

Averting Environmental Justice Claims? The Role of Environmental Management Systems*

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Key Words: Environmental justice, environmental equity, collaborative environmental governance, ISO 14001, EMS, environmental regulation, environmental risk, environmental racism, facility location

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ABSTRACT

Today, more regulatory provisions are in place for protecting low-income minority populations who shoulder a disproportionate amount of environmental risk. Recognized as communities of “environmental justice,” industrial facilities located within these areas bear greater legal liabilities for and societal scrutiny of their environmental impacts. The authors offer compelling evidence that, in an effort to avoid regulatory and societal claims that they are disproportionately harming minority and ethnic populations, businesses operating inside environmental justice communities tend to adopt an environmental management system (EMS). The article probes whether industries actually improve the environment as a consequence of EMS adoption or whether such systems are simply used to avoid greater governmental scrutiny without necessarily reducing overall environmental risks.

INTRODUCTION

In recent years, public policy and business strategy researchers have become increasingly interested in why manufacturing facilities in the United States (US) adopt various types of environmental management systems (EMS) (e.g. Coglianese & Nash, 2001; Darnall, 2003, 2006; Darnall, Henriques & Sadorsky, 2008; Potoski & Prakash, 2005a, 2005b; King & Lenox, 2001; King, Lenox & Terlaak, 2005). A primary reason why scholars are interested in EMS adoption decisions is that environmental regulators do not require EMSs, and the proliferation of these management systems is viewed as a business effort to proactively self-regulate its environmental affairs. Even in extreme cases where facilities have repeatedly violated environmental laws, regulators merely offer EMSs as one of several options available to reduce their settlement penalties. Moreover, prior to the year 2001, when US buyers began requiring certification as a condition of doing business,¹ thousands of facilities already had adopted these management systems even though EMS adoption requires a significant commitment of facility resources (Darnall & Edwards, 2006). Organizations that adopt EMSs may benefit by enhancing their environmental image and conferring external legitimacy for their operations (Bansal & Hunter, 2003). They also may be able to use their EMS to increase their internal efficiencies, create competitive advantage opportunities, and improve economic benefits (Darnall, Henriques & Sadorsky, 2008). Yet the potential environmental benefits associated with reducing pollution can be enjoyed by society at large. Together, the voluntary nature (Manne & Wallich, 1972), commitment of resources (Hay, Gray & Gates, 1976), and potential economic and societal benefits (Backman, 1975) of EMSs create at least the appearance that EMS adopters are trying to be socially responsible (Darnall, 2006).

Previous research has found that a facility's preceding environmental crises (Bansal & Hunter,

¹ For instance, Ford Motor Company required suppliers to certify at least one manufacturing site to ISO 14001 by the end of 2001 and all manufacturing sites shipping products to Ford by 2003. Similarly, General Motors required its suppliers to be ISO 14001 certified by 2002. Since then, many other US corporations have instituted similar supply chain mandates.

2003), environmental performance (King, Lenox & Terlaak, 2005), regulatory stringency (Potoski & Prakash, 2005a) and previous environmental liability (Anton, Deltas & Khanna, 2004) influence facility-level EMS adoption. Other important predictors have included parent company pressures (Darnall, 2006) international trade (Potoski & Prakash, 2004) and foreign ownership (King, Lenox & Terlaak, 2005). However, one aspect ignored in prior scholarship is the significance of facility location, especially for communities which the US Environmental Protection Agency (USEPA) (2009) designates as environmental justice areas in that environmental harms may disproportionately affect minority, ethnic and low income populations.

Understanding the relationship between EMS adoption and facility location is important to policy research for two reasons. First, facilities located in areas with larger minority and ethnic populations are subject to racial discrimination or nuisance liabilities arising from Title VI of the Civil Rights Act of 1964 (Gerrard, 2001; McCluskey, Huffaker & Rausser, 2002). These enterprises can be held legally accountable for their disproportionate environmental harms to communities with persons of color and individuals of lower socio-economic status (Ash & Fetter, 2004). By adopting EMSs, facilities located in EJ communities may be especially motivated to convey that they are operating in an environmentally responsible way in order to elicit goodwill from regulators and avoid additional scrutiny related to Title VI of the Civil Rights Act. Doing so may respond to societal calls for the fair treatment for people of all races, cultures, and incomes and avoid additional regulatory scrutiny related to Title VI of the Civil Rights Act.

The second reason why it is important to understand the factors associated with EMS adoption is that we may find that facilities which adopt these management tools differ systematically in many ways from non-EMS adopters. An appreciation for these distinctions may be essential to understanding facilities' subsequent changes in environmental performance.

This research evaluates EMS adoption as it relates to facility location. It begins by defining

EMSs, discussing their strategic value, and describing how institutional pressures might influence facilities located in EJ communities to adopt them. Using survey data and pairing it with data from secondary sources, EMS adoption is evaluated empirically by comparing facilities located in EJ communities with those that were not. As anticipated, the results offer evidence that facilities located in EJ neighborhoods are more likely to adopt an EMS.

UNDERSTANDING ENVIRONMENTAL MANAGEMENT SYSTEMS

Unlike government regulations that impose external requirements on organizations, an EMS arises from within organizations and consists of a voluntary self-regulatory structure (Coglianese & Nash, 2001). An EMS is composed of a collection of internal efforts at policymaking, assessment, planning and implementation (Coglianese & Nash, 2001). Most EMSs involve implementing a written environmental policy, training employees regarding environmental concerns, employing internal environmental audits, and developing environmental performance indicators and goals (Netherwood, 1998). However, because of their voluntary nature, there often is variation in how these procedures are utilized (Coglianese & Nash, 2001). For instance, as part of their EMS some facilities implement environmental benchmarking and accounting procedures that measure performance (Nash & Ehrenfeld, 1997) while others link employee compensation to environmental performance (Netherwood, 1998). These variations suggest that a nuanced treatment is needed when evaluating these management systems (Coglianese & Nash, 2001). That is, a typical approach of asking facilities whether they have adopted an EMS fails to account for the comprehensiveness of the EMS in that facilities that implement more of these environmental practices as part of their EMS may be regarded as having a more complete EMS than facilities with fewer of these environmental practices (Darnall, Henriques & Sadowsky, 2008).

In spite of the variations in how EMSs are implemented, a central commonality among them is their foundation of continuous environmental improvement (Kitazawa & Sarkis, 2000). At the most

basic level these activities assure that a facility's management practices conform to environmental regulations. However, the EMS structure also encourages facilities to prevent pollution by substituting unregulated for regulated inputs and by eliminating some regulated processes altogether. As a result, some facilities may no longer be subject to some costly regulatory mandates. Further, EMSs can assist enterprises to scrutinize their internal operations, engage employees in environmental issues, continually monitor their progress, and increase their knowledge about their operations. These activities create a basis upon which organizations can assess all aspects of their operations jointly, thus minimizing the shift of environmental harms from one subsystem to another (Shrivastava, 1995). They also can increase the likelihood that EMS adopters will improve their environmental performance (Anton, Deltas & Khanna, 2004; Potoski & Prakash, 2005a; King, Lenox & Terlaak, 2005; Arimura, Hibiki & Katayama, 2008; Darnall, Henriques & Sadorsky, 2008). For these reasons, the USEPA and state-level environmental agencies have implemented programs and policies that encourage organizations to adopt EMSs (USEPA, 2001a).

RELATIONSHIP BETWEEN EMS ADOPTION AND FACILITY LOCATION

Our position is that institutional pressures arising from the regulatory and societal setting encourage facilities located within EJ communities to adopt an EMS. Such a position is rooted in institutional theory, which explains that organizations operating within similar social frameworks of norms, values and assumptions often behave similarly to gain social approval (Meyer & Rowan, 1977; Scott, 2001). This theory emphasizes the fact that organizations recognize the importance of achieving social legitimacy for their long term survival and competitiveness (Suchman, 1995). Legitimate businesses are those whose actions are seen or presumed to be desirable or appropriate within some socially constructed system of norms, values, beliefs and definitions (Suchman, 1995). Legitimacy relates to the broader community in which the organization is a part (Hoffman, 1997). Achieving external legitimization is important because it contributes to an organization's long term

viability (Meyer & Rowan, 1977).

In instances where organizations have located in areas with a disproportionately high population of low income minorities and ethnic groups institutional pressures may be particularly profound, in part because of formal EJ policies and associated regulations. Facilities located in EJ communities are subject to racial discrimination or nuisance liabilities arising from Title VI of the Civil Rights Act of 1964 (Gerrard, 2001; McCluskey, Huffaker & Rausser, 2002) and are accountable for their disproportionate environmental harms to persons of color and individuals of lower socio-economic status (Ash & Fetter, 2004). Facilities found out of compliance with Title VI can lose their environmental operating permits if they are shown to discriminate intentionally (Siegel, 2002). Moreover, regulatory pressures related to EJ concerns have increased with President Clinton's 1994 signing of Executive Order (EO) 12898. This policy requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. EO 12898 potentially affects all facilities located in EJ communities in that regulators have the authority to target these areas more rigorously to ensure compliance with environmental regulations and to pressure companies to reduce their pollution emissions to a greater degree.

Other regulatory pressures for facilities in EJ communities are more normative in nature. Because of their greater concern that environmental risk be shared equitably, regulators may be more likely to work with facilities in EJ neighborhoods to reduce their risk in a collaborative way that fosters shared learning. In return, regulators may be inclined to monitor these facilities less frequently or offer greater latitude when a permitting discrepancy is discovered, assuming that the incident was accidental (Andrews *et al.*, 2003). These actions create goodwill among regulators and facilities that implement environmental practices that are not required by law (Potoski & Prakash, 2004).

Outside of incurring regulatory pressures, facilities located in EJ communities also may endure greater social pressures in that they are at greater risk of having their reputations tarnished as a result of accusations of discriminatory behavior. While companies' discriminatory behavior may be intentional or unintentional, it also may be unfounded and based entirely on external constituents' perceptions. Regardless of the circumstance, charges of environmental racism can impose unwanted media attention that leads to greater societal scrutiny that can threaten the organization's long-term viability.

Within this setting, whether or not Title VI and EO 12898 are enforced is less important than whether facility managers *believe* that they might be enforced at some point in time, and that society may be monitoring their actions to a greater degree. In response to this belief, facilities located in EJ communities may adopt an EMS to reduce their emissions below thresholds that would raise social and regulatory concern. Doing so can make the enforcement of Title VI and EO 12898 and their associated liabilities less relevant. In other instances, facilities may be motivated to send a signal to regulators and members of the community that they are proactively managing their environmental affairs, thereby diminishing the perception that these organizations are discriminating against minority populations. In this way, EMS adoption may also offer a means for facilities to distinguish themselves from their neighbors and create at least the appearance that they are behaving in an environmentally friendly way. All these actions may enhance an EMS adopter's external legitimacy (Bansal & Hunter, 2003).

For these reasons, we hypothesize that facilities are more likely to adopt an EMS if they are located in an EJ community.

Hypothesis: Facilities are more likely to adopt an EMS if they are located in an environmental justice community.

RESEARCH METHODS

Data

To evaluate our hypothesis, we relied on survey data in addition to data from secondary sources. The survey data were collected to investigate the impact of facility-level EMS adoption on environmental performance and management benefits (Andrews, Hutson & Edwards, 2005). This paper represents the first quantitative assessment of the data the authors have collected. Since the proportion of US EMS adopters to non-adopters is relatively small, the survey focused on industries for which there might be a higher than average rate of EMS adoption—motor vehicles parts and accessories (SIC 3714), chemicals and chemical preparations (SIC 2899), plastic products (SIC 3089) and coating, engraving, and allied services (SIC 3479) (Andrews, Hutson & Edwards, 2005). Within these four sectors, the survey targeted the 3,198 facilities that were required by USEPA to report their pollution emissions in the Toxic Release Inventory (TRI).²

In 2003 surveys were sent to plant managers who were responsible for the facility's environmental matters. Three postcard reminders were mailed to non-respondents. The response rate was 19.3 percent, which is similar to previous studies of organizations' environmental practices (e.g., Christmann, 2000; Delmas & Keller, 2005; Melnyk, Sroufe & Calantone, 2003), where response rates were 20.1 percent, 11.2 and 10.35 percent, respectively). Facilities which were more likely to complete the survey were expected in part to be motivated by the same factors that encourage facilities to adopt an EMS. As a consequence, the proportion of respondents which are EMS adopters is likely to be greater than that within the general population, and therefore is less reliable for discussions regarding EMS prevalence in society.

² The TRI contains data on facilities' toxic releases into the air, water and land for over 650 chemicals (USEPA, 2001b). Facilities with ten or more full-time employees that manufacture or process quantities above 25,000 pounds, or use more than 10,000 pounds of any of the 650 listed toxic substances during a calendar year, must file a separate form for each TRI chemical (USEPA, 2001b). Nearly all manufacturing firms with more than 50 employees are required to submit data to the TRI (Veresh, 2003).

Social desirability bias was addressed by ensuring anonymity for all respondents, and survey questions addressing environmental motivations were separated from questions pertaining to proactive environmental practices. In instances where a social desirability bias exists, researchers are less likely to find statistically significant relationships because there is less variability in respondents' survey answers. However, by finding statistically significant relationships, additional evidence would be offered about the strength of the relationship between the variables of interest (Hardin & Hilbe, 2001).

Measures

Dependent Variable. We measured EMS adoption three ways. Since many facilities may claim to have an EMS when they only have a portion of one, our first measure considered the comprehensiveness of a facility's EMS. *EMS comprehensiveness* is an unobserved quality that can be measured by examining a facility's diverse environmental practices (Anton, Deltas & Khanna, 2004; Darnall, Henriques & Sadorsky, 2008). To develop this measure, we relied on survey data that asked facility managers whether they had implemented ten different proactive environmental practices that have been recognized as important components of different types of EMSs: written statement of environmental policy goals; specific environmental performance objectives; specific measurable steps to meet those objectives; training for employees related to environmental aspects of their jobs; regular internal or external audits of environmental procedures (Netherwood, 1998); a procedure for identifying legal requirements; regular tracking and management of environmental compliance indicators; formal procedure for documenting environmental management practices; periodic top management reviews of environmental performance; results of environmental performance made available to employees or to the public (Coglianese & Nash, 2001). A factor analysis of these ten

environmental practices (Cronbach's alpha³ = 0.83) confirmed the existence of a single factor scale (EMS comprehensiveness). We considered an EMS to be more comprehensive if it incorporated a greater number of these environmental practices (Anton, Deltas & Khanna, 2004; Darnall, Henriques & Sadorsky, 2008).

The second EMS measure, *complete EMS*, accounted for whether or not facilities had implemented *all ten* EMS components. Facilities that had a complete EMS were believed to have an EMS that was more integrated into the facility's operational structure than facilities having an incomplete EMS or no EMS. Our third measure, *ISO 14001 certification*, considered whether facilities had their EMS certified to ISO 14001, the international EMS standard. To become certified, facilities must demonstrate that they have implemented each of the ten environmental management activities described above (ISO, 2004). However, they go a step further and undergo third party verification. Certifying to ISO 14001 can establish greater external legitimacy for facilities' environmental practices (Bansal & Hunter, 2003).

By accounting for the different types of practices that form an EMS, in addition to utilizing dichotomous measures that account for whether a facility adopts a complete EMS or an ISO 14001-certified EMS, our approach responds to criticisms that a typical dichotomous measure of EMS adoption is overly simplified (Coglianese & Nash, 2001; Darnall, Henriques & Sadorsky, 2008).

Explanatory Variables. In operationalizing an EJ area, we drew on EPA's current definition of EJ, which emphasizes "fair treatment for people of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies" (EPA, 2009).⁴ Institutional pressures

³ Cronbach's alpha ranges from 0 to 1. When alpha is .8 or over, the set of indicators is often deemed sufficiently reliable. Alpha scores of between .6 and .8 are sufficient for measures that have not yet been tested in the literature (Nunnally, 1978).

⁴ Embedded in this definition are two aspects of justice: distributive (fair treatment) and procedural (meaningful involvement). EJ advocates focus not only on the equitable distribution of environmental benefits and burdens, but also the ability of all populations to be involved in environmental decision-making. While the focus of this paper is on the distributive aspect of EJ, an EMS could address the procedural dimension as well since there are opportunities for stakeholder involvement in the EMS design process.

related to whether or not the facility was located in an EJ community were assessed by examining the deviation in community racial (*race*) and income (*income*) composition from the broader locational setting (Rhodes, 2003), in addition to the number of linguistically isolated individuals who speak Spanish (*Hispanic ethnicity*). We relied on data from EPA's Federal Registry System (FRS). FRS data identify facilities' xy coordinates and allow the placement of facilities within a spatial context. This placement is approximately 99% accurate (Antisdell, 2004). In the two instances where FRS data were not available, facility location was determined using longitude and latitude data from the TRI database, which are approximately 93% accurate (Antisdell, 2004).

The final step in establishing a facility's community involved determining whether other census block groups were located in proximity to the facility. Doing so inevitably raised questions about the appropriate boundary that defines a community. While a community of place is recognized as a network of people who are bound together because of where they reside, work, visit or otherwise spend a continuous portion of their time, previous scholarship has been surprisingly silent about the spatial dimensions that define communities of place. As such, we were guided by previous empirical research that has assessed EJ issues.

We followed Anderton et al. (1994) and Bowen et al's (1995) suggestion to begin with an analysis of areas that were as small as practical and meaningful, since geographical information can be aggregated to produce information on larger regions. We therefore used census block groups since they are the smallest spatial unit for which the US Census Bureau collects sample data. Block groups vary in population, and are defined generally by streets, roadways or other geographic features.

Additionally, we drew on Anderton's et al's (1994) suggestion that a central point in which a facility is located within a specific radius better accounts for the irregularities of census area boundaries, and that affected communities may extend into multiple census blocks. More

specifically, we defined each facility's community as the census block group in which it was located plus any block group whose central point was located within a specific radius from each facility. Although the selection of a specific radius is somewhat arbitrary, like the concerns associated with selecting a census unit of analysis, beginning with too large a geographic radius invites the possibility of "aggregation errors" and "ecological fallacies" such that conclusions from a larger unit of analysis would not hold true in analyses of smaller, more refined units (Anderton et al., 1994). Hite *et al.* (2001) suggested that a 3.25 mile radius defines a facility's community, and USEPA reports demographic data for a 3 mile radius surrounding all regulated facilities. Anderton et al. (1994) proposed a 2.5-mile radius defined a facility's "surrounding" area. By contrast, Baden & Coursey (2002) advocated that a half-mile radius defined a community. Drawing on these previous studies, we used US Census Bureau data to define a facility's community as the space within one-half mile and 3 miles of the facility. To illustrate our methodology, Figure 1 indicates how a facility's community was designated for one observation in our sample.

--INSERT FIGURE 1 HERE--

Race and ethnicity are the two most common ways to define minority populations in the US. However, their measurement is not as simple as accounting for whether a community is comprised of a significant number of racial and ethnic minorities or not. Previous scholarship suggests racial composition is a significant predictor of whether a high polluting facility exists within a community, however, when additional explanatory variables are considered, race is much less likely to be significant (Lester, Allen & Hill, 2001; Martin, Demaio & Campanelli, 1990). At issue is that simple racial proportions fail to distinguish minority communities from other areas (Bowen, 2001). To address this concern we considered the *deviation in community racial composition* as it relates to the broader locational setting (Bowen, 2001). We calculated the proportion of racial minorities in the census block groups that defined each facility's community and compared that value to the

proportion of minorities within the block groups that were located within the county in which the facility was situated. At Modarres' (2004) suggestion, facility communities with a mean racial composition that was greater than half a standard deviation above the mean racial profile of the broader locational setting were characterized as being a racial minority community. All other facility communities were characterized as non-racial minority. We called this variable *race*. In constructing this variable, in addition to our other community demographic variables, we used 2000 US Census Bureau SF3 data.⁵

Hispanic ethnicity was measured by using 2000 US Census Bureau SF3 data reporting the proportion of linguistically isolated individuals who speak Spanish. This measure was used because persons who do not speak English are more likely to be recognized as being different from the majority white population than Hispanic persons who are fluent in English (Hunter, 2000). We called this variable *Hispanic*.

To develop our *low income* variable, we relied on US Census Bureau's 2000 SF3 data to determine whether a community was characterized as being populated with low income earners. To construct this measure, we used a similar approach as the one used to assess communities' racial characteristics. That is, we accounted for the deviation in income composition from the broader locational setting (Rhodes, 2003). Using Modarres' (2004) suggested procedure, facility communities with a median household income that were less than or equal to 1 standard deviation below the mean were characterized as low income.

To assess whether income was moderated by race and ethnicity we interacted *low income* with *race* and *low income* with *Hispanic*. To place our *race*, *Hispanic*, *low income*, and interaction variables into a spatial context, we relied on GIS Arc Map v8.2.

⁵ While utilizing 2003 US Census data would have made these data more comparable with the survey data, characteristics such as race, ethnicity, income and education are relatively stable. Moreover, as a practical matter, updates to the 2000 US Census data did not contain all of the variables of interest.

Control Variables. Other prominent institutional pressures that affect an organization's external legitimacy relate to its environmental impacts. For instance, facilities with poor toxic pollution and compliance histories may choose to adopt an EMS to help manage their environmental affairs in a more proactive way. By adopting an EMS, these companies may reduce their toxic releases (Anton, Deltas & Khanna, 2004; King, Lenox & Terlaak, 2005) and improve their compliance records (Potoski & Prakash, 2005). In other instances, facilities that are examined more frequently by environmental regulators may have a greater probability of adopting an EMS (Darnall, Henriques & Sadowsky, 2008). By virtue of being watched more closely, these facilities also incur greater regulatory scrutiny than companies that are inspected less frequently. In adopting an EMS, these facilities may be signaling their ability to manage their environmental impacts in a more proactive way and sending a message to regulators that there is less need to be scrutinized so closely.

Institutional pressures from environmental regulations were measured four ways. For our first measure, *total noncompliance*, we accounted for facilities' compliance with environmental laws. Compliance data (1996-2001) were obtained from EPA's Integrated Data for Enforcement Analysis (IDEA) for each facility's noncompliances related to air, water and hazardous waste. These data were summed to create a total noncompliance value. Using the same database, our second and third regulatory pressure measures (*inspections* and *fines*) accounted for facilities' total environmental inspections and total environmental fines (logged) between 1996 and 2001 related to violations to federal air, water and hazardous waste laws. Our fourth measure of environmental regulatory pressure related to facilities' total toxic pollution emissions between 1996 and 2001. These data were obtained from EPA's TRI. As suggested by King & Lenox (2002), facility emissions (logged) were weighted by their chemical toxicity. This variable was called *weighted TRI emissions*.

There are a couple of limitations to using our four environmental measures as control variables. First we did not have access to environmental data through 2003, which is when the survey data

were collected. However, by summing facilities' environmental data across six years (1996-2001), a reasonable snapshot can be obtained regarding these organizations' overall environmental impacts. A second limitation to using these data is that the survey did not obtain the specific date in which facilities adopted their EMS. As such, it was not possible to determine whether the environmental data were related to activities prior to EMS adoption. Most likely some facilities in the sample adopted their EMSs earlier than 2001, and so post-EMS adoption environmental data were included in the dataset. As such, these data measure a facility's overall environmental liability rather than environmental pressures that existed prior to EMS adoption. Given these data limitations, we estimated our empirical models with and without our environmental controls to determine whether or not our central relationship of interest remained stable. We also took additional caution in interpreting the results associated with these variables. That is, we merely assessed whether associations existed among the environmental controls and EMS adoption rather than causal relationships. Additionally, a null finding could not rule out the possibility of environmental regulatory pressures being related to EMS adoption since we could not isolate the institutional pressures from environmental regulations that existed prior to EMS adoption.

Additionally, it is important to note that institutional pressures from environmental regulations were measured by relying on secondary data, which may not be as subjective as survey data asking for managers' perceptions of regulatory stakeholders. However, they are not completely objective in that they are subject to managers' perceptions of noncompliances, fines and inspection frequency, and this perception is likely to influence decisions to adopt an EMS. Like other institutional pressures, managerial perceptions of noncompliances, fines and inspection frequency establish how and to what extent facilities' environmental strategies will be influenced (Darnall, Henriques & Sadowsky, *forthcoming*). The relationship between noncompliances, fines and inspection frequency and facilities' EMS adoption therefore relates to managerial perceptions of these institutional pressures.

As noted in other research relying on managerial surveys (Sharma & Henriques, 2005; (Darnall, Henriques & Sadowsky, *forthcoming*; Darnall, Seol & Sarkis, 2009), there are rarely completely objective measures of these types of pressures. Moreover, previous studies that have evaluated purely subjective measures of regulatory pressures as they relate to manufacturing facilities find that all manufacturing facilities report that these pressures are important influences on their environmental practices (Johnstone, 2007). For these reasons, a more nuanced measure was needed to assess the underlying relationship between regulatory pressures and facilities' EMS adoption practices.

Non-environmental control variables also were incorporated into our empirical model. *Education*, accounted for the fact that social constituents increase their awareness of environmental issues due to a formal education. To account for these institutional pressures, we considered that communities with greater education levels were more likely to exert greater pressures for proactive environmental behaviors (Dunlap & Van Liere, 1978; Rhodes, 2003) and therefore persuade facilities to adopt an EMS. We included a measure for the percentage of community residents that earned greater than a bachelor's degree to measure the influence of educational attainment. These data were obtained from the US Census Bureau's 2000 SF3 dataset, and put into a spatial context using GIS Arc Map v8.2.

Customer pressure was included to control for institutional pressures arising from facility customers. Over the last ten years, market actors have been placing greater pressures on firms to consider their impacts to the natural environment. In particular, customers are becoming increasingly savvy about their purchasing decisions and companies' environmental activities (Konar & Cohen, 1997; Darnall, 2009). Additionally, customers within supply chains have been exerting influences on organizations to improve their environmental performance and adopt proactive environmental management strategies (Zhu & Sarkis, 2004; Zhu, Sarkis & Geng, 2005). Supply chain pressures arise because corporate customers wish to ensure that their purchases are of sufficient

environmental quality since doing so reduces environmental liabilities associated with final product development (Handfield, Walton, Sroufe & Melnyk, 2002). EMS adoption may be one way to address this heightened interest by helping companies develop an environmentally conscious reputation that invites patronage from consumers and generates opportunities for business with other organizations that value these principles (Darnall & Carmin, 2005).

We also accounted for the fact that while EMSs are implemented at the facility level, the parent company often plays a fundamental role in adoption decisions (Darnall, 2006). We measured customer and parent company pressures using survey data that asked whether or not the facility's major customer required them to implement an EMS and whether or not the facility's parent company required EMS adoption. We further used survey data that asked whether or not their major customers encouraged them to implement an EMS and whether or not the facility's parent company encouraged it to implement an EMS. Corporate pressures (Cronbach's alpha = 0.66), in addition to customer pressures (Cronbach's alpha = .80), were evaluated using factor analysis with varimax rotation, as shown in Table 1. Two factors (*corporate* and *customer pressures*) had factor loadings greater than .50. These two factors were included in our regression model.

--INSERT TABLE 1 ABOUT HERE--

To account for a facility's *foreign ownership*, we included a variable that controlled for whether or not the facility was owned by a foreign firm. To control for facility size we accounted for facilities' number of full-time employees (logged). We also included three dummy variables to control for industry effects: 1) chemicals and chemical preparations, 2) plastic products and coating, 3) engraving, and allied services. The omitted sector dummy was motor vehicles parts and accessories.

After accounting for all of our variables across the various datasets, we had a sample size of 615 manufacturing facilities.

Empirics

EMS comprehensiveness was the dependent variable in models 1 and 2. Complete EMS was the dependent variable in models 3 and 4, and ISO 14001 certified EMS was the dependent variable in models 5 and 6. We used Tobit regression to evaluate the reasons why facilities adopt a comprehensive EMS. Tobit regression was appropriate since our response variable was right censored (Wooldridge, 2002) in that it had a maximum value of 10 EMS characteristics that are commonly accepted as basic EMS components. We report the marginal effects associated with these models. Interpretation of these effects is similar to that in linear regression models. Since some facilities may adopt more ambitious environmental activities that extend beyond a few basic components. We used logistic regression techniques to evaluate the reasons why facilities adopt a complete EMS and an ISO 14001-certified EMS (models 3-6) since both response variables were dichotomous. We report odds ratios for these models since estimating marginal effects for binary independent variables in models with binary dependent variables is not advised as they suffer from poor approximations (Long & Freese, 2003). With respect to censored regression models (i.e., our tobit model), the effects of scaling, which are misleading in the binary choice model (Greene, 1997), are less likely to be present (Greene, 1998). All three dependent variables were estimated two ways to account for local populations at the one-half mile and three mile radius from each facility. Statistical analyses were performed using Stata 9.2.

Table 2 shows the correlations and descriptive statistics for each of our variables. It indicates that while correlations among our non-interacted explanatory variables were within the range of acceptability, in that they were less than .80 (Kennedy, 2003), we also evaluated the variance inflation factors (VIF) for each of our explanatory variables. The results revealed the highest VIF was 4.5, which was well below Kennedy's (2003) maximum acceptable threshold of 10.0 indicating that multicollinearity was not a concern.

--INSERT TABLE 2 ABOUT HERE--

RESULTS

The results of each of our model estimations (see Table 3) show that the likelihood ratio test statistics are significant at $p < 0.001$, indicating that the null effect of the independent variables can be rejected. The pseudo R-squared statistic is an approximation of the squared contingency coefficient, and ranges between 0 and 1, approaching 1 as the quality of the fit improves (Aldrich & Nelson, 1984). The value of this statistic is generally less than would be expected in a linear model (Greene, 1997). Our tobit models (Model 1 and 2) have a McFadden pseudo R-squared of 10.9%. Model 3 and 4 (logistic regression) have a McFadden pseudo R-squared of 23.5% and 23.9%, respectively, whereas models 5 and 6 (logistic regression) have a McFadden pseudo R-squared of 38.3% and 37.7%, respectively.

--INSERT TABLE 3 ABOUT HERE--

In evaluating the relationship between EMS adoption and the independent variables, our results show that while the estimated coefficient on *race* was statistically insignificant, the estimated coefficient for *low income* was negative and statistically significant ($p < 0.05$) for all models at the 3 mile radius. The results of our tobit regressions show that facilities whose communities were defined by a 3 mile radius and were considered low income were 83% (-0.83) less likely to adopt a more comprehensive EMS. Similarly the results of our logistic regressions indicate facilities whose communities were defined by a 3 mile radius and were considered low income were 63% less likely (1.0 - 0.37) to adopt a complete EMS, and 66% less likely (1.0 - 0.34) to adopt an ISO 14001-certified EMS. These findings suggest that EMS adopters were more likely to be located in higher income communities. However, the estimated coefficient on the interaction of *race* and *low income* was positive and statistically significant ($p < 0.05$) for all six models. That is, the results of our tobit model indicate that facilities whose communities were defined by a one-half mile radius and were

considered EJ status were 79% more likely to adopt a more comprehensive EMS. Similarly, our logit results show they were 176% more likely to adopt a complete EMS and 230% more likely to adopt an ISO 14001-certified EMS. Moreover, facilities whose communities were defined by a 3 mile radius and were classified as EJ areas were 76% more likely to adopt a more comprehensive EMS, 229% more likely to adopt a complete EMS, and 340% more likely to adopt an ISO 14001-certified EMS. Combined, these findings indicate that, in the presence of lower income populations, racial status of the population within the one-half mile and 3 mile surrounding community increases the probability that facilities will adopt an EMS. The results also offer evidence in support of our central hypothesis, which states that facilities are more likely to adopt an EMS if they are located in an EJ community. Moreover, in evaluating magnitude of the estimates related to this EJ variable, across all six models estimates were greater in size than all other explanatory variables, save two industry dummies in Models 1 and 2.

We found no statistical support for the notion that in the presence of low income populations, communities having linguistically isolated Hispanic populations had a greater probability that surrounding facilities would adopt an EMS. Given these findings, we subsequently evaluated Hispanic populations without regard to whether they were linguistically isolated and again found no statistically significant relationship between community ethnicity and facilities' EMS adoption.⁶

With respect to our control variables, facility noncompliances, total fines, total inspections and weighted TRI emissions did not differ statistically between EMS adopters and non-EMS adopters for any type of EMS. The null findings related to our environmental variables do not rule out that an association exists between environmental pressures and EMS adoption in EJ communities since we

⁶ Since education may also be viewed as environmental justice issue in that low education/income communities may be prone to greater environmental harms, we included this interaction term and re-estimated our model. We found no statistically significant relationship for the notion that, in the presence of low income populations, communities with residents who have fewer college degrees had a greater probability that surrounding facilities would adopt an EMS of any sort.

could not isolate facilities' institutional pressures from environmental regulations that existed prior to EMS adoption. However, they do suggest that there was no difference in the overall environmental liability of the facilities in the sample. In a subsequent estimation, we evaluated whether *aggregate* TRI emissions (logged), as opposed to weighted TRI emissions, were related with EMS adoption since regulatory pressures associated with simply reporting greater TRI emissions may be more relevant than the toxicity of those emissions. Consistent with our previous estimations, there was not a statistically significant relationship. We further considered whether the effect of compliance on EMS adoption may vary across levels of compliance (Potoski & Prakash, 2005b). In accounting for this issue, we included two additional variables—*total noncompliance*² and *weighted TRI emissions*². The modification also yielded no substantive differences in our findings.

Because of the limitations associated with our environmental data, we assessed our empirical models with and without the environmental controls to determine whether or not the results associated with our EJ variables were stable. The signs, magnitudes, and significance of our estimates were consistent across all models.

Related to our other control variables, as anticipated, customer pressures were associated with EMS adoption in all six models. Facilities whose communities were defined by a 3 mile radius and had greater customer pressures were more likely to adopt all types of EMSs.⁷ Facilities that endured stronger corporate pressures were more likely to adopt a more comprehensive EMS, but no more likely to adopt a complete EMS or an ISO 14001-certified EMS. Finally, as expected, across all six models, EMS adopters were more likely to be part of publicly traded organizations, foreign owned, and larger in size.

DISCUSSION AND CONCLUSIONS

⁷ To address the potential concern that corporate and customer pressures may be endogenous variables, we estimated our empirical model without these variables to determine whether our primary relationships of interest remained stable. The results of our estimations did not change substantively in that our environmental justice variables maintained their statistical significance.

This study investigates whether facilities located in EJ communities may be more likely to adopt an EMS. While previous scholarship has begun to explore the factors associated with EMS adoption, to our knowledge no studies have evaluated the importance of facility location and EMS adoption as it relates to EJ issues. By drawing on institutional theory, this research offers evidence that in the presence of lower income populations, the racial status of the surrounding community increases facilities' probabilities of adopting an EMS. As such, these facilities may be reducing their environmental harms posed to low income minority populations.

However, facilities that are located in EJ communities also have an incentive to create the *appearance* that they are improving their environmental performance in an effort to protect themselves from racial discrimination or nuisance liabilities claims arising from Title VI. These businesses may be seeking to signal that they are environmentally proactive when in fact they are not or only moderately so (King, Lenox & Terlaak, 2005). Symbolic efforts such as these may be successful at averting claims that a facility is disproportionately harming EJ communities, at least in the short-term. Previous EMS studies support this possibility. For instance, when the chemical industry was faced with stricter environmental regulations after the 1984 chemical explosion in Bhopal, India, it developed the Responsible Care program, which required industry members to adopt an EMS. The program was intended to improve members' environmental performance and the public's perception of the industry, thereby avoiding the promulgation of stricter environmental regulations. Responsible Care was successful at improving the public's perception of the chemical industry and avoiding additional regulation, but it did not improve members' environmental performance (King & Lenox, 2000). A parallel situation may exist for EMS adopters located in EJ areas in that by virtue of adopting an EMS these organizations may reduce their external environmental scrutiny. However, these same facilities may fail to improve their environmental performance in a meaningful way. This possibility is more alarming given that previous scholarship

has demonstrated positive correlations between areas with high-minority and low-income populations and the location of commercial hazardous waste facilities (e.g., Been & Gupta 1997), federal Superfund sites (Hamilton & Viscusi 1999; Hird 1993), and sources of toxics and other pollution (e.g., Cutter et al. 1996; Ringquist, 1997; Pollack & Vittas 1995).

Other issues related to facilities creating the appearance that they are attending to EJ concerns are raised because while the racial status of the surrounding community increases facilities' probabilities of adopting an EMS, ethnicity did not. These findings may be due to the fact that racial minority communities are more visible and organized than communities characterized by larger numbers of Hispanic populations, which often include larger numbers of immigrants who generally avoid taking strong positions in their communities.

To address these concerns, future research should compare the environmental performance of EMS adopters located within EJ communities (consisting of both racial and ethnic minorities) to the environmental performance of non-EMS adopters and EMS adopters that are located outside of EJ communities. For EMS adopters operating within EJ communities, the external scrutiny associated with their location may influence their environmental performance in a way that differs from other facilities. However, environmental performance may not differ, lending credence to the notion that facilities within these communities may be adopting an EMS to merely create the appearance that they are addressing their environmental risks in a proactive way.

Additionally, understanding the relationship between facility location, environmental performance and EMS adoption could have significant public policy implications in that if EMSs are shown to reduce risks that are imposed to low income minority populations, there may be good reason for regulators to encourage facilities operating in EJ communities to adopt an EMS. Moreover, offering incentives for additional facilities to adopt an EMS may benefit regulators in fulfilling their obligations to EO 12898. However, in the absence of these societal benefits,

regulators should be wary of using EMSs as meaningful environmental governance tools.

Another contribution of this research is that it offers evidence about other important factors that increase the probability of facilities adopting an EMS. It shows that facilities which adopt an EMS are more likely to have their customers and parent companies require or encourage them to do so. They also are more likely to be foreign owned, larger in size and publicly traded. These findings are important because, smaller-sized facilities comprise a significant portion of the manufacturing landscape (US Census, 2004), and a large proportion of them are privately owned businesses. However, these facilities also are more likely to incur greater costs of EMS adoption due to their more limited resources and capabilities (Darnall & Edwards, 2006). To the extent that EMS adopters located in EJ communities improve their environmental performance, regulators may need to target smaller, privately held facilities with incentives to adopt an EMS, because these entities are less likely to adopt one on their own.

While our results indicate that after controlling for location and community characteristics EMS adoption was not related to environmental regulatory pressures, additional research is needed to study this relationship further. Given our data limitations, we could not discern whether facilities that adopted EMSs were relatively dirtier or cleaner than their competitors prior to EMS adoption. Understanding this relationship would offer knowledge about whether policy makers should have greater concern about the intentions of EMS adopters in EJ communities. That is, if cleaner facilities are more likely to adopt an EMS there is less cause for distress if they fail to reduce their environmental impacts in a measurable way. However, if dirtier plants adopt an EMS and do little to modify their environmental behaviors, there is greater reason for concern. Moreover, communities that have been recognized historically as being dirty may have a disproportionate number of facilities adopting an EMS simply because their environs are notoriously dirty and therefore are targeted for enforcement action. Scholarly research also would benefit from considering how regional variations

in historical environmental concerns might affect EMS adoption, and how variations in state and local EJ policies might have a role, especially since state and local jurisdictions sometimes have their own EJ policies.

In summary, this study has evaluated whether facilities are more likely to adopt an EMS if they are located in an EJ community. The results indicate that facilities operating in EJ communities have increased probabilities of adopting an EMS, and therefore appear to be taking greater actions to avert assertions that they are disproportionately harming low income minority populations. These findings beg the question of whether or not facilities that are located in EJ communities actually improve the environment as a consequence of EMS adoption or whether this management tool is being used as means to avoid claims of racism without reducing the community's environmental risk. Our hope is that the results of this study offer sufficient reason for future scholarship to consider these issues further.

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Figure 1: Spatial determination of facility community

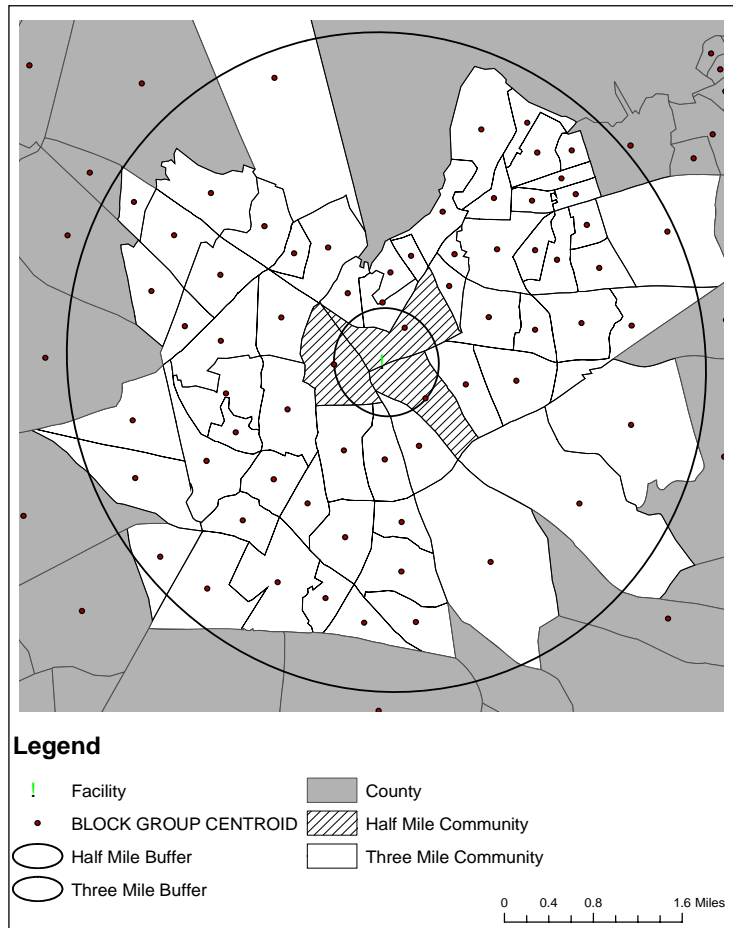


Table 1: Factor analysis results^a

| Survey Question | Factor Loadings | |
|--|---------------------------|----------------------------|
| | <i>Customer Pressures</i> | <i>Corporate Pressures</i> |
| Customers require EMS adoption | 0.74 | 0.16 |
| Customers encourage EMS adoption | 0.74 | 0.27 |
| Parent company requires EMS adoption | 0.28 | 0.56 |
| Parent company encourages EMS adoption | 0.25 | 0.61 |
| Alpha Coefficients | 0.80 | 0.66 |

^a Loadings stronger than ± 0.50 are bolded

Table 2: Correlations and descriptive statistics*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
|-------------------------------------|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|--|
| 1 Race | 1.00 | | | | | | | | | | | | | | | | | | | |
| 2 Hispanic | 0.17 | 1.00 | | | | | | | | | | | | | | | | | | |
| 3 Low income | 0.34 | 0.17 | 1.00 | | | | | | | | | | | | | | | | | |
| 4 Race x low income | 0.79 | 0.16 | 0.57 | 1.00 | | | | | | | | | | | | | | | | |
| 5 Hispanic x low income | -0.10 | 0.57 | -0.40 | -0.15 | 1.00 | | | | | | | | | | | | | | | |
| 6 Total noncompliances | -0.03 | -0.07 | 0.09 | -0.01 | -0.13 | 1.00 | | | | | | | | | | | | | | |
| 7 Total fines (log) | 0.02 | -0.02 | -0.03 | -0.05 | -0.04 | 0.34 | 1.00 | | | | | | | | | | | | | |
| 8 Total violations | -0.07 | -0.12 | -0.06 | -0.07 | -0.06 | 0.30 | 0.19 | 1.00 | | | | | | | | | | | | |
| 9 Weighted TRI emissions (log) | -0.01 | -0.07 | -0.04 | -0.02 | -0.03 | 0.18 | 0.18 | 0.17 | 1.00 | | | | | | | | | | | |
| 10 Education | 0.02 | -0.05 | 0.03 | -0.12 | -0.14 | -0.02 | -0.31 | -0.22 | 0.15 | 1.00 | | | | | | | | | | |
| 11 Customer pressure | -0.08 | 0.03 | -0.03 | 0.03 | 0.01 | -0.07 | 0.00 | -0.04 | -0.09 | 0.05 | 1.00 | | | | | | | | | |
| 12 Corporate pressure | 0.03 | 0.09 | 0.05 | 0.06 | -0.01 | 0.00 | -0.02 | -0.04 | -0.01 | -0.02 | 0.31 | 1.00 | | | | | | | | |
| 13 Publicly traded | 0.07 | 0.10 | 0.04 | 0.17 | 0.00 | -0.04 | -0.02 | -0.05 | 0.02 | -0.02 | 0.18 | 0.33 | 1.00 | | | | | | | |
| 14 Export orientation | -0.02 | 0.07 | -0.03 | -0.02 | -0.02 | -0.15 | 0.02 | -0.04 | -0.13 | -0.01 | 0.03 | 0.06 | 0.25 | 1.00 | | | | | | |
| 15 Employees (log) | 0.15 | 0.14 | 0.13 | 0.28 | -0.06 | -0.16 | -0.04 | -0.10 | -0.10 | 0.00 | 0.28 | 0.19 | 0.35 | 0.08 | 1.00 | | | | | |
| 16 Chemical & chemical preps | 0.02 | 0.01 | 0.11 | -0.07 | -0.10 | -0.01 | -0.03 | -0.07 | 0.05 | 0.04 | -0.06 | -0.04 | 0.02 | 0.02 | -0.21 | 1.00 | | | | |
| 17 Plastic products | -0.08 | -0.09 | -0.07 | -0.03 | 0.02 | 0.04 | 0.05 | 0.02 | -0.01 | 0.03 | -0.19 | -0.07 | -0.25 | -0.08 | -0.10 | -0.35 | 1.00 | | | |
| 18 Coating, engraving, allied serv. | 0.08 | 0.05 | 0.00 | 0.02 | 0.06 | 0.06 | 0.08 | 0.08 | -0.01 | -0.06 | -0.09 | -0.04 | -0.04 | -0.03 | -0.11 | -0.30 | -0.29 | 1.00 | | |
| 19 Motor veh. parts & accessories | -0.01 | 0.03 | -0.04 | 0.08 | 0.03 | -0.09 | -0.10 | -0.02 | -0.03 | -0.02 | 0.32 | 0.13 | 0.26 | 0.09 | 0.40 | -0.38 | -0.37 | -0.32 | 1.00 | |
| Mean | 0.29 | -4.83 | 0.43 | 0.20 | -1.94 | 4.16 | -11.70 | 4.04 | 4.85 | -3.48 | 0.00 | 0.00 | 0.48 | 0.14 | 4.94 | 0.26 | 0.21 | 0.25 | 0.28 | |
| Standard deviation | 0.45 | 4.99 | 0.49 | 0.40 | 4.18 | 8.78 | 9.79 | 11.11 | 4.34 | 4.99 | 0.81 | 0.68 | 0.50 | 0.35 | 1.30 | 0.44 | 0.40 | 0.43 | 0.45 | |

* N= 615; values > 0.07 are statistically significant at $p < 0.05$, two tailed tests

Table 3: Relationship between regulatory pressures, facility location and EMS adoption ^a

| Variable | COMPREHENSIVE EMS | | | | COMPLETE EMS | | | | ISO 14001-CERTIFIED EMS | | | |
|---|-----------------------------|-----------|-----------------------------|-----------|-----------------------------|-----------|-----------------------------|-----------|-----------------------------|-----------|-----------------------------|-----------|
| | Model 1— 1/2 Mile Radius | | Model 2— 3 Mile Radius | | Model 3— 1/2 Mile Radius | | Model 4— 3 Mile Radius | | Model 5— 1/2 Mile Radius | | Model 6— 3 Mile Radius | |
| | <i>Marginal Effects</i> | <i>SE</i> | <i>Marginal Effects</i> | <i>SE</i> | <i>Marginal Effects</i> | <i>SE</i> | <i>Marginal Effects</i> | <i>SE</i> | <i>Marginal Effects</i> | <i>SE</i> | <i>Marginal Effects</i> | <i>SE</i> |
| <i>Hypothesized Variables</i> ^b | | | | | | | | | | | | |
| Race | -0.78 | 0.56 | -0.26 | 0.38 | 0.56 | 0.21 | 0.85 | 0.21 | 0.87 | 0.36 | 0.87 | 0.25 |
| Hispanic | 0.01 | 0.04 | 0.04 | 0.05 | 1.02 | 0.03 | 1.03 | 0.03 | 0.98 | 0.03 | 1.02 | 0.04 |
| Low income | -0.77 | 0.47 | -1.39* | 0.64 | 0.74 | 0.23 | 0.37* | 0.17 | 0.64 | 0.25 | 0.34* | 0.18 |
| Race x low income | 1.57* | 0.73 | 1.50* | 0.75 | 2.76* | 1.34 | 3.29** | 1.72 | 3.30* | 1.84 | 4.40* | 2.73 |
| Hispanic x low income | -0.04 | 0.06 | -0.07 | 0.09 | 0.98 | 0.04 | 0.97 | 0.06 | 0.96 | 0.04 | 0.95 | 0.07 |
| <i>Control Variables</i> | | | | | | | | | | | | |
| Total noncompliances | -0.01 | 0.02 | 0.01 | 0.02 | 0.99 | 0.01 | 1.00 | 0.01 | 0.99 | 0.01 | 0.99 | 0.01 |
| Total fines (log) | -0.02 | 0.02 | -0.03 | 0.02 | 0.99 | 0.01 | 0.99 | 0.01 | 0.99 | 0.01 | 0.99 | 0.01 |
| Total inspections | 0.00 | 0.01 | 0.00 | 0.01 | 1.00 | 0.01 | 1.00 | 0.01 | 0.98 | 0.01 | 0.98 | 0.01 |
| Weighted TRI emission (log) | 0.06 | 0.04 | 0.06 | 0.04 | 1.00 | 0.02 | 1.01 | 0.02 | 1.01 | 0.03 | 1.01 | 0.03 |
| Education ^b | 0.01 | 0.11 | 0.09 | 0.26 | 1.03 | 0.08 | 1.12 | 0.20 | 1.08 | 0.10 | 0.98 | 0.20 |
| Customer pressure | 1.13*** | 0.21 | 1.14*** | 0.21 | 2.23*** | 0.30 | 2.26*** | 0.30 | 3.24*** | 0.52 | 3.26*** | 0.51 |
| Corporate pressure | 0.88*** | 0.24 | 0.87*** | 0.24 | 1.31 | 0.20 | 1.31 | 0.20 | 0.71 | 0.13 | 0.71 | 0.13 |
| Publicly traded | 1.38*** | 0.36 | 1.31** | 0.35 | 2.45*** | 0.54 | 2.31*** | 0.50 | 2.35*** | 0.61 | 2.09** | 0.54 |
| Export orientation | 1.50*** | 0.48 | 1.49*** | 0.48 | 2.03** | 0.57 | 2.08** | 0.60 | 2.46** | 0.80 | 2.68** | 0.87 |
| Employees (log) | 0.59*** | 0.14 | 0.60*** | 0.14 | 1.38*** | 0.12 | 1.39*** | 0.13 | 2.13*** | 0.24 | 2.11*** | 0.24 |
| Chemical & chemical preps | -0.57 | 0.46 | -0.60 | 0.45 | 0.77 | 0.21 | 0.77 | 0.21 | 0.43** | 0.13 | 0.41*** | 0.13 |
| Plastic products | -1.50** | 0.46 | -1.52** | 0.46 | 0.61 | 0.17 | 0.65 | 0.19 | 0.37*** | 0.12 | 0.40*** | 0.13 |
| Coating, engraving, allied serv. | -1.93*** | 0.46 | -1.94** | 0.46 | 0.32*** | 0.10 | 0.33*** | 0.10 | 0.21*** | 0.07 | 0.21*** | 0.07 |
| N | 615 | | 615 | | 615 | | 615 | | 615 | | 615 | |
| Pseudo R-squared | 0.109 | | 0.109 | | 0.235 | | 0.239 | | 0.383 | | 0.377 | |
| Likelihood ratio Chi Square(18) | 247.04** | | 247.38** | | 200.16** | | 202.60** | | 305.71** | | 300.37** | |
| Log likelihood | -1013.24 | | -1013.07 | | -325.09 | | -323.87 | | -245.79 | | -248.46 | |

a Models 1 and 2 are tobit regressions that evaluate the extent to which facilities have incorporated ten elements of various EMSs. Models 3 and 4 are logistic regressions that evaluate complete EMS adoption or whether or not facilities have implemented all ten EMS elements. Models 5 and 6 are logistic regressions that evaluate ISO 14001-certification, which requires that facilities implement all ten EMS elements and undergo external verification. Omitted industry sector is motor vehicles parts and accessories

b Denotes location-specific variable that accounts for populations within the facility's half mile and 3 mile community.

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$