



# Determinants of environmental audit frequency: The role of firm organizational structure



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## ABSTRACT

This study empirically examines the extent of environmental management practiced by US chemical manufacturing facilities, as reflected in the number of environmental internal audits conducted annually. As its focus, this study analyzes the effects of firm-level organizational structure on facility-level environmental management practices. For this empirical analysis, the study exploits unique data from a survey distributed to all U.S. chemical manufacturing permitted to discharge wastewater in 2001; the data reflect internal audits conducted during the years 1999–2001. Empirical results reveal differences in auditing behavior based on whether facilities are owned by publicly held or non-publicly held firms, owned by U.S.-based or non-U.S.-based firms, and owned by larger or smaller firms.

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## 1. Introduction

Voluntary environmental behavior has received some recent attention by economic and business research. Much research focuses on firms' participation in voluntary, government-sponsored pollution reduction programs, such as the 33/50 and Green Lights programs (e.g., Arora and Cason, 1996; Videras and Alberini, 2000; Innes and Sam, 2008); see Khanna (2001) for an exhaustive review of this literature. Other economic research examines voluntary behavior based on industry-sponsored programs or standards, such as the chemical industry's Responsible Care initiative and the International Organization of Standards (ISO) 14001 certification program (e.g., King and Lenox, 2000; Dasgupta et al., 2000; Tambunlertchai et al., 2013). Other studies examine the adoption of environmental management practices without critical references to a sponsored program (e.g., Henriques and Sadorsky, 1996; Bluffstone and Sterner, 2006; Ervin et al., 2012). While previous studies certainly improve our understanding of the motivations and impediments behind decisions to engage in voluntary environmental behavior, few studies assess the effect of firm organizational structure on facility-level decisions to adopt voluntarily environmental management practices. The exceptional studies include Khanna et al. (2007), Jones (2010), Ervin et al. (2012),

Dasgupta et al. (2000), and Arimura et al. (2008). While these exceptional studies assess elements of firm organization structure, none of these studies focus their analysis on these elements. Indeed, most studies assess only firm-level data, thus, eliminating the opportunity to control for facility-level factors, and/or focus exclusively on publicly held firms, thus, severely limiting the scope of any assessment of firm organizational structure. For example, Khanna and Anton (2002) and Anton et al. (2004) examine only firm-level data on only S&P 500 firms.

As important, very few studies examine environmental management practices within the context of compliance with effluent limits, especially since most studies identify their samples based on reference to the Toxic Release Inventory (TRI), which generally records releases that are not regulated. The exceptional studies stem from a single research project on Oregon facilities: Khanna et al. (2007), Jones (2010), and Ervin et al. (2012).

Our study contributes to the literature in both of these dimensions. To understand better the effect of firm-level organizational structure on environmental management decisions, we examine the influence of a firm's organizational structure on the number of audits annually conducted by a facility owned by that firm.<sup>2</sup> For this analysis, we define a firm's organizational structure primarily by the type of ownership structure, nationality of

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<sup>2</sup> Even though we use the term "firm" to depict the owner of a manufacturing facility, our data includes owners that are organized as cooperatives. For the sake of exposition, we interpret the term "firm" to include a cooperative.

ownership, geographical scope of operations, and size of operations, as measured by the number of U.S. facilities.

The dimensions of firm organizational structure may influence management decisions in a variety of ways. For example, firm ownership structure may affect the voluntary adoption of environmental practices; specifically, a publicly held firm may be more likely than a privately held firm to induce its facilities to adopt environmental management practices in order to avoid liability for environmental damages, which is a greater concern for publicly held firms given their greater exposure to likely plaintiffs.<sup>3</sup> Empirical evidence supports this conjecture (Arimura et al., 2008; Jones, 2010; Dasgupta et al., 2000). As another example, a firm's geographical scope may influence environmental management decisions. From one perspective, a firm with more geographically dispersed operations may be less likely than a firm with less geographically dispersed operations to induce its facilities to adopt environmental management practices because the synergies across facilities would be weaker due to varying regulations and applicable standards, e.g., state-level environmental protection laws. From another perspective, firms operating in multiple jurisdictions (e.g., countries) may choose to control pollution at the most stringent level when considering all jurisdictions involved in their operations because this approach lowers unit management costs in the presence of strong scale economies from adopting a single compliance strategy for all facilities within the corporate umbrella. While empirical evidence supports the latter perspective in the case of international scope of operations (Khanna and Anton, 2002; Ervin et al., 2012; Morrow and Rondinelli, 2002; Leonard and Decker, 2012), no empirical evidence supports the former perspective. As a third example, a larger firm may be more likely to induce its facilities to adopt environmental management practices than a smaller firm because the benefit of sending a positive signal to the public, especially to customers who presumably prefer to purchase products from a more environmentally proactive supplier, is greater for a larger firm, as long as this positive signal has "public good" aspects. And empirical evidence supports this last conjecture (Arimura et al., 2008; Ervin et al., 2012; Videras and Alberini, 2000).

As its second contribution, this study examines environmental management within the context of existing regulation. Since the early 1970s, the use of performance-based standards, frequently mis-classified as command-and-control regulations, has been the prevalent choice for governments around the world to improve and protect air and water quality. In the United States, the Clean Water Act (CWA) is the primary law protecting surface water quality. The Environmental Protection Agency (EPA) controls most of the CWA regulatory aspects through the National Pollutant Discharge Elimination System (NPDES). As its starting point, the NPDES system requires every facility that has point-source discharges to possess an effluent permit. These permits regulate wastewater pollutant discharges mainly by establishing limits on the allowable amount of the pollution.

These effluent limits represent performance-based standards, which place restrictions on only the amount of pollution. They do not require any specific approaches for controlling discharges. Within this regulatory context, facilities are free to adopt a variety of environmental management practices for controlling their discharges. When organized as a package, these various practices represent an Environmental Management System (EMS). An Environmental Management System may be monitored and certified by a third party; ISO 14001 certification represents one example. While these environmental management practices – organized as a

system or not, certified or not – may serve to comply with effluent limits, these practices frequently serve to *overcomply* with effluent limits. In this sense, these environmental management practices are also voluntary in nature, i.e., not needed in order to comply with required effluent limits.

The paper proceeds with a review of the literature on corporate environmental management in Section 2. Section 3 provides a simple conceptual sketch. Section 4 depicts the research sample. Section 5 constructs the econometric framework. Section 6 describes our data collection efforts and the gathered data. Section 7 describes the econometric methods and interprets the estimation results. Section 8 compares the empirical results to those of previous studies, discusses the study's limitations, and assesses future research angles.

## 2. Previous studies of environmental management practices

This section reviews previous studies of environmental management practices, with a focus on those studies that examine voluntary environmental management practices. Within this literature, many studies examine the motivations for companies to participate in voluntary programs created by environmental protection agencies. For example, Arora and Cason (1995, 1996), and Innes and Sam (2008) examine participation in the 33/50 program. DeCanio and Watkins (1998) and Videras and Alberini (2000) examine participation in the Green Lights program. Videras and Alberini (2000) also examine participation in the WasteWise program. Khanna et al. (2007) examine the motivations for Oregon facilities to participate in a wide variety of voluntary environmental programs.

Other empirical studies examine the motivations for companies voluntarily participating in a program sponsored by a trade association or based on commercial standards. For example, King and Lenox (2000) examine the decision to participate in the Responsible Care program of the chemical industry.

Many studies explore the decision to adopt an environmental management system and certify it according to the ISO 14001 series criteria. Some of these studies examine US companies. For example, Delmas and Toffel (2008) explore the adoption of an ISO 14001-certified environmental management system using data on facilities operating in heavily polluting U.S. sectors as of 2003. Other studies focus on Asian businesses. Christmann and Taylor (2001) use a survey of Chinese firms to explore ISO 14001 certification. Tambunlertchai et al. (2013) examine ISO 14001 certification by companies in Thailand. Several studies examine Japanese companies (Arimura et al., 2008; Mori and Welch, 2008; Nakamura et al., 2001). For example, Mori and Welch (2008) examine decisions made by Japanese manufacturing facilities in 2001 to adopt an environmental management system that is ISO 14001 certified, while also distinguishing across "early certifiers", "recent certifiers", and "in-process certifiers". Other studies explore a variety of countries, e.g., Dasgupta et al. (2000) examine Mexican companies' adoption of an ISO 14001-certified environmental management system. Lastly, some studies explore companies in multiple countries. For example, using data from a 2003 survey implemented in seven OECD countries, Henriques and Sadosky (2007) examine two related decisions: [1] to adopt an environmental management system (EMS) and [2] to certify any adopted EMS through means such as the ISO 14001 protocol.

Some empirical studies examine environmental management decisions not strongly linked to any voluntary program. Within this set of studies, we distinguish these categories of environmental management: (1) environmental management practices, which reflect mostly policies, procedures, and monitoring; (2) clean production; and (3) pollution treatment. Several studies

<sup>3</sup> We interpret the term "privately held firm" broadly enough to include both a private equity firm and a cooperative.

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