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INDUSTRY SELF-REGULATION WITHOUT SANCTIONS: THE CHEMICAL INDUSTRY'S RESPONSIBLE CARE PROGRAM

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Industry self-regulation—the voluntary association of firms to control their collective action—has been proposed as a complement to government regulation. Proponents argue that the establishment of such structures may institutionalize environmental improvement, and critics suggest that without explicit sanctions, such structures will fall victim to opportunistic behavior. In a study of the Chemical Manufacturers Association's Responsible Care Program, we investigate the predictions of these two contradictory perspectives. Our findings highlight the potential for opportunism to overcome the isomorphic pressures of even powerful self-regulatory institutions and suggest that effective industry self-regulation is difficult to maintain without explicit sanctions.

Private regulation may provide an interesting new approach for mitigating the environmental impact of economic activity. The need for a new approach is manifest. Government regulation is often intrusive or inefficient, and it can frequently be subverted (Cairncross, 1993). Laissez-faire solutions often rely on transaction-cost-free negotiation—a rarity in environmental problems (Pearce & Turner, 1990). Effective solution of environmental problems may require a "middle way between government regulation and laissez-faire prescriptions" (Rees, 1997: 481).

Rees (1997) and other scholars have suggested that industries and, in particular, trade associations, can be a central element of this middle way. Self-regulation (Gunningham, 1995; Maitland, 1985), self-enforcing institutions (Grief, 1997), self-governance (Ostrom, 1990), and communitarian regulation (Rees, 1997) are all terms adopted to describe self-organized attempts at collective action (Olson, 1965) without direct intervention by the state. In this article, we adopt the term "industry self-regulation" because this term most clearly suggests the form of institution that we are interested in—trade-association-sponsored industry standards. Such standards have proliferated in recent years and consequently have attracted attention from business, government, and environmental activists (Rees, 1997). In such industry self-regulation, companies join together to regulate their collective action to avoid a common threat or to provide a common good by establishing a standard code of conduct. Firms may be motivated to adopt such standards by external pressure from various stakeholders. For example, regardless of their individual performance, members of an industry are often "tarred by the same brush." Consequently, a few poor performers can lead to environmental regulation of the industry as a whole. As a result, companies may be compelled to join together to solve this mutual problem.

Whether such industry self-regulation will work remains an area of debate (cf. United Nations Environment Program [UNEP], 1999). Existing scholarship presents two conflicting visions. One viewpoint suggests that self-regulation will only work when it includes explicit sanctions to prevent opportunistic behavior among members (Grief, 1997). Penalties and sanctions, these scholars argue, are needed to prevent firms from free riding on others' efforts (Grief, 1997). Another viewpoint suggests that the need for such sanctions is overstated because the institutional structure of self-regulation can control behavior through informal means of coercion, the transferal of norms, and the diffusion of best practices (Nash & Ehrenfeld, 1997).

In this article, we reflect on these two perspec-

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tives by investigating a leading example of self-regulation without sanctions—the Responsible Care Program of the U.S. Chemical Manufacturers Association (CMA) (henceforth, Responsible Care). This program was created to "promote continuous improvement in member company environmental, health and safety performance in response to public concerns, and to assist members' demonstration of their improvements to critical public audiences" (CMA, 1993a). We used the literature on collective action to form hypotheses about which firms would choose to belong to the program and applied the two perspectives described above to form conflicting hypotheses about the effect of the program on behavior. We then compared the characteristics of participants in Responsible Care to those of nonparticipants and evaluated how the program influenced firm behavior. In the sections below, we begin with a review of the history and structure of Responsible Care. Then we review how theory suggests trade-association-sponsored codes like this program will work and develop testable hypotheses based on these theories.

In both its analysis and empirical domain, this research extends the existing literature. Although scholars have found numerous examples of successful self-regulation, most previous research has emphasized self-regulation of commonly owned natural resources such as fisheries and forests (e.g., Anderson & Simmons, 1993; Ostrom, 1990; Totman, 1989; Stevenson, 1991). With the exception of a detailed study of industry self-regulation in the nuclear power industry (Rees, 1994), little research has addressed the potential for self-regulation by industry associations or has explicitly addressed how limited coercive power might restrict the functioning of self-regulation. The practical need for such research is great. Despite a lack of evidence, many government officials and scholars now suggest that government and concerned environmental stakeholders should support industry self-regulation (Gunningham, 1995; Roberts, 1993), and increasingly, some stakeholders, such as socially responsible fund managers, reward firms that adopt trade-association-sponsored standards (King & Baerwald, 1998).

THE RESPONSIBLE CARE PROGRAM

Responsible Care was created in October 1989 in response to declining public opinion about the chemical industry (Simmons & Wynne, 1993). During the 1980s, the U.S. public's confidence in chemical companies steadily eroded. From 1980 to 1990, favorable opinion about the industry fell from 30 to 14 percent, and unfavorable public perceptions of the industry grew from 40 to 58 percent (CMA, 1993c). Polls showed that the public believed the chemical industry had no self-control, did not listen to the public, did not put safety and the environment first, and did not take responsibility for its processes and products (Rees, 1997). Furthermore, public outcry was not limited to individual poorly performing firms, but was directed at all firms in the industry. Industry polls showed that, except for people living within a few miles of a facility, the public did not distinguish between individual companies and the chemical industry as a whole (Buzelli, 1991). In particular, a few well-publicized events in the 1980s, most prominently the accident at a Union Carbide plant in Bhopal, India, that killed thousands, brought down the reputation of the entire industry (Rees, 1997). Major chemical companies realized that, acting on their own, they could do little to allay public fears.

The Chemical Manufacturers Association (CMA) was a natural vehicle for promoting collective improvement. The Chemical Manufacturers Association is the oldest and most prominent trade association of the U.S. chemical industry. It traces its origins to the establishment in 1872 of the Manufacturing Chemists Association by a handful of sulfuric acid producers. The CMA's original purpose was to protect member firms from injurious government regulation. In recent years, it has expanded its mission, but it maintains a strong commitment to protecting the industry from outside intervention. Currently, the CMA consists of approximately 180 firms that produce a majority of the industry's output by volume.

The creation of Responsible Care represented a recognition by the industry that improved performance among all chemical firms was essential to its public acceptability and, ultimately, its viability. According to the CMA, the purpose of Responsible Care has been twofold: to improve the environmental and safety performance of CMA members and to thereby improve public perception of the industry. All members of the CMA are required to adopt Responsible Care as a condition of membership. Responsible Care includes ten guiding principles (listed in Table 1) and six codes of management practices. These codes address how a firm interacts with the community (the community awareness and emergency response code), manages its facilities (the pollution prevention, process safety, and employee health and safety codes), and interacts with suppliers and customers (the distribution and product stewardship codes). Together the codes include over 100 management practices.

Importantly, the Responsible Care codes set standards for inputs but not for outputs. They outline

TABLE 1
Guiding Principles of Responsible Care

1. Recognize and respond to community concerns about chemicals and our operations.
2. Develop and produce chemicals that can be manufactured, transported, used and disposed of safely.
3. Make health, safety and environmental considerations a priority in our planning for all existing and new products and processes.
4. Report promptly to officials, employees, customers and the public, information on chemical-related health or environmental hazards and to recommend protective measures.
5. Counsel customers on the safe use, transportation and disposal of chemical products.
6. Operate our plants and facilities in a manner that protects the environment and the health and safety of our employees and the public.
7. Extend knowledge by conducting or supporting research on the health, safety and environmental effects of our products, processes and waste materials.
8. Work with others to resolve problems created by past handling and disposal of hazardous substances.
9. Participate with government and others in creating responsible laws, regulations and standards to safeguard the community, workplace and environment.
10. Promote the principles and practices of Responsible Care by sharing experiences and offering assistance to others who produce, handle, use, transport or dispose of chemicals.

Source: CMA (1991).

broad environmental objectives for firms and require that they perform certain functions and employ certain specialized individuals, but they do not specify what output levels will be achieved. Firms establish performance targets, as well as the means they will use to meet them. For example, the pollution prevention code requires that companies implement "ongoing reduction of wastes and releases, giving preference first to source reduction, second to recycle/reuse, and third to treatment" (CMA, 1993b). The level of reduction is not specified. In practice, this requirement could be met in many different ways, by implementing a program to reduce use of paper in administrative offices, or by phasing out the use of a particular solvent, or by designing more efficient production processes. Firms may use discretion in setting the required goals and how they achieve them.

The CMA board of directors, made up of executives from chemical firms, has limited control over members' implementation of the codes. In part this limit exists because antitrust rules restrict the extent to which industry members can use explicit penalties for noncompliance with collective agreements (Maitland, 1985). The CMA's stated policy is to revoke the membership of any company that persistently conducts its operations in a manner inconsistent with Responsible Care. In contrast to the self-regulatory effort led by the Institute of Nuclear Power Operations (INPO) in the nuclear power industry, Responsible Care does not require third parties to verify or enforce adherence to standards. In the case of the INPO, the industry association has twice chosen to reveal its own assessment to the Nuclear Regulatory Commission, which then conducted its own inspection and in one case, ordered a shutdown.

CMA firms must annually self-assess their progress toward code implementation and submit their findings, signed by their CEOs, to the CMA. "[Companies] move at the pace that's right for them," explains a CMA publication, "but they are expected to report continued progress" (CMA, 1993c: 3). Though the CMA has not expelled any of its members for failure to meet the requirements of Responsible Care, recently it began to contact and offer help to members whose progress implementing Responsible Care appeared slow. A CMA board member characterized this approach as a "velvet glove, but no iron fist" (Reisch, 1998: 13), suggesting that the CMA will apply only gentle pressure.

THEORY

The lack of an iron fist of explicit sanctions in the implementation of the CMA's Responsible Care Program highlights the basic theoretical question of this study: given limited power to penalize malfeasance, can industry self-regulation within for-profit industries be effective? Many economists have argued that without explicit penalties and sanctions, industry self-regulation will fail (Grief, 1997; Scholtz, 1984). These scholars posit that opportunistic behavior on the part of individual firms will lead to "adverse selection" and "moral hazard" and thereby ruin an industry's attempts at coordinated action (Hardin, 1968; Olson, 1965). If the industry cannot prohibit bad actors from becoming members of an association, these actors may join to disguise their poor performance (that is, adverse selection occurs). If the association cannot observe and enforce performance requirements, firms may adopt the outward form of the standard but shirk the real effort required (moral hazard occurs).

In contrast, some institutionalists have argued that industry self-regulation can still operate to shape and control behavior in the absence of explicit sanctions (Gunningham, 1995; Rees, 1997). The essence of this argument is that the institutional structure that accompanies self-regulation can control behavior through more informal coercive, normative, and mimetic means (DiMaggio & Powell, 1991; Scott, 1995). First, coercion can be achieved through more informal mechanisms, such as shaming or public exposure (Braithwaite, 1989; Milgrom, North, & Weingast, 1990; O'Hare, 1982).). Second, self-regulation can support the emergence of new norms and values that change members' preferences for collectively valued actions (Gunningham, 1995; Hoffman, 1999; Jennings & Zandbergen, 1995; Parsons, 1951; Rees, 1997). Finally, when collectively valued actions are also privately beneficial, industry self-regulation can facilitate the transfer of best practices, increasing aggregate learning and collective performance (Kraatz, 1998).

Conformity in the Absence of Explicit Sanctions

In this section, we review in greater detail the three institutional mechanisms through which industry regulation might operate to encourage collectively valued behaviors. In evaluating these mechanisms, we do not assume that firms acted rationally in joining the association. It may be that firms joined the association simply because other firms had joined, and they were thus copying the other firms without rational justification (Abrahamson & Rosenkopf, 1993), or it may be that they made calculated judgments about whom to copy and when to copy them (Kraatz, 1998). We first review how institutional forces might operate to control corporate action and then consider how strategic behavior might operate to subvert these forces.

Coercive forces. Even in the absence of explicit penalties, other means of enforcing compliance are available. An industry association can publicize the names of nonconforming members (O'Hare, 1982). Revealing the performance of members to external stakeholders can lead to intense scrutiny and can put pressure on laggards (Gunningham, 1995; King & Baerwald, 1998). Industry members can also place pressure on poor performers through social sanctions (Braithwaite, 1989). Revealing the performance of a lagging firm, even in a closed-door meeting of CEOs, causes embarrassment and action. As noted earlier, the CMA believes such reputation and shaming to be its most effective means of exerting pressure on firms. To this end, the association annually holds thousands of meetings and other forums in which members can discuss problems and negotiate solutions (Gunningham, 1995; Rees, 1997). These forums help leading firms find lagging ones and facilitate the negotiation of agreements among them. This is the essence of the "velvet glove" approach that the CMA now follows.

Normative forces. A number of authors have suggested that, in addition to changing collective behavior through informal coercive mechanisms, industry self-regulation can also produce compliance through the diffusion of values or norms (Meyer & Rowan, 1977). The formation of a standard like Responsible Care can create and codify new values and norms that penetrate the structures of participating firms, changing their preferences and thereby their routines (DiMaggio & Powell, 1991; Hoffman, 1999). Such new values and norms can be found in the text of the Responsible Care guiding principles and codes of management practices. For example, the codes concerning distribution and product stewardship contain language that suggests that the industry has changed its traditional boundaries from the fence-lines of its plants to the entire life cycles of its products. The code for community awareness and emergency response states in essence that the surrounding community is part of a firm's existence and makes clear the value of incorporating inputs from that community.

Mimetic forces. Self-regulatory institutions can shape behavior by helping disseminate information on best practices (O'Hare, 1982). The social networks created through self-regulation can act as conduits by which firms learn of ways to improve their privately valued performance. Perhaps the easiest way to transfer such valuable information is through the standard itself (O'Hare, 1982). Presumably, when the members of an organization like the CMA design and negotiate a program like Responsible Care, they create a set of requirements and guidelines that, if adopted, will actually improve environmental performance. To the extent that improving environmental performance is privately beneficial, codes of management practices may contain extensive information that is useful to achieving real change in firm financial performance. Each Responsible Care code, for example, includes approximately 15 practices that outline the steps firms should take to structure their environmental programs. Industry self-regulation programs also provide a forum for the transfer of valuable information among their participants. When members meet to administer the standard, they can exchange information about what works and what doesn't. Indeed, this is one of the chief elements of Responsible Care, according to the CMA. Its goal is to provide information to its members about successful mechanisms for improving their environmental performance. The association convenes numerous workshops to discuss the state of the art in environmental management practice.

The Threat of Opportunism

Threats to trade-association-sponsored standards arise chiefly from the potential for opportunism. Without sanctioning mechanisms, firms can adopt a standard on paper but fail to put forth the effort required to implement it. Industry standards can create a smoke screen by reducing the observable differences among firms. Left to themselves, firms would choose slightly different ways of responding to external pressure. How each firm responds might help identify its "type." External stakeholders could then use this information to put pressure on poor performers. For example, investors might be more willing to loan money to a company with good environmental performance, or environmental activists might choose not to target it for public criticism.

By making companies look alike, industry self-regulation can provide them with a form of insurance against future mishaps. For example, if faced with claims of environmental damage, a firm could use its participation to show that it was not negligent but following commonly accepted practice (Nesson, 1996). In the event of an accident, participation could be used to demonstrate that the accident was not caused by a lack of environmental concern. Note that such a smoke screen works only so long as it is very difficult for external actors to evaluate the performance of member firms. If external analysts cannot determine a member's behavior, then members of an association can acquire the legitimacy it provides without fear of eventual exposure. As in the classic "market for lemons" problem, informed outsiders are required to prevent this suboptimal outcome.

Another way of thinking about opportunism is to consider that firms may only adopt standards symbolically (Abrahamson & Rosenkopf, 1993; Meyer & Rowan, 1977); Participating in Responsible Care likely confers upon a firm some legitimacy among other firms and stakeholders such as customers and the public. Firms may adopt the outward form of the standard while failing to make necessary changes in behavior. Whether this failure results from conscious deception or naivete, the inability to verify or enforce behavior-changing investments leads to a threat of symbolic adoption.

HYPOTHESES

Formation and Membership

A long literature has explored why firms participate in cooperative ventures such as trade associations. Since changes in government regulation and other institutions might benefit or harm all members of an industry, a problem of collective action occurs (Getz, 1997; Yoffie, 1987). Olson (1965) argued that the size of a group and the existence of privileged members will affect both membership and behavior. In large groups, sanctions are necessary to overcome free rider problems. However, in small groups, it is more likely that one or a few members value the collective good so much that they are willing to bear more than their share of costs to assure that it is provided. Numerous tests of this theory have been conducted, with conflicting results (cf. Andres, 1985; Lenway & Rehbein, 1991; Masters & Baysinger, 1985; Masters & Keim, 1985; Salamon & Siegfried, 1977). Getz (1997) suggested that differences in research settings may explain the different empirical findings of the cited studies.

Theories of collective action suggest that heterogeneity among firms may cause some managers to choose to go ahead and participate even if other firms are likely to free ride off their actions. Managers of a few firms may expect that they can unilaterally improve the performance of an industry as a whole and thereby safeguard their own reputations (Miles, 1987). As Olson's (1965) work suggests, companies like Du Pont internalize so much of the costs and benefits of the collective reputation of the chemical industry that they have a dominant strategy that mandates joining Responsible Care. They may conclude that the benefit of improving the reputation of the chemical industry exceeds the private cost they incur from the free riders. They may even use the standard as a mechanism for disseminating proprietary technological information to poorly performing firms when the private benefits of collective improvement exceed the private rents from keeping the information proprietary.

Past research has measured this tendency toward a dominant strategy using market share or firm size. The extent of production in an industry is not, however, the sole determinant. The extent to which a company is diversified will mitigate its risk and may also reduce the extent to which it is associated with a given industry. For example, a diversified firm like General Electric has extensive presence in the chemical industry but is not generally associated with it. Brand identity (for instance, Clorox) and visible corporate names also represent valuable assets that could be tarnished by the collective image of an industry. Deephouse (1996) argued that more visible banks are held to higher standards and thus benefit more from isomorphism. Getz (1995) argued that stakeholders target more visible firms for social pressure. Edelman (1990, 1992) found that more visible organizations were more likely to adopt formal grievance procedures. These arguments lead to the following hypotheses:

Hypothesis 1a. Companies with more production in the chemical industry than other firms will more likely participate in the Chemical Manufacturers Association's (CMA's) Responsible Care Program.

Hypothesis 1b. Firms whose production of chemicals represents a high percentage of their total production will more likely be members of the CMA and participate in its Responsible Care Program.

Hypothesis 1c. Firms with better-known brand or corporate names will more likely be members of the CMA and participate in its Responsible Care Program.

Dirtier firms may also have a dominant strategy calling for participation in industry self-regulation because they can benefit most from the improvements the program provides (Lyon & Maxwell, 2000; Russo & Fouts, 1997). They also have a greater incentive to join to obtain the insurance against claims of negligence that such a program provides. Poorly performing firms are more likely to be the targets of both negative environmentalist campaigns and costly regulatory compliance actions (like fines). These risks should be greater if a firm participates in relatively polluting sectors or if it is relatively more polluting in the sector in which it operates. Adopting industry association standards may represent a low-cost way to learn effective environmental management practices and so reduce these costs. Adopting standards can also represent a low-cost way of insuring against such risks.

Hypothesis 2a. Firms with higher levels of pollution relative to their industries will more likely be members of the CMA and participate in its Responsible Care Program.

Hypothesis 2b. Firms that operate in industry sectors with higher average levels of pollution will more likely be members of the CMA and participate in its Responsible Care Program.

Effect on Environmental Performance

In this section, we first develop hypotheses for how the Responsible Care Program could contribute to the adoption of new values and the exchange of best practices through informal coercion and thus might cause improvement in the performance of member firms. Then, we develop a conflicting hypothesis for how the program might provide insurance and thereby reduce members' incentives to improve their environmental performance.

All three mechanisms of institutional control within Responsible Care should most strongly influence the poorest environmental performers. If Responsible Care facilitates informal coercion and internal negotiation, the worst performers would be likely to improve. Poorly performing firms are most likely to give the industry a bad reputation, and thus they are likely to face internal pressure. Poor performers are also the ones who are most likely to acquire new norms, since their mind-sets are most likely to be constricted and their values to be more misaligned (Gladwin, Kennelly, & Krause, 1995; Shrivastava, 1994). Finally, information transfer about "best practices" should most influence industry laggards. Better firms may have an incentive to help the poorer firms improve since it is in these firms that improvements can most easily be made (Hoffman, 1996).

Of course, transfer of best practices, value change, and improved negotiation could provide environmental benefits for all firms. Through the regular meetings and activities that are part of the Responsible Care Program, firms should be able to trade useful information or negotiate joint action. Numerous studies have demonstrated that the exchange of information often leads to improvements and innovation (Allen, 1977; King, 1999). Moreover, as has been discovered in quality improvement and in some areas of pollution control, these improvements may be self-perpetuating. As waste is reduced, the remaining waste becomes more visible and understandable, making it easier to further reduce pollution (King, 1995, 1999). Indeed, Nash and Howard's (1995) study of 16 Responsible Care facilities found that the principles and codes seem to have an influence on firms that already have some environmental programs and that information is better transferred among these more advanced firms. Thus, we should expect to see improvement among all members of Responsible Care.

Hypothesis 3. On the average, chemical industry firms that participate in the CMA's Responsible Care Program will improve their environ-

mental performance more than those that do not participate.

The institutional forces within Responsible Care might benefit the entire industry. The learning benefits and new values that are generated by Responsible Care may spread to the rest of the industry and cause improvement among both members and nonmembers. One way that the program can spread its benefits to the entire industry is to provide assistance with environmental management. The product stewardship and distribution codes explicitly call upon firms to audit the environmental performance of their suppliers and customers and to provide training to improve practices where necessary. Finally, Responsible Care might "raise the bar" for all companies. By publicly agreeing to the codes of Responsible Care, firms may increase stakeholder pressure on nonmembers.

Hypothesis 4. On the average, all firms in the chemical industry will have improved in environmental performance after the inception of the CMA's Responsible Care Program.

The above hypotheses express the patterns likely to appear if self-regulation effectively operates through (1) informal means of coercion, (2) the adoption of new values, and (3) the exchange of best practices. Without explicit coercive power, however, the program could be susceptible to opportunism. As we discussed earlier, industry self-regulation such as Responsible Care can provide some insurance to member firms, and thus some firms might seek to join the program to escape from stakeholder pressure. Once this pressure has diminished, they may then reduce their efforts at environmental management and become even worse polluters:

Hypothesis 5. On the average, chemical industry firms that participate in the CMA's Responsible Care Program will improve their environmental performance less than those that do not participate.

Note that Hypothesis 5 is in direct conflict with Hypothesis 3. This conflict highlights the essence of the debate surrounding Responsible Care: Can the institutional forces initiated by the CMA—informal coercion and shaming, the fostering of new values, and the transfer of best practices—facilitate effective industry self-regulation even in the absence of more explicit coercive mechanisms?

METHODS

Sample

To test these conflicting hypotheses, we collected data from a number of sources. Environmental performance data were collected from the Environmental Protection Agency's (EPA's) Toxics Release Inventory (TRI). Since 1987, the EPA has collected facility-level reports of the emissions of over 200 toxic chemicals from U.S. manufacturing firms. These TRI reports constitute one of the few sets of longitudinal data about facility environmental performance in the United States. Facilities must complete TRI reports if they manufacture or process 25,000 pounds or use more than 10,000 pounds of any listed chemical during a calendar year and employ ten or more full-time people. Our database includes more than 95 percent of the production volume of the chemical industry and covers a ten-year period (1987–96). This time frame provides both insight into firm performance prior to the establishment of Responsible Care and a long period (six years) over which to view improvement since its inception.

Previous research using TRI data has been performed predominantly at the company level (Hart & Ahuja, 1996; Levy, 1995). In part, this is because the TRI does not include information about the production volume of facilities, making it difficult to control for size differences. TRI does report Dun & Bradstreet (D&B) numbers, however. Matching the D&B number with facility-level data from Dun & Bradstreet,[1] we were able to acquire data concerning the number of employees at each facility in 1996. To fill in employee data for earlier years, we calculated the sizes of the facilities using the ratio of production in one year to the previous year, as specified in the TRI. For years prior to 1990, when

[1] Matching the two data sets proved more difficult than we originally hoped because respondents often reported their corporate D&B numbers rather than their facility D&B numbers. In some cases, they dropped leading zeros or made slight mistakes in transposing numbers. To fix these errors, we wrote a computer program to match facilities from the TRI data set to the D&B data set. This program used the zip code, Standard Industrial Classification (SIC) code, company identification, and company name to match a facility. Only if there was a unique match between location, product, and company did we conclude that we had correctly identified a facility and could merge the data. Because the Duns data were necessary to conduct our statistical analyses, we omitted nonmatched establishments from our sample. In this way, we matched over two-thirds of the facilities (3,606 facilities out of 4,221).

the production indexes were first required, we used facility trend information from Dun & Bradstreet and industry trend information from the National Bureau of Economic Research to estimate facility size information.[2] With these data in hand, we were able to construct two databases: (1) a facility-level database and (2) a company-level database constructed from aggregate facility-level data.

The chemical industry is usually defined as those facilities and firms in SIC 28, and we restricted our sample to this set. The final sample consisted of 22,476 observations at the facility level and 12,829 observations at the firm level over the entire period, 1987–96. Those observations correspond to 3,606 facilities belonging to approximately 1,500 firms. Of the total number of firms, 130 were members of the CMA and participated in Responsible Care in 1990. By 1996, that number had grown to 160. Responsible Care participants, due to their size, account for a much larger share of facilities, representing roughly one-third of all facilities in any given year. A small number of Responsible Care participants (<10) were not included in the analysis because they did not actually produce in the chemical industry (as defined by facility-level SIC codes). For example, some petroleum companies (SIC 29) are members of Responsible Care even though they have no direct chemical production.

Measures

Environmental performance: Relative emissions and sector emissions. How to measure environmental performance remains an area of active debate (Gladwin, 1993). The six codes of Responsible Care cover several issues that are related to environmental performance. For example, emergency preparedness could influence the ability of a firm to reduce human and environmental damage during an accident, but accidents are rare and thus provide little information about the firm's performance (Lenox & Haimes, 1996).

Historically, public concern about chemicals has focused to a large degree on releases of toxic chemicals during manufacture and distribution. TRI reportable emissions provide a good proxy for this measure of environmental performance. Previous research that has used TRI emissions data to measure a firm's environmental performance has been fraught with a number of conceptual problems. Our analysis improves on the use of TRI data in two significant ways: In our research, we considered the relative toxicity of the chemicals emitted, and we performed our comparisons at the facility (rather than the company) level and so better controlled for differences in products and processes.

Two hundred and forty-six chemicals have been consistently a part of the TRI database. Although all are nominally toxic at some dose, they differ widely in their impacts. The TRI database includes, for example, chlorine gas and phosgene (both chemical war agents) and food colors and methanol. To correct for these differences, we weighted each chemical by its toxicity. The weighting scheme we chose was developed by the EPA to serve as a threshold for reporting accidental spills—the "reportable quantities" (RQ) database in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). For highly toxic chemicals, emergency action must be taken for any accidental release of 1 pound or more. For relatively benign chemicals like methanol, the limit is 5,000 pounds. Reportable quantities may take on a number of values in-between. The toxicity weight for an individual chemical is calculated as the inverse of its reportable quantity.[3] We calculated aggregate releases for a given facility in a given year (E_{it}) by summing the weighted releases of the 246 common chemicals in the TRI database:

$$E_{it} = \sum_{\forall_c} w_c e_{cit},$$

where E_{it} is aggregate emissions for facility i in year t, w_c is the toxicity weight for chemical c in year t, and e_{ci} is the pounds of emissions of chemical c.

In previous research at the company level, toxic emissions have simply been aggregated from the facility level. This process, however, ignores the fact that toxic emissions are strongly influenced by facility size and the product being manufactured. We chose instead to construct a standardized measure at the facility level, *relative emissions,* and to then aggregate these comparisons to create firm

[2] When available, facility trend information from Dun & Bradstreet was used. In cases of incomplete and missing data, the industry trend as represented by the facility's four-digit SIC code was used.

[3] We compared our measures of toxicity with others, including a new EPA database of toxicity weights that is under development, an unweighted scheme, and a system developed at Purdue University and found them to be fairly well correlated for aggregate releases. The EPA toxicity measure and the RQ are correlated at .43. The Purdue toxicity measure only considers human toxicity and is correlated with the log of inverted RQs at .13. Since this measure is newer, less well known, and covers few chemicals, we decided to use the RQs. Using the Purdue measure did not change our findings.

performance. The first step in this process was to develop an environmental performance measure for each facility that allowed for meaningful comparisons across facilities. To do this, we estimated the production function between facility size and aggregate toxic emissions for each four-digit SIC code within each year using standard ordinary least squares (OLS) regression analysis. The relative environmental performance of a facility *(RE_{it})* is given by the standardized residual, or deviation, between observed emissions and predicted emissions, given the facility's size and industry sector. Thus, if a facility emits more than predicted for its size and SIC code, it will have a positive residual and a positive score for environmental impact. Thus,

$$RE_{it} = E_{it} - E^{*}_{it}.$$

$$E^{*}_{it} = \alpha_{jt} + \beta_{1jt}s_{it} + \beta_{2jt}s^{2}_{it},$$

where E^{*}_{it} is predicted emissions for facility i in year t, s_{it} is facility size, and α_{jt}, β_{1jt}, and β_{2jt} are the estimated coefficients for sector j in year t. Note that our facility measurement does not directly consider environmental impact. Rather, it measures a facility's performance relative to its sector's. The average of these facility scores thus gives a good estimate of how well a firm manages its facilities with respect to emissions.

To create a corporate-level performance measure, we created a weighted average of these facility-level scores. We weighted the scores by the percentage of total production that each facility represented for a company:

$$RE_{nt} = \sum_{i\epsilon n} (s_{it}/s_{nt})\, RE_{it},$$

where RE_{nt} is weighted relative emissions for firm n in year t, s_{it} is facility i's size in year t, and s_{nt} is firm size. Note that our measure of corporate performance does not consider whether or not a company has chosen to operate in dirty or clean segments of the chemical industry. Sectors differ widely in their emissions. Some, like industrial gases (SIC 2813), have few emissions, and others, like cellulosic manmade fibers (SIC 2823), emit dangerous chemicals. We calculated the dirtiness of a sector as the total emissions for the sector divided by the total number of employees in it. We created a firm-level measure, *sector emissions,* by aggregating the dirtiness of the mix of sectors in which a company owned facilities. In performing this aggregation, we used a weighted average, taking the percentages of the company's total production in each sector for weights. Thus,

$$IE_{nt} = \ln(\textstyle\sum_{i\epsilon n} (s_{it}/s_{nt})E_{jt}).$$

$$E_{jt} = \textstyle\sum_{i\epsilon j} E_{it},$$

where IE_{nt} is weighted industry emissions for firm n in year t, and E_{jt} is total toxicity-weighted emissions for industry j in year t.

Environmental improvement: Absolute improvement and relative improvement. To test hypotheses concerning Responsible Care's influence on the environmental performance of chemical firms, we created two measures of annual improvement in environmental performance. *Absolute improvement (AI_{nt})* was measured as the percent change in total weighted emissions over a one-year period:

$$AI_{nt} = -(E_{n(t+1)} - E_{nt})/0.5(E_{n(t+1)} + E_{nt}).$$

$$E_{nt} = \textstyle\sum_{i\epsilon n} E_{it},$$

where E_{nt} is total emissions for firm n in year t. *Relative improvement (RI_{nt})* measures the change in relative emissions over a one-year period: $RI_{nt} = -(RE_{n(t+1)} - RE_{nt})$.

Responsible Care participation. CMA membership, and thus participation in *Responsible Care,* was coded as a binary variable. Using data provided by the CMA, we coded a firm and/or its facilities as participating in Responsible Care in each year of membership. The year 1990 was chosen as the base year for participation since Responsible Care was not ratified by CMA members until October 1989. In some rare cases, facilities or business units, but not entire companies, are members, and we coded these accordingly.

Organization size. *Size* was measured with employee information from Dun & Bradstreet. Firm size was simply the logarithm of the sum of all employees at all of a firm's facilities. Although there are other acceptable measures of firm size (for instance, assets and sales), employee data are the best publicly available data for both public and private firms. For the firms for which we had both asset and employee data (343 publicly traded corporations), employees and assets were highly correlated (75.5%).

Focus within chemical industry. To estimate the degree to which each firm focused on chemical production, we created the variable *focus,* measured as the log of the total number of employees in facilities within the chemical industry over the log of the number of employees in the total company. Thus, the variable grew with the degree to which a company was focused on chemicals.

Firm visibility. To determine visibility, a continuous variable, we asked master's of business administration (M.B.A.) students at the Stern School of Business to indicate if they recognized a company's name or knew any of its brands. To keep the surveys small enough to maintain the students' interest, we randomly distributed companies among seven surveys and randomly distributed these surveys to the Stern M.B.A. students. Between 25 and 35 students responded to each of the seven surveys. *Visibility* was the percentage of those who recognized a company's name and/or brand among the number who were asked to respond for that company. Visibility varied from 0 to 1, where 1 signified that all respondents recognized the company and its brand. Table 2 gives descriptive statistics and correlations for all measures.

ANALYSIS AND RESULTS

Formation and Membership

To test our hypotheses concerning the formation of and membership in the Responsible Care Program, we used a Probit model. Our model specifies the likelihood that a given firm within the chemical industry will be a member of CMA and participate in Responsible Care, and this was our dependent variable. Our independent variables included our measures of environmental performance, firm focus, firm visibility, and firm size. The specification of the Probit model is as follows:

$$\text{Prob}\ (\textit{responsible care} = 1) = \Phi(\beta'\mathbf{x}),$$

where the vector $\mathbf{x}$ includes relative emissions, industry emissions, focus, visibility, size, and a constant. We estimated the model for three samples: all chemical firms at the inception of the Responsible Care Program (1990); subsequent entrants to Responsible Care, and non–Responsible Care firms, from 1991 through 1996; and exiters from Responsible Care, and non–Responsible Care firms, from 1991 through 1996. The latter two analyses were included to see if entrants and exiters after 1990 shared characteristics with firms participating in the program in 1990.

Our analysis supports our hypotheses that those firms that are more greatly influenced by the chemical industry's reputation will more frequently participate in Responsible Care. We hypothesized that larger firms, those with well-known names or brands, and those more focused on chemicals would more often participate. As shown in Table 3, we found that in 1990, the time of formation of Responsible Care, larger companies within the chemical industry participated disproportionately often (Hypothesis 1a). Our data also suggested that firms whose business was focused in chemicals would more frequently be members of the program (Hypothesis 1b). We also found evidence that more visible companies more frequently joined (Hypothesis 1c).

Our data also support our hypotheses that dirtier firms participate more in Responsible Care. As predicted by Hypothesis 2a, we found that companies with weaker environmental performance relative to their sectors (the relative emissions variable) were more likely to participate in Responsible Care. Likewise, companies in dirtier sectors (sector emissions) were more likely to participate (Hypothesis 2b).

We found no evidence to suggest that the membership of Responsible Care changed over time. As also shown in Table 3, we found little evidence that companies entering or exiting were different from incumbent members. We found no evidence that dirty companies were rushing to join Responsible Care or that clean companies were leaving to avoid being "painted with the same brush." With respect to the measured attributes, the characteristics of the program's members were relatively stable.

Effect on Environmental Performance

We estimated a number of models to test our hypotheses concerning the effect of Responsible Care on environmental performance in the chemical industry. As dependent variables, we used our two measures of improvement in environmental performance, absolute improvement and relative improvement. We estimated models using both a robust generalized least squares (GLS) regression analysis, with White's correction for heteroskadasticity (White, 1980), and a fixed-effects specification. The specification for the robust GLS model is:

$$\textit{Improvement} = \beta'\mathbf{x} + \delta \textit{Responsible Care} + \varepsilon,$$

where the vector $\mathbf{x}$ includes relative emissions, industry emissions, focus, visibility, size, and a constant. We employed White's correction for heteroskedasticity to address concerns that for some independent variables, variance might increase with the size of the variable; specifically, that any measurement error in the extrapolation of firm size data will be more pronounced in larger firms.

A common issue arising during the analysis of longitudinal data sets is unobserved heterogeneity in the units under study. Unobserved heterogeneity may result in incorrect inferences concerning the magnitude and significance of individual effects. To control for unobserved heterogeneity, we estimated a fixed-effects model with the specification:

$$\textit{Improvement} = \alpha'\mathbf{d} + \beta'\mathbf{x} + \delta \textit{Responsible Care} + \varepsilon,$$

TABLE 2
Descriptive Statistics and Correlations[a]

Variable	Description	Mean	s.d.	Minimum	Maximum	1	2	3	4	5	6	7
1. Responsible Care	Whether or not a firm participates in Responsible Care	0.09	0.28	0.00	1.00							
2. Relative emissions	Average relative emissions of facilities based on sector and size	−0.10	0.80	−3.76	5.63	.08***						
3. Sector emissions	Average total emissions of sectors	1.33	1.17	0.00	6.22	.27***	−.04***					
4. Focus	Ratio of chemical production to total production	0.77	0.40	0.00	1.00	−.07***	−.04***	.04***				
5. Visibility	Degree to which a firm's name or its brands are recognizable	0.04	0.13	0.00	1.00	.27***	.03	.02	−.18***			
6. Size	Natural log of firm employees	4.92	2.06	0.02	12.97	.30***	−.01	.04***	−.60***	.39***		
7. Absolute improvement	Annual percent improvement in total weighted emissions	0.09	0.76	−2.00	2.00	−.01	.12***	−.01	−.03***	.02	.04***	
8. Relative improvement	Annual improvement in relative emissions	−0.01	0.40	−3.58	3.44	−.00	.26***	−.01	−.02	.01	−.00	.51***

[a] For most variables, $n = 10{,}832$; for absolute and relative improvement, $n = 8{,}908$.
*** $p < .001$

TABLE 3
Probit Estimates of Responsible Care Participation[a]

Variable	Model 1: Responsible Care Membership, 1990	Model 2: Responsible Care Entrants, 1991–96	Model 3: Responsible Care Exiters, 1991–96
Relative emissions	0.24***	0.13*	0.20*
	(0.07)	(0.07)	(0.09)
Sector emissions	0.45***	0.26***	0.21***
	(0.05)	(0.05)	(0.06)
Focus	0.47**	0.53**	−0.03
	(0.16)	(0.17)	(0.23)
Visibility	1.24***	0.24	0.53
	(0.32)	(0.33)	(0.44)
Size	0.24***	0.24***	0.13**
	(0.03)	(0.04)	(0.05)
Constant	−4.03***	−4.74***	−3.92***
	(0.29)	(0.34)	(0.42)
n	1,508	8,552	8,507
χ^2 (df)	242.38 (5)***	87.50 (5)***	32.32 (5)***
Pseudo R^2	0.29	0.16	0.12

[a] Incumbent Responsible Care participants are not included in the entrant and exiter models. Unstandardized regression coefficients are shown, with standard errors in parentheses.

* $p < .05$
** $p < .01$
*** $p < .001$

where the vector ***d*** is a set of dummy variables corresponding to each unit (firm or facility) under observation. Note that a random-effects specification was rejected because the assumption that the random error associated with each cross-sectional unit was not correlated with the other regressors did not hold under a Hausman test (Hausman, 1978).

Our data provide no evidence that Responsible Care has positively influenced the rate of improvement among its members. Indeed, we found evidence that members of Responsible Care are improving their relative environmental performance more slowly than nonmembers (in opposition to Hypothesis 3 and in support of Hypothesis 5). In both of the robust GLS models in Table 4 (models 1 and 3), Responsible Care is significant and negative. Regressions on the firm level provide the strongest evidence. It is possible, however, that our measures do not capture all of the variance among facilities and that some of this variance is associated with Responsible Care. To correct for this possibility, we used the fixed-effects model. In those results, the effect of Responsible Care is no longer significant. Undoubtedly, this finding is partly a result of low levels of turnover in the Responsible Care membership, because a fixed-effects analysis discounts independent variables that do not vary across the time period. Hence, it is not surprising that Responsible Care does not significantly influence environmental improvement in the fixed-effects model, since there is little entry and exit into Responsible Care. The lack of a significant effect in the fixed-effects model does suggest that the late entrants (or early exiters) did not significantly change their performance after entering (or leaving). It also suggests caution in strongly asserting a negative influence of Responsible Care. The continuance of the same direction of influence would suggest greater confidence that Responsible Care has not had a *positive* impact on rates of improvement.

As one might expect, poor performers (firms high on the variable measuring relative emissions) were likely to improve faster than good performers during the year after joining. This may simply be the result of random fluctuations (a firm that has an accidental release one year will be a poor performer, and if this accident does not occur the next year, its performance will improve). It may also be the result of increased managerial and external pressure on poor performers. Finally, it may be a result of simple regression to the mean: the marginal cost of improvement is lower for firms with poor performance than for those with high performance. Poor performers may not have previously captured the "low-hanging fruit"—that is, the easy, inexpensive improvements in environmental performance they can make. A similar logic may also explain the strong relationship between size and

TABLE 4
Estimates of Relative Improvement Since Inception of Responsible Care, 1990–96[a]

	Firm Level		Facility Level	
Variable	Model 1: Robust GLS	Model 2: Fixed-Effects	Model 3: Robust GLS	Model 4: Fixed-Effects
Responsible care	−0.05**	−0.07	−0.02**	−0.01
	(0.01)	(0.04)	(0.01)	(0.02)
Relative emissions	0.13***	0.66***	0.09***	0.65***
	(0.01)	(0.01)	(0.00)	(0.01)
Sector emissions	0.00	−0.01	0.00	0.03
	(0.00)	(0.02)	(0.00)	(0.02)
Focus	−0.00	−0.01	−0.00	0.14
	(0.01)	(0.03)	(0.01)	(0.09)
Visibility	0.05		0.02	
	(0.03)		(0.02)	
Size	0.00	0.06***	0.00	0.03***
	(0.00)	(0.01)	(0.00)	(0.01)
Constant	0.00	−0.20**	−0.01	−0.31***
	(0.02)	(0.06)	(0.02)	(0.08)
n	8,908	8,908	18,108	18,108
F (df)	54.55 (6)***	717.26 (5)***	94.59 (6)***	1,401.52 (5)***
R^2				
Within		0.33		0.33
Between		0.02		0.01
Overall[b]	0.07	0.06	0.05	0.05

[a] Unstandardized coefficients of general least squares (GLS) and fixed-effects regression models are shown, with standard errors in parentheses. Visibility did not vary over time and was therefore dropped in the fixed-effects models.
[b] This overall R^2 does not include the variance explained by the dummy variables used in the fixed-effects regression.
* $p < .05$
** $p < .01$
*** $p < .001$

improvement. Larger firms or facilities may have economies of scale in pollution reduction.

Note that although all four models were significant at the .001 level, our models explain very little of the variance, in that our overall multiple squared correlations (R^2s) are small. In the case of the fixed-effects model, this may be because the cross-sectional dummy variables are capturing much of the variance. This is supported by our substantially higher "within" than "between" R^2s. The explanatory power is further reduced by discrete emissions reductions. Emissions reductions are often the result of the implementation of new manufacturing processes or new pollution control technologies such as scrubbers. Consequently, annual improvements in environmental performance may be relatively flat for a number of years before and after a significant reduction due to large capital outlays.

Overall Rates of Improvement

We hypothesized earlier that Responsible Care might influence the rate of improvement for members and nonmembers alike (Hypothesis 4). To test this prediction, we divided our panel into two periods (1987–89 and 1990–96) by creating a dummy variable for the years 1990–96 and an interaction term crossing our dummy and the Responsible Care variable. Prior to 1990, Responsible Care indicates that a firm was a member of the U.S. Chemical Manufacturers Association. The dummy variable for 1990–96 indicates whether there has been a change in the industry's rate of improvement since the inception of the Responsible Care program. The interaction term captures whether there has been a change in improvement in CMA members since the inception of Responsible Care. In this way, we could investigate Responsible Care's impact on the industry as a whole. Note that since the variable relative improvement measures the change in performance relative to the industry, it cannot be used to measure changes in the rate of improvement throughout the industry. By definition, the mean improvement in relative emissions is zero in any given year for any given sector. Thus, we only estimate the impact of Responsible Care on absolute emissions.

We found only partial evidence supporting Hy-

TABLE 5
Estimates of Absolute Improvement, 1987–96[a]

	Firm Level		Facility Level	
	Model 1: Robust GLS	Model 2: Fixed-Effects	Model 3: Robust GLS	Model 4: Fixed-Effects
Responsible care[b]	−0.02	−0.02	0.01	0.05
	(0.03)	(0.09)	(0.02)	(0.05)
Dummy for year 1990–96	0.11***	0.12***	0.13***	0.19***
	(0.02)	(0.02)	(0.02)	(0.02)
Responsible Care X dummy for year 1990–96	−0.09*	−0.11*	−0.07**	−0.09***
	(0.04)	(0.05)	(0.02)	(0.03)
Relative emissions	0.14***	0.60***	0.15***	0.78***
	(0.01)	(0.02)	(0.01)	(0.01)
Sector emissions	0.01	0.06	0.01*	0.11***
	(0.01)	(0.03)	(0.01)	(0.03)
Focus	0.02	−0.06	0.03	0.05
	(0.02)	(0.06)	(0.02)	(0.17)
Visibility	0.01		0.03	
	(0.04)		(0.03)	
Size	0.02***	0.13***	0.02***	0.16***
	(0.00)	(0.02)	(0.00)	(0.01)
Constant	−0.14***	−0.64***	−0.18***	−1.12***
	(0.04)	(0.12)	(0.03)	(0.16)
n	12,829	12,829	22,476	22,476
F (df)	42.84 (8)***	150.28 (7)***	91.55 (8)***	559.29 (7)***
R^2				
Within		0.09		0.17
Between		0.01		0.00
Overall[c]	0.03	0.02	0.03	0.03

[a] Unstandardized regression coefficients are shown, with standard errors in parentheses. Visibility did not vary over time and was therefore dropped in the fixed-effects models.

[b] Prior to 1990, Responsible Care represents membership in the U.S. Chemical Manufacturers Association.

[c] This overall R^2 does not include the variance explained by the dummy variables used in the fixed-effects regression.

* $p < .05$

** $p < .01$

*** $p < .001$

pothesis 4, as is shown in Table 5. As hypothesized, we did find that the rate of improvement in the entire chemical industry indeed increased following the inception of Responsible Care (see the 1990–96 dummy variable in Table 5). However, as we found in our earlier analyses, the rate of improvement of Responsible Care firms was slower over this time period. Looking at the coefficients, one sees that in the period from 1990 through 1996, Responsible Care members were improving no faster than they had previously. In other words, the interaction term (Responsible Care X 1990–96) almost largely counteracts the main effect of 1990–96, when the rest of the industry increased its rate of improvement. One interpretation of this result is that Responsible Care had a positive effect on the industry but not on its members. One way this could have come about would have been if Responsible Care caused environmental activists to focus more attention on nonmembers. For example, some environmental ratings organizations do use Responsible Care as a proxy for good intentions and include it in calculations of corporate environment performance. Since these ratings are made public, they could influence stakeholder (including stockholder) action. Alternatively, other external factors may have changed the rate of improvement since 1990. Possible factors include macro-level changes to the economy or regulatory environment.

Further Analysis

Our findings are summarized in Table 6. Although our findings are very stable and consistent across a range of tests, our research explains only a small portion of the variance in environmental improvement. We expect that this unexplained variance has several sources. First, as mentioned before, pollution levels are often discrete. Firms have accidents, start-up problems, maintenance cycles,

TABLE 6
Summary of Findings

Hypothesis	Finding
Formation and membership	
Hypothesis 1. Firms will more likely be members of the CMA and participate in Responsible Care when they have (1) more production in the chemical industry (2) production focused in chemicals (3) better-known brand or corporate names	Strong support for all
Hypothesis 2. Firms will more likely be members of the CMA and participate in Responsible Care when they have (1) higher levels of pollution relative to their industries (2) operate in industry sectors with higher average levels of pollution	Strong support for all
Improvement	
Hypothesis 3. On average, firms that participate in Responsible Care will improve their environmental performance *more* than nonmembers in the industry.	Not supported
Hypothesis 4. On average, the chemical industry will more rapidly improve in environmental performance after the inception of Responsible Care.	Supported only for non–Responsible Care participants
Hypothesis 5. On average, participants in Responsible Care will improve their environmental performance *less* than nonmembers in the industry.	Weakly supported

and so on that cause unusual discharges. Of more concern, however, is the difficulty of perfectly controlling for differences among facilities. Even four-digit SIC levels can include facilities of different types, and some facilities may combine production from several SIC codes. Thus, we may not have perfectly controlled for facility differences, and such mismeasurement could have influenced our findings, if it were correlated with Responsible Care participation.

Reporting requirements could also account for some unexplained variance in our sample. Sometimes firms report chemicals even when they do not need to, making them look dirtier than other members of their industry. By using the same 264 chemicals consistently, we should have much reduced this problem, but it is still possible it had some effect. It may be that firms participating in Responsible Care are more cautious (or more accurate) in reporting emissions and thereby look dirtier. However, neither of these potential sources of error should have influenced our findings with respect to the rates of improvement. Our fixed-effects model should have removed the effect of facility-level bias (assuming such a bias would be consistent over time) and thus have corrected for these problems.

It is important to remember that the industry as a whole made great strides over the time period. Total toxicity-weighted emissions were reduced by nearly 50 percent. Future research should explore what forces led to such reductions and how these may have interacted with the effect of the Responsible Care Program. Finally, it should be remembered that we used only toxic emissions in our research, since these are a reasonable measure of chemical firms' environmental performance. It is possible, however, that Responsible Care has been far more successful in improving performance with respect to some other aspects of the codes. In future research, we hope to investigate whether Responsible Care has influenced the supply chain management of participating firms. We hope to investigate if participants transfer waste material to different end uses or to companies with different performance in waste treatment. Additionally, future research could investigate the extent to which Responsible Care members experience worker accidents or unexpected releases.

Finally, future research should consider self-regulation that does not originate from the industry itself. For example, the International Standards Organization (ISO) has created an environmental management standard (ISO 14000), and some facilities in the United States have begun to seek certification under the program. Likewise, the Coalition for Environmentally Responsible Economies (CERES) has created a set of principles that firms can endorse. Both of these could provide a useful opportunity for comparison with an industry program like Responsible Care.

CONCLUSION

This article extends theoretical and empirical analysis of self-organized regulation to trade-association-sponsored standards. Our study enhances the literature on trade associations by investigating a new domain and by providing additional evidence on what characteristics lead to participation. In this article, we elucidate and evaluate the conflicting forces that help and hinder industry self-regulation. We analyze whether, in the absence of explicit sanctions, opportunism will impede the functioning of other coercive, normative, and mimetic forces. We test how these conflicting forces influenced the membership and behavior of firms participating in one of the leading attempts at industry self-regulation, the Chemical Manufacturers Association's Responsible Care Program. Our research demonstrates that both privileged companies and those in need of protection and help might chose to join a voluntary initiative.

Our research exposes the difficulty in establishing and maintaining industry self-regulation. Responsible Care has operated up to now without explicit sanctions for malfeasance. As a result, our data suggest, it has fallen victim to enough opportunism that it includes a disproportionate number of poor performers, and its members do not improve faster than nonmembers. Thus, whatever the strength of the institutional forces that Responsible Care brings to bear on its members—and these forces appear considerable—they have not been enough to counteract opportunism. Since Responsible Care represents a leading example of self-regulation in the world, our findings highlight the difficulty of creating self-regulation without explicit sanctions.

The difficulty in establishing effective self-regulation in the case of Responsible Care may be a product of the nature of the common good, or commons, being protected. With Responsible Care, what is being protected is one step removed from a real, physical commons. The chemical industry affects a physical commons—clean water, clean air, and healthy ecosystems—but it was not the threat to this shared public good that motivated the industry's initial attempts at self-organization. Rather, it was a threat to a second, reputational commons that sparked the creation of Responsible Care. A community of fishermen directly impacts its own welfare by overfishing, but excessive polluting by chemical firms influences members' welfare only to the extent that it influences this reputational commons. A trade association such as the CMA, unlike a local fishermen's union, can protect its members by working to influence perception rather than the problem itself.

In some respects, despite the thousands of firms in our study, our research represents a single case. Thus, we must be cautious in forming general theoretical conclusions. A comparison with another powerful self-regulatory institution provides additional guidance. Rees (1994) claimed that the Institute of Nuclear Power Operations (INPO) was highly successful in reducing the risk of nuclear plant accidents but notes several important differences between this program and Responsible Care. In particular, an even smaller number of companies were involved, government regulation reduced economic competition, and the Nuclear Regulatory Commission (NRC) served as a regulatory "gorilla in the closet" that could provide sanctions for opportunism and act as an outside auditor for the program (Rees, 1997). Thus, the INPO may have been successful because the threat of opportunism was reduced by enforceable sanctions.

This comparison leads us to hypothesize that explicit sanctions administered by informed outsiders may be needed to avoid opportunism within an industry self-regulatory scheme. Overseeing parties must be outsiders to ensure that sanctions are levied and are not used for other strategic purposes. Trade associations are limited as enforcers both legally and practically, since they are ultimately governed by their members. To prevent collusion, antitrust legislation forbids certain types of punitive actions on the part of trade associations. Industry members may fear that powerful association members may use sanctions strategically to punish weaker members and limit overall competition.

One alternative candidate for the job of informed outsider is the state. As was the case with both the INPO and the NRC, an active, state-run regulatory body can provide the enforcement behind a trade-association-sponsored standard. Such cases raise the issue, though, of whether such self-regulation is really any different from traditional, state-administered regulation. Other candidates for informed outsider include various types of third-party certifiers that operate independently of both the state and the relevant trade association. For example, the Motion Picture Association of America, the primary trade association of the movie industry, uses a wholly independent ratings board to assign movie ratings. Additional candidates may be the press, or nongovernmental organizations that disseminate information. By publicizing firm performance data, they may bring other forces to bear, such as public ire or regulatory scrutiny.

Whoever these outsiders may be, they must also be informed in the sense that they can effectively investigate the performance of individual firms to hold them up for scrutiny. Finding accurate performance information is not easy. Our research was conducted in a country with elaborate rules for public reporting and on one of its most measured industries. In many industries, an investigation such as ours would be almost impossible. If industry self-regulation is to achieve its promise, systems must be put in place to improve the ability of outsiders to audit improvement. To its credit, the Chemical Manufacturers Association seems to recognize this and is working to create mechanisms for measuring performance on other aspects of the codes.

We should not forget that industry self-regulation is a dynamic process and that its eventual outcome is not yet certain. Responsible Care may still evolve into a more effective industry self-regulatory scheme. In many ways, attempts at industry self-regulation resemble a diffusion process. Over time, more and more industry members may choose to participate. As a greater portion of the chemical industry participates in Responsible Care, there may be greater incentives for other firms to participate. Of course, the greater the number of participants, the more difficult it will likely be to maintain cohesion (Olson, 1965).

It may be that a program like Responsible Care will grow at first, only to experience free riding and opportunism, and will consequently fall apart and disappear over time. In contrast, there are a few hopeful signs that Responsible Care is beginning to change. Leaders within the industry are publicly recognizing that Responsible Care performance has been disappointing and that a "velvet glove" approach may not be enough to change behavior (Reisch, 1998). The program has been moving toward a third-party verification system that might help differentiate clean firms from dirty ones, allow effective use of sanctions, and finally allow the Responsible Care Program to achieve its promise.

REFERENCES

Abrahamson, E., & Rosenkopf, L. 1993. Institutional & competitive bandwagons: Using mathematical models as a tool to explore innovation diffusion. ***Academy of Management Review,*** 18: 487–517.

Allen, T. J. 1977. ***Managing the flow of technology.*** Cambridge, MA: MIT Press.

Anderson, T. L., & Simmons, R. T. (Eds.). 1993. ***The political economy of customs and culture: Informal solutions to the commons problem.*** Lanham, MD: Rowman & Littlefield.

Andres, G. J. 1985. Business involvement in campaign finance: Factors influencing the decision to form a corporate PAC. ***Political Science and Politics,*** 18: 213–220.

Ayres, I., & Braithwaite, J. 1992. ***Responsive regulation.*** New York: Oxford University Press.

Braithwaite, J. 1989. ***Crime, shame, and reintegration.*** Cambridge, England: Cambridge University Press.

Braithwaite, J. 1993. Responsive regulation in Australia. In P. Grabosky & J. Braithwaite (Eds.), ***Business regulation and Australia's future.*** Canberra: Australian Institute of Criminology.

Buzelli, D. 1991. ***Presentation to the MIT Technology, Business and Environment Program*** (July 2). Massachusetts Institute of Technology, Cambridge, MA.

Cairncross, F. 1993. ***Costing the earth.*** Boston: Harvard Business School Press.

Chemical Manufacturers Association (CMA). 1991. ***Responsible Care: A public commitment.*** Washington, DC: CMA.

Chemical Manufacturers Association. 1993a. ***Improving Responsible Care implementation: Enhancing performance and credibility.*** Washington, DC: CMA.

Chemical Manufacturers Association. 1993b. ***Pollution prevention code of management practices.*** Washington, DC: CMA.

Chemical Manufacturers Association. 1993c. ***On the road to success*** (Responsible Care progress report). Washington, DC: CMA.

Deephouse, D. L. 1996. Does isomorphism legitimate? ***Academy of Management Journal,*** 39: 1024–1039.

DiMaggio, P., & Powell, W. (Eds.). 1991. ***The new institutionalism in organizational analysis.*** Chicago: University of Chicago Press.

Edelman, L. B. 1990. Legal environments and organizational governance: The expansion of due process in the American workplace. ***American Journal of Sociology,*** 95: 1401–1440.

Edelman, L. B. 1992. Legal ambiguity and symbolic structures: Organizational mediation of civil rights law. ***American Journal of Sociology,*** 97: 1531–1576.

Getz, K. A. 1995. Implementing multilateral regulation: A preliminary theory and illustration. ***Business and Public Policy,*** 34(3): 280.

Getz, K. A. 1997. Research in corporate political action: integration and assessment. ***Business and Society,*** 36(1): 32.

Gladwin, T. N. 1993. The meaning of greening: A plea for organizational theory. In K. Fischer & J. Schott (Eds.), ***Environmental strategies for industry: International perspectives on research needs and policy implications:*** 37–61. Washington, DC: Island Press.

Gladwin, T. N., Kennelly, J. J., & Krause, T. 1995. Shifting paradigms for sustainable development: Implications for management theory and research. ***Academy of Management Review,*** 20: 874–907.

Grief, A. 1997. Microtheory and recent developments in the study of economic institutions through economic history. In D. Kreps & K. Wallis (Eds.), ***Advances in economic theory and econometrics,*** vol. 2: 79–113. Cambridge, England: Cambridge University Press.

Gunningham, N. 1995. Environment, self-regulation, and the chemical industry: Assessing Responsible Care. ***Law & Policy,*** 17(1): 57–108.

Hardin, G. 1968. The tragedy of the commons. ***Science,*** 162: 1243–1248.

Hart, S., & Ahuja, G. 1996. Does it pay to be green? An empirical examination of the relationship between emissions reduction and firm performance. ***Business Strategy and the Environment,*** 5(1): 30–37.

Hausman, J. 1978. Specification tests in econometrics. ***Econometrica,*** 46: 1251–1271.

Hoffman, A. 1996. A strategic response to investor activism. ***Sloan Management Review,*** 37(2): 51–52.

Hoffman, A. 1999. Institutional evolution and change: Environmentalism and the U.S. chemical industry. ***Academy of Management Journal,*** 42: 351–371.

Jennings, P. D., & Zandbergen, P. 1995. Ecologically sustainable organizations: An institutional approach. ***Academy of Management Review,*** 20: 1015–1052.

King, A. 1995. Innovation from differentiation: Pollution control departments and innovation in the printed circuit industry. ***IEEE Transactions on Engineering Management,*** 42(3): 270–277.

King, A. 1999. Retrieving and transferring embodied data: Implications for management of interdependence within organizations. ***Management Science,*** 45: 918–935.

King, A., & Baerwald, S. 1998. "Greening" arguments: Opportunities for the strategic management of public opinion. In K. Sexton, A. A. Marcus, & K. Easter (Eds.), ***Better environmental decisions: Strategies for governments, business and communities:*** 309–328. Washington, DC: Island Press.

Kraatz, M. 1998. Learning by association? Interorganizational networks and adaptation to environmental change. ***Academy of Management Journal,*** 41: 621–643.

Lenox, M., & Haimes, Y. 1996. The constrained extremal distribution selection method. ***Journal of Risk Analysis,*** 16(2): 161–176.

Lenway, S. A., & Rehbein, K. 1991. Leaders, followers, and free riders: An empirical test of variation in corporate political involvement. ***Academy of Management Journal,*** 34: 893–905.

Levy, D. 1995. The environmental practices and performance of TNCs. ***Transnational Corporations,*** 4(1): 44–68.

Lyon, T. P., & Maxwell, J. W. 2000. "Voluntary" approaches to environmental regulation: A survey. In M. Franzini & A. Nicita (Eds.), ***Economic institutions and environmental policy:*** Forthcoming. Aldergate, England: Ashgate.

Maitland, I. 1985. The limits of self regulation. ***California Management Review,*** 27(3): 132–147.

Masters, M. F., & Baysinger, B. D. 1985. The determinants of funds raised by corporate political action committees: An empirical examination. ***Academy of Management Journal,*** 28: 654–664.

Masters, M. E., & Keim, G. D. 1985. Determinants of PAC participation among large corporations. ***Journal of Politics,*** 47: 1158–1173.

Meyer, J., & Rowan, S. 1977. Institutionalized organizations: Formal structure as myth and ceremony. ***American Journal of Sociology.*** 83: 340–363.

Miles, R. H. 1987. ***Managing the corporate social environment: A grounded theory.*** Englewood Cliffs, NJ: Prentice-Hall.

Milgrom, P. R., North, D. C., & Weingast, B. R. 1990. The role of institutions in the revival of trade: The medieval law merchant, private judges, and the Champagne fairs. ***Economics and Politics,*** 2: 1–23.

Nash, J., & Ehrenfeld, J. 1997. Codes of environmental management practice: Assessing their potential as a tool for change. In R. H. Socolow (Ed.), ***Annual review of energy and environment,*** vol. 22: 487–535. Palo Alto, CA: Annual Reviews.

Nash, J., & Howard, J. 1995. ***Responsible Care: A study of the dynamics of shaping firm practices and values.*** Working paper, Technology, Business, and Environment Program, Massachusetts Institute of Technology, Cambridge, MA.

Nesson, C. 1996. Agent Orange meets the blue bus: Fact finding at the frontier of knowledge. ***Boston University Law Review,*** 66: 521–539.

O'Hare, M. 1982. Information strategies as regulatory surrogates. In E. Bardach & R. Kagan (Eds.), ***Social regulation: Strategies for reform.*** San Francisco: Transaction Books.

Olson, M. 1965. ***The logic of collective action.*** Cambridge, MA: Harvard University Press.

Ostrom, E. 1990. ***Governing the commons: The evolution of institutions for collective action.*** New York: Cambridge University Press.

Parsons, T. 1951. ***The social system.*** Glencoe, IL: Free Press.

Pearce, D., & Turner, K. 1990. ***Economics of natural resources and the environment.*** Baltimore: John Hopkins Press.

Rees, J. 1994. ***Hostages of each other: The transformation of nuclear safety since Three Mile Island.*** Chicago: University of Chicago Press.

Rees, J. 1997. The development of communitarian regulation in the chemical industry. ***Law and Policy,*** 19: 477.

Reisch, M. 1998. Industry ponders future of Responsible Care. ***Chemical & Engineering News,*** May 5: 13.

Roberts, M. 1993. Care gives industry a leadership role in sustainable development. ***Chemical Week,*** July 7: 20.

Russo, M., & Fouts, P. 1997. A resource-based perspective on corporate environmental performance and profitability. ***Academy of Management Journal,*** 40: 534–551.

Salamon, L. M., & Siegfried, J. J. 1977. Economic power and political influence: The impact of industry structure on public policy. ***American Political Science Review,*** 71: 1026–1043.

Scholtz, J. T. 1984. Cooperation, deterrence, and the ecology of regulation enforcement. ***Law and Society Review,*** 18(2): 179–224.

Scott, W. R. 1995. ***Institutions and organizations.*** Thousand Oaks, CA: Sage.

Shrivastava, P. 1994. CASTRATED environment: GREENING organizational science. ***Organization Studies,*** 15: 705–726.

Simmons, P., & Wynne, B. 1993. Responsible Care: Trust, credibility, and environmental management. In K. Fischer & J. Schott (Eds.), ***Environmental strategies for industry: International perspectives on research needs and policy implications:*** 201–226. Washington, DC: Island Press.

Stevenson, G. G. 1991. ***Common property economics: A general theory and land use applications.*** New York: Cambridge University Press.

Totman, C. 1989. ***The green archipelago: Forestry in preindustrial Japan.*** Berkeley, CA: University of California Press.

United Nations Environment Program (UNEP). 1999. ***Notes from the UN Commission for Sustainable Development Conference on Voluntary Initiatives and Agreements,*** March 9, Toronto.

Webber, F., & Doyle, R. 1994. Taking stock and looking to the challenges ahead. ***Chemical Week,*** July 6: 47.

White, H. 1980. A heteroskedasticity-consistent covariance matrix estimation and a direct test for heteroskedasticity. ***Econometrica,*** 48: 817–838.

Yoffie, D. B. 1987. Corporate strategies for political action: A rational model. In A. Marcus, A. Kaufman, & D. Beam (Eds.), ***Business strategy and public policy:*** 43–60. New York: Quorum.

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