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The Appeal of Voluntary Environmental Programs:
Which Firms Participate and Why?

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**THE APPEAL OF VOLUNTARY ENVIRONMENTAL PROGRAMS:
WHICH FIRMS PARTICIPATE AND WHY?**

By

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ABSTRACT

What are the reasons why firms participate in EPA's voluntary environmental programs? While EPA traditionally emphasizes the publicity aspect of participation and the possibility of benefiting from shared information about energy use or emissions reduction practices, earlier studies have suggested a number of other reasons, such as (i) to appeal to consumers who demand "green" products, and are willing to pay more for them; (ii) to preempt government regulation; (iii) to seek regulatory or compliance relief from the agency; and (iv) to gain a competitive advantage over competitors.

In this paper, we examine the determinants of participation in voluntary environmental programs, focusing on testing hypotheses (i), and (iii). We also examine hypothesis (ii), the effect of the voluntary programs' regulatory stringency and the visibility of firm participation to regulators and consumers, but in a different sense than in previous literature. Rather than focusing on one program, and simply controlling for the regulatory background of the industry the firm belongs to, we focus on a specified universe of firms (manufacturing firms among the large, publicly traded companies in the Standard and Poor 500), and analyze participation of these firms in each of three, very different, EPA voluntary programs (33/50, Green Lights and WasteWiSe).

Using firm-level data, we fit a bivariate probit model with a sample selection correction. We find that (i) publicity is an important component of participation; (ii) the worse the environmental track record of the firm, the more likely is a firm

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to participate, but only in programs directly related to highly regulated pollutants; and that (iii) firms which scrutinize their environmental performance more carefully are wary of newer programs with uncertain reach of the public and uncertain benefits. We also find some evidence broadly consistent with the notion that the information and technology transfer aspect of joining a program is valued by firms.

1. Introduction

In the early 1990s, the U.S. Environmental Protection Agency (EPA) initiated an alternative approach to environmental regulation based on voluntary pollution prevention programs, as opposed to command-and-control regulation. There are currently over a dozen voluntary environmental programs, and thousands of participating firms. These programs differ widely in their specific goals and requirements, with some – but not all – of the pollutants they address simultaneously being covered by extensive regulation.

While EPA traditionally emphasizes the publicity aspect of participation and the possibility of benefiting from shared information about energy use or emissions reduction practices, earlier empirical and theoretical studies have proposed a number of other reasons for firms to join. These include: (i) to appeal to consumers who demand “green” products, and are willing to pay more for them (Arora and Gangopadhyay, 1995; Arora and Cason, 1995, 1996; Khanna and Damon, 1999); (ii) to preempt government regulation (Segerson and Miceli, 1998; Maxwell et al, 1998); (iii) to seek regulatory or compliance relief from the agency, and show the agency that the company has improved its environmental performance (or intends to); and (iv) to gain a competitive advantage over competitors.

In this paper, we examine the determinants of participation in voluntary environmental programs, focusing on testing hypotheses (i) and (iii). We also examine hypothesis (ii), the effect of the voluntary programs' regulatory stringency and the visibility of firm participation to regulators (and consumers), but in a different sense than in previous literature. Rather than focusing on one program, and controlling for the regulatory background of the *industry* the firm belongs to, we focus on a specified universe of firms (manufacturing firms among the large, publicly traded companies in the Standard and Poor 500), and analyze participation of these firms in each of three EPA voluntary programs. We choose 33/50, Green Lights and WasteWiSe, because they address pollutants with very different regulatory stringency. In addition, while 33/50 and Green Lights are EPA's flagship programs, WasteWiSe is a younger and less established initiative. We therefore attempt to find if these programs appeal to firms with different characteristics. In doing so, we control for corporate concern for environmental performance and reputation.

Using data at the firm level from the Investor Responsibilities Research Center (IRRC) and Compustat, we fit a bivariate probit model with a sample selection correction. We find that (i) publicity is an important component of participation; (ii) the worse the environmental track record of the firm, the more likely is a firm to participate, but only in programs directly related to highly regulated pollutants; and that (iii) firms which scrutinize their environmental performance more carefully are wary of newer programs with uncertain benefits.

We also find some evidence broadly consistent with the notion that the information and technology transfer aspect of joining a program *is* valued by firms.

The remainder of the paper is organized as follows. Section 2 reviews the theoretical and empirical literature on self-regulation and environmental programs. Section 3 describes 33/50, Green Lights and WasteWiSe. We describe our data in section 4. In section 5 we present the econometric models, and in section 6 the choice of independent variables. Section 7 presents the results, and section 8 concludes.

2. Theoretical and Empirical Models of Environmental Self-Regulation

The Pollution Prevention Act of 1990 fostered voluntary programs to promote pollution prevention as a business strategy. Most of EPA's voluntary programs require firms to: (1) sign an agreement with the EPA; (2) designate a person responsible for overseeing implementation and maintaining contact with the EPA; (3) identify cost-effective opportunities to contribute to the program's goal, (4) establish goals, and (5) monitor and report progress towards fulfilling those goals. On its part, the EPA emphasizes that firms participating in its voluntary programs will benefit from public recognition and technical assistance to identify opportunities and achieve goals. Programs are flexible: there is no fee to join, no additional regulation, and firms can drop the programs at any moment without being penalized. At the end of 1996, over 6,800 organizations

were participating in one or more voluntary programs.

What are the reasons why firms participate in voluntary environmental programs? It has been suggested that they do for a number of possible reasons: (i) to appeal to consumers who demand “green” products; (ii) to preempt government regulation; (iii) to seek regulatory or compliance relief from the agency, and show the agency that they have improved their environmental performance (or intend to); and (iv) to gain a competitive advantage over competitors.

The first reason is modeled in Arora and Gangopadhyay (1995). There is a standard model of vertical differentiation in which all consumers derive the same surplus from the good but marginal rates of substitution between income and quality differ across consumers. Equilibria in this game result in environmental quality differentiation, with one firm overcomplying to attract wealthier consumers. Arora and Cason’s empirical models of firm participation in EPA’s 33/50 (1995, 1996) indeed find that proximity to final consumers (proxied by advertising expenditure) is a significant predictor of participation. Similarly, Khanna and Damon (1999) find that among firms in the chemical sector, those producing consumer goods are more likely to participate in 33/50.

Preemption as a factor for environmental overcompliance is theoretically explored in Maxwell *et al.* (1998) who explain voluntary pollution abatement as a response to the threat of environmental regulation. In the first stage of a game, firms choose the level of pollution abatement they wish to undertake. In the

second stage, environmental standards are the outcome of a political influence game between consumers and firms. In the last stage of the game, firms compete in a Cournot fashion. When consumers are able to participate in the political game but firms can preempt them from entering, it becomes profitable for firms to voluntarily abate pollution to prevent passage of more stringent regulation. Under these conditions, an increasing threat of environmental regulation is expected to induce firms to self-regulate.

In Segerson and Miceli (1998), the threat of environmental regulation is exogenously determined and uncertain. The authors analyze under what circumstances a voluntary agreement is the result of a bilateral negotiation between the regulator and a polluting firm. They demonstrate that a legislative threat occurring with strictly positive probability is sufficient to attain a voluntary agreement. Further, the level of abatement under the voluntary program is directly related to the magnitude (probability) of the threat.

The main positive implication from the Maxwell *et al.*, and Segerson and Miceli's models is that implementation and success of a voluntary agreement depend on the strength of the legislative threat. As a result, one would expect a weaker response (both in participation and goals achieved) to programs with looser regulatory background. In earlier empirical studies, regulatory background was approximated using the average pollution abatement capital expenditures (PACE) for the firm's industry (Arora and Cason, 1996).

The empirical evidence is mixed for hypothesis (iii), that firms join environmental programs to obtain compliance or regulatory relief from the agency. Arora and Cason (1996) find that fines charged to firms for past violations of the Clean Air Act do not affect the likelihood of participation in 33/50, but Khanna and Damon (1999) report that chemical firms with a history as responsible parties at Superfund sites *are* more likely to participate in 33/50.¹

Regarding reason (iv), Arora and Cason (1995) speculate that industry structure may be an important determinant of participation in 33/50, but do not find it to be a significant predictor of participation in this program.

Finally, other streams of literature have examined the importance of corporate social and environmental concerns in setting environmental performance goals. Winn (1995) conducts a four-cases study identifying organizational design, history of social responsibility, and the presence of individuals (“champions”) who advocate the introduction of environmental concerns into the corporate culture as the driving forces, all originating within the organization, for self-regulation. Henriques and Sardosky (1996) test empirically the impact of *internal* and *external* pressures on a firm’s responsiveness to environmental issues. The results suggest that customers, shareholders, government regulation, and community pressures affect the likelihood of developing a formal environmental policy.

¹ Khanna and Damon interpret this result as providing support for hypothesis (ii).

To sum, these arguments suggest that empirical models of firm participation in EPA's voluntary programs should control for proximity to consumers, stringency of the regulatory background affecting firm operation, and firm compliance record. As suggested by DeCanio and Watkins (1998), firm participation may also be influenced by company size, profitability, future profitability prospect, cost of accessing capital and ability to innovate. Participation may also reflect corporate environmental culture.

In this paper we report the results of empirical analyses of firm participation in voluntary programs that do control for these factors and specifically examine hypotheses (i) and (iii). We also examine the effect of the environmental regulatory background a firm is faced with (hypothesis (ii)), but in a different sense than in earlier literature: We separately analyze participation in *three* environmental programs – 33/50, Green Lights, and WasteWiSe – that differ by their more or less recent implementation and widespread recognition, and by their coverage of pollutants with very different regulatory background.

Specifically, while 33/50 deals with highly regulated substances/wastes, the latter two programs address forms of pollution that have traditionally relied on voluntary abatement, rather than mandatory measures. While Green Lights is a mature, well-established program, WasteWiSe remains relatively new, and relatively less known to consumers. Our separate analyses therefore attempt to find out if the attributes of these programs appeal to different types of firms.²

² To further elaborate on this point, Arora and Cason (1996) control for difference in the regulatory burden across industries (e.g., the textile industry faces less stringent regulations than pulp and paper mills). By

The main features of these programs are summarized in table 1, and the specifics are described in the next section.

3. Three Voluntary Programs

A. WasteWiSe

WasteWiSe was conceived in 1992 by the Office of Solid Waste and Emergency Response. Through consultation with businesses, EPA designed a free, voluntary program that allows organizations to set their own waste reduction goals. The program was launched January 1, 1994. The aim is the reduction of solid waste such as office paper, corrugated containers, yard trimmings and packaging. Participants sign on the program for a 3-year period. At the end of the three-year period, partners may quit the program or recommit as senior partners. Participants commit to identify cost-effective opportunities, establish reduction goals within 6 months of joining and update EPA on their accomplishments annually. Specifically, participants commit to set three waste prevention goals, one recycling collection goal, and one goal focusing on buying or manufacturing recyclables.

contrast, we compare programs dealing with pollutants with different regulatory frameworks and regulations of different stringency. Compare for instance the heavy metals and hazardous chemicals covered by 33/50, which are also subject to a variety of air quality, water quality and hazardous waste regulations and reporting requirements, and greenhouse gases (the ultimate target of Green Lights) for which only voluntary agreements have been attempted. Our econometric models still control for inter-industry variation in regulatory stringency for a given pollutant (or class of pollutants) by including industry dummies (see section 6).

The EPA conceived WasteWi\$e to appeal to all types of companies. Nearly 370 companies, located nationwide and representing a broad variety of industrial sectors, joined the program in 1994 (EPA, 1995).

B. Green Lights

Green Lights was launched in 1991. It aims to optimize energy efficiency in lighting systems in businesses and organizations in order to reduce greenhouse gas emissions. A partner joins Green Lights by signing a memorandum of understanding with the EPA. Participants agree to survey 100 percent of their facilities, and to upgrade within 5 years 90 percent of the square footage that can be upgraded profitably without compromising lighting quality. Participants must select the option with the highest earning savings while also yielding an internal rate of return of 20 percent or higher. In return the EPA provides technical expertise, information on the availability of rebates and sources of financing, information provided by other participants and allies, and publicity materials.

As of 1998, over 2500 partners, including large corporations, small businesses, and universities, had reduced their energy use by 4.7 billion-kilowatt hours, saving annually more than \$341 million.

C. 33/50

The EPA launched 33/50 In February of 1991. The goal of this program was the aggregate (*not* plant- or firm-level) reduction of releases and transfers of 17 chemicals by 33 percent in 1992 and by 50 percent in 1995, relative to baseline 1988 levels. The 33/50 chemicals were selected on the basis of toxicity, volume of industrial use and potential for reduction through pollution prevention, and include, among others, halogenated solvents and heavy metals, substances that are subject to extensive regulation as hazardous wastes, water pollutants and hazardous air pollutants or ozone precursors. This program was implemented in different waves, with EPA inviting firms in the initial waves, and then opening up participation to other qualifying firms in later waves. Companies joined by submitting individual commitments to reduce toxic releases. Once 1995 data revealed 33/50 accomplished its goals, the program ended with 1300 recognized partners.

4. The data

The data we use in our empirical analyses was collected by the Investors Responsibility Research Center (IRRC) from assorted sources, including direct surveys and EPA databases. The IRRC dataset documents the environmental performance of Standard & Poor 500, US-based firms over the years 1992-1998. Among other things, firms were queried about whether (i) they subscribe to an

environmental code of conduct developed by an outside organization; (ii) environmental performance is a factor in senior or operating management compensation; (iii) the company considers environmental risks in its selection of contractors, business partners and clients;³ (iv) they publish an environmental report; and (v) conduct environmental audits. Details about participation in voluntary environmental programs, recycling and emissions were also obtained.

In practice, 255 of the S&P 500 companies regularly returned IRRC's annual mail survey. IRRC supplemented the responses provided by these firms with quantitative information on compliance with environmental statutes and on measures of environmental performance. The number of Potentially Responsible Party (PRP) notification received by a company under the Superfund statute was obtained from EPA Superfund Enforcement Tracking System. Data on corrective actions (cleanups at contaminated sites that are still actively used by the company for storage or disposal of hazardous wastes, under the Resource Conservation and Recovery Act (RCRA)) were taken from RCRIS National Oversight database, and penalties charged to the company under RCRA were provided by the EPA. Off-site releases and transfers of prescribed chemicals were obtained from the Toxic Release Inventory.

³ It has been argued that the Superfund legislation, which imposes liability for the cost of cleaning up badly contaminated hazardous waste sites on responsible parties to be sought among the generator(s) and transporter(s) of the waste, the operator of the hazardous waste site, and, under certain conditions, other parties, should promote caution in handling toxic chemicals and in selecting providers of services, such as waste facilities (Alberini and Bartholomew, 1999; Alberini and Austin, 1999).

We merged the IRRC dataset with company-level variables contained in Standard & Poor's Compustat, such as number of employees, expenditure on research and development (R&D), and sales.

5. Econometric Models

We assume the participation decision in a voluntary program depends on the perceived discounted net benefits from participation, y_i^* . The i th firm's perceived net benefit is expressed as:

$$(1) \quad y_i^* = \mathbf{x}_i \boldsymbol{\beta} + e_i$$

where \mathbf{x} is a vector of independent variables, $\boldsymbol{\beta}$ is a vector of coefficients, and ε is an error term that follows the standard normal distribution.

Perceived net benefits are not directly observed. Instead, an indicator y_i takes on a value of one if the firm participates in the program, and zero otherwise. Since the firm is assumed to participate in the program only if the net benefits of doing so are greater than zero, this leads to a probit model of participation.

Were a firm's filling out and returning of the IRRC questionnaire unrelated to its participation in a program, equation (1) would be estimated by fitting a probit model to the IRRC data. However, it seems reasonable to suspect that the sample is affected by a selection bias. Unless the selection problem is explicitly accounted for, the estimates of the coefficients from the probit model will be biased. To address the selection bias problem, we assume that

participation in the IRRC survey is driven by an unobservable variable, r_i^* , which represents propensity to answer the survey questions, and can be written as:

$$(2) \quad r_i^* = \mathbf{z}_i \mathbf{g} + \eta_i.$$

The error term in equation (2), η_i , is normally distributed with mean zero and variance equal to 1, and is allowed to be correlated with the error term ε of equation (1), as is appropriate if the same unobserved firm-specific factors influencing participation in the program also prompt the firm to agree to participate in the survey.

Since IRRC's intention is to provide information to investors, we expect large firms, firms with a good financial performance, and innovative companies to be more likely to respond the survey. Accordingly, the vector of regressors, \mathbf{z} , should include variables proxying for firm size, propensity to innovate, and financial strength.

The IRRC data are observable only when $r_i^* > 0$ ($r_i = 1$), implying that we must estimate a model of the firm's decisions to (i) respond the IRRC's survey, and, conditional on providing the relevant information, (ii) join a voluntary program. This is a bivariate probit model with a sample selection correction. The log-likelihood for year t is:

$$(3) \quad \log L_t = \sum_{r=1, y=1} \ln \Phi(\mathbf{z}_i \mathbf{g}, \mathbf{x}_i \mathbf{b}, r) + \sum_{r=1, y=0} \ln [\Phi(\mathbf{z}_i \mathbf{g}) - \Phi(\mathbf{z}_i \mathbf{g}, \mathbf{x}_i \mathbf{b}, r)] + \sum_{r=0} \ln [1 - \Phi(\mathbf{z}_i \mathbf{g})]$$

where $\Phi(\bullet, \bullet, r)$ denotes the bivariate standard normal cdf with coefficient of correlation equal to ρ .

Initially, we treat consecutive years of observations as independent. Therefore, the log-likelihood is:

$$(4) \quad \log L = \sum_{t=1}^T \log L_t .$$

The coefficients of the model are estimated simultaneously using full-information maximum likelihood.

Since our dataset has the structure of a panel, ideally one would like to control for the presence of unobserved heterogeneity by estimating fixed- or random-effects model. In practice, amending the likelihood function (4) to incorporate fixed or random effects is very difficult. We attempt to control for the tendency of a firm to stay in a program or to never join it by fitting alternative specifications that include the lagged value of the program participation indicator among the right-hand side variables.⁴

We also experiment with a likelihood function in which a firm is deleted from the usable sample after it has joined the program. In this case, in each year only those firms with $y_{i,t-1} = 0$ contribute to the likelihood function. We

⁴ Strictly speaking, there is a fundamental difference between random-effects model and the “duration dependence” model that include participation in the previous period in the right-hand side of the model. The former implies that the tendency of firms to stay on the program or never join it depends on unobserved characteristics that persist over time. The latter implies that joining the program essentially changes the firm, and hence the likelihood that it ever drops from the program.

estimate equation (4) and its two variants for each of the three programs under study: 33/50, Green Lights and WasteWiSe.

6. What Influences Participation in a Voluntary Program?

A. Firm and Industry Characteristics

The EPA emphasizes that voluntary programs offer public recognition for outstanding achievements, and allows partners to use the program logo in their own promotion and advertising. This is expected to benefit companies that are close to consumers. A dummy that takes on the value of one if the firm produces consumer goods controls for this effect.

Other firm characteristics are likely to influence firm participation in a voluntary program. Larger firms may be more likely to participate because they are more visible or are industry leaders. We use the number of employees to measure firm size.

The better the financial position of the firm, the more likely it will be able to support the costs associated with participation. We experimented with various measures of firm financial performance. In this paper we report results based on previous year increase in sales, which are representative of the results observed when other measures were used.

It also seems reasonable to include recent R&D expenditures, normalized by employees, among the predictors of participation. The sign of the coefficient of this variable is uncertain a priori. On the one hand, one might expect

innovative firms to be more likely participants, because they may be more likely to identify opportunities for reducing pollutants, adopt newer production processes at a lower cost, and capture new markets. On the other hand, firms with more limited innovative ability might use the program to absorb pollution abatement information and technologies divulged by other participating firms or by the agency.

Finally, we include among the predictors dummies for different industrial groups to proxy for industry-specific characteristics, such as pollution intensity and regulatory burden. Industry's increase in sales is also included to capture broad market conditions.

B. Corporate Environmental Culture

Winn (1995) and Henriques and Sardosky (1996) emphasize the importance of social corporate culture within a firm to explain firm's sensitivity to environmental issues. In contrast to these authors, who capture corporate attitudes towards environmental issues,⁵ we include actual environmental practices conducted by the firms, since attitudes are not available in our dataset.

We include dummies for whether (i) the firm publishes environmental reports, (ii) conducts environmental auditing programs, (iii) regards environmental performance as a factor in senior and manager compensation, and (iv) considers environmental risks to select business partners, suppliers and

customers. These dummies capture the environmental consciousness of the firm, as well as specific concerns about improving its perceived or actual environmental performance, and/or avoiding involvement in Superfund or RCRA litigation (a concern for firms handling toxic and/or hazardous wastes).

C. Environmental Performance and Regulatory Background

It has been suggested (Arora and Cason, 1996) that firms with poor environmental compliance records may join voluntary environmental programs in hopes of obtaining relief from the EPA. If this hypothesis is correct, firms with poor environmental performance may be more likely to participate in a voluntary program. Furthermore, this effect is expected to be stronger the stricter the program's regulatory background (Maxwell *et al.*, 1998, and Segerson and Miceli, 1999).

In order to test these hypotheses, we include among the independent variables in the program participation equations measures of environmental performance chosen among those most closely related to the program under investigation.

Table 2 presents descriptive statistics for the variables used in the voluntary programs participation equations.

7. Results

⁵ Henriques and Sardosky (1996) asked companies to rate the importance of pressure sources, with 1 denoting not at all important, and 7 very important. Winn (1995) interviewed managers on whether

Our regressions focus on 207 manufacturing firms among the S&P 500 companies, followed over 1995-98. Of the 180 manufacturing firms that returned the IRRC's survey, the participation rate in 33/50 is 54%, 33% in Green Lights, and 34% for WasteWiSe. Clearly, not even among the large corporations that constitute the S&P 500 universe is participation in a voluntary pollution abatement program unanimous.

The results of the bivariate probit model with selection (equation (4)) are reported in tables 3 (survey participation equation⁶) and 4-6 (voluntary programs participation equation).

As shown in table 3, the likelihood of returning the survey questionnaire increases with the size of the firm, measured by the number of employees. The closer to the consumer the firm, the greater the probability of returning the IRRC questionnaire. This is reasonable, and is likely to be related to the firm's desire to maintain a favorable public image, to the extent that the IRRC survey data may be consulted by consumers and investors.

We were forced to omit the food, printing and transportation sector dummies because there were too few firms in this sectors for the models to converge. For those industries that *were* included in the regressions, the coefficients of the sector dummies were not significantly different from one

different pressure sources played a direct role in the adoption of a formal environmental policy.

⁶ The equation for participation in the IRRC survey reported in table 3 is actually part of the system of two equations, where the second equation predicts participation in WasteWiSe. However, the results obtained when (i) participation in the survey and participation in Green Lights, and (ii) participation in the survey and participation in 33/50 are modeled are very similar, and we omit them from the paper to save space.

another, and indicated a lower propensity to return the survey than the omitted industries.

Tables 4-6 present the results for participation in WasteWiSe, Green Lights, and 33/50, respectively. The specification reported in column (A) includes firm characteristics such as size, R&D expenditures, proximity to consumers, a measure of financial strength, industry dummies, and sales in the industry the firm belongs to. Column (B) adds variables proxying for environmental performance and compliance with environmental regulation. Column (C) replace the latter two sets of variables with other variables describing the firm's environmental practices, and, finally, (D) is the broadest model, which includes the sets of variables examined in (A) through (C).

A. Participation in WasteWiSe

As shown in Table 4, column (A), larger firms *are* more likely to join WasteWiSe. However, participation in this program is not significantly affected by any of the financial health variables we experimented with. The previous period's increase in sales is even found to have a negative (if insignificant) coefficient, which leads us to speculate whether firms might be attracted to a program of this kind for the potential savings it affords. This hypothesis is supported by the negative (and almost significant at the 10 percent level) estimated coefficient of the industry increase in sales.

As expected, whether the firm produces consumer goods is a strong predictor of participation in WasteWiSe. Specifically, if the firm produces consumer goods, its likelihood of participating in the program is 17% greater than that a firm of comparable characteristics, but that does not produce consumer goods. Finally, innovative firms (firms with greater R&D expenditures) are also more likely to participate in WasteWiSe. The marginal effect of this variable is such that if we raise R&D per employee by one standard deviation above the sample average, the probability of participating would grow by 4.78 times, holding all else unchanged.

With WasteWiSe, it is difficult to identify measures of firm environmental performance that relate directly to reduction of office and yard waste, and re-packaging of inputs and products. Since our dataset lacks information about the quantity of solid waste and recyclables, we include in the regression of column (B) variables related to the firm's generation of *hazardous waste*. Here, we reason that firms that have been involved with disposal of hazardous waste in the past, and are currently generating hazardous wastes, might pay particular attention to recycling and reduction of non-hazardous waste as well. These variables also serve as general measure of firm "greenness."

Accordingly, we include in specification (B) the number of (hazardous waste) sites at which the firm has been nominated PRP under the Superfund

legislation,⁷ and the fines charged to the firm for violations of the RCRA hazardous waste regulations.

The coefficient of the sites at which the firm is a PRP is negative and significant. We were somewhat surprised by this result. It is possible that firms with a negative environmental track record (as measured by their involvement at hazardous waste sites) shun WasteWiSe, which they may see as neither improving their image nor promoting any actual pollution reductions. On the other hand, fines for violations of the RCRA law increase the likelihood of participation, a finding that is consistent with the hypothesis that firms join voluntary programs to seek relief from the agency, among other reasons. However, both Superfund sites and penalty effects are small, and meaningful only for the most serious “offenders.”

Perhaps the most thought-provoking results are those shown in column (C). The negative sign of the coefficient of the dummy for environmental audits may be due to the fact that environmental audits are, for the most, for *internal* use. Firms undergoing environmental audits may be wishing to learn how their environmental performance can be improved, and they may refrain from joining the program (a relatively new one) until they have a reasonably clear idea of how the program’s goals can be attained, and at what costs/benefits.

By contrast, the coefficient of the dummy for whether an environmental report is published by the company is positive, and statistically significant. Its

⁷ Since Superfund imposes retroactive, strict and joint-and-several liability for the cost of environmental remediation upon the generators of the waste at contaminated sites, nomination as a PRP at Superfund sites

magnitude implies that the average firm is 24 percent more likely to participate if it does publish an environmental report. Environmental reports are intended for the public and investors, rather than for the firm's internal use, suggesting that willingness to look good in the eyes of the public and investors provides a strong motivation to join a voluntary program.

We were surprised to note the negative association between compensation of upper management based on environmental performance and the likelihood of participation. However, conversations with EPA officials revealed that EPA does *not* regard participation in voluntary programs per se as a sign of good environmental performance. If the firm managers are aware of that, they may find joining WasteWiSe less attractive or useful, and they may prefer to concentrate on other goals, such as genuine emissions reductions. This provides further support for our explanation for the negative sign of the coefficient of the PRP variable.

When the model is re-run to include a dummy for the previous year's participation in WasteWiSe (a simple way to account for the firm's tendency to remain in the program after joining it, as opposed to dropping in and out of it), the coefficient of most variables retain their signs and significance. Qualitatively similar results are seen when the likelihood function is modified to include only those firms who have not already joined the program in previous years.

B. Participation in Green Lights

Table 5 presents the results for participation in Green Lights from 1995 to 1998. Column (A) shows that among the variables related to firm size and financial performance, only firm size, measured as the number of employees, is related to participation in this program. Specifically, the more numerous the employees, the more likely is the firm to join the program.⁸

For lack of a better alternative, in specification (B) we include fines assessed to the firm for violations of the Clean Air Act requirements (since Green Lights seeks to reduce the use of electricity, and hence emissions of greenhouse gases by power plants), but we find no evidence of a correlation between these fines and the likelihood of joining *Green Lights*. We also experimented with other variables measuring environmental performance, reasoning that firms may join the program simply to improve their environmental image, even though the program in question does not specifically address the type of pollution they create, but to no avail.

When attention is restricted to the dummy variables capturing environmental practices (Column (C)), the coefficient for whether environmental performance is a factor in senior manager compensation is positive and significant at the 10 percent level, raising the likelihood of participation by a representative firm by about 9% (assuming all else unchanged). This is in sharp

⁸ Unfortunately, we did not have electricity usage for each firm, which we would have expected to be an important predictor of the likelihood of joining the program, since savings are likely to depend on energy use. It seems reasonable to believe that, in addition to benefiting from the publicity aspects of Green Lights, firms with more numerous employees may also realize greater savings in electricity bills by joining.

contrast with what seen for WasteWiSe, the difference probably being due to the broad endorsement and established reputation of Green Lights: While the EPA may still not regard participation in Green Lights as a sign of good environmental performance, the public might, and firm management might feel under pressure to join for the reputation effects.

Holding all else unchanged, firms that publish an environmental report are more likely to join Green Lights – as with WasteWiSe. This further confirms that public recognition is an important predictor of participation in a voluntary program.

Whether the company considers environmental risks to select partners, suppliers, or customers reduces the likelihood of participation. A possible interpretation for the negative and significant sign of this dummy is that firms that are able to impose their criteria to suppliers and associates do not need to rely on a voluntary initiative to attract public recognition. Another possible explanation is that the firms that are most likely to scrutinize partners are those which could become involved in expensive liability suits over Superfund cleanup, due to the particular nature of the liability imposed by this statute.⁹ These companies may have relatively little interest in Green Lights.

⁹ Under Superfund, the generators of hazardous waste that has contaminated a site are – along with transporters and owners/operators of the site – retroactively and strictly liable for the cost of cleanup at the site. If there are more than one PRPs, liability is joint-and-several, implying that any single RP could be held responsible for the entire cost of cleanup, even though others have contributed to creating the contamination problem.

Finally, firms in the electrical equipment and instruments sectors are more likely to participate in Green Lights than companies in the baseline sectors (food, printing and publishing, and transportation industries).

For comparison, DeCanio and Watkins' (1998) study of participation in Green Lights focuses on a considerably larger sample of firms with broader sector coverage. Despite their different universe of firms, both their analysis and ours reveal the importance of firm size and the different response across firms and sectors to a generic program that on paper should appeal similarly to all types of firms.

C. Participation in 33/50

Table 6 reports the results of regressions explaining participation in 33/50, the voluntary program seeking aggregate reductions (of 33% and 50%, respectively, in two distinct phases) in the emissions and releases of 17 heavy metals and hazardous substances in 1995.

Column (A) shows that, once again, larger firms are more likely to join, and that firms who have recently incurred R&D expenditures are *less* attracted into the program. Although in specification (D), the coefficient of R&D normalized by employees is no longer statistically significant, its negative sign (and comparison with the Green Lights equation, where this coefficient is also negative) is broadly consistent that the possibility that firms that are less capable of innovating on their own might join in hopes of learning to reduce emissions

from others. This interpretation is also broadly consistent with Khanna and Damon's finding that firms with *older* equipment are more likely to join 33/50.

Among the environmental performance measures, it is, of course, not surprising that TRI emissions, and especially TRI emissions of the 17 chemicals covered by the program, are positively related to the likelihood of participating in the program. In specifications (C) and (D) we omit TRI releases and include other measures of environmental performance, such as number of PRP nominations and corrective actions under RCRA, which are strongly related to the quantity of toxic chemicals created by the firm. As expected, and confirming Khanna and Damon (1999), these variables are positively related to the likelihood of participating in the program. In regressions not reported in this paper, the coefficient of fines for violations of RCRA was also found to be positive and significant. To summarize, big polluters *are* more likely to join 33/50.

We do not find that firms which produce consumer goods are more likely to participate in the program, not even when attention is restricted to firms in the chemical sector. This result is in contrast with the Khanna and Damon (1999) and Arora and Cason (1996) findings.

Finally, of the variables measuring actual environmental practices, only the coefficient of the dummy for whether the company publishes an environmental report is positive and significant.

8. Discussion and Conclusions

To examine the importance of different factors leading to participation in voluntary environmental programs, we have estimated models of participation in 33/50, Green Lights and WasteWiSe, three EPA programs that differ widely with respect to the reputation of the program, and the stringency of the regulations for the pollutants they address. The firms examined in this sample belong the Standard and Poor 500, and we econometrically account for possible sample selection bias.

The summary of our results, offered in Table 7, suggests that the possible publicity from joining a voluntary program *is* an important determinant of participation. Larger – and presumably more visible – firms are systematically more likely to join, regardless of the pollutant addressed by the program and the stringency of the regulations for that pollutant. In addition, firms who wish to show consumers about their environmental performance progress – and do so by publishing environmental reports – are typically more likely to join.

Our analysis suggests that although the publicity aspect of participation is highly valued, firms privately might be skeptical about the true impact on participation on their environmental performance. We found that firms that use environmental performance as one of the criteria for in establishing manager compensation are less likely to participate in WasteWiSe, a program that deals with solid waste and recyclables, but does little in terms of the more pressing generation of hazardous waste and emissions into air and water. The opposite effect (although weak) is seen for 33/50, a program that does seek reductions in

the releases and transfers of toxics, and (very strong) for Green Lights, probably because of the energy conservation emphasis of the latter.

Moreover, participation in any one of these program is slightly less likely among those companies which are conducting or have conducted environmental audits, presumably because these firms more critically evaluate the benefits and costs of joining vis-à-vis reducing emissions in other ways.

There is some evidence suggesting that some of the attractiveness of voluntary programs lies their “technology transfer” potential. Especially for the older and better established programs, firms with lower R&D expenditure on a per employee basis are more likely to join, perhaps because they hope to learn emissions-reducing practices from other firms or from the agency. This is consistent with Khanna and Damon’s finding that firms with older equipment make more likely candidates for 33/50. By contrast, the least established program among those we examine (WasteWiSe) elicits participation with more success among firms with greater R&D expenditures.

Finally, we find some evidence suggesting that firms with worse performance *are* attracted to voluntary programs, but only as long as the program is directly related to their own pollution reductions. This is broadly consistent with the predictions of Maxwell *et al.*, and with Segerson and Miceli’s hypothesis that a “stick-and-carrot” approach increases firm responsiveness to voluntary programs. Variables capturing firm environmental performance do influence the likelihood of participating in 33/50 and WasteWiSe, programs with

an obvious environmental appeal, but were not important with Green Lights, where the link with environmental quality and performance is more remote and rewards from participation (including savings on electricity bills) are more immediate. These results seem to confirm the hypothesis that firms are more likely to join a voluntary program the stricter the program's regulatory background.

Although the results from this paper cannot be generalized to the whole universe of manufacturing firms, our analyses reveal that participation is not unanimous, not even among the large, publicly traded companies in the S&P500, and that the appeal of participating *is* related to firm characteristics and, presumably, to the image that the firm wishes to project on consumers and regulators.

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Table 1. Summary of features of the three programs analyzed.

Program	Pollutants covered	Regulatory Background	Age of the Program	Is participation recognized by Consumers?	Can cost savings be realized through the program?
Green Lights	Greenhouse gases from fossil fuels used in power generation (only indirectly)	Weak	Since 1991; Well-established	Yes	Yes, on electricity bills (main appeal of the program)
WasteWiSe	Solid waste	Weak	Since 1994; relatively new	Unclear	Unclear
33/50	17 heavy metals and other toxic chemicals	Strong	Started in 1991 and closed in 1995	Yes, according to Arora and Cason (1996), and Khanna and Damon (1999). Also see Konar and Cohen (1997).	Maybe (if changes in production processes are possible that reduce releases and save on inputs)

Table 2. Descriptive Statistics for the Independent Variables.
(N = 585)

Variable	Mean	Standard Deviation
Employees (1,000)	44.535	76.621
R&D Expenditures (\$1,000 per employee)	.011	.018
Annual Firm's Increase in Sales	.088	.153
Firm Produces Consumer Goods	.401	.490
Environmental Performance is a Factor in Senior and Manager Compensation	.760	.427
Firm Considers Environmental Risks when Selecting Partners, Suppliers and/or Clients	.665	.472
Firm Conducts Internal Compliance Auditing Program	.965	.183
RCRA Fines (\$ per employee)	.711	10.751
CAA Fines (\$ per employee)	1.887	23.181
PRP Notifications	54.206	68.422
RCRA Corrective Actions	3.268	7.667

Table 3. Determinants of Response to the IRRC survey (1995-98) (from bivariate probit model; second equation predicts participation in WasteWiSe)
(T Statistics in parentheses) (N = 740)

Variable	Estimate	t-statistic
Number of employees	9.009***	3.026
Firm's Increase in Sales	.193	.457
The Firm Produces Consumer Goods	.426**	2.651
R&D Expenditures (\$ Thousands per employ)	2.039	.481
Paper and Allied Products (SIC 26)	-.632**	-2.129
Chemical and Petroleum Refining Industries (SIC28 & SIC29)	-.713***	-3.021
Primary Metal Industries (SIC 33)	-.865***	-2.926
Industrial and Commercial Machinery and Computer Equipment (SIC35)	-.884***	-3.668
Electronic and Other Electrical Equipment and Components (SIC 36)	-.966***	-3.561
Instruments (SIC 38)	-.843***	-3.211
Constant ^a	1.179***	5.696

** :Significant at the 5% level.

*** :Significant at the 1% level (all two-tailed tests).

^aFood and Kindred Products, Printing and Publishing, and Transportation Equipment Industries included in the intercept.

Table 4. Determinants of Participation in WasteWiSe (1995-1998) (from bivariate probit model)

(T statistics in parentheses) (N = 436)

Variable	A	B	C	D
Number of employees	3.658** (2.588)	5.080** (2.276)		4.436** (2.299)
Past Period Increase in Sales	-.346 (-.966)	-.296 (-.732)		-.330 (-.905)
Past Period R&D Expenditures (\$ 1,000 per employee)	19.529** (3.038)	16.524** (2.309)		13.264** (2.027)
The Firm Produces Consumer Goods	.485** (3.266)	.379* (1.652)		.471** (3.059)
Industry Increase in Sales	-1.375* (-1.633)	-1.249 (-1.321)		-1.373 (-1.539)
Past Period RCRA Fines (\$ per employ)		.059* (1.704)		.061* (1.757)
Potential Responsible Party Notifications		-.004** (-3.020)		-.003** (-2.392)
Environmental Performance is a Factor in Senior and Manager Compensation			-.469** (-2.827)	-.427** (-2.330)
The Firm Publishes an Environmental Report			.685*** (3.969)	.655** (3.606)
The Firm Considers Environmental Risks to Select Partners, Suppliers, Customers			.163 (.950)	.229 (1.153)
The Firm Conducts Internal Environmental Compliance Auditing			-.026 (-.120)	-.091 (-.372)
Paper and Allied Products (SIC 26)	.176 (.589)	.262 (.842)	.032 (.114)	.161 (.513)
Chemical and Petroleum Refining (SIC 28 & SIC 29)	-.191 (-.807)	.033 (.123)	-.207 (-.903)	-.268 (-.974)
Primary Metal (SIC 33)	.330 (.998)	.546 (1.424)	.171 (.544)	.284 (.780)
Machinery and Computer Equipment (SIC 35)	-.162 (-.617)	.021 (.065)	-.087 (-.352)	-.244 (-.883)
Electronic and Electrical Equipment (SIC 36)	-.014 (-.052)	.237 (.700)	.162 (.606)	.010 (.032)
Instruments (SIC 38)	.199 (.699)	.408 (1.291)	.209 (.801)	.106 (.355)

Constant	-0.785 (-3.562)	-0.625 (-1.756)	-0.174 (-.781)	-0.736 (-2.612)
Log Likelihood	-388.714	-382.345	-385.271	-369.232

*Significant at the 10% level.

**Significant at the 5% level.

Table 5. Determinants of Participation in Green Lights (1995-1998) (from bivariate probit model)

(T statistics in parentheses)(N = 436)

Variable	A	B	C	D
Number of employees	4.586** (3.782)	4.443** (3.346)		3.304** (2.426)
Past Period Increase in Sales	-.397 (-.909)	-.435 (-1.048)		-.164 (-.373)
Past Period R&D Expenditures (\$ 1,000 per employee)	-5.121 (-.759)	-4.723 (-.697)		-5.270 (-.373)
The Firm Produces Consumer Goods	.113 (.718)	.125 (.792)		.022 (.136)
Industry Increase in Sales	.066 (.076)	.050 (.059)		.042 (.046)
Past Period Clean Air Act Fines (\$ per employ)		.001 (.521)		-.000 (-.097)
PRP Notifications		.000 (.335)		.000 (.046)
Environmental Performance is a Factor in Senior and Manager Compensation			.263* (1.671)	.284* (1.648)
The Firm Publishes an Environmental Report			.676** (4.598)	.668** (4.032)
The Firm Considers Environmental Risks to Select Partners, Suppliers, and/or Customers			-.442** (-2.441)	-.346* (-1.860)
The Firm Conducts Internal Environmental Compliance Auditing			-.016 (-.082)	-.039 (-.166)
Paper and Allied Products (SIC 26)	.133 (.430)	.203 (.656)	-.356 (-1.142)	-.172 (-.502)
Chemical and Petroleum Refining (SIC 28 & SIC 29)	.625** (2.839)	.652** (2.787)	.203 (1.026)	.3293 (1.182)
Primary Metal (SIC 33)	.295 (.887)	.361 (1.088)	.233 (.739)	.124 (.351)
Machinery and Computer Equipment (SIC 35)	.182 (.717)	.231 (.912)	.035 (.163)	.049 (.192)

Electronic and Other Electrical Equipment Components (SIC 36)	1.007** (3.530)	1.065** (3.780)	.877** (3.544)	.848** (2.951)
Instruments (SIC 38)	.637** (2.399)	.681** (2.563)	.519** (2.135)	.552** (2.063)
Constant	-1.024** (-4.687)	-1.084** (-5.026)	-.399** (-2.009)	-.989** (-3.978)
Log Likelihood	-392.7154	-392.611	-375.752	-379.958

*: Significant at the 10% level.; **: Significant at the 5% level.

Table 6. Determinants of Participation in 33/50 (1995) (from bivariate probit model)

(N = 123)

Variable	A	B	C	D
Number of employees	5.235** (2.534)	3.969 (1.519)		2.446 (.825)
Past Period Increase in Sales	-1.147 (-1.029)	-1.613 (-1.196)		-.734 (-.548)
Past Period R&D Expenditures (\$ 1,000 per employee)	-28.863** (-2.124)	-21.879 (-1.299)		-21.655 (-1.120)
The Firm Produces Consumer Goods	-.163 (-.566)	-.482 (-1.329)		-.803* (-1.946)
Industry Increase in Sales	3.574 (1.330)	2.227 (.686)		1.502 (.423)
PRP Notifications		.025** (2.200)		.023** (2.022)
RCRA Corrective Actions		.405** (2.591)		.428** (2.653)
Environmental Performance a Factor in Compensation			.456 (1.482)	.333 (.702)
The Firm Publishes an Environmental Report			.573** (1.962)	.740* (1.698)
The Firm Considers Environmental Risks to Select Partners, Suppliers, and/or Customers			.026 (.088)	.520 (1.207)
The Firm Conducts Internal Environmental Compliance Auditing			.388 (1.087)	-.057 (-.102)
Paper and Allied Products (SIC 26)	.918* (1.692)	.996 (1.512)	.984** (2.125)	1.126 (1.542)

Chemical and Petroleum Refining (SIC 28 & SIC 29)	1.713** (3.670)	1.567** (2.630)	1.240** (3.638)	1.540** (2.297)
Primary Metal (SIC 33)	.728 (1.131)	.679 (.870)	1.129** (2.115)	1.118 (1.248)
Machinery and Computer Equipment (SIC 35)	.587 (1.246)	.485 (.810)	.253 (.678)	.442 (.658)
Electronic and Other Electrical Equipment (SIC 36)	.912* (1.663)	.935 (1.416)	.627 (1.501)	1.041 (1.414)
Instruments (SIC 38)	1.033* (1.832)	1.035 (1.547)	.912** (2.071)	1.172 (1.525)
Constant	-.564 (-1.201)	-1.066* (-1.785)	-1.01** (-3.099)	-1.620** (-2.164)
Log Likelihood	-62.464	-44.521	-77.284	-39.047

T-statistics in parenthesis

*: Significant at the 10% level.

**: Significant at the 5% level.

Table 7. Summary of effects of selected independent variables on participation. (Signs are bold if generally significant).

Independent Variable	WasteWi\$e	Green Lights	33/50
Employees	+	+	+
R&D (thou.per employee)	+	-	-
Firm produces consumer goods	+	+	-
PRP at Superfund sites	-	Very close to zero and insignificant	+
RCRA fines	+	Very close to zero and insignificant	+
RCRA corrective actions		Very close to zero and insignificant	+
CAA Fines		Very close to zero and insignificant	
Compensation of mgmt. Based on env. performance	-	+	+
Environmental Auditing	-	-	Alternates sign, depending on specification
Environmental Report	+	+	+

Env.risk considered when selecting contractors/partners	+	-	+
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