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Regulatory Regime Changes Under Federalism: Do States Matter More?

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Our overall project examines factors affecting environmental performance, both compliance status and emissions for air, water, and toxic pollutants, as measured with plant-level data for paper mills, oil refineries, steel mills, and electric utilities. We combine data on traditional regulatory activity (inspections and other enforcement actions) with information on community pressures and political pressures faced by the plant at both the state and local levels. We also examine spatial aspects of regulation, by looking at the impact of enforcement activity directed toward one manufacturing plant on the environmental performance of other plants nearby, and the spatial distribution of the health benefits from sulfur allowance trading.

This research project examines the impact of the U.S. Environmental Protection Agency's (EPA) Cluster Rule on the paper industry, using data from 1996-2005 for 150 pulp and paper mills. This was a pathbreaking rule for EPA in its multimedia approach, as it sought reductions in both air- and water-toxic releases from affected plants, and also anticipated reductions in conventional pollutants. We use two approaches when looking to measure the impact of the Cluster Rule. We know the date when the rule became effective for the plant, so we test for changes in toxic releases around the effective date. The Cluster Rule also imposes different requirements for different plants, depending on their production technology, and we test for bigger changes occurring at plants that faced more stringent requirements. Our analysis also includes controls for other plant and firm characteristics. Besides testing for an impact of the Cluster Rule on air- and water-toxic releases, we examine conventional air and water pollutants to see if they exhibit reductions at about the same time. Finally, the paper also examines the possibility that location matters, testing whether differences across states in regulatory stringency before the adoption of the Cluster Rule affect either the level of toxic releases or reductions in those releases around the rule change.

Our analyses yield mixed results in terms of reductions in air and water toxics, the goal of the Cluster Rule. We observed significant reductions in releases of air toxics and total toxics around the rule's effective date, but not water toxics. In addition, those reductions do not seem to be larger at the plants expected to face greater stringency under the Cluster Rule. There also is little evidence of dramatic reductions in conventional air and water pollutants. However, we do find significant evidence for the importance of plant location, driven by state-level differences in regulatory stringency as measured by Congressional pro-environment voting in the state. Plants located in states with greater stringency had significantly lower toxic releases before the rule took effect, but a smaller reduction in toxic releases, which suggests that some of the reductions required by the Cluster Rule had already been accomplished in those high-stringency states. This emphasizes the importance of considering the "federal" structure of U.S. regulatory policy, with differences in stringency across states having implications for the impact of changes in regulatory policy at the national level.

The Persistence of Economic Factors in Shaping Regulation and Environmental Performance: The Limits of Regulation and Social License Pressures

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Many students of regulation, ourselves among them, have questioned models of regulation and business behavior that emphasize economic motives alone, and find instead that social pressures and social norms (relating to environmentalism and law-abidingness) play an important role in inducing businesses to comply with regulations and to go beyond compliance. This research project explores the limits of such “social license” pressures. Whereas our previous research focused on highly visible, closely regulated industries and on larger corporations, this project explores the limits of “social license” pressures by examining regulation of dangerous particulate and NO_x emissions from smaller heavy-duty diesel trucking companies that operate in highly competitive, minimally profitable markets and find it extremely difficult to afford or pass on the cost of best-available emission control technologies. We find that economic variables—most prominently the high cost of new, low-polluting vehicles—have: (1) limited the coerciveness of direct regulation of vehicle owners and operators (who have not been compelled or induced to retire older, higher polluting trucks); (2) dwarfed the reach and effectiveness of the governmental programs that subsidize the purchase of new vehicles; and (3) elevated the importance of each company’s “economic license”—as opposed to its “social license”—in shaping its environmental performance.

Company-level variation in environmental performance was assessed via in-depth field interviews of 16 small- and medium-sized trucking firms, 8 in Texas, and 8 in California. Social license pressures played virtually no role in shaping the firms’ choices that affect emissions (e.g., average age of fleet, maintenance practices, controls on operating speeds and idling). We find that intercompany variation on those dimensions are shaped primarily by: (1) the firm’s particular market niche—the kinds of goods being hauled, and how far they are being hauled; and (2) the firms’ financial state.

Oregon Business Decisions for Environmental Management

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We surveyed 1964 Oregon facilities in 2004-2005 regarding their business environmental management (BEM) actions, environmental performance levels, and other characteristics. The sample included construction, electronics, food and wood products manufacturing, transport, and accommodations—Oregon's major industrial sectors. The mail survey queried facilities about their motivations and barriers for environmental management, environmental policies, practices, performance data, and general characteristics. A response rate of 35 percent was achieved. Tests reveal that self-selection bias is not present.

Three analyses were conducted. In the first, we analyzed the motivations for facilities to participate in voluntary environmental programs (VEPs), and to adopt environmental management practices (EMPs). We used observed facility characteristics to proxy for the effects of external factors such as regulatory, consumer, and investor pressures, and internal factors such as technical and resource capacity on voluntary environmental behavior. Second, we examined the incentives that affect the intensity with which facilities implement EMPs and pollution prevention (P2) practices. This analysis tested the roles of internal drivers, including managerial attitudes toward the environment; external factors, such as regulation; perceived subjective pressures, such as investors; and objective factors captured by facility characteristics, such as ownership status. Third, we tested a new model of facility environmental management in which decisions on EMPs, P2 practices, and environmental performance (EP) are interlinked. This model hypothesizes that facility managers maximize their utility by considering the effects of BEM actions on profit and the values that they receive from environmental stewardship.

The results of all three approaches are generally consistent in showing the importance of regulatory pressures as well as managerial attitudes and perceptions that environmental issues are a significant concern in motivating participation in VEPs, adoption of EMPs, and use of P2 practices. We also found that larger facilities are more likely to participate in more VEPs, but are likely to adopt more EMPs only if they perceived environmental issues to be of significant concern. Facilities with this perception also were more likely to be influenced by competitive pressures to adopt more EMPs and P2 practices. Consumer and interest group pressures are found to play insignificant or weakly significant roles in voluntary environmental decisions. For the interlinked model, investor pressure also was found to positively influence EMP adoption. EMP intensity significantly increases P2 actions; however, EMP or P2 actions do not show significant effect on EP. EP, measured as the change in emissions and wastes in 2004, was positively influenced by 2003 BEM expenditures, parent company ownership, and mid-sized operations, but negatively affected by 2004 BEM expenditures and environmental penalties.

We conclude that environmental regulations are a complement to voluntary BEM, not a substitute. The findings also demonstrate the powerful role of management attitudes toward the environment in BEM decisions. These two factors, along with selected market forces and facility characteristics, significantly and differentially affect VEP, EMP, or P2 decisions. The findings suggest that effective policies must identify the most influential factors for the policy target, VEP participation, EMP adoption or EP, and the synergistic relationships between BEM decisions.

Future work will refine the interlinked model, improve measures of environmental performance, and explore the factors that shape management values toward the environment.

Pollution Prevention Practices: Determinants of Adoption and Effectiveness in Reducing Toxic Releases

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Many firms are undertaking environmentally friendly organizational change by applying the philosophy of Total Quality Environment Management (TQEM) with its emphasis on reducing waste and increasing efficiency. They also are voluntarily adopting technologies to prevent pollution at the source. The purpose of this research project is to examine whether and to what extent the adoption of TQEM is fostering pollution prevention (P2) activities and how the effect of TQEM differs across different types of innovations. We also examined the implications of P2 activities for the toxic release performance of firms.

These issues were investigated using a detailed panel dataset on P2 practices adopted by a sample of S&P 500 firms that report to the Toxics Release Inventory. We used two different approaches to examine the effect of TQEM on P2 practices adopted by firms. Under the first approach, we used a treatment effects model to examine the effects of TQEM, while controlling for a variety of other regulatory and market pressures that might be driving the adoption of such practices. Under the second approach, we classified the effects of TQEM based on five attributes regarding whether they involve: (1) a physical change in equipment; (2) a change in materials used; (3) a change in operating procedures; and whether they are (4) visible to consumers; and (5) enhance efficiency. We used fixed effects models to examine how the count of P2 activities are affected by TQEM adoption, and we took into account the differences in the nature of pollution prevention activities and that their response to TQEM adoption may vary, depending on their attributes. In examining the effect of P2 activities on toxic releases, we used panel data at the facility level to examine the effects of current and lagged P2 activities on toxic releases while controlling for inertia in the extent to which firms can improve environmental performance.

We found that TQEM leads firms to adopt P2 techniques even after we control for the effects of various types of regulatory pressures and firm-specific characteristics. Moreover, we found that the presence of “complementary assets,” in the form of technical capability of the firm, is important for creating an internal capacity to undertake P2 adoption. However, we discovered that the effect of TQEM on P2 is nonuniform and provides stronger support for the adoption of practices that involve procedural changes or have unclassified/customized attributes. Visibility to consumers or efficiency enhancement does not incrementally contribute to the effect of TQEM on P2 adoption. Because the P2 activities most strongly affected by TQEM are generally more prevalent in the petroleum refining and chemical manufacturing sectors, our simulations showed that these sectors experience the largest impact from the adoption of TQEM on the rate of P2 innovation. Our analysis indicated that firms do experience diminishing returns to P2. Finally, we found that the effect of P2 on toxic release is rather weak and transitory. P2 activities adopted a year ago have a significant negative impact on current toxic releases, but P2 adoption in earlier years has a weakly positive or insignificant impact on current toxic releases. These findings suggest that although there exist some “low hanging fruit” for P2, the extent of voluntary adoption of P2 practices and their impact on toxic releases is likely to diminish over time in the absence of any regulatory stimulus.

Institutions for Removing Information Asymmetries in the Market for Corporate Environmental Performance

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The goal of this research project is to assess the conditions under which certification of environmental management practices removes information asymmetries between firms and stakeholders by credibly signaling about superior environmental performance. Issues that may limit the signaling ability of certification schemes include firm strategic behaviors that dilute the standard's value and design problems within management standards that cause "unwanted" firms to select into certification.

This project involves both conceptual and empirical analyses, with the empirical analyses using longitudinal datasets that contain information on certification with the ISO 14001 Environmental Management Standard as well as facility toxic releases.

Conceptual analyses suggest that the two unique elements of certified environmental management standards—codification and certification of practices—simultaneously enable and restrict the ability of standards like ISO 14001 to signal about superior environmental performance and guide socially desired firm behaviors. Although codification and certification are enabling because they allow a certified standard to shape firm behaviors in settings where other soft-law institutions are ineffective, they also are limiting because they induce a mix of both low- and high-performing firms to participate, thereby weakening decentralized enforcement processes and reducing the standard's signaling value.

Empirical analyses suggest that additional problems arise due to multi-plant firms engaging in strategic adoption behaviors. The issue is that standards like ISO 14001 may be designed to not only signal about existing performance levels but also improve on these levels. As a result of this improvement aspect, stakeholders may especially pressure poor performing firms to seek certification of ISO 14001, and adopting the standard may become a means for firms to assuage stakeholder demands. However, because of difficulties associated with fully internalizing the benefits of green firm practices, actual certification rewards are uncertain. Multi-plant firms may respond to this uncertainty by minimizing adoption costs through certifying their better performing plants, rather than their poorer performing ones. This selection is obviously not in the interests of stakeholders who would like the lowest performers to adopt and certify best environmental practices. The resulting situation may be described as multi-plant firms using ISO 14001 to engage in "satisficing adoption" that allows harvesting stakeholder approval with only minimal organizational changes.

To date, findings suggest that ISO 14001 has not been as effective as hoped for in that it neither is a reliable signal of superior environmental performance nor an improvement tool that substantially improves the performance of poor performing firms. Because these issues seem to be at least partially the consequence of the standard's design, solutions may require not only "patches" that ameliorate unwanted effects once they occur, but also standard redesigns.

Future work will focus on validating some of these insights by performing comparative analyses with the ISO 9000 quality management standard as well as broadening and triangulating measures of environment performance by using permit compliance data.

Evaluating Voluntary Climate Programs in the United States

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Voluntary programs are playing an increasingly important role in environmental management. Despite their growing importance, however, they have been subject to limited evaluation. As is well known, program evaluation in the absence of randomized experiments is difficult because the decision to participate may not be random and, in particular, may be correlated with the outcomes. The present research is designed to overcome these problems by measuring the environmental effectiveness of two voluntary climate change programs—the U.S. Environmental Protection Agency’s (EPA) Climate Wise Program, and U.S. Department of Energy’s Voluntary Reporting of Greenhouse Gases Program, 1605(b)—with particular attention to the participation decision and how various assumptions affect estimates of program effects. For both programs, the analysis focuses on manufacturing firms and uses confidential U.S. Census data to create a comparison group as well as measure outcomes (expenditures on fuel and electricity).

Overall, we found that the effects from Climate Wise and 1605(b) on fuel and electricity expenditures are no more than 10 percent and likely less than 5 percent. There is virtually no evidence of a statistically significant effect of either Climate Wise or 1605(b) on fuel costs. There is some statistically significant evidence that participation in Climate Wise led to a slight (3-5%) increase in electricity costs that vanishes after 2 years. There also is some statistically significant evidence that participation in 1605(b) led to a slight (4-8%) decrease in electricity costs that persists for at least 3 years.

Voluntary Agreements To Improve Environmental Quality: Are Late Joiners the Free Riders?

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Within the context of environmental voluntary agreements (VAs), this research project analyzes how free riding affects the effectiveness of collective corporate political strategies that aim at shaping government policy. We demonstrate that substantive cooperative strategies are more likely to be pursued by firms that enter a VA at its initiation, whereas free riding or symbolic cooperation is more likely to be adopted by late joiners. We also demonstrate that late joiners and early joiners within VAs adopt different cooperative strategies because they face different institutional pressures. We find that late joiners that cooperate only symbolically may endanger the overall effectiveness of a VA. Our analysis is based on the strategies of firms participating in the Climate Challenge Program established in 1995 by the U.S. Department of Energy and the representatives of the national electric utilities to reduce greenhouse gas emissions.

What Drives Participation in State Voluntary Cleanup Programs? Evidence From Oregon

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Over a quarter of a century after the passage of federal Superfund legislation, hundreds of thousands of properties contaminated with hazardous substances have yet to be remediated. To reduce this backlog, all but a handful of states have created Voluntary Cleanup Programs (VCPs) that offer liability relief, subsidies, and other incentives for responsible parties to voluntarily clean up contaminated properties. Today, thousands of sites are participating in these programs. Nevertheless, we still know little about the factors that drive enrollment, and information is needed to enhance the programs' efficiency and effectiveness.

This research project examines the factors that influence the decisions of both private firms and public organizations to participate in VCPs. The research has five components: (1) case studies of selected state VCPs; (2) a game theoretic model of a private actor's decision about whether to enroll in a VCP; (3) structured interviews of VCP program officials in each state; (4) a survey of VCP participants; and (5) econometric analyses of VCP participation in Oregon. We concentrated on the last component in this presentation.

Our econometric analysis focuses on Oregon because it has a program with sizable enrollment and is one of a small number of states that maintains a database of known contaminated sites that are not participating in its voluntary or mandatory cleanup programs. We employed a duration model that explicitly accounts for the timing of regulatory activities. In contrast to previous econometric research on VCPs, our results suggest that Oregon's program does not mainly attract sites with little or no contamination seeking a regulatory "clean bill of health." Furthermore, regulatory pressure—in particular, Oregon's practice of compiling a public list of sites with confirmed contamination—has a statistically significant association with VCP participation. Together, these findings imply that Oregon has been able to spur voluntary remediation by disclosing information on contamination. Our results comport with key themes in the literature on voluntary environmental programs—the threat of mandatory regulation spurs participation in such programs, and disclosure of environmental performance information is an efficient policy tool for promoting abatement and remediation.

The Consequences of Self-Policing

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Over the last decade, both the U.S. Environmental Protection Agency (EPA) and the states have placed increased emphasis on environmental auditing and self-policing as a means for achieving better environmental compliance. In particular, EPA's Audit Policy encourages facilities to self-police by offering significant penalty reductions for facilities that meet certain conditions. EPA's Web Site also notes that when facilities self-police, it can render "formal EPA investigations and enforcement actions unnecessary." This statement implies that EPA's Audit Policy may provide additional incentives in the form of reduced future enforcement. The goal of this study is to determine what the future consequences of self-policing are to be able to better understand how the Audit Policy or similar self-policing policies can affect facility compliance behavior. In addition, the analysis provides insight into other factors that motivate self-policing. A more complete understanding of the factors that drive facilities to self-police also will help to assess the effectiveness of the current policy and potentially can be used to fine-tune the program to increase its effectiveness.

To inform the empirical analysis, a theoretical model of self-policing was constructed in a targeted enforcement regime. The model suggests that facilities with a high probability of enforcement are more likely to disclose than facilities with a low probability of enforcement, *ceteris paribus*. The model also implies that disclosures in the recent past should decrease the probability of future inspections, and that the effect of disclosures on future inspections should depend on the facility's compliance history (i.e., whether or not they are in a target group).

The empirical analysis includes approximately 631,000 regulated hazardous waste facilities in the United States. The analysis examines the effect a disclosure in 2001 has on the probability that a facility is inspected in 2002. The analysis also examines what factors drive facilities to disclose. The most important finding is that facilities that self-disclose are rewarded with a significantly lower probability of inspection in the near future. There also is some evidence that the reward for disclosure is smaller for facilities with relatively good compliance records. This lends support to the concern that facilities could use the disclosure of minor violations strategically to discourage future inspections. The analysis also shows that facilities that have not been inspected over the past 5 years are less likely to disclose, whereas facilities that are inspected frequently are more likely to disclose, in part because they have more to gain from decreasing future enforcement efforts. Large- and small-quantity generators are more likely to disclose, as are facilities that are regulated under more than one media program. However, hazardous waste treatment, storage, and disposal facilities are less likely to disclose. Finally, facilities in states with environmental audit immunity or self-policing policies are more likely to disclose as such policies provide additional incentives for disclosure. Although the results of the analysis are obviously most relevant for EPA's Audit Policy, they also will provide important lessons on the use of self-policing as a regulatory tool in other policy arenas.

Green Production Through Competitive Testing

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Electronics waste is damaging to the environment and human health, especially in developing countries. New regulations in the European Union, California, and China prohibit the sale of electronics containing certain hazardous substances. However, because testing for these substances is expensive and destructive of the product, regulators cannot test all or even a significant fraction of the electronics sold.

To the extent that regulators block the sale of products that they discover are noncompliant, electronics manufacturers have an incentive to test competitors' products and reveal violations to the regulator. A manufacturer benefits by blocking its competitor(s) from the market, because this makes the manufacturer's products more attractive to consumers, allowing the manufacturer to command a higher price in the end-market.

We found that in many cases, regulators need not test products directly, but instead can rely on electronics manufacturers to do all the testing. There are several reasons why relying on competitive testing can be attractive. First, manufacturers may have a better understanding than the regulator of how violations occur, and hence may be able to uncover violations with less testing expense than the regulator. Second, firms may have a better understanding of the cost of compliance. Consequently, the less well-informed regulator may devote a level of testing investment that may be too high or too low relative to what is socially optimal. In contrast, under competitive testing, testing and compliance expenditures will reflect what the firms understand to be the true costs of compliance, which may improve social welfare.

Relying on competitive testing is most effective in markets dominated by a few firms (e.g., video-gaming consoles) because these firms have the strongest incentives to test their competitors. Conversely, it is least effective in highly competitive markets (e.g., commodity-type consumer electronics) composed of many small firms.

The preceding discussion applies when the structure of the industry (i.e., the number of firms and their capacities) is fixed. The impact of competitive testing is more nuanced when long-run decisions such as entry are taken into account. Reliance on competitive testing causes entry and expanded production by manufacturers with low quality, weak brands and, consequently, low compliance. Thus, in industries where the barrier to entry for low-end firms is low, regulators should be cautious about relying on competitive testing.

The phenomenon of competitive testing has the potential to play out in any competitive market governed by product-based environmental, health, or safety standards, and our insights apply more broadly to these settings.

Disclosure as a Regulatory Instrument for the Environment: A Study of the Toxic Release Inventory in the Printed Circuit Board Industry

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The objective of this research is to develop evidence of the impact on toxic releases of public disclosure of polluting behavior through the Toxic Release Inventory (TRI). We focused our attention on the printed circuit board (PCB) industry. PCB production is one of the largest contributors to pollution in the microelectronic industry, an industry that is rapidly changing in both market structure and technology. One interesting aspect of the industry is that the changes in market structure that have occurred—decreasing concentration and an increasing number of foreign producers competing on cost—would tend to make it less likely for the informal regulatory approach of the TRI to be successful. Yet reported toxic releases in the PCB industry have fallen by more than 96 percent between 1988 and 2003. Why? There are a number of factors that contribute to the explanation for the reduction in releases. In part, plant exit by the dirtiest plants over time has helped reduce the overall level of releases by the industry. However, this is not the only explanation. We found that non-attainment status for the criteria air pollutants also has an important effect. In particular, plants located in non-attainment counties have significantly lower TRI releases, which suggests that regulations for the criteria for air pollutants may have beneficial effects on toxic releases as well. We estimate that in the absence of non-attainment regulations, current TRI levels could be between 125 and 245 percent higher than they are currently. Formal regulations for hazardous air pollutants and pollutants falling under the Clean Water Act also appear to have had beneficial effects on TRI releases. However, we also find that facilities located in attainment counties eventually “catch up” with their non-attainment counterparts. Over time, the dirtier facilities located in attainment counties reduce their toxic releases until they are as clean as the facilities located in non-attainment counties. We interpret this as evidence that TRI reporting does have an effect on firm response. Furthermore, we found that state-level TRI programs that have target reduction goals for toxic releases induce significant reductions in TRI releases even without having noncompliance penalties. In the case of states that only have outreach programs to help TRI polluters learn about pollution prevention programs (e.g., for air releases), these programs also have a beneficial effect on release levels. These latter results are important as they provide policymakers with ways in which they can enhance the likelihood of a successful mandatory disclosure program for pollution abatement. First, by providing a credible threat of more formal regulation, firms respond by “voluntarily” cleaning up. Second, by disseminating information on pollution prevention and abatement, we also may see additional reductions in releases.

The Effectiveness of Information Disclosure: An Examination of the TRI

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Controlling toxic chemicals is one of the most challenging tasks faced by environmental regulators due to the range of industries, number of chemicals, and variation in toxicity and exposure. These factors can make traditional approaches to regulation such as technology standards, performance standards, and market-based instruments (e.g., tradable permit systems) less attractive for toxic chemicals than for other pollutants. Information disclosure programs, such as the Toxics Release Inventory (TRI), are potentially innovative alternative regulatory instruments. To be considered a viable regulatory tool (as opposed to a general policy tool), the information disclosure program must result in improvements in environmental performance. In the case of the TRI, this means decreases in toxic chemical releases, toxicity of releases, and other similar measures. This research project seeks to determine the degree to which information disclosure itself results in improvements in environmental performance.

Analysis of the effect of the TRI in reducing releases of toxic chemicals has been hindered by the absence of a clear control group that can identify what would have happened to toxic releases in the absence of TRI reporting requirements. In typical analyses of regulatory efficacy, average outcomes for facilities that are subject to the regulation are compared with average outcomes for facilities that are not subject to the regulations. With the TRI, the difficulty lies in isolating a control group because the researcher only observes data on toxic releases for facilities that are subject to the regulatory reporting requirements, and only in years in which reporting has been in effect. Are observed decreases in toxic releases due to the disclosure requirements or due to other factors such as general changes in the industry or overall economy?

This research project tries to isolate the effect of information disclosure. We used changes in the TRI reporting requirements to help isolate the causal effect of disclosure from other potential explanations of changes in environmental performance. The TRI program has undergone several different changes in reporting requirements including: (1) requiring additional categories of facilities to report; (2) requiring reports for additional chemicals; and (3) lowering reporting thresholds for particular chemicals. In all three cases, one can think of “treatment” as being newly subject to the TRI requirements (e.g., a facility required to report for the first time or a facility reporting on a chemical for the first time). The “control” group then represents facilities that have reported previously.

At this workshop, we will present preliminary results from analyses of adding new chemicals and lowering reporting thresholds. We found no evidence that facilities newly reporting for a chemical have greater proportional decreases in total releases. Future work will examine whether these firms have different proportional decreases in onsite releases, have different proportional decreases in releases weighted by toxicity, or engage in more source reduction activities.

Regulation With Competing Objectives, Self-Reporting, and Imperfect Monitoring

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Our project entails a broad study of incentives for compliance with environmental information disclosure programs (e.g., the Toxic Release Inventory [TRI]), as well as consequent incentives to emit pollutants. We plan to address the optimal design of such programs with a focus on the incentives generated by alternative enforcement regimes.

Regulatory agencies, including the U.S. Environmental Protection Agency (EPA), commonly cite two categories of benefits associated with information disclosure programs. The first, an indirect benefit, arises from the internalization of the social costs of emissions (and consequent reductions in emissions) due to market responses to disclosures or regulatory instruments such as taxes on disclosed emissions. The second, a direct benefit, results from the disclosure of previously private information. Referring to information disclosure programs in a recent report that describes the U.S. experience with various environmental policies, EPA states, “The environmental information embodied in these approaches has economic value...even in the absence of any changes in emissions by firms.” Timely information about emissions may enable potential damages to be avoided or mitigated both by affected parties and public agencies. For example, disclosure may reduce consumption of contaminated water by alerting individuals of the need for avoidance or proper treatment. Disclosure also may decrease the environmental impacts of a toxic release by accelerating cleanup efforts.

Our initial theoretical work models a firm’s choice of emissions level and of disclosure (i.e., what share of actual emissions to report) as a function of a particular regulatory enforcement context. Firms are assessed a per-unit tax on disclosed emissions and a per-unit penalty on any undisclosed emissions that are subsequently detected by an audit. The audit is imperfect in that it reveals a percentage of actual emissions. After solving for optimal firm behavior as a function of the model’s parameters, we examined the optimal choice of tax and audit probability by a regulator (taking other parameters as exogenously determined). When auditing firm behavior is costly, a policymaker must account for three factors when designing regulatory policy: (1) the benefit of reduced emissions arising from internalizing social costs; (2) the direct social benefit of disclosure of emissions that do occur; and (3) enforcement costs. Because disclosure of emissions is directly beneficial but actual emissions are imperfectly observable, policymakers face a trade-off between inducing truthful self-reporting and deterring emissions. Internalizing the social costs of emissions, such as through a tax, will deter emissions, but it also may reduce incentives for firms to truthfully disclose their emissions.

The next step in this research project involves incorporating the possibility of financial insolvency into the above model of firm compliance. Such a model will allow us to explore the potential for developing an endogenous audit process that depends on a firm’s financial status. We will test the behavioral hypotheses from this model using experimental methods and secondary data analysis.

Competing Environmental Labels

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We study markets in which consumers prefer environmentally friendly products but cannot determine the environmental quality of any given firm's product on their own. A nongovernmental organization (NGO) can establish a voluntary standard and label the products of firms whose products comply with the standard. Alternatively, industry can create its own standard and label. We compare the stringency of these two labels and analyze how they interact when both voluntary programs are available.

Consumer Labeling and Motivation Crowding-Out

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The primary objective of this research project is to explore consumer reactions to environmental product labels on market goods. This exploration will focus on two particular aspects of these reactions. First, consumer willingness to pay for the reduction of greenhouse gas emissions associated with the production of energy through the choice of either energy-saving products or the use of green energy and production processes will be estimated. Second, the effect that a product label based on an environmental attribute with both public and private benefits (e.g., emissions reductions and cost savings associated with more energy-efficient appliances) has on consumers will be contrasted with that of a label based on an attribute with purely public benefits (e.g., reduced emissions associated with a more energy-efficient production process and the use of renewable energy in such production). Research suggests that the inclusion of relatively small extrinsic rewards (such as cost savings from an energy-efficient appliance) can actually decrease the effect of existing intrinsic rewards (such as the internal motivation for consuming an environmentally friendly product). This effect, commonly referred to as motivation crowding-out, has important implications for the selection, design, and marketing of environmental attributes or labels.

The exploration of consumer responses will involve the use of conjoint analysis (contingent choice) surveys in which subsamples of respondents reveal their preferences in a series of comparisons between varieties of an energy-using home appliance. The appliance varieties will be distinguished by different levels of privately relevant attributes, including price, and also by whether or not they have obtained an environmental “seal-of-approval” label. The benefits associated with the label will vary across subsamples. In two subsamples, both private and public benefits (e.g., energy cost savings and emissions reductions) will be associated with the label, whereas only public benefits will be featured in the other two. The magnitude of the benefits will vary between a low and a high value and generate four separate subsamples.

We expect to find that: (1) respondent willingness to pay is, on average, increased by the existence of public benefits; (2) this increase is tied to demographic and attitudinal variables; and (3) this effect is increased by the addition of substantial private benefits, but reduced by the addition of a modest private benefit. The results of these experiments have the potential to influence both the design and marketing of a variety of information disclosure programs and to evaluate the potential of these programs for altering individual behavior.

To date, our efforts have focused on a comprehensive review of the literature and on survey instrument design. A large number of recent additions to the literature have caused us to think more critically about some of the principles underlying our analysis. The next step in this research project is to finalize the survey instrument through focus group analyses.

Voluntary Information Programs and Environmental Regulation: Evidence From “Spare the Air”

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The primary goal of this research project is to assess whether individuals change their transportation choices in response to “Spare the Air” (STA) advisories, a public voluntary information program in the San Francisco Bay Area that elicits reductions in automobile trips on days when ground-level ozone is predicted to exceed Air Quality Standards (AQS). Because some of the emissions from automobiles are a direct precursor to ozone formation, this program intends to lower ozone levels and improve the chances of attaining AQS in order to avoid costly regulations.

The secondary goal of this project is to assess whether ozone levels are affected by any STA-induced changes in transportation decisions. STAs may be a more efficient mechanism than traditional regulations for lowering ozone levels because it allows policymakers to focus regulatory effort only on those days when the effort is needed to avoid exceeding ozone standards. Given that numerous areas throughout the country have since implemented similar voluntary programs, evaluating their impact is necessary to determine how these programs can best be incorporated into state and local efforts to meet AQS.

To assess the impact of STAs, we used administrative data on highway traffic volumes, public transit ridership, and observed ozone levels in the Bay Area. Because STAs are issued when ozone levels are predicted to exceed a particular threshold, we used a regression discontinuity design to identify the effect of STAs by comparing outcomes on days just above the threshold to outcomes on days just below the threshold. This design controls for confounding factors to the extent that they are similar around the threshold. Therefore, any difference in transportation outcomes can be directly attributed to the STA advisory. We also used traffic conditions in Southern California, an area without STAs, to estimate difference-in-differences models.

Our preliminary results suggest that STAs reduce total daily traffic by 2.5-3.5 percent, with the largest effect during and just after the morning commuting periods. STAs have no statistically significant effect on total daily public transit use, but they do have borderline statistically significant effects during peak commuting periods. STAs, however, do not have a statistically significant effect on ozone levels.

Our results cast doubt on the effectiveness of the STA program and, because the program has the best chance of working in an environmentally friendly area with several public transit alternatives, we suspect that comparable traffic programs elsewhere in the United States are unlikely to significantly improve air quality. The fact that individuals respond to STAs suggests that such voluntary information programs have a potential role in regulatory policy, but such programs alone do not appear sufficient for detecting improvements in air quality; additional incentives appear necessary.

National-Scale Activity Survey

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The National-Scale Activity Survey (N-SAS) will collect a variety of data related to the Air Quality Index (AQI) and the public's awareness of and response to air pollution in general, focusing initially on ozone with the potential for future waves focusing on particle pollution. N-SAS consists of two complementary surveys. The first is a cross-sectional survey measuring awareness, knowledge, and stated responses to air quality warnings. The second survey will collect activity diary data on a smaller sample of individuals in a specific area or areas to measure actual behavioral changes on high ozone days. The data collected through N-SAS will support outreach programs and policy analysis at EPA. The results of the survey will be useful for accountability initiatives and will enhance the design of informational-outreach programs such as the AQI, improving exposure modeling and benefits analysis.