise would have for every drop in pollution rankings caused by the introduction of the new industries (resulting in, at minimum, tens of millions of pounds less total emissions reductions). This is the first paper to demonstrate explicitly that facility emissions are influenced by state pollution rankings.

This finding is important for two reasons. First, it demonstrates that the TRI does influence facility emissions, thereby bolstering the general case for "Right to Know"

[8] Facilities that rank high nationally will by definition also rank high at the state level and therefore examining the behavior of "worst polluters" at the state level will includes these facilities.

programs. Organizations such as the World Bank are currently investigating whether "Right to Know" programs may be a cost-effective environmental regulatory tool for developing countries given the (perceived) success of the TRI and its relatively low cost. In addition, efforts are underway in the EU to create a program similar to the TRI[9] and many groups in the U.S. would like to see the program expanded. Second, the econometric results underline how changes to a "Right to Know" program can have unintended consequences; in this case the expansion of the TRI (with the intent of putting pressure on a larger number of highly polluting firms) decreased the incentives for firms already covered by the program to reduce their emissions.

The remainder of the paper is organized as follows: Section II surveys the TRI literature as well as recent work regarding other "Right to Know" programs. Section III provides an overview of the TRI data and potential problems regarding its accuracy. Section IV addresses the question as to whether facility emissions are affected by state TRI pollution rankings. In Section V the policy implications of the results are discussed.

II. Literature Review

There are few researchers who have studied the TRI who believe that the correlation between toxic emissions reductions and the TRI program is coincidental. A large group of social scientists posit that by enabling government agencies, non-governmental organizations, and the general public to rank polluters the TRI has helped to focus political pressure on the largest emitters (Cohen 1997, Fung and O'Rourke 2000, Graham 2000, Jobe 1999, Stephan 2002). Fung and O'Rourke (2000) refer to pollution rankings as a "Maxi-Min" policy instrument, in which *maximum* attention is focused on the firms with *minimal* environmental performance. In addition, before the advent of the TRI, many facilities had never before performed environmental audits, and detailed

[9] For a description of the new EU program see the article entitled, "EU Launches Emissions List" in *Chemical and Engineering News*, March 1, 2004, Vol. 82(9).

analyses of their own emissions may have helped them become more efficient (U.S. EPA 2003)[10].

A number of researchers have been able to demonstrate a link between TRI reporting and stock performance. Hamilton (1995) found that the TRI did provide "new" information to investors and that the stock performance of publicly traded companies was significantly and negatively correlated with toxic releases on the day after the TRI report was released in 1989, often translating into decreases in stock valuation of millions of dollars per firm. Khanna et al. (1998) examined the stock returns for major firms in the chemical industry between 1989-1994 on the day after the TRI data was released and found that from 1990-1994 firms whose emissions were worse compared to their own past emissions, or relative to industry trends, suffered significant and negative stock valuations. Cohen and Konar (2001) found that toxic releases were negatively correlated with stock performance for a sample of S&P 500 manufacturing firms in 1989.

Regarding the composition of emission reductions, Hamilton (1999) found that firms which emitted more carcinogenic chemicals were more likely to reduce emissions between 1988 and 1991[11].

Within a developing country context, Afsah et al. (2000) found that an environmental "Right to Know" program in Indonesia led firms to reduce their emissions, while also improving facility efficiency by requiring internal environmental audits[12]. In Canada, where the government enacted a program very similar to the TRI, Antweiller and Harrison (2002) found evidence that "green consumerism" linked to pollution reporting had a significant effect on toxic emissions reductions.

Zhe Jin and Leslie (2003) analyzed the effects of a unique "Right to Know" program in Los Angeles, CA, which mandates that all restaurants clearly post the results of their health inspection scores. They find that not only is consumer demand sensitive to the restaurant health scores (lower health scores bringing less demand), but that after the introduction of the program, the incidence of food-borne illnesses decreased both due to

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[10] This can be thought of as a manifestation of the "Porter Hypothesis." Regulation may actually help firms become more profitable since it forces them to be efficient in ways they would not have discovered in the absence of the regulation.

[11] This is the only study which attempts to specifically assess the health risk of different TRI chemicals and determine whether these were targeted for greater reductions than others.

[12] They describe the process by which firms were "shamed" into reducing emissions after being highlighted as serious polluters.

the increased demand for cleaner restaurants as well as health improvements made in response to the program in formerly poorly rated restaurants.

In summary, the TRI has been demonstrated to influence the stock valuation of U.S. firms, and similar "Right to Know" programs in other countries have influenced firm emissions. In addition, U.S. firms emitting highly carcinogenic chemicals have been sensitive to the TRI reporting and decreased these types of emissions more than firms whose emissions are less toxic. "Right to Know" programs are not limited to environmental data and a program based on health inspections has also influenced the behavior of both consumers and restaurant owners in L.A., resulting in less illness.

The following study adds to the research on "Right to Know" programs by examining whether the TRI has had broad effects on the emissions of facilities throughout the entire United States through the medium of facility state pollution rankings. This is the first paper to examine specifically whether facility emissions are influenced by pollution rankings. "Top Polluter" lists are an efficient way of both presenting emissions data to the public and for prioritizing regulatory action, and therefore, examining the extent to which firms respond to their rankings is a logical next step in the large and growing TRI literature.

III. The TRI Data: An Overview

The TRI data come from the EPA, which provides the raw emissions data for all TRI facilities for all years as well as additional descriptive information such as the facility name, address, zip code, 4-digit ISIC, and parent company name. The emissions are reported separately for each of the 667 listed chemicals[13], divided into air and water emissions. A facility's total emissions is calculated by summing all of a facility's emissions to both air and water in a given year. The yearly installments of the TRI data are made available to the public in June a year and a half after the end of any given reporting year, such that what is made available in June 2003 is the data through all of 2001. The number of facilities reporting under the TRI from 1987-2001 ranged from approximately 21,000 (in 1996) to more than 24,000 (in 1990). State pollution rankings

[13] This is the number required for the most recent reporting year.

are created by ranking the facilities in each state by total emissions, such that highest emitter is ranked #1.

Figure 1 shows the national distribution of TRI facilities in 2001. The majority of facilities are concentrated east of the Mississippi River, with the majority of these 30+ states containing hundreds of facilities. There are relatively few TRI facilities scattered throughout the West except for the coastal states, which also contain significant concentrations of facilities, particularly in California.

The releases of chemicals covered by the TRI legislation have declined by approximately two-thirds since the program's inception and the majority of these reductions have come from the nation's largest emitters. Figures 2a and 2b show the mean of annual percentage changes in emissions for various top ranked polluters; nationally and averaged across states respectively[14]. Although not perfectly monotonic, there is a clear downward trend in percent emissions reductions as pollution rankings improve, both at the national and the state level. It is important to emphasize that the rankings are based on facility emissions from two years prior. For example, in the year 2000 the rankings are based on emissions data from 1998. Figures 2a and 2b show the average percentage reduction in emissions from the period in which the rankings were based (e.g. 1998) through the current period (e.g. 2000). From an econometric standpoint this lag between current emissions and rankings ensures that simultaneity is not a problem. A facility's emissions in the current period do not affect its current rankings.

The larger percentage reductions for top ranked facilities translate into very large changes in total emissions since emission are highly concentrated amongst the largest emitters. Out of the more than 20,000 TRI facilities the top 10 nationally ranked polluters accounted for approximately 14-42% of total emissions from 1988-2001 in any given year, while the top 100 accounted for nearly 37-67%[15]. The sum of the top 10 ranked state polluters (approximately 500 facilities[16]) accounted for close to 60% of total emissions during this time period, while the sum of the top 100 state facilities (less than a quarter of the total number of facilities) accounted for close to 90% of total emissions.

[14] For the states rankings I do no include any rankings above 100 since many states do not have more than 100 TRI facilities.
[15] These percentages increased substantially in 1998 with the addition of seven new highly polluting industries for which a small number of facilities account for an even greater bulk of the new emissions.
[16] Not all 50 states have 10 TRI facilities.

These numbers indicate that focusing on the top ranked polluters concentrates attention on those facilities that emit the overwhelming majority of total toxic emissions throughout the United States.

The TRI data is self-reported by firms and firms are not required to specifically monitor all of their TRI chemical releases, but at minimum, must present reasonable release estimates. The EPA does not employ a comprehensive system for auditing TRI reports and firms do not face regulatory penalties for inaccurate TRI reporting. One of the major issues with this study is that any reductions in emissions may be due to non-truthful or inaccurate reporting by facilities and not real reductions since enforcement is lax. On occasion, however, the EPA has cross-checked data reported under the TRI with data reported under other regulatory regimes and found it to be largely consistent. In addition, regional EPA offices audit firms who report the 10 greatest changes in emissions (whether positive or negative) by ISIC code, and ask them to verify that their data is accurate[17]. Finally, although there is the potential for cheating on TRI reports, as well as the incentives to do so, especially for large polluters or polluters in sensitive environmental areas or near population centers, if firms are worried about their public image the potential cost of being exposed as a cheater may be high and serve as a countervailing disincentive.

In summary, despite limited efforts to ensure the accuracy of the TRI data, no direct on-site monitoring of TRI facilities is performed, and since the majority of TRI reported data is based on estimates, the accuracy of the facility-level data is certainly questionable. It is important, however, to note that almost all large-scale databases suffer from similar degrees of measurement error and the TRI is the best U.S. facility-level emissions data available[18]. In addition, this study seeks to uncover statistical evidence that facilities reported *lower* emissions reductions (i.e. higher emissions) when their rankings improved exogenously. If anything, untruthful reporting is more likely to occur in instances where firms report *greater* emissions reductions (i.e. lower emissions).

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[17] I received this information from EPA employees in Region 9.

[18] A recent report by the Environmental Integrity Project (2004) analyzes TRI emissions data in 2001 in Texas and finds underreporting in the range of 15%, with greater disparities for some highly carcinogenic chemicals. The group attributes this less to purposeful cheating on the part of firms, than on the outdated estimation techniques used for TRI reporting.

Therefore, in the event that such evidence exists it may actually be a conservative estimate of the true changes in emissions reductions.

III. Do TRI State Pollution Rankings Cause Firms To Alter Their Toxic Emissions?

The ideal way to test for the effects of state pollution rankings on facility emissions would be to randomly create and disclose rankings in different states and then observe the changes in emissions between the control and treatment groups, utilizing a difference in difference approach. In the absence of such an experiment, the most credible way to identify the effects of state rankings on emissions is within the context of a quasi-natural experiment in which there is an exogenous shock to the state rankings. Just such a shock occurred in 1998 when Congress changed the TRI rules and required seven additional industries to begin to disclose their emissions data (see Table 1). This rule change instantly added thousands of new facilities to the TRI, spread out across all 50 states. New industries accounted for approximately 1,900 additional facilities in 1998 and 2,150 in 2001. These new industries were (and are) some of the countries largest polluters, and therefore, their addition greatly affected the pollution rankings for the facilities that were already under the jurisdiction of the TRI. Since these changes to the pollution rankings were completely exogenous any changes in facility emissions that can be traced to these changes provide evidence that rankings influence facility emissions.

In the absence of an exogenous change to the pollution rankings it is not possible to accurately identify the link between rankings and changes in facility emissions. Using a facility's ranking as a right-hand-side variable in a regression where the dependent variable is the change in emissions, is simply analogous to inserting a proxy for the size of past facility emissions. All things equal, bigger emitters will change their emissions more in absolute terms than smaller facilities even if all facilities alter their emissions by the similar percentage amounts. Showing that facilities that are ranked high on "Top Polluter" lists reduced emissions more than other facilities alone is not sufficient evidence that rankings matter. For example, a large facility ranked #1 that earned this rank based on emissions of 1,000,000 pounds of toxic releases might reduce its emissions by 100,000 pounds in the next period, while the #11 firm, which emitted 10,000 pounds, may reduce its emissions by only 1,000 pounds. The much larger change in absolute emissions for the #1 ranked facility doesn't prove that rankings matter since both facilities decreased emissions by 10%. Avoiding this problem by instead using the percentage changes in emissions as the dependent variable, however, creates serious econometric problems because the percentage changes for smaller facilities are extremely noisy due to the fact that small absolute changes in emissions lead to big percentage swings, both positive and negative. For example, a facility that emits 1000 (100) pounds in one period and 100 (1000) in the next (relatively small absolute changes in either direction) results in a percentage change of -90% or (+1000%). Even if the percentage changes in emissions did not exhibit these large swings, larger percentage emissions reductions for top ranked facilities might be due to the overall greater pressure facing larger polluters and not due specifically to the disclosure of pollution rankings.

Figure 3 shows total TRI emissions from 1988-2001, as well as a breakdown of the total emissions for facilities within the original and the new TRI industries. Total emissions steadily declined from close to six billion pounds in 1988 to a little over two billion in 1997, and then jumped to almost seven billion pounds in 1998 due to the expansion of the TRI reporting rules. This expansion had been fought and stalled in Congress for many years and its passage could not have been easily anticipated by firms.

It is important to note that the addition of the seven new industries in 1998 only had the effect of potentially lowering the rankings of existing facilities. Any new entrants that emitted more than an existing facility led to a lower ranking for the existing facility, while those that emitted less were ranked below them on the list and did not change their ranking. For example, if an existing facility emitted 10,000 pounds and was ranked #2 and one of the new facilities emitted 11,000 pounds (a quantity more than the #2 facility) then the existing facility's rank improved to #3. However, if the new facility emitted 9,000 pounds (a quantity less than the #2 facility) then the existing facility remained ranked #2 with one more facility added below them in the rankings.

The change to the TRI rules in 1998 produced large cross-section variation in the changes to state rankings because some states had a high proportion of new entrants while others did not[19]. Tables 2a and 2b show the reshuffling of the rankings in

Connecticut and Colorado respectively, two states with largely different mixes of these additional TRI industries. Since pollution rankings are based on emissions data two years prior, the 1998 rule changes only showed up in publicly disclosed pollution rankings in the year 2000, and then subsequently in 2001 as well. The leftmost column in Tables 2a and 2b represents the state ranking for total emissions based only on the industries originally covered by the TRI; this is the ranking that a facility would have had in the absence of the rule change in 1998. For the years 2000 and 2001 this ranking is broken into two additional columns: a) the actual state ranking based on the complete list of facilities under the TRI beginning in 1998, which are the rankings that were made public, and b) the exogenous change in ranking brought about by the rule change, which is simply the difference between the actual reported ranking and what the ranking would have been without the addition of the new industries. In Connecticut, the majority of the facilities that comprised the "Top 10" lists based only on the pre-1998 industries were largely the same as those which actually comprised the "Top 10" lists when all industries were included (i.e. these facilities did not experience major drops in their rankings due to the introduction of the new industries). In Colorado, however, the facilities comprising the pre-1998 industries experienced significant drops in their rankings after the TRI rule change, such that the majority of those who would have been amongst the "Top 10" facilities found themselves outside of the "Top 10" in both 2000 and 2001.

If it were true that state pollution rankings influenced facility emissions we would expect to see the "Top 10" facilities within the original TRI industries in Connecticut continue to experience significant pressure to reduce emissions from 1998 through 2001. In Colorado, however, this pressure would have dissipated after 1998 and we might expect to witness a slow down in emissions reductions, or even a rise in emissions, amongst the facilities that largely escaped inclusion in the "Top 10" lists due solely to the 1998 rule change. This prediction is borne out by the data. Figure 4 shows the emissions for the "Top 10" facilities based only on the list of pre-1998 industries (the first column in Tables 2a and 2b) in Connecticut and Colorado from 1995-2001. The "Top 10" facilities in Colorado increased their emissions after 1998 while those in Connecticut continued their decline.

More generally, if the exogenous improvements in rankings (which are always a positive number- see Tables 2a and 2b) across states led facilities to reduce emissions less than they would have in the absence of these changes (or even increase emissions) then we would expect these changes to be positively correlated with increased emissions in the years the rankings were made public. The raw data support this. The exogenous change in rankings is correlated with the change in emissions (in 1000's of pounds) at the facility level in the year 2000 at 1.2 and significant at the 90% confidence level, and in 2001 it is correlated at 3.3 and significant at the 95% level; indicating that the more rankings exogenously improved (i.e. the more a facility's ranking dropped) the less facilities reduce their emissions.

We now turn to a simple regression format in order to establish the robustness and better estimate the magnitude of the effect of the exogenous change in rankings on facility emissions.

$$(1)\ \Delta E_{j,t} = \beta_0 + \overbrace{\beta_1 R^{B}_{j,t} + \beta_2 R^{CH}_{j,t}}^{R^{A}_{j,t}} + \delta Z_{j,t} + \varepsilon_{j,t}$$

$$(2)\ \Delta E_{j,t} = \beta_0 + \beta_1 R^{B}_{j,t} + \beta_2 R^{CH}_{j,t} + \alpha\, T10_{j,t} + \lambda T10^{*}_{j,t} + \delta Z_{j,t} + \varepsilon_{j,t}$$

Equation 1 states that facility j's change in emissions from period t-1 to t (ΔE) is a function of the facility's actual state emissions ranking (R^{A})[20], which can be decomposed into a base ranking (R^{B})- the facility's ranking based only on the industries covered by the TRI pre-1998- and the exogenous change in ranking (R^{CH}) brought about by the introduction of the new industries in 1998 (described above)[21], a vector of industry, time, and geographic controls (Z), and a disturbance term (e).

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[20] Which is determined by the facility's emissions in period t-2.

[21] There is reason to believe that this model will produce conservative estimates of the effects of the exogenous shock to the rankings. Facilities in states with many new TRI entrants first received their updated rankings with the introduction of the new industries in the year 2000, even though in 1998 they knew that the TRI rules had changed and that their future rankings were going to be improved. It is reasonable to believe that they took advantage of this improvement in their rankings prior to the official publication in 2000 (as Figure 3 might indicate with respect to Colorado) and therefore, the two-year lag in the reporting of rankings leads to an underestimation of the effect of the new entrants on changes in emissions.

During all the years prior to 2000 R^{CH} equals zero for all facilities[22] since the exogenous change only shows up in the years 2000 and 2001. Referring back to Tables 2a and 2b, the leftmost column is the base ranking (R^B) and the exogenous change column is R^{CH}. These terms sum to the actual state ranking (R^A). For example, in Table 2b, the facility in Colorado that would have had a rank of 1 in the year 2000 if the TRI database had not expanded had base a base rank still equal to 1. Due to the rule change this facility experienced an exogenous drop of 7 in its ranking, which produced an actual rank of 8; the rank that was made available to the public. If pollution rankings did not influence this facility's emissions then the change in rank from 1 to 8 should have had no effect on its subsequent change in emissions. Therefore, the null hypothesis is that B_2 equals zero. If the exogenous improvement in rankings decreases a facility's future emissions reductions (due to less public pressure and hence less potential costs) B_2 should be positive since the more the ranking drops the less the facility is in the "Top Polluter" spotlight. Since the base ranking is a direct proxy for past total emissions, the expected sign of B_1 is positive as well given that lower ranked facilities (a higher number) will likely be correlated with less emissions reductions (which are negative) simply by virtue of the differences in the absolute size of total emissions.

As described above, a very large share of emissions are concentrated within the "Top 10" facilities and these often receive the most negative media coverage both from print and television sources[23]. Equation 2 adds a dummy variable for facilities that are ranked within the "Top 10" in period t. The expected sign on α is negative because the expectations is that firms falling within this "Top Polluter" category will decrease emissions more than firms outside of this list.

Two additional specifications add the lagged change in emissions to the right-hand side of both equations (1) and (2), producing (1') and (2'), as a way to control for the potential effects of mean reversion.

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[22] The change in rankings didn't show up until 2000 due to the one and a half year lag in TRI reporting.

[23] The "Top 10" phenomenon in media can be found by perusing both LexisNexis periodical searches and archives of articles cataloged by GetActive. Another common categorization is the "Dirty Dozen" but this is less popular and closely approximates the "Top 10."

$$(1') \ \Delta \mathrm{E}_{\mathrm{j,\,t}} = \beta_0 + \beta_1 R^{\mathrm{B}}_{j,t} + \beta_2 R^{\mathrm{CH}}_{j,t} + \rho \Delta \mathrm{E}_{\mathrm{j,\,t\text{-}1}} + \delta Z_{j,t} + \varepsilon_{j,t}$$

$$(2') \ \Delta \mathrm{E}_{\mathrm{j,\,t}} = \beta_0 + \beta_1 R^{\mathrm{B}}_{j,t} + \beta_2 R^{\mathrm{CH}}_{j,t} + \rho \Delta \mathrm{E}_{\mathrm{j,\,t\text{-}1}} + \alpha \, T10_{j,t} + \delta Z_{j,t} + \varepsilon_{j,t}$$

The years 1995-2001 are used for the estimation since during this period the chemicals listed on the TRI were largely constant, and therefore comparing emissions across these years captures actual emissions changes and not just changes in the chemical reporting rules[24]. Therefore, since R^A is determined using emissions from two periods prior the sample only includes annual changes in emissions from the years 1997-2001. The sample includes periods both before the exogenous change showed up in the rankings (1997-1999) and periods after it did (2000-2001), which in turn, help to precisely identify the effect of the exogenous change on emissions. The coefficient on R^{CH} picks up differences in emissions changes amongst "Top Ranked" facilities within states across the two time periods, as well as cross-sectional differences across states after the TRI rule change. In the sample the variable R^{CH} ranges from 0 to 38 with a mean of approximately 4.5 and a standard deviation of approximately 7.5[25].

The control vector (Z) includes four-digit SIC code, state, and year dummies for the OLS specification. Regressions using facility fixed effects, which can capture some of the facility-specific characteristics, are also estimated and for these specifications year dummies are included. In the fixed effects specification that includes the lagged change in emissions, the lag term is instrumented with the previous three lags (t-2 to t-4) in order to address endogeneity. To address likely serial correlation at the facility level the error terms are clustered by facility.

The sample includes the top 100 largest emitters by state[26], where the rankings are based only on the industries included under the original pre-1998 TRI regime[27]. It is important to remember that none of the facilities from the new industries are included,

[24] A few chemicals were added in 2000 but they didn't greatly affect the rankings of top polluters.
[25] This is in 2000 and 2001. In all other years it has a mean and standard deviation of zero.
[26] I chose the "top 100" since Scorecard, which came online in the year 1998, provides ranking lists of the top 100 facilities by state.
[27] These are the base rankings defined by R^B.

only the facilities in the industries that had been covered by the TRI since its inception in 1987.

Table 3a reports the results for the unbalanced panel[28]. The coefficient on the exogenous change in rankings is positive, large, and statistically significant at the 99% level across all four OLS specifications. Directly extrapolating these results would indicate that for each improvement in rankings facilities emitted approximately 4,800 pounds more than they would have without the improvement in their rankings (i.e. reduced 4,800 less). In the fixed effects specifications the coefficient on the change in rankings is approximately 6,100 pounds and is statistically significant at the 99% level across all four specifications as well.

The coefficient on the base ranking is positive and significant at the 99% level across all specifications, except (8), indicating that as expected lower ranked facilities reduce their emissions less than higher ranked facilities. In specification (8) the coefficient still has the correct sign. The coefficient on lagged emissions is negative in the two OLS specifications, but only significant in the fixed effects specifications, in which it has opposing signs in specifications (6) and (8). The coefficient on being in the "Top 10" is large, negative, and statistically significant at the 99% level across all specifications, indicating that the "Top 10" facilities reduced emissions by 70,000-170,000 pounds more per year than those ranked outside of the "Top 10."

Table 3b reports the result for the balanced panel. The results are largely unchanged except that the coefficients on the exogenous change in rankings are a little higher in both the OLS and fixed effects regressions. This may be because facilities that existed across all periods had more experience with the pollution rankings and also because the unbalanced panel contains facilities that exited before 2001, and thus were less likely to invest in or be concerned with pollution abatement.

Substituting the percentage change in emissions for the absolute change in emissions as the dependent variables leads to results that are not statistically significant. As mentioned earlier, this is because the percentage change variable is extremely noisy; for low emitting firms relatively minor changes in emissions create big percentage swings. As Figure 2a and 2b indicate, however, the results in Table 3a and 3b are not

[28] The sample which includes facilities that did not exist in every year from 1995-2001.

driven by the fact that all facilities are reducing emissions by similar percentages, which then show up as big absolute reductions for top ranked facilities and small reductions for lower ranked facilities. The data point to the exact opposite, percentage changes in emissions are overall largest for the largest emitters.

As an added check for robustness the results are reported for the same regressions using the top 101-200 state ranked facilities for both the unbalanced and balanced panel. Across all specifications the coefficient on the exogenous change in ranking has a t statistic close to zero (see Tables 3c and 3d), indicating as expected, that the exogenous improvement in rankings for these smaller and very low ranked facilities did not influence their emissions.

One of the problems with the above specifications is that they do not allow for differential effects of the exogenous change based on the initial rankings of the facilities. For example, it is reasonable to assume that an exogenous drop in rankings would affect a firm in the "Top 10" more than one in the "Top 41-50." A way to capture the differences in emissions reductions across facilities with different initial rankings is for the right-hand side variables to include a set of dummy variables corresponding to the ranking deciles (e.g. "Top 10", "Top 11-20", "Top 21-30", etc.) that takes on a 1 if the facility falls within this range based on the rankings only within the original pre-1998 TRI industries, plus an additional dummy variable equal to 1 if the exogenous change caused the facility to move outside of that particular decile[29]. For example, a facility that was originally ranked 25th but ended up ranked 35th after the exogenous change would have a 1 for the dummy variable "Top 21-30" and a 1 for a dummy variable indicating that it was no longer in the "Top 21-30." Specification (3) below illustrates this approach:

(3) $\Delta E_{j,t} = \beta_0 + \beta_1 R^{CH}_{j,t} + \varphi_1 \mathrm{Top10}_{j,t} + \tau_1 \mathrm{NoLongerTop10}_{j,t} + \varphi_2 \mathrm{Top11\text{-}20}_{j,t} +$
$\tau_2 \mathrm{NoLongerTop11\text{-}20}_{j,t} + \varphi_3 \mathrm{Top21\text{-}30}_{j,t} + \tau_3 \mathrm{NoLongerTop21\text{-}30}_{j,t} + \varphi_4 \mathrm{Top31\text{-}40}_{j,t} +$
$\tau_4 \mathrm{NoLongerTop31\text{-}40}_{j,t} + \varphi_5 \mathrm{Top41\text{-}50}_{j,t} + \tau_5 \mathrm{NoLongerTop41\text{-}50}_{j,t} + \varphi_6 \mathrm{Top51\text{-}60}_{j,t} +$
$\tau_6 \mathrm{NoLongerTop61\text{-}70}_{j,t} + \varphi_7 \mathrm{Top61\text{-}70}_{j,t} + \tau_7 \mathrm{NoLongerTop61\text{-}70}_{j,t} + \varphi_8 \mathrm{Top71\text{-}80}_{j,t} +$

[29] Remember, the exogenous change in rankings has the asymmetric effect of only being able to improve a facility's ranking. Thus, for example, there is no possibility that a formerly "top 20" facility could have been moved into the "top 10" after the exogenous change, only to a lower decile.

τ_8NoLongerTop71-80$_{j,t}$ + φ_9Top81-90$_{j,t}$ + τ_9NoLongerTop81-90$_{j,t}$ + τ_{10}NoLongerTop91-100$_{j,t}$ + Δ E$_{j,t-1}$ + $\delta Z_{j,t} + \varepsilon_{j,t}$

The expectation is that the coefficients on the decile dummy variables (φ) will start out highly negative and then increase as the deciles go from the "Top 10" to the "Top 11-20", "Top 21-30", etc., due to the fact that lower ranked facilities on average reduce emissions less than higher ranked facilities (again referring to Figures 2a and 2b). The coefficients corresponding to movement outside of the deciles due to the exogenous change in rankings (τ) should be positive[30] and decrease as the changes go from "NoLongerTop10" onwards since the expectation is that the lower ranked facilities should be influenced less by the exogenous change in rankings.

Table 4 contains the results of specification (3) using OLS and fixed effects for both the balanced and unbalanced panel. The coefficients all have the expected signs and the overwhelming majority are significant at the 99% level. Figure 5 plots the coefficients on the decile group dummy variables from the fixed effects specification with the balanced panel; the lines trace the point estimates and the dark bars are the 95% confidence intervals. As anticipated, as the ranking deciles improve facilities reduce emissions less in a strictly monotonic fashion. It is not possible to reject the possibility that many of the point estimates for coefficients in adjacent or nearby decile groups are the same, but clearly there are large differences across the entire sample.

Figure 6 plots the coefficients and the confidence intervals for the emissions increases (or lower reductions) associated with the exogenous change in decile rankings. As expected, the point estimates for emissions increases are overall higher for the higher ranked deciles, but the confidence intervals are such that it is not possible to reject the possibility that the coefficients are all essentially the same. This somewhat puzzling result may be due to the fact that many of the facilities who began in the bottom half of the "Top 100" rankings were pushed close to or over the "Top 100" threshold after the exogenous change. The average improvement in ranking due to the exogenous change for decile groups 60-100 is 16, significantly higher than the average of 12 for lower deciles. Just as being ranked high on a "Top 100" list is likely to be correlated with increased

[30] Due to the improvement in rankings- this is the same logic that operated in specifications (1) and (2).

pressure to decrease emissions, moving close to the bottom or completely off the list likely removes significant external pressure on firms, and therefore could strongly influence facility emissions in a positive direction. This is likely given that Scorecard makes uses of the "Top 100" lists and receives by far the majority of public scrutiny of all media outlets; millions of internet hits each year.

V. Conclusions

The above results provide evidence that the TRI database does influence facility emissions. Facilities that experienced exogenous drops in their pollution rankings reduced emissions less than they would have if they had not experienced this change. Simply multiplying the average coefficient on the exogenous change in rankings by the sum of the rankings changes, the total is in the tens of millions of pounds of additional toxic releases in 2000 and 2001. Apart from this effect, facilities ranked within the "Top 10" reduced emissions significantly more than those outside of this ranking category, indicating that this stigma may be a powerful incentive for firms to reduce their pollution. Factoring in that due to the exogenous change in rankings many of the existing TRI facilities were removed from state "Top 10" lists, the increased emissions brought on by the change in the TRI rules for the already existing facilities is in the hundreds of millions of pounds. This suggests that the overall magnitude of the effect of the exogenous change in rankings brought about by the expansion of the TRI rules was large in absolute terms. Relative to the billions of pounds of total TRI emissions the change represents a 1-2% increase, which is reasonable.

These results have significant policy implications. Although changes to the TRI reporting rules led to less emissions reductions among already existing firms, the finding that firms do respond to pollution rankings should bolster the overall case for "Right to Know" programs. The TRI is clearly providing members of the public and policy makers with useful information, which they are acting on to pressure firms to change their behavior, and the costs (real or perceived) are significant enough that firms respond. Given that the maintenance costs of the TRI for the U.S. government have remained extremely low, at approximately $25 million a year, and the cost to industry of providing the information has dropped from approximately $550 million in the first year to $300 million a year since[31] (Fung and O'Rourke 2000), the TRI may be a potentially cost-effective means of better enabling the public to express its environmental preferences. The TRI currently covers only a small fraction of the toxic chemicals emitted in the U.S. (approximately 5%) so there is significant room to expand the scope of the program. In addition, many developing countries, where resources are severely limited, may benefit from establishing programs modeled on the TRI. This would not only provide information to domestic citizens in other countries, but also allow citizens and organizations in the developed world to gauge the environmental performance of firms within host countries, which could have a secondary effect on their behavior.

These results also highlight the potential unintended consequences of bringing new entrants under the jurisdiction of the TRI. While the inclusion of new industries in 1998 shifted the focus to facilities that polluted significantly more than already existing facilities, at the same time, this expansion decreased incentives for the latter group of facilities to reduce their emissions. Depending on the relative susceptibility of the new and existing firms to public pressure as well as their abatement costs, it is open question whether the change in the TRI rules will lead to long-term increases or decreases in total emissions across the United States. More data points are necessary in order to see whether the changes in the emissions in the original TRI firms are offset by decreases in emissions from the new entrants. Total emissions from the new TRI industries decreased by over one billion pounds from 1998 to 2001, and if a significant percentage of this reduction is due to the TRI reporting this would suggest that the net result of the change in the TRI's rules has been much lower national emissions[32].

Despite the likelihood that the facility-level data provided by the TRI is not entirely precise, the results of the current study are still of interest and policy-relevant because they indicate that at minimum firms are concerned with the ***public perception*** of their emissions. I find evidence that once firms experience improvements in their

[31] This does not include the actual costs of emissions reductions, but simply the cost of providing the information to the government that the TRI legislation requires. The estimated cost of U.S. environmental regulation is in the hundreds of billions per year.
[32] However, the largest decrease in emissions for the new industries occurred in 2001, at a time when the country suffered a recession, and total emissions in 2000 was actually almost identical to total emissions in 1998.

pollution rankings they actually report *lower* emissions reductions, which is the opposite direction expected from untruthful reporting. This indicates that firms are thinking strategically about their pollution rankings. A question remains as to whether changes in facility emissions would be as sensitive to pollution rankings if monitoring and enforcement were more stringent.

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Figure 1: Distribution of TRI Facilities 2001

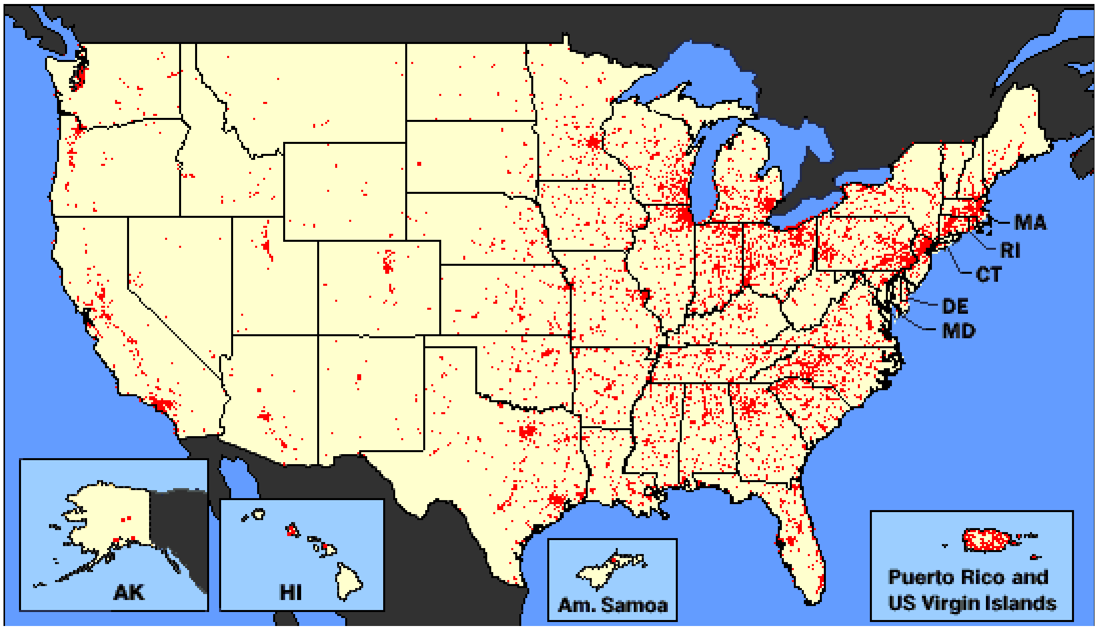

Figure 2a: Mean Percentage Reduction In Total Emissions By National Rankings 1988-2001

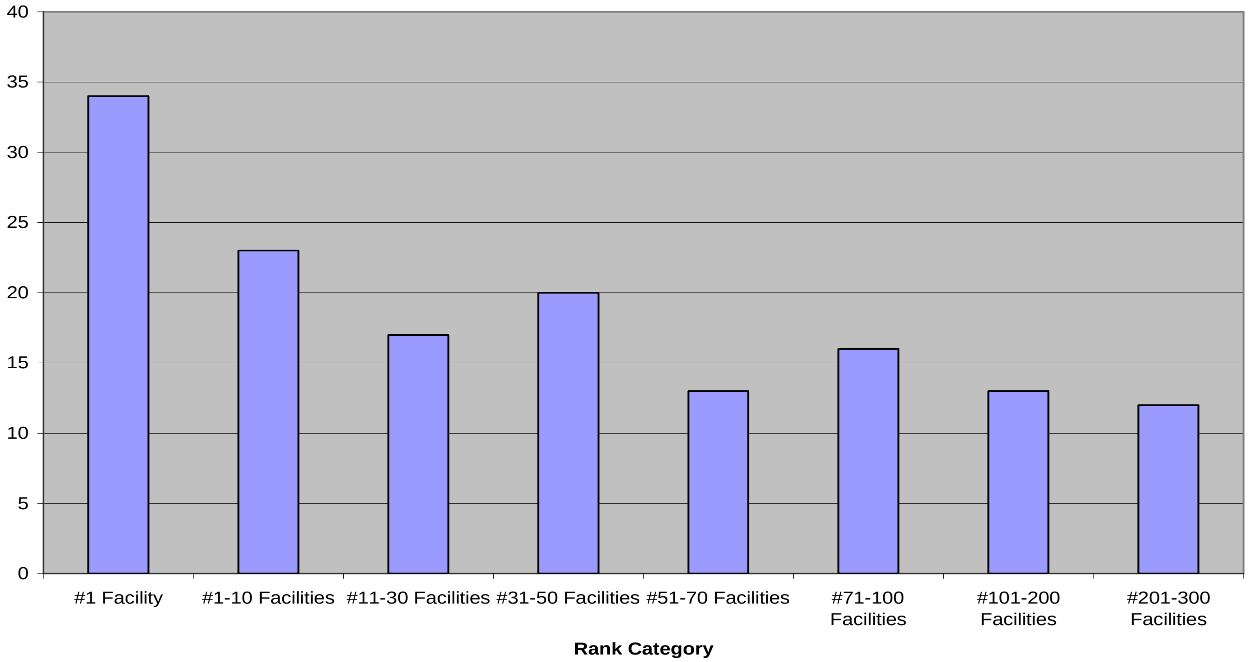

Figure 2b: Mean Percentage Reductions In Total Emissions For State Rankings 1988-2001 (29 states with at least 200 TRI facilities)

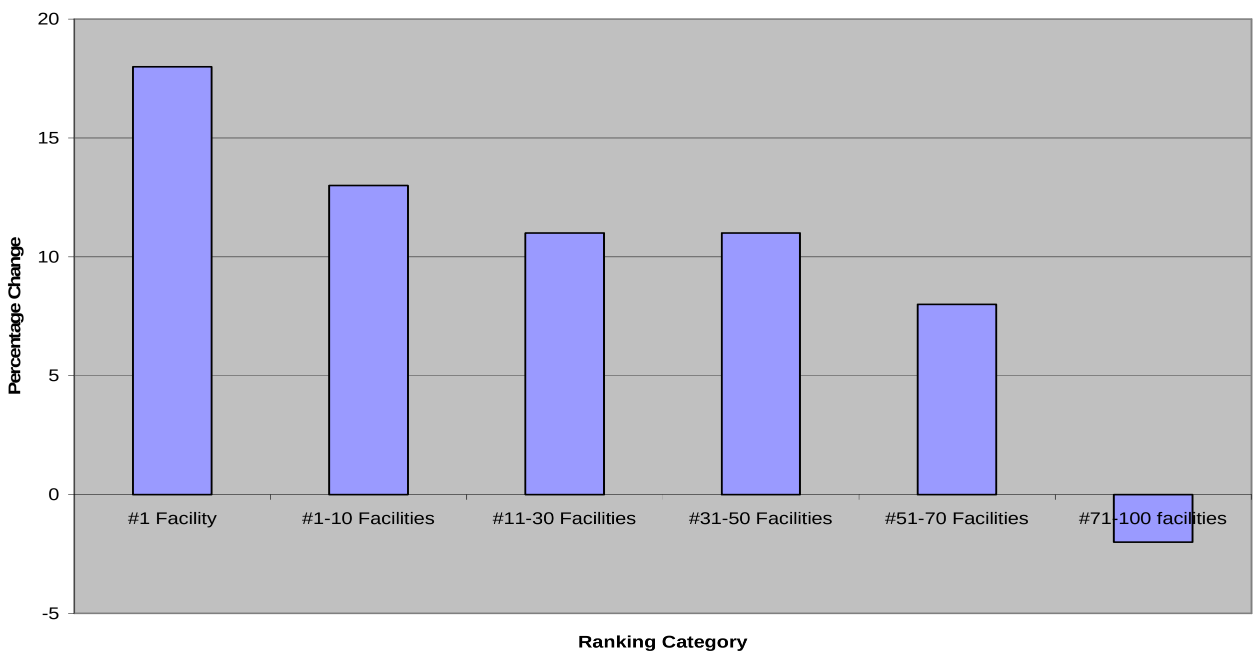

Figure 3: Total TRI Emissions 1988-2000

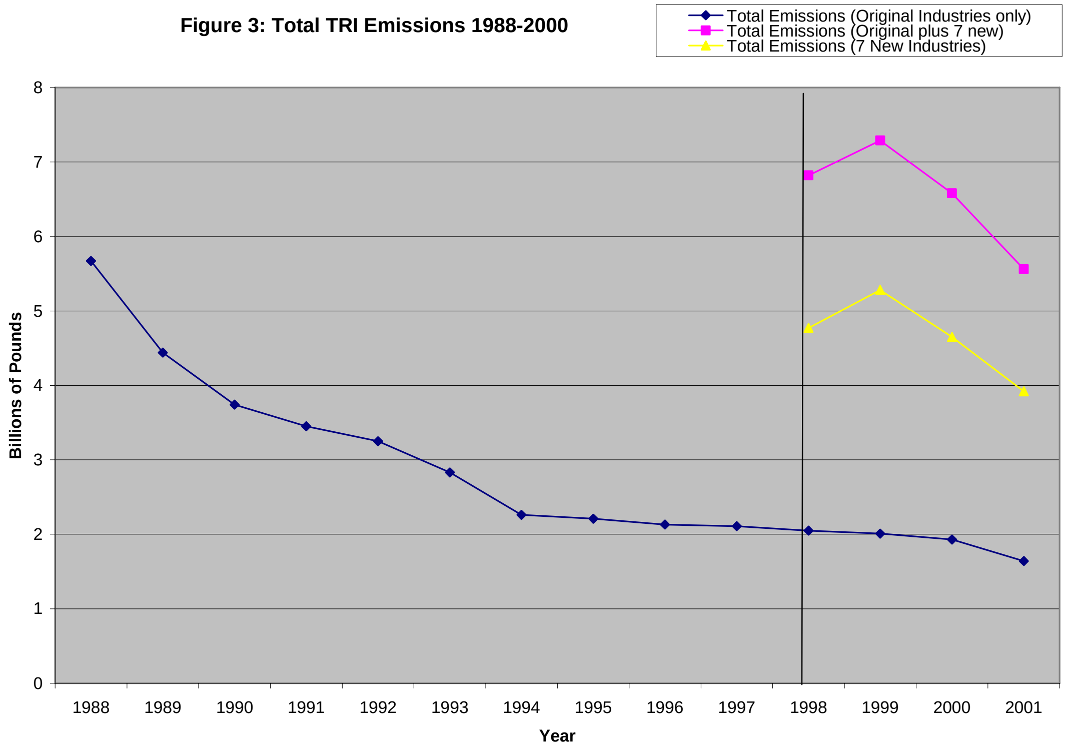

Figure 4: Total TRI Emissions For "Top 10" Facilities (Based Only on Pre-1998 Industries) 1995-2001

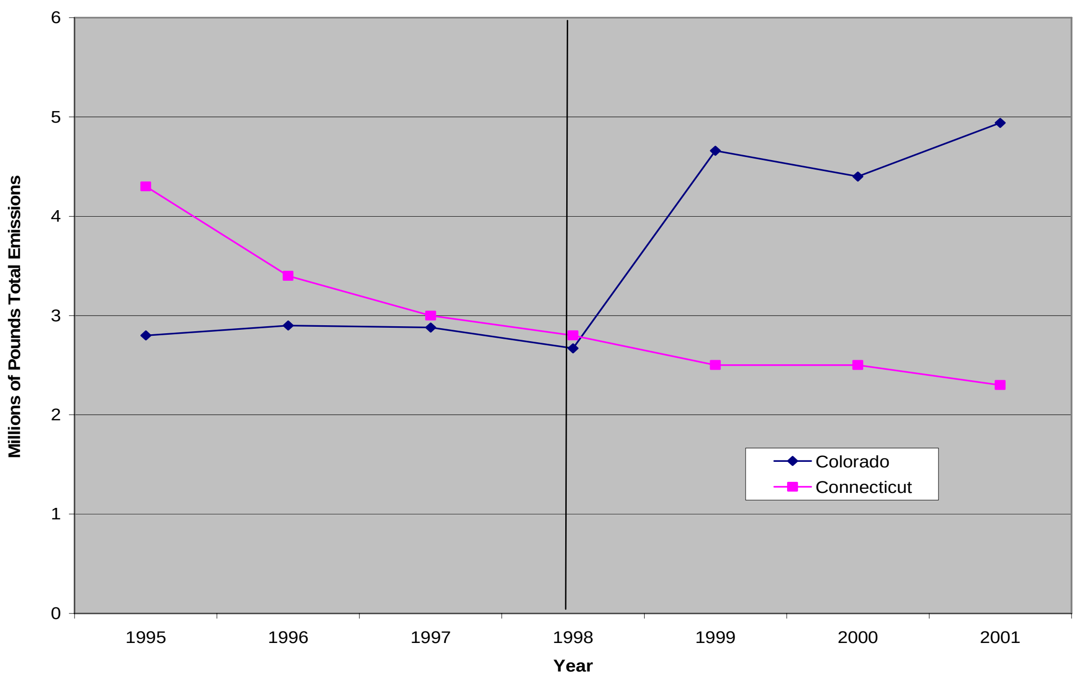

Figure 5: Coefficients and 95% Confidence Intervals on Decile Dummies
(1,000s of Pounds of Emissions Reductions)

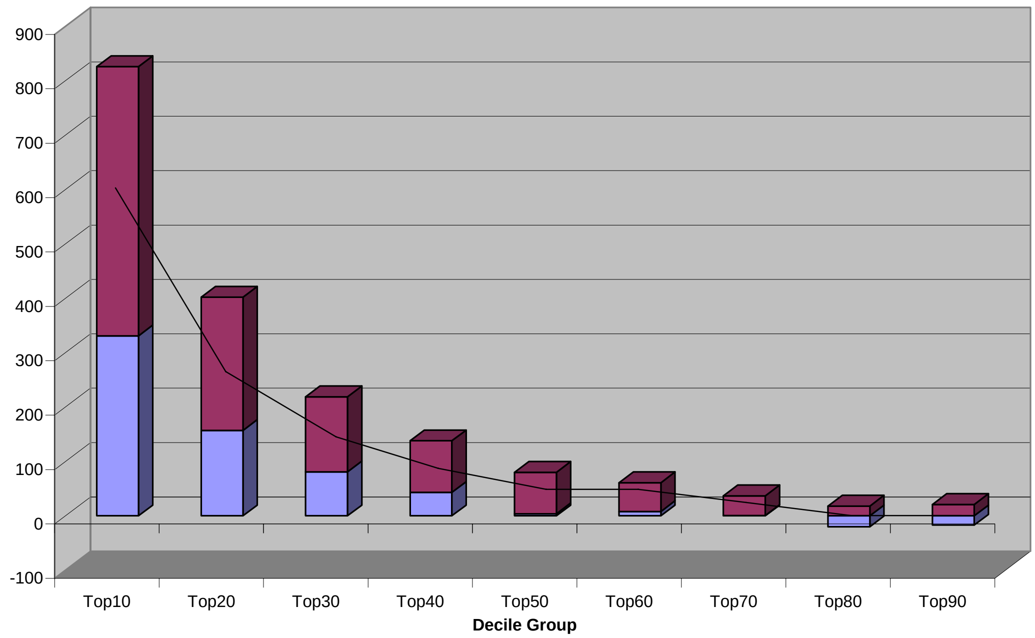

Figure 6: Coefficients and 95% Confidence Intervals on Exogenous Change Dummies
(1,000s of Pounds of Emissions Increases)

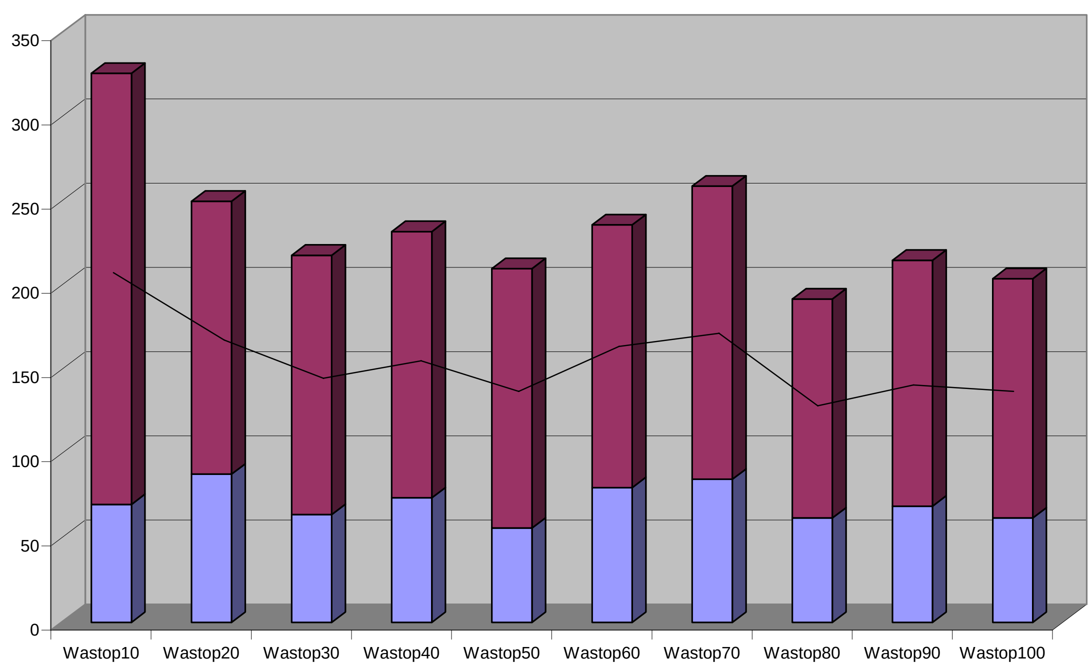

Table 1: New Industries Reporting to TRI as of the 1998 Reporting Year

SIC	Industry Group
10	Metal mining (except for SIC codes 1011,1081, and 1094)
12	Coal mining (except for 1241 and extraction activities)
4911, 4931, and 4939	Electrical utilities that combust coal and/or oil
4953	Resource Conservation and Recovery Act (RCRA) Subtitle C hazardous waste treatment and disposal facilities
5169	Chemicals and allied products wholesale distributors
5171	Petroleum bulk plants and terminals
7389	Solvent recovery services

Table 2a: "Top 10" Ranked Facilities Based on Pre-1998 TRI Industries
Connecticut 2000-2001

Facility Ranking (Within Original TRI Industries only)	2000		2001	
	Actual State Rank	Exog Change	Actual State Rank	Exog Change
1	1	0	1	0
2	2	0	2	0
3	3	0	3	0
4	4	0	4	0
5	5	0	5	0
6	7	1	6	0
7	8	1	8	1
8	10	2	9	1
9	12	3	10	1
10	13	3	12	2

Table 2b: "Top 10" Ranked Facilities Based on Pre-1998 TRI Industries
Colorado 2000-2001

Facility Ranking (Within Original TRI Industries)	2000		2001	
	Actual State Rank	Exog Change	Actual State Rank	Exog Change
1	8	7	2	1
2	11	9	5	4
3	12	9	9	6
4	13	9	11	7
5	14	9	12	7
6	16	10	14	8
7	18	11	20	13
8	20	12	21	13
9	21	12	22	13
10	24	14	25	15

Table 3a: Dependent Variable: Change in Total Emissions (1,000 pounds)
Top 100 State Facilities 1995-2001: Unbalanced Panel

	OLS (1-4)				Fixed Effects (5-8)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Base Ranking (R^B)	1.1 (.2)***	1.3 (.3)***	.49 (.1)***	.63 (.2)***	1.9 (.3)***	3.6 (.8)***	1.6 (.3)***	.57 (.7)
Exogenous Change in Ranking (R^{CH})	4.8 (1.4)***	5.1 (1.4)***	4.6 (1.4)***	4.9 (1.4)***	5.9 (1.8)***	7.0 (2.1)***	6.0 (1.8)***	5.6 (1.8)***
Emissions Change (t-1)	..	-.2 (.1)	..	-.2 (.1)	..	-.4 (.2)**	..	.3 (.04)***
Top 10 Dummy	..	..	-145.1 (32.7)***	-168.7 (37.7)***	..	..	-136.4 (30.2)***	-74.4 (44.1)*
No. obs	20136	20136	20136	20136	20162	20162	20162	18479
R^2[33]	.05	.07	.05	.08	.003	.001	.004	.002
No. Groups	n/a	n/a	n/a	n/a	5902	5902	5902	5432
SIC dummies	Y	Y	Y	Y	N	N	N	N
State dummies	Y	Y	Y	Y	N	N	N	N
Year dummies	Y	Y	Y	Y	Y	Y	Y	Y

Table 3b: Dependent Variable: Change in Total Emissions (1,000 pounds)
Top 100 State Facilities 1995-2001: Balanced Panel

	OLS (1-4)				Fixed Effects (5-8)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Base Ranking (R^B)	1.1 (.2)***	1.4 (.3)***	.47 (.1)***	.61 (.2)***	2.0 (.3)***	3.8 (.9)***	1.7 (.3)***	1.0 (.7)
Exogenous Change in Ranking (R^{CH})	5.6 (1.6)***	6.0 (1.6)***	5.4 (1.5)***	5.7 (1.6)***	6.2 (2.0)***	7.6 (2.3)***	6.4 (2.0)***	6.0 (1.8)***
Emissions Change (t-1)	..	-.2 (.1)	..	-.2 (.1)	..	-.4 (.2)**	..	.1 (.04)***
Top 10 Dummy	..	..	-157.8 (34.3)***	-184.1 (40.1)***	..	..	-136.4 (31.2)***	-90.2 (44.7)**
No. obs	17427	17427	17427	17427	17447	17447	17447	16790
R^2	.05	.07	.05	.08	.003	.002	.005	.003
No. Groups	n/a	n/a	n/a	n/a	4652	4652	4652	4598
SIC dummies	Y	Y	Y	Y	N	N	N	N
State dummies	Y	Y	Y	Y	N	N	N	N
Year dummies	Y	Y	Y	Y	Y	Y	Y	Y

Huber-White Standard Errors Clustered at the Facility Level in ( ): *= 90% confidence, **=95%, ***=99%

[33] For fixed effects I report the overall R squared.

Table 3c: Dependent Variable: Change in Total Emissions (1,000 pounds)
Top 101-200 State Facilities 1995-2001: Unbalanced Panel

	OLS (1-2)		Fixed Effects (3-4)	
	(1)	**(2)**	**(3)**	**(4)**
Base Ranking (R^B)	.03 (.02)**	.03 (.02)	.12 (.04)***	.3 (.03)***
Exogenous Change in Ranking (R^{CH})	.02 (.08)	.02 (.07)	.03 (.1)	.03 (.1)
Emissions Change (t-1)	..	-.4 (.1)***	..	-.8 (.05)***
No. obs	14841	14841	14902	13176
R^2	.03	.16	.003	.13
No. Groups	n/a	n/a	5997	5290
SIC dummies	Y	Y	N	N
State dummies	Y	Y	N	N
Year dummies	Y	Y	Y	Y

Huber-White Standard Errors Clustered at the Facility Level in ( ): *= 90% confidence, **=95%, ***=99%

Table 3d: Dependent Variable: Change in Total Emissions (1,000 pounds)
Top 101-200 State Facilities 1995-2001: Balanced Panel

	OLS (1-2)		Fixed Effects (3-4)	
	(1)	**(2)**	**(3)**	**(4)**
Base Ranking (R^B)	.03 (.02)	.02 (.02)	.14 (.04)	.4 (.03)***
Exogenous Change in Ranking (R^{CH})	.03 (.1)	.02 (.1)	.05 (.1)	.03 (.1)
Emissions Change (t-1)	..	-.4 (.1)***	..	-.8 (.05)***
No. obs	12047	12047	12091	11536
R^2	.03	.16	.003	.13
No. Groups	n/a	n/a	4443	4352
SIC dummies	Y	Y	N	N
State dummies	Y	Y	N	N
Year dummies	Y	Y	Y	Y

Huber-White Standard Errors Clustered at the Facility Level in ( ): *= 90% confidence, **=95%, ***=99%

Table 4: Dependent Variable: Change in Total Emissions (1,000 pounds)
Top 100 State Facilities 1995-2001

	Unbalanced Panel		Balanced Panel	
	OLS	Fixed Effects	OLS	Fixed Effects
Exogenous Change in Ranking (R^{CH})	1.7 (1.0)	1.7 (1.4)	2.2 (1.1)	2.1 (1.6)
Emissions Change (t-1)	-.0002 (.0001)	-.0004 (.0002)**	-.0002 (.0001)	-.0004 (.0002)**
Top10	-205.4 (42.4)***	-561.7 (118.4)***	-218.9 (45.8)***	-578.6 (126.4)***
NoLongerTop10	182.0 (58.3)***	186.2 (62.4)***	209.1 (62.2)***	197.6 (65.3)***
Top11-20	-49.4 (13.9)***	-263.3 (58.9)***	-53.4 (15.9)***	-279.4 (62.7)***
NoLongerTop11-20	103.9 (31.6)***	159.0 (39.1)***	122.6 (32.4)***	168.5 (41.2)***
Top21-30	-28.1 (9.9)***	-141.1 (33.0)***	-28.6 (11.6)	-149.9 (35.1)***
NoLongerTop21-30	88.9 (26.1)***	135.1 (37.4)***	101.7 (28.9)***	141.3 (39.3)***
Top31-40	-20.0 (9.3)***	-84.3 (22.7)***	-19.9 (10.9)	-90.5 (24.1)***
NoLongerTop31-40	90.6 (27.3)***	143.2 (37.8)***	101.7 (30.4)***	152.9 (40.4)***
Top41-50	-3.7 (10.1)	-41.2 (17.7)***	.2 (12.3)	-42.2 (19.4)***
NoLongerTop41-50	82.7 (25.8)***	129.2 (37.1)***	89.0 (28.3)***	133.4 (39.4)***
Top51-60	-5.5 (7.6)	-33.1 (12.3)***	-4.1 (9.2)	-34.6 (13.4)***
NoLongerTop51-60	90.7 (25.3)***	152.0 (37.7)***	97.4 (27.9)***	157.7 (39.8)***
Top61-70	-10.2 (6.2)	-18.8 (8.7)***	-8.8 (7.6)	-18.4 (9.6)***
NoLongerTop61-70	102.1 (29.6)***	166.9 (42.1)***	110.0 (32.2)***	172.1 (44.4)***
Top71-80	4.5 (6.3)	2.1 (9.0)	2.9 (7.6)	.9 (9.8)
NoLongerTop71-80	80.9 (23.0)***	123.6 (30.9)***	90.4 (26.2)***	126.8 (33.0)***
Top81-90	-.7 (6.7)	-1.3 (8.6)	-2.8 (7.6)	-2.0 (9.6)
NoLongerTop81-90	99.0 (26.6)***	137.8 (35.0)	107.5 (29.2)***	142.1 (37.1)***
NoLongerTop91-100	92.6 (25.0)***	131.4 (34.1)***	99.7 (27.4)***	132.9 (36.0)***
No. obs	20136	20162	17427	17447
R^2	.08	.02	.08	.02
No. Groups	n/a	5902	n/a	4652
SIC dummies	Yes	No	Yes	No
State dummies	Yes	No	Yes	No
Year dummies	Yes	Yes	Yes	Yes

Huber-White Standard Errors Clustered at the Facility Level in ( ): *= 90% confidence, **=95%, ***=99%