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Evaluating the Effectiveness of EPA Voluntary Programs: An Examination of the Strategic Goals Program for Metal Finishers

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The views in this paper are those of the authors and do not necessarily represent those of the US Environmental Protection Agency.

Abstract:

Voluntary approaches have become a popular in the U.S. to enhance the efficacy and scope of existing regulations and to reduce emissions in sectors or for pollutants where formal environmental regulation is lacking. In this paper, we examine the effectiveness of a particular EPA voluntary program for the metal finishing industry, the Strategic Goals Program (SGP). The Strategic Goals Program is a good candidate for evaluation because it had a credible regulatory threat at the time the program was implemented, we can measure both baseline emissions and progress towards explicit environmental goals, and we have data for participants and non-participants. We look at the decision to participate in the SGP and also try to determine what effect, if any, this program has had on the pollution profile of facilities. In addition, we examine whether the voluntary program had any discernible impact on toxicity-weighted emissions. Finally, we explore the possibility that we have a bimodal distribution in the sample caused by the different motivations of facilities to join a voluntary program. A number of factors influence a firm's decision to participate in SGP, including trade group membership. However, we do not find robust evidence that SGP participation has had a significant impact on emission reductions. This result continues to hold when we adjust emissions to account for toxicity. Our measure of the threat of regulation is correlated with emission reductions for both participants and non-participants.

Key Words: voluntary approaches, program effectiveness, air emissions.
Subject Areas: 52 (Environmental Policy); 18 (Pollution Control Options and Economic Incentives)

1. Introduction[1]

Environmental policies in the U.S. have always strived to provide adequate environmental protection to individuals. Increasingly, regulators have sought to provide that protection at the lowest possible cost. This has led to the use of more flexible market-based and voluntary approaches to augment traditional command-and-control regulatory approaches. Voluntary approaches, in particular, have become increasingly popular in the U.S. as a way to enhance the efficacy and scope of existing regulations and to reduce emissions in sectors or for pollutants where formal environmental regulation is lacking. In this paper, we examine the effectiveness of voluntary approaches by focusing on a particular EPA program in the metal finishing industry, the Strategic Goals Program (SGP). We examine the decisions of facilities to participate in the program and the impact of the program on facilities' emissions reductions.

Since the introduction of EPA's first voluntary program in 1991, the 33/50 program, there has been a large increase in the number of voluntary programs used to address environmental issues in the U.S. There are currently over 50 voluntary programs administered by the EPA at the federal level and countless more exist at the state and local levels (Brouhle, Griffths, and Wolverton, 2005). The literature posits a variety of reasons why firms may join voluntary programs. Voluntary programs may allow firms to reduce costs[2] (Blackman and Boyd, 2002) and/or improve their environmental reputation with "green" consumers and investors (Arora and Gangopadyay, 1995; Arora and Cason, 1996; Khanna and Damon, 1999). A more cynical view argues that firms may join voluntary agreements to provide a smokescreen for poor environmental performance (Harrison, 1999) or to forestall or influence future regulations (Maxwell et al., 2000; Lutz et al., 2000). From the EPA's perspective, voluntary programs can often achieve environmental objectives "more quickly and with lower costs than would be the case with regulatory approaches" (Sunnevag, 2000). Lower costs are said to arise from the flexibility that voluntary agreements provide to firms. These policies may also be welfare enhancing if they lead to greater levels of innovation (Wallace, 1995). Alberini and Segerson (2002) demonstrate theoretically that a credible regulatory threat and reliable monitoring of progress towards an environmental goal increases the effectiveness of a voluntary approach. Alternatively, some argue that voluntary agreements allow the

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[2] Lower costs may arise directly from the program (e.g., the use of energy efficient lighting in Green Lights) or indirectly through other channels (e.g., a voluntary agreement that reduces a firm's environmental risk may lower insurance premiums). Environmentally-friendly firms may also find it easier to raise capital if environmental performance results in higher stock market valuations (Hamilton, 1995; Konar and Cohen, 2001).

EPA to expand its bureaucracy and oversight to new areas of environmental protection (Maxwell and Lyon, 1999).

While there has been vigorous debate as to why voluntary agreements are used and their potential advantages over traditional policy tools, evidence on their effectiveness is limited and mixed. Part of this stems from the difficulty in evaluating voluntary programs. Since voluntary agreements often target broad environmental issues, it is sometimes difficult to find a measurable environmental output to gauge success.[3] A more substantive difficulty in evaluating the environmental effectiveness of voluntary programs is establishing a proper baseline from which to measure environmental improvements. Critics often argue that voluntary programs represent nothing more than a business-as-usual scenario.[4] Bizer (1999) argues that the flexibility offered to firms as part of voluntary programs often results in failure to achieve the environmental goals.

In spite of these difficulties, a number of papers have investigated the environmental effectiveness of voluntary programs. Khanna and Damon (1999) show that while the 33/50 program did not reach EPA's goal of a 33 percent reduction in toxic emissions by 1992 and a 50 percent reduction by 1995, it did encourage participants to reduce their pollution more than non-participants. GAO (1994) reports that, of the reductions EPA counts as progress towards the emissions reduction goals of the 33/50 program, 25 percent were from non-participants and 40 percent took place before the program was established (Davies et al. (1996) show similar findings).

GAO (1997) examines four EPA voluntary climate change programs, including Green Lights, but relies on EPA reported results and interviews of select participants to reach its conclusions. The GAO study suggests that there is reason to believe that at least some of the lighting upgrades undertaken by participants were due to non-program factors. Horowitz (2004) finds that the Green Lights program successfully promoted energy efficiency and resulted in a substantial decrease of carbon emissions. Morgenstern and Al-Jurf (1999) find that the Green Lights and 33/50 programs resulted in much more modest emission reductions than what regulators often claim. Studies of other voluntary programs find

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[3] For example, the Design for the Environment program encourages firms to incorporate environmental considerations directly into the design of their products. This goal makes it difficult to identify a measurable environmental output with which to evaluate the program.

[4] There is evidence that this is sometimes the case. For example, the Joint Declaration of the German Industry on Climate Protection pledged a 20% reduction in energy consumption by 2005. This translated into an annual reduction of only 1.3%, whereas the industry had reduced emissions by 2.3% annually in the years 1970-1993 (OECD, 1999). The 33/50 program also faced criticism when it claimed that it had achieved its goal of a 50% reduction in toxic emissions in 1995 when firms had started reducing pollution prior to the implementation of the program (Khanna and Damon, 1999).

different outcomes. King and Lenox (2000) and Welch et al. (2000) report that Responsible Care and ClimateWise did *not* result in firms improving their environmental performance relative to others. In fact, there is evidence that participants in both programs actually performed worse than non-participants.

Given the lack of consensus on the environmental effectiveness of voluntary programs, it is important to examine other programs in an attempt to identify features of a successful program. We select the Strategic Goals Program (SGP), a voluntary program in the metal finishing industry, to evaluate in this regard. Several program characteristics make this program especially relevant for evaluation. First, unlike broad-based voluntary programs evaluated in the past (e.g. 33/50 or Green Lights), the Strategic Goals Program is a sector-based program.[5] Second, the SGP had a credible regulatory threat at the time the program was implemented, which allows us to assess the role of a traditional regulatory threat in tandem with this voluntary approach. Third, the SGP allows for the measurement of both baseline emissions and progress towards explicit environmental goals. Fourth, we have data for both participants and non-participants, allowing us to evaluate whether the SGP program had a noticeable impact on participant emissions.

Similar to other papers in the literature that evaluate a particular voluntary program, we look at the decision to participate in the SGP and also try to determine what effect, if any, this program has had on the pollution profile of facilities. While adopting a similar approach, this study differs from many other studies of voluntary programs in several important ways. First, we explicitly test whether the participation decision is endogeneous to subsequent emission reduction decisions. Past studies have assumed that this is the case and have used an instrumental variable approach when including participation in the emission equation. Second, in addition to quantifying the effect of the SGP on facilities' decisions of how many pounds to emit, we also examine whether the voluntary program had any discernible impact on toxicity-weighted emissions, which are more closely linked to the effects such emissions have on human health and the environment. Finally, we explore the possibility that we have a bimodal distribution in the sample caused by the different motivations of facilities to join a voluntary program. Some facilities may join a voluntary program in good faith as a way to reduce costs or improve their environmental reputation and hence their market share. Other facilities, however, may find a voluntary program appealing as a smokescreen for poor environmental performance. To explore this

[5] The SGP formally ended in 2002. In 2003, the EPA introduced its Sector Strategies Program in which the Agency establishes a relationship with industry stakeholders and promotes regulatory changes, environmental management systems, and compliance assistance based upon the specific needs of the sector (Federal Register, 2003). Currently there are twelve sectors in this program, including the metal finishing industry. The metal finishing Sector Strategies Program is not the same as the SGP, but it is based partly on the lessons learned during the SGP.

possibility, we split our sample based upon the size of a facility's emissions to see if we gain a better understanding of the factors driving the participation decision when we examine the two groups separately.

The paper is organized as follows. Section 2 describes the SGP in some detail. Section 3 presents the empirical model. Our data and the variables used in the empirical analysis are explained in section 4. Summary statistics are presented in section 5. Results are presented in section 6. Section 7 concludes.

2. Metal Finishing Strategic Goals Program

The origin of the EPA's Strategic Goals Program (SGP) can be traced to the Common Sense Initiative. Launched in 1994, the Common Sense Initiative aimed to achieve environmental improvements by giving firms flexibility and incentives to meet regulatory goals (US EPA, 1997). Rather than relying on strict guidelines and command-and-control regulations for specific media (e.g., air, land, or water), the premise of the initiative was that firms would find innovative ways to reduce their environmental impacts if they were given flexibility to address pollution control in a more holistic fashion. The appeal of flexible, voluntary efforts to reduce environmental pollution was further enhanced when the metal finishing industry came under the threat of new regulation. First introduced in 1995, the Effluent Limitations Guidelines and New Source Performance Standards for the Metal Products and Machinery Point Source Category (referred to as the MP&M regulation) sought to impose strict new effluent guidelines and pretreatment standards for wastewater discharges from metal products and machinery facilities.[6] With this and other threatened regulations in the background, the SGP was launched for the metal finishing industry in 1998 by the EPA in cooperation with a number of industry trade organizations.[7] Within a year, the program had over two hundred and fifty participants. By the program's conclusion in 2002, five hundred and fifty facilities had joined the SGP, with most new participants joining in 2000 or after.

The Strategic Goals Program encouraged companies "to go beyond environmental compliance" (see SGP Website) by establishing seven specific goals:

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[6] Note that the final version of the MP&M regulation, signed in 2003, exempted the metal finishing industry. Although the industry is not subject to the stricter guidelines, the regulatory threat did exist in the period we study. An indicator of the severity of this threat is that the exclusion of the metal finishing industry in the final version of the rule was hailed as "the achievement of a generation" by the National Association of Metal Finishers.

[7] The SGP was founded in cooperation with the National Association of Metal Finishers (NAMF), American Electroplaters and Surface Finishers Society (AESF), Metal Finishing Suppliers Association (MFSA), and Surface Finishing Industry Council (SFIC).

- 50% reduction in water usage
- 25% reduction in energy use
- 90% reduction in organic TRI releases
- 50% reduction in metals released to water and air (as reported to TRI)
- 50% reduction in land disposal of hazardous sludge
- 98% metals utilization
- Reduction in human exposure to toxic materials in the facility and surrounding community.[8]

Facilities that joined the SGP committed to accomplishing these goals by 2002. The achievement of these goals was measured against a 1992 baseline. When facilities joined the SGP, they were asked to estimate their baseline emissions, using an alternate year if 1992 data were unavailable.

To encourage facilities to join and to help them meet the seven program goals, the SGP offered participants a number of resources. The SGP established the National Metal Finishing Resource Center (NMFRC) to act as a clearinghouse of technical information and a place where firms could seek assistance in improving their environmental performance. The NMFRC collected annual surveys to track the environmental performance of SGP members, determined if facilities had met any or all of the above goals, and provided online access to a feature that compares a firm's performance to the performance of other firms that belong to the SGP.[9] By identifying areas where facilities scored poorly, the hope was that firms would learn where to focus their efforts to improve in the future. The SGP also offered free, non-regulatory environmental audits, on-site technical assistance, funding for environmental technologies, free workshops on energy, water and waste reduction, environmental management system (EMS) training, and free interns to help firms fill out paperwork associated with the program.

The Strategic Goals Program is a good candidate for assessing the environmental effectiveness of voluntary programs. First, the agreement was implemented when the industry faced a credible regulatory threat (i.e., the MP&M regulation), which may have encouraged real efforts by firms to improve their performance. Second, the program set explicit targets designed to discourage firms from simply providing lip-service to environmental efforts. Third, the annual reporting and environmental performance comparison of pollution levels allowed firms to monitor their progress relative to a baseline and to identify areas for improvement. And finally, the SGP established an independent, third party

[8] Activities to reduce human exposure to toxic materials include pollution prevention, chemical substitution, employee training in environmental hazards, and local emergency planning committees.
[9] These data are not shared with the US EPA in a way that allows for facility identification.

organization (i.e., NMFRC) to provide technical assistance and information to firms. We seek to answer the following questions with regard to the SGP:

- What factors affected a facility's decision to participate in the SGP voluntary program?
- What factors affected facility TRI air emissions - explicitly targeted for reduction by the SGP –, and did the SGP play a role in affecting those emissions?
- Did the SGP make progress in reducing human exposure to toxic materials, also an explicit goal of the program?
- Do low and high emitters view the SGP participation decision similarly?

3. Empirical Model

To the extent that firms derive some net benefit from a voluntary program, they will join. The extent to which this translates into real behavioral change (i.e., reductions in emissions) must also be directly associated with the derivation of positive net benefits, since firms will incur additional costs to make these changes. We present a modeling framework in this section to examine factors associated with the decision to join and with emissions changes.

First, we separately model the facility's net benefit from participation D_{it}^* in the voluntary program,

$$D_{it}^* = \beta_1 X_{1it} + \varepsilon_{1it}\,, \qquad (1)$$

where X_{1it} is a vector of exogenous variables for the ith firm at time t, β_1 is a vector of parameters, and ε_{1it} is a random error term. Since the net benefits of participating, D_{it}^*, are not observed, we proxy for this with the observed participation decision of the facility, D_{it}:

$$\begin{aligned} D_{it} &= 1 \quad \text{if } D_{it}^* > 0 \\ &= 0 \quad \text{otherwise.} \end{aligned} \qquad (2)$$

This allows us to estimate

$$D_{it} = F(\beta_1 X_{1it}) + \mu_{it}\,. \qquad (3)$$

If $F(\cdot)$ is the cumulative distribution of the standard normal variate ε_{1it}, then equation (3) can be estimated using the probit model.

Next, we characterize the pollution level of facility *i* at time *t* as

$$Y_{it} = \alpha D_{it} + \beta_2 X_{2it} + \varepsilon_{2it}, \qquad (4)$$

where Y_{it} represents the level of pollution, D_{it}, represents participation in the SGP, X_{2it} represents a vector of exogenous facility-specific variables, α is a parameter, β_2 is a vector of parameters, and ε_{2it} is a random error term.

Pollution levels at a single point in time, however, are not helpful in measuring the program's impact on facility behavior. Other studies, such as Khanna and Damon (1999), resolve this issue by using a panel dataset. Due to data constraints with respect to many of the variables, we are unable to construct a panel dataset. This means that our results focus on long term program impacts; that is, we examine how the program affected emissions over the entirety of its existence.

To examine whether the Strategic Goals Program affected facility emission behavior, we examine how pollution levels change over the time period for which the SGP was in place, controlling for other factors:

$$\Delta Y_{it} = \alpha \Delta D_{it} + \beta_2 \Delta X_{2it} + \Delta \varepsilon_{2it}, \qquad (5)$$

where Δ is the change in the variable between time period *t* and *t-1*. Estimation of equation (5) may lead to biased estimates if the participation variable, D_{it}, is not exogenous. Facilities that receive the most benefits from the SGP – be that cover from regulatory threat or increased flexibility in reducing emissions – may also be the most likely to join the program. We test for this bias and consider using an instrumental variable approach instead of letting participation directly enter equation (5). To implement the instrument approach, we first separately estimate the participation decision in equation (3) using a probabilistic choice model to obtain consistent estimates of $\hat{\beta}_1$. We then estimate the predicted probability of participation, $\hat{D}_{it} = F\left(\hat{\beta}_1 X_{1it}\right)$. Finally, we use this predicted probability of participation as an instrument in estimating equation (5). Note, the final estimates of α and β_2 are consistent (see Hartman, 1988; Khanna and Damon, 1999; Welch et al., 2000).

4. Data

To evaluate the SGP, we create a unique dataset from a variety of sources, including several from EPA: the Toxic Releases Inventory (TRI),[10] the Enforcement and Compliance History Online (ECHO), and the Resource Conservation and Recovery Act Information database (RCRIS). We limit our study to facilities reporting emissions to TRI in the metal finishing industry (SIC codes 3471) in the continental United States. Because chemicals are added and deleted from the TRI reporting requirements over time, we only retain observations for chemicals required to annually report to the TRI over the entire study period. Since two of the SGP's seven goals relate directly to TRI emissions (90% reduction in organic TRI releases and 50% reduction in metals released to water and air), these data should provide a useful measure of the relative progress of members and non-members towards the voluntary program's goals.

Since these databases do not have common facility identifiers, we matched the data using both name-address combinations and name-city-state combinations. We then identified unsuccessful matches, checked discrepancies using EPA's Envirofacts,[11] and matched by hand those with spelling errors or other inconsistencies. To these data, we have added information on the attainment status for a facility's county, information on participation in other voluntary agreements, information on SGP and trade group participation, state-level dues and contributions to environmental organizations, an index of regulatory stringency based on Levinson (2001), socioeconomic characteristics of the surrounding neighborhoods,[12] and facility-specific economic information from InfoUSA. We have dropped facilities that were late joiners of the program, in 2000 or 2001, since there may have been insufficient time to achieve significant changes in behavior before the program ended in 2002. In total we have 201 facilities in our data set, 65 of which are SGP members. Our sample of SGP participants represents approximately 25% of the total SGP population that signed up to participate prior to 2000.

4A. Variables

We estimate two regression equations, one that examines what factors affect a facility's participation in the SGP and one that examines what factors affect a facility's emissions behavior. The dependent

[10] Facilities that have fewer than 10 full-time employees, manufacture less than 25,000 pounds of emissions of a listed chemical, or use less than 10,000 pounds of a listed chemical do not have to report to the TRI. While the metal finishing industry is mostly comprised of small establishments – 50% have less than 10 employees according to US Census - there are more than 500 facilities that report to the TRI in a given year.
[11] Envirofacts contains facility information such as alternate names and addresses for a given facility that can be used to successfully match discrepancies between databases.
[12] The socioeconomic data originally comes from the US Census of Population and Housing. We take these data from EPA's ECHO database, which has matched the data to a 3 mile radius around each TRI facility.

variable for the participation equation is defined as *SGP*, which equals 1 if the facility joined the SGP and 0 otherwise. The dependent variable for the emissions equation compares average air emissions in two sets of years: prior to the start of the SGP and just after the end of the program.[13] Specifically, we create a variable called *REDUCTION IN TRI EMISSIONS*, which is defined at the facility level as the difference between the log of the average total TRI air emissions in 2002-2003 and the log of average total TRI air emissions in 1995-1996. We also define the dependent variable in terms of point air emissions, which allows us to examine the robustness of our results. We do not rely on the difference between single-year emissions (e.g., 2003 – 1996) for the dependent variable because we want to limit the impact of year-to-year fluctuations in emissions that may result from changes in estimation techniques and reporting errors (US EPA, 2002).

As highlighted in equation (5) of the empirical model, the emissions regression includes as an independent variable a measure of SGP participation. We include the predicted probability of joining the SGP as an instrument for participation. Because many factors that affect a facility's net benefits from joining the SGP also affect its emissions, the vectors X_{1it} and X_{2it} may contain many of the same explanatory variables. The predicted probability of joining the SGP will help separate out the effects of these variables on participation and emissions behavior. We characterize the independent variables affecting participation and emissions into four categories: program motivation, regulatory environment, community and environmental pressures, and firm and facility-specific characteristics. Table 1 lists all of the variables and indicates in which equation they appear.

1. Program Motivation

Firms may demonstrate a different propensity to join and to reduce emissions based on the relative cleanliness of their facilities. Facilities that are relatively clean may be more dedicated to environmental goals and therefore more likely to join the program and to subsequently reduce emissions. Alternatively, relatively dirty facilities may join the program to gain an enhanced reputation by associating themselves with an environmental program without necessarily changing their behavior drastically. To capture these possible effects, we include *TOTAL TRI RELEASES,* defined as the log of total air emissions in 1996, in both the participation and emission reductions equations.[14] Participation in the SGP may also depend on the ease in which a facility can meet program goals. Recall that the SGP allows facilities to benchmark

[13] We considered broadening our use of TRI emissions to include both total air and surface water emissions. However, surface water emissions are non-zero in relatively few cases. For instance, 89% of the facilities in our dataset reported zero surface water emissions in 1995 while 95% reported 10 or fewer pounds of emissions. The correlation coefficient between total air and surface water emissions is 0.99.

[14] When we use point air emissions for the dependent variable, we define these variables as point air emissions.

pollution to 1992 levels, rather than to the level of pollution at the time the facility joined the program. Thus, facilities that had already made reductions could join and, with little change in behavior, point to progress toward SGP goals. We create a variable *PRIOR REDUCTIONS* to measure the reductions in releases prior to the start of the program. Specifically, we measure the difference between the log of 1996 air emissions and the log of 1993 total air emissions.[15] We include this variable only in the SGP participation equation.[16]

2. Regulatory Environment

Differences in the regulatory environment facilities face also may affect decisions about whether to participate in the SGP and how much to reduce emissions. The existing literature emphasizes the importance of a regulatory threat to encourage firms to take real, environmental actions (Segerson and Micelli, 1998; Khanna et al., 1998; Henriques and Sadorsky, 1996; Welch et al., 2000). The MP&M regulation acted as a viable, potential regulation during this time period. The regulation was first proposed in 1995 and proposed again in revised form in 2001. While the MP&M rule pertains to water effluent discharges, air emissions are often generated through the same processes from the use of solvents, acids, and metals used as inputs in surface preparation, plating, and finishing. To the extent that facilities look for ways to reduce wastewater discharges through input substitution, pollution prevention, or metal recovery processes, they also are likely to reduce air emissions. To capture the effect of potentially stricter levels of regulation on the propensity to join, we calculate the proportion of a firm's total 1996 TRI air emissions subject to the 1995 proposed MP&M rule. *MP&M RELEASES TO TOTAL RELEASES* ranges from zero to one with higher values indicating facilities that were affected more by the proposed regulation. For the emissions equation, we define *CHANGE IN MP&M TO TOTAL RELEASES* as the difference between the proportion of total releases in 2002-03 subject to the 1995 and 2001 proposed MP&M rules and the proportion of total releases subject to these rules in 1995-96. Negative values indicate that a greater proportion of emissions changes occurred in chemicals that were under threat of regulation.

[15] We explored defining this as the difference in 1992 and 1996 emissions, but we want to balance missing observations in the early years of the TRI with the ability to capture past emissions behavior and previous reductions that count as progress in the SGP (since the baseline is 1992). There are a number of possible ways to treat facilities with missing emissions data for 1993: (1) assume that emissions are 0 (this assumes that if they fall below the threshold, emissions are likely to be small), (2) assume emissions in 1993 were similar to average emissions for 1994 and 1995 (this assumes no production changes that would have affected emissions), or (3) drop the observations. We explore options (1) and (3) in this analysis.

[16] Khanna and Damon (1999) also do not include prior reductions in the emissions equation.

Facilities may experience different levels of regulatory oversight given their past environmental performance. Facilities that have been out of compliance with environmental regulations may have an incentive to improve environmental performance to remove themselves from EPA scrutiny. From the RCRIS database, we use several measures of non-compliance. For the participation equation, we use two variables to represent the five year enforcement history prior to the beginning of the SGP: *PENALTY HISTORY*, which is the log of the total assessed penalties between 1992 and 1996, and *VIOLATION HISTORY*, which is total number of violations between 1992 and 1996.[17] For the emissions equation, we use *TOTAL PENALTIES*, the log of all financial penalties imposed in 1995 and 1996, and *TOTAL INSPECTIONS*, the total number of RCRA inspections in 1995 and 1996, as representative of a typical amount of regulatory attention received by the facility in any two-year time period. We do not use changes in penalty amounts or inspections over time in the emissions equation since they are likely to be endogeneous with changes in emissions.

Finally, firms may differ in their regulatory environment due to the location of their facility. We capture differences in the regulatory environment of a given location through the county's attainment status with the National Ambient Air Quality Standard for SO_2 and the stringency of state regulations. The variable *NON-ATTAINMENT* is a dummy variable that indicates whether a facility is located in a county out-of-attainment with federally mandated levels for sulfur dioxide air emissions. Counties in non-attainment face greater scrutiny and are required to implement specific plans and regulations to work toward compliance in the future. For the participation equation, this dummy variable is equal to 1 if the county in which the facility is located has been in non-attainment for SO_2 in the years prior (1992 – 1996) to the beginning of the SGP. For the emissions equation, we use *CHANGE IN NON-ATTAINMENT*, equal to 1 if a county's attainment status has changed between 1996 and 2002. Note that no county that was in attainment in 1992 went out of attainment in later years. However, a noticeable number of counties have gone from non-attainment to attainment status.[18] The overall regulatory pressure at the state level is captured by the variable, *STATE REGULATIONS*. This index comes from Levinson (2001) and captures the relative stringency of environmental regulations across states. Levinson proxies for the stringency of state regulations by comparing the actual expenditure on pollution abatement in a given state to the predicted expenditure on pollution abatement given the industrial mix of the state. He assumes that actual costs greater than predicted costs are the result of stricter regulations in the state. This index is only

[17] RCRIS also has a measure of the total number of inspections and total number of enforcement actions. Both of these variables are highly correlated with the total number of violations. The literature is not clear about which of these might be a better measure of past enforcement behavior.

[18] For instance, in 1996, 29 facilities were located in counties out-of-attainment for sulfur dioxide. In 2003, 20 were in non-attainment counties.

available at the beginning of our study period, for the period from 1991-1993. It is therefore only included in the participation equation. We define a set of location dummy variables to capture other statewide differences that may contribute to differences in participation rates or in changes in emissions for facilities in a state with a large concentration of metal finishing facilities (IL, TX, CA, OH, and MI).

3. Community/Environmental Pressure

In addition to facing regulatory pressures that vary by location, firms also face different community and environmental pressures. To capture potential differences in community pressure, we use two demographic characteristics from ECHO (based on US Census of Population and Housing), *PERCENT MINORITY* and *POPULATION DENSITY* (defined as the log of population density), in a three mile radius around the facility. We also include a third demographic variable, *AFFLUENT*, a dummy variable from InfoUSA that indicates whether a facility is located in an affluent neighborhood. The environmental justice literature argues that hazardous waste facilities are located in communities that are poorer, have more minorities, and are less dense (Boer et al., 1997; Goldman and Fitton, 1994). In addition to including these variables, Hamilton (1993, 1995) shows that firms which handle hazardous waste consider the potential for political action in a given community in their expansion decisions. Therefore, we also measure the environmental pressure that a facility may face using the total dues and contributions to environmental organizations by state collected annually by the National Center for Charitable Statistics of the Urban Institute. For the participation equation, we use *ENV GROUP CONTRIBUTIONS*, the log of environmental dues and contributions in 1996. For the emissions equation, we use the *CHANGE IN ENV GROUP CONTRIBUTIONS*, which is the difference in the log of total dues and contributions in 2001 (the last year for which we have these data) and 1996.

4. Facility and firm-specific characteristics

Firm and facility-specific characteristics make up the fourth set of variables that may influence either a facility's decision to join the SGP or its emissions behavior. Since the SGP was launched with the support of the National Association of Metal Finishers, we expect that member firms of this trade organization are more familiar with the program and hence more likely to join. Also, to the extent that poor environmental performance by a subset of firms casts a negative image on the industry as a whole, trade association groups have a significant interest in promoting the voluntary program (King, Lenox, and Barnett, 2001). We therefore identify whether the firm belongs to the National Association of Metal Finishers with the dummy variable *NAMF*.[19] We also identify firms that belong to the 33/50 program, Energy Star, or

[19] The list of firms that belong to *NAMF* is available on its website: www.namf.org.

WasteWise with the dummy variable *OTHER VAS*. Participating in one voluntary program may lead to participation in others (Arora and Cason, 1996; Alberini and Videras, 2000). To the extent that exposure to other voluntary agreements changes a facility's perception and actions with respect to the SGP, it also may be a relevant factor in explaining emissions behavior.

Other facility-specific information such as size, production level, and technology are no doubt important in predicting environmental behavior. For instance, larger facilities may be more visible and hence under more pressure from consumers, shareholders, and regulators (Arora and Cason, 1996; Welch et al., 2000), or they may be more environmentally responsive if economies of scale exist in implementing environmental protection activities (Dasgupta et al., 2000). Unfortunately, these factors are also the most difficult factors to measure. Since most firms in the metal finishing industry are private companies, financial data are often not available. From InfoUSA, we include *EMPLOYEE SIZE*, the log of the number of employees at the facility, and, *PUBLIC,* a dummy variable that indicates whether a facility is publicly or privately held.

5. Summary Statistics

According to the US Census of Manufacturers, there were 3,399 establishments in the metal finishing industry (SIC code 3471) in 1997. Of these, 771 facilities submitted full reports to the TRI in 1996. Our sample consists of 201 metal finishing facilities throughout the United States or 26 percent of those that reported to the TRI in 1996. These facilities met a number of criteria: (1) they were present in other datasets we utilized for the study, and (2) the facilities reported to the TRI in all study years (i.e. 1995, 1996, 2002, and 2003). The facilities in our sample are located in 40 of 48 states. However, five states - Illinois, California, Michigan, Ohio, and Texas – account for 48% of the facilities in our sample. Data from the US Census of Manufacturers confirm that this distribution is representative of the industry as a whole (Approximately 47% of the industry is located in one of these five states).

Total air emissions for metal finishers reporting to TRI have declined over the study period. In 1995 and 1996, total air emissions were approximately 2.3 million pounds, with 88 percent of emissions coming from point sources. Total air emissions from metal finishers decreased to a little over 1 million pounds by 2003, a 52 percent decrease from 1995 reported emissions. SGP participants experienced a more moderate decline in emissions over the same time period. Facilities that belong to the SGP emitted 225,000 pounds in 1995. By 2003, emissions had declined to 210,000 pounds, a mere 7 percent decline in total air emissions. The SGP goal for organic TRI releases was a 90% reduction from 1992 releases. If we examine the change in emissions from prior to the start of the program, we find that emissions for SGP members have actually increased overall between 1993 and 2003.

The summary statistics presented in Table 2 shed light on one possible reason why SGP participants did not see as great a decline in emissions as the industry as a whole. SGP members emit far less air pollution than the industry average. This is true across the entire study period. In 1995, SGP members emitted an average of 3,464 pounds into the air. Non-participants had average emissions more than four times that amount. By 2003, SGP members decreased average emissions to 3,214 pounds, a small decrease. While non-participants saw a vastly greater decline in average emissions over the same time period (a 57% decrease between 1995 and 2003), their 2003 emissions were still twice the average emissions of SGP participants. There also appears to be less variance in SGP participant emissions than there is for non-participants. This is confirmed when we calculate the coefficient of variation for SGP and non-SGP facilities (see Table 3). In each year, the coefficient of variation is substantially smaller for the SGP facilities than it is for the non-SGP facilities.

Table 4 presents summary statistics for the continuous independent variables in the participation and emissions equations. Note the following trends. As already mentioned, we see that the average amount of pollution emitted prior to the SGP, from 1993-1996, increased slightly for SGP participants and decreased slightly for non-participants. SGP participants also tend to have lower penalties but almost the same number of violations as non-participants, on average. SGP participants tend to have fewer employees than non-SGP participants. They tend to be located in states where environmental groups receive greater dues and contributions than do other facilities. Finally, SGP participants tend to have a higher proportion of releases that stem from MP&M chemicals. While both participants and non-participants have tended to decrease the proportion of their releases subject to the MP&M rule, participants decreased this proportion by about 5% on average while non-participants decreased this proportion by 1% on average. We do not identify any sizable differences in means between SGP participants and non-participants for the other variables.

Table 5 presents summary statistics for the independent dummy variables. We see that a higher percent of SGP participants are in counties that are in non-attainment prior to joining the SGP. However, there is little difference in the percent of participants and non-participants in counties that have gone back into attainment over the study period. SGP participants are also more likely to be members of the professional organization, NAMF, to belong to other voluntary agreements, and to be privately-held facilities. Finally, more SGP participants than non-participants are located in affluent neighborhoods.

6. Results

We present results from several sets of regressions in this section that are designed to address four questions. Section 6A seeks to answer the question of what factors affected a facility's decision to participate in the SGP voluntary program. Section 6B addresses the question, what factors affected facility TRI air emissions - explicitly targeted for reduction by the SGP –, and did the SGP play a role in affecting those emissions? Section 6C presents results that address the question of whether or not SGP made progress in reducing human exposure to toxic materials, also an explicit goal of the program? Finally, section 6D reexamines the participation decision to answer the question of whether low and high emitters view the SGP participation decision similarly.

6A. What Factors Affected a Facility's Decision to Participate in the SGP?

We begin by attempting to identify factors that affected a facility's voluntary decision to participate in the Strategic Goals Program. To this end, we run a series of probit regressions (see equation 3). Recall that the dependent variable, *SGP*, equals 1 if a facility participated in the SGP and 0 otherwise. There are two basic differences between the four sets of coefficient estimates presented in the Table 6. First, the regressions in columns (1) and (2) use point source air emissions to define the variables *TOTAL TRI RELEASES*, *MP&M RELEASES TO TOTAL RELEASES*, and *PRIOR REDUCTIONS*, while the regressions in columns (3) and (4) use total air emissions for these variables. Second, the regressions in columns (1) and (3) use all 201 observations, while the regressions in columns (2) and (4) rely on a subset of 168 observations based on facilities that reported to TRI in 1993 (See footnote 15). Corrections for heteroskedasticity were made using White's estimator of variance.

Notice that the results are quite robust across the four different specifications for most variables. In all cases, the sign of the coefficient does not change across specifications. However, the significance of two variables, *NON-ATTAINMENT* and *STATE REGULATIONS*, vary with the sample size: *NON-ATTAINMENT* is significant only for the full sample, while *STATE REGULATION* is significant only for the restricted sample. Also, the proportion of *MP&M RELEASES TO TOTAL RELEASES* is significant for three out of the four specifications. Second, notice that the pseudo R-squared is about 0.28 for the full sample and 0.31 for the restricted sample regressions.

To evaluate how accurately the regressors predict participation in the SGP we calculate the predicted probability and compare it to facilities' actual decisions. We find that overall the model correctly predicts the participation decision about 77% of the time. However, when we examine participants and non-participants separately, we find noticeable differences in our ability to predict the participation decision correctly. For instance, for total air emissions, using the full sample, the model correctly predicts when a facility will join the SGP only 57% of the time, while it correctly predicts when a facility will not join the SGP 86% of the time. In other words, based on the information available in our regressions the model accurately predicts non-participation but under-predicts participation. Some facilities join the SGP for reasons other than those for which we have controlled. It is possible that these reasons are particular to the firm, and therefore not easily captured in regression analyses that do not allow for facility-specific fixed effects. For instance, perhaps upper management has taken a personal interest in environmental issues or in program participation or perhaps EPA has a long-term relationship with the firms through other programs and rulemaking processes that affect the participation decision. Unfortunately, we cannot account for these idiosyncratic effects.

We now turn to a discussion of the key findings. First, variables included to account for possible emissions-related motivations for joining the program are generally not significant. *PRIOR REDUCTIONS* are included in the regressions to allow for the possibility that facilities that have already made progress in reducing emissions prior to the SGP would want to count these reductions as progress towards SGP goals, making it less costly for them to enjoy the benefits of the program and therefore more likely to join. The regression analysis fails to find evidence of this effect, confirming the indications from the summary statistics that this effect is not present. *TOTAL TRI RELEASES* in 1996 are included in the regressions to allow for the possibility that cleaner or more environmentally responsible firms may be more likely to join. Despite preliminary evidence from the summary statistics to suggest this might be the case, we find no confirmation of this effect in the regression analysis.

Several of the variables associated with the regulatory environment at the time facilities decided whether to participate in the SGP are significant. There is evidence that facilities respond to differences in regulatory stringency at the federal level: facilities that are located in a county out of attainment with federal air regulations are more likely to join the SGP. We note that the proportion of *MP&M RELEASES TO TOTAL RELEASES* is positive and significant for three out of four of the specifications. This confirms that antidotal evidence that the MP&M regulation played a role in early history of the Strategic Goals Program, with the proportion of a firm's emissions stemming from chemicals potentially subject to the MP&M rule positively affecting the likelihood of joining SGP. Larger penalties or a greater number of violations do not appear to affect a facility's SGP decision.[20] This may be because facilities do not view voluntary programs as having an impact on the amount of regulatory scrutiny they face from EPA. Finally, facilities located in states with more stringent environmental regulations are more likely to join the SGP, but this result is only significant in the restricted sample.

Two of the variables included to measure community pressure, *PERCENT MINORITY* and *POPULATION DENSITY,* are significant. A higher share of minorities in the neighborhood that surrounds a facility reduces the likelihood that the facility joins the SGP. However, facilities in denser neighborhoods are more likely to join the SGP. To the extent that these variables proxy for the degree of community pressure the facility faces to be a good corporate citizen, they both adhere to hypotheses in the literature (see Hamilton, 1995). A facility that is trying to minimize the costs of potential compensation to the community for environmental damages will be more likely to join a voluntary program (whether as cover for its behavior or to reduce emissions is unknown) in areas where there are more people to potentially compensate and where there are higher levels of collective action. The variable *AFFLUENT* is not significant. However, this variable may not suitably capture important differences in income level since it is a dummy variable. The variable associated with environmental pressure, *ENV GROUP CONTRIBUTIONS*, is positive and significant. The more dues and contributions received by environmental groups in the state, the more likely a facility in that state will join the SGP. The California and Illinois state dummy variables are generally negative and significant. In other words, a facility located in a state with a large number of metal finishing facilities is less likely to join the SGP. This may indicate that there are few spillovers across facilities within the same state with regard to the voluntary program.

Of the firm and facility characteristics included in the regressions, only *NAMF* is significant. Facilities that belong to the trade association are more likely to join the SGP. This finding adheres to expectations, since NAMF was actively involved in the creation of the voluntary agreement, advertised the SGP widely to its members, and encouraged them to join. While we hypothesized that larger facilities, facilities that had joined other voluntary programs, and facilities affiliated with public companies would be more likely to join the SGP, none of these variables are significant.

To examine the economic importance of the significant variables, the marginal effect of a change in a particular variable on the probability of joining the SGP is evaluated (see Table 7). For the purpose of

[20] This is also true for various permutations of this variable, including number of inspections and number of enforcement actions.

discussion, we refer to the marginal effects for equation 1. The largest marginal effect is associated with membership in the trade association, NAMF. Members are 37 percent more likely to join the SGP. Several other dummy variables also have large effects, with facilities located in counties that are in non-attainment 26 percent more likely to join the SGP, while those in California and Illinois are 26 and 18 percent less likely to join the SGP, respectively. Of the continuous variables, *PERCENT MINORITY* and *ENV GROUP CONTRIBUTIONS* have the largest effects. An increase of 1 percent in the proportion of minorities surrounding a facility decreases the likelihood of joining SGP by 0.37 percent, while a 1 percent increase in the state's environmental contributions increases the likelihood of joining the SGP by 0.24 percent. With a slightly smaller impact, a 1 percent increase in the proportion of MP&M releases to total releases increases the probability of joining the SGP by 0.15 percent. *POPULATION DENSITY* produces the smallest statistically significant marginal impact: a 1 percent increase in the surrounding population density increases the likelihood of a facility joining the SGP by 0.09 percent. The *STATE REGULATION* variable is slightly harder to interpret. This index ranges from 0.54 to 1.84 in our sample, with a mean value of 0.94. It is greater than one if the industry in that state spent more on pollution abatement then the industries in other states. Since a 1 percent increase in this variable evaluated at the mean is slightly less than 0.01, we can say that a 1 percent increase in a state's Levinson index increases the probably of facilities in that state joining the SGP by slightly less than 0.41 percent.

6B. What Factors Affect Facility TRI Air Emissions, and Did the SGP Play a Role in Affecting Those Emissions?

We next examine the results for the raw (i.e. non-toxicity weighted) emission changes regression. The dependent variable in this case is the difference in logs of average air emissions from 2002-2003 to 1995-1996. Care should be taken in interpreting the coefficient estimates: if a facility increases emissions over time, then the dependent variable is positive; if a facility reduces emissions over time then the dependent variable is negative. Table 8 presents the results. Similar to Table 6, the regressions in columns (1) and (2) use point source air emissions to define the dependent variable as well as the independent variables *CHANGE IN MP&M TO TOTAL RELEASES* and *TOTAL TRI RELEASES.* The regressions in columns (3) and (4) use total air emissions to define these variables. Second, columns (1) and (3) use all 201 observations, while columns (2) and (4) restrict the sample to 168 observations based on facilities that reported to TRI in 1993 (see footnote 15). Corrections for heteroskedasticity are made for all specifications using White's estimator of variance. The R-squared for the emissions equation ranges from 0.41 for the full sample to about 0.43 for the restricted sample.

Before discussing the results, recall that we include the predicted probability of joining the SGP as an independent variable in the regression. Previous literature (e.g., Hartmann 1988, Khanna and Damon 1999, and Welch et al. 2000) take a similar approach under the assumption that facilities that are most likely to join may also be the most likely to reduce emissions. If this is the case, including SGP participation directly in the emissions regression would result in biased estimates. A common solution in the literature has been to regress the participation decision on a set of independent variables and then to use the predicted probability of participation as an instrument for SGP participation in the emission equation. In our review of the literature, we found no case where the authors explicitly tested for the existence of such bias in the participation decision. We attempt to do so here and find that we can reject the null hypothesis that OLS without the instrumental variable approach is a consistent estimator for three out of the four specifications.[21] This result suggests that it is necessary to use the predicted probability of joining SGP when evaluating facility emissions behavior.

We begin by discussing whether the probability of joining the SGP had any effect on the change in average emissions from 1995-96 to 2002-03. The coefficient on the probability of joining the SGP is negative in all four cases: facilities with a high probability of joining the SGP reduce emissions by more than facilities with a low probability of joining. While this result appears to support the effectiveness of the SGP, it is only significant at the 10 percent level for the two point air emission specifications. It is also important to note that significance is not particularly robust to minor but alternate specifications of the model. We therefore conclude that the SGP has not been the driving force behind emission reductions. This result seems to lend itself to the hypothesis in the literature that facilities often join voluntary programs, perhaps with good intentions but make few real changes in behavior as a direct result of joining the program. We know from the summary statistics that SGP facilities, on average, emit far less initially than non-SGP facilities. This may mean that while relatively clean facilities derive some

[21] Our test for endogeneity is complicated by the fact that the participation decision is modeled using a probit. The standard approach when endogenity is suspected is to use the Durbin-Wu-Hausman test in which the variable suspected to be endogeneous is regressed on a set of instruments, and then both the residuals from this regression and the suspected variable itself are included in the subsequent regression. If the coefficient on the residuals is significantly different from zero, then the suspected variable is endogenous and the instrumental variable approach is warranted. However, this test is commonly conducted when the variable in question is linearly modeled. If we employ a standard OLS regression for our participation decision and conduct the standard test for endogenity, we reject the null hypothesis of a zero coefficient in three of the four cases. Only in the total air, restricted sample regression model do we fail to reject the null hypothesis. If we use a probit model for the participation decision, the interpretation of errors is more difficult. Davidson and MacKinnon (1993) show that including the predicted variables from a modeled instrument, rather than the residuals, and testing for the significance on this coefficient produces an equivalent result. Using the predicted values of our probit equation to test for endogeneity, we reject the null hypothesis for both point source emission models (and, thus, suspect endogenity), but fail to reject it for both total air emissions models.

benefit from joining the SGP, the program does not provide sufficient incentive to these facilities for further reductions in emissions.

Both variables associated with emissions-related program motivations, *TOTAL TRI RELEASES* and the *CHANGE IN MP&M TO TOTAL RELEASES,* are consistently significant across all specifications. *TOTAL TRI RELEASES* are negatively correlated with emission changes over the study period, whether the sample is constrained or the dependent variable is defined using total or point source air emissions. In other words, the dirtier the facility in 1996, the more progress it made in reducing its emissions over the next seven years. This result makes sense if we consider that dirtier facilities may be able to invest relatively little initially to make large reductions in emissions; cleaner facilities may have already addressed the "low-hanging fruit," the simplest and least costly reductions and therefore incur higher costs to reduce emissions further. The change in the proportion of total releases under threat of regulation from the 1995 and 2001 MP&M rules also is positively related to emission changes. This implies that the proposed MP&M regulation has had an effect on firm behavior: facilities that have reduced emissions of MP&M chemicals relative to total releases have made more progress in reducing air emissions over this time period. Coupled with the insignificant result on the predicted probability of joining the SGP, this result provides evidence that the voluntary program alone did not effectively replace the traditional policy tool, which here appears to be a large motivating factor for reducing emissions.[22]

Only one of the variables associated with regulatory pressure is significant across most specifications: *TOTAL INSPECTIONS*. The number of inspections a facility faced in 1995 and 1996 is negatively correlated with emission changes. This result is intuitive: facilities that historically have been inspected more frequently by EPA reduce their emissions by more than facilities that face less EPA oversight. The variable *TOTAL PENALTIES* has a small but positive effect on emission changes, a counter-intuitive result. However, this result is never significant. The dummy variable indicating a change in *NON-ATTAINMENT* status has a negative coefficient, but it is significant only for the regressions that rely on point source air emissions. Recall that no county changes from attainment to non-attainment over the time period. Thus, this variable indicates that facilities in counties that went into attainment reduced point air emissions more over the time period than facilities in counties where attainment status remained unchanged. State dummies are included to soak up any remaining differences due to changes in the state-

[22] Alternate specifications included an interaction term between the regulatory variable, *CHANGES IN MP&M TO TOTAL RELEASES*, and the voluntary program variable, *Probability of joining SGP,* as well as a variable capturing the level of *MP&M RELEASES TO TOTAL RELEASES*. Neither was significant nor changed the basic results of the regressions presented here.

level regulatory environment or other factors over the study period. None of these variables are consistently significant.

None of the variables included in the regressions to capture community or environmental pressure on the facility, *PERCENT MINORITY*, *POPULATION DENSITY*, and *CHANGE IN ENV CONTRIBUTIONS*, are significant for any of the specifications. While these variables may influence a facility's decision of whether to join the SGP, they do not appear to influence subsequent decisions of how much to reduce emissions.

Of the variables included to represent firm and facility characteristics, *EMPLOYEE SIZE* is positive and significant in all four specifications. We find that larger facilities reduce emissions less than smaller facilities. More relevant than employee size at a given point in time would be the change in the number of employees or in sales over the study period. With these data, we could control for growth in facility production over time. Unfortunately, we do not have access to such data.[23] Membership in the industry trade association, NAMF, which had a strong influence on a facility's decision to join the SGP, is significant for the two point air emission specifications. However, it is also positive, meaning that NAMF members make fewer reductions than non-members. In an alternate specification not presented here, we also examined the possibility that facilities that belonged to both NAMF and the SGP would respond differently than NAMF members that decided not to join the SGP. That variable was never significant nor did it affect the sign or significance of *NAMF*. Finally, if a facility is affiliated with a publicly listed firm, we find that it reduced emissions more than facilities owned by privately held firms. This result holds true for all four specifications but is significant only for the point air emission equations.

6C. Did the SGP Make Progress in Reducing Human Exposure to Toxic Materials?

The results discussed in the two previous sections examine the impact of the Strategic Goals Program on a facility's raw emissions. While we do not find strong evidence that the program had an effect on raw emissions, the program could still be a success if it encouraged facilities to reduce the risks associated with emissions. In particular, one of the SGP's seven goals is to reduce "human exposure to toxicity

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[23] Since we cannot control for production changes, we rely on one of the following assumptions: (1) output is constant over time, or (2) if output varies, the change in output is independent of SGP participation. While the first assumption may not be reasonable, there is reason to believe that the second assumption holds. In the metal finishing industry, "estimates in the mid-1990s placed environmental management costs at 10-14% of sales for U.S. job shop facilities" (Haverman, 1996). While SGP has the potential to affect a firm's cost at the margin, it is more likely that other, general market factors overwhelm any pollution-related cost expenditures. Perhaps the best evidence that SGP does not systematically create competitive advantages for firms is the fact that less than 10% of the industry joined the program.

materials in the facility and surrounding community." It is conceivable that the SGP encouraged firms to substitute away from relatively toxic into less toxic chemicals, which would result in a decrease in the potential harmfulness of a facility's emissions. To examine whether the SGP had a positive impact on human health and the environment through a relatively greater reduction in the toxicity-weighted emissions of its participants, we continue to rely on an empirical model similar to equation (5), but we now model $\Delta Y^*_{it} = \alpha \Delta D_{it} + \beta_2 \Delta X^*_{2it} + \Delta \varepsilon_{2it}$. Y^*_{it} still represents the level of air emissions for facility *i* at time *t*, however, we calculate the hazard level of a facility's emissions by using the EPA's Risk-Screening Environmental Indicators (RSEI) tool to weight emissions of chemicals by their toxicity levels before aggregating to the facility level. The dependent variable for the emission changes equation, ΔY^*_{it}, is defined as the difference in the log of the toxicity-weighted air emissions in 2002-2003 and the log of the toxicity-weighted air emissions in 1995-1996. As in equation (5), D_{it}, continues to represent participation in SGP. X^*_{2it} represents a vector of exogenous facility-specific variables, but several of the independent variables for the emission changes equation that appear in X_{2it}, *CHANGES IN MP&M TO TOTAL RELEASES* and *TOTAL TRI RELEASES,* have been weighted by toxicity. For the participation equation, the dependent variable continues to be modeled as defined in equation (3); however, *PRIOR REDUCTIONS, MP&M RELEASES TO TOTAL RELEASES,* and *TOTAL TRI RELEASES,* which are included in the vector of independent variables for the participation equation, X_{1it}, are also weighted by toxicity.

The results for the participation decision equation when *PRIOR REDUCTIONS, MP&M RELEASES TO TOTAL RELEASES,* and *TOTAL TRI RELEASES* are weighted by toxicity are very similar to those presented in Table 7 and are therefore not repeated here.[24] In other words, the signs and significance of factors affecting the decision of whether to participate in SGP appear to be largely unchanged when we account for differences in toxicity across chemicals.

The results for the emission changes equation when accounting for toxicity are presented in Table 9. Similar to the results based on raw emissions, the effect of the predicted probability of joining the SGP on the change in (toxicity weighted) emissions is negative: facilities with a high probability of joining the SGP reduce their toxicity weighted emissions by more than facilities with a low probability of joining. However, the result is not significant for any of the four specifications. Hence, we are unable to find evidence that the SGP had a consistently significant effect on either a firm's raw emissions or toxicity weighted emissions. Another common result shared between the models is the effect of the MP&M rule

[24] Results are available on request from the authors.

on raw and toxicity-weighted emissions. Facilities with the greatest reductions in MP&M releases relative to total releases experience the largest reductions in overall toxicity weighted emissions. Finally, we note that none of the significant and very few of the insignificant coefficients change sign when emissions are adjusted for toxicity.

There are several differences from the results for raw emissions (reported in Table 8) that are worth noting. First, many of the variables that were important predictors in the change in raw emissions are no longer significantly related to changes in emissions when adjusted for toxicity. For instance, *CHANGE IN NON-ATTAINMENT*, *NAMF*, and *TOTAL INSPECTIONS* are no longer significant for any specification reported in Table 9. Given that information most readily available to regulators as well as the regulated community is pounds of emissions, this result is not too surprising. For instance, EPA enforcement may target facilities that are "bad actors" or those that emit large amounts of emissions, but EPA enforcement may be unlikely to track changes in the relative risk of those emissions over time. A second difference between the raw emissions and toxicity weighted emission results is the magnitude of the coefficients for *CHANGE IN MP&M TO TOTAL RELEASES*. The coefficient on this variable is almost three times larger when emissions are weighted by toxicity. It is this effect that has the greatest explanatory power for changes in toxicity-weighted emissions. This is not an unexpected result since MP&M chemicals are, on average, four times more toxic than all other TRI chemicals emitted by metal finishing facilities. It appears that, to the extent that regulations such as the MP&M rule target relatively more harmful chemicals, they have a discernible effect not only on overall emissions but also on the toxicity of those emissions. Finally, the predictive power of all four regressions has increased from an adjusted R-squared of between 0.41 and 0.44 to between 0.61 and 0.65.

6D. SGP Participation: Small vs. Large Emitters

The literature posits a variety of reasons why facilities may choose to join a voluntary program. On the one hand, some firms may join a voluntary program to implement real steps to address environmental concerns in the hope of reducing costs or improving their environmental reputation and hence their market share. On the other hand, some firms may use participation in a voluntary program as a smokescreen to provide cover for failing to implement any real step to address poor environmental performance. Because the motivating factors of these two groups of facilities are so different, it is possible that we have a bimodal distribution in our sample: each group joins the SGP for fundamentally different reasons. By lumping facilities together and estimating a single regression, we may have a less reliable picture of the factors driving the participation decision than if we split the sample and estimate two separate regressions. Since the results of the participation model are used to create an instrument for the emissions regression, providing a better fit of the model (and hence a better instrument) may impact the results in the emissions regression. In this section, we explore the possibility of a bimodal distribution, by allowing the coefficients to differ between the two groups instead of forcing them to be identical. We do this by splitting the sample roughly in half based on facility total air emissions in 1995.[25] The relatively low emitters have average emissions of 154 pounds in 1995, while the relatively high emitters have average emissions of 24,610 pounds in 1995. It is therefore conceivable that these two groups of facilities would view the benefits and costs of joining a voluntary program differently. We run separate probit regressions for these two sets of facilities.

Before discussing the results it is worth noting that in spite of the summary statistics in Table 2 that show SGP participants emit far less initially than non-participants, we do not find that all SGP participants are in the half of the sample with lower emissions. Of 65 SGP participants, 31 are considered relatively low emitters, while 34 are categorized as relatively high emitters. This allows us to derive conclusions about factors affecting the participation decisions of facilities from both samples. Also, while we did explore splitting the sample in an equivalent manner for the emission reductions equation, we find that an F-test for the hypothesis that the regression results are significantly different for the two sub-samples is only significant for one of the four model specifications. Thus, the split sample results for the emissions reduction equation are not reported here.

Table 10 presents results for a set of probit regressions similar to regressions (1) and (3) in Table 6 but split between relatively low and high emitters. We note that we were unable to include several variables in the split-sample analysis: *TOTAL PENALTIES*, *PUBLIC*, and the state dummies for Texas and California. In each case, for one half of the sample no facilities meet the particular criterion (e.g., located in Texas), while for the other half of the sample all the facilities meet the criterion. Only the state dummy for California was significant in the overall sample regressions. In spite of this limitation, the regressions in Table 10 perform fairly well. The adjusted R-squared ranges from 0.32 to 0.33 for the smaller emitters, comparable to the regressions for the overall sample. For the larger emitters, we see a visible improvement in the explanatory power of the participation decision regression: the adjusted R-squared increases from approximately 0.3 to between 0.42 and 0.45. Our ability to correctly predict the participation decisions of facilities also improves for both samples, particularly for facilities that decide to join the SGP. For relatively low emitters, we correctly predict between 59 and 68 percent of those that

[25] Another way to split the sample is on the basis of emissions per unit of output or per employee prior to when the program started. Given data constraints such splits were not possible. The employment information from InfoUSA is for only one year, collected well after the start of the SGP. The output information from InfoUSA suffers from the same shortcoming and is also missing for a substantial number of observations.

join the SGP and between 84 and 87 percent of those that do not join. For relatively high emitters, we correctly predict between 65 and 71 percent of those that join the SGP and between 87 and 90 percent of those that do not join. An F-test confirms that the split sample approach is warranted for the participation decision: the regression results are significantly different across the two sub-samples at the 5% level for all four specifications.

Results are consistent across point air and total air emissions, so for purposes of discussion, we focus on the point air emission results in Table 10, specifications (1a) and (1b). A number of details are worth noting. First, many results continue to hold for the two sub-samples that were evident for the overall sample. For instance, variables such as *TOTAL TRI RELEASES* and *PRIOR REDUCTIONS* are still not significant predictors of SGP participation. Other variables, such as *PERCENT MINORITY* and *NAMF,* continue to be significant predictors of SGP participation for both sub-samples. Second, two variables that are not significant in the overall sample now appear to be significant for one of the two sub-samples. Membership in *OTHER VAS* and *STATE REGULATIONS* significantly increase the likelihood that larger emitters join the SGP. Third, several of the variables that are significant, positive predictors of SGP participation in the overall sample now appear to be significant for only one of the two sub-samples. The ratio of *MP&M RELEASES TO TOTAL RELEASES* and *NON-ATTAINMENT* status continue to significantly increase the likelihood that a relatively low emitting facility joins the SGP, while *POPULATION DENSITY* and *ENV GROUP CONTRIBUTIONS* continue to significantly increase the likelihood that a relatively large emitting facility joins the SGP.

While not reported in a table here, the marginal effects of a change in a particular variable on the probability of joining the SGP in the split sample do warrant brief mention. For the purpose of discussion, we again refer to specifications (1a) and (1b). As mentioned previously, *NAMF* continues to be important for both low and high emitters. For relatively high-emitting facilities, the marginal effect is quite similar to that for the overall sample (38 percent). However, if a relatively low-emitting facility is a NAMF member, it is 52 percent more likely to join the SGP. As expected, in cases where a variable is significant for only one of the two sub-samples, the marginal effect is typically larger for the sub-sample driving the effect then it is for the overall sample. For example, a low-emitting facility located in a non-attainment area is 70 percent more likely to join the SGP (compared to 26 percent in the overall sample). Finally, for variables that are not significant in the overall sample –stringency of state regulations and membership in other voluntary programs – a 1 percent increase in the measure for the stringency of state regulations increases the probability that a high-emitting facility will join the SGP by approximately 0.62

percent while membership in another VA increases the probability that a low-emitting facility will join the SGP by 41 percent.

Using our improved estimates for SGP participation based on our split sample results, we re-calculate the instrument for participation in SGP and re-run the raw emissions and toxicity-weighted emissions regressions. The results from these regressions are very similar to the previous results. In particular, participation in the SPG appears to have no significant impact on emissions behavior.

7. Conclusion

In this paper, we examine the decision of a facility to participate in the Strategic Goals Program (SGP) and the impact the SGP has on subsequent emissions behavior to evaluate whether participants reduce their emissions by more than non-participants. We use a probit model to examine factors that contribute to a facility's decision of whether to participate in the SGP. Finding evidence of endogeneity, we use the results of the probit equation to calculate the predicted probability of joining the SGP and include this variable on the right-hand side of the emission reductions equation, which is estimated using Ordinary Least Squares.

The probit estimation for the participation decision performs reasonably well and indicates that factors such as community characteristics (such as percent minority and population density), environmental pressure (proxied by environmental group dues and contributions), and membership in the professional organization, NAMF, matter. We find limited evidence that the proportion of emissions potentially subject to the proposed MP&M regulation is related to a facility's participation decision. One of the largest influences on the participation decision is membership in NAMF. To the extent that wide-spread participation in voluntary agreements in an objective of the EPA, this implies that EPA should work closely with industry groups in promoting future voluntary initiatives.

When we evaluate relatively low and high emitters separately, we find that several of these factors continue to be important for the participation decisions of both sub-samples (e.g., membership in NAMF, and percent minority). Several facility-specific factors (such as membership in other VAs) that do not have explanatory power in the overall sample appear to be important determinants of SGP participation for at least one of the sub-samples. Also in a number of cases, factors that are important in the overall sample (such as population density) do not matter equally for low and high emitters. When we use the split sample approach, our ability to correctly predict participation in the SGP improves for all facilities, especially those with relatively high emissions.

The emissions regression performs fairly well and demonstrates a number of intriguing results. First, we do not find robust evidence that the SGP had a significant impact on emission reductions. This result continues to hold when we adjust emissions to account for toxicity. This result seems to lend itself to the hypothesis in the literature that facilities often join voluntary programs, perhaps with good intentions, but they make no real changes in behavior as a direct result of joining the program. We know from the summary statistics that SGP facilities, on average, emit far less initially than non-SGP facilities. This may mean that while relatively clean facilities derive some benefit from joining the SGP, the program does not provide sufficient incentive to these facilities for further reductions in emissions. Future research should consider other benefits that firms may receive from participation in voluntary agreements.[26]

Two other emission-related variables are consistently important in explaining emission reductions of metal finishers reporting to the TRI, regardless of SGP participation. The dirtier a facility is just prior to the introduction of the SGP, the larger its reductions in emissions over the study period. Also, the larger the reduction in releases potentially subject to the MP&M rule as a proportion of total releases, the larger the reduction in emissions overall. One may make the case that the threat of regulation induced metal finishers, regardless of their participation in the SGP, to reduce emissions in a successful attempt at either avoiding or preparing for regulation. While the SGP does not appear to be directly related to emission reductions, it still may have played a subtle role in the rulemaking process, introducing into the discussion more flexible alternatives to regulation: while we cannot definitely identify the reasons, we know that metal finishers were successful in exempting themselves from the MP&M rule. Other variables related to emission reductions include a change in non-attainment status, employment size, the number of inspections a facility typically faces, whether a facility is publicly held, and membership in NAMF.

[26] This is not to imply that firms participating in the SGP are not making progress to their goals. The NMFRC websites reports very positive progress toward SGP goals by participants. There are a number of reasons why our result differs from those reported by NMFRC. First, and most importantly, we are looking at the statistical difference between SGP participants and non-participants, not measuring the progress of participants toward meeting SGP goals. Second, even among participants, the NMFRC and our study use a different sample of firms. While we use publicly available TRI data, NMFRC uses self-reported, program specific data. This data allows them to use a different base year and may include much smaller firms than are represented in TRI data.

Table 1: Summary of Independent Variables by Equation

Category	Variable	Definition	Participation Equation	Emissions Equation
Program Motivation	*TOTAL TRI RELEASES*	Ln(1996 air emissions)	√	√
	PRIOR REDUCTIONS	Ln(1996 air emissions) – Ln(1993 air emissions)	√	
Regulatory Environment	*MP&M RELEASES TO TOTAL RELEASES*	1995-96 air emissions subject to the 1995 MP&M rule/1995-96 total air emissions	√	
	CHANGE IN MP&M TO TOTAL RELEASES	(2002-03 MP&M emissions/2002-03 total emissions) – (1995-96 MP&M emissions/1995-96 total emissions)		√
	PENALTY HISTORY	Ln(proposed penalties, SEPs, & final assessed monetary penalties) over five years prior to SGP (1992-96)	√	
	VIOLATION HISTORY	Total number of violations over five years prior to SGP (1992-96)	√	
	TOTAL PENALTIES	Ln(proposed penalties, SEPS, & final assessed monetary penalties) in 1995-96		√
	TOTAL INSPECTIONS	Total number of RCRA inspections in 1995-96		√
	NON-ATTAINMENT	1 if the county in which facility is located was in non-attainment for SO_2 in at least 1 year from 1992-96	√	
	CHANGE IN NON-ATTAINMENT	1 if the county attainment status has changed from 1996 to 2001		√
	STATE REGULATIONS	Levinson index	√	
	STATE DUMMIES	Dummy variables for states with more than 20 facilities (MI, IL, OH, TX, CA)	√	√
Community/ Environmental Pressure	*PERCENT MINORITY*	Percent minority within 3 mile radius	√	√
	POPULATION DENSITY	Ln(population density within 3 mile radius)	√	√
	AFFLUENT	1 if the neighborhood is designated affluent	√	
	ENV GROUP CONTRIBUTIONS	Ln(1996 dues & contributions to environmental groups in a state)	√	
	CHANGE IN ENV CONTRIBUTIONS	Ln(2001 dues & contributions) – Ln(1996 dues & contributions)		√
Facility and Firm Specific Characteristics	*NAMF*	1 if a member of NAMF	√	√
	OTHER VAS	1 if belongs to 33/50, Energy Star, or WasteWise	√	√
	EMPLOYEE SIZE	Ln(number of employees)	√	√
	PUBLIC	1 if firm is public	√	√

Table 2: Average Total Air Emissions in SIC 3471 and 3479

	Total Sample (201 facilities)		SGP Participants (65 facilities)		SGP Non-Participants (136 facilities)	
Year	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
1995	11,226	55,619	3,464	7,782	14,935	67,166
1996	10,712	46,743	4,595	10,827	13,635	56,167
2002	6,867	28,301	3,472	7,816	8,470	33,904
2003	5,419	19,699	3,214	7,108	6,472	23,398
Figures are in pounds of releases. Source: Toxic Release Inventory						

Table 3: Coefficient of Variation for Total Air Emissions in SIC 3471 and 3479

Year	SGP Participants (65 facilities)	SGP Non-Participants (136 facilities)
1995	2.25	4.50
1996	2.36	4.12
2000	2.25	3.99
2001	2.21	3.62
= standard deviation/mean		

Table 4: Summary Statistics for Continuous Variables

Variable	Total Sample (201 facilities)		SGP Participants (65 facilities)		Non-Participants (136 facilities)	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
TRI Emissions in 1996 (pounds)[a,b]	10,712	46,743	4,595	10,827	13,635	56,167
Change in TRI Emissions from 1993 to 1996 (pounds)[a, b]	-1,412	31,151	2,497	9,049	-3,281	37,255
MP&M Emissions in 1995-96 divided by Totol Emsissions in 1995-96[b]	0.38	0.46	0.43	0.47	0.36	0.46
Change in MP&M Emisssions to Total Emissions from 1995-96 to 2002-03[b]	-0.03	0.32	-0.05	0.34	-0.01	0.31
Total Penalties from 1992 to 1996[a]	$2,024	$12,775	$946	$6,857	$2,539	$14,788
Number of Violations from 1992 to 1996	2.16	3.69	2.17	3.73	2.16	3.68
Levinson Index	0.94	0.18	0.94	0.18	0.94	0.18
Percent Minority within a 3 mile radius	0.37	0.25	0.35	0.25	0.37	0.26
Population Density within a 3 mile radius[a]	4,664	4,778	4,718	3,487	4,639	5,296
Total Environmental Group Contributions in 1996 (millions)[a]	$45.7	$60.6	$59.8	$71.4	$38.9	$53.6
Change in Environmental Group Contributions, 1996 to 2001 (millions)[a]	-$5.5	$24.1	-$6.9	$3.1	-$4.8	$19.8
Number of Employees[a]	95	110	86	65	99	126

[a] Reported in natural units (e.g. pounds, dollars) not the units used in the regressions (e.g. logs).
[b] Reported using total (point and non-point) emissions. A similar relationship is found for point emissions.

Table 5: Summary Statistics for Dummy Variables

Variable	Total Sample (201 facilities)	SGP Participants (65 facilities)	Non-Participants (136 facilities)
Facilities in non- attainment counties	14%	18%	12%
Facilities in counties that changed attainment status between 1996 and 2001	3%	5%	3%
Facilities in affluent neighborhood	18%	22%	16%
Members of NAMF	49%	80%	35%
Participate in other voluntary programs	8%	12%	7%
Publicly traded firms	4%	2%	6%

Table 6: Coefficient Estimates for the SGP Participation Equation

		Point Air		Total Air	
		Full Sample	**Restricted Sample**	**Full Sample**	**Restricted Sample**
Variables		**(1)**	**(2)**	**(3)**	**(4)**
TOTAL TRI RELEASES		0.01 (0.04)	0.04 (0.04)	-0.02 (0.04)	-0.01 (0.04)
PRIOR REDUCTIONS		0.05 (0.05)	0.01 (0.07)	0.05 (0.05)	0.02 (0.08)
MP&M RELEASES TO TOTAL RELEASES		0.48 * (0.29)	0.68 ** (0.32)	0.37 (0.26)	0.59 * (0.31)
PENALTY HISTORY		-0.05 (0.05)	-0.05 (0.06)	-0.06 (0.05)	-0.05 (0.05)
VIOLATION HISTORY		0.02 (0.03)	0.04 (0.04)	0.03 (0.03)	0.05 (0.04)
NON-ATTAINMENT		0.75 * (0.39)	0.67 (0.41)	0.70 * (0.37)	0.59 (0.39)
STATE REGULATIONS		1.35 (0.88)	1.81 ** (0.90)	1.18 (0.86)	1.66 ** (0.83)
PERCENT MINORITY		-1.22 * (0.65)	-1.53 ** (0.73)	-1.43 *** (0.68)	-1.80 ** (0.74)
POPULATION DENSITY		0.28 ** (0.14)	0.40 *** (0.15)	0.28 ** (0.13)	0.38 ** (0.15)
AFFLUENT		-0.01 (0.30)	-0.18 (0.38)	-0.03 (0.30)	-0.14 (0.34)
ENV GROUP CONTRIBUTIONS		0.78 *** (0.21)	0.80 *** (0.22)	0.81 *** (0.20)	0.85 *** (0.22)
NAMF		1.25 *** (0.26)	1.17 *** (0.29)	1.20 *** (0.26)	1.13 *** (0.30)
OTHER VAS		0.31 (0.35)	0.37 (0.42)	0.34 (0.35)	0.40 (0.42)
EMPLOYEE SIZE		0.07 (0.14)	-0.09 (0.17)	0.12 (0.14)	0.04 (0.17)
PUBLIC		-0.38 (0.47)	-0.31 (0.49)	-0.27 (0.46)	-0.16 (0.46)
IL		-0.71 * (0.36)	-0.81 * (0.42)	-0.65 * (0.36)	-0.74 * (0.41)
CA		-1.51 ** (0.68)	-0.97 (0.76)	-1.61 ** (0.68)	-1.08 (0.75)
MI		0.18 (0.37)	0.09 (0.41)	0.19 (0.37)	0.10 (0.42)
OH		-0.54 (0.39)	-0.62 (0.41)	-0.46 (0.38)	-0.48 (0.40)
TX		-0.50 (0.77)	-0.80 (0.86)	-0.20 (0.78)	-0.51 (0.85)
Constant		-18.08 *** (4.10)	-19.06 *** (4.28)	-18.34 *** (3.99)	-19.89 *** (4.33)
Observations		201	168	201	168
Log likelihood		-90.31	-72.54	-90.65	-73.09
Correctly predicted	Participants	54%	56%	57%	61%
	Non-participants	85%	89%	86%	87%
Pseudo R^2		0.29	0.31	0.28	0.31

Dependent Variable: Participation in SGP; equals 1 if firm participates in SGP, equal to 0 otherwise.
The number of stars indicates the level of significance of a coefficient: * means it is significant at 10%; ** means it is significant at 5%; and *** means it is significant at 1%. Robust standard errors are listed in parentheses.

Table 7: Marginal Effects for Variables Significantly Affecting SGP Participation

	Point Air		Total Air	
	Full Sample	Restricted Sample	Full Sample	Restricted Sample
Variables	**(1)**	**(2)**	**(3)**	**(4)**
MP&M RELEASES TO TOTAL RELEASES	0.15 * (0.09)	0.20 ** (0.09)	0.11 (0.08)	0.17 * (0.09)
NON-ATTAINMENT	0.26 * (0.15)	0.23 * (0.15)	0.24 * (0.14)	-0.20 (0.14)
STATE REGULATIONS	0.41 (0.27)	0.54 ** (0.27)	0.36 (0.26)	0.49 ** 0.24
PERCENT MINORITY	-0.37 * (0.20)	-0.45 ** (0.21)	-0.43 *** (0.21)	-0.53 ** (0.21)
POPULATION DENSITY	0.09 ** (0.04)	0.12 *** (0.04)	0.08 ** (0.04)	0.11 ** (0.04)
ENV GROUP CONTRIBUTIONS	0.24 *** (0.06)	0.24 *** (0.06)	0.24 *** (0.06)	0.25 *** (0.06)
NAMF	0.37 *** (0.07)	0.34 *** (0.08)	0.35 *** (0.07)	0.32 *** (0.08)
IL	-0.18 * (0.08)	-0.19 * (0.08)	-0.16 * (0.08)	-0.18 * (0.08)
CA	-0.26 ** (0.05)	-0.19 (0.09)	-0.26 ** (0.05)	-0.20 (0.07)

Table 8: Coefficient Estimates for the Raw Emissions Reduction Equation

	Point Air		Total Air	
	Full Sample	Restricted Sample	Full Sample	Restricted Sample
Variables	**(1)**	**(2)**	**(3)**	**(4)**
Probability of joining SGP	-1.79 * (1.07)	-1.54 * (0.93)	-1.27 (0.92)	-0.50 (0.87)
TOTAL TRI RELEASES	-0.19 *** (0.05)	-0.17 *** (0.05)	-0.29 *** (0.06)	-0.26 *** (0.06)
CHANGE IN MP&M TO TOTAL RELEASES	3.15 *** (0.45)	3.41 *** (0.49)	3.15 *** (0.51)	3.41 *** (0.51)
TOTAL PENALTIES	0.02 (0.04)	0.04 (0.05)	0.03 (0.04)	0.03 (0.05)
TOTAL INSPECTIONS	-0.15 (0.12)	-0.22 * (0.13)	-0.26 * (0.14)	-0.32** (0.14)
CHANGE IN NON-ATTAINMENT	-1.35 * (0.74)	-1.71 * (0.89)	-0.79 (1.12)	-0.74 (1.40)
PERCENT MINORITY	-0.25 (0.88)	-0.24 (0.81)	0.41 (0.89)	0.73 (0.76)
POPULATION DENSITY	-0.05 (0.20)	-0.01 (0.16)	-0.10 (0.18)	-0.16 (0.13)
CHANGE IN ENV CONTRIBUTIONS	0.18 (0.239)	0.13 (0.44)	0.00 (0.44)	0.15 (0.52)
NAMF	1.05 * (0.55)	0.97 ** (0.48)	0.74 (0.46)	0.57 (0.42)
OTHER VAS	0.24 (0.40)	0.47 (0.33)	0.18 (0.44)	0.27 (0.30)
EMPLOYEE SIZE	0.44 ** (0.17)	0.34 ** (0.17)	0.37 ** (0.18)	030 * (0.16)
PUBLIC	-1.46 * (0.77)	-1.38 * (0.76)	-0.72 (0.53)	-0.70 (0.49)
IL	-0.39 (0.46)	-0.87 (0.457)	-0.71 (0.61)	-0.45 (0.60)
CA	-0.64 (0.560)	-1.06 (0.94)	-2.04 *** (0.78)	-1.54 (1.06)
MI	-1.04 (0.66)	-0.20 (0.53)	-0.45 (0.43)	-0.21 (0.48)
OH	-0.10 (0.44)	-0.80 * (0.42)	-0.77 (0.50)	-0.36 (0.43)
TX	-0.61 (0.50)	0.43 (0.83)	-0.45 (0.71)	-0.52 (0.91)
Constant	-0.52 * (1.66)	-0.62 * (1.30)	1.18 (1.62)	1.43 (1.21)
R-squared	0.41	0.44	0.41	0.43
Observations	201	168	201	168

Dependent Variable: Log average air emissions in 2002-2003 minus log average air emissions in 1995-1996. Note that * indicates a coefficient is significant at 10%; ** indicates it is significant at 5%; and *** indicates it is significant at 1%. Robust standard errors are listed in parentheses.

Table 9: Coefficient Estimates for the Toxicity-Weighted Emissions Reduction Equation

	Point Air		Total Air	
	Full Sample	**Restricted Sample**	**Full Sample**	**Restricted Sample**
Variables	**(1)**	**(2)**	**(3)**	**(4)**
Probability of joining SGP	-2.62 (1.95)	-2.55 (2.00)	-2.01 (1.58)	-1.23 (1.63)
TOTAL TRI RELEASES	-0.19 *** (0.05)	-0.17 *** (0.06)	-0.31 *** (0.08)	-0.30 *** (0.09)
CHANGE IN MP&M TO TOTAL RELEASES	9.42 *** (0.90)	9.32 *** (1.02)	8.99 *** (0.87)	8.96 *** (0.92)
TOTAL PENALTIES	0.00 (0.08)	0.05 (0.09)	0.02 (0.07)	0.05 (0.09)
TOTAL INSPECTIONS	-0.04 (0.20)	-0.11 (0.20)	-0.28 (0.26)	-0.36 (0.26)
CHANGE IN NON-ATTAINMENT	-1.93 (1.23)	-2.56 (1.57)	-1.57 (1.67)	-1.82 (2.16)
PERCENT MINORITY	-1.49 (1.37)	-1.71 (1.36)	-0.99 (1.23)	-0.44 (1.25)
POPULATION DENSITY	0.10 (0.31)	0.31 (0.32)	-0.06 (0.26)	-0.09 (0.24)
CHANGE IN ENV CONTRIBUTIONS	0.01 (0.81)	-0.12 (0.91)	-0.36 (0.79)	-0.41 (0.92)
NAMF	1.54 (0.95)	1.46 (0.94)	1.08 (0.85)	0.88 (0.84)
OTHER VAS	0.29 (0.54)	0.56 (0.56)	0.40 (0.49)	0.47 (0.49)
EMPLOYEE SIZE	0.56 ** (0.22)	0.45 (0.23)	0.22 * (0.24)	0.08 (0.23)
PUBLIC	-1.08 (0.77)	-0.87 * (0.76)	-0.85 (0.46)	-0.69 (0.47)
IL	-1.16 (0.94)	-1.84 * (0.95)	-1.11 (0.85)	-1.42 (0.90)
CA	-2.16 * (1.15)	-1.81 (1.61)	-2.88 ** (1.27)	-2.33 (1.71)
MI	0.06 (0.65)	-0.24 (0.76)	-0.89 (0.92)	-0.98 (1.10)
OH	-0.43 (0.88)	-1.04 (0.78)	-1.15 (0.70)	-0.80 (0.70)
TX	1.39 * (0.82)	1.29 (0.95)	0.50 (0.85)	0.25 (0.89)
Constant	-0.98 (2.61)	-2.01 (2.69)	3.85 (2.56)	4.11 (2.48)
R-squared	0.63	0.61	0.65	0.64
Observations	201	168	201	168

Dependent Variable: Log average toxicity-weighted air emissions in 2002-2003 minus log average toxicity-wieghted air emissions in 1995-1996.
Note that * indicates a coefficient is significant at 10%; ** indicates it is significant at 5%; and *** indicates it is significant at 1%. Robust standard errors are listed in parentheses.

Table 10: SGP Participation for the Sample Split between Low & High Emitters

		Point Air - Full Sample		Total Air - Full Sample	
		Low Emitters	High Emitters	Low Emitters	High Emitters
Variables		**(1a)**	**(1b)**	**(3a)**	**(3b)**
TOTAL TRI RELEASES		-0.06 (0.07)	0.12 * (0.07)	0.01 (0.07)	0.06 (0.15)
PRIOR REDUCTIONS		0.14 (0.09)	0.00 (0.07)	0.07 (0.08)	0.06 (0.07)
MP&M RELEASES TO TOTAL RELEASES		0.74 * (0.42)	0.40 (0.52)	0.83 ** (0.38)	-0.02 (0.68)
VIOLATIONS HISTORY		-0.01 (0.04)	0.05 (0.06)	-0.01 (0.04)	0.05 (0.07)
NON-ATTAINMENT		2.06 *** (0.49)	0.16 (0.54)	2.14 *** (0.52)	0.45 (0.56)
STATE REGULATIONS		0.80 (0.86)	2.41 * (1.24)	1.17 (0.79)	2.18 * (1.19)
PERCENT MINORITY		-2.10 ** (0.95)	-1.43 (1.11)	-2.53 ** (0.93)	-2.11 ** (1.04)
POPULATION DENSITY		0.26 (0.23)	0.50 *** (0.18)	0.28 (0.26)	0.44 ** (0.20)
AFFLUENT		-0.39 (0.41)	-0.35 (0.53)	-0.44 (0.43)	-0.20 (0.55)
ENV GROUP CONTRIBUTIONS		0.21 (0.17)	1.34 *** (0.46)	0.18 (0.17)	1.38 *** (0.45)
NAMF		1.93 *** (0.35)	1.50 *** (0.46)	1.95 *** (0.39)	1.19 *** (0.44)
OTHER VAS		-0.98 (0.63)	1.21 ** (0.48)	-0.95 (0.62)	1.42 *** (0.53)
EMPLOYEE SIZE		0.34 (0.22)	-0.25 (0.22)	0.35 (0.22)	-0.15 (0.21)
IL		-0.47 (0.43)	-0.38 (0.56)	-0.54 (0.46)	-0.13 (0.59)
MI		-0.36 (0.55)	1.12 (0.78)	-0.15 (0.54)	1.38 * (0.72)
OH		-2.13 *** (0.66)	0.82 (0.62)	-2.00 *** (0.61)	0.61 (0.61)
Constant		-8.57 *** (3.61)	-30.22 *** (8.84)	-8.89 *** (3.95)	-30.17 *** (9.38)
Observations		110	91	110	91
Log likelihood		-46.11	-31.91	-45.33	-33.68
Correctly predicted	Participants	59%	71%	68%	65%
	Non-participants	84%	90%	87%	87%
Pseudo R^2		0.32	0.45	0.33	0.42

Dependent Variable: Participation in SGP; equals 1 if firm participates in SGP, equal to 0 otherwise.
The number of stars indicates the level of significance of a coefficient: * means it is significant at 10%; ** means it is significant at 5%; and *** means it is significant at 1%. Robust standard errors are listed in parentheses.

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