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How Firms Respond to Mandatory Information Disclosure

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HOW FIRMS RESPOND TO MANDATORY INFORMATION DISCLOSURE[§]

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We explore which organizations are particularly likely to resist, or acquiesce to, new institutional pressures that arise from mandatory information disclosure regulations. We hypothesize that when information is disclosed about organizational performance, certain organizational characteristics amplify pressures to improve. Examining organizational responses to a change in a prominent information disclosure program, we provide some of the first empirical evidence characterizing organizations' heterogeneous responses to information disclosure regulations. We find that private ownership and proximity to headquarters and corporate siblings are associated with superior performance trends following information disclosure. We also find that regional density moderates effect of establishment size on performance improvement. We find no evidence that capability transfers are associated with performance improvement. We highlight implications for institutional theory, managers, and policymakers.

Keywords: information disclosure, institutional theory, empirical analysis, Toxics Release Inventory, environmental strategy, mandatory disclosure.

INTRODUCTION

Organizations are required to respond to a host of diverse, external pressures from varied constituencies and stakeholders. Among these are regulators who impose market-based, mandatory information disclosure programs. Outside stakeholders utilize information disclosed about firm behavior to exert pressure to modify or curb undesired behaviors. Recent years have seen a significant increase in the use of information disclosure as a regulatory mechanism. Information disclosure has, for example, been used to force firms to reveal details of the use and disposal of toxic chemicals, require food manufacturers to post nutritional information about their products, and force restaurants to reveal their hygiene scores.

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Most research on the effectiveness of information disclosure has focused on average effects across the population of affected firms, on aspects of disclosure programs that influence their success (Weil *et al.*, 2006; Fung, Graham, and Weil, 2007), or on how variation in their external environment affects firms' responses (Delmas and Toffel, 2011). But the structure and nature of organizations may account for differential responses to external pressure. Hence, our research questions: "When new institutional pressures arise, which organizations are particularly likely to resist or acquiesce?" and "When subjected to new information disclosure mandates, which types of organizations are more likely to subsequently improve their performance in ways that meet policymakers' objectives?"

In this paper, we argue that the degree to which performance improves following information disclosure will depend, in part, on specific features of the organizations. We hypothesize that greater improvement will be seen among establishments subject to greater internal and external pressure to improve as well as among those with greater access to the capabilities needed to do so. We test our hypotheses using data from one of the most famous instances of information disclosure legislation, the Toxics Release Inventory (TRI), which is often credited with bringing about significant improvements in environmental performance (Hart, 2010). We examine how thousands of organizations have responded to this regulatory requirement to publicly disclose emissions of hundreds of toxic chemicals, and exploit an exogenous shock that occurred when the agency expanded the number of chemicals required to be reported. Our research is especially important given the prominence of the TRI program and the importance of achieving improved environmental performance.

We examine the differential performance of establishments based on five organizational moderators: proximity to headquarters; proximity to siblings; presence of better-performing siblings; establishment size; and ownership structure, namely, whether the parent firm is public or private. Using emissions reductions as our performance indicator, we find that establishments located close to their headquarters outperform those with headquarters farther away. We also find that establishments with proximate siblings outperform those with siblings that are not proximate, and that in dense regions larger establishments outperform smaller establishments, but in sparse regions no effect of size is observed.

Finally, establishments owned by privately held firms outperform establishments owned by publicly traded firms.

The remainder of our paper proceeds as follows. In the next section, we review the pertinent literature on institutional theory and information disclosure responses. We then develop theory and hypotheses that relate organizational characteristics to responses to this new institutional pressure. Detailed descriptions of our data and the methods used to test our hypotheses follow. We conclude with a discussion of our results and their implications.

LITERATURE REVIEW

Two related streams of literature form the foundation for the theory on which we base our hypotheses. We first consider research that examines how organizations respond to information disclosure, with particular attention to the relatively small set of papers that analyzes firms' heterogeneous reactions to information disclosure requirements. We then briefly review the relevant literature from neo-institutional theory, the broader theoretical field most relevant to understanding how information disclosure requirements affect organizations.

Responses to information disclosure

One stream within the literature on how information disclosure affects organizations is focused on how stakeholders including journalists, investors, and customers respond to information disclosed about a firm. For example, prior studies have found that information disclosed about firms' pollution levels can stimulate media coverage and depress market valuations of the firms (Hamilton, 1995) as well as of neighboring homes (Oberholzer-Gee and Mitsunari, 2006). Other studies have found that investors enjoy excess returns following increased mandatory corporate financial disclosures, because such disclosure forces managers to heighten their focus on shareholder value(Greenstone, Oyer, and Vissing-Jorgensen, 2006), and that disclosure of nutrition information can lead customers to reduce their caloric consumption (Bollinger, Leslie, and Sorensen, 2011). Still other studies have found regulators to reduce scrutiny of companies that self-disclose compliance violations (Toffel and Short, 2011).

Whereas most of these studies have examined average treatment effects, a few recent studies have identified heterogeneous effects of information disclosure. For example, disclosure of nutritional information was found to be particularly effective in reducing caloric consumption in areas populated by wealthier, more highly educated consumers who had previously consumed more calories (Bollinger *et al.*, 2011). Information disclosure programs may also interact with other regulatory mechanisms. For example, facilities have been found to improve to a greater degree following disclosure of environmental information in states in which they are also required to evaluate and report on their production processes (Bennear, 2007). More closely related to our research are studies that have investigated organizations' responses to information disclosed about them. For example, two studies that examined how graduate and professional schools responded to school rankings found that officials in lower ranked schools reacted defensively by focusing on their respective strengths and reallocating resources strategically to influence future rankings (Elsbach and Kramer, 1996; Espeland and Sauder, 2007). Several studies have concluded that government programs requiring disclosure of performance information have spurred companies to improve environmental performance (Blackman, Afsah, and Ratunanda, 2004; Konar and Cohen, 1997; Scorse, 2010), food and water safety (Bennear and Olmstead, 2008; Jin and Leslie, 2003), and surgical outcomes (Cutler, Huckman, and Landrum, 2004; Hannan *et al.*, 1994; Peterson *et al.*, 1998).

A few studies have identified factors associated with particularly acute organizational responses to information disclosure. For example, studies have found performance especially likely to improve in organizations that receive significantly poor ratings (Blackman *et al.*, 2004; Chatterji and Toffel, 2010; Scorse, 2010), particularly in the face of the additional external pressure of being in a highly regulated industry (Chatterji and Toffel, 2010). Other studies have found greater improvement among franchised establishments revealed by an information disclosure program to be performing substantially below company-owned counterparts (Jin and Leslie, 2009).

Mandatory information disclosure policies are premised on the notion that forcing organizations to reveal information can induce stakeholder pressure which prompts the organizations to change their behavior (Weil *et al.,* 2006). Such pressure, however, is not uniformly distributed. Prior literature has shown pressure to vary with location, industry, and the nature of the information disclosed. For example, environmental concerns are more salient in some locations than in others (McConnell and Schwab, 1990; Sine and Lee, 2009). Regional differences are also observed in relation to health concerns and enactment of health-related policies. For example, tobacco control policies in universities are more prevalent in some regions of the United States than in others (Halperin and Rigotti, 2003). Another geographic dimension associated with differential responses is proximity to competitors. For example, changes in consumer buying behavior are more likely to be observed in markets subject to competition, which facilitates customers' switching when newly available information reveals existing suppliers to be worse-performing (Bollinger *et al.*, 2011).

Institutional theory

Institutional theory provides a basis for studying how external pressures affect organizational behavior. The rationale for mandatory information disclosure programs is to provide better information to firms' stakeholders including customers, investors, employees, government agencies, and interest groups. For example, restaurant patrons' consumption of high calorie foods may decline following restaurants' disclosure of nutritional information, and local groups may protest pollution levels at a facility following publication of its Toxic Release Inventory results. Such actions constitute a form of institutional pressure that can motivate some firms to improve along the metrics of the information disclosed.

Much of the empirical research that examines the effects of institutional pressure has focused on how organizational practices diffuse through an organizational field (e.g., Delmas and Toffel, 2008; Edelman, 1992; Tolbert and Zucker, 1983) or on the degree to which organizational compliance with institutional demands is merely symbolic, involving no substantive changes to operations (Goodrick and Salancik, 1996; Okhmatovskiy and David, 2011; Toffel and Short, 2011; Westphal and Zajac, 2001). In contrast, we examine not how pressures induce firms to adopt specific practices, real or symbolic, but rather how institutional pressures lead to heterogeneity in changes in organizational performance.

Our work also relates to studies of firms' reactions to institutional pressures exerted by regulators (Henriques and Sadorsky, 1996; Khanna and Anton, 2002; Reid and Toffel, 2009), local communities (Florida and Davison, 2001; Henriques and Sadorsky, 1996), customers (Delmas and Montiel, 2008), competitors (Darnall, 2009), and shareholders (Reid and Toffel, 2009). But whereas these studies, like most in the institutional theory domain, tend to focus on average organizational responses to pressures emanating from different sources, our work examines heterogeneous responses. A recent review of empirical literature based on institutional theory concludes that there exists a "lack of understanding of the conditions under which institutional pressures and organizational characteristics explain the adoption of beyond compliance strategies" (Delmas and Toffel, 2011). Recent studies have found evidence that organizational responses to institutional pressures are moderated by organizational structure (Delmas and Toffel, 2008; Okhmatovskiy and David, 2011), location (Lounsbury 2007), marginal operating costs, and perceived benefits (Chatterji and Toffel, 2010). By theorizing and empirically testing hypotheses that certain organizational factors moderate how organizations respond to institutional pressure, we contribute to the nascent literature that examines heterogeneous responses to institutional pressures.

We build on the prior literature, which largely focuses on external institutional factors associated with differential responses to information disclosure, by theorizing that particular organizational attributes also affect the degree to which organizations alter their performance in response to information disclosure mandates. Some of the limited research in this domain has found that firms facing lower-cost opportunities to improve were especially likely to do so after being rated poorly by a third-party (Chatterji and Toffel, 2010). Although a cross-sectional analysis found an association between family ownership and lower pollution levels (Berrone *et al*., 2010), our study is, to our knowledge, among the first to explore how organizational attributes moderate firms' responses to institutional pressures that stem from mandatory information disclosure. We propose that three organizational attributes, in particular, moderate companies' responses to local environmental pressures associated with disclosure of pollution levels.

Specifically, we hypothesize that privately owned and more geographically concentrated establishments will be particularly responsive to these pressures by exhibiting greater environmental performance improvement, and that the effect of establishment size on improvement will depend upon local competitive conditions.

THEORY AND HYPOTHESES

Information disclosure, pressure, and performance

The effectiveness of information disclosure in changing firms' (and individuals') behaviors hinges on the perceived costs and benefits of the changes (Chatterji and Toffel, 2010; Fung *et al.* 2007; Jin and Leslie, 2009). For example, Jin and Leslie (2009) model restaurants' hygiene changes as a function of the marginal cost of improvement and the benefit of increased business that stems from improved hygiene. Chatterji and Toffel (2010) argue that firms in environmentally sensitive industries incur higher costs from disclosure of poor environmental performance due to the increased potential for inspection and greater intensity of public scrutiny. They find firms in such industries to be more likely to improve performance after receiving poor environmental ratings. This illustrates a common issue with information disclosure as intended to "reduce specific risks or performance problems" (Fung et al., 2007: 5). That is, information disclosure, whether mandated by government or promulgated by private parties such as ratings agencies, is intended to shine a light on previously hidden dimensions of performance with the intention of spurring improvement on the part of the disclosing actors.

We suggest that information disclosure is more likely to lead to improved performance among establishments that attract particularly salient pressures from internal or external stakeholders and that have preferential access to intra-organizational expertise. The degree to which concern about internal and external pressures prompts managerial responses depends on particular characteristics of an establishment and its parent company. We hypothesize below that proximity to headquarters motivates improved performance and provides the means to achieve it. We also hypothesize that certain organizational characteristics that heighten the perception of external pressure following information disclosure mandates account for firms being particularly likely to respond by improving their performance.

The role of internal pressure and ease of capability transfer in performance improvement

Information that reveals an establishment like a restaurant (Jin and Leslie, 2009), factory (King and Lenox, 2002), or vehicle service station (Pierce and Toffel, 2011) to be performing poorly can affect the reputation of its parent and sibling organizations. Because poor performance revealed by information disclosure requirements can harm organizations' reputations and stock prices (Hamilton, 1995; Konar and Cohen, 1997), the revelation of poor performance can prompt investment in improved procedures (including staff training and internal monitoring) and capital equipment aimed at improving performance (Chatterji and Toffel, 2010). We consider how revealing its poor performance generates pressure on an establishment to improve, and how that pressure is magnified by an establishment's embeddeness in a community.

Local embeddedness

When poor performance is revealed by mandatory information disclosure, pressure from an establishment's stakeholders can prompt subsequent performance improvement. Because firms tend to be particularly embedded in the communities in which they are headquartered (Marquis and Battilana, 2009), they behave in ways that seek to preserve their relationships with those communities. This embeddedness magnifies the effect of stakeholder pressure on subsidiary establishments located in their headquarters communities. For example, such establishments, being especially likely to try to ingratiate themselves to their communities, are less likely to lay off workers (Greenwood *et al.*, 2010) and more likely to source from local firms (Audia and Rider, 2010). Similarly, we argue that establishments located in their headquarters' communities will be particularly responsive to stakeholder pressures.

Proximity to headquarters also magnifies internal pressure on establishments revealed to be performing poorly because the information is particularly visible and salient to top management, which has strong incentives and the authority to press for improved performance. Proximity also facilitates the monitoring of and provision of assistance to such establishments. To summarize, proximity to headquarters is likely to magnify pressure from external and internal stakeholders, which increases the intensity with which the establishment will respond.

> **H1: Environmental performance will improve to a greater degree in establishments in the same geographic area as their headquarters than in establishments outside their headquarters area.**

Proximity to sibling establishments

Proximity not only to headquarters, but also to other establishments owned by the same parent can increase pressure on poorly performing establishments to improve. Being collocated with sibling establishments increases an establishment's visibility in a local area and ties siblings together such that information about one establishment, whether positive or negative, can affect the others (Carney and Gedajlovic, 1991). This reputational spillover means that any given establishment's performance has implications for sibling establishments in the same area (Jin and Leslie, 2009). Thus, poorly performing establishments with proximate siblings can experience strong internal pressure to improve.

In addition to fostering reputational spillovers that increase internal pressure, proximity to siblings facilitates the monitoring of, and transfer of capabilities needed to improve, performance. The personal, face-to-face communication that facilitates knowledge transfer (Darr, Argote, and Epple, 1995) becomes more costly and difficult as distance increases (Lafontaine and Slade, 2007; Berchicci, Dowell, and King, 2011). Indeed, one prescription for facilitating knowledge transfer is to cultivate closer relationships between sender and receiver (Szulanski 1996). To the extent that it engenders such relationships, physical proximity will enhance an establishment's ability to learn from its siblings.

> **H2: Environmental performance will improve to a greater degree in establishments with proximate corporate siblings than in isolated establishments.**

Capability transfer

We hypothesize above two mechanisms that lead to improvement, proximity enhancing both reputational spillovers and the ease with which capabilities are transferred. Although we expect both mechanisms to play a role in spurring improvement, it would be useful to isolate their effects in order to assess their relative magnitudes. We outline conditions under which capability transfer is most likely, in order to assess the degree to which that mechanism leads to greater performance improvement. We argue that two conditions are necessary for an establishment to benefit from capability transfer from a sibling: (1) the presence of a superior-performing sibling, and (2) a perceived need to enact the transfer.

The first necessary condition for capability transfer is the existence of the capability in at least one of an establishment's siblings. An establishment that has no other siblings that possess the capability is left to develop it on its own or attempt to learn other firms, which is more difficult because capabilities and the tacit knowledge on which they depend transfer more readily within than across firms (Darr, *et al*. 1995). Thus, an establishment with at least one superior performing sibling is more likely to benefit from capability transfer than an establishment that lacks such a repository of capability.

The existence of a superior performing sibling that possesses the potential to provide capabilities does not guarantee the transfer of those capabilities to a poorly performing sibling. Significant barriers to transferring capabilities within organizations often results in persistent performance differences between a firm's establishments (Chew, Bresnahan, and Clark, 1990; O'Dell and Grayson, 1998; Szulanski, 1996). Absent an event that creates urgency, these barriers can impede the transfer of capabilities to where they are needed most (Berchicci *et al.*, 2011). Disclosure of information about an establishment's performance can generate the sense of urgency that spurs efforts to overcome these barriers. Thus, to the extent that intra-organizational capability transfers are activated following information disclosure, greater performance improvement will be observed among establishments that have stronger performing siblings.

> **H3: Environmental performance will improve to a greater degree in establishments with stronger-performing corporate siblings than in establishments with only weaker-performing corporate siblings.**

Proximity enhancing capability transfer

Capability transfers, even when prompted by a sense of urgency, can nevertheless be difficult to achieve due, for example, to the complexity of the capability to be transferred, a poor relationship between sender and receiver, and lack of absorptive capacity on the part of the recipient (Szulanski 1996). One factor that can diminish the barriers to knowledge transfer is the proximity between the source and recipient. Proximity is particularly beneficial for overcoming the barriers associated with complexity of the knowledge and for improving the relationship between the source and recipient. Proximity reduces the cost of context-rich interactions, such as face-to-face meetings (Argote, McEvily, and Reagans, 2003) that are particularly beneficial for transmitting tacit knowledge that underlies capabilities, and increases trust between the sender and recipient (Bresman, Birkinshaw, and Nobel, 1999; Szulanski, Cappetta, and Jensen, 2004). Establishments proximate to each other share a common institutional context, which also increases the likelihood that information conveyed between them is relevant and likely to be accepted (Williams, 2007). Therefore, when establishments have well performing siblings from which they can learn, proximity to these siblings can enhance the transfer of their superior capabilities (Berchicci *et al.*, 2011; Darr *et al.*, 1995).

> **H4a: Environmental performance will improve to a greater degree in establishments that are proximate to well-performing corporate siblings.**

Company headquarters can be a repository of capabilities (Grant, 1996) and disseminator of the best practices exhibited by its subsidiaries (Lenox and King, 2004). Establishments proximate to their headquarters are especially likely to be exposed to such best practices because proximity facilitates the interpersonal interaction through which tacit knowledge is often disseminated. Proximity to headquarters also enhances monitoring (Kalnins and Lafontaine, 2010) which allows the headquarters to more effectively assess how successfully the capabilities are transferring.

> **H4b: Among establishments with well-performing corporate siblings, environmental performance will improve to a greater degree in those proximate to headquarters.**

The role of external pressure in performance improvement

Organizational characteristics affect not only internal (intra-firm) pressures, but also the salience of external pressures. We hypothesize that, among establishments that face common institutional pressures, size and ownership structure will moderate the responses to performance disclosure. Below, we theorize that relative size within its institutional field affects the pressure on, and thus response of, an establishment. We further propose that establishments owned by publicly traded firms face different pressures than those owned by private firms, which leads to different responses. For each of these organizational characteristics, we offer competing theories that predict opposing moderating effects.

Establishment size and regional density

Although theory suggests that size is likely to moderate an establishment's sensitivity to external pressures, whether size promotes or inhibits such sensitivity remains ambiguous. Institutional theorists, for example, argue that larger organizations' greater visibility makes them especially attendant to the need to maintain legitimacy (Goodstein, 1994; Ingram and Simons, 1995), which suggests that they would be particularly sensitive to external pressures occasioned by information disclosure. Resource dependence theory (Pfeffer and Salancik, 1978), on the other hand, suggests that firms will attend to pressures that emanate from stakeholders who control critical resources. To the extent that larger firms are more powerful and thus less dependent on local regulators and pressure groups, they can be expected to be better able to resist external pressures that surface in the wake of disclosure of performance information (Drope and Hansen, 2006; Grant, Bergesen, and Jones, 2002).

We propose that these opposing views can be reconciled by considering how an organization's context influences the mechanisms by which size affects sensitivity to pressure. Institutional theorists' argument that maintaining legitimacy is more important for larger firms (Goodstein, 1994) is based on the assumption that larger organizations, being more visible in their communities, are more likely to attract media attention (Ingram and Simons, 1995) and be held to higher standards than smaller counterpart organizations (Goodstein, 1994).

But despite being more visible and under greater scrutiny, larger establishments may also be better positioned to resist, and therefore less sensitive to, local pressure generated by information disclosure. Larger establishments can accrue power through superior political access, and can more easily afford to lobby or donate to politicians and to sue regulatory agencies (Drope and Hansen, 2006; Hansen, Mitchell, and Drope, 2005; Schuler, 1996). Greater political and social capital may also accrue to larger establishments by virtue of providing employment for greater numbers of individuals. Larger establishments can direct these formidable resources at reducing the pressure exerted on them by local regulators or non-governmental organizations to improve performance revealed by mandatory information disclosure. Thus, larger establishments may exhibit less improvement than smaller establishments in the wake of disclosure of performance information.

The different theories articulated above thus suggest opposing influences of size: larger organizations might be either particularly responsive, or particularly unresponsive, depending on which theory is embraced, to external pressures that follow information disclosure. Under what circumstances might each mechanism dominate? We suggest that a critical factor that moderates how size affects an organization's responsiveness is its economic, social, and political power in the region from which the pressure emanates. For example, a 1,000-employee establishment that accounts for but a tiny fraction of economic activity in a region has less power than a similar-size establishment that accounts for a large proportion of the economic activity in its region. A large number of establishments in a given area dilutes any given establishment's potential power, rendering it more vulnerable to pressure exerted by regulators and concerned groups. A large establishment will have much greater leverage in the presence of relatively few other establishments. Such an establishment will likely be able to leverage its contributions to community tax revenues and employment (e.g., Boal and Ransom, 1997) or membership in the local elite and influence with local regulators (Marquis and Battalina, 2009).

The foregoing arguments suggest that the number of other establishments in a region moderates the effect of establishment size on performance improvement following information disclosure in the following way. We consider a region with a relatively large number of reporting establishments to be a *dense* region, and one with relatively few reporting establishments to be a *sparse* region. Stated as a pair of difference-in-difference relationships, we expect larger establishments to exhibit (a) greater performance improvement than smaller establishments in dense regions, but (b) less improvement than smaller establishments in sparse regions. We combine these relationships into a single statement by hypothesizing a triple difference: that relative improvement among large establishments will be greater in dense regions than in sparse regions.[1]

H5: Larger organizations' environmental performance improvement will exceed that of smaller establishments to a greater degree in dense regions than in sparse regions.

Public ownership

Following disclosure of performance information, there are several reasons why performance improvement can be expected to be greater among establishments owned by publicly traded firms than among establishments owned by privately held firms. First, being accountable to a greater number of audiences, publicly traded firms face more requirements than their privately owned counterparts to report information about their operations (Fischer and Pollock, 2004; Mascarenhas, 1989). Second, publicly traded firms are vulnerable to investors who seek to use their ownership stake to influence management decisions. Whereas public firms have investors that have access to publicity-laden shareholder resolutions and other mechanisms through which they can attempt to influence management decisions, private firms seldom encounter activist investors (David, Bloom, and Hillman, 2007; Gillan and Starks, 2000; Reid and Toffel, 2009). Third, disclosed information can affect the stock price of publicly traded firms (Konar and Cohen, 1997), which can lead corporate managers to increase pressure on subsidiary establishments to improve performance. The absence of stock price concerns renders private firms less sensitive to external pressure to improve following disclosure of performance information (Schulze *et al.*, 2001).

H6a: Environmental performance will improve to a greater degree in establishments owned by publicly traded firms than in establishments owned by privately held firms.

Conversely, that public firms' shareholders are often principally concerned with share price may, in fact, reduce public firms' sensitivity to mandatory disclosure of performance information. Operational improvements (e.g., capital equipment, development of new capabilities) often require significant additional investment that have long payback periods, and sometimes are not profitable even in the long

[1] Foreshadowing our empirical approach, we analyze each of these two difference-in-differences, which compare performance trends of large establishments to small establishments in sparse regions, and separately in dense regions, and then compare the trend differences estimated by the two regressions.

run (Christmann, 2000; King and Lenox, 2002). To the extent that financial returns derived from investments in operational performance improvements are unclear or occur only over long time horizons, we expect publicly traded firms under pressure to maintain short term profits and stock prices to be less likely to make such investments (Fischer and Pollock, 2004). Private firm owners are relatively more insulated from short term financial pressures exerted by outside investors and likely to have significant portions of their own wealth concentrated in their firms (Moskowitz and Vissing-Jørgensen, 2002), both of which increases the likelihood that they will make long-term investments to secure the firms' survival (Schulze *et al.*, 2001).

H6b: Environmental performance will improve to a greater degree in establishments owned by privately held firms than in establishments owned by publicly traded firms.

DATA AND MEASURES

Empirical context and sample

We empirically test our hypotheses by taking advantage of a policy change that occurred when the U.S. Environmental Protection Agency (EPA) expanded the scope of the Toxics Release Inventory (TRI). The U.S. Emergency Planning and Community Right-to-Know Act of 1986 created the TRI, which requires establishments to publicly report annually waste, transfers, and releases of certain toxic chemicals. An establishment is required to report if it (1) operates within particular industry sectors including manufacturing, mining, electric utilities, hazardous waste treatment, and chemical distribution, (2) employs ten or more individuals, and (3) manufactures, imports, processes, or otherwise uses any of the listed toxic chemicals in amounts that exceed reporting thresholds (U.S. EPA 2004). TRI became operational in 1987, and EPA has periodically expanded the list of chemicals to be reported. We leverage this fact in our identification strategy, as described below. As of 2011, the EPA requires disclosure of 593 individual chemicals in 30 chemical categories (U.S. EPA, 2011). To construct our database, we supplement establishments' annual TRI reports with Dun and Bradstreet data obtained from the National Establishment Time-Series (NETS) database, as described below. Our resulting panel dataset consists of

38,175 establishments over the years 1995 to 2000 (217,575 establishment-years), the six-year period that followed EPA's largest expansion of the list of chemicals that comprises the TRI.

Dependent variable

We measure environmental performance based on toxic chemical emissions data from the TRI database, a widely used approach (e.g., Berrone *et al.*, 2010; Chatterji and Toffel, 2010; King and Lenox, 2000; King and Shaver, 2001; Toffel and Marshall, 2004). In November 1994, the EPA issued a rule that expanded the list of toxic chemicals required to be reported by 243 (in addition to the 363 already required to be reported), effective in 1995 (U.S. EPA, 1994). Our outcome measure is *total releases* of these 243 chemicals that were added in 1995, which includes the total pounds each firm reported to the TRI as production waste, transfers, and emissions. We obtained TRI data from the EPA's Risk-Screening Environmental Indicators (RSEI) Model (versions 2.1.2 and 2.1.3) (U.S. EPA, 2010). Our models employ the log of these annual values after adding one. Whereas some studies apply various weights to these chemicals to account for differences in toxicity, simply summing the pounds of emissions was a commonly used approach by the media and prominent nonprofit organizations and in government publications during the sample period (Toffel and Marshall, 2004), as well as by academic studies examining institutional pressure and responses to TRI releases (e.g., Chatterji and Toffel, 2010, Dooley and Fryxell, 1999, Feldman, Soyka, and Ameer, 1997, Konar and Cohen, 2001).

Moderators

Headquarters proximity

We measure proximity to headquarters as a dichotomous variable, *proximate headquarters*, coded "1" for establishments located in the same city as their headquarters, and "0" otherwise. We obtained establishment addresses from the TRI database and headquarters addresses from the NETS database. To cleanly identify the effect of the 1995 policy change on firm behavior, we pursue the customary practice of measuring the hypothesized establishment-level characteristics fixed at their value in 1994, just prior to the policy change. In the absence of a 1994 value, we use an establishment's 1993 value. We employ this practice for all hypothesized moderators described below.

Sibling proximity

We measure the extent to which an establishment's poor performance might impugn the reputation of other establishments in its corporate family based on whether any other TRI-reporting establishments are located within the same city. We created *proximate sibling* as a dichotomous, establishment-level, time invariant variable coded "1" for establishments with at least one sibling in the same city in 1994, and "0" otherwise. We obtained the identities and addresses of each establishment's siblings from the NETS database.

Progressive sibling

We created a dichotomous variable to indicate whether any of its siblings performed substantially better than the focal establishment. We coded an establishment as possessing a *progressive sibling* as "1" if at least one sibling had standardized abnormal emissions (in 1994) at least one standard deviation better than (below) the focal establishment's standardized abnormal emissions, and "0" otherwise. Based on an approach pioneered by King and Lenox (2000), our calculation for standardized abnormal emissions begins with an OLS regression that predicts total toxic releases based on employment, employment-squared, and a full set of dummies for two-digit SIC codes. We include all chemicals that were part of the TRI from its inception through 1994 (thereby excluding the chemicals added in 1995 that make up *total releases,* our dependent variable). Employment and two-digit SIC codes are obtained from NETS. The regression yields a predicted emissions level given an establishment's size and industry. We calculate abnormal emissions as an establishment's actual emissions less its predicted emissions, which we then standardize with a mean of zero and standard deviation of one within each two-digit SIC code.

Large establishment

We considered establishments to be large based on their employment levels in 1994 relative to other TRI establishments in the same state. Specifically, we created *large establishment* as a time-invariant, establishment-level, dichotomous variable coded “1” if an establishment’s employment in 1994 exceeded the median employment of all TRI establishments in the same state that year, and “0” otherwise. We obtained establishment employment levels from NETS.

Regional density

We distinguish sparse from dense regions based on the density of TRI-reporting establishments in a city. Specifically, we identify as sparse a city that had fewer TRI-reporting establishments during 1994 than the median number of 11 for all U.S. cities during those years. An establishment was considered to be located in a dense city if the number of TRI-reporting establishments therein was at or above this median number of 11.

Public ownership

We created a time-invariant, establishment-level, dichotomous variable, *public ownership,* coded “1” if an establishment was owned by a publicly traded firm, and “0” if by a privately owned firm, in 1994, based on data from the NETS database.

Controls

An establishment’s toxic chemical emissions being, in part, a function of its activity level and industry, we include several control variables to capture these important covariates.

Establishment size

We control for establishment size via employment level (Aravind and Christmann, 2011; Chatterji and Toffel, 2010; Diestre and Rajagopalan, 2011; King and Lenox, 2000; King, Lenox, and Terlaak, 2005; Potoski and Prakash, 2005; Russo and Harrison, 2005). We obtained annual employment data from NETS and used *log employment* in our models to reduce skew.

Establishment production

We control for changes in production volumes by obtaining annual production ratios (i.e., the ratio of an establishment’s production level in a given year to its production level the prior year) from the

TRI database (Berrone and Gomez-Mejia, 2009; Scorse, 2010; Terlaak and King, 2006). Establishments are required to provide a production ratio for each chemical reported to the TRI database, each year. For establishments that reported different production ratios in a given year (e.g., for different production lines in a plant), we employed the median value for the establishment-year. Across the distribution of median annual establishment production ratios, we winsorized at the 5th and 95th percentiles to avoid undue influence from outliers. We then linearly interpolated missing interior production ratio values. Using these production ratios, we calculated the relative production level for each establishment-year relative to 1994 (our baseline year) using the following equation. First, we created a normalized baseline year for all establishments by setting $\textit{relative production level}_{i,t}$ equal to "1" in the year 1994. Then, for each subsequent year starting in 1995, we calculated $\textit{relative production level}_{i,t}$ for establishment *i* in year *t* as follows:

$$\textit{relative production level}_{i,t} = \textit{production ratio}_{i,t} \times \textit{relative production level}_{i,t-1}$$

In our regressions, we include the log of *relative production level* to match our log dependent variable and a dummy variable coded "1" if an observation's value was based on an interpolated production ratio, and "0" otherwise.

Industry

Toxic chemical emissions being, in part, a function of industry activities (Berrone *et al.*, 2010; Diestre and Rajagopalan, 2011; King and Lenox, 2000; Potoski and Prakash, 2005), we control for differences between industries by including a full set of industry dummies based on 2-digit Standard Industrial Classification (SIC) codes using NETS data. To facilitate model convergence, we collapsed relatively rare SIC codes, that is, those with fewer than 100 establishment-year observations in each of our samples, into a single "other" category.

Sample descriptive statistics and summary statistics and correlations are reported in Tables 1 and 2.

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Insert Tables 1 and 2 about here

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EMPIRICAL ANALYSIS

Model specification

Establishments are required to report to EPA only toxic chemical emissions that exceed specific TRI reporting thresholds. As a result, our dependent variable, *total releases,* is missing (left-censored) in years during which an establishment's emissions range from zero (no emissions) to emissions levels that fall below TRI reporting thresholds. Prior research indicates that establishments for which emissions dip below reporting thresholds seldom cease entirely to use these chemicals, which suggests that they often continue to release unreported emissions, and that treating such missing values as zero would likely result in biased estimates (Bennear, 2008). As a result, we estimate an interval regression whereby left-censored observations of the dependent variable are specified to range between 0 and the minimum positive value of *total releases* reported by other establishments that year, L_t. We estimate the following model for establishment *i* in year *t*:

$$Y^*_{i,t} = \beta_1(M_i \times \gamma_t) + \beta_2 M_i + \beta_3\gamma_t + \beta_4 X_{i,t} + \varepsilon_{i,t},$$

where $Y^*_{i,t}$ is the latent dependent variable and is related to the observed dependent variable, $Y_{i,t}$, based on the following observation rule:

$$Y_{i,t} = \begin{cases} Y^*_{i,t} \; if \; Y^*_{i,t} > L_t \\ L_t \; if \; 0 \le Y^*_{i,t} \le L_t \end{cases}$$

M_i represents the time-invariant moderator described above, γ_t is an annual counter (0 in 1995, 1 in 1996, etc.) that captures the secular trend, and $X_{i,t}$ represents control variables (*log employment*, *log relative production level*, *production level interpolated,* and industry dummies).

Identification

Our identification strategy relies on the exogenous policy shock that occurred in 1995 when EPA expanded the number of chemicals required to be reported to the TRI substantially, by 243, from 363 to 606 chemicals. Our analysis compares how various types of establishments responded to the requirement to disclose the newly listed chemicals. Specifically, we compare performance trends during a six-year period that begins in 1995, the initial year the newly added chemicals were required to be reported, and ends in 2000.

A number of our hypotheses predict behaviors based on the relationship between a focal establishment and its siblings (H2-H4). To sharpen the identification, our empirical analysis of these hypotheses is based on a sample restricted to establishments with at least one TRI-reporting sibling. This enables us, when testing H2, to compare the behavior of establishments with proximate siblings to that of establishments with non-proximate siblings, and, when testing H3, to compare performance trends between (a) establishments with intra-firm access to knowledge and capabilities from better-performing siblings, and (b) establishments with siblings that do not outperform them.

To estimate how density moderates the behavior of large organizations (Hypothesis 5), we test whether the extent to which large establishments improved more than small establishments in sparse regions is exceeded by the extent to which large establishments improved more than small establishments in dense regions. We test this pair of difference-in-differences using a triple difference approach (i.e., differences-in-differences-in-differences), which has been used in many domains to facilitate comparisons across two groups in two different contexts (e.g., Basker and Noel, 2009; Costa and Kahn, 2000; Currie *et al.*, 2009; Gruber, 1994). Specifically, we estimate our model on the subsample of establishments in cities with few TRI-reporting establishments (sparse), and then on the subsample of establishments in cities with many TRI-reporting establishments (dense). We then compare the coefficients that estimate the gap in trends, and test whether the former is exceeded by the latter.

Primary results

We estimate our models using interval regression, and include each interaction term in a separate regression model. In all cases, we report standard errors clustered by establishment, and include dummy variables coded "1" if *relative production level* or *log employment* was recoded from missing to zero, and "0" otherwise (Greene, 2008: 62; Maddala, 1977: 202;). This approach, commonly employed in econometric analysis, is algebraically equivalent to recoding missing values with the variable's mean (Greene, 2007: 62). Our primary results are reported in Table 3.

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Insert Table 3 about here
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Headquarters proximity

The model displayed in Column 1 includes the interaction between the secular trend and *proximate headquarters.* The results indicate that establishments in the same city as their headquarters exhibited a superior environmental performance trend compared to establishments with more distant headquarters (β = -0.040, $p < 0.01$), which supports Hypothesis 1. This interaction term coefficient represents the average annual difference in emissions trends between these two groups of establishments. To interpret the magnitude of this effect, we note the positive annual trend among establishments with headquarters in a different city (the baseline group) (β = 0.088, $p < 0.01$), which equates to an average increase of 0.53 log points over our six-year sample period (1995-2000) (calculated as 0.088*6), and an increase of 59% beyond the total releases sample mean of 0.90 log points (Table 2). In contrast, the average headquarters-proximate establishment increased total releases by just 0.29 log points (calculated as [0.088-0.040]*6), which amounts to 32% of the sample mean. Given that the latter constitutes nearly half the growth rate of the former, we conclude that this statistically significant difference is also a substantial one.

Reputation spillover

To analyze the effects of a proximate sibling, we restrict the sample to establishments with at least one TRI-reporting corporate sibling, and control for the number of siblings (fixed at their 1994 values, then logged). The results in Column 2 reveal that establishments with proximate siblings exhibit a superior performance trend compared to establishments with non-proximate siblings (β = -0.020, $p < 0.05$), which supports Hypothesis 2. The average annual trend among establishments with non-proximate siblings (β = 0.094, $p < 0.01$) implies a total 0.56 log point increase over the six-year sample period. In comparison, establishments with proximate siblings increased total releases by 0.44 log points, a 21% lower growth rate.

Capabilities transfer

The model that tests H3 compares the performance trends of establishments with superior-performing corporate siblings to those of establishments with more poorly performing siblings, and is estimated on the subsample of establishments with corporate siblings. The results (Column 3) indicate that the performance trends of the two groups are statistically indistinguishable, which fails to support Hypothesis 3.[2]

Proximity enhancing capability transfer

We next investigated whether capability transfers from superior-performing siblings are enhanced by geographic proximity. To examine whether proximity enhances transfers made directly between siblings, we analyze the subsample of establishments with progressive siblings and test whether the performance of establishments proximate to their progressive siblings is superior to that of establishments with progressive siblings further removed. The results reported in Column 4 provide no evidence of this.

To examine whether a focal establishment's proximity to headquarters (which can serve as an information clearinghouse) enhances capability transfers from a progressive sibling, we limit our sample to establishments with at least one sibling. We find no evidence that establishments with a progressive sibling and proximate headquarters outperform other establishments (Column 5). Thus, we find no evidence to support Hypotheses 4a or 4b.

[2] We also estimated this model on a subsample of establishments with siblings that likely faced greater pressure and thus demand to access the intra-firm knowledge and capabilities of their progressive siblings. The subsample includes those establishments whose overall toxic chemical releases were among the top ten in their county in 1994. This model yielded no significant differences in performance trends between establishments with progressive siblings and establishments whose performance was more akin to their siblings. Thus, we found no support for Hypothesis 3.

Large organizations and density

Among establishments in sparse regions (cities with fewer TRI-reporters than the sample median), we find a greater increase in total releases among larger than smaller establishments (Column 6: $\beta = 0.028$, $p < 0.01$). Among establishments in more dense regions (the opposite subsample: cities with more TRI-reporters than the sample median), the negative coefficient implies that larger establishments improve more than smaller establishments, but the difference is not statistically significant (Column 7: $\beta = -0.013$, $p = 0.14$). To test whether larger establishments' superior performance relative to that of smaller establishments in dense regions exceeded their relative performance difference in sparse regions, we estimated a seemingly unrelated regression that simultaneously estimated these two models. The results revealed a statistically significant difference between these two interaction term coefficients of opposing signs ($\chi^2 = 11.63$, $p < 0.01$), which supports Hypothesis 5.

What is the magnitude of these differences? In sparse regions, smaller establishments' (the baseline group) positive (worsening) performance trend ($\beta = 0.034$, $p < 0.01$) amounts to a 0.20 log point increase in total releases over the six-year sample period. In contrast, larger establishments increased total releases by 0.37 log points, which amounts to nearly twice (1.9 times) the increase exhibited by smaller establishments. The difference between large and small establishments is similarly substantial in dense regions. Annual growth among smaller establishments ($\beta = 0.058$, $p < 0.01$), the baseline in the regression, amounts to 0.35 log points of *total releases* over six years. In contrast, larger establishments experienced an average total increase of 0.27 log points, which amounts to just 77% of the increase exhibited by smaller establishments. To graphically depict the difference in trends between larger and smaller establishment in sparse and dense regions, we calculated the gap in trends as follows. We calculated the average annual predicted value for larger establishments within sparse regions, and deducted from this the corresponding figures for smaller establishments. The growing gap over time between larger and smaller establishments is depicted as the rising, bold, solid line in Figure 1, surrounded by dashed lines representing the 95% confidence interval. We repeated these calculations for dense regions. The narrowing gap over time between larger and smaller establishments is depicted as the declining, thin, solid line in Figure 1. The difference between these trends is statistically significant, as indicated by the chi-squared test statistic described above.

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Insert Figure 1 about here
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Public ownership

As reported in Column 8, average environmental performance trends were better for privately-held establishments than for publicly-owned establishments (β = 0.060, $p < 0.01$), which supports Hypothesis 6b, but not Hypothesis 6a. The average annual trend of publicly-owned establishments (0.035 + 0.060 = 0.095) was nearly triple (2.7 times) the average annual trend of privately-owned establishments (β = 0.035, $p < 0.01$). Over the six year sample period, these average trends amount to total emissions increasing by 0.57 log points (63% of the sample mean) for establishments with publicly owned parent firms, compared to 0.21 log points (23% of the sample mean) for establishments with privately held parent firms.

Robustness tests

We conducted a number of robustness tests to assess the sensitivity of our results to controlling for establishments' pre-trends and local environmental pressures, moderator measurement, model specification, and subsampling strategy.

Historical performance trends

Our primary analysis examines the environmental performance trends of toxic chemical emissions in the first few years after public disclosure was required. We conclude from our primary results that public disclosure influenced the differential subsequent performance trends we observed. A potential threat to the validity of this conclusion is our inability to observe historical performance trends for these chemical emissions. Were the performance trends that became publicly observable with the new disclosure requirements perhaps already occurring beforehand, but known only to the establishments? While we cannot observe that trend, we can observe establishments' performance trends of the original

TRI chemicals whose reporting had been required before the 1995 policy change. We conducted the following tests to assess the likelihood that the validity of our conclusions is threatened by these historical performance trends. We calculated each establishment's *historical release trend* based on other toxic chemicals that were required to be reported from 1991 to 1994, the years immediately preceding the 1995 expansion. Specifically, for each establishment *i*, we calculated a percent change metric that is robust to outliers using the following equation:

$$\textit{historical releases trend}_i = (\textit{average total releases}_{i,1993\text{-}1994} - \textit{average total releases}_{i,1991\text{-}1992}) \,/\, (0.5 \times \textit{average total releases}_{i,1993\text{-}1994} + 0.5 \times \textit{average total releases}_{i,1991\text{-}1992})$$

By construction, this metric ranges from –2 to +2.

To control for the influence of historical performance trends (1991-1994) on establishments' subsequent performance trends (1995 and after), we added to our model the interaction between *historical releases trend* and the *annual counter.* Because *historical releases trend* was sometimes undefined, owing to an establishment's total releases throughout 1991-1994 being below the reporting threshold or actually zero, we recoded missing values of *historical releases trend* to zero, and created a dummy variable to indicate these instances of recoding. We included in the regression both this dummy variable and its interaction with the annual counter. These models yielded results (reported in Table A-1 in the Appendix) substantively the same as the primary results for all hypotheses.

Alternative specifications for independent variables

In testing our hypotheses, we had to choose an appropriate geographic scope to create our measures of proximity for headquarters and siblings, as well as for assessing the effect of regional density on the relative improvement of large and small establishments. To determine if our results were sensitive to these decisions, we performed a number of robustness tests. For headquarters proximity, our results are substantively similar when we measure proximity more narrowly, as the same three-digit ZIP Code, or more broadly, as the same state (results reported in Columns 1-2 of Table A-5 in the Appendix). For sibling proximity, the results are substantively similar when we measure proximity more narrowly, as the same three-digit ZIP Code (Table A-5, Column 3). Relying on a broader geographic definition of proximity (same county) also yields a negative coefficient, but one that is half the magnitude and not statistically significant (Table A-5, Column 4: $\beta = -0.012$, $p < 0.16$). These results begin to sketch the boundaries that limit the geographic scope of reputation spillovers.

In testing the moderating effect of local density on the relative improvement of large and small facilities, we measured density at the city level and considered facilities to be large if they employed more people than the median facility in their state. We continue to find support for Hypothesis 5 when we categorize sparse versus dense communities based on the number of TRI establishments in the same county being less or greater than the county median of 41 (Columns 1-2 of Table A-6 in the Appendix).[3] We also continue to find support for Hypothesis 5 when we define large establishments as those with employment levels among the top quartile in their state, rather than exceeding the state median, in 1994.[4]

In testing the effect of capability transfer, we assumed that an establishment could learn from any of its siblings with superior capabilities, even if those siblings are in unrelated industries. It may be, however, that similarity in production processes facilitates transfer. However, we continue to find no evidence of capabilities transferred from progressive siblings when we focus on those that shared with the focal establishment the same two-digit SIC code (Column 5 of Table A-5). We also assessed whether changing the definition of progressive sibling would affect our results, but there was no affect for facilities with siblings that exhibited dramatically better performance, measured as two standard deviations lower abnormal releases (results not reported).

[3] Larger establishments exhibited worse performance trends than smaller establishments in sparse counties, and better performance trends than smaller establishments in dense counties.
[4] In sparse cities, we continue to observe larger establishments exhibiting significantly worse performance trends than smaller firms, using either of these definitions of large (Column 3 of Table A-6, $p<0.01$). In dense cities, we find little difference in performance between large and small establishments using this alternative measure (Column 4). Seemingly unrelated regression indicated that the difference between these trends is statistically significant ($\chi^2=10.70$, $p<0.01$).

Local environmental preferences

Because some prior studies have highlighted the importance of local community environmental pressures on establishments' environmental management practices (e.g., Delmas and Toffel 2008; Hamilton, 1999), we assessed the extent to which our results are robust to this factor. Like others, we measure community environmental pressures using the League of Conservation Voters (LCV) National Environmental Scorecard, which calculates the proportion of environmental bills favored by each House of Representatives member. We employ the LCV score of the Representative of the district in which an establishment is located. We conducted two types of analysis. First, we looked for evidence that community environmental pressures influenced environmental performance trends. We created a dichotomous variable called *green district*, which was coded "1" if the 1994 LCV score of an establishment's Representative was greater than the sample median (46 out of 100), and "0" otherwise. Interacting the moderator with the temporal trend variable, we find no evidence that performance trends differed based on whether facilities were located in communities with stronger or weaker environmental preferences (Column 9 of Table A-2 in the Appendix). We then assessed whether controlling for community environmental preferences affected our primary results by including as an additional control variable the annual LCV score of an establishment's Representative. These models, which also control for historical release trends, yield substantively the same results as our primary model. Together, these results indicate that our results are robust to considerations of community environmental pressure.

OLS regression

As an alternative to interval regression, we re-estimated our models using ordinary least squares (OLS) with establishment-level fixed effects, an approach used by others to estimate toxic chemical emissions from the TRI database (e.g., Hanna and Oliva, 2010; King and Lenox, 2000; Russo, 2009). We continue to cluster standard errors by establishment. The OLS results (see Table A-3 in the Appendix) support Hypotheses 1, 2, 5,[5] and 6b, just as our primary interval regression models (Table 3) do.[6] OLS models continue to support these hypotheses when we also control for *historical releases trend* (see Table A-4).

DISCUSSION

Our analysis reveals that organizational characteristics influence the degree to which establishments improve their performance in response to mandatory information disclosure requirements. Below, we describe how our study contributes to the literatures on information disclosure and institutional theory.

Contributions to information disclosure research

Mandating information disclosure as a means of regulating organizational behavior has become more prevalent in recent years, yet the circumstances under which these programs are successful in changing organizations' actions are only beginning to be understood (Fung *et al.*, 2007; Toffel and Short, 2011). The need for evaluation is especially great in the field of environmental policy, in which information disclosure is especially prevalent and has been referred to as the "third wave" of policy instruments, following earlier eras of command-and-control (e.g., technology mandates) and market-based mechanisms such as tradable permits (Delmas, Montes-Sancho, and Shimshack, 2010; Tietenberg, 1998). In this paper, we identify several key organizational attributes that moderate the effect of information disclosure mandates on organizational performance. We obtain four significant results. First, establishments located near their headquarters improve more rapidly than other establishments. Second,

[5] In testing Hypothesis 5, our OLS models, like our primary results based on interval regression, yield point estimates that indicate that larger establishments exhibited worse performance trends than smaller establishments within sparse regions (Column 6 of Tables A-2 and A-3), but better performance trends than smaller establishments within dense regions (Column 7 of Tables A-2 and A-3), and that the difference between these two effects is statistically significant (Table A-2: $F=14.13$, $p<0.01$, Table A-3: $F=13.50$, $p<0.01$). However, whereas the interval regression models revealed a statistically significant difference in trends within sparse but not dense regions, our OLS models revealed statistically significant different performance trends within dense regions but only marginally significant differences in sparse regions. Thus, while interval regression and OLS regression yield robust support for H5, the different inferences within subsamples suggests caution when interpreting the decomposition between contexts.

[6] The OLS results in Table A-3 also provides supporting evidence of Hypothesis 3 (Column 3: $\beta = -0.031$, $p < 0.01$).

establishments located proximate to corporate siblings improve more rapidly. Third, larger establishments improve more rapidly in dense regions than in sparse regions. Finally, establishments that belong to publicly traded firms improve more slowly than those owned by privately held firms.

The findings related to proximity to headquarters and corporate siblings suggest that establishments are particularly careful to protect their images close to their homes and clustered operations. Prior research has argued that firms are embedded in their headquarters' communities and hence are more concerned with their reputations within those communities (Audia and Ryder, 2010; Marquis and Battilana, 2009). Our results are consistent with this, and further suggest that embeddedness can occur with respect not only to headquarters but also to clusters of establishments within a region.

We note that our result regarding headquarters proximity contradicts recent research in sociology. Grant, Jones, and Trautner (2004) find no difference in pollution rates between establishments that are in the same state as their headquarters and those that are not. Their analysis, however, did not consider improvement over time, but rather absolute levels of emissions, and the use of a broader geographic region might mute the effects of both community embeddedness and transfer of capabilities.

An alternative explanation for the proximity results is that proximity enhances capability transfer (Berchicci *et al.*, 2011), and establishments proximate to headquarters or corporate siblings are thus better positioned to receive capabilities needed to improve performance. We do not find, however, superior improvement among establishments that have siblings with above-average historical performance, even if those siblings are proximate. It thus appears that the effect of proximity on improvement is due more to increased sensitivity to pressures exerted by the community in which an establishment is especially embedded than to preferential access to capabilities that can be transferred to the establishment.

Our results with respect to establishment size suggest that the density of local manufacturing establishments moderates the effect of size on improvement. In relatively dense areas, the visibility of large establishments appears to outweigh the power they possess, whereas in sparse areas they appear to be more likely to exercise their power. Our findings extend findings in sociology regarding the size-environmental performance relationship that suggest that large establishments have the ability to abuse their powerful positions within society including the ability to create disproportionate levels of pollution (Freudenberg, 2005; Grant *et al.*, 2002).

Finally, to our knowledge, ours is the first study that compares the environmental performance of establishments owned by publicly traded companies to that of establishments owned by privately held companies. We find that establishments owned by public firms improve significantly more slowly than establishments owned by privately held companies. Future research is required to distinguish the mechanisms that underlie these results. Greater pressure on establishments owned by publicly traded companies to achieve growth (Mascarenhas, 1989) might deter investments in environmental improvement projects with less certain returns or longer payback periods. In contrast, establishments owned by privately held firms, which generally have more concentrated ownership, might be more willing and able to undertake projects that create other forms of utility valued by their owners, which Berrone *et al.* (2010) refer to as "socioemotional wealth." These explanations are not mutually exclusive, as each assumes a greater tendency of establishments owned by privately held firms to make investments in environmental improvements even if the financial returns are unclear. Future work is needed to more precisely identify the mechanisms at play and circumstances under which each type of ownership is more likely to foster better environmental performance.

Our analysis provides important evidence that organizational features moderate the degree to which mandatory information disclosure influences subsequent performance. Future research could build on our results by exploring other organizational characteristics and institutional features upon which performance improvement is contingent as well as examine other information disclosure contexts that might provide data on additional dimensions of performance. For example, our establishment-level data prevents us from exploring how financial performance, brand equity, and board membership might influence organizations' responses to information disclosure mandates.

Contributions to institutional theory

Institutional theory is particularly well suited to illuminating how external pressures affect organizations. Of particular importance to strategic management scholarship is the need to further refine institutional theory to further our understanding of why firms respond differently to common institutional pressures. For example, why, among firms in similar institutional environments, do some implement environmental management strategies that go well beyond regulatory compliance requirements while others pursue more laggard approaches (Delmas and Toffel, 2011)? In particular, what organizational attributes moderate the effects of institutional pressures?

Our findings suggest that institutional pressures are particularly effective in shaping the behavior of organizations that possess particular characteristics and capabilities. For example, two organizational features appear to magnify institutional pressures to improve: proximity to siblings or headquarters, and being owned by a privately held firm. Our analysis confirmed that both features are associated with superior performance trends following mandatory information disclosure. Our finding that locally-headquartered firms are more strongly influenced by communities than by subsidiary units provides important evidence of a phenomenon that has not received a great deal of prior attention (Marquis and Battalina, 2009: 296). Our work extends prior research that demonstrated that firms are embedded in the cities in which they are headquartered, and that this embeddedness has implications for their actions. Lounsbury (2007), for example, demonstrates that mutual funds' strategies reflect the logics of the cities in which they are headquartered, Boston funds being more conservative than those headquartered in New York. Greenwood et al. (2010) find more geographically concentrated firms, which are more closely tied to their region's interests, to be less likely to pursue downsizing strategies. Our findings go beyond prior studies by explicitly contrasting responses to institutional pressures by establishments proximate to their headquarters with those of establishments more distant from their headquarters. Our results suggest that institutional pressures are intensified by internal pressure to improve performance, especially when the headquarters has a direct interest in avoiding fracturing its (and the establishment's) relationship with its home community.

There is little prior research on how institutional pressures might affect establishments owned by publicly traded companies differently from establishments owned by privately held companies, but our results are somewhat surprising in light of research in a related area. Darnall and Edwards (2006), investigating the relative implementation costs of environmental management systems (EMS) for privately and publicly owned firms, found publicly owned firms to have significantly lower implementation costs, which they attribute to such firms' superior access to resources. If the costs of implementing EMS are lower for publicly owned firms, one might expect the costs of acquiescing to pressure to improve environmental performance to also be lower for such firms, but we find establishments owned by privately held firms to be more likely to improve under pressure. Our findings suggest that, at least in our context, privately held firms' greater resource constraints are outweighed by their ability to make investments without regard to short-term financial market reactions.

Our findings with regard to establishment size helps resolve the seemingly contradictory arguments posited in prior research about whether larger or smaller organizations are more responsive to institutional pressure. Whereas some research argues that larger organizations must be more responsive to pressure to maintain legitimacy (Goodstein, 1994), other research emphasizes larger organizations' greater power, which better enables them to resist such pressure (Grant *et al.*, 2002), implying less responsiveness. That our findings yield evidence that supports both arguments reveals the importance of accounting for an organization's context to an understanding of the effect of size. Our finding that, in regions with many establishments, larger organizations improve faster than smaller ones suggests that the formers' need to preserve legitimacy trumps their power over local regulators and pressure groups, which is diluted by a high concentration of establishments. However, our finding that, in regions with few other establishments, larger establishments tend to improve less quickly than smaller ones suggests that in this context the formers' power to resist local pressure trumps the need for legitimacy.

Our study also reveals the importance to future research in institutional theory of accounting for both inter- and intra-organizational heterogeneity in attempts to understand the effects of institutional pressure. That is, we find differences in how establishments reacted to institutional pressures to be based not only on organizational attributes like public versus private ownership, but also on intra-organizational structures such as proximity to other establishments within the same firm.

In addressing the "lack of understanding of the conditions under which institutional pressures and organizational characteristics explain the adoption of beyond compliance strategies" (Delmas and Toffel, 2011), our research goes beyond assessing their impact on environmental management practices (e.g., Delmas and Montiel, 2009; Delmas and Toffel, 2008; Hoffman, 2001; King *et al.*, 2005) to consider environmental performance implications. Nonetheless, many opportunities remain for exploring how institutional pressures and organizational characteristics interact to affect operational and financial performance indicators in other domains.

Implications for policymakers and managers

Our findings have implications for both the design of information disclosure programs and the managers of firms targeted by such programs. For policymakers designing information disclosure programs, our results suggest that their effectiveness depends in part on the industrial organization of a program's target population. For example, industries largely populated by establishments owned by privately held firms may be more responsive to information disclosure programs than industries populated by establishments owned by publicly traded firms. Understanding and anticipating these differences can help regulators improve the efficiency and effectiveness of targeting schemes that supplement information disclosure so as to exert more pressure on laggards.

For corporate managers, our results suggest the need to be aware of how organizational features are likely to affect subsidiary establishments' responsiveness to information disclosure programs, which might in turn affect corporate action. For example, our finding that information disclosure prompts greater performance improvement among establishments closer to headquarters might lead some corporate managers to provide more support for (and/or exert more pressure on) more remote establishments.

CONCLUSION

Organizations exhibit heterogeneous responses to institutional pressure created by information disclosure programs. Our analysis of changes in establishments' environmental performance following expansion of the EPA's TRI program suggests that organizational characteristics explain some of this heterogeneity. With information disclosure programs proliferating, our findings regarding factors that magnify or dampen their effectiveness in spurring establishments to improve their performance become more salient with respect to the achievement of these programs' objectives. In identifying establishment-level as well as intra-organizational attributes associated with heterogeneous responses to institutional pressure, we contribute to an important literature that seeks to leverage institutional theory to explain heterogeneous organizational strategies.

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Table 1. Sample description

SIC	Industry	Establishments	Percent
17	Construction special trade contractors	216	0.6%
20	Food and kindred products	2,809	7.4%
22	Textile mill products	694	1.8%
23	Apparel and other finished products made from fabrics and similar materials	107	0.3%
24	Lumber and wood products, except furniture	1,205	3.2%
25	Furniture and fixtures	820	2.2%
26	Paper and allied products	1,032	2.7%
27	Printing, publishing, and allied industries	553	1.5%
28	Chemicals and allied products	4,700	12.3%
29	Petroleum refining and related industries	503	1.3%
30	Rubber and miscellaneous plastics products	2,163	5.7%
31	Leather and leather products	135	0.4%
32	Stone, clay, glass, and concrete products	1,488	3.9%
33	Primary metal industries	2,648	6.9%
34	Fabricated metal products, except machinery and transportation equipment	4,359	11.4%
35	Industrial and commercial machinery and computer equipment	2,553	6.7%
36	Electronic and other electrical equipment and components, except computer equipment	2,593	6.8%
37	Transportation equipment	1,917	5.0%
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	875	2.3%
39	Miscellaneous manufacturing industries	609	1.6%
42	Motor freight transportation and warehousing	299	0.8%
49	Electric, gas, and sanitary services	668	1.8%
50	Wholesale Trade-durable Goods	973	2.6%
51	Wholesale Trade-non-durable Goods	1,536	4.0%
52	Building materials, hardware, garden supply, and mobile home dealers	125	0.3%
55	Automotive dealers and gasoline service stations	279	0.7%
59	Miscellaneous retail	130	0.3%
73	Business services	412	1.1%
76	Miscellaneous repair services	111	0.3%
87	Engineering, accounting, research, management, and related services	315	0.8%
	Other	1,348	3.5%
	Total	38,175	100%

Table 2. Descriptive statistics

Panel A. Summary Statistics

		Obs	Mean	SD	Min	Max
1.	Toxic releases to all media of 1995 added chemicals (log pounds)	217,575	0.90	2.89	0.00	17.11
2.	Proximate headquarters§	213,762	0.38	0.48	0.00	1.00
3.	Proximate sibling§	217,575	0.11	0.32	0.00	1.00
4.	Progressive sibling§	164,215	0.30	0.46	0.00	1.00
5.	Large facility§	164,215	0.51	0.50	0.00	1.00
6.	Public ownership§	159,061	0.29	0.45	0.00	1.00
7.	Relative production ratio (log)	217,575	0.09	0.29	-1.89	3.46
8.	Production ratio interpolated	217,575	0.03	0.17	0.00	1.00
9.	Employees (log)	217,575	3.67	2.12	0.00	10.09

Panel B. Pairwise correlations

	1.	2.	3.	4.	5.	6.	7.	8.
1. Toxic releases to all media of 1995 added chemicals (log pounds)	1.00							
2. Proximate headquarters§	-0.08	1.00						
3. Proximate sibling§	0.02	0.00	1.00					
4. Progressive sibling§	0.17	-0.41	0.14	1.00				
5. Large facility§	0.09	-0.21	0.07	0.24	1.00			
6. Public ownership§	0.10	-0.41	0.09	0.33	0.26	1.00		
7. Relative production ratio (log)	0.12	-0.03	0.01	0.12	0.05	0.02	1.00	
8. Production ratio interpolated	-0.02	-0.01	0.00	0.03	0.02	-0.01	0.08	1.00
9. Employees (log)	0.06	-0.08	0.05	0.28	0.73	0.29	0.06	0.01

Notes: § denotes dummy variable whose value is based on establishment status in 1994 (or, if missing, in 1993), before the policy change that occurred in 1995.

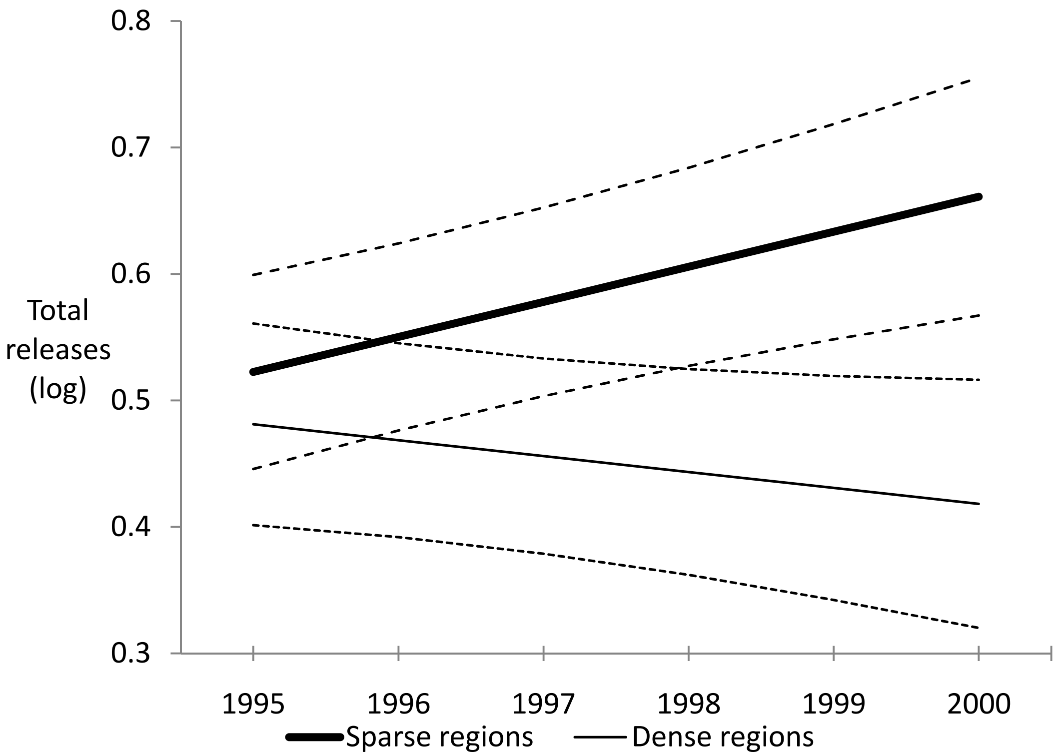
Table 3. Primary interval regression results

Dependent Variable: Total releases

	Sample:	(1) Full sample	(2) Have siblings	(3) Have siblings	(4) Have progressive siblings	(5) Have siblings	(6) In sparse cities	(7) In dense cities	(8) Full sample
	Proximate headquarters	-0.038				0.038			
		[0.025]				[0.059]			
H1.	Proximate headquarters × Annual Counter	-0.040**				-0.035**			
		[0.005]				[0.013]			
	Proximate sibling		0.033		0.001				
			[0.045]		[0.130]				
H2.	Proximate sibling × Annual counter		-0.020*						
			[0.009]						
	Progressive sibling			0.043		0.078			
				[0.047]		[0.050]			
H3.	Progressive sibling × Annual counter			0.002		-0.006			
				[0.008]		[0.009]			
	Progressive, proximate sibling				0.436*				
					[0.206]				
H4a.	Progressive, proximate sibling × Annual counter				0.003				
					[0.028]				
	Progressive, non-proximate sibling				0.762*				
					[0.347]				
H4a.	Progressive, non-proximate sibling × Annual counter				0.093				
					[0.072]				
	Progressive sibling × Proximate Headquarters					-0.205			
						[0.130]			
H4b.	Progressive sibling × Proximate headquarters × Annual counter					0.010			
						[0.025]			
	Large facility						-0.172**	-0.077	
							[0.060]	[0.064]	
H5.	Large facility × Annual counter						0.028**	-0.013	
							[0.008]	[0.009]	
	Public ownership								0.008
									[0.038]
H6.	Public ownership × Annual counter								0.060**
									[0.007]
	Annual counter	0.088**	0.094**	0.072**	-0.020	0.080**	0.034**	0.058**	0.035**
		[0.004]	[0.004]	[0.006]	[0.072]	[0.006]	[0.006]	[0.006]	[0.003]
	Log number of siblings (in 1994)		0.039**						
			[0.011]						
	Relative production level	0.218**	0.211**	0.146+	0.128	0.144+	0.139+	0.222**	0.181**
		[0.053]	[0.070]	[0.078]	[0.098]	[0.079]	[0.082]	[0.081]	[0.058]
	Log employment	0.198**	0.245**	0.296**	0.466**	0.293**	0.283**	0.262**	0.239**
		[0.012]	[0.016]	[0.018]	[0.032]	[0.019]	[0.025]	[0.027]	[0.014]
	Constant	1.469*	1.096**	1.144+	-0.141	1.135+	1.118+	1.554	1.134+
		[0.653]	[0.398]	[0.647]	[0.413]	[0.647]	[0.677]	[1.066]	[0.617]
	Industry (2-digit SIC) dummies	Included	Included	Included	Included	Included	Included	Included	Included
	Observations (facility-years)	213,762	137,385	101,388	47,275	99,709	84,435	79,780	159,061
	Number of facilities	37,537	23,806	17,737	8,199	17,445	14,893	14,266	28,279

Notes: All models estimated with interval regression (left censored). Brackets contain standard errors clustered by establishment; ** p<0.01, * p<0.05, + p<0.10. All samples include establishment-years during 1995-2000. The dependent variable is log (plus 1) of total releases reported to TRI of the 243 toxic chemicals that were added to the TRI chemical list in 1995. These total releases include those reported as production waste, transfers offsite, and emissions to air, land, water, and underground injection. All models also include a dummy to indicate observations for which the relative production level values were interpolated.

Figure 1.
Average difference in total releases between larger and smaller establishments (H5)



Note: These lines represent the annual average predicted values of larger establishments minus the annual average predicted values of smaller establishments and 95% confidence intervals, based on Models 5 (sparse regions represented by thick line) and 6 (dense regions represented by thin line) in Table 3.

APPENDIX

Table A-1. Interval regression including *historical releases trend*

Dependent Variable: Total releases

	Sample:	(1) Full sample	(2) Have siblings	(3) Have siblings	(4) Have progressive siblings	(5) Have siblings	(6) In sparse cities	(7) In dense cities	(8) Full sample
	Proximate headquarters	-0.034				0.032			
		[0.025]				[0.059]			
H1.	Proximate headquarters × Annual counter	-0.040**				-0.028*			
		[0.005]				[0.013]			
	Proximate sibling		0.034		-0.001				
			[0.045]		[0.129]				
H2.	Proximate sibling × Annual counter		-0.020*						
			[0.009]						
	Progressive sibling			0.028		0.057			
				[0.053]		[0.056]			
H3.	Progressive sibling × Annual counter			0.028**		0.020+			
				[0.010]		[0.011]			
	Progressive, proximate sibling				0.429*				
					[0.205]				
H4a.	Progressive, proximate sibling × Annual counter				0.006				
					[0.028]				
	Progressive, non-proximate sibling				0.788*				
					[0.345]				
H4a.	Progressive, non-proximate sibling × Annual counter				0.094				
					[0.071]				
	Progressive sibling × Proximate headquarters					-0.189			
						[0.130]			
H4b.	Progressive sibling × Proximate headquarters × Annual counter					0.005			
						[0.025]			
	Large facility						-0.180**	-0.090	
							[0.060]	[0.064]	
H5.	Large facility × Annual counter						0.030**	-0.008	
							[0.008]	[0.008]	
	Public ownership								-0.003
									[0.038]
H6.	Public ownership × Annual counter								0.062**
									[0.007]
	Annual counter	0.077**	0.073**	0.039**	-0.032	0.048**	0.031**	0.048**	0.029**
		[0.005]	[0.006]	[0.009]	[0.072]	[0.010]	[0.007]	[0.008]	[0.005]
	Historical releases trend	-0.116**	-0.131**	-0.117**	-0.114**	-0.116**	-0.099**	-0.085**	-0.101**
		[0.015]	[0.021]	[0.024]	[0.037]	[0.025]	[0.024]	[0.023]	[0.017]
	Historical releases trend × Annual counter	0.009**	0.011**	0.011*	0.001	0.012**	0.011*	0.007	0.010**
		[0.003]	[0.004]	[0.004]	[0.006]	[0.004]	[0.004]	[0.004]	[0.003]
	Historical releases trend missing	-0.039	-0.082*	-0.038	-0.424**	-0.057	0.052	0.012	0.020
		[0.029]	[0.041]	[0.052]	[0.105]	[0.052]	[0.045]	[0.043]	[0.032]
	Historical releases trend missing × Annual counter	0.026**	0.048**	0.053**	0.079**	0.051**	0.009	0.021*	0.016**
		[0.005]	[0.007]	[0.010]	[0.019]	[0.010]	[0.008]	[0.009]	[0.006]
	Log number of siblings (in 1994)		0.038**						
			[0.011]						
	Relative production level	0.226**	0.224**	0.156*	0.139	0.154+	0.146+	0.225**	0.186**
		[0.053]	[0.070]	[0.078]	[0.098]	[0.079]	[0.082]	[0.081]	[0.058]
	Log employment	0.196**	0.243**	0.292**	0.458**	0.289**	0.282**	0.262**	0.238**
		[0.012]	[0.016]	[0.018]	[0.032]	[0.019]	[0.025]	[0.027]	[0.014]
	Constant	1.511*	1.168**	1.179+	0.007	1.181+	1.129+	1.551	1.154+
		[0.655]	[0.397]	[0.647]	[0.416]	[0.647]	[0.682]	[1.070]	[0.622]
	Industry (2-digit SIC) dummies	Included	Included	Included	Included	Included	Included	Included	Included
	Observations (facility-years)	213,762	137,385	101,388	47,275	99,709	84,435	79,780	159,061
	Number of facilities	37,537	23,806	17,737	8,199	17,445	14,893	14,266	28,279

Notes: All models estimated with interval regression (left censored). Brackets contain standard errors clustered by establishment; ** p<0.01, * p<0.05, + p<0.10. All samples include establishment-years during 1995-2000. The dependent variable is log (plus 1) of total releases reported to TRI of the 243 toxic chemicals that were added to the TRI chemical list in 1995. These total releases include those reported as production waste, transfers, and releases to air, land, water, and underground injection. All models also include a dummy to indicate observations for which the relative production level values were interpolated.

Table A-2. Interval regression including *district LCV score* and *historical releases trend*

Dependent Variable: Total releases

	Sample:	(1) Full sample	(2) Have siblings	(3) Have siblings	(4) Have progressive siblings	(5) Have siblings	(6) In sparse cities	(7) In dense cities	(8) Full sample	(9) Full sample
	Proximate headquarters	-0.036				0.037				
		[0.025]				[0.059]				
H1.	Proximate headquarters × Annual counter	-0.040**				-0.029*				
		[0.005]				[0.013]				
	Proximate sibling		0.072		0.036					
			[0.046]		[0.130]					
H2.	Proximate sibling × Annual counter		-0.020*							
			[0.009]							
	Progressive sibling			0.026		0.056				
				[0.053]		[0.056]				
H3.	Progressive sibling × Annual counter			0.028**		0.020+				
				[0.010]		[0.011]				
	Progressive, proximate sibling				0.415*					
					[0.205]					
H4a.	Progressive, proximate sibling × Annual counter				0.006					
					[0.028]					
	Progressive, non-proximate sibling				0.821*					
					[0.345]					
H4a.	Progressive, non-proximate sibling × Annual counter				0.094					
					[0.071]					
	Progressive sibling × Proximate Headquarters					-0.193				
						[0.130]				
H4b.	Progressive sibling × Proximate headquarters × Annual counter					0.005				
						[0.025]				
	Large facility						-0.183**	-0.091		
							[0.060]	[0.064]		
H5.	Large facility × Annual counter						0.030**	-0.008		
							[0.008]	[0.008]		
	Public ownership								0.000	
									[0.038]	
H6.	Public ownership × Annual counter								0.062**	
									[0.007]	
	Green district									0.004
										[0.025]
	Green district × Annual counter									0.007
										[0.005]
	Annual counter	0.077**	0.073**	0.039**	-0.032	0.048**	0.030**	0.048**	0.029**	0.069**
		[0.005]	[0.006]	[0.009]	[0.072]	[0.010]	[0.007]	[0.008]	[0.005]	[0.004]
	Historical releases trend	-0.115**	-0.130**	-0.117**	-0.114**	-0.115**	-0.098**	-0.086**	-0.101**	
		[0.015]	[0.021]	[0.024]	[0.037]	[0.025]	[0.024]	[0.023]	[0.017]	
	Historical releases trend × Annual counter	0.009**	0.011**	0.011*	0.001	0.012**	0.011**	0.007	0.010**	
		[0.003]	[0.004]	[0.004]	[0.006]	[0.004]	[0.004]	[0.004]	[0.003]	
	Historical releases trend missing	-0.030	-0.067	-0.023	-0.413**	-0.041	0.060	0.021	0.030	
		[0.029]	[0.041]	[0.052]	[0.105]	[0.052]	[0.045]	[0.043]	[0.032]	
	Historical releases trend missing × Annual counter	0.027**	0.048**	0.054**	0.079**	0.051**	0.009	0.022*	0.016**	
		[0.005]	[0.007]	[0.010]	[0.019]	[0.010]	[0.008]	[0.009]	[0.006]	
	District LCV score	0.001	0.000	0.000	-0.000	0.000	0.001	-0.000	0.000	
		[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.000]	
	Log number of siblings (in 1994)		0.039**							
			[0.011]							
	Relative production level	0.228**	0.225**	0.157*	0.141	0.155*	0.146+	0.225**	0.187**	0.221**
		[0.053]	[0.070]	[0.078]	[0.098]	[0.079]	[0.082]	[0.081]	[0.058]	[0.053]
	Log employment	0.198**	0.245**	0.295**	0.460**	0.292**	0.285**	0.263**	0.240**	0.208**
		[0.012]	[0.016]	[0.018]	[0.032]	[0.019]	[0.025]	[0.027]	[0.014]	[0.012]
	Constant	1.517*	1.181**	1.239+	-0.031	1.232+	1.125+	1.576	1.173+	1.411*
		[0.655]	[0.394]	[0.642]	[0.418]	[0.641]	[0.683]	[1.068]	[0.623]	[0.651]
	Industry (2-digit SIC) dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included
	Observations (facility-years)	213,762	137,385	101,388	47,275	99,709	84,435	79,780	159,061	218,315
	Number of facilities	37,537	23,806	17,737	8,199	17,445	14,893	14,266	28,279	38,338

Notes: All models estimated with interval regression (left censored). Brackets contain standard errors clustered by establishment; ** p<0.01, * p<0.05, + p<0.10. All samples include establishment-years during 1995-2000. The dependent variable is log (plus 1) of total releases reported to TRI of the 243 toxic chemicals that were added to the TRI chemical list in 1995. These total releases include those reported as production waste, transfers, and releases to air, land, water, and underground injection. All models also include a dummy to indicate observations for which the relative production level values were interpolated.

Table A-3. OLS fixed effects models

Dependent Variable: Total releases

	Sample:	(1) Full sample	(2) Have siblings	(3) Have siblings	(4) Have progressive siblings	(5) Have siblings	(6) In sparse cities	(7) In dense cities	(8) Full sample
H1.	Proximate headquarters × Annual counter	-0.039**				-0.046**			
		[0.005]				[0.013]			
H2.	Proximate sibling × Annual counter		-0.019*						
			[0.009]						
H3.	Progressive sibling × Annual counter			-0.031**		-0.040**			
				[0.008]		[0.009]			
H4a.	Progressive, proximate sibling × Annual counter				0.006				
					[0.028]				
H4a.	Progressive, non-proximate sibling × Annual counter				0.118+				
					[0.070]				
H4b.	Progressive sibling × Proximate headquarters × Annual counter					0.017			
						[0.025]			
H5.	Large facility × Annual counter						0.008	-0.037**	
							[0.008]	[0.009]	
H6.	Public ownership × Annual counter								0.053**
									[0.007]
	Annual counter	0.102**	0.106**	0.109**	-0.040	0.119**	0.070**	0.094**	0.059**
		[0.004]	[0.004]	[0.006]	[0.071]	[0.006]	[0.006]	[0.006]	[0.003]
	Relative production level	0.235**	0.271**	0.278**	0.264**	0.282**	0.164**	0.299**	0.242**
		[0.034]	[0.045]	[0.049]	[0.062]	[0.050]	[0.048]	[0.055]	[0.037]
	Log employment	0.032**	0.024+	0.031+	0.083**	0.030	0.047*	0.039+	0.043**
		[0.011]	[0.013]	[0.019]	[0.030]	[0.019]	[0.020]	[0.021]	[0.014]
	Constant	0.873**	1.131**	1.090**	1.186**	1.075**	0.792**	0.831**	0.811**
		[0.047]	[0.063]	[0.090]	[0.155]	[0.090]	[0.090]	[0.093]	[0.064]
	Establishment fixed-effects	Included	Included	Included	Included	Included	Included	Included	Included
	Observations (facility-years)	213,762	137,385	101,388	47,275	99,709	84,435	79,780	159,061
	Number of facilities	37,537	23,806	17,737	8,199	17,445	14,893	14,266	28,279

Notes: All models estimated with OLS regression with establishment fixed effects. Brackets contain standard errors clustered by establishment; ** p<0.01, * p<0.05, + p<0.10. All samples include establishment-years during 1995-2000. The dependent variable is log (plus 1) of total releases reported to TRI of the 243 toxic chemicals that were added to the TRI chemical list in 1995. These total releases include those reported as production waste, transfers, and releases to air, land, water, and underground injection. The main effects of the hypothesized moderators (e.g., proximate headquarters) are time-invariant at the establishment-level, and thus are absorbed by the establishment fixed effects. All models also include a dummy to indicate observations for which the relative production level values were interpolated.

Table A-4. OLS fixed effects models (including *historical releases trend)*

Dependent Variable: Total releases

	Sample:	(1) Full sample	(2) Have siblings	(3) Have siblings	(4) Have progressive siblings	(5) Have siblings	(6) In sparse cities	(7) In dense cities	(8) Full sample
H1.	Proximate headquarters × Annual counter	-0.041**				-0.033*			
		[0.005]				[0.013]			
H2.	Proximate sibling × Annual counter		-0.018*						
			[0.009]						
H3.	Progressive sibling × Annual counter			0.011		0.003			
				[0.010]		[0.011]			
H4a.	Progressive proximate × Annual counter				0.010				
					[0.028]				
H4a.	Progressive distant × Annual counter				0.117+				
					[0.070]				
H4b.	Progressive sibling × Proximate headquarters × Annual counter					0.008			
						[0.025]			
H5.	Large facility × Annual counter						0.015+	-0.027**	
							[0.008]	[0.008]	
H6.	Public ownership × Annual counter								0.057**
									[0.007]
	Annual counter	0.072**	0.068**	0.054**	-0.053	0.064**	0.045**	0.063**	0.033**
		[0.005]	[0.005]	[0.009]	[0.071]	[0.009]	[0.007]	[0.007]	[0.005]
	Historical releases trend × Annual counter	0.003	0.006	0.008+	0.001	0.008+	0.005	0.001	0.005
		[0.003]	[0.004]	[0.004]	[0.006]	[0.004]	[0.004]	[0.004]	[0.003]
	Historical releases trend missing × Annual counter	0.063**	0.079**	0.082**	0.101**	0.080**	0.045**	0.057**	0.054**
		[0.005]	[0.007]	[0.010]	[0.019]	[0.010]	[0.008]	[0.008]	[0.006]
	Relative production level	0.268**	0.315**	0.302**	0.274**	0.306**	0.185**	0.322**	0.267**
		[0.034]	[0.045]	[0.049]	[0.062]	[0.050]	[0.048]	[0.055]	[0.037]
	Log employment	0.032**	0.027*	0.025	0.081**	0.024	0.045*	0.034+	0.036**
		[0.011]	[0.013]	[0.018]	[0.030]	[0.018]	[0.020]	[0.020]	[0.014]
	Constant	0.838**	1.081**	1.106**	1.193**	1.092**	0.787**	0.831**	0.819**
		[0.047]	[0.063]	[0.089]	[0.153]	[0.089]	[0.090]	[0.092]	[0.064]
	Establishment fixed-effects	Included	Included	Included	Included	Included	Included	Included	Included
	Observations (facility-years)	213,762	137,385	101,388	47,275	99,709	84,435	79,780	159,061
	Number of facilities	37,537	23,806	17,737	8,199	17,445	14,893	14,266	28,279

Notes: All models estimated with OLS regression with establishment fixed effects. Brackets contain standard errors clustered by establishment; ** p<0.01, * p<0.05, + p<0.10. All samples include establishment-years during 1995-2000. The dependent variable is log (plus 1) of total releases reported to TRI of the 243 toxic chemicals that were added to the TRI chemical list in 1995. These total releases include those reported as production waste, transfers, and releases to air, land, water, and underground injection. The main effects (e.g., proximate headquarters) are time-invariant at the establishment-level, and thus are absorbed by the establishment fixed effects. All models also include a dummy to indicate observations for which the relative production level values were interpolated.

Table A-5. Robustness tests: Alternative definitions of proximate and progressive

Dependent Variable: Total releases

		(1)	(2)	(3)	(4)	(5)
	Sample	Full sample	Full sample	Have siblings	Have siblings	Have siblings
	Proximate headquarters (same 3-digit Zip Code)	-0.040				
		[0.025]				
H1.	Proximate headquarters (same 3-digit Zip Code) × Annual counter	-0.040**				
		[0.005]				
	Proximate headquarters (same state)		-0.004			
			[0.026]			
H1.	Proximate headquarters (same state) × Annual counter		-0.033**			
			[0.005]			
	Proximate sibling (same 3-digit Zip Code)			0.080*		
				[0.040]		
H2.	Proximate sibling (same 3-digit Zip Code) × Annual counter			-0.021**		
				[0.008]		
	Proximate sibling (same county)				0.029	
					[0.041]	
H2.	Proximate sibling (same county) × Annual counter				-0.012	
					[0.008]	
	Progressive industry sibling					0.086+
						[0.052]
H3.	Progressive industry sibling × Annual counter					-0.004
						[0.009]
	Annual counter	0.089**	0.090**	0.096**	0.093**	0.074**
		[0.004]	[0.004]	[0.005]	[0.004]	[0.005]
	Log number of siblings (in 1994)			0.038**	0.039**	
				[0.011]	[0.011]	
	Relative production level	0.217**	0.218**	0.210**	0.211**	0.147+
		[0.053]	[0.053]	[0.070]	[0.070]	[0.078]
	Log employment	0.197**	0.201**	0.245**	0.245**	0.295**
		[0.012]	[0.012]	[0.016]	[0.016]	[0.018]
	Constant	1.480*	1.448*	1.066**	1.091**	1.153+
		[0.656]	[0.653]	[0.398]	[0.398]	[0.646]
	Industry (2-digit SIC) dummies	Included	Included	Included	Included	Included
	Observations (facility-years)	213,762	213,762	137,385	137,385	101,388
	Number of facilities	37,537	37,537	23,806	23,806	17,737

Notes: All models estimated with interval regression (left censored). Brackets contain standard errors clustered by establishment; ** p<0.01, * p<0.05, + p<0.10. All samples include establishment-years during 1995-2000. The dependent variable is log (plus 1) of total releases reported to TRI of the 243 toxic chemicals that were added to the TRI chemical list in 1995. These total releases include those reported as production waste, transfers, and releases to air, land, water, and underground injection. All models also include a dummy to indicate observations for which the relative production level values were interpolated.

Table A-6. Robustness tests: Alternative definitions of large establishment as well as sparse and dense regions

Dependent Variable: Total releases

	Sample:	(1) In sparse counties	(2) In dense counties	(3) In sparse cities	(4) In dense cities
	Large facility	-0.241**	-0.015		
		[0.063]	[0.061]		
H5.	Large facility × Annual counter	0.031**	-0.014+		
		[0.008]	[0.009]		
	Largest 25th percentile facility			0.044	0.265**
				[0.064]	[0.071]
H5.	Largest 25th percentile facility ×Annual counter			0.039**	-0.010
				[0.010]	[0.011]
	Annual counter	0.030**	0.060**	0.040**	0.055**
		[0.006]	[0.006]	[0.005]	[0.005]
	Relative production level	0.054	0.296**	0.148+	0.226**
		[0.081]	[0.083]	[0.082]	[0.081]
	Log employment	0.315**	0.226**	0.227**	0.186**
		[0.026]	[0.025]	[0.020]	[0.022]
	Constant	1.189+	1.241+	1.224+	1.789+
		[0.712]	[0.664]	[0.683]	[1.058]
	Industry (2-digit SIC) dummies	Included	Included	Included	Included
	Observations (facility-years)	83,110	81,105	84,435	79,780
	Number of facilities	14,588	14,571	14,893	14,266

Notes: All models estimated with interval regression (left censored). Brackets contain standard errors clustered by establishment; ** p<0.01, * p<0.05, + p<0.10. All samples include establishment-years during 1995-2000. The dependent variable is log (plus 1) of total releases reported to TRI of the 243 toxic chemicals that were added to the TRI chemical list in 1995. These total releases include those reported as production waste, transfers, and releases to air, land, water, and underground injection. All models also include a dummy to indicate observations for which the relative production level values were interpolated.

The following subsamples were used: Column 1 includes establishments in sparse cities (fewer than the county median of 41 establishments); Column 2 includes establishments in dense cities (greater than the city median of 41 establishments); Column 3 includes establishments in sparse cities (fewer than the city median of 11 establishments); Column 4 includes establishments in dense cities (greater than the city median of 11 establishments).