December 2008

EVALUATING THE ISO 14001 ENVIRONMENTAL MANAGEMENT STANDARD AND PCS DATA FOR ENVIRONMENTAL MANAGEMENT RESEARCH: THEORY AND DATA

by

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EXECUTIVE SUMMARY

This final report has two parts. The first part provides a conceptual and empirical analysis of the functioning of the ISO 14001 Environmental Management Standard. ISO 14001 codifies a set of best environmental management practices, and offers third party certification to firms that comply with these practices. The standard has enjoyed widespread diffusion: By the end of 2006, approximately 130,000 firms worldwide were ISO 14001 certified.

Some practitioners and scholars view certification with ISO 14001 as a means that helps firms overcome information asymmetries in the market for corporate environmental performance. Others focus on the standard's codification element and view ISO 14001 as a toolbox that assists firms in improving their environmental performance. The conceptual analysis in this project suggests that while certification and codification may allow ISO 14001 to guide firm behaviors in areas where other instruments of soft law fail, they also reduce the standard's effectiveness in shaping firm behaviors by attracting an inconsistent mix of participants that will weaken decentralized enforcement processes.

The empirical analysis in the project explores how multi-unit firms employ certification with ISO 14001. Using a large seven year panel dataset of U.S. manufacturing firms, it finds that multi unit firms use certification strategically in that they seemingly satisfy stakeholder pressures by adopting ISO 14001 so as to improve their environmental performance, but that certification actually occurs at firm plants that already have better, rather than poor, environmental performance.

The second part of this report provides a description of Permit Compliance System (PCS) data. Compared to other data held at the EPA, most notably data from the Toxic Release Inventory (TRI), PCS data has rarely been used in environmental management research. While the data description in this report should facilitate future use, an evaluation of the data also reveals that PCS data has a number of important problems that make it at least partially inferior to TRI data. The appendix of this report contains explanations for many of the PCS data fields that lack needed descriptions.

PART I: An Analysis of the Functioning of ISO 14001

Introduction

Certification schemes have become omnipresent. Today firms may certify their practices in areas as diverse as information security, labor management, quality management, environmental management, food safety, accounting, and ethics. Examples of certification schemes that have enjoyed widespread diffusion include the ISO 14001 Environmental Management Standard, the focus of this project. Sponsored by the International Organization for Standardization (ISO), the ISO 14001 standard codifies a set of environmental management practices, including the development of environmental objectives and policies, the provision of training and documentation, delegation of responsibilities, and internal performance audits. It also creates a system for third-party auditors to certify compliance with the stated environmental management practices. By the end of 2006 approximately 130,000 firms worldwide were ISO 14001 certified (ISO, 2006)

Much like envisioned by its creators, in an ideal world, ISO 14001 functions as both a tool that improves firm environmental performance and as a signal of superior environmental performance. The notion is that prescribed best practices enable firms to improve their environmental performance to reach some superior levels. Certification of these practices then serves as a signal that allows stakeholders to distinguish good performers from poor performers, thereby overcoming information asymmetries in the market for corporate environmental performance.

Yet empirical data paints a different picture. While there is evidence that firms indeed seek certification with ISO 14001 when information asymmetries are particularly high, other accounts clash with this signaling notion since they suggest that certified firms have inferior environmental performance, rather than superior environmental performance. Furthermore, there is conflicting evidence regarding the degree to which adopted best practices lead to improvements in environmental performance.

In this first part of this project, I explore the functioning of ISO 14001 from several angles. First, I conceptually analyze how the two distinguishing features of certified management standards like ISO 14001 (the codification and the certification of a set of best practices) enable ISO 1400, on the one hand, to guide firm behaviors in realms where other instruments of soft law commonly fail. On the other hand, however, these two features can reduce its effectiveness in guiding firm behaviors by attracting an incompatible mix of participants that weakens enforcement processes. I then empirically analyze adoption patterns of ISO 14001 among multi-unit firms to further assess the functioning of the ISO 14001 environmental management standard.

Conceptual Analysis of the Potential of ISO 14001 to Shape Socially Desired Firm Behaviors

Background

Norms, informal rules, and codes of behavior can create order without law by relying on a decentralized enforcement process in which noncompliance is penalized with social and economic sanctions (Ellickson, 1991; Greif, 1993; North, 1990). Scholars suggest that these norm-like institutions are particularly effective if firms share a consensus about expected behaviors, if behaviors are observable, and if decentralized enforcement processes are consistent (Bendor & Swistak, 2001; Ostrom, 2000; Weiss, 2000). Yet absent these conditions, they exert only a weak force on firm behaviors. Given the potentially powerful effect of norm-like institutions on firm behaviors, possibilities to extend their functioning beyond established boundary conditions carry important implications for institutional theory and management practice.

Here, I analyze the ability of one such norm-like institution — the ISO 14001 environmental management standard — to extend its functioning beyond these conditions through the codification and certification of environmental best practices. I argue that codification and certification enable ISO 14001 to shape firm activities when consensus about expected behaviors is incomplete and when behaviors are difficult to observe. I further suggest, However, that these same two elements limit the scope of norm-like institutions like ISO 14001 by encouraging patterns of compliance that introduce inconsistencies into decentralized enforcement processes.

Certified management standards (CMS) like the ISO 14001 environmental management standard or the SA 8000 labor management standard are a norm-like institution in that they are, like norms, classified as a private-decentralized institution (Ingram & Clay, 2000; King, Lenox, & Terlaak, 2005). They are a private institution because they are created by non-state actors, and they are a decentralized institution because they rely on diffuse social and economic interaction for enforcing compliance (Ingram & Clay, 2000). For policy makers, understanding the functioning of private-decentralized institutions has become particularly important as they attempt to ensure social welfare by supplementing state-made laws and regulations with nonmandatory initiatives such as CMS, codes of conduct, and reporting frameworks (Delmas & Terlaak, 2001; Gunningham, Grabosky, & Sinclair, 1998; Khanna, 2001; Post, 2000). The use of nonmandatory social initiatives is also an important phenomenon for management practice. Some managers report that adoption of such initiatives has been essential for their firms' organizational and financial health (Grow, Hamm, & Lee, 2005).

Previous research on CMS has built on their similarities to norms and consequently has likened the functioning of CMS to the functioning of norms (Delmas, 2003; Guler, Guillen, & Macpherson, 2002; Mendel, 2002). While such a conceptualization seems intuitive and has generated important insights, I focus on CMS's unique attributes: codification and certification. Highlighting this difference between CMS and norms allows shedding light on the potential of private-decentralized institutions to create order without law in settings with incomplete consensus and information — settings in which norm-like institutions are expected to be ineffective (Greif, 1993; Ostrom, 2000; Weiss, 2000).

I consider how strategic firm responses affect the ability of private-decentralized institutions to guide firm behaviors. Modeling firm responses to such institutions as strategic is relatively

common in New Institutional Economics (e.g., Ostrom, 2000), but much less so in the management literature (Ingram & Silverman, 2002; Scott, 2001). Yet conceptualizing firm responses as passively driven by isomorphic pressures unnecessarily restricts understanding of the mechanisms through which private-decentralized institutions guide firms. This has prompted scholars to call for integrating strategic behavior into the analysis of private-decentralized institutions (Dacin, Goodstein, & Scott, 2002; Ingram & Silverman, 2002; Oliver, 1991). Taking this strategic perspective, I suggest that codification and certification may limit the effectiveness of private-decentralized institutions through soliciting patterns of firm compliance that undermine decentralized enforcement processes.

The presented analysis also contributes to the growing literature on corporate social responsibility (e.g., Frederick, 1994; McWilliams & Siegel, 2001). An important debate in this literature centers on the role of nonmandatory social initiatives to guide desired firm behaviors (Jiang & Bansal, 2003; Khanna, 2001; King & Lenox; 2000; Post, 2000). My analysis contributes to this debate by offering insights into the functioning of one strong example of a nonmandatory social initiative. It furthermore contributes by providing potential contingent effects that can support the transition from corporate social responsiveness (i.e., socially responsible behaviors caused by external forces) to corporate social responsibility (i.e., socially responsible behaviors caused by intrinsic conviction; Frederick, 1994).

I follow the behavioral assumptions of the boundedly-rational choice perspective, and assume that firms are self-interested and seek to maximize profits (Ingram & Clay, 2000; Simon, 1957). These assumptions associate my analysis with a direction in the literature on corporate social behavior that focuses on institutional reforms *given* organizational values, rather than on the development of theories that provide the moral underpinnings for better firm behaviors (Frederick, 1994).

Next, I use Ingram and Clay's (2000) categorization of institutions to juxtapose CMS like ISO 14001 against other institutions that may shape socially desired firm behaviors. Doing so allows circumscribing the research context and clarifies differences between private-decentralized institutions such as CMS and public-centralized institutions such as laws. I then employ a macro perspective to theorize about the enabling effects of codification and certification. Specifically, I hold constant firm attributes and discuss how codification and certification may enable CMS to command firm compliance in various settings in which norms would normally fail. Following, I take a micro perspective and allow for firm differences to theorize how codification and certification may solicit a pattern of compliance that undermines the decentralized enforcement process and thus limits ISO 14001's effectiveness to guide firm behaviors. The last part of this analysis discusses my analysis.

Classifying Social Initiatives

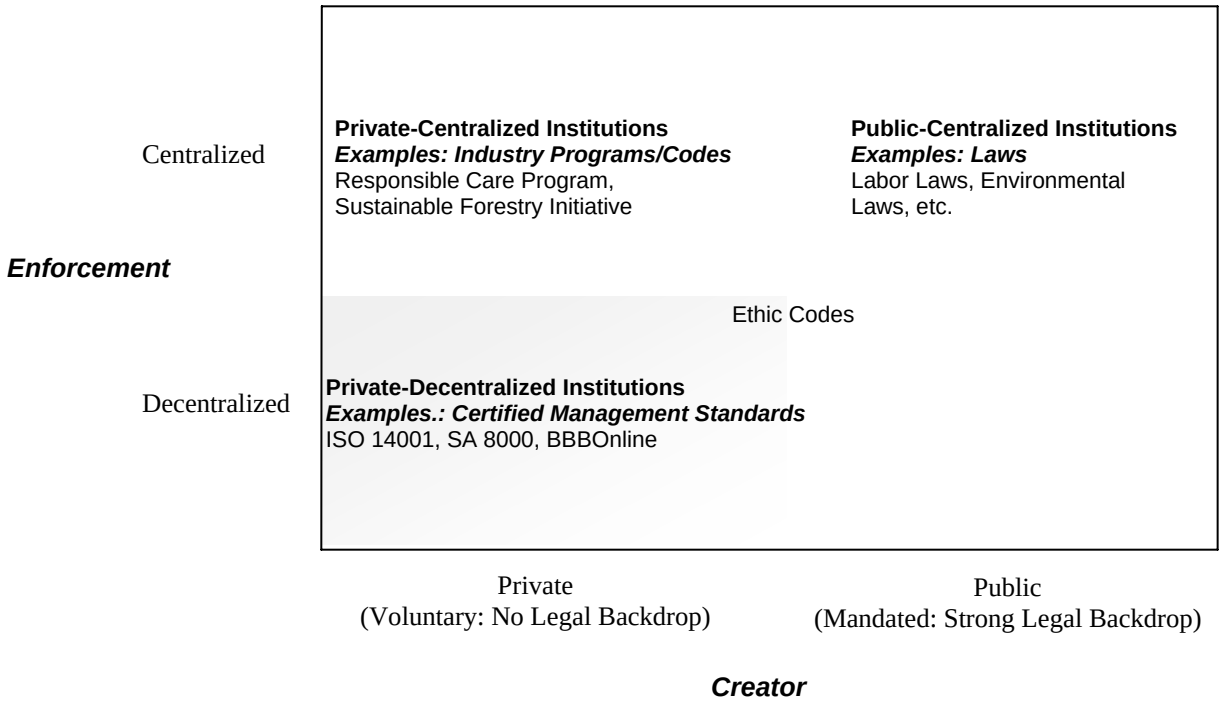
Ingram and Clay (2000) classify institutions based on two dimensions: (1) public or private and (2) centralized or decentralized. Public or private refers to who makes the institution. States produce public institutions whereas organizations and individuals create private institutions. The second dimension, centralized versus decentralized, refers to how the institution is enforced. Centralized institutions are enforced through designated central functionaries whereas decentralized institutions rely on diffuse individuals to punish institutional violations (Ingram & Silverman, 2002).

Laws are a classic example of a public-centralized institution (Ingram & Clay, 2000). They are a public institution because they are created by the state. They are a centralized institution because they are enforced by a court system, that is, a designated functionary. Note that this classification considers both private law and public law as public-centralized institutions. Although private law gives standing to private and decentralized actors to bring a cause of action, it is a central designated functionary (the courts) that adjudicates violations and imposes penalties. Hierarchies and industry codes (e.g., the codes that govern members of the diamond and cotton industries) are examples of private-centralized institutions (Bernstein, 1992, 2001; Ingram & Silverman, 2002). They are private because they are created by organizations other than states, and they are centralized because they designate an authority that enforces compliance. Finally, norms are the archetype of a private-decentralized institution (Ingram & Silverman, 2002). They emerge from unorganized social interaction, and they are enforced through uncoordinated and decentralized interactions of individual actors.

Voluntary social initiatives may take the form of private-decentralized institutions or private-centralized ones. Figure 1 illustrates the various positions.

FIGURE 1

Institutional Classification of Social Initiatives



Voluntary social initiatives resemble a private-centralized institution if they are centrally enforced. The chemical industry's Responsible Care Program and forestry's Sustainable Forestry Program, for example, are created and enforced through the respective industry associations.

These associations have central enforcement power because they arbitrate violations and can exclude noncompliant firms from the associations (King & Lenox, 2000).

As a private-decentralized institution, CMS lack a designated enforcement functionary. Instead, CMS derive their power from the uncoordinated social and economic interaction among firms and other transacting parties such as industrial buyers, end consumers, and communities (Loya & Boli, 1999). Examples of CMS include the ISO 14001 environmental management standard, the SA 8000 labor management standard, and the BBBOnLine information management standard. Note that these standards are housed in specific (centralized) institutions: ISO 14001 is housed in the International Organization for Standardization, a private nongovernmental organization; SA 8000 is housed in Social Accountability International, a nonprofit organization; and BBBOnline is housed in the Council of Better Business Bureaus, another private, nonprofit organization. However, these institutions merely maintain the standards and are not held responsible for their enforcement. Besides sharing the defining features of a private-decentralized institution, these standards also have in common that their creation involved representatives from various stakeholder groups (e.g., NGOs, industry, and consumers; European Commission, 2003; OECD, 2001). They furthermore resemble one another in that they all provide codified management practices and third-party certifications for compliant firms.

A distinction that coincides with the differentiation of public and private institutions is whether or not litigation can be used to enforce compliance. Due to the authority vested in states, noncompliance with public (i.e., state-created) institutions can have legal consequences. For Figure 1, considering this additional distinction allows a more differentiated treatment of ethics codes. I position ethics codes as a hybrid between a private-decentralized institution and a public-centralized one. I use these codes to highlight the possibility that private institutions that are theoretically voluntary (i.e., not legally required) may not be voluntary in practice and that they consequently resemble a public-centralized institution that is enforced through a designated functionary. In the case of ethics codes, adoption has become practically mandatory and centrally enforced because the Federal Sentencing Guidelines reduce sentences for firms that have compliance and ethic codes.[1] Thus, as far as the absence of an ethics code can be interpreted to give private actors the right of action for breach of directors' fiduciary duty, ethics codes begin resembling a public-centralized institution that is enforced through a designated functionary. The Sarbanes-Oxley Act further strengthens the legal backdrop of ethics codes by requiring that firms disclose their code or else explain why they do not have one. For my analysis, distinguishing between initiatives that are only theoretically voluntary versus those that are also practically voluntary is important. My analysis examines how a private-decentralized institution may create order *without* law. Thus, my reasoning refers to the functioning of initiatives that operate against weak legal backgrounds, maintain that noncompliance is legal, and leave firms with a real choice to comply or not.

1 Courts find that the absence of such codes can be a cause of action for managerial breach of fiduciary conduct. In the *Caremark* case, for instance, the Delaware Court dismissed allegations of criminal violations on the grounds that the company's directors had performed their duties as evidenced by the existence of a compliance and ethics program (Transparency International, 2004).

Conceptual Analysis

Institutional similarities between CMS and norms make it tempting to liken the functioning of CMS (and ISO 14001) to that of norms. Yet rather than uncovering parallels between these two institutions, I use the literature on norms to suggest how codification and certification enable CMS to shape firm behaviors in settings in which norms are expected to fail. I initially abstract from firm differences, implying that hypotheses are governed by ceteris paribus assumptions with regard to firm attributes. Subsequently, I allow for firm differences in order to analyze how codification and certification may result in compliance patterns that inhibit CMS's effectiveness in guiding firm behaviors.

Certified Management Standards and Norms

How do CMS shape firm behaviors under conditions of incomplete consensus and information – settings that violate the boundary conditions for norms to function? I first review how norms shape firm behaviors before analyzing the enabling and impeding effects that codification and certification have on private-decentralized institutions.

Despite the lack of legal sanctions, norms can be a powerful influence on firm behaviors (Ellickson, 1991; North, 1990; Ostrom, 2000; Uzzi, 1996). "Norms specify how things should be done; they define legitimate means to pursue valued ends" (Scott, 2001: 55). Intrinsic incentives are an important driver for firm compliance when norms are internalized (Scott, 2001). Concepts from New Institutional Economics emphasize how external incentives can cause interest-seeking firms to adhere to norms even if norms are not internalized (Greif, 1993; Ingram & Clay, 2000; Ostrom, 2000). One such incentive is the threat of penalizing noncompliance with economic and social sanctions. Rejection of a norm may be punished through cessation of social relationships, ostracism from the group, and refusal of future economic exchange (Ellickson, 1991; Ingram & Silverman, 2002). Thus, while these social and economic penalties cannot be sought through litigation (as would be the case for noncompliance with laws), norms may be able to create order without law by using decentralized social and economic interaction to tie the potential for future gains to current compliance (Axelrod, 1986; Greif, 1993).

Research on norms suggests that a number of boundary conditions must exist for norms to command compliance (Axelrod, 1986; Greif, 1993; Ostrom, 2000). One condition is a consensus about the means and ends implied by the norm (Salbu, 1994; Weiss, 2000). Another condition is the risk of tarnishing one's reputation when rejecting the norm. This risk is perceived if there is agreement about the worth of compliance and if noncompliance can be detected (Bendor & Swistak, 2001; Greif, 1993; Weiss, 2000).[2]

Interestingly, while CMS share the defining institutional features of norms, they appear to guide firm behaviors in settings that do not meet the conditions for norms to function. Internet security management standards, for example, operate in a field that is young and still lacks consensus on best practices (Hunker, 2002). Other standards guide firm behaviors in settings that lack consensus about best practices because of firms' heterogeneous cultural backgrounds. Labor management standards, for example, coordinate the interaction of firms from various countries and continents. Furthermore, some CMS operate in settings in which non-compliance with practices is difficult to detect. End consumers in the United States, for instance, cannot observe if

2 Other factors that shape a norm's effectiveness in guiding firms include participation rules, relationship duration, access to a mechanism to resolve disputes, and a shared desire to maximize welfare (Ostrom, 2000; Weiss, 2000).

a garment manufacturer indeed complies with best environmental practices (or labor management practices) in remotely located textile mills. The question, then, is how a CMS like ISO 14001 may guide firm behaviors when consensus about best practices is incomplete and when transacting parties have difficulties observing relevant firm practices.

Enabling Effects of Codification and Certification

CMS and norms share their defining institutional features, but CMS differ from norms in that they capture in a written and codified form how things should be done. Furthermore, unlike norms, CMS entail a certification element that makes visible whether a firm indeed does things how they should be done. I argue that these two features allow CMS to engage firms in settings in which norms would fail to do so.

Codification of practices. Norms are typically unwritten and, as a result, need to rely on agents to share a common understanding of the legitimate means to pursue valued ends (Bendor & Swistak, 2001; Bilder, 2000; Scott, 2001). If agents lacked consensus on the interpretation of means and ends, sanctioning would become unsystematic because different behaviors constitute compliance or defection, and the norm would consequently lose its effectiveness in guiding firm behaviors (Weiss, 2000). With respect to the informal laws that coordinated the activities of the Maghribi traders, Greif (1993: 531) argues that "for punishment to be effective there must be a consensus about which actions constitute 'cheating'." Building on insights from the literature on collaboration and knowledge codification, I argue that codification of how things should be done may enable CMS to shape the behavior of firms even in settings in which consensus on how things should be done is incomplete.

Collaborating firms need to agree on ways to interact and manage the transfer of knowledge, products, and services. Codification of organizational rules and knowledge can facilitate such consensus in two ways. First, codification can increase consensus through requiring agents (organizations) to make explicit their rules (Benezech, Lambert, Lanoux, et al., 2001). Research on the Delphi method suggests that by forcing agents to spell out their own rules, codification can enable iterative rounds of benchmarking that foster consensus on various issues (Munier & Ronde, 2001). Second, codification may reduce the problems of incomplete consensus by creating reference points that limit room for divergent interpretations (Avadikyan, Llerena, Matt, et al., 2001). Codified contents may become an authority to which agents can turn when uncertain about appropriate behaviors (Cowan, David & Foray, 2000). Thus, codification allows the reconstitution of knowledge and rules for different periods, geographical locations, and agents (Cohendet & Meyer-Krahmer, 2001; Cowan et al., 2000).

For CMS, these findings suggest that through codifying best practices, CMS may both foster consensus and reduce the problems of incomplete consensus. They foster consensus by encouraging conversations on how things should be done (Salbu, 1994), and they ameliorate the negative consequences of incomplete consensus by creating explicit reference points to which firms can refer to assess behaviors. However, this is not to suggest that codification can overcome deep divisions in organizational interpretations of values and ideas (Salbu, 1994). Just as firms would need to agree upon basic aspects in firm collaborations, they also need to agree on, for example, the desirability of environmental protection or worker safety. Once a basic agreement is in place, codification may help reconcile different notions of managing the natural environment or workers' safety.

As far as codification fosters consensus or counteracts the negative consequences of incomplete consensus, it should facilitate the decentralized process that enforces compliance to private-decentralized institutions. Consequently, I expect that CMS like ISO 14001 are more effective than unwritten norms in guiding firm behaviors in settings in which there is incomplete consensus on how things should be done:

Proposition 1: Certified management standards like ISO 14001 will be more effective than norms in guiding firm practices in settings in which consensus about these practices is incomplete.

Proposition 1 can be made more applicable by specifying contexts in which consensus about best practices is likely to be incomplete. One such situation is an emerging management field. Just as emerging industries lack consensus on dominant business models (Aldrich & Fiol, 1994; Sanders & Boivie, 2004), recently emerged management fields frequently lack consensus on how to do things. For instance, Eisenhardt and Martin (2000) cite examples of Internet firms adopting simple rules to guide strategic decisions as a response to a lack of dominant solutions in rapidly evolving industry conditions. Similarly, firms still struggle to define both content and scope of environmental best practices. It takes time for firms to form a consensus in emerging fields because learning is slow, situations are complex, information is sparse and contradictory, and mind frames are resistant to change (Cole, 1998). As a result, different notions still exist, for example, for best managing the security and reliability of the Internet and other distributed information technology systems (Hunker, 2002). Yet despite incomplete consensus, CMS that address environmental practices (such as ISO 14001) and Internet and information security (such as BBBOnLine) have started guiding firm behaviors in this area. To the extent that codification of practices helps reconcile and reduce the effects of incomplete consensus about best practices, I expect that:

H1a: Certified management standards like ISO 14001 will be more effective than norms in guiding firm practices in recently emerged management areas such as environmental management.

Consensus may also be incomplete when transactions involve parties with heterogeneous cultural backgrounds (Adler, 1986; Graham, Mintu, & Rodgers, 1994; Hofstede, 1980). Stephens and Greer (1995) note that cross-national firm alliances are frequently doomed to fail due to heterogeneous cultural assumptions that initiate or compound differences in organizational processes, technology, and practices. For instance, U.S. employees typically consider participatory management as part of best labor management practices, whereas Mexican employees feel more uncomfortable providing decision-making input or assuming decision-making responsibilities (Stephens & Greer, 1995).

Salbu (1994) notes that cultural differences are particularly stark in the context of international business ethics because culturally derived norms (rather than, for example, technology) define limits of acceptable behaviors. Yet, despite distinct cultural differences and associated incomplete consensus, CMS now guide environmental and labor management practices in cross-border firm transactions (OECD, 2001). Cultural firm differences also exist, albeit to a lesser degree, in cross-industry transactions. In fact, cross-industry differences in cultures and beliefs may be sufficiently stark to hamper collaborative efforts (Albino, Garavelli, & Schiuma, 1999; Simonin, 1999). Yet the ISO 14001 environmental management standard, as Well as other standards, guide firm practices in cross-industry interactions. Thus, if differences in cultural

backgrounds are associated with incomplete consensus on how things should be done, and if codification reduces such incomplete consensus, I anticipate the following:

H1b: Certified management standards like ISO 14001 will be more effective than norms in guiding firm practices in cross-cultural transactions.

Certification of practices. The threat of sanctioning noncompliance by tarnishing the defector's reputation is an important driver for firm compliance to norms (Bendor & Swistak, 2001; Ingram & Clay, 2000). For this threat to be effective, however, relevant firm activities need to be visible to transacting partners so that defection can be detected and publicized (Greif, 1993; Weiss, 2000). Letter exchanges between Maghribi traders who relied on a system of private-decentralized institutions to regulate the behavior of agents underlines the degree to which information about behaviors is a critical element for the functioning of so-called lawless systems. In the case of the Maghribi traders, merchants had established a letter exchange system to verify trade-related information and to inform one another about past behaviors of agents (Greif, 1993).

Many firm activities are inherently difficult to observe for transacting partners. Environmental or labor management practices, for example, primarily relate to firm internal processes, which makes them difficult to observe for external exchange partners. I argue that certification may partially overcome this problem and allow CMS to guide firm behaviors in settings in which incomplete information would, ceteris paribus, reduce the effectiveness of norms to shape firm behaviors. Consequently, CMS play an important role in guiding firm activities when norms are ineffective or absent. CMS offer third-party certification to firms that comply with the practices outlined in the standard. Firms need to recertify at regular time intervals (typically every three years) as Well as submit to annual surveillance audits in order to maintain certification (SAI, 2004b). Certified companies have permission to publicly display their certification. These certifications make transparent a firm's behavior under conditions when such behavior could not otherwise be inferred.

At a minimum, certification indicates to transacting parties that the firm has implemented the practices outlined in the CMS. As far as these practices result in superior performance, certification may also be a proxy indicator for firm performance in the area targeted by the standard (e.g., superior environmental protection or information security; European Commission, 2003). Furthermore, if best practices are linked to general firm competencies (Wenmoth & Dobbin, 1994), certification can also be an indicator of underlying firm capabilities. However, certification cannot indicate what a firm does poorly or does not do at all. This is because certification is voluntary, and a lack of certification hence does not allow inference about the practices and attributes of noncertified firms.[3] As a result, certification can merely identify firms that do good but it does not necessarily identify those that do bad.

Despite revealing only compliance (and not defection), certification may nonetheless be able to shape firm behaviors by enabling transacting parties to reward compliance (rather than sanction defection). Of course, transacting parties will reward certification only if they attach a worth to firm compliance with the practices outlined in the CMS. In the context of environmental management standards, for example, transacting partners may reward certification because they believe that best environmental practices are evidence of superior operational performance that

3 For example, survey results suggest that firms sometimes comply with best practice yet forgo certification to avoid certification costs, further adjustments to systems, or inspection by outside agents (Naveh, Marcus, Allen, et al., 1999).

translates into higher-quality products (Russo & Fouts, 1997). Industrial buyers may furthermore attach a worth to supplier compliance because best environmental practices may reduce the risk of accidents that cause shortages of important input materials and damage the reputation of supply chain partners (Reinhardt, 1999; Slawsky, 2004). End consumers may be willing to reward certification because supporting environmentally conscious firms may confer prestige within a community, induce others to purchase from these firms, or simply fulfill an enlightened self-interest (Reinhardt, 1998). A similar logic may influence the willingness of transacting parties to reward compliance with best labor management practices. Therefore, as far as certification of compliance with CMS practices is associated with a reward, certification may be a substitute for the incentive effect that results from sanctioning noncompliance in settings with full information. As a result, CMS may be more effective than norms in guiding firm behaviors in settings in which relevant firm activities are difficult to observe:

Proposition 2: Certified management standards like ISO 14001 will be more effective than norms in guiding firm practices in settings in which these practices are difficult to observe.

Next, two hypotheses increase the applicability of Proposition 2 by stipulating conditions that make it difficult for transacting partners to observe firm activities. First, physical distance may prohibit interested parties from observing firm practices (Hamilton, Godfrey, & Linge, 1979). This is because physical distance makes it more difficult for parties to visit relevant firm sites and collect information. Furthermore, any information that does spill out from the firm is likely to be localized and slow to travel the greater the distance (Adams, 2002). As a result, certification may enable CMS to be more effective than norms in guiding firm practices when geographical distance inhibits transacting parties from fully observing relevant practices. Cases in point are CMS that guide labor management practices in overseas garment manufacturer plants. Therefore, I expect that:

H2a: Certified management standards like ISO 14001 will be more effective than norms in guiding firm practices that are physically removed from transacting parties.

Some products and services allow transacting parties to infer about specific firm activities. For example, poor customer service allows customers some inference about the firm's employee training programs (Guy, 1997; Reidenbach & Minton, 1991). Similarly, poor quality control practices may manifest in defective products. To the extent that firm behaviors translate into output attributes and to the extent that these attributes are observable, the need to make firm behavior observable through certification decreases. Yet product (or service) quality may not always be assessable, and, furthermore, not all firm practices translate into noticeable product attributes.

The quality of goods and services may not be assessable at all – even after consumption – in the case of credence goods (Nelson, 1974). For example, assessing the services of medical doctors is problematic. Even after receiving treatment, patients often cannot assess if the specific treatment was required and whether subsequent Well-being (or discomfort) is linked to the treatment (Emons, 1997). Whereas credence qualities make it particularly difficult to assess product attributes and thus prohibit inference about *any* underlying firm practices, other goods may reveal their quality prior to or after consumption and yet still do not allow inference about particular firm activities. For example, although a defective garment may allow inference about

the manufacturer's quality-control practices, it does not allow inference about the firm's environmental management practices, nor does it inform the buyer whether the firm treats its workers fairly. This is because environmental management practices and most labor management practices primarily manifest at the firm's site – for example, through decreased emissions or greater worker happiness – rather than in end products. For cases in which product and service attributes do not allow transacting parties to infer about a firm's practices of interest (such as environmental practices or information security practices), I hence expect that certification of these practices enables CMS to be more effective than norms in guiding firm behavior in the respective management areas.

H2b: Certified management standards like ISO 14001 will be more effective than norms in guiding firm practices that are not manifested in product and service attributes.

I thus far have held constant firm attributes and I have theorized how codification and certification of practices may enable ISO 14001 to be more effective than norms in establishing order without law. Next, I hold constant environmental conditions while allowing for firm differences in order to theorize how codification and certification may reduce the effectiveness of CMS.

Impeding Effects of Codification and Certification

Following the assumptions of a boundedly rational approach to firm behavior, firm responses to CMS are driven by explicit, firm individual cost-benefit considerations, and compliance occurs only if deemed profitable. Because firms diverge in resources and performances, compliance costs and benefits will differ across firms, and firm responses to CMS therefore will vary. I explain these differential firm responses and theorize how resulting patterns of compliance may result in inconsistent enforcement processes that reduce the effectiveness of CMS to guide firm behaviors.

Codification of practices. Research in corporate social responsibility suggests that firm inefficiencies can create room for win-win situations – that is, situations in which an improvement in firm practices increases firm efficiencies as Well as social welfare (Graedel & Allenby, 1995; Porter & van der Linde, 1995; Reinhardt, 1999). Boyd, Tolley, and Pang (2002), for example, find that technical improvements allowed producers of glass containers to reduce nitrogen oxide emissions while improving their productivity. The magnitude of such win-win situations is debated (Palmer, Oates, & Portney, 1995) but agreement exists that firm inefficiencies are quite common and difficult to ameliorate (Frantz, 1988; Leibenstein, 1966). One reason for the persistence of substandard practices is the cost of identifying better ones (Arrow, 1974). Through compilation and codification of available best practices in their respective management areas, CMS may reduce this cost. Research suggests that compilation and codification are increasingly important as operational choices have become more numerous and complex (O'Dell & Grayson, 1998; Ruggles, 1998). Thus, assuming a potential for win-win situations, codification of best practices may enable CMS to improve social welfare as Well as firm efficiency in the standards' respective management areas.

Firm inefficiencies vary across firms (Frantz, 1988), and the potential of codified practices to reduce these varying levels of inefficiencies may be related in two ways. From the perspective of theories of absorptive capacity (Cohen & Levinthal, 1990), high-performing, efficient firms may be better able to exploit codified practices. This is because firms require absorptive capacity to

utilize external knowledge, and firms with larger absorptive capacity presumably have smaller inefficiencies because of their greater abilities to update and adapt their resource bases (Cohen & Levinthal, 1990; Zahra & George, 2002).

Conversely, firms with higher inefficiencies – that is, poor performers in the respective management areas – may benefit more from codified practices because their marginal costs for improving efficiency are smaller. Presumably, firms with substandard practices have more opportunities to exploit low-hanging fruit (Reinhardt, 1999). Furthermore, arguments of absorptive capacity have proven particularly relevant in the context of transferring and exploiting complex and tacit knowledge in alliances and technology ventures (Lane & Lubatkin, 1998; Mowery, Oxley, & Silverman, 1996). CMS, However, tend to offer a relatively simple set of codified good practices (Hemenway & Hale, 1996). As a result, the level of absorptive capacity required for exploiting these practices may be comparably small. Thus, I expect that codification of practices translates into comparably greater efficiency gains for firms with lower performance in the management area targeted by the CMS and that these firms thus comply with the CMS. Therefore, I posit that:

Proposition 3a: Certified management standards like ISO 14001 engage firms that have below average performance in the respective management areas targeted by the standards (here: environmental performance).

Certification of practices. Incomplete information about a firm's performance may reduce social welfare by inhibiting transacting parties from identifying and encouraging better-performing firms (Akerlof, 1970). For example, transacting parties may be willing to reward firms that protect their private information. However, incomplete information about relevant firm performance inhibits them from differentiating between truthful claims of superior consumer privacy and false ones. As a result, they are unwilling to reward firms that claim to protect consumer privacy, and firms thus have little incentive to ensure the safety of private information. This may result in an underprovision of socially desired goods such as consumer privacy in e-commerce, environmental protection, or protection of labor (Reinhardt, 1998). Certification of best practices may be one way to address this problem of asymmetric information (Akerlof, 1970).

Following the structure of a signaling game (and temporarily leaving aside the effect of codification) suggests that the net benefit of certification is larger for firms with superior performance in the management area targeted by the standard (Spence, 1973). This is because the willingness of transacting parties to reward certification should be similar across certified firms (at least within an industry), but poor performers incur greater certification costs. As far as poor performance is symptomatic of a lack of underlying firm capabilities, poor performers will incur greater costs because each unit of adjustment that is required for bringing practices up to par for certification requires greater efforts. Firms with higher performance, in contrast, incur loIr certification costs because practices are already up to par and because better firm capabilities reduce the cost of any needed adjustments. Scholars find that in the context of environmental management standards, compliance costs are indeed greater for firms with lower environmental performance (Darnall & Edwards; 2004; Ferrer, Gavronski, & de Laureano, 2003). Practitioners confirm a compliance cost function that slopes downward with firm performance in the context of quality management standards (Marquardt, 1992).

If the reward for certification is constant and if certification costs increase with a decrease in firm performance, then the net benefit of certification is larger for firms with better performance in the standard's respective management area. Thus, I expect that certification of practices translates into comparably greater benefits for firms with higher performance and that such high performers thus engage in CMS:

Proposition 3b: Certified management standards (like ISO 14001) engage firms that have above-average performance in the respective management areas targeted by the standards (here: environmental performance)

Combining the effects of codification & certification. Private-decentralized institutions derive their power from uncoordinated social and economic interaction (Ingram & Clay, 2000). I argue that codification can reduce the effectiveness of this decentralized interaction through causing failure in the sorting effect of certification. This failure results in compliance by both high and low performers and introduces inconsistencies into the enforcement process.

Certification of practices allows transacting parties to differentiate high performers from low performers if gaining certification is too costly or impossible for the latter group (Spence, 1973). Recall that in the context of CMS, certification does not attest to specific performance levels or outcomes; instead, it attests to the existence of (or compliance with) certain practices (European Commission, 2003). However, attesting to practices rather than outcomes does not automatically preclude certification from differentiating among performance levels. Differentiation is still possible if compliance to best practices either is indicative of superior levels of performance or induces superior performance. I argue that codification reduces the likelihood for either scenario to occur.

Certification of CMS practices may be indicative of high firm performance if identification and implementation of these practices requires capabilities that are more frequently possessed by firms that perform well in the management area targeted by the CMS. In fact, research suggests that in general, better-performing firms tend to have greater capabilities to execute thorough searches and identify best practices (George, 2005). However, CMS codify best practices and make them widely available, thereby reducing search and implementation costs and enabling poor performers to receive certification. A practitioner explains that in the case of ISO 14001, for example, the standard "outlines system elements, with advice on how to initiate, implement, improve, and sustain the system" (Jayathirtha, 2001: 248). A simplified analogy describes this situation: One can think of certification of practices as an exam that tests *how* students solve problems (i.e., the process of problem solving).[4] Presumably, only intelligent students are able to identify best processes. However, the provision of codified practices translates into the provision of a course reader that outlines best approaches to problem solving. Given this course reader, merely testing whether students can recite approaches to problem solving would no longer differentiate across intelligence levels.

Certification of practices and simultaneous codification would not necessarily reduce the sorting effect of certification if compliance with codified practices resulted in comparably superior performance levels. Returning to the analogy, passing the exam could still be indicative of higher intelligence levels if studying the course reader allowed poorer-performing students to improve their intelligence. Yet the effect of complying with codified practices on firm performance is

4 For this analogy to correspond, the exam needs to test whether students can perform certain processes (practices) rather than whether students arrive at a specific answer to a given problem (outcome).

likely to vary according to firm capabilities and initial firm performance (Cohen & Levinthal, 1990). It is possible that codified practices remove the worst inefficiencies, but they may not turn laggards into leaders. Absent other firm capabilities that enable a firm to modify codified practices in order to meet individual needs and absent capabilities that allow an ongoing learning process, improvements may be limited, and resulting performance levels may vary and continue to lag behind (Zahra & George, 2002). Research suggests that in some cases, implementation of codified practices may even decrease performance (Westphal, Gulati, & Shortell, 1997).

If compliance with best practices does not allow inference about superior firm performance and if compliance does not necessarily induce superior performance, certification can no longer differentiate high performers from poor performers. This situation threatens the decentralized enforcement process: as ongoing interaction between firms and transacting parties provides some information about the performance level of compliant (certified) firms, parties may cease rewarding certification as they realize that both high and low performers are certified. This is a major issue for the ISO 9000 quality management standard, which served as the role model for its younger ISO 14001 sibling. For ISO 9000, a practitioner remarked that "my worst supplier was ISO registered and my best is not" (Naveh et al., 1999: 278). Another one remarked that "ISO continues to be perceived as no sign of quality" (Naveh et al., 1999: 273). As transacting parties cease rewarding compliance, however, firms lack the incentive to comply with practices at socially desired levels.[5]

Problems also arise if some parties use evidence of compliant high performers to interpret CMS certification as a signal of superior performance while others infer from compliant low performers that CMS serve as an improvement tool for laggards. For example, in the context of the ISO 14001 environmental management standard, some practitioners expect the CMS to "distinguish companies that are doing the bare minimum from those that are committed to environmental excellence" (Morella, 1996), whereas others expect the CMS to provide "a toolbox of good ideas" that removes firm inefficiencies in poorly performing firms (Collins, 1996; Fielding, 1998; Klaver & Jonker, 2000). Such different interpretations are problematic because they result in inconsistent patterns of enforcement. Specifically, parties that view CMS as improvement tools may sanction noncompliant firms that are believed to be poor performers or, conversely, reward compliant firms that are believed to be poor performers. Such a pattern of enforcement is inconsistent with the one that is pursued by those who interpret CMS as signals of superior performance. As a result, firms are confronted with inconsistent and spotty enforcement patterns that ultimately reduce the effectiveness of CMS to guide firm behaviors.

Codification (and certification) may thus be a double-edged sword. On the one hand, I suggested earlier that codification may create consensus on how things should be done – for example, codification may spell out the reporting procedures that help protect consumer information. On the other hand, codification, in combination with certification, may attract a pattern of compliant firms that creates confusion about the more general meaning of the CMS – for example, are these reporting procedures part of superior consumer protection systems on which leading firms rely, or are they basic tools that allow firms that lack comprehensive systems to minimally respond to consumer concerns? As far as this confusion results in inconsistent enforcement patterns,

5 Note that as far as compliance allows firms to remove inefficiencies, I should continue to observe some compliance. However, underprovision would result as soon as socially desired levels of compliance are above levels that are required for firms' internal improvements.

decentralized enforcement processes are impeded and the effectiveness of CMS to guide firm behaviors will be reduced. Therefore, I expect that:

Proposition 4: Engaging above and below average performers weakens decentralized enforcement processes and thereby reduces the effectiveness of Certified Management Standards like ISO 14001 to guide firm practices.

Conclusion

Implications for Research on Corporate Social Behavior

Following previous research on CMS, I have conceptualized CMS as a private-decentralized institution. Yet unlike previous researchers, I did not focus on broader environmental conditions such as regulatory environments and isomorphic pressures to explain firm responses to CMS like ISO 14001 and ISO 9000 (Delmas, 2003; Guler et al., 2002; Mendel, 2002). Instead, I have discussed how some of ISO 14001's unique features (i.e., codification and certification) affect this institution's ability to guide socially desired firm behaviors. I find that codification and certification have both enabling and impeding effects. Thus, my discussion implies that success and failure of CMS may be only partially explained through analysis of broader institutional conditions. Future research on CMS may benefit from further investigating this institution's inherent features. For example, some CMS (like BBBOnLine) require that firms submit to a clearinghouse system that keeps track of complaints against each firm. Such a system may enable CMS to command firm compliance in short-term transactions – a situation in which compliance to private-decentralized is thought to be low because it lacks the incentive effect of the shadow of the future (Axelrod, 1984).

Conceptualizing CMS as a private-decentralized institution implies that compliance to CMS is voluntary rather than legally mandated. Empirically, such conceptualization seems appropriate since most CMS indeed operate, currently, against comparably Weak legal backdrops (Brunsson & Jacobsson, 2000). Generally, legal backdrops are weaker in the context of institutions that span across national borders and legislative terrains (Brunsson & Jacobsson, 2000). Yet, institutional conditions may change such that some CMS begin operating against stronger legal backgrounds. For example, as firms seek to comply with the information security theme in the Sarbanes-Oxley Act (Messmer, 2003), compliance to information management standards such as ISO 1799 and *BBBOnLine* may eventually become practically (though not technically) legally required. Thus, future research may consider conceptualizing CMS as a hybrid that incorporates features of both a private-decentralized institution and a public-centralized institution.

For practitioners, this analysis has a very clear message: the design of CMS matters. For policy makers, design elements like codification and certification matter in that they critically influence whether and how CMS guide desired firm behaviors. This, in turn, has implications for the degree to which CMS may complement or replace public-centralized institutions in the pursuit of social welfare. For managers, design matters because it affects enforcement patterns and facilitates (or impedes) coordination with transacting partners. This report suggests that though codification and certification may broaden the applicability of CMS, they risk getting CMS stuck in the middle. Providing a tool for improvement and acting as a signal for superior performance may be exclusive endeavors that can be made compatible only under some very specific conditions.

The analysis also speaks to recent efforts to connect the literatures on corporate social responsibility (CSR1) and corporate social responsiveness (CSR2; Frederick, 1994). "CSR2 shuns philosophy in favor of a managerial approach" and replaces "the abstract and often highly elusive principle of CSR1" with a "focus on the practical aspects of making organizations more socially responsible to tangible forces in the surrounding environment" (Frederick, 1994: 155). CSR2 explicitly acknowledges that corporate social responsiveness may face constraints imposed by the capital markets, and it calls for exploration of institutional reforms that make social responsiveness a practical reality (Frederick, 1994). My analysis moves in the realm of CSR2, and I conceptualize firm responses to CMS as driven by external sanctions and the quest for internal benefits. This conceptualization echoes recent survey results that suggest that firms continue to be designed as profit-making mechanisms with "no interest in the good of society" (Bartlett & Preston, 2000: 199), but it limits my analysis in that it does not address corporate social behavior that is driven by higher considerations (Windsor, 2001). Yet my analysis does not categorically exclude some of the more philosophical issues tied to corporate social responsibility. In fact, it is possible that CMS represent the middle stage that bridges corporate social behavior driven by laws and corporate social behavior driven by firm intrinsic considerations of right and wrong. As management practices evolve, CMS may present a temporary state that is akin to "provisional statements of the present status of the moral conversations" (Salbu, 1994). As CMS practices become an integral part of transacting, firms may internalize them such that compliance is ultimately driven by firm internal notions of how to do socially responsible business rather than by external sanctions and the potential for internal benefits. Future research should explore the role of CMS in providing a stepping-stone in this process.

Limitations

The framework has some limitations that need consideration as the presented ideas get refined and tested in future research. Rather than assuming that firm responses to CMS are driven by isomorphic pressures, I have conceptualized firm responses as strategic in the sense that firms actively respond to CMS and comply only if benefits outweigh costs. I have, However, not considered the possibility that firms, in an effort to look good without doing good, may act strategically in the sense that they decouple stated practices from actual behaviors. Research on the adoption of ethics codes suggests that such decoupling is especially likely when external pressures for social performance are high (Kimerling, 2001; Iaver, Trevino & Cochran, 1999). Decoupling processes have also been documented in the context of quality management (Kostova & Roth, 2002) and the adoption of stock repurchase programs (Westphal & Zajac, 2001). In the context of CMS, decoupling may be less of a concern because third-party certification limits the extent of such behaviors. However, while making decoupling less likely, recent accounting scandals suggest that certification systems can be faulty and may fail to prevent decoupling. Certification systems may break down as certifiers are caught in conflicts of interest due to consulting activities and due to fee collection (OECD, 2001; O'Rourke, 2002; Naveh et al., 1999). Thus, decoupling may remain a risk, and there is a need for future research to identify conditions when such risks become salient.

My analysis partially hinges on the willingness of transacting parties to assign a worth to firm compliance with best practices. I have assumed that this willingness is given. Yet actual willingness to reward compliance will depend on the degree to which transacting parties can internalize the benefits that arise from firm compliance to best practices. I have argued that even

in the case of a public good (such as environmental protection) willingness to reward compliance exists to the extent to which the public good can be bundled with private benefits. Yet as long as benefits remain that cannot be internalized, resulting levels of compliance will be below socially desired levels. Thus, the ability of CMS to entice firms into the production of public goods is limited.

When discussing CMS like ISO 14001 as a means to guide socially desired firm behaviors, it is important to acknowledge the difficulty of defining effectiveness. I have explored the ability of CMS to trigger immediate effects on firm behavior. However, besides assessing CMS with respect to their intended effect on firm behavior, one might assess CMS (and other voluntary social initiatives) with respect to their capacity of initiating a dialogue, increasing awareness, and changing mind frames (Massie, 2000; Salbu, 1994). The Sullivan Principles (a voluntary initiative on labor practices in South Africa), for example, may not have been particularly effective in changing employment practices but have successfully changed corporate investors' perceptions about apartheid (Massie, 2000). Similarly, some argue that the value of the ISO 14001 environmental management standard primarily lies in rising awareness among both corporations and end consumers about the need, possibilities, and costs and benefits to protect the natural environment.

Empirical Analysis: Certification with ISO 14001 among Multi-Unit Firms

Background

Scholars interested in CMS have persistently applied a signaling framework to the analysis of standards like ISO 14001. Signaling theory from economics (Akerlof, 1970; Spence, 1973) offers a compelling explanation for the popularity of certification schemes in area as diverse as information security, labor management, quality management, environmental management, food safety, accounting, and ethics. Signaling theory posits that when information asymmetries make it difficult for one party to assess the practices of another party the informed party may use certification to communicate about the superiority of its practices.

Research indeed suggests that firms are more likely to certify their practices when information asymmetries with their stakeholders are high (Jiang & Bansal, 2003). Yet empirical irregularities suggest an incomplete fit between signaling theory and the functioning of certified management standards like ISO 14001. Scholars exploring ISO 14001, for example, have found that certified organizations often do not have better environmental performance (Andrews, Darnall, Gallagher, et al., 2001) and that instead poor performers select into certification (King, Lenox, & Terlaak, 2005). This is in contrast to the notion from signaling theory that certification is indicative of superior performance.

I here address this incomplete fit between signaling theory and the actual usage of CMS by suggesting that firms engage in a form of "satisficing signaling". I argue that a signaling model, in its simplest form, can only incompletely capture the actual usage of CMS like ISO 14001 because their design differs from certification schemes that are typically and appropriately analyzed through a signaling lens. I focus on three aspects that differentiate a CMS like ISO 14001 and that warrant modifications to the application of the simple, traditional signaling model to the analysis of ISO 14001. The first aspect is that social CMS outline best practices that, if implemented, likely improve the attribute about which certification is expected to signal. This deviates from the assumption of signaling theory that this attribute is constant (Spence, 1973). The second differentiating aspect is that firms cannot internalize all the benefits resulting from the implementation of the practices outlined in a social CMS. The third aspect is that the decision to get certified is frequently made by corporate headquarters rather than by the individual plants that ultimately receive certification (Darnall, 2003). I predict and test empirically that the combination of these three aspects will result in certification patterns that not only do not match a signaling model but also reveal strategic maneuvering on part of multi-unit firms.

The Appeal of Signaling Theory for the Analysis of Certified Management Standards

Scholars have used signaling theory to explain the behavior of firms and other social agents in a variety of contexts including labor markets (e.g., Bedard, 2001; Frazis, 2002), advertising (Milgrom & Roberts, 1986), finance (John & Williams, 1985; Leland & Pyle, 1977), and government policy (Barro & Gordon, 1983; Rodrik, 1998). The theory's capacity to explain a broad range of behaviors that help overcome information asymmetries makes it a promising perspective for the analysis of CMS. CMS specify best practices relating to specific management

areas (such as quality management, environmental management, or internet security) and provide third-party certification to firms that implement these practices. It is this certification element that provides the link to signaling theory; presumably, only firms that follow best practices can select into certification and certification therefore communicates to stakeholders about the superiority of firm practices (and possibly performance).

Empirical research provides support for the notion that firms use certification schemes as signaling devices. For example, Kim et al. (1996) show how AACSB accreditation may allow schools to signal about high quality education and student ability, thereby enabling graduates from AACSB accredited schools to earn higher wages than graduates from schools without such accreditation. Signaling theory has also been applied to the analysis of the ISO 9000 quality management standard. ISO 9000 was created in 1987 by the International Organization of Standardization in Geneva and is possibly the most prominent of all CMS. Anderson, Daly and Johnson (1999: 32) argue and find that "by virtue of its cost and attested veracity, ISO 9000 certification may serve as a credible signal of process quality control that distinguishes firms from uncertified competitors." Similarly, Ferguson (1996) argues that buyers use ISO 9000 certification as a screening tool to select suppliers with superior quality management practices. Terlaak and King (2006) find that the effect of ISO certification on a firm's production growth is depending upon the degree to which information asymmetries are present.

When the International Organization of Standardization created ISO 14001 in 1995, they closely designed it after the ISO 9000 quality management standard, and it therefore is not surprising that the notion of CMS playing a signaling role remained prevalent in the analysis of ISO 14001 (e.g., Bansal & Hunter, 2003; Chapple, Cooke, Galt, et al., 2001a, 2001b; Nakamura, Takahshi, & Vertinsky, 2001). Jiang and Bansal (2003), for instance, find that firms seek certification with ISO 14001 when information asymmetries make it difficult to communicate about their environmental practices and performance. In contrast, firms merely adopt environmental management systems – i.e., they adopt environmental practices but do not get certification – if stakeholders can easily assess firm practices and performance. King et al. (2005) produce similar evidence using a large panel dataset of ISO 14001 certification among U.S. manufacturing facilities. They also find that information asymmetries strongly affect certification with ISO 14001 but that they have no significant effect on environmental practice adoption. Despite this seemingly appropriate fit of signaling theory to the analysis of CMS like ISO 14001, there is evidence that this fit is but incomplete. Studies showing that companies with below average environmental performance (and possibly practices) are more prone to seek certification with ISO 14001 (e.g., Andrews et al, 2001; King et al., 2005) contradict signaling theory according to which firms with better practices and performance select into certification. In Spence's classic job market signaling model (Spence, 1973), only students with high productivity will invest into education and the accompanying diploma because only these students can expect that the wages for college graduates outweigh the costs of attending college. Low productivity students, in contrast, do not have this expectation because they incur greater difficulties and costs for receiving a diploma.

The applicability of signaling theory to the analysis of CMS may furthermore be limited because CMS require the implementation of practices that likely change the very performance attribute about which certification is expected to signal. In fact, some studies find evidence that adoption of ISO 9000 and ISO 14001 improve a firm's quality and environmental performance, respectively (Corbett, Montes-Sanco & Kirsch, 2005; King & Lenox, 2001; King et al, 2005;

Naveh, Marcus, Allen, et al., 1999). This finding is inconsistent with signaling theory's assumption that certification communicates about an innate, stable attribute that is unaffected by the signaling action (Spence, 1973).

Taken together, previous research suggests that a signaling framework is a useful perspective for exploring the usage of CMS but it also reveals that this framework requires extensions so as to grasp fully this institution's functioning. I next build on this previous research and identify three differentiating aspects of social CMS to develop a framework that while considering the signaling elements of CMS also acknowledges the elements that are incompatible with a classic signaling perspective.

Hypotheses Development

Changes in the attribute about which the organization signals

Classic signaling theory assumes that the attribute about which the informed party signals is stable. Specifically, in Spence's original job market signaling model (Spence, 1973), education does not significantly alter the productive capabilities of a student. Consider that if education Ire productive relative to its costs, investment into education would be valuable to all – including low productivity students -- and attending college (or receiving a diploma) would consequently no longer differentiate high from low productivity students (Spence, 1973: 368).

The notion of education being relatively unproductive conflicts with the core idea of human capital theory that education augments natural abilities (Becker, 1965; Mincer, 1988). Thus, while human capital theory and signaling theory concur that schooling increases labor income, they provide different rationales for this correlation. Human capital argues that the premium paid to college graduates is a reflection of the graduates' learned skills whereas signaling theory argues that the premium is a reflection of the diploma's signal about the graduates' innate skills. This difference in reasoning has led to numerous studies testing the two hypotheses (Bedard, 2001; Frazis, 2002; Kroch & Sjoblom, 1994; also see Riley (2001) for a review of this debate). Results suggest that the premium paid to college graduates ultimately is a combination of the effect of human capital accumulation and the effect of being recognized as having inherently higher productivity (Bedard, 2001).

Just as education both influences and is indicative of a student's productive capabilities, a CMS may both influence and indicate about a firm's performance in the area targeted by the standard. CMS outline best management practices that companies need to implement in order to receive certification. These practices likely affect performance – in the context of certified environmental management standards, for example, the practices are expected (Darnall & Edwards, 2006) and found (King et al., 2005) to reduce a firm's impact on the natural environment.

If CMS not only signal about firm performance but also improve this performance, stakeholders should be particularly likely to pressure low performing firms into adopting a standard. Assuming that stakeholders are "motivated by a desire to bring about changes in a targeted firm's behavior along some dimension of concern to the group" (Eesley & Lenox, 2006: 6), they should focus their efforts on low performers because these low performers likely are able to pick low hanging fruit – i.e., low performers should be able to gain a unit of improvement at lower

costs than high performers (or, alternatively, realize more units of improvements at the same costs) (Eesley & Lenox, 2006). In the context of labor management standards, for instance, stakeholders likely focus adoption pressures on firms with poor labor management records (e.g., high accident rates), whereas they target firms with poor environmental performance in the context of certified environmental management standards.

For stakeholders to focus their efforts on low performers they need to be able to identify such low performers. This can be complicated by information asymmetries that make it difficult to differentiate among firm performances. Indeed, the very notion that firms use certification as a signaling device implies the presence of asymmetric information. However, information may not be entirely incomplete because news reports, non-profit groups, and governmental data sources likely provide some information to stakeholders. The Environmental Protection Agency, for example, provides several publicly available datasets that inform about firm environmental performance. Human Rights Watch, a non-profit group, informs about firms' labor management practices in developing countries. The information provided by these sources may still be insufficient for stakeholders to undertake fine-grained differentiations of firm performances (e.g., to tell apart an average performer from one that performs slightly above average), but it may be adequate for identifying low (versus high) performers. In fact, research suggests that stakeholders typically are able to gather sufficient information so as to identify and apply pressures to poorly performing firms (Eesley & Lenox, 2006; Rehbein, Waddock, & Graves, 2004). Thus, I expect stakeholders to apply adoption pressures to heavy polluters and that plants with poor environmental performance are therefore particularly prone to adopting a certified environmental management standard:

Hypothesis 1: Plants with poor environmental performance are more likely to adopt ISO 14001 than plants with good environmental performance.

Internalizing the benefits from adopting and certifying of best practices

It is possible that low performers adopt CMS for reasons that go beyond stakeholder pressures. In particular, low performing organizations may expect adoption of best practices to enhance operations and thereby improve their economic bottom line. Put differently, there may be a good business case for adopting a management standard that is independent of the existence of stakeholder pressures. In the context of the ISO 9000 quality management standard, for example, adopters report significant increases in customer satisfaction and reductions in the cost of quality (Naveh et al., 1999). However, this reasoning may be less operational in the context of social CMS – i.e., management standards that are at least partially associated with positive external effects for society -- because firms may have difficulties internalizing the standards' benefits.

Generally, adoption of a certified management standard is expected to result in operational benefits and market benefits (Corbett et al., 2005). A firm may receive operational benefits when adherence to the standard's practices improves its internal functioning. Market benefits result from the premium that a firm may be able to demand in return for communicating about the superiority of its practices. For example, market participants may be willing to pay a premium to an ISO 9000 certified firm because they expect to purchase more consistent product quality. However, in the context of a social CMS (such as an environmental management standard) firms likely are uncertain about receiving either one of these benefits.

Social CMS require the implementation of practices that are beneficial for society as a whole. An environmental management standard, for instance, requires the implementation of practices that

benefit the natural environment. Whether these practices also benefit a firm's economic bottom line is not always clear (King & Lenox, 2002; Palmer, Oates, & Portney, 1995). Some scholars suggest that profit maximization and protecting the natural environment are mutually exclusive and that reducing a firm's impact on the natural environment therefore comes at a financial penalty (Friedman, 1970). Yet a more recent and widespread view stresses that the effect of environmental protection on a firm's economic bottom line is conditional upon a myriad of factors including whether the firm pursues waste prevention versus waste treatment (King & Lenox, 2002), the degree to which environmental efforts are supported by upper management (Maharaj & Ramnath, 2005), and the ownership structure of the company (Darnall & Edwards, 2006; Russo & Fouts, 1997). Thus, while it is possible that environmental best practices improve a firm's operational performance and thus its economic bottom line it is by no means an automatism that consistently ensures such positive correlation.

The market benefit of adopting a social CMS may be similarly uncertain because market participants typically have a limited willingness to pay for public goods such as environmental protection. Willingness to pay is limited because the consumption of public goods is non-exclusive; for example, a market participant that pays for a firm's effort to protect the environment cannot exclude non-paying market participants from also benefiting from the cleaner. However, willingness to pay does need not be zero because a few market participants may be able to internalize at least some of the benefit associated with the public good. For example, an end consumer may be willing to pay some premium to environmentally conscious firms because purchasing from these firms confers social prestige or simply makes the consumer feel better (Reinhardt, 1998). Furthermore, some industrial buyers may benefit because suppliers with superior environmental performance may have smaller risks for spills and other environmental accidents that interrupt supply (Reinhardt, 1999). Thus, to the (frequently unknown) degree that market participants can internalize some of the benefits associated with a public good like environmental protection <u>some</u> willingness to pay may exit. However, this willingness will remain below the costs of producing this good as long as at least some portion of the good's benefits cannot be fully internalized.

The uncertainty associated with receiving any operational or market benefits from the adoption of a social CMS makes it more difficult to make a business case for the adoption of such a standard. Adoption costs are certain — a firm is required to rearrange its practices or adopt new ones in order to comply with the standard and it needs to pay the fees to receive certification — whereas the payoffs from adoption are uncertain. This uncertainty creates an interesting situation when considered in combination with the decision making structures in multi-plant firms.

Signaling in multi-tiered decision structures

Research suggests that up to 90% of publicly traded facilities and 64% of privately owned facilities adopt a CMS like ISO 14000 because their parent company either required or encouraged them to do so (Darnall, 2003). These numbers suggests that in the majority of cases, it is not the plants that receive actual certification but their corporate headquarters that make the decision to pursue adoption of a CMS. Translating this situation into the context of Spence's job-market signaling model (Spence, 1973), it would be the family head, rather than the student, who decides which of the family's children will attend college. If a multi-plant firm decides which of its plants to certify, which ones will it chose?

I argue that multi-plant firms will select one of their better performing facilities to receive

certification because minimizing adoption costs is important in face of the standard's uncertain payoffs. Choosing a high performer may not guarantee a positive net benefit from adoption but it nonetheless reduces adoption costs because a better performing plant may already have in place the practices required by the standard. This would reduce the costs associated with rearranging processes so as to accommodate required new practices. Furthermore, better performing facilities likely have greater absorptive capacity (Zahra & George, 2002) which should facilitate the implementation of new practices where needed. For certification with an environmental management standard, a firm may also try to lower adoption costs by choosing a plant that operates in relatively cleaner industries, i.e., in industries that inherently have smaller environmental impacts and where adherence to environmentally friendly practices thus is less costly. Finally, a multi-plant firm may reduce the costs of adopting a CMS by choosing a plant with prior experience with CMS. Research indicates that firms with prior management standard experience benefit from lower future adoption costs because they can draw on previously developed adoption and implementation knowledge (Darnall & Edwrads, 2006).

Note that a firm's choice as to which plant to certify with a CMS likely looks different if the firm expected that adoption of the CMS resulted in operational benefits. Specifically, consider that if the firm expected that the practices outlined in the CMS primarily improved its internal operations (rather than result in positive external effects for society as a whole), it would have good business reasons to mandate adoption by its poorest performing plants because these plants would realize the greatest improvements at lowest costs. Similarly, a firm would chose a poor performing plant if it Ire certain that market participants Ire willing to pay a premium that fully and proportionally rewards each unit of improvement. Yet given the uncertainty about the operational and market benefits associated with a social CMS, multi-plant firms likely attempt ensuring a net adoption benefit by minimizing adoption costs. I therefore expect:

Hypothesis 2: Within multi-plant firms, plants with better environmental performance are more likely to adopt ISO 14001 than plants with lower environmental performance.

Hypothesis 3: Within multi-plant firms, plants operating in cleaner industries are more likely to adopt ISO 14001 than plants operating in dirtier industries.

Hypothesis 4: Within multi-plant firms, plants with prior experience with certified management standards are more likely to adopt ISO 14001 than plants without such prior experience.

Simultaneous consideration of Hypotheses 1 through 4 suggests that a framework of "satisficing signaling" may result in some unexpected adoption patterns. Specifically, while stakeholder pressures may cause lower performing organizations to adopt a CMS (Hypothesis 1), the uncertainty associated with the standard's payoffs in combination with the decision making structure of multi-plant firms might result in a situation in which certified plants are better within-firm performers (Hypothesis 2), operate in cleaner industries (Hypothesis 3), and have prior experience with management standards (Hypothesis 4). I describe this adoption pattern as 'satisficing signaling': While poor performing plants respond to stakeholder pressures by adopting and certifying best practices, these plants are ultimately better within-firm performers. Yet certification by better within-firm performers conflicts with the interests of stakeholders whose mission would be fulfilled to a greater degree if the poorest within-firm performer adopted and certified best environmental practices.

Empirical Analysis

Sample

I use a sample of 5,215 facilities drawn from the population of U.S. manufacturing facilities from the years 1995 to 2002 to test my hypotheses. I used data from U.S. EPA's Toxic Release Inventory (TRI), Dun & Bradstreet's (D&B) directory of facilities, and COMPUSTAT to gather relevant facility and firm information. I also gathered industry-level information from the Bureau of Economic Analysis (BEA) and the Census Bureau of Foreign Trade. I used the QSU database of ISO 14001 certified facilities to collect information on facilities that received ISO 14001 certification during my panel period. The sample includes all facilities that report to the TRI dataset and for which I have complete information for all relevant variables. I limit the sample to industries in which there is at least one adopter of ISO 14001. Furthermore, my theory requires that firms can chose which of their plants seeks certification and the sample is therefore restricted to multi-plant firms that possess three or more facilities.

Measures

Dependent variable. The dependent variable is *Certification* with the ISO 14001 environmental management standard. This a binary variable taking on unity in the year a facility certifies with ISO 14001. There are 447 facilities in my sample that receive certification during the panel period and for which I have complete information for all other variables.

Independent variables. I create *Facility Environmental Performance* to test Hypothesis 1. For each facility and year, I use information from the TRI dataset to capture in pounds a facility's toxicity-weighted emissions into the environment as well as its waste transfer to an offsite treatment facility. To toxicity-weigh emissions, I multiply each chemical with the inverse of its reportable quantity in CERLA. For highly toxic chemicals, CERCLA reporting thresholds are as low as one pound. The lower CERLA's reporting threshold, the more toxic the chemical, and hence the more weight the chemical receives in my weighing system. I calculate aggregate releases for a given facility in a given year by summing the weighted releases of the 246 common chemicals that have required reporting throughout TRI's entire history. (I focus on chemicals for which reporting requirements have remained constant to avoid distortions and biases introduced by changes in reporting requirements). Because emissions vary widely across industries and year, I normalize released facility emissions by industry (4-digit SIC code) and year such that I measure a facility's emissions relative to the emissions of other plants in that industry and year. I furthermore inverse the sign since more emissions are a sign of poorer environmental performance.

To test Hypothesis 2, I create C*leaner Firm Performer*. Plants report their corporate parent to the TRI dataset and I use this information to construct firm trees and track ownership changes over time. For each year, I then calculate the average of facility environmental performance (see above) of all plants belonging to one firm and create a binary variable that takes on unity for those facilities whose environmental performance is better than average. Thus, *Cleaner Firm Performer* is a binary variable that indicates for each year if a facility's (normalized) environmental performance is better than the average of the (normalized) environmental performances of all firm plants. For example, a firm may have four facilities in four different

industries. Assume that in the year 1999 the normalized environmental performance of the first facility is -1.4 (indicating that it is a below average performer in its industry), that of the second facility is -0.3, that of the third one is 0.0 (indicating that its performance is industry average), and that of the fourth one is 2.2 (indicating that its performance is above average in its industry). The average of these scores is 0.125. Thus, the variable *Cleaner Firm Performer* is coded as 0 for the first three facilities and as unity for the fourth facility.

I create the variable *In Cleaner Industry* to test Hypothesis 3. This also is a binary variable and it takes on unity if a facility operates in an industry that is cleaner than the average industries of the other firm facilities. Specifically, I use the TRI dataset to capture for each industry (4-digit SIC code) and year the industry's total toxicity-weighted emissions. For each firm and year, I then calculate the average emissions of the industries in which its facilities operate. If a plant operates in an industry that emits less than this average the binary variable *In Cleaner Industry* takes on unity. Thus, this variable identifies those firm plants that operate in industries that have a smaller environmental impact than the average industries of their sister plants.

The variable *ISO 9000 Certification* tests Hypothesis 4. For each facility and year, this variable indicates whether the facility is certified with the ISO 9000 quality management standard. I use the QSU database of ISO 9000 certified facilities to collect information on the facilities that received certification with the quality management standard between 1995 and 2001.

Control variables. Information asymmetries may affect an organization's propensity to adopt the ISO 14001 certified management standard (Jiang & Bansal, 2003; King et al., 2005). I create two variables to control for this influence. First, for each facility and year, I capture the facility's industry's R&D intensity. Research suggests that investments into R&D both reflect and influence the level of firm intangible attributes such that stakeholders have greater difficulty assessing firm performance in R&D intensive industries (Aboody & Lev 2000; Chauvin & Hirschey 1993). Thus, I use Compustat database to measure an industry's investments into *R&D Intensity*. Because R&D expenditures are only reported on the corporate level, I exclusively consider data from corporations that operate in a single 4-digit SIC code.

For each such corporation, I calculate annual R&D intensity by dividing R&D expenditures by sales. I then average and log this data for each four digit SIC code and year to measure annual industry R&D Intensity.

I measure a facility industry's propensity to sell its products outside of the U.S. to control for the information asymmetries present in international trade. Research suggests that information asymmetries increase with spatial distance between buyers and seller. Thus, I use shipment data classified by SIC code from the BEA and export data from the U.S. Census Bureau to create the variable *Export*, which measures for each four digit SIC code and year the percentage of exports of shipments.

A facility's propensity to certify with ISO 14001 may furthermore be influenced by coercive pressures. Two variables control for this effect. First, *Auto Supplier* is a binary variable that indicates whether a facility sells its products to an automobile manufacturer. The automobile industry has been the most active in advocating ISO 14001 among supply chain partners. For instance, Ford, GM, and Toyota have all announced that they give preference to ISO 14001 certified facilities.

Second, I follow a procedure devised by Meyer (1995) to capture coercive pressures emanating

from regulatory agencies. Specifically, *Regulatory Stringency* captures the logged aggregate emissions per state over the sum of the Gross State Product in four polluting sectors (chemicals, pulp & paper, textiles, and petroleum products). I update this index for every year and take its inverse so that the value increases with an increase in regulatory stringency (i.e., as state wide emissions per dollar of Gross State Product decrease).

I create *Industry Certification* to measure the influence of mimetic adoption pressures. This variable reflects the annual percentage of ISO 14001 certified facilities in each 4-digit SIC code.

Facility and firm attributes may furthermore influence adoption propensities. For example, resources and slack available to both the facility and firm may influence adoption of ISO 14001. I thus create the variable *Relative Facility Size* which captures for each facility and year its logged number of employees. I normalize this variable (by industry and year) to account for the fact that the meaning and influence of specific facility sizes on adoption propensities varies across industries. I measure *Firm Size* by summing the employee numbers of all facilities belonging to a firm in a specific year and log this count to reduce its skew. Because ownership structures may influence the cost and propensity of adopting a management standard (Darnall & Edwards, 2006), I also create the binary variable *Publicly Held* to indicate whether a facility is owned by a publicly held corporations.

Finally, I include year fixed effects to account for the influence of temporally changing diffusion dynamics (Rogers, 1995) as well as the influence of temporal changes in broader economic conditions. Table 1 presents descriptive statistics and a correlation table.

TABLE 1

Variable	Mean	Std. dev.	Min.	Max.	1	2	3	4	5	6	7	8	9	10	11	12
1 Facility Env. Perf.	-0.14	0.99	-4.36	4.45	1.00											
2 Cleaner Firm Performer	0.51	0.50	0.00	1.00	0.53	1.00										
3 In Cleaner Industry	0.45	0.50	0.00	1.00	-0.01	0.05	1.00									
4 ISO 9000 Certification	0.21	0.41	0.00	1.00	-0.07	-0.05	0.01	1.00								
5 R&D Intensity	0.03	0.02	0.00	0.16	-0.02	0.00	0.01	0.06	1.00							
6 Export	0.05	0.05	0.00	0.57	-0.02	-0.02	-0.04	0.11	0.08	1.00						
7 Auto Supplier	0.08	0.27	0.00	1.00	0.01	0.00	-0.14	-0.02	0.08	0.05	1.00					
8 Regul. Stringency	0.13	0.02	0.09	0.22	0.05	0.07	0.03	0.07	0.04	-0.04	-0.03	1.00				
9 Industry Certific	0.38	1.03	0.00	14.71	0.01	-0.01	-0.07	0.18	-0.05	0.16	0.15	0.00	1.00			
10 Rel. Facility Size	0.25	0.95	-4.66	5.73	-0.29	-0.18	0.04	0.11	0.03	-0.01	-0.02	0.01	-0.02	1.00		
11 Firm Size	83.39	99.47	0.00	674.88	-0.05	0.00	0.16	-0.02	0.01	0.06	0.16	-0.02	0.04	0.12	1.00	
12 Publicly Held	0.78	0.41	0.00	1.00	-0.04	0.00	0.13	0.03	0.05	0.07	-0.02	-0.01	0.03	0.05	0.17	1.00

N = 36093

Model

I analyze certification with ISO 14001 using a discrete time random effect logistic model. For each facility, I predict certification with ISO 14001 in t+1. As soon as a facility has certified with ISO 14001 I no longer consider it in my sample because it no longer is at risk to adopt. The model uses a maximum likelihood procedure (based on a Gauss-Hermite quadrature approximation) to estimate the likelihood that a facility certifies with ISO 14001. The model is specified as:

$$P_{it+1} = F(Z) = F(a_i + b\mathbf{X}_{it}) = e^{(Z\ \ )}_{it}/(1 + e^{(Z\ \ )}_{it})$$

where P is the probability that facility i will certify with ISO 14001 in the next year (t+1). The vector X_{it} represents the characteristics of the i_{th} facility or its industry in year t. The facility individual or random effects are measured as a_i. I use a random effects model to correct for unobserved heterogeneity among units and a lack of independence across observations of the same firm. I use the random, rather than a fixed effect specification because the fixed effect model would disregard all observations that did not adopt ISO within the panel period. Because the random effect specification in the model makes some assumptions about the distribution of a_i (it assumes that facility heterogeneity is randomly distributed), I perform a number of tests to ensure its robustness for my analysis. I describe these tests in the section below.

Results

Table 2 reports the results of my analysis. Model 1 in Table 2 shows the results of the base model which includes the control variables. Information asymmetries as captured by the facility industry's R&D intensity significantly increase a facility's propensity to certify with the ISO 14001 environmental management standard whereas a facility's tendency to export does not have a significant effect. Coercive pressures from auto manufacturers also increase adoption propensities, as do mimetic pressures resulting from greater diffusion of ISO 14001 within the industry. Regulatory stringency has no significantly effect on ISO 14001 certification, possibly because of regulators having other means to request and monitor firm environmental performance. Finally, facility and firm size both increase an organization's likelihood to certify with ISO 14001. Public ownership decreases that likelihood.

TABLE 2: Model Results

Variables	Model 1	Model 2	Model 3	Model 4
Facility Environmental Perf.		-0.160**	-0.168**	0.852**
		(0.058)	(0.059)	(0.046)
Cleaner Firm Performer		0.255*	0.292*	1.265*
		(0.113)	(0.115)	(0.133)
In Cleaner Industry		0.375***	0.267*	1.402***
		(0.101)	(0.118)	(0.134)
ISO 9000 Certification		0.557***	0.464**	1.733***
		(0.100)	(0.104)	(0.164)
R&D Intensity	9.273**	8.815**	10.215*	3.941**
	(2.704)	(2.880)	(4.194)	(11.048)
Export	0.836	0.553	-0.208	1.964
	(0.842)	(0.866)	(1.239)	(1.638)
Auto Supplier	1.404***	1.524***	24.772**	4.309***
	(0.130)	(0.134)	(1.126)	(0.508)
Regulatory Stringency	3.598	2.887	3.456	1.542
	(2.909)	(2.933)	(3.191)	(4.003)
Industry Certification	0.071**	0.064*	-0.034	1.052*
	(0.026)	(0.026)	(0.034)	(0.022)
Relative Facility Size	0.377***	0.324***	0.381**	1.359***
	(0.056)	(0.058)	(0.061)	(0.071)
Firm Size	0.001**	0.001**	0.001*	1.001***
	(0.000)	(0.000)	(0.001)	(0.000)
Publicly Held	-0.254*	-0.335**	-0.312*	0.720**
	(0.117)	(0.118)	(0.122)	(0.079)
Year Fixed Effects	Incl.	Incl.	Incl.	Incl.
Industry Fixed Effects	-	-	Incl.	-
Chi-Square (df)	641 (15)***	680 (19)***	1281 (91)***	753 (20)***
Log Likelihood	-1976.89	-1949.89	-1853.49	1499.47

N = 36093.
Constant emitted due to RE specification
* = p<0.05; ** = p<0.01; *** = p<0.001. All tests are two tailed.

Model 2 presents the fully specified model. I find support for Hypothesis 1 that facilities with poorer environmental performance (relative to other industry facilities) are more likely to certify with ISO 14001. I argue that this is due to stakeholders targeting their efforts on such poor performers. Results also lend support to Hypotheses 2 through 4. Specifically, facilities with better environmental performance than other firm-facilities are more likely certify with ISO 14001 (Hypothesis 2)[6]. I argue that corporate headquarters select their better performers for certification because they are uncertain (i) whether adoption will be rewarded with any benefits, and (ii) how the magnitude of these benefits relates to potential improvements resulting from the implementation of best practices. Given this uncertainty, firms likely seek to minimize adoption costs by requesting certification by their better performers. Results furthermore indicate that firms seek to reduce adoption costs by requesting certification from plants that operate in industries that are cleaner than the industries of other firm facilities (Hypothesis 3) and that have prior experience with management standards (Hypothesis 4).

In Models 3 and 4, I perform tests to ensure the robustness of these results. In Model 3, I include industry fixed effects (on the three digit SIC code level) to test whether results may be confounded by some underlying industry-specific tendency to certify. As expected, the industry dummies reduce the significance of some of the industry level variables (such as *R&D Intensity* and *Industry Certification*) but Model 4 confirms the results for the independent variables. Model 4 is specified as a non-parametric partial-likelihood Cox-regression in order to test whether results are robust to the log odds specification of Models 1 through 4. I cluster observations on the facility level to control for a lack of independence among these observations over time. Note that in Model 4 the reported coefficients represent hazard rates. Coefficient greater than unity indicate that the variable has a positive effect on adoption propensities whereas coefficients smaller than unity indicate negative effects. For the hypothesized relationships, I obtain results that are consistent in sign and significance to those produced in the logistic analyses.

Conclusion

I analyze corporate use of certification with the ISO 14001 environmental management standard. Previous studies frequently have applied signaling theory to the analysis of CMS like ISO 14001 but empirical irregularities suggest that this theory provides only a partial explanation for the actual usage of the standards. In this analysis, I address this gap by analyzing how three specific aspects of CMS may modify signaling dynamics. Specifically, the signaling framework developed here considers (i) that CMS require the implementation of practices that likely change the attribute about which a firm may signal, (ii) the uncertainty of the payoffs of adopting a social CMS, and (iii) the room for strategic behavior that is created by the fact that multi-plant firms can choose which of their plants to certify. Within the context of a certified environmental management standard the resulting framework suggests that contrary to traditional signaling theory, organizations with poor environmental performance will seek certification, yet these poor performers are actually organizations that outperform other plants within their firm. Furthermore, they operate in relatively cleaner industries and have prior experience with management standards. I label this adoption pattern “satisficing signaling”: While firms with poor performing plants seemingly respond to stakeholder pressures to adopt a CMS, they are not truly acting in

6 The coefficient of *Cleaner Firm Performer* is significant at the 0.5 level but note that its p-value equals 0.024 and thus is well below the $p<0.05$ cutoff.

the interests of stakeholders because they certify better within-firm performers that operate in cleaner industries.

For signaling theory, the results of this study imply that the theory may be enhanced by considering multi-tiered decision structures. In the context of Spence's classic signaling model, it may not solely be the student who decides to go to college – instead, the family head may also be involved in the decision which of the offspring to send to college. In the context of CMS, corporate headquarters likely influence the decision which plant will seek certification. This report suggests that such multi-tiered decision structures require explicit consideration because they likely influence signaling dynamics if the interests of the various decision makers differ and if the benefits of pursuing a signaling action are uncertain. This study furthermore highlights the implications of a signal communicating about variable attributes, rather than fixed, innate ones. In cases in which the signaling action is likely to modify (e.g., improve) the attributes of the signaling party, the signal becomes a device to communicate about this potential change. In the case of certified environmental management standard, for instance, certification might no longer be a signal of superior environmental performance – instead, it might signal about a firm's efforts to improve this performance.

For research on certified management standards, this study points to the importance of the level of analysis. Many studies focus either on the firm level or on the facility level to analyze adoption of CMS. Jiang and Bansal (2003) and Chapple et al. (2001a, 2001b), for example, study the firm attributes that may influence certification decisions, whereas King et al. (2005) and Darnall & Edwards (2006) primarily focus on the effects of facility attributes. Both perspectives have their merits; a focus on the facility level is informative because certification with a CMS typically occurs at the facility level. Yet the decision to seek certification frequently occurs at the firm level, thereby justifying (and necessitating) a firm-level focus. By focusing on a within-firm perspective, this report highlights yet another level of analysis that thus far has been neglected. A within-firm perspective may contribute to my understanding of observed adoption patterns because it allows considering that multi-plant firms can engage in strategic behavior when choosing which of their plants to certify. Furthermore, a within-firm perspective enables us to explicitly analyze how facilities of multi-plant firms respond to pressures and requests originating from both their industry context and their firm context.

This research also has implications for policy makers. For policy makers understanding firm usage of social CMS is particularly important because it has traditionally been their responsibility to ensure that firms provide an adequate amount of public goods such as environmental protection. The results of this study suggest that at least one example of a social CMS – the ISO 14001 certified environmental management standard - can be a helpful tool in ensuring some extent of environmental protection; specifically, firm environmental performance may be enhanced by stakeholders pressuring plants with poor environmental performance into adopting best environmental practices. Yet as a stand alone tool social CMS are unlikely to lead to desirable firm environmental performance. Because firms are uncertain about the payoffs associated with adopting a social CMS -- environmental best practices may not translate into operational benefits and market participants may not be willing to reward improvements in environmental performance -- multi-plants firms may be better off certifying their high performing plants who can certify at lower costs. As a result, the environmental CMS fails to improve the environmental practices of the poorest performing plants (which have the greatest room and need for improvements). For policy makers, this implies that some intervention may be

required so as to ensure a premium that provides an incentive for the firm to certify their poorest performers. This premium could be in the form of regulatory relief, free positive publicity, or technical assistance in converting environmental improvements into operational benefits – what matters most is that the premium is proportional to any improvements, thereby providing an incentive to adopt and certify social best practices in plants that most need it.

Epilogue

Research to date has provided accumulating evidence that certification with 14001 can play but a limited role in removing information asymmetries in the market for corporate environmental performance. As discussed in this report, this is primarily due to the standard's design, but may partially also be attributable to failures in the certification system. At the outset of this study, however, the limitations of ISO 14001 as a signaling instrument were not yet fully documented. Hence, some initial analysis was conducted under the assumption that signaling models correctly capture the functioning of certified management standards. In such as scenario, actual adoption patterns may then be expected to match signaling theory imperfectly if firms engage in what is called "countersignaling". I did not find any empirical support for this notion. However, for completeness, I briefly report about the concept of countersignaling and my empirical tests.

Applying the notion of 'countersignaling' (Feltovich, Harbauch, & To, 2001) to the context of ISO 14001 certification suggests that certification behavior may not be monotonically increasing with firm environmental performance so that we find average performing firms, rather than well performing firms, certifying with ISO 14001. One explanation is offered by Fremling & Posner (1999) who show that high quality agents that already have a good reputation have lower marginal returns from signaling than lower quality ones. As a result, signaling might become less attractive for the high quality type. The concept of countersignaling is related to this explanation. It suggests that if extra information on the performance of the firm is available, and if this information is still somewhat noisy, a situation emerges in which higher performing companies will *not* certify with ISO 14001 in order to differentiate themselves from the average performing type (Feltovich et al., 2001). The underlying driver is that the extra information is sufficient to separate the high performing company from the low performing one, but too noisy for the average performing company to be certain that stakeholders won't confuse it with a poor performing firm. Because of this uncertainty, firms with average environmental performance will feel compelled to signal so as to differentiate itself from the low performing firm. Since average performing firms are certifying with ISO 14001 to differentiate themselves from low performing one, firms with above average environmental performance will choose *not* to certify with ISO 14001 so as to differentiate itself from the average performer. In a sense, forgoing certification becomes a signal in itself. By taking an action that is too risky for the average performing company, the high performer shows its confidence that the extra information is favorable to them (Feltovich et al, 1999).

I performed extensive explorative analysis to test the notion that the environmental performance of certifying firms systematically varies across levels of information asymmetries. I used different measures to capture the varying degrees to which market participants may have access to extra information about the firms' environmental performance. These measures included firm and industry level advertising intensity, firm size, public versus privately owned, industry size,

and firm and industry level R&D intensity. I found no support for a systematic relationship between levels of information asymmetries (i.e., levels of availability of additional information) and the environmental performance (as captured by relative TRI emissions) of certifying firms. This, combined with other findings that question the signaling function of ISO 14001, suggests that a signaling lens can only provide a limited understanding of the function and meaning of this environmental management standard.

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PART II: THE USE OF PCS DATA FOR ENVIRONMENTAL MANAGEMENT RESEARCH

Introduction

The Permit Compliance System (PCS) is a data management system used to compile all relevant facts about a facility's water discharge permit such as the facility's permit conditions, self-monitoring data, the inspections performed, and any enforcement actions taken. PCS is the national data base for the National Pollutant Discharge Elimination System (NPDES program), which requires point sources discharging pollutants into waters of the United States to obtain a permit. The EPA is currently is modernizing PCS and replacing it with the Integrated Compliance Information System (ICIS). 24 States/territories currently use ICIS. Data in PCS and ICIS are updated by States and /or Regions depending on data entry agreements. Data entry timing into PCS or ICIS can be uneven so that some inaccuracies temporarily exist due to data migration-related issues and the nature of the data entry.

Researchers interested in using achievable, longitudinal data for research related to firm and facility level environmental performance most typically use data from the Toxic Release Inventory (TRI). This database provides annual data on facility emissions (releases, disposals, and transfer) of any of approximately 650 toxic chemicals as specified in the Emergency Planning and Community Right to Know Act (EPCRA) section 131. TRI data has a number of important advantages, including mandatory, annual reporting for facilities with essentially any practically meaningful manufacturing activities, it is very easily accessible, covers a substantial time period, has relatively stable reporting requirements and patterns, and, importantly, comes with very extensive and detailed documentation and supporting materials and explanations. Notwithstanding these advantages, it is possible that its frequent use also is partially created by path dependency, meaning that it is the result of research following in the footsteps of some early and very visible work within the environmental management arena that has used TRI data. The strong and sometimes exclusive focus on TRI data has led to some criticism and calls for exploring other data that may capture firm and facility level environmental performance and allow triangulating performance measures derived from TRI.

Very few studies within environmental management have used PCS data. (Professor Earnhart at the University of Kansas and his colleagues represent an exception). This project will discuss that there are multiple reasons for this. These include difficulties to access the data, large amounts of missing data, and very little concise and readily available information that helps researchers understand the database. This project addresses this by summarizing and synthesizing information related to PCS so as to provide a more readily available manual that may facilitate greater usage of PCS data in the future. The project also provides an initial assessment of the suitability of PCS data for research in environmental management.

Overview of PCS

Who Reports?

Any facility classified as major facility (see further below on more explanation of this classification) with a NPDES permit needs to report discharge data as related to its pernit. Any facility discharging wastewater from a direct point course into any water body (streams, lakes, etc) is required to have a NPDES permit. Discharges into the groundwater require no NDPES permit by federal law, but States are free to require a permit if they wish to. Indirect discharges (i.e., discharges to publicly owned treatment works (POTW) require no permits. The first round of NPDES permits was issued in 1973. Permits may be administered by States or the EPA.

The EPA Envirofacts Data - Water Discharge Permits map layer shows locations of more than 101,000 sites in the United States, Puerto Rico, and the U.S. Virgin Islands that discharge waste water into United States waters as of May, 2005. As of 2007, PCS captures approximately 6,500 facilities that are classified as major dischargers, and 88,000 that are classified as facilities minor dischargers. Major municipal dischargers are facilities with flows greater 1Mio gallons per day as well as facilities with industrial pretreatment programs. Major industrial facilities are determined based on specific ratings criteria developed by the EPA and the States. The criteria can vary across States. Typical examples of major dischargers include petroleum refineries, electric utilities, and larger wastewater treatment plants. Examples of minor dischargers are gas stations and neighborhood dry cleaners. Note that the vast majority of facilities captured in PCS are classified as minor discharger

While all NPDES permit holders classified as major dischargers should be captured in PCS, not all minor dischargers are captured. This is because States that have authority to administer NPDES permits are not required to use the PCS or ICIS system to enter and automatically track NPDES related information at non-major facilities. However, several states are voluntarily tracking at least individually permitted non-major facilities in PCS or ICIS. The 2006 non-major limit and Discharge Monitoring Report (DMR) chart (at http://www.epa-echo.gov/echo/docs/percent_dmrs_2006.pdf) shows the percentage of minor discharges with individual permits that are tracked in PCS or ICIS by state or territory. On average, approximately 50% of all minor facilities are captured in PCS, but this percentage varies greatly across states.

What is reported, and when?

Reporting requirements vary for major and minor facilities. Facilities classified as major self-report their discharges to the States (typically on a monthly basis and as specified in the permit). This report is referred to as the Discharge Monitoring Report (DMR). Discharge information relates to NPDES specified limits for conventional pollutants (BOD5, TSS, fecal coliform, pH, fecal coliform, oil and grease), toxic pollutants, and non-conventional pollutants. The States (or EPA, depending on the permitting authority) collect this discharge information and input it to PCS, in combination with the corresponding permit limits, inspections, violations, enforcement actions, and penalties.

Minor facilities whose NDPES permit is administered by their state may not be captured in the PCS database at all (see above). As far as they are captured, States can only report whether an inspection has occurred. For minor facilities, actual facility discharge information may or may not be reported, depending on what the State wishes to report.

The following are exact reporting requirements for the permitting authorities (as of May 2005). These requirements apply to "federally-defined" data fields in each PCS database.

Data Entry Requirements	Notices of Violation	Inspection	Violations	Enforcement Actions	Penalties	Est # Facilities
Major	Yes	Yes	Yes	Yes	EPA only	6,565
Non-major	No	Yes	No	No	No	87,939

Data recorded in PCS is organized into the following subject areas: Information related to the (i) permitted facility, (ii) its outfalls and discharges, (iii) its permit performance, (iv) enforcement, (v) its compliance schedule, (vi) inspections, and (vii) references. An overview of the organization of the dataset is available at http://www.epa.gov/enviro/html/pcs/pcs_subj.html

Discharge Information

The periodicity of the discharge information of major facilities varies. The NPDES Program is structured so that facilities are required to periodically evaluate compliance with the effluent limitations established in their permit and provide results to the permitting authority. Frequency for monitoring pollutants is determined on a case-by-case basis and decisions set forth in the states. Exact reporting schedules are stated in each permit and, for major facilities, are reported to PCS. Commonly, (major) facilities are required to report on a monthly basis. At a minimum, permittees (with certain specific exceptions) must monitor for all limited pollutants and report data at least once per year.

NPDES reporting and monitoring requirements can be reduced based on demonstration of excellent historical performances. A facility has excellent historical performances if it has consistently met a set of compliance and enforcement criteria and has demonstrated the ability to consistently discharge pollutants below permit limits. Reductions are determined parameter-by-parameter based on existing monitoring frequency and percentage below the limit the parameter is discharging. Reductions are incorporated into the permit at the time of permit reissuance. To remain eligible for reductions the facility must maintain parameter performance levels and good compliance and enforcement history.

Permittees are required to monitor pollutant mass (or other applicable unit of measure), effluent volume, provide other measurements (as appropriate) and utilize the test methods established at 40 CFR 136. Permits can also require the permittee to monitor for additional parameters or processes not directly linked to the effluent discharge such as storm water, combined sewer overflows, municipal sludge, and/or treatment plant influent. Some States have their own recommended sampling guidelines.

Compliance Inspections Information

Compliance inspections refer to all field-related regulatory activities conducted to determine permit compliance. Such field activities may include evaluation inspections (nonsampling),

sampling inspections, other specialized inspections, and remote sensing. Certain inspections, such as diagnostic inspections and performance audit inspections, aid the regulatory agency in evaluating the facility's problems in addition to providing information to support enforcement action. Biomonitoring inspections are specifically targeted at facilities with effluent suspected or identified as causing toxicity problems that threaten the ecological balance of the receiving waters.

Compliance inspections take place irregularly and are undertaken for one or more of the following purposes: To establish a regulatory presence to defer violations, to ensure that permit requirements are being met or to determine if permit conditions are adequate, to check the completeness and accuracy of a permittee's performance and compliance records, to assess the adequacy of the permittee's self-monitoring and reporting program, to determine the progress or completion of corrective action, to obtain independent compliance data on a facility's discharge, to evaluate the permittee's operation and maintenance activities and to observe the status of construction required by the permit.

Enforcement Action Information

Once a (major) facility has been identified as having apparent permit violations the EPA or the NPDES State or Tribal organization will review the facility's compliance history. Such a review includes an assessment of the magnitude, frequency, and duration of violations. Significant permit violations are identified and a determination of the appropriate enforcement response is made.

Section 309 of the Act authorizes the Agency to bring civil or criminal action against facilities which violate their NPDES permit conditions. EPA Regions and authorized States have specific procedures for reviewing self-monitoring and inspection data and for deciding what type of enforcement action is warranted. (list in EA Action).

NDPES Permit Requirements

NPDES permit requirements have evolved over the years. This creates challenges especially for researchers that are interested in tracking permit related information across time. Researchers using PCS data for longitudinal analysis should be aware of the following milestones.

The first round of NPDES permits, issued from 1973 through 1976, required non-municipal (industrial) facilities to meet two technology-based standards: Best Practicable Control Technology Currently Available (BPT) and Best Available Technology Economically Achievable (BAT). Compliance deadlines were July 1, 1977 and July 1, 1983 respectively. Municipal facilities were required to meet secondary (biological) treatment standards by July 1, 1977.

The 1977 Amendments, formally known as the Clean Water Act (CWA), shifted the emphasis from controlling "conventional" pollutants to controlling toxic discharges. Section 304(a)(4) of the CWA designated the following as conventional pollutants: Five day biochemical oxygen demand (BOD5),Total suspended solids (TSS),pH, Fecal coliform, and Oil and grease (O&G) (added in 1979 in 40 CFR §401.16). Section 307(a)(1) of the CWA required the establishment of a published list of toxic pollutants or combination of pollutants often called priority pollutants (listed in 40 CFR §401.15). Originally 65 toxic pollutants and classes of pollutants were

included (40 CFR Part 401.15); in the late 1970s this list was expanded to 126 pollutants and classes of pollutants (Appendix A to 40 CFR Part 423). Substances such as chlorine or ammonia that are not specifically listed as conventional or toxic pollutants are called non-conventional pollutants. Conventional pollutants, controlled by BPT in the first round of permitting, were now subject to a new level of control termed Best Conventional Pollutant Control Technology (BCT) with a compliance deadline of July 1, 1984. BCT i replaces BAT for the control of conventional pollutants, while BAT remains in effect for the toxic and non-conventional pollutants.

The Water Quality Act (WQA) again extended the time to meet BAT and BCT effluent limits to a compliance deadline of March 31, 1989 for both. The WQA also established new schedules for industrial and municipal storm water discharges to be regulated by NPDES permits. In addition to meeting water quality-based standards, industrial storm water discharges must meet the equivalent of BAT and BCT effluent quality standards. Discharges from municipal separate storm sewer systems (MS4s) were required to have controls to reduce pollutant discharges to the "maximum extent practicable". Additionally, the WQA required the EPA to identify toxics in sewage sludge and establish numeric limits to control these toxics. A statutory anti-backsliding requirement was also established limiting the circumstances under which an existing permit can be modified or reissued with less stringent effluent limits, standards, or conditions than those already imposed.

Data Entry into PCS

Larger, centrally organized agencies typically have specialized personnel responsible for enforcing the terms of NPDES permits. In other organizations, the individual who writes the permit also is responsible for such enforcement activities as Discharge Monitoring Report (DMR) tracking, facility inspections, and enforcement recommendations. In the event of a judicial enforcement action, the permit writer can be called upon to testify regarding the specific requirements of the permit or its basis.

Facilities report their compliance and status information by submitting Compliance Schedule Reports and Discharge Monitoring Reports (DMR) to Regions or delegated States which enter the information into the system. Inspection and enforcement information is collected and entered by Regions and/or delegated States

EPA Regional Offices and States that have been approved to administer the NPDES Program are required by regulation to report quarterly on major facilities that are not in compliance with the terms and conditions of their permit (i.e., effluent limitations meet the criteria for reportable noncompliance [RNC], schedules, and reporting requirements).

The NPDES Program consists of various components, including: NPDES base program for municipal and industrial facilities, federal facilities, general permitting, the pretreatment rogram (POTWs), and biosolids. A state may receive authorization to administer one or more of the NPDES Program components. For example, if a state has received authorization to administer the NPDES base program for municipal and industrial facilities, but no authorization to administer permitting for federal facilities, EPA would continue to issue permits to federal facilities (e.g., military bases, national parks, federal lands, etc.) The process of authorization for states includes a public review and comment period, and a public hearing. If EPA disapproves the program, EPA remains the permitting authority for that program. A chart of state programs as of April 2003 can be found at (http://cfpub2.epa.gov/npdes/statestats.cfm).

Suitability of PCS Data for Research on Facility & Firm Level Environmental Performance

Overall, PCS data is not very suitable for most research on facility and firm level environmental performance. This holds particularly true when considering its value relative to TRI data. That said, PCS has some distinct advantages that may make it attractive for narrowly defined sets of research questions. These advantages include the frequency with which major facilities report about their discharges, as well as its potential suitability for environmental biogeochemistry research. I will briefly discuss these advantages before assessing some of its most important limitations.

Advantages of PCS Data

Frequency of Discharge Data

For most major facilities, PCS provides monthly discharge data. This compares to annual reporting intervals in the TRI. EPA's Enforcement and Compliance Online (ECHO) Database also cannot compare. ECHO only provides enforcement and compliance data (that is partially pulled out of PCS) and no actual discharge data.

Monthly discharge data can be compared to actual permit limits, allowing researchers to assess not only the extent of compliance but also whether the company is overcomplying (a feature that is rare in other compliance datasets). Monthly information can potentially also allow researchers to much more carefully asses cause and effects relationships. Data availability frequently drives researchers to assess cause and effects in annual intervals. Annual intervals may be appropriate for some research questions and contexts, but more fine grained information likely is required when effects are expected to occur in shorter timeframes. PCS data provides the possibility for such fine grained analyses.

Biogeochemistry Research

PCS data provides detailed information on discharge locations. More specifically, for each of its discharge points (i.e., discharging pipes), each (major) facility provides information on the exact discharge location and amounts (concentrations etc). Combined with information regarding receiving water bodies, this data can be valuable for "real world experiments" (as opposed to laboratory experiments) in water quality management at the watershed level and the fate and transport of pollutants in the environment.

Disadvantages of PCS Data

Inconsistent Reporting Requirements Across Time and Firms

Inconsistencies in PCS reporting requirements pose a serious challenge for researchers interested in using PCS data for assessing facility (or firm) level environmental performance. Some of these inconsistencies create more serious problems than others.

It is relatively common for regulations governing reporting requirements to change over the years. Reporting requirements for the TRI dataset, for example, have changed several times: originally, only manufacturing facilities were required to report to TRI. Since 1994, federally

owned facilities also have to report. Furthermore, at its inception, TRI covered ca 300 reportable chemicals. In 1995, 300 additional chemicals were added. As outlined earlier in this manual, PCS reporting requirements have changed in a similar manner. However, the inconsistencies introduces by these changes are somewhat systematic and hence can be corrected or controlled for in statistical analyses.

More serious inconsistencies are introduced by cross firm differences in permit requirements. Permit writers have discretion to adjust allowable limits and reporting requirements (for the same pollutants) according to the water quality of the receiving water bodies, the economic conditions of the facility, and the facility's past permit performance. These variations are not systematic, and hence threaten the suitability of PCS data for comparing compliance data. For example, two facilities that are otherwise identical and discharge the same amount/concentration of a certain pollutants may have differing compliance status because permit limitations were stricter for one than the other. Cross firm comparison of actual discharges also can be hampered by differences in reporting requirements in terms of the frequency of reporting as well as the sampling methods used.

Missing Data

PCS data tables and fields have a lot of missing data. This is partially due to the fact that in 2007, only 6% (6,640) of captured facilities were major facilities. As outlined before, states do not need to report any information on minor facilities, and if they wish to report, the exact data fields that are filled in vary. Furthermore, as of September 2007, 18% of the 6,640 reporting major facilities were affected by EPA's backlog dealing with permit applications. For these 1120 facilities, recent data is missing or false. Even for facilities classified as major and operating with a valid permit, datafields that should be filled in sometimes are blank. Because reporting procedures are complex and vary across states and firms, it is difficult to track down the parties that might hold the information to fill in missing data.

Missing Code Descriptions

A major problem using PCS data is that for approximately 60 of its data fields, users are referred to the PCS code description table for decoding relevant variables. The code description table, however, often only provides the possible range of variable values/codes in combination with descriptions that do not make sense without any further explanations. For example, the field "Compliance Schedule Event" contains "A five-digit code indicating the particular event that the permittee is scheduled to comply with. The first two digits (being any alphabetic or numeric character) represent the event, and the last two digits represent the Region or State establishing the event". To decode these five-digit codes, users are referred to Code Description Table 020. In Table 020, the description of the codes from the Compliance Schedule Event then read, for example: code "11510" means "Quarterly Report #20", code "11910" means "comments", and code "11808" means "18th Bioassay Result". These translations are not helpful since no further explanations are offered to reveal, for example, the meaning of "18th Bioassay Result". Sometimes, users can search the internet for manuals that state agencies have posted to guide permitting authorities when reporting data to the PCS system. However, this search is tedious and not always successful. The appendix of this report provides explanations for some data fields for which given code descriptions were insufficient.

Access Difficulties

Use of PCS is severely hampered by difficulties accessing it. Unlike TRI data, which is made available annually and accessible for all via the internet, and which can be downloaded in a batch format, PCS data needs to be accessed through individual queries via the Envirofacts interface. For researchers interested in establishing large, longitudinal datasets, such individual queries are inefficient and time consuming, if not infeasible. EPA grantees can directly access the PCS database as technical users and through a remote connection. However, this possibility is limited to grantees only, hence restricting substantially the potential pool of users. Furthermore, experience suggests that even for grantees who received technical user access, downloading larger batches of data still is difficult or impossible since various firewalls (that supposedly can be managed through using SecuRemote) cause unstable connections that get interrupted as larger batches of data pass through.

Lack of documentation

A final issue relates to missing and insufficient documentation. Use of TRI data has been encouraged by readily available and detailed documentation that makes it easy to understand reporting structures and interpret reported information. While the EPA provides an overview of PCS's model structure (including the relations between the various data tables) on its webpage, very little other information is readily available. At times, manuals posted by permitting state agencies explain about reporting structures, requirements, and variable descriptions, but there is no centralized information clearing house to provide the information needed to understand and use PCS data for research in environmental management. Potential users should be made aware that almost all information contained in PCS that relates to inspections and enforcement can also be found in the ECHO database. ECHO is much more user friendly and comes with extensive documentations. Hence, for researchers just interested in inspections and enforcements, ECHO might be the better choice.

Conclusion

The Permit Compliance System (PCS) is a data management system used to compile all relevant facts about a facility's water discharge permit such as the facility's permit conditions, self-monitoring data, the inspections performed, and any enforcement actions taken. This report provides an initial "manual" of this dataset to facilitate its use in future environmental management research. The manual includes a description of the data contained in PCS, an explanation of reporting structures, reporting requirements, and other relevant facts. It also augments explanations and PCS code descriptions provided by the EPA. Overall, PCS data comes with a lot of issues, making its use rather cumbersome. Researchers interested in discharges and emissions may find it easier to use TRI data (although TRI data is annual, as compared to a mostly monthly reporting structure in PCS). Researchers interested in inspection and enforcement actions may find it easier to use data contained ECHO.

References and Useful Links

(links current as of 8/25/08)

EPA Terms of Environment: Glossary, Abbreviations & Acronyms
http://www.epa.gov/OCEPAterms/

Map of Water discharge permits
(http://www-atlas.usgs.gov/mld/efct02x.html)

Status Report for Non-tribal Individual Major Permits Published September 2007
http://www.epa.gov/npdes/pubs/grade.pdf

Permit Status Report for Non-Tribal Major Individual, Minor Individual, and Non-Stormwater General Permit Covered Facilities - September 2007
http://www.epa.gov/npdes/pubs/grade_all.pdf

U.S. EPA NPDES Permit Writers' Manual. Published December 1996 by the EPA
EPA-833-B-96-003
http://www.mcelroylaw.com/US%20EPA%20NPDES%20Permit%20Writers%20Guide%201996.pdf

Summary of EPA Compliance & Enforcement Data Entry Requirements
http://www.epa-echo.gov/echo/data_entry_requirements_table.html

Priority Pollutants/307(a) Toxics
http://www.epa.gov/waterscience/methods/pollutants.htm

Pretreatment Program
http://cfpub.epa.gov/npdes/home.cfm?program_id=3

Biosolids
http://cfpub.epa.gov/npdes/munipermitting/biosolids.cfm

State and Tribal Program Authorization
http://cfpub.epa.gov/npdes/statestribes/astatus.cfm

Municipalities and Wastewater Treatment Plants
http://cfpub.epa.gov/npdes/home.cfm?program_id=13

Industrial and Commercial Facilities
http://cfpub.epa.gov/npdes/home.cfm?program_id=14

Map of state programs
(http://www.epa.gov/npdes/images/State_NPDES_Prog_Auth.pdf)

PCS table subject areas
http://www.epa.gov/enviro/html/pcs/pcs_subj.html

APPENDIX I: PCS CODE EXPLANATIONS

The appendix provides explanations of many of the code descriptions that were found to be insufficient. Variables in the PCS data model are typically in code form. The PCS code description table provides translations for the codes. However, these explanations are frequently inadequate for users other than permitting authorities (and potentially permittees).

Please see accompanying Excel file named “Code Explanations for Code Description.

APPENDIX II: DELIVERABLES

Publications in Peer Reviewed Journals and Proceedings

Terlaak, A. (2007) "Order without Law: The Role of Certified Management Standards in Shaping Socially Desired Firm Behaviors". Academy of Management Review, 32(3): 968-985.

Terlaak, A. (2007) "Satisficing Signaling: Corporate Social Strategy and Certified Management Standards". Academy of Management Best Paper Proceedings.

Presentations

Invited Presentation at the Lundquist School of Business, University of Oregon, Eugene. April 2008.: "Satisficing Signaling: Corporate Social Strategy and Certified Management Standards".

Invited presentation at EPA Workshop Environmental Behavior and Decision-Making: Corporate Environmental Behavior and Benefits of Environmental Information Disclosure. New York City, NY. January 14 – 16 2008: "Certified management standards: An institution for removing information asymmetries in the market for corporate environmental performance?"

Academy of Management, Philadelphia, PA, August 2007: "Adoption of ISO 14001 among multi unit firms"

Association for Public Policy Analysis and Management Fall Conference, Madison, WI. November 2006): "Corporate Social Strategy and Certification with ISO 14001"

University of Wisconsin-Madison Seminar Series, April 2005: "Engaging firms as social change agents through certified management standards".

Workshops to Disseminate Results

Academy of Management, Anaheim CA. August 2008: Organized a Professional Development Workshop on Databases for Research on Environmental Management and Corporate Social Responsibility