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Sources of specification errors in the assessment of voluntary environmental programs: understanding program impacts

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Abstract Voluntary environmental policy has often been criticized as picking the low-hanging fruit, producing benefits that are relegated to a self-selected sample, and improvements observed in voluntary environmental policy are indistinguishable from business as usual. These criticisms are, in part, the result of the two-stage models used to evaluate voluntary environmental programs that may over-control for the mechanisms that lead to program effectiveness. In addition, voluntary environmental policy may play a valuable role in achieving effective, efficient, and meaningful change in corporate behavior through spillover of public goods to non-participating firms, and changing norms of corporate behavior that are not detected using econometric methods. This manuscript details evidence across the body of literature that supports this hypothesis and suggests a variety of mechanisms that voluntary environmental programs may produce social welfare benefits with low social costs. The decision to employ voluntary environmental programs should be based on an assessment of trade-offs of consequences between adopting ineffective programs and costs involved with failing to adopt effective programs.

Keywords Voluntary environmental policy · Pollution abatement · Corporate sustainability · Program evaluation

Introduction

The promises of voluntary environmental policy (VEP) include increased cooperation between government and business, reduced implementation, monitoring, and enforcement costs, and increased satisfaction by parties while attaining environmental goals. After over a decade of research on the effectiveness of voluntary environmental policy (VEP), the

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findings of VEP effectiveness have been somewhat mixed, with a review of quantitative evidence suggesting that VEP is ineffective (Lyon and Maxwell 2007). While this finding may be due to specification error in the way that these programs are evaluated, formal models of VEP conclude that "An environmental tax is inherently a more effective instrument than a PVP (public voluntary program) (Lyon and Maxwell 2007)."

In this manuscript, I argue that important benefits of voluntary environmental programs may not be captured by econometric methods used to evaluate these programs. Creating the appropriate mechanism for firm managers to signal environmental improvements to stakeholders, disseminating best practices across an industry, reducing information or search costs associated with improved environmental behavior, or shifting norms of behavior may fail to appear in standard program evaluations, or have been controlled for through model specifications. Further, these benefits may accrue with low opportunity costs or social costs, depending on program design and alternative policy opportunities. The effectiveness and efficiency of voluntary environmental programs depends on the trade-offs of consequences of adopting alternative policy instruments, and in comparison with inaction–or not adopting a voluntary or mandatory program.

Formal modeling efforts and recent empirical research have had a difficult time quantifying the value of shifting the social norms of business behavior, increased cooperation between firms and government, reduced conflict, the potential social costs of monetizing environmental improvements, and have potentially underestimated the benefit of achieving low-cost environmental improvements with low-cost voluntary initiatives. In a business environment that is defined by leaders and laggards and where laggards seek to emulate the successes of industry leaders, achieving substantial long-run change in business behavior may be dependent on encouraging business leaders to adopt improved environmental management practices so that this shift in behavior eventually disseminates to all market participants. Evidence supporting this type of dissemination of best practices has been documented across the environmental management literature (e.g., (Darnall et al. 2009; Lange 2009; Matisoff et al. 2012; Potoski and Prakash 2005b, 2013). In real-world situations, where neither economic incentives nor voluntary programs meet theoretically optimal conditions, it is possible that the efficiency and effectiveness of a voluntary program could exceed that of mandatory government-driven regulations (Matisoff 2013).

Conversely, the literature on voluntary programs has ignored the impact of displacing more effective mandatory programs through voluntary or international NGO-based initiatives (Lyon and Maxwell 2007). It is possible that implementing public voluntary environmental programs may dry up any existing political will to mandate, implement, or enforce policies or standards that can be more effective (Lyon and Maxwell 2004). Voluntary programs that are not sufficiently stringent may reward bad actors and obscure bad environmental behavior. And voluntary programs may waste resources on programs that ultimately provide disincentives for additional environmental innovation. However, some empirical research demonstrates that voluntary and mandatory regulation can be complementary, rather than competing (Arimura et al. 2008; Potoski and Prakash 2005a, b, 2013).

This paper is organized as follows: First, I outline several possible mechanisms and evidence from the literature that suggests that voluntary environmental programs have benefits that have not been captured in existing quantitative analyses, second, I discuss the trade-offs of adopting ineffective VEP in comparison with the consequences of failing to adopt effective voluntary environmental policy, and finally, I generate a series of recommendations regarding future research of VEP.

Specification error in evaluations of voluntary environmental programs

Previous research suggests that empirical models have failed to find effective voluntary environmental programs due to specification error (Lyon and Maxwell 2007). Most rigorous quantitative evaluations of voluntary policies use a two-stage approach to evaluate voluntary program effectiveness, and define effective programs as those that change the trajectory of firm or plant level environmental behavior as a result of participation, compared with the trajectory of environmental behavior of a non-participating control group. While these programs and accompanying evaluations often address toxic or greenhouse gas emissions behavior, they may also examine a wide range of environmental behaviors including the adoption of environmental management systems (EMS), the installation of green lighting systems, or the environmental footprint of ski resorts.

In a typical two-stage approach to evaluating voluntary environmental programs, the first stage controls for the self-selection of firm participation into a voluntary program through an instrumental variable or matching approach, while the second stage compares the environmental performance of participating firms against non-participating firms. This method of evaluation compares firm performance to a Business as Usual (BAU) baseline (Koehler 2007).

A review of the voluntary environmental program literature demonstrates that most studies of voluntary programs have found that the environmental behavior of targeted facilities improves under voluntary environmental regulation; however, once non-participating firms' behavior is controlled for, or once firm behavior preceding voluntary program adoption is controlled for, these programs appear ineffective (Darnall and Sides 2008). Specification error occurs when econometric models do not accurately test hypotheses they are designed to test. Below, I discuss four potential sources of specification error in studies of public voluntary environmental programs.

Selection bias and two-stage models

The decision to participate in a voluntary environmental program is likely to be strategically related to future emissions levels, creating selection bias that makes programs appear overly effective.[1] As a result, two-stage models or matching models are employed to control for observable differences between participants and non-participants (Heckman et al. 1996). The two-stage models, intentioned to reduce the concern that observed changes in environmental behavior, are not due to unobserved differences in firms that drive both participation and environmental outcomes, but are due to program effectiveness, eliminates a major potential pathway to program effectiveness. If firms join voluntary programs to signal to stakeholders or to take advantage of marketing benefits provided by program participation, and these program benefits are conditioned upon observable characteristics of firms, econometric specifications that control for these observable characteristics eliminate that pathway to program success.

Marketing and other financial benefits to firms rely on the ability of firms to gain a competitive advantage through participation by signaling to stakeholders. Numerous studies have noted differences between participants and non-participants of voluntary environmental programs (Koehler 2007; Lenox and Nash 2003). Factors such as firm visibility (Coglianese and Nash 2006; Khanna and Damon 1999; King and Lenox 2000;

[1] Alternatively, in the case of greenwashing, the selection bias could lead dirtier firms to be more likely to participate. Lenox and Nash (2003) find evidence of both cases.

Potoski and Prakash 2005a), regulatory pressure (Alberini and Segerson 2002; Arora and Cason 1996; King and Lenox 2000; Rivera et al. 2006), market pressure (Potoski and Prakash 2005a, b), R&D expenditures (Arora and Cason 1996; DeCanio and Watkins 1998; Khanna and Anton 2002; King and Lenox 2001a), age of equipment (Arora and Cason 1996), financial performance (Arora and Cason 1996; Coglianese and Nash 2006; Dasgupta et al. 2000; Khanna and Damon 1999; Rivera et al. 2006; Welch et al. 2000), and program stringency (Lenox and Nash 2003), impact a firm's decision to participate in voluntary programs.

Controlling for observable and unobservable firm heterogeneity, typical in program evaluation studies, produces a stronger causal claim for program effectiveness. However, these efforts have the effect of controlling for factors that might lead a firm to participate in and provide environmental benefits associated with a voluntary environmental program. If certain firms are more likely to take advantage of opportunities to signal stakeholders through participation in a voluntary program, controlling for the propensity for firms to participate in a voluntary program removes that pathway to program success. Further, participants and non-participants frequently have different pollution profiles, making participants more (or less) pollution intensive prior to participation, and making subsequent reductions in pollution easier (or more difficult) to achieve (Bui and Kapon 2012; King and Lenox 2000).

Specifically, the interaction effect between firm characteristics and program participation might produce environmental benefits. Participation in a voluntary program may enable firms to take advantage of observable or unobserved characteristics, such as managerial slack, by allowing firms to signal to investors, consumers, or other stakeholders. By controlling for the likelihood to participate in programs and then only examining within-firm or within-plant changes over time, researchers may be over-controlling for differences across firms, incorrectly leading to findings of ineffective voluntary programs.

Heterogeneity in program effects due to program design

Second, heterogeneous effects across different types of agreements, and across different rule designs, can explain some findings of ineffectiveness. Effective programs have rule structures that mitigate two central collective action problems: attracting firms and other entities to participate in the program and ensuring that participants adhere to program obligations (Potoski and Prakash 2009). Without rule structures that overcome these collective action challenges, voluntary programs are not likely to be effective in achieving desirable environmental outcomes. Many public voluntary programs lack rules (e.g., third-party audits) that mitigate collective action problems that thwart efficacy (Potoski and Prakash 2009). Weaker private initiatives that focus on information provision and do not require changes in behavior from participants or allow firms to set their own goals and targets have been found to be ineffective (King and Lenox 2000).

Certain types of voluntary programs are more susceptible to gaming by industry and are more susceptible to greenwash (Lenox and Nash 2003). Public programs that label products using stringent standards (such as EPA's Energy Star label) appear to be effective, while programs by industry associations may have incentives to undercut more stringent NGO or government labels (Fischer and Lyon 2014). Programs sponsored by the EPA or other agencies that confer a label to firms for setting their own targets (such as Sustainable Slopes or the 1605b program) have the potential to be coopted by bad actors and be susceptible to greenwash. Industry-led initiatives have fared particularly poorly in the

evaluation literature (Gamper-Rabindran and Finger 2013). VEPs using self-reported inspections rather than third-party audits also fare poorly (Darnall and Sides 2008; Gamper-Rabindran and Finger 2013). With incentives to obfuscate and diminish the standards associated with eco-labeling, firms may use VEP to avoid more stringent commitments while creating the appearance of improved environmental behavior.

Formal models suggest that environmental management systems may be less prone to this sort of gamesmanship (Lyon and Maxwell 2011). Private voluntary agreements that have an institutional design that contains the costs and benefits to program participants supports this hypothesis (Arimura et al. 2008; Darnall and Kim 2012; Darnall and Sides 2008; Dasgupta et al. 2000; Matisoff 2012; Potoski and Prakash 2005b). Empirical evidence for ISO 14000, Pollution Prevention (P2) programs, and other environmental management systems suggests that programs that focus on improved capacity building at the firm level, improved management standards, and developing new markets and technologies may be more effective mechanisms for environmental improvement than labeling programs or programs where firms set their own pollution reduction targets. When targets are set, information provided, or labels awarded, third-party auditing is a crucial design component. Nevertheless, more research is needed to understand the design components of voluntary programs that make them more (or less) effective.

Alternatively, private agreements backed by a strong regulatory threat may be able to achieve substantial environmental improvements (Lyon and Maxwell 2004). And programs that have strong internal sanctioning rules may be more likely to achieve environmental benefits (Lenox and Nash 2003). Bilateral voluntary agreements, such as the EPA's agreement with the pressurized wood industry, may be backed by a strong regulatory threat and can generate substantial reductions of toxics (Hsueh 2013). In this sense, a strong regulatory threat may create the appropriate institutional pressures to lead to changes in corporate behavior, though Lyon and Maxwell (2004) argue that these will likely be less effective than mandatory regulation.

Diffusion of behavior from participants to non-participants

Third, program participation in two-stage models is coded with a binary metric of program participation. Plants or firms that participate in a program are coded with a "1" and plants or firms that do not participate in a program are coded with a "0." This modeling specification assumes that costs and benefits to program participants are limited to just those participants and do not spillover to non-participants. If VEP can help shift behavior of the industry leaders, or if VEP simply rewards industry leaders for early changes in environmental management, then industry laggards will improve their environmental behavior as well, simply to keep pace with the leaders. These types of behaviors are not captured by dichotomous program participation specifications.

The literature has been unable to establish major changes in environmental behavior from participating firms in comparison with non-participants, generally concluding that environmental benefits may accrue to participants and non-participants alike (Darnall and Sides 2008; Lyon and Maxwell 2007; Morgenstern et al. 2007). Econometric analyses have also demonstrated that public voluntary programs' effect on firm behavior is significant only in the first years of a program (Sam and Innes 2007), which may be due to emissions reductions that were already planned or already had occurred (Vidovic and Khanna 2007).

Findings across the literature suggest that the environmental performance of participating firms improves and that the environmental performance of the entire industry improves as well, leading to findings of ineffective voluntary programs (Koehler 2007).[2] In the Sustainable Slopes program, 28 % of ski slopes receive an "F" rating in 2001, decreasing to 11 % in 2005, but there is no statistically significant difference between participants and non-participants (Rivera et al. 2006). In EPA's 33/50 program, targeted chemical releases declined by 50 % from 1988–1994, meeting the 50 % reduction target a year ahead of schedule (Environmental Protection Agency 1999). In the DOE's Climate Challenge program, electric utilities reduced or sequestered 237 million metric tons of carbon (Edison Electric Institute 2003). EPA's Climate Wise program claimed to have "started or completed more than 1,000 energy efficiency and emission reduction projects eliminating almost 3.3 million tons of carbon from the atmosphere" in 1997 alone (US Environmental Protection Agency 1998). Altogether, the program claims to reduce emissions significantly while saving firms hundreds of millions of dollars (Morgenstern et al. 2007).

Researchers are often skeptical of these claims, however, due to the difficulty of comparing claims to a baseline of what would have occurred without the voluntary program (Alberini and Segerson 2002). In addition, when environmental goals are determined by industry rather than by an environmental agency, it is particularly difficult to ascribe environmental improvements to specific voluntary initiatives (Alberini and Segerson 2002).

It is possible that voluntary environmental improvements disseminate across an entire industry and accrue to participating firms and non-participating firms (Lyon and Maxwell 2007). In a public voluntary program, the regulatory agency—usually the EPA or DOE—has incentive to share best practices and technologies with both participants and non-participants alike. Under this model, the regulatory agency explicitly disseminates information to participants and non-participants in order to maximize environmental benefits (Lyon and Maxwell 2007). Alternatively, this dissemination need not be explicit. Because industry routinely implements best practices, industry laggards attempt to mimic the successful strategies and practices of industry leaders. Evidence from the Green Lights program demonstrates that best practices for energy efficiency can disseminate across industries and geographical regions (DeCanio and Watkins 1998). Evidence from the Green Slopes program shows modest average environmental improvement across all western ski slopes between 2001 and 2005; however, this improvement is only statistically significant for one of the five metrics of environmental performance, once the two-stage model that accounts for the probability of participation is specified (Rivera et al. 2006).

Voluntary programs may reduce search costs, transaction costs, and help disseminate best practices across an industry (Hsueh and Prakash 2012). A wide range of voluntary environmental programs including voluntary environmental management systems, labeling and certification programs, and information disclosure programs may help firms reduce market barriers that are more likely to produce myopic or other sub-optimal behavior.

Environmental management systems (EMS) and labeling programs, such as ISO certification or Forest Stewardship Council (FSC) certification, may reduce myopic behavior by lowering information costs, and improving internal processes related to learning and management (King and Lenox 2001b; Rickenbach and Overdevest 2006). EMS-certified facilities appear to be associated with modest environmental improvements, or "low-hanging fruit," such as reduced spills, leaks, and decreases in hazardous and non-hazardous waste generation (Andrews et al. 2003, 2006). Interestingly, studies of certifications

[2] Koehler (2007) provides a thorough review of motivations for participation in and the effectiveness of voluntary environmental programs.

also suggest improvement of economic performance (Blackman and Rivera 2011). Studies of the voluntary ISO environmental management program have demonstrated that firms voluntarily adopting this program are more likely to be in compliance with environmental regulations (Potoski and Prakash 2005b) and are more likely to improve environmental performance (Potoski and Prakash 2005a; Toffel 2006). In the case that firms may lack the capacity to comply with environmental regulations, voluntary programs to provide compliance assistance have proven effective (Bui and Kapon 2012; Stafford 2012). According to this model, more effort should be spent eliminating barriers to attaining these low and no cost environmental improvements and helping improve firm environmental management.

Further, if voluntary program participants are already environmental leaders and the VEP simply helps these firms signal to consumers and investors of their environmental leadership, then program impact estimates will find that VEP participants improve behavior less than non-participants after joining the program. This signal may encourage non-participants to emulate industry leaders. Several threads of research lend credence to this hypothesis (Lange 2009; Matisoff et al. 2012). Environmental behavior that disseminates across geographical regions and industrial sectors supports the conclusion that the dissemination of voluntary environmental behavior might be responsible for environmental improvements in participating and non-participating firms (DeCanio and Watkins 1998; Matisoff 2012; Prakash and Potoski 2007).

In the Department of Energy (DOE)'s Climate Challenge program for electric utilities, program participation had, at best, no impact on greenhouse gas (GHG) emissions and some results suggest that program participation negatively impacted environmental performance, particularly among late joiners (Welch et al. 2000). In the 33/50 program, early joiners reduced their emissions more than non-participants, but this effect is neutralized when late joiners are considered (Delmas and Montes-Sancho 2007). Similarly, the Climate Wise voluntary agreement had only a modest and temporary impact on reducing carbon emissions from program participants. Most environmental improvements were matched by non-participants, and that the poor environmental performance late joiners undermined efforts of early joiners to improve environmental performance, reducing the overall effectiveness of the program (Morgenstern et al. 2007). All of these studies could be evidence of "catch up" by non-participants.

A more explicit test of this hypothesis occurs in Lange (2009) who finds spillover benefits in the Coal Combustion Products Partnership (C2P2). Lange finds that when a difference in differences estimator is applied, the C2P2 partners are no different than non-partners in reuse of coal combustion products. However, the total amount and percentage of reuse of coal combustion products has increased, and non-partners in states with a greater C2P2 presence have increased reuse rate more than non-partners without as large of a C2P2 presence. Thus, Lange recommends examining VEP effectiveness not just through the lens of participant behavior, but through the lens of industry behavior. Similarly, Bui and Kapon (2012) find that Pollution Prevention (P2) programs facilitate information spillovers and reduced toxic emissions, primarily through industry networks, leading to the underestimation of the effectiveness of P2 programs when spillovers are not considered. An effective program may not just improve participant behavior to the BAU case, but may improve non-participant behavior as well.

A wide range of voluntary environmental programs including voluntary environmental management systems, labeling and certification programs, and information disclosure programs may help firms reduce market barriers that are more likely to produce myopic or other sub-optimal behavior.

Changing social norms due to voluntary environmental programs

If researchers have examined the incorrect dependent variable, this would constitute another type of specification error. Most formal modeling and empirical research has been firmly rooted in a rational model of voluntary program participation and effectiveness. According to this model, firms participate in voluntary programs due to tangible benefits, such as improving their public image, small program subsidies, such as technical assistance, and the potential to deflect or weaken future mandatory regulations (Khanna 2001; Khanna and Damon 1999; King and Lenox 2000; Lyon and Maxwell 2004). Participation in VEPs may represent a shift toward broader stakeholder responsibilities and may help shape the development of corporate norms and develop trust between the regulator, firm, and stakeholders (Koehler 2007).

The more important effect of VEP can be to change the social norms of firm behavior to improve responsiveness to environmental concerns, and change the perception of the stakeholder responsibilities of the firm. The dissemination and convergence of firm carbon accounting supports the perspective that shifting norms can facilitate changes in environmental behavior (Matisoff et al. 2012). Non-participants, by attempting to keep pace with industry leaders, may improve environmental behavior as much or even more than participating firms, due to lower marginal costs of pollution abatement. If changes in environmental behavior disseminate to non-participating firms, who might have lower marginal costs of pollution abatement, then statistical analysis that shows non-participating firms' substantial improvement of environmental behavior may be misinterpreted.

Initial motivations for VEP did not focus as much on the environmental benefits of voluntary environmental policy, but rather focused on changing the nature of industry–government interaction from a combative relationship toward a more productive and collaborative nature (Anton et al. 2004). The rising enforcement costs of existing regulation, combined with cutbacks in agency funds for the enforcement of regulation, and an increasing number of citizen enforcement actions against firms for violating existing laws and against the agency for lax enforcement, led to a desire to find a collaborative approach between government and industry to address environmental problems (Khanna 2001; Maxwell et al. 2000; Morgenstern and Pizer 2007). Voluntary approaches may enhance the prospects for improved satisfaction with government and generate more positive and productive relationships between government and industry (Durant et al. 2004); however, these outcomes have not received much attention in the empirical literature (Table 1).

Advantages and disadvantages of VEP

Voluntary environmental policy may hold several advantages that have been overlooked by empirical research attempting to measure the specific impacts of voluntary environmental programs and may highlight several pathways to program success. These advantages include environmental benefits that have not been measured due to two-stage modeling choices and masked improvement across an entire industry, shifting norms of firm behavior and spillover effects from participants to non-participants that lead to the improvement of environmental performance, and the heterogeneity in program design that leads some programs to be much more effective than others. Further, much of this research has downplayed the possibility for voluntary programs to crowd out or undermine support for more effective mandatory programs (Table 2).

Table 1 Sources of specification errors in voluntary environmental program evaluation

Sources of specification error	Challenges when evaluating VEP
Selection bias and two-stage models	Voluntary programs allow firms to take advantage of unique attributes and signal to stakeholders
Heterogeneity in program effects	Variation in program design: environmental management systems, compliance assistance, and third-party certification enhance effectiveness
Diffusion of behavior from participants to non-participants	Reduction in search costs and technology costs lead to adoption by non-participants
Changing norms of behavior	Goals of VEP include changing norms, improving trust, and developing stronger stakeholder relationships and responsibilities for the firm

Advantages of voluntary environmental programs

Recent findings criticize VEP because it may select the low-cost abaters of emissions through voluntary participation and reward firms who may have improved their environmental performance without the existence of the program in a process known as greenwashing (Lyon and Maxwell 2007). This possibility is typically controlled for in two-stage models by comparing the treatment group to a sample that is as likely to have participated. However, as discussed above, programs that diffuse improved environmental behavior and shift environmental norms may be an effective pathway for voluntary environmental programs to improve environmental outcomes. Further, allowing firms to signal through a self-selection process may be the appropriate avenue to program effectiveness.

Because firms will not undertake costly environmental improvements voluntarily, all environmental improvements obtained from a VEP are expected to be low or no cost (Börkley et al. 1998). However, if a goal of regulation is to achieve low-cost emissions reductions, then using VEP in order to achieve easy and low-cost emissions reductions might be an easy way to pick the low-hanging fruit. Because firms may not automatically take advantage of negative cost environmental improvements, VEP may provide for the ability of firms to develop and disseminate incremental improvements (Börkley et al. 1998).

A variety of reasons may exist that prevent firm managers from optimization or can explain firms' failure to employ cost-effective environmental management strategies. Firm characteristics play an important role in how firms make decisions regarding energy and environmental decisions (DeCanio and Watkins 1998). Complex processes may make optimization impossible. Firm managers have expertise and interest in maximizing the core business of their company and do not give much attention to energy efficiency issues (Matisoff 2010).

Under an alternative model of VEP, where firms do not achieve 'cost-effective' energy efficiency improvements due to a variety of search costs, transaction costs, capital constraints, and high discount rates (see (DeCanio 1998; Hassett and Metcalf 1993; Jaffe and Stavins 1994) for a discussion), providing public goods such as lower information costs and improved information availability can help firms improve environmental performance (Börkley et al. 1998; Gillingham et al. 2009; Peters and Romi 2010).

Previous research has demonstrated a wide variety of strategies that firms may have toward energy efficiency (Kolk and Pinske 2004, 2005). While some firms may even have

Table 2 Possible advantages and disadvantages of voluntary programs

Advantages	Disadvantages
Building firm capacity	Crowding out mandatory programs
Reducing search costs and information costs	Wasting resources on ineffective programs
Achieving low-cost environmental improvements (picking low-hanging fruit)	Greenwashing bad environmental behavior
Changing norms of behavior	Reducing environmental technology innovation
Disseminating best practices	
Reducing conflict between firms and regulators	

a good understanding of how environmental issues impact their firm, this understanding may not translate to changes in long-term investment decisions (Hoffman 2007). In addition, firms operate under considerable technological and regulatory uncertainty, which can limit the ability of firms to accurately calculate costs and benefits from environmental improvements (Considine and Larson 2006).

Increasing evidence demonstrates that energy and environmental decisions and investments are highly influenced by firm capacity and that many firms do not have the technical capacity to maximize energy efficiency or to minimize pollution output (Bui and Kapon 2012; Matisoff 2010; Stafford 2012). Implementing tradable permits or environmental taxes may generate revenue from firms, but it may not change environmental behavior if the underlying problem is a lack of technical capacity and understanding of energy efficiency issues. Voluntary programs may help firms overcome market barriers by lowering information and search costs, allowing firms to experiment with new policy tools, new technologies, and facilitate policy learning (Bui and Kapon 2012; Hsueh and Prakash 2012; Stafford 2012). Improved management capacity may serve as a mechanism for achieving low-cost pollution reduction, and reducing risk and liabilities due to decreased litigation and enforcement costs (Alberini and Segerson 2002; Börkley et al. 1998; Segerson and Miceli 1998). To the extent that the fulfillment of these goals does not result immediately in improved environmental behavior, and the extent to which these benefits are not constrained to the participants in voluntary programs, econometric models are unlikely to capture these benefits.

Further, voluntary programs may produce benefits that are not easily achieved through market-based or other mandatory environmental policies. In concentrated or regulated markets, such as the electric utility industry, firms may face little pressure to minimize costs when cost increases can be passed on to consumers, bringing into question the ability of a price-based policy to induce behavioral change (Matisoff et al. 2014). Voluntary environmental programs that disseminate best practices or that encourage firms to implement environmental management systems have the capacity to improve environmental performance at a low cost (Börkley et al. 1998). Evidence from the Chicago Climate Exchange, a private voluntary cap-and-trade system, which showed reductions of carbon emissions relative to BAU, suggests that regulated utilities are able to find low or no cost sources of emissions reductions (Matisoff 2012). However, these emissions reductions were not likely due to the program itself, but due to a broader strategic shift by participating firms. In this instance, the VEP was not likely the cause of emission

reductions, but instead serves as a signal of management strategy to investors and stakeholders, as well as a mechanism to facilitate learning of a new policy instrument.

Disadvantages of voluntary environmental programs

While VEP may have several advantages that have not been examined through the empirical literature and rational economic models, it may also have some disadvantages. Primarily, the implementation of voluntary environmental policy can undermine support for more stringent mandatory regulations (Lyon and Maxwell 2004). According to formal models, where a VEP is an explicit attempt to attain less-stringent and less costly regulations in comparison with mandatory efforts, the adoption of a less-stringent voluntary program can erode any political will to implement strict mandatory regulation (Lyon and Maxwell 2004).

Second, greenwashing, or using a VEP to disguise poor environmental performance, is an additional threat of these programs. When firms' selectively report environmental information to create an overly positive corporate image, this may be termed 'greenwashing' (Lyon and Maxwell 2011).[3] VEP may contribute to greenwash by allowing firms to selectively report positive information or adopt green marketing, without actual improvement of environmental performance (Kim and Lyon 2011; Rivera and de Leon 2004; Rivera et al. 2006). Empirical results suggest that voluntary programs can increase firm level emissions and that non-participating firms improve their environmental behavior more than participating firms (Darnall and Sides 2008; Gamper-Rabindran and Finger 2013). The Responsible Care program—an industry initiative at self-regulation that initially did not have stringent goals or third-party auditing—shows the dangers of such initiatives (Gamper-Rabindran and Finger 2013).[4] Further programs, such as 33/50, have been suggested to deter future innovation in environmental technologies (Carrión-Flores et al. 2013).

Government sponsored programs, if designed poorly, may be subject to manipulation by firms and lead to greenwashing. The DOE 1605b program, for example, allowed firms to selectively report emissions reductions (Kim and Lyon 2011). While the chemical industry appeared to improve as a whole due to its Responsible Care program, participating firms improved behavior more slowly than non-participating firms, making it possible that firms joined to mask poor environmental behavior (Gamper-Rabindran and Finger 2013; King and Lenox 2000). And participants in the Sustainable Slopes initiative received even lower environmental ratings from third-party NGOs as non-participating firms, leading to fears that the Green Slopes initiative provided cover for poor environmental performance (Rivera and de Leon 2004). Finally, LEED buildings, while designed to reduce energy consumption, may actually lead to greater energy consumption by commercial buildings, due to building quality and electricity consumption serving as complements, rather than as substitutes (Kahn et al. 2013).

Weighting the advantages and disadvantages of voluntary programs

In order to best understand the appropriate uses for voluntary environmental policy, the consequences of applying ineffective voluntary programs and the consequences of failing

[3] See Lyon and Maxwell (2011) for a discussion of the definitions of greenwash.

[4] The Responsible Care program has added third-party auditing since 2002, as well as more stringent goals.

to adopt effective voluntary environmental programs must be understood. A comparative risk analysis can help guide decision-making regarding the evaluation of voluntary environmental programs.

Research evaluating VEP using statistical analyses has focused on avoiding the adoption of ineffective VEP. Statistical analyses hinge on trade-offs of type I versus type II errors. By setting statistical significance α at .1, .05, or .01, as it is typical in statistical analyses, researchers favor making a type II error—or wrongly concluding that VEP is ineffective, when VEP is actually effective, over a type I error—concluding that VEP is effective, when it is not.

The consequences of adopting ineffective VEP

The consequences of adopting an ineffective VEP are equivalent making a type I error (α) in statistical analyses of voluntary environmental programs. These consequences may include government expenditures for ineffective voluntary programs, forgone opportunities for stricter mandatory regulation, and the possibility of awarding recognition to firms that are not improving environmental behavior.

Evidence of greenwashing suggests that ineffective voluntary programs may reward firms that do not actually improve voluntary behavior, in comparison with non-participating firms. However, this research demonstrates that it is rare for firms participating in VEP to produce environmental behavior that is worse than they would have without regulation, or whether behavior of the entire industry has improved (Darnall and Kim 2012; Darnall and Sides 2008). It is unclear whether greenwashing has reduced gains of other voluntary programs, crowded out more effective mandatory programs, or diminished the value of firms' environmental efforts. Empirical research has also been unable to determine whether VEP adoption prevents or hinders the adoption of stricter mandatory environmental policies, as predicted by game theoretical models (Lyon and Maxwell 2004). Voluntary programs make up less than two percent of the EPA budget (Darnall and Sides 2008), but it remains unclear what the costs of ineffective VEP are. While ineffective VEP may erode trust, crowd out more effective mandatory policy, lead to reduced environmental commitments from firms, or dilute the environmental commitments of other firms, these hypotheses have not been tested empirically.

The consequences of failing to adopt effective VEP

Even though statistical analyses conclude that VEP is ineffective, or has only minimal gains, these results have been generated by comparing participating firms to a control group of non-participating firms that have also improved their environmental behavior. With evidence demonstrating that public voluntary programs have benefits that may accrue to participating and non-participating firms alike, due to potential spillovers between the treatment and control groups, statistical analyses are unable to distinguish whether observed environmental improvements are due to VEP. When concluding that VEP is ineffective, it is possible that researchers are committing a type II error, wrongly concluding that VEP is ineffective.

Under a perspective where norms may shift toward improved environmental stewardship across industry, the consequences of failing to adopt VEP that is responsible for both improvements to participating firms and non-participants would result in lower levels of environmental performance and higher levels of emissions in participants and non-participants.

Under a model of VEP where environmental improvements are forgone due to search costs, information costs, transaction costs, and limited firm capacity, the role of VEP is to help firms to overcome cognitive or other market barriers that prevent them from realizing these opportunities. If the dissemination of best practices and the recognition of firms that make strides to improve energy efficiency help industry to achieve low-cost environmental improvements, then the failure to adopt effective VEP may result in a much higher cost of environmental policy implementation.

In addition to environmental benefits that may accrue due to VEP, motivations for VEP include changing the combative nature of environmental policy in the USA and establishing a more collaborative approach to environmental policy. Private certification programs such as LEED, Forest Stewardship Council (FSC), and the Marine Stewardship Council (MSC) have the potential to facilitate private governance and leverage consumer preferences for sustainable products. Other government labeling programs, such as Energy Star, have the potential to harness consumer preferences without heavy-handed governmental intervention. In the frequently maligned 33/50 program, target toxic chemical releases were reduced by over 50 % in just 7 years without lawsuits or the conflict that accompanies mandatory regulation.

Voluntary environmental policy (VEP) provides an opportunity to allow firms to shift social norms toward environmental stewardship and sustainability and claims recognition for their efforts. Without voluntary policy tools, government may have to resort to the more traditional, and more combative nature of traditional regulation, and firms may be less willing to voluntarily change their behavior. This sort of shift in environmental policy has the potential to generate trust and other benefits that have not been addressed by empirical research.

A role for voluntary environmental programs under findings of ineffectiveness

These results point toward a different direction for voluntary environmental programs as well as the design of better VEP. Voluntary environmental programs ought to be designed in order to minimize possible consequences of implementing ineffective voluntary agreements, while maximizing the possible benefits of implementing effective VEP. Promoting third-party auditing systems and environmental management systems, for example, may address some of the problematic VEPs.

In order to maximize the potential gains of voluntary environmental programs, environmental goals must be carefully considered. Voluntary programs appear to be most successful when programs involve the dissemination of incremental improvements, improve the capacity of firms, and allow them to take advantage of low to no cost environmental improvements (Lyon and Maxwell 2007). Programs that facilitate the sharing, dissemination, and transparency of information also have potential to perform well (Cohen and Santhakumar 2007; Konar and Cohen 1997), though efforts to improve compliance capacity and disseminate and process information can improve the efficacy of these programs (Bae et al. 2010; Bui and Kapon 2012; Stafford 2012).

While the focus on information disclosure and improved environmental management does not guarantee environmental improvements or set environmental targets, research seems to suggest that these types of programs can facilitate improved environmental behavior. For negotiated agreements or other programs that set environmental goals, lessons for VEP are less clear. If environmental improvements are attached to social welfare improvements, perhaps whether or not the VEP can be demonstrated to be the cause of

these welfare improvements is less important. Rather, success ought to be measured by setting environmentally appropriate targets and achieving those environmental goals. If these benefits accrue because of a shift of norms, culture, or improved behavior, and behavior shifts across industry, it may be less important that program participation caused these environmental improvements, or whether participation and firm signaling helped shifted environmental behavior across industry. If environmental goals are set at appropriate levels, perhaps policymakers should be satisfied with the achievement of these goals, and should focus on other benefits of VEP, such as the reduction in transaction and enforcement costs, building a collaborative relationship between government and industry, and the possible improvements in the cost-effectiveness of achieving these environmental targets.

Research suggests that firms do not minimize costs associated with energy and tradable emissions permit costs due to a lack of capacity regarding carbon trading and a considerable amount institutional uncertainty, leading firms to pursue business as usual strategies, rather than attempt to optimize (Matisoff 2010). Further, because regulated utilities and other industries may not be subject to competitive or price pressures, voluntary initiatives may be more effective at producing environmental improvement than even a price-based mechanism such as a carbon tax. A government or non-governmental facilitator that helps disseminate best practices toward improved environmental and energy management might help firms achieve improved behavior.

Alternatively, VEP may be viewed as a response to government failure and the political inability to implement more stringent mandatory regulation (Lyon 2013). Under this view, VEP represents an opportunity to improve social welfare where the politics of mandatory regulation are too difficult, budgets are constrained, or the regulatory capacity (e.g., in a developing country) is insufficient for the enforcement of mandatory regulation.

Improving evaluations of voluntary environmental programs

This research points toward a need for continued research in VEP along several dimensions. First, additional research is needed to examine the role that VEP plays in changing the norms of corporate environmental behavior across an industry, rather than just among participants. Examining changes in behavior over time by participants and non-participants may help identify changes in environmental behavior by leaders and laggards, though the exact timing of participation may be difficult to pinpoint. Universal participation models or assessing larger units of spatial aggregation may be able to capture spillover effects, though these models are also susceptible to a variety of other weaknesses. Assessing the effectiveness of a voluntary program by scaling up to examine industry-level effects can also help capture spillover effects across industry (Lange 2009). Several studies that find that voluntary environmental programs have been effective use industry-level or larger geographical units of analysis, in order to capture spillover effects that may accrue due to learning, capacity building, or market creation (Bui and Kapon 2012; Lange 2009; Potoski and Prakash 2013; Prakash and Potoski 2007; Simcoe and Toffel 2011). Research that compares plant and firm level outcomes to industry, state, and country level outcomes, and more closely identifies the spillover effects of improved practices due to VEP across an industry can help shed light on the trade-offs of the level of analysis employed in evaluation studies.

Second, if voluntary programs help improve information flows, research that examines patent citations and the dissemination of environmental technology may demonstrate an

impact of voluntary environmental programs (Brouhle and Graham 2014). Technology adoption studies that employ the epidemic model of technology adoption and diffusion may also help researchers understand information flows and changes in norms and environmental management (Geroski 2000). Future studies that seek to evaluate the 'softer' benefits of cooperative and collaborative decision-making between firms and government, development of trust, responsiveness to stakeholder interests, generation of public goods (such as reduced information costs), as well as shifts of norms that result from VEP can help evaluate the promises of VEP that may not be as directly linked to environmental outcomes.

Third, a shift toward a more explicit cost-benefit or comparative risk assessment framework for voluntary environmental programs may help policymakers and researchers understand whether these programs are cost-effective, what sorts of costs are incurred by these programs, what sorts of benefits are achieved, and the risks of the programs (Prakash and Potoski 2012). For programs that are tied to reductions in toxics or other human or environmental health and welfare-related impacts, a more explicit tie to epidemiological or environmental goals may be appropriate. For programs that are information, management, or process oriented, research that focuses on the alignment of program goals with voluntary program design may help demonstrate.

Finally, increased efforts to evaluate voluntary approaches to environmental policy in comparison with empirical alternatives may help researchers and policymakers understand the real-world trade-offs of voluntary environmental programs, rather than the theoretical implications of adopting VEP. The existing stream of VEP research has demonstrated that VEP alone will not likely achieve stringent environmental goals in place of mandatory regulation. Future research must determine when VEP can be implemented without producing negative consequences and what types of benefits society can reap from the implementation of VEP, in comparison with other regulatory approaches.

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