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Public Voluntary Programs Reconsidered

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Abstract

“Public voluntary programs” (PVPs) involve government offers of positive publicity and technical assistance to firms that reach certain environmental goals. A growing body of empirical evidence suggests these programs often have little impact on the behavior of their participants. A natural policy conclusion would be to eliminate these programs, but this paper offers several reasons not to jump to such a conclusion. We first present a political-economic framework in which PVPs are viewed as modest subsidies used when political opposition makes stronger environmental regulation infeasible. We then explore the design of PVPs in detail, showing how PVPs can potentially enhance the diffusion of cost-effective techniques for pollution abatement, so long as the information involved is not competitively sensitive. Identifying the effects of PVPs econometrically is difficult because information is likely to diffuse to non-participants. Thus, after the early phases of even a successful PVP, it may well be impossible to detect a difference in performance between participants and non-participants.

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1 Introduction

For years environmental regulators have relied upon various forms of taxes, subsidies and command and control regulations to remedy environmental problems. Recently, however, new tools---what we call public voluntary environmental programs, or PVPs ---have been added to the regulator's tool box. Public voluntary programs typically invite firms to set and achieve environmental goals, and offer modest subsidies to encourage firms to participate. These subsidies consist of various combinations of favorable publicity, technical assistance and opportunities for positive interactions with regulators. PVPs have been developed to address a variety of issues, including agriculture, air quality, energy efficiency and climate change, labeling, pollution prevention, waste management, and water. Among these, the areas with the most PVP activity are pollution prevention and climate change.

Perhaps the best known US PVP was the 33/50 Program operated by the U.S. Environmental Protection Agency (EPA) between 1991 and 1995.¹ This program identified seventeen high-priority toxic chemicals, and invited thousands of industrial companies to join the program and reduce their emissions of these chemicals 33% by 1992 and 50% by 1995. According to the EPA's Final Report on the Program, the most important feature of the program was that the agency "encouraged participants to set their own reduction goals, oriented to their own time frames, and most did so. Of the 1,294 companies participating, 1,066 set measurable goals for reducing their releases and transfers of the 17 targeted chemicals against the 1988 baseline."² The EPA was very pleased with the apparent success of the program, claiming that "The 33/50 Program achieved its goal in 1994, one year ahead of schedule, primarily through program participants' efforts."³

President Clinton's Climate Change Action Plan (CCAP), released in October 1993, spawned many public voluntary programs including Green Lights, Climate Wise, Motor Challenge and Energy Star Buildings among many others. As in the case of 33/50, participants in these PVPs were provided with case studies detailing the cost savings of program participants, and were offered technical information aimed at aiding the development of a program action plan. The programs also offered seminars at which firms could exchange information about cost savings, access to question hotlines, free software, and access to databases of equipment suppliers and financing programs.

Despite government enthusiasm for PVPs, econometric analysis of PVPs suggests that they are largely ineffective.⁴ However, our analysis of PVPs and their design suggests that identifying the effects of PVPs is inherently difficult. First, some PVPs (notably the 33/50 Program) were created under regulatory threat, making it hard to disentangle the

¹ Toxic reductions were measured against a 1988 baseline, but according to US EPA (1999) companies were not invited to participate until the spring of 1991, hence we consider that as the beginning of the program.

² US EPA (1999), p. 4.

³ US EPA (1999), p. 1.

⁴ We review several prominent empirical papers on PVPs in section 2.

effects of the threat from the effects of the PVP. Second, one aspect of most PVPs is an attempt to diffuse information about pollution abatement throughout industry, and this information may be received by non-participants as well as participants. If so, there will be little or no difference in performance between firms that join an information-oriented PVP and those that do not. It is possible that a difference would be observed in the early phases of a program, when the government is trying to attract participants who already have information to share. Once the program moves to the dissemination stage, however, there is likely to be no measurable difference between participants and non-participants. This is a point that has not been recognized in the empirical literature on PVPs, and that demands a reinterpretation of the findings in this literature.

This paper presents a framework in which conventional regulation and public voluntary programs (PVPs) can be considered in a unified political/economic approach, thereby allowing a sharper comparison of their relative merits. We show that in the absence of significant political opposition, an environmental tax (or an equivalent program such as a cap-and-trade program) is superior to a PVP. However, if political opposition to the tax is high, then PVPs may be preferable. The modest subsidies implicit in PVPs can be provided in a variety of ways, with potentially important implications for the effectiveness of such programs. Hence, we analyze the structure of PVPs in detail, showing that PVPs can enhance the diffusion of cost-effective techniques for pollution abatement, so long as the information involved is not competitively sensitive. We conclude that PVPs have a role to play in environmental policy, but that it is much more restricted than is sometimes portrayed by advocates of voluntary approaches.

The paper is organized as follows. The following section reviews recent empirical findings on the performance of PVPs. Section 3 presents an overview of our framework, and section 4 draws out its policy implications. Section 5 studies the design of PVPs, with an emphasis on their ability to enhance the diffusion of information about pollution abatement, and section 6 concludes.

2 Empirical Evidence on the Performance of PVPs

In this section we review the still small body of hard quantitative evidence on how well PVPs perform. While there are many qualitative case studies of individual programs, and quite a few papers that study which firms are likely to join PVPs, our interest here is on whether these programs have any measurable impact on the behavior of firms that join. We begin by discussing the most widely studied PVP, the EPA's 33/50 Program, then turn to climate change PVPs, and finally discuss other programs, including the Sustainable Slopes program for ski areas and the EPA's Performance Track Program. Overall, the empirical results suggest that participation in these PVPs had little or no impact on firms' environmental performance.

2.1 Toxic Chemical Emissions: The 33/50 Program

The EPA's 33/50 program was initiated in 1988, and is considered the grandfather of all voluntary programs. Its primary goal was to convince companies to set goals for reducing toxic chemical emissions by 50% by the year 1995, from a 1988 baseline.

The program emerged shortly after the deadly chemical release from Union Carbide's plant in Bhopal, India, which killed over 3,000 people. Chemical industry leaders became seriously concerned about the industry's "license to operate," especially after survey results found that the chemical industry's reputation among the public was in the same league with the tobacco and the nuclear industries, both of which had been saddled with intrusive and burdensome regulations. Indeed, the Chemical Manufacturer's Association was concerned enough to create the Responsible Care program to improve the public's trust of the industry.⁵

It was in this context that William Reilly, EPA Administrator and former head of the World Wildlife Fund, called a small group of chemical industry leaders into his office and told them he expected substantial reductions in toxic emissions, which could be accomplished voluntarily or through regulations. The industry representatives preferred a voluntary approach, but there was clearly a regulatory threat looming behind the program.⁶

According to the EPA the program consisted of four major elements: "outreach to companies to encourage commitments; public recognition of companies for their commitments, pollution prevention efforts, and achievements; technical assistance to help companies overcome barriers and achieve commitments through pollution prevention practices; and evaluation of the effectiveness of both industry and government efforts in a voluntary, cooperative program."⁷

Outreach was accomplished by sending solicitation letters to companies directly, inviting them to participate. In addition, EPA convened "a series of about a dozen meetings with top executives from different industrial manufacturing sectors: chemicals; transportation related; machinery and electrical equipment; iron, steel, and primary metals; pulp and paper; petroleum refining; pharmaceuticals; wood and metal furniture; rubber and related products; and metal finishings and coatings. Trade associations, such as the Chemical Manufacturers Association, were instrumental in helping arrange these sessions."⁸

Public recognition was to be created in "program publications, press releases, and in speeches and other routine federal and state communications. Companies submitting reduction commitments receive a formal certificate of participation from EPA."⁹

⁵ See King and Lenox (2000) for a more complete discussion of the Responsible Care program.

⁶ Personal communication from David Buzzelli, Retired Vice President and Director, Dow Chemical, March 14, 2003.

⁷ US EPA (1992), p. 3.

⁸ US EPA (1992), p. 4.

⁹ Ibid.

With regard to technical assistance, there were five components: 1) A series of workshops across the country with industry to exchange information on pollution prevention theory and practices; 2) the Pollution Prevention Information Exchange System, a free computer bulletin board containing technical and policy information on pollution prevention; 3) bibliographic reports on pollution prevention and recycling techniques; 4) a pollution prevention resource guide, which identifies key pollution prevention documents, industry specific guidance manuals, fact sheets, and videos; and 5) a list of successful and innovative pollution prevention practices companies have implemented as part of the 33/50 Program.¹⁰

Because the program builds upon the readily-accessible information reported through the EPA's Toxic Release Inventory (TRI), it is the most widely studied of voluntary programs. However, researchers are divided on the impacts of the program. All four papers that we discuss below employ a two-stage methodology of the sort pioneered by Heckman (1979), in which the first stage predicts the probability a given firm participates in the program, and the second stage estimates performance controlling for the likelihood of participation. This method avoids the selection bias that occurs if one simply includes program participation as a variable without controlling for the antecedents that explain participation.

Khanna and Damon (1998) were the first to study whether 33/50 participation made a difference in the level of chemical reductions undertaken by firms over the period 1991-1993, and concluded that 33/50 Program participants reduced emissions significantly more than did other firms in the chemical industry during this period. This paper has been widely cited as evidence that PVPs work. Sam and Innes (2006) also analyze the 33/50 Program, using a larger set of explanatory variables and a longer time horizon, and also conclude program participation reduced emissions, but only had a significant impact on emissions in 1991 and 1992. In later years they find no evidence that program participants reduced emissions any more than did non-participants.

Vidovic and Khanna (2006), in contrast, find no impact at all from 33/50 Program participation. They include a variable measuring emission reductions during the two years prior to the inception of the 33/50 Program, and find that once this variable is included, the predicted probability of participation has no impact on emissions at the firm level. They thus conclude that most of the reported impact of the program came from “free riding” by early joiners who had already accomplished significant reductions without the benefit of the program. This is consistent with raw data reported in US EPA (1999, p. 2), which shows that industry had already achieved a 32.1% reduction in emissions by 1991, when EPA began inviting companies to participate. Finally, Gamper-Rabindran (2007) revisits the 33/50 Program’s effectiveness, accounting for some measurement problems inherent in the Program.¹¹ He finds that participants in the

¹⁰ Ibid, p. 5.

¹¹ First, he excludes two ozone depleting substances (ODS)---carbon tetrachloride and methylchloroform (or 1.1.1-trichloroethane)---that were included in the 17 chemicals on the 33/50 Program’s list, but whose reduction can better be attributed to mandatory phase-outs under the Clean Air Act. Their reduction accounted for one-fifth of the aggregate reduction of 33/50 chemicals from all Toxic Release Inventory

fabricated metals and paper industries cut emissions relative to non-participants, while in the chemical and primary metals industries participants actually did less emissions reduction than non-participants.¹² Furthermore, even in the industries where participation seemed to be beneficial, the vast bulk of the apparent emission reductions were really transfers off-site rather than true pollution prevention. Gamper-Rabindran thus concludes that the program has been ineffective in achieving its goals.

2.2 Climate Change

Most of the US climate change PVPs aim to increase investments in energy efficiency. They emphasize the private benefits to firms and individuals of adopting energy efficient equipment, and attempt to solve the "market failures" that limit the spread of these technologies. The climate change VAs were begun under the first Bush Administration after President Bush promised to be the "environmental president." Most of them, however, were promulgated as part of the Clinton Administration's efforts to achieve reductions in greenhouse gases after the "Earth Summit" in Rio de Janeiro in June 1992.

In contrast to the 33/50 Program's origins, there does not appear to have been a substantial regulatory "threat" driving the adoption of climate-oriented PVPs. Indeed, the first Bush Administration opposed strong actions to combat global warming, and was publicly derided by US environmental groups and by most other nations of the world for its refusal at the "Earth Summit" to agree to a timetable with specific targets for reducing emissions of greenhouse gases.

After President Clinton was elected in November of 1992, one of his early actions was to announce support for stronger measures to prevent climate change. In the early months of 1993, his administration floated a variety of proposals to tax energy, including a carbon tax and a broader-based "BTU tax" based on the energy content of fuels as measured in British Thermal Units. The political backlash was fast and furious, and within a few months the Administration had abandoned the BTU tax initiative. When the Administration presented its Climate Change Action Plan (CCAP) later in the year, the focus was shifted away from mandatory regulations to subsidies (including \$200 million per year to stimulate the adoption of more energy-efficient technologies) and voluntary programs. The environmental community was not impressed. Alden Meyer, director of the program on climate change and energy at the Union of Concerned Scientists, argued

(TRI) plants. He also excludes chemicals whose changes in reporting requirements led to paper reductions in emissions. Changes in the reporting requirement of ammonium sulfate in 1994 accounted for 27 percent of the total reduction in toxic releases reported for 1988-91, while the de-listing of non-aerosol sulphuric and hydrochloric acid in 1994 and 1995 led to similar paper reductions.

¹² Gamper-Rabindran's results for the chemical industry parallel King and Lenox's (2000) study of the chemical industry's self-regulatory Responsible Care program. King and Lenox find that participants in the program did not reduce emissions more rapidly than non-participants. If anything, they may have reduced less rapidly than non-participants.

that the plan placed too much emphasis on voluntary measures, "with no prospect of hammers or sticks to bring us into compliance if those don't work."¹³

Released in October 1993, the President's Climate Change Action Plan (CCAP) spawned many public voluntary programs including Green Lights, Climate Wise, Motor Challenge and Energy Star Buildings among many others. Unfortunately, there is very little work that attempts to measure the impact of these programs on emissions, although there is a large literature describing the programs, and a few papers that assess empirically the factors driving firms to participate and the benefits claimed by participants.¹⁴ One of the few published papers that measures the impact of any of these programs is Welch, Mazur and Bretschneider's (2000) study of the Department of Energy's (DOE's) Climate Challenge program for electric utilities. The Climate Challenge program invited utilities to set their own targets for carbon dioxide emissions reductions, develop their own approaches to achieving reductions, and self-report on their progress. Stated benefits of participation included the possibility of preempting binding legislation, public relations advantages, cost savings, and the possibility of obtaining early reduction credits in the event that mandatory climate change legislation is passed.¹⁵

Welch et al. (2000) find that participation in the Climate Challenge program most likely had no impact on greenhouse gas emissions, although some of their results suggest it may have actually had a detrimental impact. They point out that there was no real regulatory threat during the time period they studied (1995 to 1997), and that this may explain why the program had little effect on participant behavior. It is also important to note that on average, the 50 large utilities in their sample cut CO₂ emissions by 6.3 million tons per firm over the sample period. The average reduction pledged by program participants was 3 million tons, which is less than half the average actual reductions achieved by all firms. Thus, it is not the case that participants took no action; it is just that non-participants reduced emissions just as fast as participants. As a result, it is possible that DOE is correct when it claims that "A significant effect of the Climate Challenge program is the shift in thinking of electric utility management and strategic planners to include the mitigation of greenhouse gas emissions into their corporate culture and philosophy," and that "Climate Challenge has served as a catalyst for utility support of many of the voluntary CCAP actions..."¹⁶

Morgenstern and Pizer (2007, chapter 7) study the EPA's Climate Wise program, a PVP initiated in 1993 and targeted at the non-utility industrial sector, with an emphasis on encouraging energy efficiency, renewable energy and pollution prevention techniques. In 2000, Climate Wise was renamed and placed under EPA's Energy Star umbrella. The main requirements for a participant were that they develop a baseline estimate of its greenhouse gas (GHG) emissions, pledge future reductions, and make periodic progress

¹³ William K. Stevens, "U.S. Prepares to Unveil Blueprint for Reducing Heat-Trapping Gases," New York Times, October 12, 1993, page C4.

¹⁴ DeCanio (1998) finds that firms participating in the Green Lights program reported rapid payback on their investments, and questions why more firms did not join the program.

¹⁵ Climate Challenge Executive Summary, http://www.climatevision.gov/climate_challenge/execsumm/execsumm.htm

¹⁶ Ibid.

reports. Like most PVPs, the program offered public recognition and technical assistance to participants. At its peak, the program had over 600 members with thousands of facilities nationwide. Morgenstern and Pizer's basic conclusion is that the program had only a transient effect on fuel use and emissions, with the best estimate being a 3% reduction during the program's initial phase. They note that there is also some evidence that participants actually increased their electricity use in achieving these apparent reductions, so the program's overall impact on the environment is unclear. Interestingly, they speculate that "it may be fair to say that the effect of Climate Wise was to accelerate energy-saving behavior that eventually arose among program participants and nonparticipants alike."¹⁷

2.3 Other Programs

The only other formal empirical assessment of PVPs of which we are aware is Rivera and de Leon's (2004) study of the Sustainable Slopes Program, a voluntary environmental initiative established by the U.S. National Ski Areas Association in partnership with federal and state government agencies. The program was created in response to growing criticism by environmentalists of the western ski industry's expansion plans, which emphasized concerns about landscape destruction, deforestation, water and air pollution, and damage to wildlife habitats.

The program, created by the National Ski Areas Association (NSAA) in 2000, aims to promote "beyond compliance" principles that cover 21 general areas of environmental management. Participant ski areas are expected to implement annual self-assessment of their environmental performance; it does not include specific environmental performance standards or third party oversight for participants. In its first year of operation, 160 ski areas enrolled in the program, a number that increased to 170 in 2001, and has since remained constant at 173 ski areas. The self-assessment survey of environmental performance distributed by the program was completed by 79 ski areas in 2003, about 11% less than in 2001 and 2002.

Rivera and de Leon measure the performance of the program using ratings created by the Ski Area Citizens Coalition, an alliance of American environmental organizations. They find that "participant ski areas appear to be correlated with lower third-party environmental performance ratings."¹⁸ They attribute the poor performance of the program to loosely specified performance criteria and lax reporting requirements.

Finally, Coglianesi and Nash (2007) study the EPA's Performance Track Program. This program cut across various industry sectors, and offered additional regulatory flexibility and reduced inspection frequency to firms that had demonstrated a track record of environmental compliance. Although the authors' analysis does not present a formal quantitative analysis of the performance impacts of participation, they conclude that "it appears that many businesses simply do not perceive the rewards offered by government

¹⁷ Morgenstern and Pizer (2007), p. 134.

¹⁸ Rivera and De Leon (2004), p. 417.

to be very significant at all... The conclusion from this analysis is that the level of participation in programs like Performance Track will likely remain quite modest.”¹⁹

2.4 Overall Empirical Conclusions

The papers we have reviewed here indicate that PVPs have had little or no impact on the behavior of participants. Even the 33/50 Program, for which initial studies found significant impacts, seems under further study to have had little effect overall. Climate Wise appeared to create a small and transient beneficial effect on greenhouse gas emissions, Climate Challenge had no measurable effect, and Sustainable Slopes arguably had a negative impact. These findings are broadly consistent with the case study literature, as represented in Morgenstern and Pizer (2007). Some case studies suggest a cautiously optimistic conclusion that PVPs may offer modest benefits. However, as Morgenstern and Pizer (2007, p. 184) conclude: “[N]one of the case study authors found truly convincing evidence of dramatic environmental improvements. Therefore, we find it hard to argue for voluntary programs where there is a clear desire for major changes in behavior.”

3 An Overview of Our Framework

The best-known theoretical model of PVPs is that of Lyon and Maxwell (2003), which treats PVPs as modest subsidies.²⁰ In this section, we present a framework for understanding PVPs that is based on that paper; section 4 derives its main implications for public policy. This framework is very helpful for allowing us to identify the appropriate role of PVPs relative to traditional regulation. However, it does not allow us to make distinctions among the many different PVPs one observes in practice. Hence, in section 5 we delve deeper into the details of PVPs, in order to provide policy guidance regarding how best to structure such programs.

In this section we lay out a three-stage game of environmental policy played by a regulator and the firms in an industry.²¹ The heart of the game is the regulator’s choice between creating a public voluntary program (PVP) or proposing an environmental tax to the legislature, a choice based on the regulator’s expectations about the political and market responses of industry to the two alternatives. We will not present the technical aspects of the analysis, but will describe our assumptions and the structure of the model in enough detail that the reader can understand how we reach our conclusions. We couch our discussion in terms of an environmental tax, but with the recognition that our analysis would apply equally well to other regulatory measures such as a cap and trade system. As we proceed through the analysis of the model, we highlight our primary conclusions in the form of a series of italicized and numbered *Remarks*.

¹⁹ Coglianese and Nash (2007), p. 112.

²⁰ The models of Segerson and Miceli (1998) and Maxwell, Lyon and Hackett (2000) are closely related, but we consider them to be models of negotiated agreements and self-regulation, respectively, rather than of PVPs. For further discussion of these differences, see Lyon and Maxwell (2004).

²¹ For technical details, see Lyon and Maxwell (2003). For a broader perspective on corporate environmentalism, see Lyon and Maxwell (2004).

In the first stage of the game, the industry can self-regulate through pollution abatement in an attempt to preempt the imposition of government regulation. In stage 2 of the game, the regulator decides whether to propose an environmental tax, and sets its level, τ . In stage 3, if the regulator chooses not to propose a tax, or if the proposed tax is not passed by the legislature, the regulator may propose a PVP involving a subsidy s , paid for by raising costly public funds.²²

The industry consists of a group of domestic manufacturing plants that supply an export product that sells at a fixed world price.²³ Plants differ according to their efficiency (and hence profitability), and also in their costs of adopting an environmental technology, which is assumed to eliminate all environmental costs associated with production. Efficient plants have higher profits due to lower costs, and their higher efficiency also translates into lower costs of adopting the new technology. This is consistent with the observation that firms undertaking voluntary actions are typically the larger, more profitable members of an industry.²⁴ Each plant in operation emits pollutants that impose an external cost on domestic consumers. The net social welfare generated by a given plant is equal to the plant's economic profits minus the environmental costs it imposes on society. We assume that some plants currently in operation are actually creating negative net benefits for society; in other words, the environmental damage they cause is greater than the profits they generate. From the perspective of overall social welfare, such plants should be shut down. If the regulator had a free hand, and was unconstrained by political considerations, it could induce dirty, inefficient plants to shut down by imposing a tax τ set equal to the social cost of pollution. (The cost of proposing and implementing the tax is assumed to be a fixed amount K .) Any plant that could adopt the pollution control technology at a cost less than the tax would do so and avoid paying the tax. Firms, however, have a strong incentive to oppose any tax, so we make the realistic assumption that the chances of a tax bill passing through the legislature diminish the larger are the costs the bill would impose upon industry.

In the absence of a tax, the regulator may create a PVP to encourage the adoption of the environmental technology. We assume the cost K of implementing the PVP is the same as the cost of implementing the tax, so as not to have our results hinge on exogenous

²² We purposely do not assume that voluntary actions are cheaper than actions mandated by law, as doing so would make it too easy to reach simplistic conclusions about the superiority of voluntary measures. We also assume away the possibility of "win-win" solutions in which the adoption of environmentally-friendly technology lowers cost; economic analysis is not needed to conclude that these actions are desirable, nor are subsidies required to induce adoption.

²³ By assuming a competitive global market we leave out consideration of "green consumers." While this is clearly an interesting issue, we eschew it in order to keep our model tractable and because green consumers are arguably fairly unimportant in many markets, especially those for intermediate products. As Lyon and Maxwell (2000) discuss, the empirical support for the notion that green consumerism drives corporate environmental efforts is mixed at best.

²⁴ Alcoa, for example, participates in the EPA's Climate Leaders program, and is a part of the US Climate Action Partnership, a group of ten large companies and four environmental groups, that have jointly taken a public stance in favor of a mandatory climate change policy. For details on the US Climate Action Partnership, see <http://www.us-cap.org/>

differences in the cost of the two programs. We follow Carraro and Siniscalco (1996) in modeling the public voluntary agreement as a subsidy, s , set optimally by the regulator, which is payable to any plant that adopts the environmental technology. Note that a PVP is a specialized form of subsidy, which can only be collected by plants that stay in business and participate in the PVP program. We assume the subsidies paid by the regulatory authorities involve costly public funds. In addition, we assume plants that adopted the environmental technology before the PVP was established cannot be excluded from receiving the benefits of participating in the PVP, an assumption that is consistent with government practice in the public voluntary programs we discussed in section 2 above.²⁵

Throughout section 4, we treat PVPs as providing a subsidy to participating firms. In section 5, we investigate the nature of these subsidies in more detail. Such subsidies do not take the form of direct cash payments, but are instead implicit subsidies created through offering public recognition, regulatory benefits, or information and technical assistance. The first two of these benefits are basically private goods that fit readily within the structure we have laid out above. However, information can be considered a public good, and may have very different implications for the design and performance of PVPs over time. We assume that there exist some environmental investments that actually provide private benefits to a firm, but that some firms may be unaware of the value of these private benefits. In particular, large firms may find it worthwhile to invest in acquiring information, while smaller firms may be unable to afford it. A well-designed PVP can enhance the diffusion of information about pollution-abating technologies and practices to firms that would otherwise lack incentives to gather that information. To the extent PVP information reaches firms that are not official participants, however, the performance of participants may not be statistically different from non-participants. This observation fundamentally changes how one interprets the empirical evidence on PVPs, suggesting they may have been more effective than existing studies show.

4 Self-Regulation, Taxation and PVPs

In this section, we work backward through the game, beginning with the stage 3 decision regarding whether to offer a PVP, then turning to the stage 2 decision regarding taxation, and finally the industry's stage 1 decision regarding self-regulation.

Stage 3: The Public Voluntary Program

²⁵ For example, in the area of climate change, leading firms that have already begun reducing carbon dioxide emissions hope to acquire "early reduction credits" that they can trade in for emissions credits if and when a mandatory system is put in place. In the case of PVPs based on the provision of technical information, as discussed in Haddad, Howard and Paton (2004), matters may be somewhat different, since information on environmentally-friendly technology is redundant for firms that have already adopted the technology. Firms that have already adopted then have no incentive to join the program, which would tend to hold down the cost of running the PVP.

If there is no legislation, the regulator may incur a fixed cost K and create a PVP consisting of a positive subsidy s , payable to plants that adopt the environmental technology.²⁶ The level of the subsidy is chosen to maximize social welfare. Since the regulator cannot identify the cost of an individual plant, it must set a single subsidy level that applies to all plants. Plants can then be divided into two groups, those that choose to join the PVP program and adopt the environmental technology, and those that do not. Overall social welfare sums up the net contributions of both groups (profits minus environmental damages), and subtracts the cost of raising funds to cover the aggregate subsidy payments made.

If public funds were not costly, the optimal subsidy would simply be equal to the environmental harm done by each plant. This is an intuitively appealing criterion for setting the subsidy level, as it ensures that all plants that can adopt the technology at a cost less than their environmental damages will do so. When public funds are costly, however, the optimal subsidy is distorted downwards, and too few plants will adopt the environmental technology, relative to the case of costless public funds. At the margin, the regulator faces a tradeoff between inducing additional participation in the program and paying out additional subsidies to plants that would participate in the program anyway. When the participation rate is unresponsive to increases in the subsidy, and public funds are costly, it becomes very burdensome to raise the level of participation in the program, and the distortion in the subsidy grows. Typically, the industry's responsiveness to subsidy increases is dampened as the heterogeneity in plant adoption costs grows larger, so it becomes increasingly costly to induce additional plants to participate in a voluntary program as industry heterogeneity grows. Overall, social welfare under a PVP increases when the cost of public funds is low and the cost of technology adoption does not vary greatly across plants.²⁷

Stage 2: Proposal of an Environmental Tax

In the second stage of the game, the regulator may propose an environmental tax τ which can be implemented at a cost K . It is easy to see that any tax proposal will result in losses to the industry. As a result, industry will oppose even an optimal tax, and the tax actually proposed by the regulator will be distorted away from its most beneficial level. For clarity of exposition, we start our analysis with the case where there is no political opposition, and then move on to study the regulator's behavior when tax proposals face political resistance.

The welfare gains from taxation, relative to government inaction, come in three parts. First, there are social gains from forcing inefficient plants to exit the industry, since the profits these plants generate are less than the environmental damage they cause. Second

²⁶ Our model was constructed primarily to reflect the U.S. experience with PVPs, in which PVPs tend to be substitutes for emission taxes or other mandatory policies. For an analysis in which voluntary agreements are used in conjunction with emission taxes, see the analysis of the U.K. system in de Muizon and Glachant (2004).

²⁷ In addition, of course, the net social benefits of the PVP must exceed the cost of creating the program. We will assume this condition holds throughout the remainder of this section, since otherwise a PVP would never be offered.

is the social value of the tax revenues raised from the emissions tax, which can offset the need to raise public funds through other means. Third are the social gains from adoptions of the environmental technology by efficient plants.

When regulators do not face political opposition from industry, the optimal pollution tax generates greater social benefits than does the optimal public voluntary program. There are two reasons for this. First, a fundamental limitation of the PVP is that it cannot subsidize plants to exit the industry; plants must stay in business in order to collect any benefits from the PVP program. Second, in a world with costly public funds, a tax that generates public revenues is preferable to a subsidy that drains public coffers. Both effects make a tax preferable to a PVP when political pressures are irrelevant.

Remark 1: An environmental tax is inherently a more effective instrument than a PVP.

In reality, of course, political opposition is important. Industry losses from a tax occur in several different forms. Inefficient plants exit the industry and their profits are lost. Moderately efficient plants will continue operations, but each plant will incur losses equal to the tax. Efficient plants will be induced to adopt the environmental technology, which is costly. The sum of these losses constitutes the total direct costs borne by industry from the tax proposal. However, additional indirect costs are possible due to the loss of potential subsidies from a PVP. These opportunity costs of a tax must also be taken into account.

Since industry losses are positive for any positive tax, industry can always be expected to oppose a tax. This fact alters the regulator's objective function. Specifically, the regulator will optimize the expected benefits of the tax, given that legislation favoring the tax will only pass with some probability less than one. As one might expect, with political resistance the regulator weakens the tax, relative to its socially optimal level, so as to increase its chances of passage. Nevertheless, the greater inherent effectiveness of a tax outweighs the benefits of a PVP unless political opposition would substantially weaken any feasible tax. As a result, we have the following remark.

Remark 2: A PVP should only be used if political opposition to an environmental tax is high.

As mentioned at the outset of this paper, public voluntary programs—despite their inherent weaknesses—are becoming more popular. It is interesting, therefore, to examine how welfare is affected when the regulator has the possibility of offering a PVP after legislative efforts fail.

Remark 3: Offering a PVP may increase industry political resistance to a tax, thereby reducing the effectiveness of the tax and its likelihood of passage.

The intuition behind Remark 3 is simple: if the industry knows a PVP will be offered after a tax fails, it has more incentive to oppose the tax so it can collect the subsidy that is offered under the PVP. Whether the possibility of a PVP is likely to have negative

incentive effects depends upon political circumstances. If society has reached the point where there is a reasonable likelihood of passing strong environmental legislation, then it would be best if the regulator could commit *not* to offer a PVP. This would help to maintain the political pressure for strong regulation. In contrast, when the chances of strong legislation are minimal, offering a PVP is unlikely to prevent passage of a strong bill but can offer at least some environmental improvement. In such a situation, a PVP may be a worthwhile policy.

Stage 1: Self-Regulation

In our framework, incentives for unilateral voluntary action exist only because of the threat of taxation. Put another way, if the probability of legislation is zero then the industry has no incentive to engage in voluntary activity.

It is important to recognize that greater self-regulation reduces the social benefits of offering a PVP; greater industry self-regulation means the subsidy program is increasingly providing unnecessary subsidies to firms that have already adopted the clean technology without government assistance. Thus, as self-regulation increases, a tax proposal looks increasingly desirable, from a social perspective, relative to a PVP. From industry's perspective, this means that self-regulation is unprofitable unless it is extensive enough to preempt the proposed tax---otherwise, self-regulation just increases the likelihood of a tax and decreases the likelihood of a subsidy.

Remark 4: Preemptive industry self-regulation is preferable to government action.

The reasoning behind this remark is as follows. As industry undertakes more unilateral action, the regulator can be more aggressive in proposing a tax, since industry will have less reason to oppose it. If the level of unilateral action is so high that the regulator decides not to propose a tax at all, this must be because society is even better off under preemption than it would be if the tax were imposed.

5 The Design of PVP Programs

The discussion thus far has treated PVPs as providing a subsidy to participating firms. In this section, we investigate the nature of these subsidies in more detail. As we described in the Introduction, such subsidies do not take the form of direct cash payments, but are instead implicit subsidies created through offering public recognition, regulatory benefits, or information and technical assistance. The first two of these benefits are basically private goods that fit readily within the structure we have laid out above. However, information can be considered a public good, and may have very different implications for the design and performance of PVPs over time. In this section, we analyze the structure of PVP subsidies, focusing on their informational dimensions.

5.1 The Informational Structure of PVPs

We assume there exist some environmental investments that actually provide private benefits to a firm, but that some firms may be unaware of the value of these private benefits. They may take the form of a reduction in energy usage, increased employee morale and productivity, or enhanced consumer, community and regulatory relations. It should be clear that these benefits may vary across firms for several reasons. For example, if there are economies of scale in building employee morale, then larger firms may benefit more from an increase in morale than smaller firms. Similarly, firms that deal with regulatory authorities on a regular basis may benefit more from improved regulatory relations than firm that interact infrequently with these authorities. For these reasons, large firms may find it worthwhile to invest in acquiring information, while smaller firms may be unable to afford this type of investment. A well-designed PVP can enhance the diffusion of information about pollution-abating technologies and practices to firms that would otherwise lack incentives to gather that information.

A regulator attempting to enhance the diffusion of information about pollution control opportunities is faced with two decisions. First, it must decide how to acquire information about the value of alternative pollution abatement technologies, and second, it must decide how to distribute this information to firms. With regard to the first decision, the regulator has two options: it could undertake research and development itself or it could attempt to obtain information from firms that are already informed. In some cases, such as those in which firm-level experience with the environmental investment is necessary for learning, only the latter option will be open to the regulator.

Obtaining information from firms that are already informed is the most desirable option for the regulator to follow as long as the information being passed to the uninformed firms does not threaten the competitive position of the informed firms and hence undermine their incentives to participate. The EPA's Green Lights program provides such an example. The installation of an energy-efficient lighting system tends to lower a firm's overhead and should consequently have little impact on the firm's competitive position. Furthermore, lighting is used in all types of industries, so much of the sharing will be with firms in other industries. In this case, informed firms need to be offered only minor inducements to provide the information to the regulator. Typical benefits provided by PVPs include access to EPA officials, highly visible publicity, or a widely-recognized logo that can be used on the firm's products---which may be enough to convince informed firms to participate when information is not competitively sensitive.

Remark 5: A cost-effective PVP offers a group of informed firms inducements that cover their costs of sharing information. It then subsidizes the cost of providing that information to uninformed firms.

The story we have just told is consistent with the work of Darnall (2003). She reports results from a small-scale survey that asked companies to identify their rationales for participation in the EPA's Environmental Management System Pilot Program, and the benefits actually obtained. Among the findings was a striking difference between privately held and publicly traded firms. For example, privately held firms were more likely to report learning valuable new information from participation than were publicly

traded companies. In our framework, these firms are uninformed firms that did not invest in gathering information on their own.

For competitively valuable information, firms will be reluctant to share the information with rivals. Any benefits government regulators can provide are unlikely to outweigh damage to a firm's market position. Hence, PVPs are unlikely to be effective unless the information involved is not competitively sensitive.

Remark 6: PVPs focusing on information that is not competitively sensitive are more likely to be successful.

Once the regulator learns the value of a given abatement technology, it must then decide whether and how to transmit the information to uninformed firms. There are a variety of ways for sharing information, which subsidize information acquisition to different extents and in different ways. For example, in many cases the regulator places case studies on its website, which provide at least partial information to firms at a cost to the government that is virtually zero. In other cases, such as the Climate Leaders program and the Green Power Partnership, the regulator offers direct technical assistance to participating firms. In still other cases, such as the Natural Gas Star program, the regulator facilitates meetings at which firms can share information among themselves. Such meetings may allow for fuller information transmission, but it is costly for firms to travel to meetings and allocate employee time to attending them. Thus, there is a range of options for the regulator regarding the extent to which it subsidizes the information acquisition of uninformed firms.

Remark 7: Regulators have a variety of options for enhancing information diffusion, whose use depends in part on the complexity of the information presented and the extent to which it must be tailored to the circumstances of individual firms.

Once the government agency has obtained the relevant information, and decided how to diffuse the information, the government faces a third question: with whom should the information be shared? Should it restrict information access to participants in PVPs, or should it attempt to diffuse the information as broadly as possible? For an agency charged with protecting the natural environment, it is clearly desirable to share information as widely as possible, thereby having the greatest possible beneficial impact on the environment. Once firms join the PVP, the EPA would still have incentives to make information available more broadly. The only reason for the agency to withhold information from non-participants would be to "prove" that PVPs work.

Remark 8: Once a government agency has acquired pollution abatement information, environmental benefits are greatest if it is made available to all firms who might benefit from it, regardless of whether they participate in a PVP or not.

This remark has strong implications for empirical analysis of PVPs. It means that there may be no good reason to expect a difference in performance between firms that join a PVP and those that do not. It is possible that a difference would be observed in the early phases of a program, when the government is trying to attract participants who already

have information to share. Once the program moves to the dissemination stage, however, there is likely to be no measurable difference between participants and non-participants. This is a point that generally has not been recognized in the empirical literature on PVPs, and that demands a reinterpretation of the findings in this literature.

Remark 9: Given that the information offered by a PVP will gradually diffuse beyond PVP members, performance differences between participants and non-participants should diminish over time.

5.2 The Structure of EPA PVPs

We turn now to reviewing the PVPs offered by the US EPA, with an eye to assessing the importance of information provision in the PVPs that are observed in practice. A careful review of the EPA's partnership programs reveals certain common features found in many of these programs. In Table 1 we identify these common features, and characterize each partnership program according to which features it includes. In the following paragraphs we discuss each of the main features used in EPA PVPs.

From a high-level perspective, the two most common elements of PVPs appear to be: 1) disseminating information about emissions control techniques more broadly throughout firms in particular industries, and 2) providing public recognition to those companies that go beyond compliance with existing regulations. In addition, there are several other techniques that are often used in PVPs. Some PVPs provide regulatory benefits in the form of reduced regulatory delays for certifying new facilities (Project XL), reduced priority for inspection (Performance Track) or improved access to EPA officials (Climate Leaders).²⁸ Other programs provide third-party certification of the environmental effectiveness of certain technologies (Environmental Technology Verification Program), a reliable compendium of information about the environmental attributes of competing products (Green Vehicle Guide) or work to improve labeling of consumer products (Consumer Labeling Initiative).²⁹

As Table 1 shows, there are several different types of information-oriented PVPs. First, some involve government-sponsored research aimed at creating new knowledge, which can then be diffused throughout an industry. Second, some programs codify the knowledge of certain leading firms, through case studies, for example, and make that information available to other firms in the industry. Third, still other programs place more emphasis on peer-to-peer sharing of information, rather than transmitting information through the regulator as intermediary. Each of these types of programs has certain special characteristics, which we now discuss.

²⁸ Maxwell and Decker (2006) present a model of programs like Performance Track that reward good corporate behavior with a reduced likelihood of inspection.

²⁹ A few PVPs involve helping industry to solve coordination problems that can inhibit the adoption of environmentally friendly practices. The EPA's Water Alliances for Voluntary Efficiency has helped hotels to coordinate on encourage hotel guests to re-use towels instead of washing them each day. Similarly, EPA's EnergyStar program helped the VCR industry coordinate on the use of inexpensive circuitry that reduces power consumption during periods when the VCR is not in use.

Government-sponsored research is relatively unusual among PVPs. Design for the Environment and Green Chemistry are among the more prominent programs that utilize this approach. Even Design for the Environment sponsored little original research. Its focus was instead on pulling together the existing body of knowledge on the environmental impacts of alternative technologies in particular industries, an approach we discuss in more depth below. Government-sponsored original research seems to be used primarily in industries where there are no or few large firms that can generate the knowledge themselves. For example, one of the first projects under the Design for the Environment program was aimed at the dry cleaning industry, whose firms are too small to undertake projects aimed at generating new knowledge (or even staying abreast of the existing knowledge base) on the environmental impacts of alternative dry cleaning technologies.

Programs that codify the existing knowledge of leading firms are the single most common tool used within the family of EPA partnership programs. For example, many PVPs provide case studies of successful projects undertaken by participating firms. Some types of knowledge, of course, are difficult for the EPA to generate directly. This is the case, for example, for learning-by-doing, that is, knowledge that accrues during the process of conducting business. Government-sponsored research is a poor means for attempting to create this knowledge. Even if the knowledge could be generated directly through government sponsorship, at least in principle, it is often more efficient for the regulator to collect data on the experience firms have already accumulated rather than to try and generate new knowledge on its own, assuming firms can be persuaded to share their existing stock of information. Firms, in turn, are more likely to share such information if it is widely applicable across a variety of industries, rather than of use only to help out their rivals within the same industry. Sharing within an industry is also more likely if it involves information that reduces fixed costs rather than variable costs, since such cost reductions have no impact on market share within the industry.

In cases where it is efficient for EPA to obtain information from leading firms, the regulator must provide some form of inducement to these firms to compensate them for the knowledge they share. This is typically done through public recognition for the firm, recognition within the firm of its "environmental champions," providing access to regulatory officials, or offering regulatory flexibility of various sorts. This need to reward firms that share information helps to explain the structure of many PVPs, which typically feature both information provision and public recognition. The information itself is of particular value to smaller firms, or privately-held firms, which may have less of a knowledge base, while the public recognition benefits are attractive to larger firms with a more extensive knowledge base. The regulator can bring two specific sources of value to these interactions that are unlikely to be duplicated by the firms themselves. First, the regulator can help cover the cost of transmitting information from firm to firm, by undertaking the efforts needed to document successful case studies and make them available to others. Second, the regulator can provide public recognition with greater credibility than can individual firms or trade associations operating directly.

Peer-to-peer information sharing is an aspect of PVPs that is distinct from the transmission in written form of codified knowledge and case studies. Ongoing interactions with give and take are particularly useful when firms are engaged in long-term processes of continuous improvement in the environmental arena. One-time achievements can be documented and posted on the web, but web postings will always lag behind the ongoing creation of new knowledge. Face-to-face interactions are also helpful when one cannot simply replicate one firm's experience in another firm's operational setting. In such cases, the opportunity for immediate feedback helps firms to determine just how applicable other firms' experience is for their own idiosyncratic problems. This may have particular value when the technological processes involved are complex, and are difficult for EPA officials to convey accurately without having actual industry experience.

6 Conclusions

There is growing concern that public voluntary programs for environmental protection are ineffective. Most empirical studies of PVPs find that either participation made no difference in environmental performance, or that any difference occurred only in early periods and quickly disappeared. As these studies focus primarily on the 33/50 Program and climate change, we conclude by revisiting these findings in light of our analytical framework.

Clearly the evidence is mixed regarding whether 33/50 participation quickened the pace of toxic chemicals reductions. The most likely impacts appear to have been in the early years of the program, among firms EPA first invited to participate in the program.³⁰ This is consistent with the presence of a serious regulatory threat hanging over the program. Industry leaders such as DuPont and Dow felt keenly that a strong and rapid response to Reilly's invitation was required in order to protect the chemical industry's future profitability, regardless of whether they actually obtained direct benefits from program participation. Furthermore, DuPont famously phased out its production of ozone-depleting compounds more rapidly than required by law, which may explain some of the early-stage reductions.³¹ The lack of a measurable impact in later years of the program is also consistent with our information-diffusion argument: by 1993, the basic techniques of pollution prevention may have diffused to firms that did not participate in 33/50, making it impossible to detect a difference empirically.³²

Climate change is perhaps the classic case in which, lacking a regulatory threat, EPA and DOE designed PVPs to diffuse information, emphasizing the benefits of energy-efficient

³⁰ However, the papers that find significant early-stage effects did not control for the regulatory phase-out of ozone-depleting compounds or the paper reductions created by changes in reporting requirements; nor did they assess whether these reductions went beyond the reductions accomplished before firms joined the program.

³¹ See Reinhardt (2000), pp. 61-65.

³² The fact that firms continued to join the program even after information was fully diffused is not inconsistent with our analysis. The program offered various non-informational benefits whose value may vary across firms and affect their participation decisions, such as favorable publicity, improved employee morale and improved regulatory relations.

appliances and practices. As our framework predicts, in the case of Climate Wise any differences in performance between participants and non-participants disappeared over time. On the other hand, the Climate Challenge program, which had little emphasis on information, seems to have had no effect at all.

There appears to be a growing consensus that PVPs are at best of modest impact and at worst a form of greenwash that diverts public attention from important environmental problems. However, our analysis suggests that these conclusions are premature. Given that these programs are typically created out of political weakness, there is no reason to expect them to have large impacts. However, recent empirical findings that PVPs have no impacts seem to us to be misspecified. If we are correct that information on pollution abatement techniques diffuses to non-participants as well as participants, then the empirical studies evaluating PVPs have arguably pursued empirical strategies that cannot possibly identify the true impact of these programs. If a PVP is effective in disseminating information about pollution prevention throughout the manufacturing sector, then all firms would be reducing their emissions at roughly the same rate---which appears to be the case. There would be no evidence that PVP participants performed better than non-participants, even if the program was actually wildly successful!

Our analysis suggests that new econometric strategies are required to measure the true impact of public voluntary programs. The problem is that it is very difficult to control for the true state of information possessed by program non-participants. One recent study on the diffusion of energy efficiency to owners of commercial buildings found that information diffusion had a positive and significant effect on investment in new energy efficient practices.³³ Future studies of PVPs might try to control for knowledge possessed by non-participants, although this is likely to be difficult. An alternative strategy would be to exploit policy differences across states or countries, but even then it will be difficult to control for information spillovers across political boundaries. It may be possible to learn from the literature on technology diffusion, which has begun to estimate spillover effects explicitly.³⁴ In the meantime, our analysis gives the managers of PVPs at the DOE and EPA a bit more ammunition with which to defend their programs in the face of the growing empirical assault on the effectiveness of these programs.

We have presented a framework in which these conclusions are not surprising, though perhaps not inevitable. Our framework has two main features. First, PVPs are shaped by political considerations, and typically arise from weakness, not from strength; hence, expectations for their performance should be low. Second, many PVPs seem to be designed as tools for enhancing the diffusion of information about pollution abatement techniques; when this is the case, after the initial periods of a program we should not expect to observe significant differences between the performance of participants and non-participants.

The political origin of PVPs suggests that they should not be regarded as a powerful new policy instrument. Rather, they should be viewed as a limited tool that may be useful in

³³ See Morgenstern and Al-Jurf (1999).

³⁴ See, for example, Audretsch and Feldman (1996).

settings where more powerful policy instruments are infeasible. Indeed, policymakers should approach PVPs with caution, since their very availability may increase industry resistance to the use of more powerful regulatory tools. This resistance increases because the hope of obtaining a subsidy (through a PVP) strengthens industry's resolve to fight traditional regulatory tools of taxes and standards, which impose direct costs on the industry.

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Table 1: EPA Voluntary Partnership Program Characteristics

Program	Information Provision				Govt. R&D	P2P Exchange	Certification	Public Recognition	Regulatory Benefits	Coordination	Grant Funding	Info Disclosure	Goal Setting
	Software	Cases	Lists	Tech Info	Tech. Asst.								
AgSTAR		•					•		•				
Pesticide Environmental Stewardship Program		•							•		•		
Commuter Choice Leadership Initiative		•					•		•				
Green Vehicle Guide		•											
Indoor Air Quality		•											
Voluntary Diesel Retrofit Program		•											
Climate Leaders		•						•	•			•	•
Coalbed Methane Outreach Program		•					•						
Combined Heat and Power Partnership		•											
ENERGYSTAR	•	•	•				•	•	•				
Green Power Partnership			•					•				•	•
HFC-23 Emission Reduction Program													
Landfill Methane Outreach Program (LMOP)		•	•				•					•	
Mobile Air Conditioning Climate Protection Partnership							•			•			
Natural Gas STAR Program	•	•			•		•		•				•
SF6 Emission Reduction Partnership													•
for Electric Power Systems		•		•			•	•	•				
Voluntary Aluminum Industrial Partnership				•			•	•					•
Consumer Labeling Initiative					•		•						
Design for the Environment				•	•	•	•		•				
Green Chemistry	•			•		•							
Green Engineering		•					•						
National Waste Minimization Partnership Program		•	•	•			•		•				
Sustainable Futures Initiative	•			•	•				•				
National Environmental Performance Track							•		•				
Project XL									•		•		
Industry Sector Performance Programs		•	•	•									
Environmental Technology Verification Program							•						
Hospitals for a Healthy Environment		•	•	•									•
Waste Wise		•	•	•	•		•		•			•	•
Water Alliances for Voluntary Efficiency	•			•					•	•		•	