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The Role of Private Decentralized Institutions in Sustaining Industry Self-Regulation

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An emerging body of institutional scholarship emphasizes the role played by private decentralized institutions in facilitating collective action among organizations. However, these institutions often suffer from free riding and opportunism. This may lead firms to exit the institution and eventually cause its collapse. In this paper, we explore how private decentralized institutions may be sustained despite these problems. We focus on one form of private decentralized institution—trade association–sponsored industry self-regulatory programs. We advance two alternative hypotheses to explain the sustained existence of industry self-regulatory institutions: (a) Firms participate to gain a participation-contingent benefit, and (b) firms participate to maintain a generally beneficial institution. Using a 10-year panel of data from the chemical industry, we find evidence consistent with the latter hypothesis for at least one prominent example of self-regulation. Our findings have implications for both specific models of industry self-regulation and general theories of collective action.

Key words: institutions; industry self-regulation; environmental strategy

Organization scholars have long been interested in the prospects for organizations to coordinate their activities to achieve jointly desired ends. More recently, institutional scholars have emphasized the role that private decentralized institutions play in facilitating collective action among organizations (see Ingram and Silverman 2002 for a review). Private decentralized institutions lack the authority of the state, and participation is voluntary. Their value arises from the diffuse action of numerous social and economic actors who reward (or punish) firms for their actions. Institutional scholars have long appreciated that the voluntary nature of private decentralized institutions may encourage some firms to free ride on the actions of others, because each organization may benefit from the action of others even if it fails to take action itself (Olson 1965, North 1990, Ostrom 1990). For example, a commercial fishing company will benefit from the efforts of other firms to limit their fish harvest (to preserve fish stocks) even if the initial company fails to abide by these norms. Given the voluntary nature of private decentralized institutions, organizations will be tempted to ignore institutional tenets, and eventually such defection can cause the collapse of institutional arrangements.

In this paper, we explore how private decentralized institutions can be sustained. We focus on one form of private decentralized institution—trade association–sponsored industry self-regulatory programs. Industry self-regulation is the voluntary association of firms to control their collective behavior (King and Lenox 2000). In recent years, a number of trade associations have created industry self-regulatory programs in an attempt to avoid costly government regulation or to reduce negative externalities that arise from business activities. Across industries as diverse as television broadcasting and chemical production, firms have banded together to allay the concerns of stakeholders or forestall government regulation. Numerous examples of industry self-regulation now exist in several nations.

Scholars have proposed several ways that self-regulation may be sustained (Ostrom et al. 1994). The most common suggestion is that participation in self-regulation provides a benefit that is conditional on participation. For example, participation may expose a firm to practices that facilitate operational improvements. Alternatively, membership may signal that a firm is superior to nonmembers on some dimension of concern and thereby allow the firm to obtain a premium for goods and services. Finally, social actors may deem participants to have greater legitimacy and so provide them with preferential treatment and privileged access to resources.

An alternative, less-explored hypothesis is that even when the benefit of an institution spills over to nonmembers, firms may still voluntarily incur the cost of participation to maintain the institution. A firm's share of the public benefit may be so great that it chooses to participate, regardless of the actions of other firms. For example, firms that disproportionately bear the burden of government regulation may have a strong incentive to make self-regulatory programs work, because self-regulation can help forestall costly state regulation. Another possibility is that a group of firms may continue to participate because the self-regulatory effort would collapse if the firms were to defect.

In this paper, we explore whether industry self-regulation is sustained because of the participation-contingent benefit that participation provides or because of the desire of some firms to maintain the institution. To this end, we investigate the relative degree to which industry self-regulatory efforts create value for participating and nonparticipating firms in an industry. Empirically, we examine one of the foremost examples of industry self-regulation—the Responsible Care (RC) program sponsored by the American Chemistry Council (ACC). The RC program was initiated in 1989 by the ACC in an attempt to reduce the harmful environmental impacts of chemical manufacturing operations and combat negative industry perceptions by government regulators, community activists, and consumers.

Using panel data over the period 1987–1996, we compare whether the advent of RC created value for both participating and nonparticipating firms. We explore whether firms would have been better off had their managers made different choices about whether to participate. We find evidence that, while participants had incentives to free ride off the program, most firms, including those that chose to participate, would have been harmed if the program had failed. We propose that self-regulation persists because managers in participating firms recognize that their firm's defection from the self-regulatory program (and the reciprocal defection of other firms) would cause the agreement to degrade (or collapse) and make the managers' firm worse off. Thus, we find some support for the relatively understudied hypothesis that self-regulation may be sustained by a group of firms that wish to maintain the institution. These findings have implications not only for our understanding of industry self-regulation, but also for theories of private decentralized institutions.

Theory and Review

The collective nature of government regulation and stakeholder pressure often links the fate of one firm to the fate of another firm within the industry (King et al. 2001). Fatal accidents, damaging spills, and the emission of toxic pollutants have consequences for both the offending firm and for similar firms within an industry. The acts of one firm may encourage government intervention, raise insurance premiums, and attract protests and boycotts for all firms within an industry. As a consequence, all firms in an industry may share a common industry reputation or regulatory fate.

This industry commons makes it difficult for any single firm to unilaterally reduce its pooled risk. One explanation for industry self-regulation is that it represents an attempt to collectively reduce this pooled risk. To be successful, industry self-regulation must also be compatible with the incentives of participating firms. Finding such an incentive-compatible solution is made more difficult by legal restrictions on the types of sanctions that firms can levy against one another for failing to comply with self-regulatory efforts. Due to antitrust concerns, self-regulatory institutions and members may not coerce other firms in the industry to participate. Many industry self-regulatory efforts fail to even impose internal sanctions. As a result, self-regulatory programs can be subject to free riding from both participants and nonparticipants. Previous research has found that when self-regulatory programs lack systems for monitoring compliance with rules and for sanctioning noncompliance, they often include firms that participate symbolically and thus fail to take actions consistent with self-regulatory goals (King and Lenox 2000, Lenox and Nash 2003).

Despite these limitations, we still observe examples of sustained self-regulatory institutions (Ostrom et al. 1994). Below, we elaborate on two general theories to explain how self-regulatory institutions overcome problems caused by their voluntary nature.

Participation-Contingent Benefit Hypothesis

Self-regulation can be self-sustaining if it provides a private benefit that is contingent on participation. As long as these participation-contingent benefits exceed the cost of participating, firms will participate, even if some of the benefits of self-regulation (e.g., forestalling government regulation or improving the industry's reputation) spill over to nonparticipants. We consider four potential sources of participation-contingent benefit: operational benefits, affiliation benefits, signaling benefits, and legitimacy benefits.

First, participation in industry self-regulation may improve a firm's operational efficiency. Self-regulatory programs define a bundle of managerial and technological practices. Participants in RC, for example, agree to adopt more than 100 specific managerial practices (Nash and Ehrenfeld 1996). Previous empirical work finds that firms sometimes experience efficiency gains as a result of adopting the types of pollution-prevention practices required as part of RC (King and Lenox 2002). To the extent that members are only exposed to these beneficial practices by participating in the self-regulatory program, firms may be motivated to self-regulate.

Second, participants may gain benefits from affiliation with the organization that coordinates the self-regulatory effort. In the case of RC, participation is a condition of membership in the ACC (formerly the Chemical Manufacturers Association). To the extent that being a member of the trade association provides benefits that exceed the costs of joining the association and participating in the self-regulatory program, firms may seek membership.[1] Potential benefits include the ability to influence the lobbying efforts of the trade association in ways favorable to the firm as the trade association attempts to shape government legislation.

Third, self-regulation may provide participants with a mechanism for credibly communicating their superiority along some unobserved dimension, i.e., signaling benefit. The logic follows the lines of the classic Spence

(1973) model of education as a means to signal to job markets. In Spence's model, a college degree does not improve a student's productivity, but it is still valuable to high-productivity students because it distinguishes the student from low-productivity students. Following Spence's model, Terlaak and King (2002) suggest that if the cost of self-regulating is inversely related to the performance in the area targeted by a self-regulatory program, participation may effectively distinguish high- and low-performing firms. For example, if it is less costly for an environmentally benign firm to satisfy the requirements of a self-regulatory code, then self-regulation may serve as a mechanism to distinguish good firms from bad. High performers will then be able to gain a price premium or beneficial stakeholder treatment.

Finally, institutional scholars have long emphasized the legitimacy benefits that institutional membership may provide (DiMaggio and Powell 1991, North 1990). Subscribing to a self-regulatory initiative may make a firm more attractive as a trading partner with other economic actors. In the chemical industry, many competitors are also suppliers to one another in various feed-stocks. Participation in self-regulatory institutions such as RC may lead to preferable treatment by other firms that participate. Furthermore, downstream consumers and upstream suppliers may confer resources or other forms of preferable treatment on firms that participate.

Maintain Institution Hypothesis

Olson (1965), in his seminal work on collective action, suggests that firms may self-regulate when their share of the public good generated by self-regulation exceeds their private cost. Thus, even in the absence of a participation-contingent benefit, firms may self-regulate if they gain a substantial share of the goodwill created by their actions. Olson (1965) proposes that this logic explains contributions to industry lobbying. If an individual firm's benefit from lobbying exceeds its expense, it will lobby government despite the potential for spillovers to competitors. This simple cost-benefit calculus requires no coordination or agreement between parties. Firms act unilaterally based on their incentives.[2]

Some scholars go a step further and propose that, even in the absence of unilateral incentives, a formal agreement can be structured to maintain a self-regulatory institution (Segerson and Dawson 2001). In these models, firms form an agreement to achieve a certain level of performance. As with the Olson model, the benefit of this agreement spills over to nonparticipants. Unlike the Olson model, benefits accrue to participants only if a sufficient number of organizations join the self-regulatory effort. Although each individual participant has incentives to renege on the agreement and free ride on others, the participants recognize that doing so would cause further reneging and that this would lead to degradation or collapse of the self-regulatory agreement. Because participants profit from the existence of the self-regulation, they continue to participate.

Segerson and Dawson (2001) propose a model where costly government regulation is imposed on firms if they fail to reach some minimum pollution reduction through self-regulation. Although the avoidance of such regulation is a public good, a critical number of firms band together and divide the emissions reduction. Although each would prefer to leave the agreement, they fear that doing so would raise the proportion borne by the rest, cause more defection, and thereby cause the entire agreement to collapse. Essentially, Segerson and Dawson (2001) argue that self-regulatory programs are constantly on the verge of falling apart. Even though each member firm could gain from exiting (so long as the program continued), each continues as a member to keep the program from collapsing.

Similar models have been proposed in the context of self-enforcing international environmental agreements (Kolstad 2003). Radner and Dutta (1999) propose a structure that does not require a regulatory threat. In their model of global warming regulation, nations agree to a reduction in annual carbon dioxide emissions. Although the reductions are costly, nations agree to such reductions to reduce the threat of global warming. Although each would prefer to free ride, they recognize that doing so would increase defection by other countries and increase the cost of global warming. Radner and Dutta (1999) demonstrate that equilibria exist in which a self-regulatory agreement is superior both globally and privately to the business-as-usual case, in the absence of self-regulation.

The incentives to maintain a self-regulatory institution need not be solely pecuniary. Institutional scholars have proposed that normative pressures may be sufficient to sustain self-regulatory institutions (Gunningham 1995, Hoffman 1997, Rees 1997, Jennings and Zandbergen 1995). Industry norms and values may change members' preferences for maintaining the institution. The formation of a standard such as RC may create and codify new values and norms that penetrate into the structures of participating firms, causing them to act, even in the absence of a pecuniary benefit (Hoffman 1997, DiMaggio and Powell 1991).

Distinguishing Between Hypotheses

Distinguishing between these two theories of self-regulation requires evaluating of how firms benefit from self-regulation. Given the existence of a sustainable self-regulatory institution, each firm faces a potential payoff (π_i) depending on whether ($M_i = 1$) or not ($M_i = 0$) it participates in the self-regulatory effort.

$$\pi_i = \begin{cases} \alpha_i B_{ISR} + (\gamma_i - \lambda_i) B_M & \text{if } M_i = 1 \\ \alpha_i B_{ISR} & \text{if } M_i = 0, \end{cases} \quad (1)$$

where B_{ISR} is a binary variable indicating the existence of the self-regulatory institution. This variable takes a value of 1 if the institution exists and 0 if it does not. B_M is a binary variable indicating membership in the institution (with a value of 0 for nonmembers and a value of 1 for members). We assume that the degree to which firms bear the cost of government regulation varies as a function of firm attributes, and thus the benefit of self-regulation (e.g., forestalling government regulation) differs across firms (captured by α_i). We further assume that the participation-contingent benefits and costs vary across firms based on their type (captured by γ_i and λ_i, respectively). For example, consumer-oriented firms may benefit more from participating in the institution as a signal to customers of superior quality.

For sufficiently high participation-contingent benefits and low participation costs, we would predict that all firms will join the self-regulatory institution ($\gamma_i - \lambda_i > 0$, $\forall\, i$). If, instead, we see a set of firms participate in the institution and a set of firms that choose not participate, we would predict that there exists a subset of firms that benefits ($\gamma_{i\leq m} - \lambda_{i\leq m} > 0$, $i = 1$ to m) and a subset that does not benefit ($\gamma_{i>m} - \lambda_{i>m} < 0$, $i = m$ to N) from participating. If we assume that participants and nonparticipants gain equally from the existence of the institution (if $\bar{\alpha}_{i\leq m} = \bar{\alpha}_{i>m}$), participants should obtain a greater net benefit from the existence of the institution than do nonparticipants because the former gains the additional participation-contingent benefit ($(\gamma_i - \lambda_i)B_M > 0$)

$$\begin{gathered}\pi_{i\leq m} = \alpha_i B_{ISR} + (\gamma_i - \lambda_i)B_M \\ \pi_{i>m} = \alpha_i B_{ISR} \\ (\gamma_i - \lambda_i)B_M > 0 \quad \text{for } M = 1 \\ \text{if } \bar{\alpha}_{i\leq m} = \bar{\alpha}_{i>n} \\ \bar{\pi}_{M=1} > \bar{\pi}_{M=0}.\end{gathered} \tag{2}$$

Thus, empirical evidence that formation of the institution benefited participants more than nonparticipants would be consistent with our participation-contingent benefit hypothesis.

According to the analysis above, no firm would participate in the institution if it entailed cost ($\lambda_i > 0$) and did not provide a participation-contingent benefit ($\gamma_i B_M = 0$). Without a participation-contingent incentive, another rationale is needed to maintain the institution. One possibility is that institutions are maintained by a linchpin equilibrium. In this case, a group of firms maintains the institution even if they must expend resources to maintain it because the firms are better off if it exists. Given the existence of the institution, other firms choose to free ride. In this model, membership influences the existence of the institution, and thus the value of participating in the program π_i^M and the value of free riding π_i^F are both a function of the number of members (m) in the institution. Membership will be stable if

$$\begin{aligned}\pi^M_{i\leq m}(m) &> \pi^F_{i\leq m}(m-1) \\ \pi^F_{i>m}(m) &> \pi^M_{i>m}(m+1).\end{aligned} \tag{3}$$

In other words, all m members are better off participating than not participating, and no nonmember has an incentive to join. Given our linchpin analysis, the institution collapses if one firm exists, and thus $\pi^F_{i\leq m}(m-1) = 0$. Moreover, because the institution provides a pure public good, $\pi^F_{i>m}(m)$ is greater than $\pi^M_{i>m}(m+1)$ for any m sufficient to sustain the coalition, because firms will not willingly accrue extra cost. Thus, the mth firm participates because it faces the following payoff:

$$\begin{gathered}\pi_m = \begin{cases} \alpha_m B_{ISR} - \lambda_m B_M & \text{if } M = 1 \\ 0 & \text{if } M = 0 \end{cases} \\ \pi_m = \alpha_m B_{ISR} - \lambda_m B_M > 0.\end{gathered} \tag{4}$$

In other words, the mth firm cannot free ride on the program, because if it does not participate, the institution will collapse, and it benefits enough from the existence of the program to invest in its maintenance. If the continuance of the institution did not depend on its membership, participants would be better off free riding. Thus, if we find empirical evidence that, *ceteris paribus,* participants appear to be better off not participating (even though they benefit from the existence of the institution), we will have empirical evidence that is consistent with our maintain-institution hypothesis.

Method and Data

To evaluate these competing models of industry self-regulation, we investigate the financial impact of a leading example of industry self-regulation—the ACC's RC program. RC was created in response to a realization by industry members that the actions of one chemical firm could influence the reputation and financial performance of other firms in the industry. The most striking illustration was a massive accident at a Union Carbide plant in Bhopal, India, in 1986 that left thousands dead. Not only was Union Carbide's stock devalued, but the stocks of many leading chemical firms were also devalued (Blacconiere and Patten 1994). Managers of chemical firms believed that if any chemical firm again committed such an egregious act, "all would be tarred by the same brush" (Rees 1997).

The RC program is administered by the ACC. This program has been called "the most ambitious and comprehensive environmental, health and safety improvement effort ever attempted by an industry" (Hirl 1992, p. 26) and "the most significant and far-reaching self-regulatory scheme ever adopted" (Gunningham 1995,

p. 61). Participants pledge to uphold a set of 10 principles and to adopt six codes of management practice. The codes require that firms adopt certain practices, dedicate staff to specific activities, and employ particular techniques. They do not, however, set specific performance criteria. Any firm that wishes to belong to the ACC must agree to abide by RC's principles and codes.

RC was adopted by the ACC in the fall of 1989. A number of leading firms within the trade association were instrumental in its establishment. While it is difficult to precisely attribute cause, a number of firms exited the ACC during the period that RC was created. A number of other firms joined the ACC after RC was established. We speculate that underlying attributes of these firms were changing (e.g., they were growing or changing their product mixes) and that motivated their entry or exit into the program.

Most previous research on RC has employed historical analysis or case study approaches to explore the program (cf. Rees 1997). In one exception, King and Lenox (2000) use econometric techniques to investigate the environmental performance of member and nonmember firms. Once again, they argue that firms join to gain protection from future liability and to protect the value of their existing assets. They find that firms with greater risk of pollution liability (more polluting or from more polluting industries) are more likely to participate in the program. They also find that firms that are large, more focused in chemicals, and better known are more likely to participate. King and Lenox (2000) did not examine the financial implications of RC for the chemical industry.

Measures

To estimate whether RC created value for firms in the chemical industry, we created a panel of chemical firms before and after the creation of the program. To construct our panel, we collected data on the financial performance of all publicly traded chemical firms in the United States during the period 1987–1996. We identified firms as part of the chemical industry that had at least one U.S. manufacturing facility that listed its primary industry affiliation as Standard Industry Classification (SIC) 28—"chemicals and allied products." The period 1987–1996 was chosen to give us ample time to observe value creation before and after the founding of RC. RC was ratified in October 1989, and most firms began participating in 1990.

We gathered financial data from Standard & Poor's Compustat Annual Database. RC membership data were provided by the ACC. Additional measures were created using the U.S. Environmental Protection Agency's (EPA's) Toxic Release Inventory (TRI)—a database of emissions of toxic chemicals from U.S.-based production facilities. The resulting database includes 1,473 observations of 198 publicly traded companies, of which 48 were members of RC. The panel is unbalanced, with some firms entering and exiting because of changes in ownership and solvency. The average firm is in the sample for more than seven years.

To capture the creation of firm value, we adopt *Tobin's q*—the market valuation of a firm over the value of its tangible assets. *Tobin's q* has been widely used in the strategy literature as a measure of firm value and is a good proxy for a firm's competitive advantage (Montgomery and Wernerfelt 1988). We calculate *Tobin's q* by dividing the sum of firm equity value, book value of long-term debt, and net current liabilities by the sum of the book value of assets (Chung and Pruitt 1994). We do not calculate the replacement value of tangible assets as proposed by Lindenberg and Ross (1981), because past research has found little qualitative difference between this measure and the simplified version used in this analysis (Chung and Pruitt 1994). We choose to use *Tobin's q* rather than accounting measures of financial performance, such as return on assets or return on sales, because *Tobin's q* reflects expected future gains and is less subject to vagaries in reporting (Dowell et al. 2000).

To analyze the impact of RC on chemical firms, we adopt a differences-in-differences (DID) approach, in which we compare the financial performance of firms before and after the inception of RC in October of 1989. First, we create a binary variable to indicate whether RC was in existence during that year (*RC exists*). Second, we create a binary variable to indicate whether a firm was a member of the ACC and hence a participant in RC beginning in 1990 (*ACC member*).[3] Finally, we create an interaction term between *RC exists* and *ACC member* to indicate that a firm participated in RC in that year (*RC member*).

Our DID analysis allows us to explore the impact that the creation of the RC program had on the chemical industry as a whole, as well as on member and nonmember firms individually. This is a powerful way to access the effect of a treatment such as the RC program. We can compare whether firms that subscribe to the program perform better after the treatment (i.e., the program's creation) relative to a control group of nonparticipants during the same pre- and post–time frame. The full DID specification for our model is as follows:

$$\begin{aligned} \textit{Tobin's } q_{it} &= \beta_1(\textit{ACC member})_{it} + \beta_2(\textit{RC exists})_t \\ &\quad + \beta_3(\textit{RC member})_{it} + \boldsymbol{\gamma} X_{it} + \boldsymbol{\alpha} D_i + \varepsilon_{it}, \end{aligned}$$

where **X** is a set of control variables and **D** is a vector of firm-fixed-effects, that is, dummy variables for each firm. The inclusion of firm fixed effects helps control for stable, unobserved differences between firms.

We include as controls a number of measures that analysts have found to influence the financial performance of firms (Berger and Ofek 1995). To control for differences in firm size, we calculate the log of the company's total assets (*Firm assets*). The capital intensity of a firm (*Capital intensity*) is calculated by dividing capital expenditures by sales. To control for the extent to which companies are investing in research and development (R&D), we calculate the R&D intensity (*R&D intensity*) for each firm by dividing R&D expenses by total assets. We calculate the leverage of a firm (*Leverage*) as the ratio of its debt to assets. To increase our confidence that observed changes in *Tobin's q* may be attributed to RC, we include *Average Tobin's q* (the average yearly value of *Tobin's q* for firms outside the chemical industry) as a control for macrolevel effects, such as the bull market of the 1990s.

While the DID approach is a widely accepted standard for accessing treatment effects in policy analysis, it requires the strong assumption that, absent the treatment, the treated and control groups would realize the same change in performance conditional on their observable characteristics. It is doubtful that ACC firms and non-ACC firms would have experienced identical changes in *Tobin's q* if RC had never come about. At the root of the problem is that firms choose to be members of the ACC and the RC program. Firms do not randomly choose whether or not to join the ACC and the RC program, but instead make this decision based on their underlying characteristics.

A number of approaches have been recommended to handle selection. Wooldridge (2002) and others propose an instrumental variable approach using a probit or logit specification in the first stage and the estimates for membership as the instrument in the second stage. Maddala (1983) proposes a modification to the classic Heckman (1979) selection model to analyze treatment effects. He proposes a two-stage model using a probit specification to estimate membership choice based on firm characteristics, and then to estimate each firm's performance using independent variables and a set of factors from the choice model that corrects for differences in membership decisions. A third approach is to use a propensity score matching model where those receiving the treatment are systematically matched and compared with similar firms not receiving the treatment (Abadie 2005).

The best way to address selection in a panel remains a contentious issue. The instrumental variable approach depends on the adoption of valid instruments that predict selection but not outcome. The treatment effects model assumes that the error terms of the first- and second-stage regressions are jointly normally distributed. Given these trade-offs, we adopt a pluralistic approach and estimate both an instrumental variable and a treatment model approach. For the instrumental variable approach, the full panel is used and firm-fixed-effects are included in the second stage of the analysis. For the treatment model, we reduce the panel to a cross-section based on the average value of our measures in the period after the advent of RC (1990–1996).

For the choice models in the instrumental variables model and the treatment model, we use the specification developed by King and Lenox (2000).[4] They argue that firms that are larger, better known, and more focused in chemicals and that pollute more or come from more-polluting sectors are more likely to join the ACC and RC. For the treatment model, we adopt a probit specification and estimate using the cross-section

$$\text{Prob}(\textit{ACC member} = 1) = \Phi(\boldsymbol{\beta}'\mathbf{X}),$$

where the vector **X** includes measures of a firm's environmental performance, its size, the degree to which it focuses on chemical operations, and the degree to which it has a well-known corporate or brand name, and a constant. For the instrumental variable model, we adopt a random-effects logit with the same vector **X** and estimate over the entire panel.

We measure the firm's environmental performance in two ways. *Relative emissions* measures the annual emission of toxic chemicals by a firm relative to its industry and given its size. *Segment emissions* measures the degree to which the company operates in industries that entail a lot of pollution. For both measures, we use data from the TRI. (Please refer to the appendix for a detailed description of the measures' construction.) To measure the degree to which a firm focuses on chemical production, we create 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 (*Focus*). We measure the degree to which each company is well known (*Visibility*) by measuring the percentage of business school students who recognized a company's name or brand, or both.[5] Visibility varies from 0 to 1, where 1 signifies that all respondents recognized the company and its brands. A summary of all variables can be found in Table 1.

Analysis and Results

To examine the financial implications of the RC program, we begin with a standard estimation with firm fixed effects (see Table 2). To correct for potential heteroskedasticity, we present robust standard errors using White's estimator of variance (White 1980). In Model 1, we estimate the net effect of the program on all firms in the industry using the relative improvement in performance among chemical firms since the advent of RC (*RC exists*). We find that chemical firms experienced an additional 0.15 increase in *Tobin's q* on average in the years after the start of RC in 1990 (Model 1). While *Average Tobin's q* is positive and significantly related to *Tobin's q* in the chemical industry, inclusion of this control did not remove the effect of *RC exists*. We find that the R&D intensity of the firm has a significant, positive impact on *Tobin's q*.

Table 1a Descriptive Statistics

Variable	Description	Mean	Standard deviation	Min	Max
Tobin's q	Firm market valuation over replacement value of assets	1.42	0.96	0.23	11.29
RC member	Whether or not a firm participates in RC	0.20	0.40	0	1
ACC member	Whether a firm is a member of the ACC	0.28	0.45	0	1
Firm size	Natural log of firm assets	7.06	1.93	0.90	11.47
Capital intensity	Capital expenditures over sales	0.07	0.07	0	1.19
R&D intensity	R&D outlays over assets	0.04	0.05	0	1.03
Leverage	The ratio of debt to firm assets	0.18	0.14	0	1.41
Relative emissions	Average relative emissions of the firm's facilities based on sector and size	0.06	0.65	−2.30	3.62
Segment emissions	Average total emissions of sectors in which the firm operates	8.89	29.36	0.01	441.73
Focus	Ratio of chemical production to total	0.45	0.45	0	1
Visibility	Degree to which a firm's name or brands are recognizable	0.18	0.28	0	0.98

Note. $N = 1{,}462$ (198 firms).

Table 1b Correlations

	1	2	3	4	5	6	7	8	9	10
1. *Tobin's q*	1.00									
2. *RC member*	−0.12	1.00								
3. *Firm size*	0.01	0.38*	1.00							
4. *Capital intensity*	0.19*	0.09	0.07	1.00						
5. *R&D intensity*	0.53*	−0.06	−0.08	0.18*	1.00					
6. *Leverage*	−0.33*	0.04	0.03	−0.05	−0.33*	1.00				
7. *Relative emissions*	−0.10	0.13	−0.02	−0.09	−0.07	0.54*	1.00			
8. *Segment emissions*	−0.13	0.31*	0.27*	0.14*	0.03	0.03	−0.04	1.00		
9. *Focus*	0.25*	0.13	−0.13	0.11	0.26*	−0.16*	−0.09	−0.03	1.00	
10. *Visibility*	0.18*	0.15*	0.50*	0.01	0.04	−0.19*	0.76*	0.01	−0.01	1.00

Notes. $N = 1{,}462$ (198 firms).
*$p < 0.05$.

In Models 2 and 3, we estimate separately the net effect of the program on the subsets of firms that were not in RC (Model 2) and firms that were part of RC (Model 3). Models 2 and 3 suggest that the *Tobin's q* of both sets improved during the period after the formation of RC. We find that the coefficient for *RC exists* equals 0.20 among nonparticipants (Model 2) versus 0.10 for participants (Model 3). This difference between these coefficients (0.10) is significant at the 0.10 level. Thus we find moderate evidence that RC members gained relatively less than nonmembers in the period after the formation of RC.

Next, we turn our attention to analyzing whether firms tend to benefit from their choice to participate. In Model 4, we include dummy variables to indicate whether a firm is a member of ACC (*ACC member*) and a member of RC (*RC member*). Because we do not consider the general industry effect (*RC exists*), we include year fixed effects to control for unobserved heterogeneity across time. We find that members of ACC have a significantly higher *Tobin's q* on average (*ACC member* coefficient of 0.25). However, we find that since the advent of RC, this advantage has gone down (*RC member* coefficient of −0.13).

In Model 5, we run our full DID specification. We can calculate the degree to which members benefited from the creation of the program by comparing the sum of *RC member*, *ACC member*, and *RC exists* (0.31) with the coefficient for *ACC member* (0.24). Our coefficient estimates imply that ACC members benefited from the program (a 0.07 improvement in *Tobin's q*). However, we interpret this coefficient with great caution because we are confident in this estimate at only an 85% confidence interval ($p \leq 0.15$). Once again, our model suggests that members of the chemical industry that were not members of RC gained financially after the formation of RC (the coefficient of $\textit{RC exists} = 0.20$, $p < 0.001$).

To address self-selection into the RC program, we adopt our instrumental variable and treatment specifications. In the first stage of the instrumental variable approach, we use a logit specification with firm random effects (see Table 3) to estimate the likelihood that a firm will choose to participate. Our coefficient estimates are consistent with King and Lenox's findings on RC (King and Lenox 2000). We find that larger, more polluting, more chemically oriented firms that operate in more-polluting segments of the chemical industry are more likely to join the ACC and participate in RC. We do not find that more-visible firms are significantly more

Table 2 Estimates of Financial Performance (*Tobin's q*), 1987–1996

	1	2	3	4	5	6	7
Sample	All firms	Non-ACC members	ACC members	All firms	All firms	All firms	All firms (cross-section)
Specification	OLS	OLS	OLS	OLS	OLS	IV	Treatment
RC exists (years 1990–1996)	0.15***	0.20***	0.10*		0.20***	0.37**	
	(0.03)	(0.04)	(0.04)		(0.04)	(0.12)	
RC member				−0.13*	−0.13*	−0.64†	−0.91***
				(0.05)	(0.05)	(0.34)	(0.22)
ACC member				0.25**	0.24**	2.07†	
					(0.09)	(0.09)	(1.20)
Controls							
Firm size	−0.13	−0.14	−0.37***	−0.17	−0.14	−0.18**	−0.10**
	(0.09)	(0.10)	(0.17)	(0.10)	(0.09)	(0.07)	(0.03)
Capital intensity	0.67	0.59	1.65*	0.65*	0.68	0.72*	1.61†
	(0.37)	(0.38)	(0.79)	(0.34)	(0.37)	(0.31)	(0.92)
R&D intensity	4.86***	4.55***	2.63	4.85***	4.83***	4.31***	7.25***
	(0.99)	(0.99)	(4.04)	(0.93)	(0.99)	(0.79)	(1.06)
Leverage	−0.08	−0.04	0.04	−0.09	−0.05	0.04	−1.10*
	(0.16)	(0.20)	(0.23)	(0.16)	(0.16)	(0.19)	(0.44)
Focus	0.08	0.05	0.08	0.04	0.07	0.04	0.41**
	(0.06)	(0.10)	(0.05)	(0.06)	(0.06)	(0.08)	(0.14)
Average *Tobin's q*	0.60***	0.60***	0.75		0.62***	0.69***	1.00
	(0.11)	(0.14)	(0.15)		(0.10)	(0.14)	(0.69)
Firm-fixed-effects	Included	Included	Included	Included	Included	Included	Included
Year fixed-effects			Included				
Self-selection correction (λ)							−0.290***
							(0.06)
Firms	198	150	48	198	198	198	198
N	1,462	1,043	419	1,462	1,462	1,462	198
F (df)	17.2 (7)***	12.7 (7)***	5.6 (7)***	11.2 (16)***	15.9 (9)***		
Wald χ^2						9,905.4***	115.4***
Adj. R^2	0.7286	0.7158	0.7837	0.7413			0.7294

Notes. Robust standard errors in parentheses. RC = RC, OLS = Ordinary Least Squares.
$^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$ (two-tailed test).

likely to be members, though the coefficient is positive as predicted.

For our instrumental variable approach, we use the estimates from the first stage (including our second-stage exogenous variables) as instruments for membership in the second stage. In Model 6 of Table 2, we continue to observe that nonmembers realize an increase in their *Tobin's q* after the advent of RC. Once again, while ACC members benefit greatly from the participation in the trade association, the relative benefit of membership decreased after RC. Unlike Model 5, the net benefit to ACC members of creating RC is negative (though not statistically significant).

We have some concerns with these estimates, however. The magnitude of both coefficients is extremely large (suggesting that membership in the ACC had an outsized impact on *Tobin's q*) and uncertain ($p < 0.10$). This may be due in part to limits with our instruments, *Relative emissions* and *Sector emissions*. Although we find evidence that they have a non-zero effect on the choice to join RC, they may violate the exclusion restriction that they have a negligible impact on *Tobin's q*.

Table 3 Estimates of ACC Membership

	8	9
Sample specification	Full panel RE logit	Cross-section probit
Firm size	2.05***	0.33***
	(0.27)	(0.07)
Relative emissions	3.17***	0.34*
	(0.54)	(0.16)
Segment emissions	0.18***	0.04***
	(0.03)	(0.01)
Focus	1.91***	0.75**
	(0.55)	(0.26)
Visibility	0.75	0.12
	(1.11)	(0.47)
Constant	−19.08***	−3.54***
	(2.32)	(0.59)
Firm random effects	Included	
Year fixed effects	Included	
Firms	198	198
N	1,462	198
χ^2 (df)	65.45 (5)***	52.84 (5)***

Notes. Standard errors in parentheses. RE = random effects.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$ (two-tailed test).

Another concern is the use of a binary choice model in the panel. For the purposes of estimation, we assume that the decision to participate in RC is dependent on a firm's characteristics today and independent of a firm's decision to participate in the past. As a robustness test, we relax this assumption and allow participation to be in part determined by a firm's previous year participation decision. This results in second-stage estimates more in line with Model 5, though not all coefficients are statistically significant at a 90% confidence interval.[6]

In Model 7, we estimate our treatment model. Once again, we first estimate our choice model, this time using our probit specification and the panel cross-section (see Table 3). In the second stage, we correct for potential selection using a self-selection correction parameter estimated from the first stage. Because we are relying on the cross-section, we no longer estimate coefficients for *RC exists* or *ACC member*. Note that the coefficient of the self-selection correction parameter (λ) is significant, providing evidence that self-selection is evident in the sample. Controlling for self-selection in this way, we find that members of RC gained relatively less than did nonmembers after the advent of the program. This is not to say that member firms did not benefit from the creation of the program. Rather, given the continued existence of the program, they had incentives not to participate.[7]

In summary, we find evidence that is consistent with our hypothesis that firms that participated in RC benefited from the program, but that the goodwill that the program created spilled over to firms that did not participate. Furthermore, we present evidence that those firms that did participate did not gain as much from the advent of RC as those who did not participate. This is not to say that member firms are irrational. Rather, it suggests that member firms may have been better off by not participating if the program were to continue without their membership.

Discussion

Our analysis provides insight into how industry self-regulation may be sustained despite its voluntary nature. We find evidence consistent with our hypothesis that firms within the chemical industry benefited from the creation of the RC program. On average, we find that ACC members experienced a 5% increase in *Tobin's q* after the program began. Furthermore, we find evidence consistent with our hypothesis that the benefits of the RC program spilled over to nonmembers. On average, we find that nonparticipating chemical firms experienced a 13% increase in *Tobin's q* after the advent of the program.

Interestingly, we find evidence that some RC members may have been better served by exiting the program (assuming the program were to continue to function). In particular, the participation-contingent value created by being a member of the ACC declined by more than 50% (a boost in *Tobin's q* of 0.25 prior to RC versus a boost of 0.12 afterward). As a result, some members may have benefited more from free riding on the program—gaining the public benefits of the program while avoiding the costs of program membership. Thus, our results suggest that some firms remain in the program because of a desire, to maintain the institution. This is not to say that RC provided no private benefit, only that the costs of self-regulation reduced the participation-contingent benefit that participation in ACC provided. We infer that while member firms would prefer to free ride on the program, given that RC exists, these firms recognize that, if they leave the program, the program may very well collapse and they will fail to benefit from the existence of the institution.

These estimates of the financial impact of RC are large enough to warrant concern and consideration. As a comparison, we estimate that a similar 10% average gain in *Tobin's q* could be achieved by raising average R&D intensity from 4% to 6% of assets. Does this seem reasonable for the creation of a self-regulatory program such as RC? Consider first the estimated benefit to ACC members from the creation of RC. The estimated 0.10 increase in *Tobin's q* represents a change of $1 billion in market value for a firm the size of Dow Chemical (with a $19 billion market cap in 1996). Converting this into discounted cash flows (at a 10% discount rate) would correspond to approximately an extra $100 million in additional profit per year for a firm that generated $4.2 billion in operating profits in 1995. As a baseline, the chemical industry spent approximately $6 billion per year on environmental compliance with U.S. regulations during this period (Hoffman 1997). If Dow, with a 10% market share in 1995, accounted for 10% of these compliance costs, RC would deliver savings close to those estimated if it reduced expected regulatory costs by 16%.

What about our estimates of the cost of participating in the program (versus free riding)? We estimate that participating reduced Dow's *Tobin's q* by 0.13, or almost $1.4 billion. At a 10% discount rate, this would represent an additional cost of $140 million per year. This *estimate* seems inflated. Previous studies have found wide variance in the effort that firms put forth to comply with the provisions of RC (Nash and Ehrenfeld 1996). In some instances, firms appear to have joined with RC but failed to comply with its tenets (King and Lenox 2000). If Dow fully complied with RC, $140 million would be roughly a 23% increase in Dow's total cost of compliance with both U.S. law and the RC program.

Additional Considerations

An interesting picture begins to emerge when we combine these findings with summary statistics of RC participants and nonparticipants. Consistent with maintaining the institution hypothesis, we find that RC participants tend to be larger, more-visible, and more chemically focused than nonparticipants (see Table 4). Arguably, the exit of these firms would have led to the collapse of the RC program. The active participation of these industry leaders was perhaps necessary to placate concerned stakeholders about the success of the self-regulatory effort. We speculate that firms join in the first place because they disproportionately bear the cost of poor industry reputation. Government regulation may be more costly for these firms, given their size and focus. In addition, these large visible firms are more likely to attract stakeholder ire from poor industry performance. Compounding matters is that participants are from far more polluting segments of the chemical industry than are nonparticipants (see Table 4). Because these firms stand to gain more from the creation of the self-regulatory program, they are willing to endure the greater costs of participation to prevent the institution's collapse.

After the creation of the RC program, participants substantially reduced their absolute emissions. Such reductions are likely necessary to placate stakeholders and generate private benefits for the industry. Interestingly, however, the change in relative emissions of participants is less than for nonparticipants. In fact, firms saw their relative emissions increase, while nonparticipating firms saw their relative emissions decrease. In other words, the substantial reductions made by the large, participating firms were not as great as the smaller reductions made by smaller, nonparticipating firms in the same sectors. This is consistent with the findings of King and Lenox (2000), who find that RC membership was negatively correlated with reductions in relative emissions since the advent of RC. King and Lenox (2000) propose that this negative correlation was driven by participating firms that did not put forth the effort necessary to meet the standards specified in the program; that is, they failed to truly self-regulate. These firms were able to avoid meeting the standards because RC lacked explicit monitoring and sanctioning mechanisms.

Table 4 Sample Comparisons Based on Participation Choice

	RC firms	Non-RC firms
N	48	150
Average size prior to 1990	7.865	6.513
Average focus prior to 1990	0.560	0.360
Average visibility prior to 1990	0.257	0.177
Average segment emissions prior to 1990	27.425	6.864
Average relative emissions prior to 1990	0.171	0.120
Average annual change in absolute emissions after 1990	−4,920	−1,510
Average annual change in relative emissions after 1990	0.006	−0.013

Note. RC = RC .

This finding raises some important questions about the functioning of RC. If the program indeed failed to increase the rate of emission reductions, how did it create value for the industry? In other words, why did stakeholders (e.g., government regulators) reward the chemical industry for the creation of RC (e.g., by forestalling or reducing government regulation)?

One answer may be that stakeholders were more concerned with absolute emissions reductions than with the rate of reductions. While King and Lenox (2000) argue that such absolute reductions may have been achieved even in the absence of RC, stakeholders may have inferred a causal link. Another possibility is that despite the lack of effort of some participants, the actions of leading firms that did comply with the program were sufficient to placate stakeholders. Finally, the mere existence of the RC program may have been sufficient to create value for the industry if it aided the ACC's lobbying efforts, independent of whether it changed the rate of emissions reductions. Further research is needed to answer this question definitively.

Given the lack of explicit monitoring and sanctioning in RC, another interesting question is why nonparticipating firms did not join the self-regulatory effort to gain any of the participation-contingent benefits membership provides while simultaneously not abiding by the tenets of the institution and thus avoiding most of the costs of membership. We advance a two-part answer to this question. First, while the membership fees for entry into the ACC are trivial for large firms, for smaller firms these fees could be quite substantial relative to the firms' revenues. In addition, simple membership and participation in ACC (independent of RC) consumes scarce managerial attention. Second, these firms would likely receive less of the participation-contingent benefit, such as liability protection, that membership may provide, because on average these firms polluted less and were from cleaner segments of the chemical industry. Thus, the costs of membership were more significant and the benefits less attractive for this set of smaller, cleaner firms.

Robustness and Limitations

We assume throughout our analysis that firms exercise strategic foresight when deciding to join self-regulatory efforts, but other explanations cannot be ruled out. One explanation consistent with our findings is that RC members mistakenly contribute to the overall industry reputation despite the costs. Some scholars doubt that managers have the capacity to assess such complex, contingent outcomes (Bazerman et al. 1999). Mimetic forces may play a strong role in shaping membership (Ostrom et al. 1994, Hoffman 1997). Having little information available and having to guess about the actions of others, managers may decide to emulate the behavior of a few leading companies in the industry without fully considering the potential for differences in incentives (Gunningham and Rees 1997). Chemical firms may have blindly followed the ACC's lead without fully considering the costs and benefits of RC participation. Once the decision to participate in the association was made, there may not have been sufficient information to change the firms' initial decision.

Another possibility is that we incorrectly assume that managers of participating firms are attempting to create value. Managers may choose to join RC because they wish to satisfy particular stakeholders. For example, they may seek to retain personally valuable social ties (Rees 1997). They might also attempt to satisfy a subset of existing or potential stockholders. Some firms attract investors interested in relatively steady dividends and growth. If switching from one set of investors to another group requires a large investment, managers may rationally choose to manage their firms according to the risk preferences of their existing investors. Given some of the large and conservative companies that are members of RC, it seems possible that they indeed have conservative investors and tend to act in a risk-averse manner.

There remain several reasons to be cautious in extrapolating too broadly from our results. Our analysis attempts to infer the strategic costs and benefits of the program by analyzing the effect of membership on a firm's market valuation before and after the creation of the program. Although we use fixed-effects analysis to reduce the effect of stable unobserved differences between firms, we cannot rule out time-varying, firm-specific effects that may explain both membership and performance. The most critical concern with our approach is that our temporal variable (*RC exists*) may reflect other factors that had an impact on the performance of RC members and nonmembers (both together and differentially). Though we control for contemporaneous macroeconomic changes over time, there may have been other industry-specific changes that caused financial performance to improve differentially between members and nonmembers since 1990, independent of the RC program.[8]

We have taken a number of steps to allay these concerns. Although we could not randomly assign firms into RC, we adopted two approaches to address the firms' selection to participate in the RC program. Our instrumental variable and treatment models used two-stage approaches that explicitly modeled the decision to enter into the ACC and RC. The results from these two analyses were consistent and give us a greater confidence that RC was driving the results reported.

Finally, our sample does not include private companies, because our dependent variable (*Tobin's q*) is based in part on the market valuation of the firm. These firms might face different stakeholder pressure, and their decisions to participate (or not) might influence the overall membership and performance in the program. Comparing our descriptive statistics with those from King and Lenox (2000), which include private firms, we find, not surprisingly, that firms in our sample tend to be larger and more visible. As a result, our sample has a higher proportion of RC members versus the entire sample (20% versus 8%). However, this seems unlikely to affect our general results. Even if we assume that the smaller, private firms not represented in our sample do not benefit from the creation of RC, we would still find that RC created positive value for the industry overall, on average, and that the advantage of being a member of the ACC was reduced after the advent of RC.

Conclusion

In this paper, we explore the interplay between private benefits and public spillovers and examine whether industry self-regulation may be maintained despite its voluntary nature. We present evidence that both nonparticipants and participants were better off because of the creation of a self-regulatory institution. While we find some evidence that suggests that participation in industry self-regulatory efforts provides a participation-contingent benefit, it appears to be less than the private cost of self-regulation and minor compared with the collective contribution to industry reputation that the existence of the institution provides. We have concerns about the magnitude of the effects we estimate, but, taken together, our results suggest that industry self-regulation may be sustained by a desire to maintain the institution. Despite evidence that the existence of RC created value for the industry as a whole and that a subset of firms joined the effort but failed to truly self-regulate, a group of large, visible, leading firms appears to have continued to support the institution.

For organizations and their stakeholders, this research provides important insights into the conditions under which we may expect firms to collectively self-regulate. Our research suggests that despite prior evidence of the seeming failure of the RC program to improve environmental performance on average, a critical number of firms may band together to create value for the industry despite the presence of opportunistic behavior of some members. For policymakers, this raises interesting questions about how to respond to self-regulatory efforts that are in part successful and yet still suffer from free riding and opportunism. For firms, our findings provide some guidance into the motivations of others within the industry that are most likely to participate in self-regulatory arrangements.

For organizational scholars, our research suggests industry self-regulation may appear under more delicate and complicated conditions than previously believed. Our results are consistent with models of self-regulation that propose that a critical number of firms may band together to ensure the provision of a collective good even though each would be better off if they did not participate if the program were to continue (Radner and Dutta 1999, Segerson and Dawson 2001). These firms participate because if a firm leaves the program, the increased cost of maintaining the institution will cause remaining members to leave and the entire structure will collapse. The firms stay in the program because they recognize that this critical state has been reached, and they prefer to maintain the institution.

Our results have implications not only for industry self-regulation, but also for our understanding of private decentralized institutions in general. We present evidence that such institutions may be maintained despite incentives to free ride when subsets of organizations recognize both the value of maintaining the institution and that the institution will collapse without their participation. While institutional scholarship has emphasized that coercive, normative, and mimetic forces may motivate compliance with existing institutional tenets, less attention has been paid to the sustaining of the institutional structure itself. Our research complements existing institutional scholarship by demonstrating the possibility for firms to collectively maintain private decentralized institutions even in the presence of incentives to defect.

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Appendix. Environmental Performance Measures

We follow the procedures developed by previous researchers of RC (King and Lenox 2000). These measures are based on all facilities in the TRI. Facilities must complete annual TRI reports if they manufacture or process 25,000 pounds (or about 11,340 kilograms), use more than 10,000 pounds of any listed chemical during a calendar year, and have 10 or more full-time employees. Two hundred 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 effects. We account for differences in toxicity by using the EPA's Reportable Quantity toxicity scale to weight the effect of each chemical. We measure the toxicity-weighted emissions (pollution) for a given facility in a given year by summing the weighted releases of the 246 common chemicals in the TRI database.

$$E_{it} = \sum_{\forall c} w_c e_{cit}, \tag{A1}$$

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.

Toxic emissions are strongly influenced by facility size and the product being manufactured. To estimate the relative performance of each firm, we first measure the relative performance of each facility owned by the firm. We use an ordinary least squares regression to estimate the production function between facility size and aggregate toxic emissions for all facilities within each four-digit standard industrial classification (SIC) code in each year. 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.

$$\ln(E_{it}) = \alpha_{jt} + \beta_{1jt} s_{it} + \beta_{2jt} s_{it}^2 + \varepsilon_{jt} \tag{A2}$$
$$RE_{it} = \varepsilon_{jt} / \sigma_{\varepsilon_{jt}},$$

where E_{it} is the 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. The residual is represented by ε_{jt} and the standard error of the residual by $\sigma\varepsilon_{jt}$.

To create a corporate level measure of performance (*Relative emissions*), we calculate the weighted average of the facility-level scores. We weight the scores by the percentage of total production that each facility represented for the company.

$$RE_{nt} = \ln\left(\sum_{i \in n} (s_{it}/s_{nt}) / e^{RE_{it}}\right), \tag{A3}$$

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 *Relative emissions* does not consider whether a company has chosen to operate in dirty or clean segments of the industry. We create our firm-level measure (*Segment emissions*) of the firm's tendency to operate in dirty or clean industry sectors by aggregating the dirtiness of the sectors in which a company owns a facility. We calculated each sector's "dirtiness" by taking the log of the sum of the total emissions for the sector and then dividing by the log of the total number of employees in the sector (i.e., log emissions per log employees).

$$SE_{nt} = \ln\left(\sum_{i \in n} (s_{it}/s_{nt}) \mathrm{Ln}(E_{jt}) / \mathrm{Ln}(\mathrm{Empl}_{jt})\right), \tag{A4}$$

where SE_{nt} is weighted segment emissions for firm n in year t, E_{jt} is total toxicity-weighted emissions for industry j in year t, s_{it} is facility i size in year t, and s_{nt} is firm size, and Empl_{jt} is the total employees or industry j in year t.

Endnotes

[1]In the case of the ACC, the cost of joining the trade association varies by firm size. For larger firms, the membership fees are trivial. The costs of participating in the RC program (i.e., to self-regulate) are harder to quantify, but interviewed firm managers suggest that they can be substantial (Nash and Ehrenfeld 1996).

[2]A similar argument has been made in the classic cartel-stability literature (d'Aspremont et al. 1983, Donsimoni et al. 1986). Donsimoni et al. (1986) argue that a stable cartel is

one in which members do not have an incentive to leave and nonmembers do not have an incentive to join.

[3]Note that the membership of the ACC (and participation in RC) changed over time. A number of firms quit the ACC at the time the RC program was ratified and adoption became a condition of membership. A number of firms joined the ACC (and hence RC) post-1990, as well.

[4]In the instrumental variables specification, the first stage includes the exogenous variables from the second stage of our model, as well as the regressors from our choice model.

[5]MBA students at a large U.S. business school 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 students' interest, companies were randomly distributed among seven surveys, and these surveys were randomly distributed. Between 25 and 35 students responded to each of the seven surveys.

[6]Coefficient estimate and standard errors in parentheses, respectively: *RC exist* (0.16, 0.50), *RC member* (−0.14, 0.08), *ACC member* (0.24, 0.18).

[7]As an additional robustness test, we adopted a propensity score–matching procedure. First, those receiving the treatment were systematically matched to similar firms not receiving the treatment, based on the firm characteristics measured for our previous models. Matching is achieved using a nearest-neighbor estimator with replacement and no caliper restrictions. We then calculate the sample average treatment effect (SATE) by comparing the *Tobin's q* of matched pairs of firms. We estimate a negative, significant ($p < 0.01$) SATE where the coefficient equals −0.19 and the standard error is 0.07. In other words, the impact of being in RC is a 0.19 reduction in a firm's *Tobin's q*.

[8]An example of those changes are the Clear Air Act Amendments of 1990. However, these amendments were themselves influenced by the lobbying and actions of the ACC, including the establishment of the RC program. More importantly, our empirical efforts to address selection in our panel cast serious doubts on the possibility that the amendments are driving our results. For example, in the propensity-scoring model, we pair firms based on their characteristics. Thus, we would compare firms with similar attributes (size, focus, visibility, etc.) that are in RC and that are not and still observe a difference.

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