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, while critics suggest that without explicit sanctions such structures will fall victim to opportunistic behavior. In a study of the Chemical Manufacturer 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.

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Private regulation "by associations, by firms, by peers, and by individual consciousness" may provide an interesting new approach for mitigating the environmental impact of economic activity (Ayres and Braithwaite 1992: 3). The need for a new approach is manifest. Government regulation is often intrusive or inefficient, and frequently can be readily 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)."

Rees (1997) and other scholars suggest that industries, and in particular, trade associations, can be a central element of this middle way. Self-regulation (Maitland, 1985; Gunningham, 1995), 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 (Olsen, 1965) without the direct intervention by the state. In this paper, we adopt the term "industry self-regulation" because this 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, a group of 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 form such a standard 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 (c.f. 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 off others' efforts (Grief, 1997). Another viewpoint suggests that the need for such sanctions is overstated because the institutional structure of self-regulation can still control behavior through informal means of coercion, the transferal of norms, and the diffusion of best practice (Nash & Ehrenfeld, 1997).

In this paper, we reflect on these two perspectives by investigating a leading example of self regulation without sanctions -- the U.S. Chemical Manufacturer Association's Responsible Care Program. Responsible Care 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 use the literature on collective action to form hypotheses about which firms will choose to belong to the program and use the two perspectives above to form conflicting hypotheses about the effect of the program on behavior. We then compare the characteristics of participants of Responsible Care to non-participants and evaluate 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 such as Responsible Care will work and develop testable hypotheses based on these theories. We then test these hypotheses and reflect on how our findings advance practical and theoretical understanding of industry self-regulation.

In both its analysis and empirical domain, this research extends the existing literature. While 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 (see, for example, Totman, 1989; Ostrom, 1990; Stevenson, 1991; Anderson & Simmons, 1993). 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 industry 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 (Roberts, 1993; Gunningham, 1995); 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 of 1989 in response to declining public opinion about the chemical industry. During the 1980s, public confidence in chemical companies steadily eroded. From 1980 to 1990, favorable opinion about the chemical industry fell from 30% to 14%, while public perceptions of the industry as "unfavorable" grew from 40% to 58% (CMA, 1993). 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 poor-performing firms, but was directed at all firms in the industry. Industry polls showed that the public, except those living within a few miles of a facility, did not distinguish between individual companies and the chemical industry as a whole (Buzelli, 1991). In particular, a few well-publicized events in the 1980's, 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 Manufacturing Association (CMA) was a natural vehicle to promote collective improvement. The Chemical Manufacturing 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. 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 constitute 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 two-fold: to improve environmental and safety performance of CMA members and thereby to improve public perception. All members of CMA are required to adopt Responsible Care as a condition of membership in the trade association. Responsible Care includes ten guiding principles (listed in Table 1) and six codes of management practices. Codes address how a firm interacts with the community (Community Awareness and

Emergency Response Code), manages its facilities (Pollution Prevention, Process Safety, and Employee Health and Safety Codes), and interacts with suppliers and customers (Distribution and Product Stewardship Codes). Together the codes include over 100 management practices.

Insert Table 1 about here

Importantly, the Responsible Care codes set standards for inputs but not for outputs. They outline broad environmental objectives for firms, require that the firm 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 phasing out the use of a particular solvent, or 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 is because anti-trust rules often restrict the extent to which industry members can use explicit penalties for non-compliance 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, third parties are not required to verify or enforce adherence to Responsible Care standards. In the case of the INPO, the industry association has twice chosen to reveal their own assessment to the NRC, which then can conducted its own inspection and in one case ordered a shut down.

CMA firms must annually self-assess their progress toward code implementation and submit their findings, signed by the CEO, to 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 appears slow. A CMA Board member characterized this approach as a "velvet glove, but no iron fist" (Reisch, 1998), suggesting that CMA will apply only gentle pressure.

THEORY

The lack of an "iron fist" of explicit sanctions in Responsible Care highlights the basic theoretical question of this paper: given limited power to penalize malfeasance, can industry self-regulation within for-profit industries be effective? Many economists argue that without explicit penalties and sanctions, industry self-regulation will fail (Scholtz, 1984; Grief, 1996). Opportunistic behavior on the part of individual firms will lead to adverse selection and moral hazard and thereby ruin the industry's attempts at coordinated action (Olson, 1965). If the industry cannot prohibit bad actors from becoming members, these actors may join to disguise their poor performance (i.e., adverse selection). If the association cannot observe and enforce performance requirements, firms may adopt the outward form of the standard but shirk the real effort required (i.e., moral hazard).

In contrast, other scholars argue that industry self-regulation can still operate to control behavior in the absence of explicit sanctions. The essence of this argument is that the institutional structure that accompanies self-regulation can act to control behavior through coercive, normative, and mimetic means (DiMaggio & Powell, 1991; Scott, 1995). First, even in the absence of explicit sanctions, coercion may 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, 1995; Rees, 1997; Jennings & Zandbergen, 1995; Parsons, 1951)**.** Finally, when collectively valued actions are also privately beneficial, industry self-regulation may facilitate the transfer of best practices among its members, 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 managers have acted rationally in deciding to join the association. It may be that they have no rational justification for their decision and, for example, are mindlessly copying other firms who join (Abrahamson & Rosenkopf, 1997), or it may be that they have made a calculated judgement about when to join or whom to emulate (Kratz, 1998). Whatever the reason for membership, 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. The association may publicize the names of non-conforming members (O'Hare, 1982). Revealing the performance of members to external stakeholders can cause intense scrutiny and pressure on laggards (Gunningham, 1995, King & Baerwald,1998). Industry members can also place pressure on poor performers through social sanctions (Braithwaite, 1989). Revealing the relative performance of a lagging firm, even in a closed door meeting of CEOs, causes embarrassment. As noted earlier, the CMA believes such reputation and shaming to be its most effective means of exerting pressure on firms. To this end, CMA annually holds thousands of meetings and other forums in which members can discuss problems and negotiate solutions (Rees, 1997; Gunningham, 1995). 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, which the CMA now follows.

Normative forces. In addition to changing collective behavior through informal coercive mechanisms, a number of authors have suggested that 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 may create and codify new values and norms that penetrate into the structures of participating firms, changing their preferences and their routines (Hoffman, 1995; DiMaggio & Powell, 1991). 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 Distribution and Product Stewardship codes contain language that suggest that the industry has changed its traditional boundaries from the fence-line of its plants to the entire life-cycle of its products. The Community Awareness and

Emergency Response code 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 may shape behavior by helping to disseminate information on best practices (O'Hare, 1982). The social networks created through self-regulation may 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 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-regulations 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 may 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 distinguish the "type" of firm. External stakeholders could then use this information to provide pressure on poor performers.

By creating a "smoke screen" through which companies look alike, industry self regulation can provide companies with a form of insurance against future mishaps. For example, if faced with claims of environmental damage, participation could be used to show that the firm was not negligent but following commonly accepted practice (Nesson, 1996). In the advent of an accident, participation could be used to demonstrate that the accident was not caused by a lack of environmental concern. Note that this 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 the association can acquire the public relations and legitimacy it provides without fear of eventual exposure. As in the classic "market for lemons" problem, informed outsiders are required to prevent this sub-optimal outcome.

Another way of thinking about opportunism is to consider that firms may only adopt the standard symbolically (Meyer & Rowan, 1977; Abrahamson & Rosenkopf, 1997). Participating in Responsible Care likely confers upon a firm some legitimacy among other firms and among 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 actions 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 (Yoffie, 1987; Getz, 1997). Olson (1965) argued that the size of the 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 as groups become smaller, it becomes 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 the theory have been conducted with conflicting results (c.f. Salamon and Siegfried, 1977; Masters and Keim, 1985; Andres, 1985; Masters & Baysinger, 1985; and Lenway and Rehbein, 1991). Getz (1997) suggests that differences in research setting may explain the different empirical findings.

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 the industry as a whole and thereby safeguard their own reputation (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 industry that they have a dominant strategy to join Responsible Care. They may conclude that the benefit of improving the reputation of the chemical industry exceeds the private cost from free-riders. They may even expect to use Responsible Care as a mechanism for disseminating proprietary technological information to poor 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, however, not the sole determinant. Brand identity (e.g., Clorox) or a visible corporate name also represent valuable assets that could be tarnished by the collective image of the industry. Deephouse (1996) argues that more visible banks are held to higher standards and thus benefit more from isomorphism. Getz (1995) argues that stakeholders target more visible firms for social pressure. Edelman (1990, 1992) found that more visible organizations were most likely to adopt formal grievance procedures. On the other hand, the extent to which a company is diversified will mitigate the firm's risk and may also reduce the extent to which the firm is associated with the industry. For example, a diversified firm like General Electric has extensive presence in the chemical industry but is not generally associated with it.

Hypothesis 1a: Companies with more production in the chemical industry will more often be members of CMA and participate in Responsible Care.

Hypothesis 1b: Firms whose production of chemicals represents a greater percentage of their total production will more often be members of CMA and participate in Responsible Care.

Hypothesis 1c: Firms with better known brand or corporate names will more often be members of CMA and participate in Responsible Care.

Dirtier firms may also have a dominant strategy to participate in industry self-regulations because they can benefit most from the program [Lyon & Maxwell, 1999; Russo & Fouts, 1997]. Poor performing firms within their industries can most easily benefit from information distributed within the program because they have not yet performed basic environmental improvements. Additionally, poor performing firms are more likely to be attacked by environmental organizations, targeted for legal action, or subject to regulatory scrutiny, and thus benefit more from the informal insurance that the self-regulation provides. Whatever their relative environmental performance, firms which operate in relatively polluting industry sectors should also seek the insurance of the industry standard, because companies in more polluting industries have a greater risk of a harmful accident or a damaging law suit.

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

Hypothesis 2b: Firms that operate in industry sectors with higher average levels of pollution will more often be members of CMA and participate in Responsible Care

Effect on Environmental Performance

In this section, we first develop hypotheses for how Responsible Care could operate through coercive, normative, or mimetic means to change the behavior of member firms. Then, we develop a conflicting hypothesis for how such regulation might reduce incentives to improve environmental performance.

Coercive, normative, and mimetic forces within Responsible Care should most strongly influence the poorest environmental performers. If Responsible Care facilitates informal coercion and internal negotiation, the worst performers are likely to improve. Poor performing firms are most likely to give the industry a bad reputation, and thus are likely to face internal pressure. Poor performing firms 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 more misaligned (Gladwin, Kennelly, & Krause, 1995; Shrivastava, 1994). Finally, information transfer about best practice 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 might also benefit all firms, not just the laggards. Through the regular meetings and activities that are part of Responsible

Care, 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, forthcoming). Indeed, in a study of 16 facilities, Nash and Howard (1995) found that Responsible Care most influenced firms that already had some environmental program and that information flowed more easily among these more advanced firms. If so,, we should expect to see improvement among all members of Responsible Care.

Hypothesis 3: On average, firms that participate in Responsible Care will improve their environmental performance more than non-members in the industry.

The learning benefits and new values that are generated by Responsible Care may spread to the rest of the industry and cause improvement both among Responsible Care members and among non-members. One way that Responsible Care can spread the 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 increasing stakeholder pressure on non-members.

Hypothesis 4: On average, the chemical industry will more rapidly improve in environmental performance after the inception of Responsible Care.

The above hypotheses express what patterns are 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 may seek to join Responsible Care to escape from stakeholder pressure. Once members, and this pressure has been reduced, they may then reduce their effort at environmental management and become worse polluters.

Hypothesis 5: On average, participants in Responsible Care will improve their environmental performance less than non-members in the industry.

Note that hypothesis five is in direct conflict with hypothesis three. 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?

DATA & MEASURES

Sample

To test these conflicting hypotheses, we collected data from a number of sources. Environmental performance data were collected from the EPA's Toxic Release Inventory (TRI). Since 1987, the EPA has collected facility-level reports of the emissions of over two hundred toxic chemicals from U.S. manufacturing firms. These TRI reports constitute one of the few longitudinal data sets of facility environmental performance in the Unites 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. The database includes more than 95% of the production volume of the chemical industry and covers a ten-year period (1987-1996). This time frame also provides insight into firm performance prior to the establishment of Responsible Care, and provides a six year time frame over which to view improvement since its inception.

Previous research using TRI data has been performed predominantly at the company level (Levy, 1995; Hart & Ahuja, 1996). 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 and Bradstreet (D&B) numbers, however. Matching the D&B number with the Duns Database[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 size 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 the production indexes were first required, we used facility trend information from Dun and 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, 1987-1996. Those observations correspond to 3606 facilities belonging to approximately 1500 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 (l0) 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, 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 the 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 the environmental performance in the chemical industry has focused on releases of toxic chemicals during manufacture. TRI reportable emissions provide a good proxy for this measure of environmental performance, and these data have been used in numerous studies. Our analysis improves on previous methods in two significant ways. We consider the relative toxicity of the chemicals emitted, and we perform our comparisons at the facility (rather than the company) level and so better control for differences in product and process.

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 impact. The TRI database includes, for example, chlorine gas and phosgene (both chemical war agents) and food color 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 CERCLA statute. For highly toxic chemicals (e.g. arsenic), emergency action must be taken for any accidental release of one pound or more. For relatively benign chemicals like isopropyl alcohol, the limit is 5000 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] Aggregate releases for a given facility in a given year (E_{it}) were constructed by summing the weighted releases of the 246 common chemicals in the TRI database.

$$E_{it} = \sum_{\forall c} w_c e_{cit} \qquad (1)$$

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.

Previous research at the company level has simply aggregated toxic emissions from the facility level. This ignores however, 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 then to aggregate these comparisons to create firm 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 4-digit SIC code within each year using standard OLS regression. The relative environmental performance of a facility (RE_{it}) is given by the standardized residual, or deviation, between observed and predicted emissions given the facility's size and industry sector. Thus, if a facility emits more than predicted given its size and SIC code, it will have a positive residual and a positive score for environmental impact.

$$RE_{it} = E_{it} - E^*_{it} \qquad (2)$$

$$E^*_{it} = a_{jt} + b_{1jt}\, s_{it} + b_{2jt}\, s_{it}^2$$

where E^*_{it} is predicted emissions for facility i in year t, s_{it} is facility size, and a_{jt}, b_{1jt}, and b_{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 in that year. The average of these facility scores thus gives a good estimation of how well a firm manages its facilities with respect to emissions.

To create a corporate level of performance, 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 the company.

$$RE_{nt} = \sum_{\forall i \text{ in } n} (s_{it}/s_{nt})RE_{it} \quad (3)$$

where RE_{nt} is weighted relative emissions for firm n in year t, s_{it} is facility i 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 industry. Sectors differ widely in their emissions. Some like industrial gases (SIC 2813) have few emissions, while others like cellulosic manmade fibers (SIC 2823) emit dangerous chemicals. We calculate the dirtiness of the sector as the total emissions for the sector divided by the total number of employees in the sector, i.e., emissions per employee. We create a firm-level measure (*Sector Emissions*) by aggregating the dirtiness of the mix of sectors in which a company owns a facility. In performing this aggregation, we use a weighted average, using the percentage of the company's total production in each sector for weights.

$$IE_{nt} = \ln\left(\sum_{\forall i \text{ in } n} (s_{it}/s_{nt})E_{jt}\right) \quad (4)$$

$$E_{jt} = \sum_{\forall i \text{ in } j} E_{it}$$

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*, *Relative Improvement*). To test out 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})is measured as the percent change in total weighted emissions over a one year period.

$$AI_{nt} = -\left(E_{n(t+1)} - E_{nt}\right)/0.5\left(E_{n(t+1)} + E_{nt}\right) \quad (5)$$

$$E_{nt} = \sum_{\forall i \text{ in } n} E_{it}$$

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.

$$RI_{nt} = -\left(RE_{n(t+1)} - RE_{nt}\right) \qquad (6)$$

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

Organization size (*Size*) Organization size (*Size*) was measured using employee information from Dun and Bradstreet. Firm size is simply the log of the sum of all employees at all of their facilities. While there are other acceptable measures of firm size (e.g., assets and sales), employee data is the best information available for both public and private firms. For the firm data for which we have both asset and employee data (343 publicly traded corporations), the logs of employees and assets were highly correlated (75.5%).

Focus within chemical industry (*Focus*). To estimate the degree to which each firm focuses on chemical production, we created a variable that is the ratio of the log of the total employees in facilities within the chemical industry over the log of employees in the total company. Thus, the variable grows with the degree to which the company is focused within the chemical industry.

Firm visibility (*Visibility*). Firm visibility is coded as a continuous variable. Students at the Stern School of Business were asked to indicate if they recognized a company's name or knew any of its brands. To keep the surveys small enough to maintain the student's interest, companies were randomly distributed among seven surveys, and these surveys were randomly distributed to Stern MBA students. Between 25 and 35 students responded to each of the seven surveys. Visibility represents the percentage of those students who recognized a company's name and/or brand over the number who were asked to respond for that company. Visibility varies from zero to one where one signifies that all respondents recognized the company.

Insert Tables 2a & 2b about here

ANALYSIS & RESULTS

Formation and Membership

To test our hypotheses concerning the formation 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 is our dependent variable. Our independent variables include our measures of environmental performance, firm focus, firm visibility, and firm size. The specification of the probit model is as follows:

$$\text{Prob}\,(\textit{Responsible Care} = 1) = \Phi(b'\boldsymbol{x}) \qquad (7)$$

where the vector $\boldsymbol{x}$ includes *relative emissions*, *industry emissions*, *focus*, *visibility*, *size,* and a constant. We estimate the model for three samples: all chemical firms at the inception of Responsible Care (1990), subsequent entrants to Responsible Care and non-Responsible Care firms from 1991-1996, and exiters from Responsible Care and non-Responsible Care firms from 1991-1996. The latter two analyses are included to see if entrants and exiters post 1990 shared the same characteristics of firms participating in Responsible Care in 1990.

Insert Table 3 about here

Our analysis supports our hypotheses that those firms that are more greatly influenced by the industry's reputation will more frequently participate in Responsible Care. We hypothesize that larger firms, those with well-known names or brands, and those more focussed in 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 Responsible Care (Hypothesis 1b). We also found evidence that more visible companies more frequently joined Responsible Care (Hypothesis 1c).

Our data also support our hypotheses that "dirtier" firms participate in Responsible Care. As predicted by Hypothesis 2a, we found that companies with weaker environmental performance relative to their sectors (*Relative Emissions*) 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 is changing over time. As also shown in Table 3, we find little evidence that companies entering or exiting are different from incumbent members. We find no evidence that dirty companies are rushing to join Responsible Care or that clean companies are leaving to avoid being "tarred by the same brush". With respect to the measured attributes, the characteristics of the members are relatively stable.

Effect on Environmental Performance

We estimate 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 use our two measures of improvement in environmental performance: *Absolute Improvement* and *Relative Improvement*. We estimated models using both a robust GLS regression with White's correction for heteroskadasticity (White, 1980) and a fixed-effects specification. The specification for the robust GLS model is:

$$Improvement = b'\mathbf{x} + d\ Responsible\ Care + e \tag{8}$$

where the vector $\mathbf{x}$ includes *relative emissions*, *industry emissions*, *focus*, *visibility*, *size*, and a constant. White's correction for heteroskadasticity is employed to address concerns that for some independent variables, variance may 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 specification:

$$Improvement = a'\mathbf{d} + b'\mathbf{x} + d\ Responsible\ Care + e \tag{9}$$

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

Insert Table 4 about here

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 non-members (in opposition to Hypothesis 3 and in support of Hypothesis 5). In both of the robust GLS models (models 1 & 3), *Responsible Care* was significant and negative. Regressions on the firm level provided 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-effect model. When this is done, the effect of Responsible Care is no longer significant. This lack of significance is do in large part to the specification of the fixed effect model. In a fixed effect specification the Responsible Care variable can only provide additional explanatory power if it varies over the 1990-1996 time frame. The lack of a significant effect in the fixed-effect model suggests that the late entrants (or early exiters) did not significantly change their performance after entering (or leaving). The lack of a significant effect in the fixed effects suggests caution in strongly asserting a negative influence of Responsible Care. The continuance of the same direction of influence suggests greater confidence that Responsible Care has not had a *positive* impact on rates of improvement versus non-members.

As one might expect, poor performers (*Relative Emissions*) were likely to improve faster than good performers during the next year. 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, poor performing firms may not have captured the "low-hanging fruit", i.e., easy, inexpensive improvements in environmental performance, making it easier for them to improve. The strong relationship between size and improvement suggests that existence of economies of scale in pollution reduction.

Note that while all four models were significant at the $p < 0.001$ level, our models explain very little of the variance (i.e., our overall R^2 statistics 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^2 statistics. The explanatory power is further reduced by what appears to be the "discrete" nature of 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.

Overall Rates of Improvement

We hypothesized earlier that Responsible Care might influence the rate of improvement for members and non-members alike (Hypothesis 4). To test this, we divided our panel into two periods (1987-1989 & 1990-1996) by creating a dummy variable for the years 1990-1996 and an interaction variable between our dummy and *Responsible Care*. Prior to 1990, *Responsible Care* indicates that a firm was a member of the U.S. Chemical Manufactures Association. The dummy variable for 1990-1996 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 investigate Responsible Care's impact on the industry as a whole. Note, since *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.

Insert Table 5 about here

We found only partial evidence for Hypothesis 4. As hypothesized, we did find that the rate of improvement in the entire chemical industry indeed improved following the inception of Responsible Care (see the 1990-96 dummy variable in Table 5). However, as we found in our earlier analyses, Responsible Care firms improved more slowly over this time period. Looking at the coefficients, one sees that in the period from 1990 to 1996, Responsible Care members were improving no faster than they had previously. In other words, the interaction term (*Responsible Care X Dummy for 1990-96*), largely counteracts the main effect of 1990-1996, when the rest of the industry increased its rate of improvement. One interpretation of this result is that Responsible Care had a greater positive effect on non-members than on its members — perhaps by focusing the attention of stakeholders on non-members.

Insert Table 6 about here

Further Analysis

Future research is needed to refine and verify our findings. While our findings are 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 often include discrete changes. Accidents, start-up problems, and maintenance cycles, all cause unusual discharges. Of more concern, however, is the difficulty of perfectly controlling for differences among our facilities. Even 4-digit SIC levels can include facilities of different type, and some facilities may combine production from several SICs. Thus, in this analysis we may still not perfectly control for facility differences. Such mismeasurement could influence the interpretation of our robust GLS analysis of improvement after 1990 if unobserved differences are correlated with Responsible Care participation.

Unobserved differences could also cause erroneous inference from our analysis of the characteristics of Responsible Care members. For example, it may be that firms participating in Responsible Care are more cautious (or more accurate) in reporting emissions and thereby look dirtier. Alternatively, they might have higher labor productivity in production (but not in waste management).

Either way, they would appear dirtier in 1990. If emissions data is in fact overstated for Responsible Care members in 1990, our finding of slower improvement might represent diminishing returns to improvement for Responsible Care members. By using only the consistent 264 chemicals, we hoped to limit the first problem, but it is still possible it had some effect on our analysis of membership. Our fixed-effects analysis of improvement should remove the effect of facility level bias (assuming such a bias would be consistent over time) and thus be relatively immune to unobserved heterogeneity.

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%, and improvements occurred in other aspects of environmental performance. It is possible that with respect to some other aspects of the codes, Responsible Care members made greater improvements. In future research, for example, we hope to investigate whether Responsible Care 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.

Future research should also consider self-regulation that does not originate from the industry itself. For example, the International Standards Organization 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 which firms can endorse. Both of these could provide a useful opportunity for comparison with an industry program like Responsible Care.

Self regulation is a dynamic process that is affected by its membership. The effectiveness of a program, and the attractiveness of joining, may change as membership increases or decreases (Olson, 1965; Rader, 1981). Future research should consider these dynamic processes to determine if and how equilibria emerge over time. Future research might also seek to uncover the extent to which such self-regulation can remain robust following unexpected disturbances such as accidents or social changes.

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 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 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 non-members. Thus, the institutional pressure that Responsible Care exerts on its members appears to have inadequately counteracted 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 commons being protected. With Responsible Care, the commons being protected is one step removed from a real physical commons. The chemical industry alters a physical commons -- clean water, clean air, and healthy ecosystems -- but it was not the threat to this commons that motivated its initial attempts at self-organization. Rather, it was a threat to a second "reputational" commons that sparked the creation of Responsible Care. Excessive polluting by chemical firms influences members' welfare only to the extent that it influences this reputational commons (unlike the direct impact of over-fishing on a community of fishermen). A trade association such as CMA, unlike a local fisherman's union, can protect its members by working to influence perception rather than the problem itself.

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. Joseph Rees (1994) claims that the Institute of Nuclear Power Operations (INPO) was highly successful in reducing the risk of accidents in Nuclear Power but notes several important differences with Responsible Care. In particular, an even smaller number of companies were involved, government regulation reduced economic competition, and the Nuclear Regulatory Commission provided a "regulatory gorilla in the closet" which could be used to sanction 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 leads us to hypothesize that explicit sanctions administered by "informed outsiders" may be needed to avoid opportunism within an industry self-regulation. Overseeing parties must be "outsiders" to ensure that their assessments are unbiased and that sanctions are levied and are not used for individual strategic means. Trade associations, as insiders, are limited as enforcers both legally and practically. In contrast, an active state-run regulatory body, as was the case with INPO and the NRC, may provide the enforcement behind a trade-association sponsored standard. Other candidates include various types of third-party certifiers who operate independently of both the state and the trade association. For example, the Motion Picture Association of America (MPAA), the primary trade association of the movie industry, uses a wholly independent Ratings Board to assign movie ratings. One final candidate may be the press or non-governmental organizations who disseminate information. By publicizing firm performance data, they may bring other forces to bare such as public ire or regulatory scrutiny. Whomever these outsiders may be, they must also be "informed" in the sense that they may effectively investigate the performance of individual firms to hold them up for scrutiny. Becoming informed in this way may prove very difficult. 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 Manufacturer's Association 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. 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" 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 sanctioning, and finally allow Responsible Care to achieve its promise.

ENDNOTES

[1] Matching the two data sets proved more difficult then we originally hoped because respondents often reported their corporate D&B number rather than their facility D&B. In some cases, they dropped leading zeros or made slight mistakes in transposing the number. 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, 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 are necessary to conduct our statistical analyses, we omitted non-matched establishments from our sample. In this way, we matched over two-thirds of the facilities (3606 facilities out of 4221).

[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 when looking at aggregate releases. The EPA toxicity measure and the RQ are correlated at 0.43. The Purdue toxicity measure only considers human toxicity and is correlated with the log of inverted RQs at 0.13. Since this measure is newer, less well known, and covers few chemicals, we decided to use the RQs. Using the Purdue measure does not change our findings.

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TABLE 1
Guiding Principles of Responsible Care (CMA, 1991)

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.

TABLE 2a
Descriptive Statistics (1990-1996)

Variable	Description	Mean	Standard Deviation	Minimum	Maximum
Responsible Care	Whether or not a firm participates in Responsible Care	0.086	0.281	0	1
Relative Emissions	Average relative emissions of facilities based on sector and size	-0.103	0.800	-3.760	5.629
Sector Emissions	Average total emissions of sectors	1.326	1.167	0	6.217
Focus	Ratio of chemical production to total production (using natural log of employees)	0.774	0.400	0	1
Visibility	Degree to which a firm's name or its brands are recognizable	0.037	0.132	0	1
Size	Natural log of firm employees	4.921	2.061	0.018	12.965
Absolute Improvement	Annual percent improvement in total weighted emissions	0.094	0.761	-2	2
Relative Improvement	Annual improvement in relative emissions	-0.008	0.397	-3.579	3.437

Note: n = 10832, except for *Absolute* and *Relative Improvement*, where n = 8908

TABLE 2B
Correlations (1990-1996)

	1	2	3	4	5	6	7
1. Responsible Care							
2. Relative Emissions	0.079 *						
3. Sector Emissions	0.270 *	-0.039 *					
4. Focus	-0.071 *	-0.044 *	0.039 *				
5. Visibility	0.271 *	0.025	0.017	-0.179 *			
6. Size	0.300 *	-0.011	0.039 *	-0.595 *	0.385 *		
7. Absolute Improvement	-0.005	0.116 *	-0.013	-0.028 *	0.020	0.042 *	
8. Relative Improvement	-0.004	0.255 *	-0.006	-0.015	0.014	-0.004	0.514 *

Note: n = 8908, * $p < 0.001$

TABLE 3
Probit Estimates of Responsible Care Participation

	1 Responsible Care (Membership in 1990)	2 Responsible Care (Entrants: 1991-1996)	3 Responsible Care (Exiters: 1991-1996)
Relative Emissions	0.237 ***	0.128 *	0.198 *
	(0.069)	(0.066)	(0.091)
Sector Emissions	0.448 ***	0.256 ***	0.207 ***
	(0.049)	(0.046)	(0.061)
Focus	0.468 **	0.532 **	-0.027
	(0.160)	(0.172)	(0.226)
Visibility	1.235 ***	0.237	0.526
	(0.314)	(0.332)	(0.436)
Size	0.244 ***	0.240 ***	0.131 **
	(0.032)	(0.036)	(0.049)
constant	-4.027 ***	-4.735 ***	-3.916 ***
	(0.292)	(0.335)	(0.422)
n	1508	8552	8507
c^2 (*df*)	242.38 (5) ***	87.50 (5) ***	32.32 (5) ***
R^2 (pseudo)	0.2911	0.1557	0.1197

Note: Incumbent Responsible Care participants are not included in the entrant and exiter models.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 4
Estimates of Relative Improvement Since Inception of Responsible Care (1990-1996)

	Firm Level		Facility Level	
	1	2	3	4
	Robust GLS	Fixed Effects	Robust GLS	Fixed Effects
Responsible Care	-0.045 **	-0.070	-0.021 **	-0.009
	(0.014)	(0.040)	(0.008)	(0.021)
Relative Emissions	0.127 ***	0.663 ***	0.094 ***	0.647 ***
	(0.008)	(0.011)	(0.004)	(0.008)
Sector Emissions	0.004	-0.011	0.004	0.025
	(0.004)	(0.021)	(0.003)	(0.015)
Focus	-0.004	-0.008	-0.004	0.137
	(0.014)	(0.032)	(0.011)	(0.089)
Visibility	0.045		0.017	
	(0.026)		(0.016)	
Size	0.000	0.056 ***	0.003	0.034 ***
	(0.003)	(0.010)	(0.003)	(0.007)
constant	0.004	-0.197 **	-0.012	-0.307 ***
	(0.023)	(0.062)	(0.016)	(0.082)
n	8908	8908	18108	18108
F (*df*)	54.55 (6) ***	717.26 (5) ***	94.59 (6) ***	1401.52 (5) ***
R^2: within		0.3329		0.3259
between		0.0186		0.0103
overall	0.0659	0.0623	0.0479	0.0473

Note: *Visibility* does not vary over time and is therefore dropped in the fixed effects models
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 5
Estimates of Absolute Improvement (1987-1996)

	Firm Level				Facility Level			
	1		2		3		4	
	Robust GLS		Fixed Effects		Robust GLS		Fixed Effects	
Responsible Care[+]	-0.019		-0.022		0.006		0.046	
	(0.034)		(0.085)		(0.021)		(0.045)	
Dummy for year 1990-1996	0.108	***	0.119	***	0.131	***	0.193	***
	(0.016)		(0.017)		(0.016)		(0.015)	
Responsible Care X	-0.091	*	-0.108	*	-0.074	**	-0.086	***
Dummy for year 1990-96	(0.038)		(0.053)		(0.024)		(0.026)	
Relative Emissions	0.139	***	0.595	***	0.145	***	0.778	***
	(0.009)		(0.018)		(0.006)		(0.013)	
Sector Emissions	0.012		0.058		0.011	*	0.113	***
	(0.006)		(0.034)		(0.005)		(0.026)	
Focus	0.020		-0.058		0.034		0.045	
	(0.021)		(0.055)		(0.019)		(0.169)	
Visibility	0.014				0.031			
	(0.040)				(0.026)			
Size	0.023	***	0.129	***	0.024	***	0.160	***
	(0.004)		(0.019)		(0.004)		(0.013)	
constant	-0.139	***	-0.638	***	-0.183	***	-1.120	***
	(0.038)		(0.116)		(0.029)		(0.155)	
n	12829		12829		22476		22476	
F (*df*)	42.84 (8)	***	150.28 (7)	***	91.55 (8)	***	559.29 (7)	***
R^2: within			0.0913				0.1691	
between			0.0066				0.0032	
overall	0.0250		0.0223		0.0343		0.0310	

Note: *Visibility* does not vary over time and is therefore dropped in the fixed effects models
[+] Prior to 1990, *Responsible Care* represents membership in the U.S. Chemical Manufacturers Association
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 6
Summary of Findings

Hypothesis	Finding
Formation and Membership	
H1. Firms will more often be members of CMA and participate in Responsible Care when they have a: more production in the chemical industry. b: production focused in chemicals. c: better known brand or corporate names.	Strong support for all
H2. Firms will more often be members of CMA and participate in Responsible Care when they have a: higher levels of pollution relative to their industries. b: operate in industry sectors with higher average levels of pollution.	Strong support for all
Improvement	
H3. On average, firms that participate in Responsible Care will improve their environmental performance <u>more</u> than non members in the industry.	Not supported
H4. On average, the chemical industry will more rapidly improve in environmental performance after the inception of Responsible Care.	Supported only for non-RC participants.
H5. On average, participants in Responsible Care will improve their environmental performance <u>less</u> than non members in the industry.	Weakly supported.