Corporate Characteristics, Political Embeddedness and Environmental Pollution by Large U.S. Corporations

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Organizational and environmental sociology contain surprisingly few studies of the corporation as one of the sources of environmental pollution. To fill this gap, we focus on the parent company as the unit of analysis and elaborate environmental theories that focus on the organizational and political-legal causes of pollution. Using a compiled longitudinal dataset of corporations in Standard & Poor's 500 from 1994 through 2001, we test hypotheses derived from an organizational political economy framework. We find that corporations with more complex structures, greater capital dependence and those headquartered in a state with lower environmental standards have higher pollution rates. In addition, the dollar amount of penalties did not curb pollution rates during this period of weakened federal environmental protection.

In recent decades, researchers, policy makers and the public have become increasingly concerned with the adverse consequences of environmental pollution. Central to this literature is the *treadmill of production* framework, which focuses on the inherent tendency of capitalist expansion that leads to ecological disruption and environmental degradation (Dunlap and Catton 1979; Catton 1980; Schnaiberg 1980; Buttel 2004; Gould, Pellow and Schnaiberg 2008). Research in this tradition examines a wide range of conditions that affect environmental pollution; it maintains that ecosystems are increasingly used as source of raw materials and sinks for toxic wastes, that companies profit at the expense of the environment. Macro-level research has demonstrated that environmental degradation disproportionately affects less developed countries (Rudel 1993; York, Rosa and Dietz 2004; Bunker and Ciccantell 2005; Jorgenson, Dick and Mahutga 2007; Gould, Pellow and Schnaiberg 2008; Stretesky and Lynch 2009). Studies have also shown disproportionate effects of environmental pollution on disadvantaged communities in advanced societies (Bullard 1994; Pellow, Weinberg and Schnaiberg 2001; Freudenburg 2005; Saha and Mohai 2005; Downey 2007). This focus on the social structure, which examines how the organization of

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collective human activity affects the environment, has been broadly categorized as "ecostructuralism."(Grant, Jones and Bergenson 2002)

Recently, environmental sociologists have begun to examine the relationship between the meso-organizational level of the social structure and environmental pollution. These researchers suggest that organizations conceal environmental pollution to preserve their organizational viability (Beamish 2000, 2002) and that large organizations are "the most intensive and effective environmental destroyers."(Perrow 1997:66) However, few quantitative studies focus on the meso-level organizational causes of environmental pollution. The primary exception is Grant and his colleagues who focus on production facilities as the unit of analysis (Grant et al. 2002; Grant and Jones 2003). We suggest that it is important to extend this organizational-level analysis and focus on parent companies where corporate executives, by virtue of their ultimate decision-making authority, exercise discretion when setting corporate strategies and dictating objectives for operating managers.

Our research contributes to the literature on organizations and the environment in several ways. First, it incorporates concepts from economic, environmental, organizational and political sociology to elaborate a political economy framework to identify organizational and political causes of environmental pollution. Second, this new focus on parent companies points to a new direction in understanding the social causes of environmental pollutions. Third, whereas previous research focused a limited number of organizational characteristics (i.e., size and whether a facility is located in a subsidiary) (Grant et al. 2002; Grant and Jones 2003), our study examines the effects of a much broader range of corporate characteristics on environmental pollution. Fourth, whereas previous research tends to focus on a single industry or is based on cross-sectional data (Nadeau 1997; Kagan, Gunningham and Thornton 2003; Grant et al., 2002; Grant, Trautner, Downey and Thiebaud 2010; Prechel 2010), our analysis includes the Standard & Poor 500, which consists of the largest U.S. parent companies in several economic sectors and is based on a longitudinal dataset for the period of 1994 to 2001.We maintain that it is important to examine the cause of environmental pollution in these corporations because (1. the size of the largest corporations has rapidly increased in recent years and (2. decisions made in the largest corporations have widespread effects on the social and physical environments. To illustrate, during our study period (1994-2001), the mean assets held by corporations in Standard & Poor's 500 more than doubled, increasing from $15.6 billion to $35.0 billion,[1] and the group as a whole accounts for 75 percent of U.S. equities. By expanding the scope of theory and research, this study contributes to the "new ecological paradigm" (Dunlap and Catton 1979; Jermier 2008) that calls for reconstructing current theory and research in environmental sociology in ways that affect public policy (Freudenburg, Gramling, Laska and Erikson 2009).

Theoretical Elaboration: Organizational Political Economy

Our theoretical elaboration incorporates Sutherland's (1949) seminal insight that variations in social structures provide differential opportunities to engage in certain behaviors. We maintain that variations in social structures create different dependences, incentives and opportunities for corporations to externalize pollution costs to society. In particular, we suggest that historical variation in corporate-state relations provides a starting point to understand corporate pollution. State policies give form to corporate structures and organizational hierarchies, which in turn set up the context for managerial decisions and corporate behaviors. In short, historical conditions structure the motives and actions of social actors as well as their interests and opportunities for satisfying them (Prechel 1990). Conditions entail the structure of available alternatives as well as incentives and constraints that affect aggregates of individual actions (e.g., collective decisions) (Hernes 1976).

Dependencies and Incentives

Resource dependence theory maintains that when corporations are externally constrained and controlled they become resource dependent, which creates uncertainty and loss of autonomy both of which potentially threaten corporations' capacity to survive (Zald 1970; Pfeffer and Salancik 1978). Because capital is among the most crucial resources to ensure corporate survival, capital dependence affects corporate strategies and how corporations manage their finances (Palmer, Jennings and Zhou 1993). Thus, capital dependence on external stakeholders creates incentives for managers to satisfy these social actors who have control over critical resources. Among the most influential stakeholders that emerged during the 1980s were institutional investors who own large amounts of corporate securities (Useem 1996; Krier 2005). This capital dependent relationship creates incentives for corporate managers to increase shareholder value. Failure to do so may cause institutional investors to disinvest from the company, withhold future investments and/or pressure the board of directors to replace top management.

The increased use of stock options as a form of executive compensation creates another incentive for managers to externalize pollution costs. This pressure accelerated in the 1990s when stock options were viewed as an inducement for management to behave more like owners. The managerial imperative to improve corporate balance sheets and increase shareholder value entails lowering costs, which may result in a decision to forgo investments in new pollution abatement technologies.

Opportunities

Prior research has demonstrated that variation in social structure – such as regulatory policy, enforcement structures, economic conditions and organizational characteristics – provides differential opportunities for corporate crime and deviance (Sutherland 1949; Clinard and Yeager 1980; Simpson 1986). Drawing from this literature, we focus on corporate and political structures and maintain that variations in these dimensions of the social structure create differential opportunities for corporations to engage in environmental pollution.

This formulation assumes that corporations are rational calculators that evaluate the costs and consequences of their behavior. Because managers have discretion in the decision-making process, behaviors occur when the anticipated benefits of committing an act outweigh the perceived costs (Paternoster and Simpson 1996; Stretesky 2006). This is an important consideration for our analysis because beginning with the Carter Administration in the 1970s the laws and enforcement structures governing corporate pollution were redefined in ways that reduced the cost to corporations for environmental pollution (Sunstein 1996). Under these political-legal arrangements, corporate management is expected to be more responsive to economic incentives and less responsive to political deterrence.

To summarize, this organizational political economy perspective maintains that the corporate and political structures enacted in the 1980s and the 1990s created dependencies, incentives and opportunities for corporate pollution. Whereas capital dependence on external stakeholders creates incentives, the corporate and political structures provide opportunities for corporations to externalize their pollution costs to society. Insofar as differential organizational and political structures affect environmental pollution, our research has important policy implications because government policies affect the way in which corporations are structured, which affects their behavior.

Hypotheses

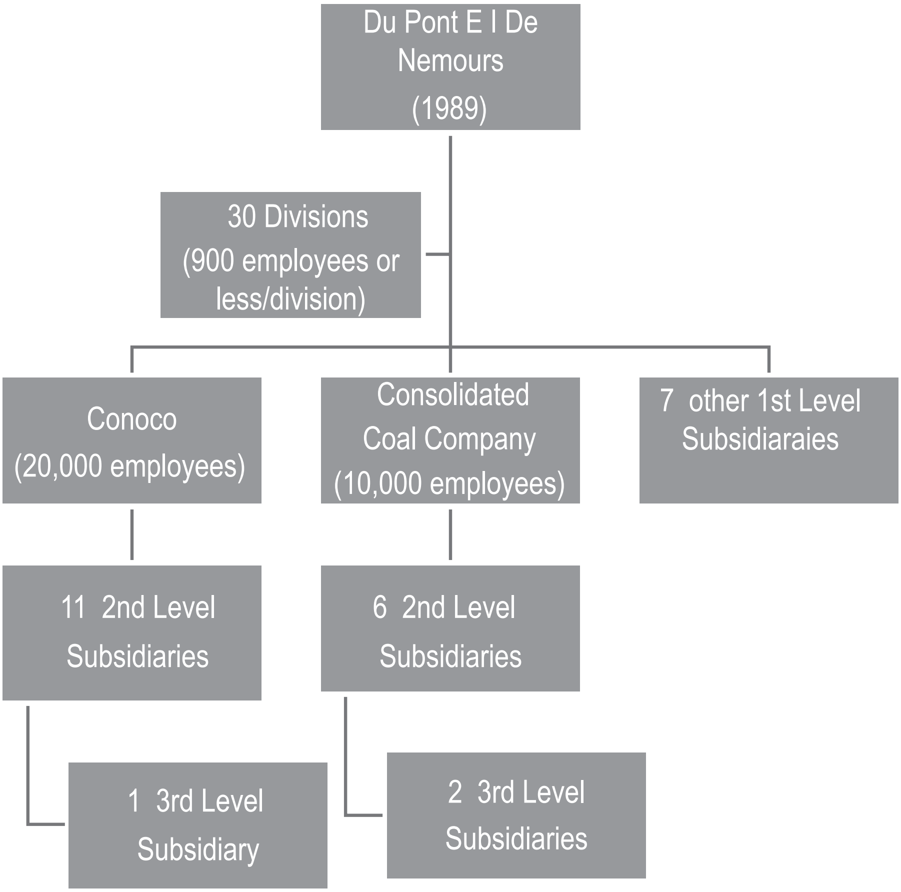
Based on this theoretical framework, we develop the following hypotheses to test whether, and the extent to which, corporate characteristics and dimensions of the political-legal environment affect corporations' pollution rates. The first set of hypotheses focuses on the relationship between corporate structure and environmental pollution by examining organizational complexity.

Organizational Complexity

In response to the declining profits and capital shortages in the early 1980s, corporations in the manufacturing sector mobilized politically to redefine the laws governing how management structured corporate entities. One of their primary agendas was to reduce dependence on debt financing (i.e., bank loans) and make greater use of *equity financing*: issuances of corporate securities (i.e., stocks, bonds). Among the most important outcomes was a provision in the *Tax Reform Act of 1986* that eliminated the capital transfer tax between subsidiary corporations and their parent companies. Soon after this legislation was passed, many of the largest U.S. corporations transformed their divisions into subsidiaries to gain access to equity markets (Prechel and Boies 1998). The emergent *multilayer-subsidiary form* has a parent company at the top of the corporate hierarchy that operates as a financial management company with two or more levels of legally separate subsidiary corporations embedded in it (Prechel 2000) (see Figure 1). Subsequent mergers and acquisitions further increased organizational complexity in terms of the number of subsidiaries and the number of subsidiary levels within a single corporation.

The property rights associated with the multilayer-subsidiary form have several important implications. First, they allow parent companies to retain ownership

Figure 1. The Multilayer-Subsidiary Form at DuPont E I De Nemours, 1989



control of subsidiaries through majority voting interest. *Subsidiaries* are legally independent corporations in which the parent company owns more than 50 percent of their stock. Second, subsidiary profits can be transferred to the parent company in the form of tax-free dividends. This property right allows top management to increase capital flows via dividends from subsidiaries to the parent company. Thus, parent company management can starve subsidiaries for capital and curtail their capacity to invest in pollution abatement technologies. Third, organizing corporate entities as subsidiaries creates a *liability firewall* between these legally-independent corporate entities. This political-legal arrangement protects the parent company's assets by containing potential losses to the subsidiary where the adverse event occurs. Such events that are protected under this corporate veil include economic losses, bankruptcy or liability lawsuits for environmental damages. Under most conditions, the courts treat the subsidiary corporation as a separate legal entity from its shareholders, even when the primary or sole shareholder (i.e., owns 100 percent of the stock) is the parent company (Krendl and Krendl 1978). In short, this corporate veil limits the parent company's risk to their investment in a subsidiary corporation, thereby protecting other assets held by the parent company.

Because each layer in this hierarchy creates another legal barrier, parent companies that have more layers of subsidiaries are more protected from liability for damages that occur in subsidiaries; only the assets in the subsidiary are liable under the initial lawsuit. Holding the parent company liable for additional damages requires separate legal actions. In order to collect compensation for damages, the plaintiff must convince the court that managers in the parent company are responsible for decisions made by the subsidiary that caused the damage (see Prechel 2000). For these reasons, we expect that, other things being equal, corporations with a taller subsidiary hierarchy have a higher level of pollution.

> H1: *Parent companies with more layers of subsidiaries have higher pollution rates.*

Many of the giant corporations in our study group also have a large number of operating facilities. Although many corporations have implemented sophisticated controls to monitor their operating units (Prechel 1994), organizational complexity intensifies the problem of *bounded rationality*: the cognitive limits of individual decision makers restrict top management's ability to exercise control over day-to-day operations. Because bounded rationality limits the capacity of top management in the parent company to effectively monitor and control pollution when a large number of facilities are embedded in a single corporation, we hypothesize:

> H2: *Parent companies with more facilities have higher pollution rates.*

Capital Dependence

The hypotheses in this section test the effects of capital dependence on environmental pollution. Our first capital dependence hypothesis suggests that lower profits are inversely related to corporations' environmental pollution for two interrelated reasons. On the one hand, managerial discretion over toxic emissions increased in the 1990s when regulatory and enforcement structures weakened. On the other, obtaining a higher return on investment becomes a more imperative task for corporations due to the ascendance of institutional investors and the emphasis on increasing shareholder value (Useem 1993, 1996; Davis and Thompson 1994; Krier 2005). Thus, executives in parent companies with low profits have incentives to transfer working capital from subsidiaries and invest into outlets that obtain the highest rate of return. By the same token, managers at the facility level are also rewarded by placing a higher priority on meeting financial over environmental goals. Under these conditions, managers may forego investing in pollution abatement technologies. Further, cost-cutting strategies can result in accidents that emit toxic chemicals. To illustrate, the deficiencies in design and management that caused the 1984 chemical disaster in Bhopal by Union Carbide India Limited were partially driven by pressure from the parent company, Union Carbide Corporation, to reduce costs in this subsidiary (Pearce and Tombs 1993). Similarly, the cost cutting strategy of British Petroleum, the parent company, has been directly or indirectly linked to the recent environmental disaster in the Gulf of Mexico and the 2005 explosion in its Texas City facility (Beamish 2010). Thus, corporations with lower profits are more likely to have higher toxic emissions.

H3: Corporations with lower profits have higher pollution rates.

Although change to the multilayer-subsidiary form increased the use of equity financing, corporations continued to carry a substantial amount of debt. This was due, in part, to the widespread merger and acquisition strategies of the 1980s and 1990s. To illustrate, the value of outstanding commercial paper almost equalled the value of all commercial loans held by banks in the mid-1990s (Davis 2009). These statistics are consistent with the finding that the long-term debt divided by current assets of the corporations in our sample increased from 12 percent in 1993 to 16 percent in 2000.

Debt financing creates incentives for top management in the parent company to pressure facility managers to cut costs. This suggests that a higher level of debt as a form of capital dependence may create incentives for corporations not to invest in pollution abatement technologies.

H4: Corporations with higher debt have higher pollution rates.

Corporations' Political Embeddedness

A central tenet of economic sociology is that corporations and markets are embedded in political structures (Polanyi 1944). Contemporary formulations of political embeddedness maintain that corporations mobilize politically to transform the political-legal arrangements in which they are embedded. Therefore, political embeddedness is conceptualized as a variable that exists on an embedded-disembedded continuum and the degree of political embeddedness varies over time (Prechel and Morris 2010).

To illustrate, beginning in the mid-1970s, neoliberal corporate activists asserted the superiority of unregulated markets and criticized the embedded liberalism of the 1960s and 1970s when political structures were enacted to limit management autonomy (Ruggie 1992). Supporters of neoliberalism asserted that the social, economic and political problems that emerged in the 1970s and 1980s could be solved by self-regulating markets (Stiglitz 2002). These initiatives were followed by a series of Presidential executive orders and Congressional acts that made benefit-cost-analysis a central component of environmental regulation (Yeager 1991; Sunstein 1996). Together, these public policies and enforcement structures subjected economic policies to a lower level of environmental scrutiny and environmental policies to a higher level of economic scrutiny (Daynes 1999; Soden and Steel 1999). This historical transition shifted corporations toward the disembedded end of the embedded-disembedded continuum.

The first hypothesis in this section tests the effects of variation in corporations' political embeddedness by focusing on regulatory deterrence. There is significant disagreement on the effects of government deterrence on environmental pollution. Some research suggests that institutional incentives are adequate to encourage firms to invest in technologies that reduce pollution (Mol 1995). These incentives include declining stock valuations that occur from negative publicity after the media reports environmental violations (Hamilton 1995; Ambec and Lanoie 2008). Other studies show that fines levied against corporations for environmental violations are inducements to invest in pollution abatement technologies (Lee and Alm 2004). Still others suggest that federal-level regulatory enforcement agencies tend to favor larger, more powerful corporations and disproportionately burden smaller corporations (Yeager 1987).

We suggest that the mixed evidence on the effects of penalties is due to the historical variation in environmental regulations and enforcement. As previously mentioned, the Carter Administration began to adopt a market-driven agenda and reduce regulatory controls in the 1970s. This agenda gained momentum in the early 1980s during the Reagan Administration, which further weakened regulatory law and relaxed the enforcement of existing laws. Although enforcement of pollution laws improved during the George H.W. Bush Administration, environmental pollution was not a high priority in the Clinton Administration. Further, given the demands on investment capital and the low fines for environmental pollution in relationship to revenues (i.e., several hundred thousand dollars in fines vs. several hundred million dollars in revenues for a typical case in our sample), as rational actors, corporate managers may decide that it is more cost efficient to pay the fine than to invest in expensive pollution abatement technologies. For these reasons, we hypothesize that under such historical conditions:

> H5: *The amount of penalties does not have a deterrent effect on corporate pollution rates.*

Our second political embeddedness hypothesis examines the effects of the federalist political structure. This dimension of corporations' political environment has received renewed attention since the 1980s when neoliberal policies at the federal level provided states with greater responsibility for environmental regulation. Some researchers suggest that despite the presence of state-level regulatory agencies, little direct monitoring of the environment is done by these agencies (Kirsch 1998). Others maintain that strong regional differences exist and that federalist political-legal arrangements resulted in a "race to the bottom" with regard to environmental pollution standards. This was most pronounced among Sunbelt states, which were desperate for corporate expansion to offset slow economic growth during the recession of the early 1980s (Harrison and Bluestone 1988). By the early 1990s, environmental policies in many southern states provided opportunities for corporations to externalize their pollution costs to the environment (Hall and Kerr 1991).

On the other end of the spectrum, in response to political pressure from environmental groups, some states enacted legislation that limits environmental pollution. To illustrate, New Jersey passed the Right-to-Know Act in 1984 to obtain more precise information on toxic emissions. In 1986, California enacted the Safe Drinking Water Act and the Toxic Enforcement Act, requiring corporations to provide "clear and reasonable warning" of dangerous chemicals to affected residents (Stavins 2000:54). In addition, California enacted legislation in 1987 that required corporations to track the emissions of more than 700 toxic chemicals. By the early 1990s, most states had passed some legislation to contain environmental pollution (Hall and Kerr 1991).

State-level environmental policies became more important in the 1990s and 2000s when some industries were given permission to use production techniques that released more toxic chemicals in the air, land, and water than previously permitted (Cusolito 2010). These permissions made corporations exempt from some aspects of the Clean Air Act, the Clean Water Act, the Superfund Act and the Resources Conservation Recovery Act. State-level polices are also important because the EPA allocates authority to states to specify the conditions under which corporations can obtain permits for toxic emissions. To illustrate, the emission requirements under these flexible permits were set so low by the Texas Commission on Environmental Quality that after a long dispute the EPA invalidated the permits for more than 120 facilities in 2010.

To summarize, the political-legal arrangements of states on the embedded end of this embedded-disembedded continuum (i.e., states with stronger environmental policies) deter corporate pollution in several ways. First, states that enact stronger pollution standards and enforcement structures decrease opportunities for corporations to pollute the environment. Moreover, the capital resources over which states have control, such as tax credits, provide incentives for parent companies to ensure that their facilities adhere to state environmental laws. Second, state laws reflect the values and norms of corporations' immediate institutional environment (Meyer and Rowan 1977). Concerns for legitimacy and social standing may create incentives for corporations located in states with strong environmental laws to voluntarily reduce their emission rates. Moreover, top managers may pressure facility-level managers to behave in environmentally responsible ways because adverse environmental publicity results in a lower stock price (Hamilton 1995; Koehler and Cram 2001) and a loss of market share when environmentally conscious consumers and organizations boycott their products (Ambec and Lanoie 2008). Thus, we hypothesize:

> H6*: Parent companies whose headquarters are located in states with higher environmental standards have lower pollution rates.*

Research Design

Data

The sample consists of a subgroup of Standard & Poor's 500 corporations that were required by the EPA to report toxic emissions during the study period (1994-2001) under the Toxic Release Inventory initiative. These corporations have the following primary two-digit Standard Industrial Classification codes: manufacturing (20), tobacco (21), apparel (23), lumber and wood (24), furniture (25), paper (26), printing and publishing (27), chemicals (28), petroleum and coal (29), rubber and plastics (30), primary metals (33), fabricated metals (34), machinery (excluding electrical, 35), electrical and electronic equipment (36), transportation equipment (37), instruments (38) and miscellaneous manufacturing (39). Controlling for industrial heterogeneity allows us to evaluate the net effects of other corporate characteristics on environmental pollution.

The sample was obtained from the 2002 S&P 500. The S&P 500 consists of large companies in leading U.S. industries and captures 75 percent of U.S. equities. We collected data on the parent companies in the sample from 1994 to 2001. Initially, there were 219 parent companies in the sample. Missing data reduced the study group to 175 corporations. The missing data was primarily on the organizational structure variable. However, our data source, Dun and Bradstreet, provides the most comprehensive information on this variable. The final dataset used for analysis consisted of 1,269 firm-year observations.

Dependent Variable

We calculate parent company pollution rates, the dependent variable, by dividing the company's annual total tons of toxic chemical emissions by its total annual sales. This measure of pollution is parallel to a widely-used, macro-level measure that defines a nation-state's pollution rate as the total quantity of pollutant emissions (e.g., CO_2) per unit of GDP in a year (York, Rosa and Dietz 2004; Jorgenson 2009; Perkins and Neumayer 2009). A natural logarithm form of this variable was used in the regression analysis.

The data on total toxic emissions by the parent company is compiled by the Investor Responsibility Research Center. Based on the EPA's Toxic Release Inventory, which contains pounds of emissions on each toxic chemical emitted by individual facilities, IRRC attributes the data from the facilities to the subsidiaries. Then, the subsidiary data are followed up through the corporate hierarchy until the compilation process reaches the ultimate parent company (Investor Responsibility Research Center 2001). The IRRC data ensures that the TRI facility-level aggregations accurately correspond with the ownership structure of the multilayer-subsidiary form.[2]

Since its first release in 1989, the TRI data have become the primary measure of a plant's environmental performance and are used extensively by environmental activists, regulators and academics (Hamilton 2005). Researchers have shown that the data provide a valid and reliable means of measuring corporate toxic emissions and have been subject to a high degree of scrutiny (Hamilton 2005; Arota and Cason 1995; Grant et al. 2002; Grant et al. 2010).

Nevertheless, there are three potential shortcomings. First, the EPA requires facilities to report emissions if they meet the following conditions: manufacture or process more than 25,000 pounds per year or use more than 10,000 pounds of a particular chemical, have more than 10 employees, and are in a specified SIC code (RiskMetrics Group 2001). These stipulations eliminate small facilities. Second, the TRI data are self reported and, therefore, open to the criticism of underreporting. However, much social science data is self reported. A third potential criticism could be that our use of the total pounds of chemical emission does not take into account the toxicity of each pollutant. Although there are advantages in using the risk-based measure, especially in studies that focus on the impact on local communities (e.g., Grant et al. 2010), some chemicals in the TRI data are not assigned toxicity weights and are excluded from this measure. Our aggregate measure is arguably more comprehensive because it includes all chemicals defined as toxic by the EPA. To clarify, this measure of toxic emission does not include CO_2 emission, which is a primary source of greenhouse gases associated with global warming.

Independent Variables

Our first measure of organizational complexity was the number of subsidiary layers based on the data from Dun & Bradstreet. The second measure of organizational complexity is the number of facilities that are nested inside the parent company and its subsidiaries. Data for this variable was obtained from the TRI. Our two measurement of capital dependence are return on equity and debt-to-assets ratio. Penalty as deterrence was measured by the dollar amount in fines on corporations for violating environmental regulations.[3] A natural logarithm of the variable was used in regression analysis. The effect of states' political-legal arrangements was measured by the 1991-1992 Green Policies Score. Green policies score is a core component of the better known Green Index (Hall and Kerr 1991). Each state's green policies score was derived by summing its ranks on 77 environmental policy-related indicators, including four on congressional leaderships' voting records and 73 on state policy initiatives pertaining to environmental issues. The green policies score of the state where the parent companies are located in our study group varies from 764 for California to 2,843 for Tennessee (Hall and Kerr 1991).[4] Thus, there is substantial variation on this dimension of political embeddedness.

Six control variables were included in order to rule out potential confounding effects. The number of divisions was included to control for whether the presence of any remaining divisions (e.g., those that had not been changed to subsidiaries) had an effect on pollution rates. Because no liability firewall exists between divisions and the central office, corporations that retain the multidivisional form may be more cautious about externalizing their pollution costs to society. Change of stock price – which was calculated by subtracting the calendar-year-close price in the current year from that of the previous year – controls for the shareholder conception of value thesis (Useem 1993; Davis and Thompson 1994; Krier 2005). Another control variable, age of the corporation, was measured by the number of years since first incorporation. We included this variable because organizational theories suggest that age is an impediment to change (Hannan and Freeman 1984), including adoption of new pollution abatement technologies.[5] Organization size was measured by the natural logarithm of the number of employees. Prior research reached little consensus on the relationship between corporation size and pollution. Research that focuses on the corporation shows that large corporations violate environmental laws (i.e., the Clean Water Act) less often than small companies (Yeager 1991). Similarly, research suggests that large corporations are more likely to invest in technologies that reduce pollution because they have the resources to do so, and stockholders and communities create inducements to reduce pollution (i.e., negative publicity resulting in stock devaluation) (Hamilton 1995; Koehler and Cram 2001). In contrast, research that identifies the facility as the unit of analysis shows that larger chemical facilities have higher toxic emission rates (Grant et al. 2002). Similarly, others maintain that large corporations disproportionally use the environment for waste disposal, because smaller firms in the same industry produce "the same products and materials with significantly lower levels of pollution." (Freudenburg 2005:94) Dummy variables for corporations' primary two-digit SIC were included to account for variation across industrial sectors. Dummy variables for five geographic regions (i.e., West, Southwest, Midwest, Southeast and Northeast) were used to account for regional variations affecting corporate pollution rate.

We obtained information for the organizational and financial variables from Dun and Bradstreet and Compustat. Like data on the dependent variable, data on the number of facilities and amount of fines were obtained from the IRRC's compilation of the TRI data. The Green Policy Score for each state was obtained from Hall and Kerr (1991). Table 1 lists each of the above variables employed in the analysis and their descriptive statistics from the selected years (i.e., 1994, 1998 and 2001).

Models

We used generalized estimating equations method, which is based on quasi-likelihood estimation, for the longitudinal analysis. The GEE model is an extension of generalized linear models to the case of correlated data. It accounts for autocorrelation (e.g. yearly measurements of the same firms) by estimating the correlation structure of the error terms (Liang and Zeger 1986).

Compared to random-effects model, the GEE approach is preferable for the current study for several reasons. First, the selection of variance-covariance matrix for the repeated measures in GEE is not as critical as that for the REM (Hedeker and Gibbons 2006). Unlike REM, GEE produces robust standard errors regardless of the choice of the variance-covariance structure. This makes the GEE approach especially suitable to studies that are more interested in regression coefficients than in the variance-covariance structure (Rabe-Hesketh and Everitt 2004). Second, GEE does not require complete data across time. This feature fits well with our dataset as it contains missing values for some firm-year observations.[6] Third, GEE provides regression estimates that are "population-averaged" rather than "subject-specific." This feature fits with our research purpose of explaining the variations of pollution rates across firms (Hardin

Table 1: Means/Percent and Standard Deviation of Independent Variables Used in the Multivariate Analysis on Pollution Rates of Parent Companies in S&P 500 in Selected Years

Independent Variable	1994		1998		2001	
Organizational Structure						
Number of subsidiary layers	2.1	(1.2)	2.0	(1.0)	2.0	(1.0)
Number of facilities	18.2	(22.7)	16.7	(22.4)	16.2	(22.4)
Capital Dependence						
Return on equity	22.1	(32.1)	16.4	(22.8)	11.7	(73.6)
Current debt/assets (%)	12.7	(16.4)	15.3	(18.1)	13.4	(19.8)
Political Structure						
Amount of fines (in $1,000s)	114	(.3)	56	(.2)	123	(.9)
Amount of fines (in dollars, log)	4.8	(5.5)	3.3	(4.9)	1.7	(4.0)
State green policies score (/100)	16.2	(.1)	16.0	(.1)	15.7	(.1)
Control Variables						
Number of divisions	2.1	(3.5)	1.9	(3.6)	1.8	(3.6)
Change of stock price (in dollars)	-.1	(4.5)	2.6	(11.5)	-3.6	(16.2)
Organizational age (in years)	79.1	(40.4)	78.6	(42.3)	76.6	(43.9)
Number of employees (in 1,000s)	31.7	(46.4)	32.0	(36.8)	34.3	(36.6)
Number of employees (in 1,000s, log)	2.8	(1.2)	2.9	(1.1)	3.0	(1.1)
Industrial Sector on Two-digit SIC						
20-Manufacturing	9.9		8.9		8.6	
21-Tobacco	.6		.6		1.0	
23-Apparel	2.5		2.2		2.0	
24-Lumber and wood	1.2		1.1		1.0	
25-Furniture	1.2		1.1		1.0	
26-Paper	5.0		4.5		4.6	
27-Printing and publishing	6.2		5.6		5.1	
28-Chemicals	18.6		17.3		16.2	
29-Petroleum and coal	3.7		2.8		3.1	
30-Rubber and plastics	3.1		3.4		3.1	
33-Primary metals	5.0		4.5		4.1	
34-Fabricated metals	4.4		3.9		3.6	
35-Machinery (excluding electrical)	11.2		12.9		12.2	
36-Electrical and electronic equipment	11.8		14.0		16.8	
37-Transportation equipment	4.4		5.0		6.1	
38-Instruments	9.9		11.2		10.7	
39-Miscellaneous manufacturing	1.2		1.1		1.0	

Continued

Table 1 ***continued***

Geographic Region			
West	15.5	19.0	21.3
Southwest	5.6	4.5	4.6
Midwest	32.9	30.7	30.5
Southest	6.8	7.8	8.1
Northeast	39.1	38.0	35.5
N of Corporations	161	179	197

and Hilbe 2003; Hedeker and Gibbons 2006; Rabe-Hesketh; Everitt 2004). In all, GEE is more widely applicable and uses information more efficiently.[7]

Our GEE model specifies a first-order autoregressive correlation structure, which assumes the correlation between time points r and s to be $p^{|r-s|}$. This specification is in congruence with the observed pattern of within-subject correlation matrix from our data. We also conducted diagnostic analysis to rule out possibility of multicollinearity and sensitivity test to make sure the estimates were consistent across different model specifications.[8]

Results

Table 2 reports the results of the GEE models. The first two columns report results from the model using total emissions divided by sales as the dependent variable. The next two columns report results from the model using total emissions as an alternative measure of the dependent variable. The following interpretation of the results is based on the first model because we consider the standardization of total emission by sales to be a preferable measure of the dependent variable.[9]

The results show that the number of subsidiary layers had a significant positive effect on pollution rates ($p < .05$). The magnitude of the coefficient suggests that a corporation with one more layer of subsidiaries produced a 2.5 percent higher emission rate (see Table 2). Given that some parent companies in our sample have up to seven layers of subsidiaries, the firms at the high end of this distribution produced 15 percent more pollution than those with only one layer. This result provides support to our first hypothesis that parent companies with more layers of subsidiaries pollute at higher levels. Also as expected, the number of facilities has a significant positive effect on the pollution rate ($p < .001$). Each additional facility is estimated to increase the pollution rate by 1.5 percent (see Table 2). Given that about 25 percent of the parent companies in the sample have 20 or more facilities and some of them have more than 100 facilities, the difference in the number of facilities has a substantial effect on pollution rates. The results provided evidence to support both hypotheses relating to organizational complexity; more complex corporations pollute at a higher rate.

With regard to our measures of capital dependence, the results show that return on equity had a significant negative effect on emission rates ($p < .001$). For a 1 percent decrease in return on equity, an average corporation increases its pollution rate by

Table 2: Effects of Independent Variables on Pollution Rates of American Corporations in S&P 500, 1994-2001

	Total Emission/Sales		Total Emission	
	Coefficient	S.E.	Coefficient	S.E.
Organizational Structure				
Number of subsidiary layers	.025*	.0129	.051	.0677
Number of facilities	.015***	.0018	.062***	.0078
Capital Dependence				
Return on equity	-.001***	.0002	-.003**	.0010
Current debt/assets (%)	.001*	.0005	.001	.0030
Political Structure				
Amount of fines (in $1,000s, log)	.001	.0016	.002	.0086
Green policies score (/100)	.088***	.0227	.002**	.0006
Control Variables				
Number of divisions	-.006	.0049	-.012	.0251
Change of stock price (in dollars)	.000	.0004	.001	.0020
Organizational age (in years)	.008***	.0022	.026***	.0055
Number of employees (in 1,000s, log)	-.278***	.0332	.595***	.1432
Industrial Sector on Two-digit SIC[a]				
20-Manufacturing	-2.418***	.4902	-4.662***	1.1928
21-Tobacco	-1.915*	.8503	-.749	2.1193
23-Apparel	-2.512***	.7288	-7.325***	1.7624
24-Lumber and wood	1.267+	.7311	2.719	1.8003
25-Furniture	-1.427+	.8283	-3.599+	1.9906
27-Printing and publishing	-2.476***	.5143	-7.543***	1.2537
28-Chemicals	-1.220**	.4500	-1.902+	1.0940
29-Petroleum and coal	-1.241+	.6508	.218	1.5702
30-Rubber and plastics	-1.499*	.6532	-4.219**	1.5875
33-Primary metals	.017	.5657	-.688	1.3665
34-Fabricated Metals	-.972+	.5591	-1.436	1.3502
35-Machinery (excluding electrical)	-1.683***	.4510	-3.622***	1.0988
36-Electrical and electronic equipment	-1.938***	.4495	-2.980**	1.0962
37-Transportation equipment	-1.196*	.5078	-1.845	1.2453
38-Instruments	-1.619***	.4621	-2.281*	1.1273
39-Miscellaneous manufacturing	-2.348**	.8268	-6.763**	1.9908

Continued

Table 2 *continued*

	Total Emission/Sales		Total Emission	
	Coefficient	S.E.	Coefficient	S.E.
Geographic Region[a]				
Southwest	-.981	.6109	-.981	.6109
Midwest	-.250	.3088	-.250	.3088
Southest	-.557	.4414	-.557	.4414
Northeast	-.058	.2644	-.058	.2644
Constant	-2.960***	.4769	-2.150+	1.1822
Wald chi-square	313***		435***	
N (firm-years)	1,269		1,269	
Number of Firms	175		175	

+p < .1 *p < .05 **p < .01 ***p < .001 (two-tailed tests)

.1 percent (see Table 2). This supports the third hypothesis that corporations with lower profitability tend to have higher pollution rates. With regard to corporate debt level, the results indicated that corporations with a higher ratio of current debt over assets pollute at higher rates ($p < .05$), as stated in the Hypothesis 4. To quantify the relationship, regression results showed that a 1 percent increase in debt/asset ratio was associated with a .1 percent increase in the pollution rate. These findings support both of our hypotheses on capital dependence.

Hypothesis 5, that penalties do not have an effect on corporate pollution rates, is supported. The results show that there is no statistically significant relationship between penalties imposed on corporation for environmental violations and corporate pollution rates. This finding (or non-finding of the relationship) that penalties were not effective deterrents to corporate pollution suggests that fines for violating environmental pollution standards did not offer sufficiently high cost incentives for corporations to invest in pollution abatement technologies. We used the green policies score to measure a dimension of corporations' political embeddedness: environment-related political-legal arrangements in the state where the parent company is located. The results show that there is a statistically significant relationship between the state's ranking in green policies and its corporations' pollution rate ($p < .001$). As the score was defined in a way that a higher score indicates lower environmental standards, we found that a 100-point increase of the score led to about a 9 percent higher emission rate. To illustrate, a corporation located in a state on the politically disembedded end of the green-state continuum (i.e., Tennessee with a score of 2,843) with similar characteristics to a state on the politically embedded end of the continuum (i.e., California with a score of 764) could have pollution rates that are twice as high (2,843-764)/100*9).[10]

Among the control variables, the number of divisions and change in share price did not affect pollution rates. With regard to organizational age, older firms tended to have a higher emission rate than younger firms, other things being equal. This finding suggests that age inertia (e.g., sunk costs) constrains management from incorporating pollution abatement technologies into the production process (Hannan and Freeman 1984). Further, because older corporations tend to have more political clout, they may be given more leeway with regard to meeting pollution guidelines. This scenario is particularly likely in the neoliberal era when states have more authority over enforcement and economic growth is associated with creating "a friendly business environment." We also found that corporations with a larger labor force tend to have lower pollution rates. This may suggest that because large corporations are more likely to become targets for environment activism and public scrutiny, they tend to be more careful about their green image in general and toxic emissions in particular. The model shows that there is no statistically significant regional difference in corporate pollution rate. We suspect this is largely due to the fact we have already taken the state green policy score into account. Similar to research suggesting that almost 60 percent of all U.S. toxic emissions are from industries that account for 5 percent of GNP (Freudenburg 2005), our study found that significant variation exists across industries. The paper industry (SIC = 26), which is the omitted category in the models, comprised of 4.6 percent of the corporations in our analysis (see Table 1) has the highest pollution rate among all industries in the sample. This is consistent with its notoriety as a source of chemically intensive pollution (Kagan et al. 2003). Comparable high pollution rates exist in the metal industries (primary metals, SIC = 33, and fabricated metals, SIC = 34). In contrast, the printing and publishing industry (SIC = 27), which constitutes 5.7 percent of the sample, had the lowest pollution rate in the sample. Compared to an average corporation in the paper industry, a corporation in printing and publishing industry has a pollution rate of only 8 percent of its counterpart in the paper industry (exp(-2.476) = .08, see Table 2).

To summarize, the panel data analysis supports all six hypotheses. The overall findings suggest that corporations characterized by more layers of subsidiaries, more facilities, lower profitability, higher debt and headquartered in states with lower environmental standards pollute at higher rates. Also, as expected, penalties did not curb corporations' toxic emissions during our study period when environmental protections were weakened.

Conclusion

In this article, we set out to examine the effects of two dimensions of the social structure (i.e., organizational and political) on environmental pollution. To this end, we focused on the parent company as the unit of analysis, elaborated an organizational political economy framework, and quantitatively examined a wider range of variables than previous research. The analysis shows that the organizational and political characteristics that prevailed during the study period created dependencies, incentives and opportunities for corporations to externalize their pollution costs to society.

The findings advance our understanding of the relationship between environmental pollution and organizational and political dimensions of the social structure in several ways. First, the analysis supports our differential social structure hypotheses. Parent companies with more facilities and layers of subsidiaries have higher pollution rates while controlling for the number of divisions where all assets are organized into a single legal entity. There are two plausible explanations for this finding. On the one hand, each subsidiary layer provides a liability firewall to protect the assets held by the parent company. Subsidiary layers create greater organizational distance between the parent company, where most assets are held, and the location in the corporation where pollution occurs (i.e., facilities). This social structure protects parent companies and their managers from lawsuits for social and ecological damages caused by toxic emissions. On the other hand, bounded rationality may limit the capacity of top management in the parent company to monitor subsidiary managers in more complex structures (i.e., those with more facilities). However, this second explanation should be viewed critically and requires further investigation because top management has the capacity to set up sophisticated computerized controls to monitor managers in its facilities and subsidiaries (Prechel 1994). Providing a full account of *why* these dimensions of the corporations' structure are associated with higher rates of environmental pollution is beyond of the scope of this article. However, the finding that corporations organized as the multilayer-subsidiary form with taller subsidiary hierarchies pollute at higher rates is important because the majority of the largest U.S. corporations, which produce a large portion of the total environmental pollution, are organized with this corporate form.

Second, capital dependence in the form of higher debt and lower profits is associated with higher rates of environmental pollution. Capital dependence during this historical period is, in part, a consequence of changes in a separate policy arena that permitted managers to engage in costly merger and acquisition strategies. Together, the relentless expansion to capture markets, the shareholder conception of value where investors extracted wealth from corporations at the expense of other stakeholders (e.g., employees, communities, societies), and financialization where capital was shifted into nonproductive assets (e.g., derivatives) left many firms over leveraged with few liquid assets. Firms with these characteristics had less capital to reinvest in pollution abatement technologies to contain environmental pollution.

Third, both dimensions of our political embeddedness framework are supported. On the one hand, we contextualized our quantitative analysis by summarizing previous research showing that environment controls were shifted toward the disembedded end of the embedded-disembedded continuum during our study period. Our findings that fines for violating pollution standards do not deter corporations is consistent with the general argument that neoliberal enforcement structures provide opportunities for corporations to externalize their pollution costs. On the other hand, our quantitative measure of state-level political embeddedness shows that states with stronger green policies deter environmental pollution. This finding on green policy has both positive and negative implications. On the positive side, it shows that regional states can enact public policies that make a difference in corporate pollution rates. On the negative side, in the absence of rigorous environmental controls at the federal level, corporations can locate in states that tolerate higher levels of pollution. This supports the argument that federalist political structures create incentives for individual states to race to the bottom with regard to pollution regulations. Thus, decentralizing regulatory authority to regional states creates incentives for states with fiscal problems, or those where neoliberalism is most pervasive, to permit corporate pollution in order to create jobs and increase corporate tax revenues. Although reducing cost is a consideration for all corporations, top management in financially constrained companies is particularly likely to relocate to, or focus their expansion strategies on, states that are closer to the disembedded end of embedded-disembedded continuum. As the current economic crisis continues, this trend is likely to accelerate.

The quantitative analysis also shows that larger corporations better control their pollution rates. However, this finding must be contextualized because all the companies in our analysis are Standard & Poor 500 companies, and thus are the largest of all firms; the mean number of employees in these parent companies was in excess of 30,000 (Table 1). Therefore, the analysis does not suggest that large corporations pollute less than small corporations in absolute terms. This relationship may be due to the financial and organizational flexibility of the multilayer-subsidiary form, which provides management with increased capacity to offset higher polluting facilities in some of its subsidiaries by issuing securities in its subsidiaries and using the capital to acquire less polluting facilities.

This financial and organizational flexibility of the multilayer-subsidiary form has important public policy implications, because some environmental policy makers and lobby groups (i.e., financial services corporations) are advocating market-based options (e.g., cap-and-trade) where corporations can trade or purchase pollution limits (e.g., carbon emission derivatives) from other corporations. When a corporation is organized as the multilayer-subsidiary form these trades can occur among legally independent subsidiary corporations that are owned by the same parent company. In short, these organizational and political structures allow parent companies to manage their pollution in ways that have minimal effects on overall pollution reduction. This market-based solution will certainly create additional revenues for the financial services industry; however, it is less clear that creating another derivatives market will result in corporations' lowering their environmental pollution. Thus, contemporary political embeddedness, which emphasized benefit-cost analysis and neoliberal self-policing policies, provides corporations with few incentives to reduce their pollution levels but ample opportunities to pollute.

The findings from this research provide essential information for policy makers to develop comprehensive regulatory interventions that move beyond the traditional confines of industry-based (e.g., chemical, electrical) environmental policy and focus on how characteristics that are shared by corporations across industrial sectors effect pollution. One obvious policy to revisit is the relevant clauses of the Tax Reform Act of 1986 and related legislation that enable parent companies to protect their assets from lawsuits for ecological (and other) damages by restructuring as the multilayer-subsidiary form. Environmental regulatory reform is critically important at this historical juncture because as the current economic crisis continues parent companies are likely to put more pressure on facility- and subsidiary-level managers. As these managers, whose compensation and prospects for promotion are based largely on financial performance, seek to reduce costs and increase profits,externalizing pollution costs is the means to an end.

Notes

1. The amounts were in 2001 dollars, adjusted for inflation.
2. The number of chemicals included in the TRI dataset increases over time as the EPA identifies more toxic chemicals. However, little change occurred during our study period except in 2000 when EPA expanded the number of chemicals on the list from 588 to 608. As the main purpose of this study is to account for the variations of pollution emission across corporations at discrete time points, not over time, this change of reporting should have no substantive effect on the results. Moreover, we performed an additional analysis in which we add to the models a dummy variable indicating the years before and after the change in 2000. These results are consistent with the findings reported in Table 2.
3. Our research design also avoids the problem with the calculation of penalties by aggregating all fines up to the parent company. Specifically, the EPA permits corporations to divide penalty fines among their facilities. If a parent company exercises this option in order to preserve the financial condition of a financially weak subsidiary where a violation occurred, the facility-level fines underestimate fines paid by facilities that commit the violation and the effects of this form of deterrence. Only when the entire penalty is paid by the violating facility does the data accurately estimate the relationship between penalties and pollution.
4. The analysis was also conducted using the Green Index. There was no discernable difference in the results. We use the Green Policies Score because it directly measures the green political-legal arrangements of a state.
5. In contrast to research that focuses on the pollution of a facility and measures the age of the facility, our concern is with the propensity of the organization to change and therefore measures the age of the corporation, a standard organizational measurement of inertia.
6. The GEE model does require that the time points of measurement are fixed. Therefore, it would not be well-suited to analyzing unequally-spaced longitudinal data with regard to the timing of measurements.
7. Another appeal of the GEE is that it can be used for analysis of both normal continuous outcomes and categorical or count outcomes (Hedeker and Gibbons 2006:131).
8. We also estimated our models using the REM, and the results are comparable to that of the GEE. With certain specifications, the REM could be equivalent to the GEE (Hedeker and Gibbons 2006).
9. One anonymous reviewer suggested that we use total emission as an alternative measure of the dependent variable. Table 2 shows the results are largely comparable between the two models except for the number of subsidiary layers and debt-to-assets ratio. Both coefficients point to the expected direction but fail to reach the significance level.
10. One limitation of the measure should be noted. The green policies score has not been updated since its 1991 release. Therefore, our analysis treated it as unchanged during the period

(1994-2001) of this study. This could be potentially problematic if changes in state policies do not follow a path-dependence nature. The finding here nevertheless is, at least, suggestive.

References

Ambec, Stefan, and Paul Lanoie. 2008. "Does it Pay to be Green? A Systematic Overview." *Academy of Management Perspectives* 22(4):45-62.

Arota, Seema and Timothy Cason. 1995. "An Experiment in Voluntary Environmental Regulation: Participation in EPA's 33/50 Program." *Journal of Environmental Economics and Management*, 28:271-86.

Beamish, Thomas. 2000. "Accumulating Trouble: Complex Organization, a Culture of Silence, and a Secret Spill." *Social Problems* 47(4):473-98.

______. 2002. *Silent Spill*. MIT Press.

______. 2010. "The Gulf Spill and the Hobson's Choice of Oil Production." Available at: http://envirosoc.org/Newsletters/Summer10.pdf.

Bullard, Robert. 1994. *Dumping in Dixie: Race Class and Environmental Quality*. Westview.

Bunker, Stephen, and Paul Ciccantell. 2005. *Globalization and the Race for Resources*. Johns Hopkins University Press.

Buttel, Frederick. 2004. "The Treadmill of Production: An Appreciation, Assessment, and Agenda for Research." *Organization and Environment* 17(3):323-36.

Catton, William. 1980. *Overshoot: The Ecological Basis of Revolutionary Change*. University of Illinois Press.

Clinard, Marshall, and Peter Yeager. 1980. *Corporate Crime: The First Comprehensive Account of Illegal Practices among America's Top Corporations*. Free Press.

Cusolito, Kara. 2010. "The Next Drilling Disaster?" Available at: http://www.thenation.com/article/next-drilling-disaster.

Davis, Gerald. 2009. *Managed by the Market: How Finance Re-shaped America*. Oxford University Press.

Davis, Gerald, and Tracy Thompson. 1994. "A Social Movement Perspective on Corporate Control." *Administrative Science Quarterly* 39(1):141-73.

Daynes, Byron. 1999. "Bill Clinton: The Environmental Presidency." Pp. 259-312. *The Environmental Presidency*. Dennis Soden, editor. State University of New York Press.

Dietz, Thomas, Eugene Rosa and Richard York. 2007. "Driving the Human Ecological Footprint." *Frontiers in Ecology and the Environment* 5(1):13-8.

Downey, Liam. 2007. "US Metropolitan Area Variation in Environmental Quality Outcomes." *Urban Studies* 44(5):953-77.

Dunlap, Riley, and William Catton. 1979. "Environmental Sociology." *Annual Review of Sociology* 5:243-73.

Environmental Work Group. 2008. "Colorado's Chemical Injection." Available at: http://www.ewg.org/reports/injection.

Freudenberg, William. 2005. "Privileged Access, Privileged Accounts: Toward a Socially Structured Theory of Resources and Discourses." *Social Forces* 84(1):89-114.

Freudenberg, William, Robert Gramling, Shirley Laska and Kai T. Erikson. 2009. *Catastrophe in the Making: The Engineering of Katrina and the Disasters of Tomorrow*. Island Press.

Gould, Kenneth, David Pellow and Allan Schnaiberg. 2008. *The Treadmill of Production: Injustice & Unsustainability in the Global Economy*. Paradigm.

Grant, II, Don Sherman, Andrew W. Jones and Albert J. Bergesen. 2002. "Organizational Size and Pollution: The Case of the U.S. Chemical Industry." *American Sociological Review* 67(3):389-407.

Grant, II, Don Sherman, and Andrew W. Jones. 2003. "Are Subsidiaries More Prone to Pollute? New Evidence From the EPA's Toxics Release Inventory." *Social Science Quarterly* 84(1):162-73.

Grant, II, Don Sherman, Mary Trautner, Liam Downey and Lisa Thiebaud. 2010. "Bring the Polluters Back In: Environmental Inequality and the Organization of Chemical Production." *American Sociological Review* 75(4):479-504.

Hall, Bob, and Mary Lee Kerr. 1991. *1991-1992 Green Index: A State-by-state Guide to the Nation's Environmental Health*. Inland Press.

Hamilton, James. 1995. "Pollution as News: Media and Stock Market Reactions to the Toxics Release Inventory Data." *Journal of Environmental Economics and Management* 28(1):98-113.

______. 2005. *Regulation through Revelation: The Origin, Politics, and Impacts of the Toxic Release Inventory Program*. Cambridge University Press.

Hannan, Michael, and John Freeman. 1984. "Structural Inertia and Organizational Change." *American Sociological Review* 49(2):149-64.

Hardin, James W., and Joseph Hilbe. 2003. *Generalized Estimating Equations*. Chapman & Hall.

Harrison, Bennett, and Barry Bluestone. 1988. *The Great U. Turn*. Basic Books.

Hernes, Gudmund. 1976. "Structural Change in Social Process." *American Journal of Sociology* 82(3):513-47.

Hedeker, Donald, and Robert D. Gibbons. 2006. *Longitudinal Data Analysis*. Wiley & Sons.

Investor Responsibility Research Center. 2001. "Corporate Benchmark Service." IRRC.

Jermier, John. 2008. "Exploring Deep Subjectivity in Sociology and Organizational Studies." *Organization & Environment* 21(4):460-70.

Jorgenson, Andrew. 2009. "The Transnational Organization of Production, the Scale of Degradation, and Ecoefficiency." *Human Ecology Review* 16(1):64-74.

Jorgenson, Andrew, Christopher Dick and Matthew Mahutga. 2007. "Foreign Investment Dependence and the Environment: An Ecostructural Approach." *Social Problems* 54(3):371-94.

Jorgenson, Andrew, and Kennon Kuykendall. 2008. "Globalization, Foreign Investment Dependence and Agriculture Production." *Social Forces* 87(1):529-60.

Kagan, Robert, Neil Gunningham and Dorothy Thornton. 2003. "Explaining Corporate Environmental Performance: How Does Regulation Matter?" *Law & Society Review* 37(1):51-90.

Kirsch, Max. 1998. *In the Wake of the Giant: Multinational Restructuring and Uneven Development in a New England Community*. State University of New York Press.

Koehler, Dihan, and Donald Cram. 2001. "The Financial Impact of Corporate Environmental Performance." Boston: Harvard School of Public Health working paper.

Krendl, Cathy, and James Krendl. 1978. "Piercing the Corporate Veil." *Denver Law Journal* 55(1):52-55.

Krier, Dan. 2005. *Speculative Management*. State University of New York Press.

Lee, Amanda, and James Alm. 2004. "The Clean Air Amendments and Firm Investment in Pollution Abatement Equipment." *Land Economics* 80(3):433-47.

Liang, Kung-Yee, and Scott L. Zeger. 1986. "Longitudinal Data Analysis Using Generalized Linear Models." Biometrika 73(1):13-22.

Meyer, John, and Brian Rowan. 1977. "Institutionalized Organizations: Formal Structure as Myth and Ceremony." *American Journal of Sociology* 83(2):340-63.

Mol, Arthus. 1995. *The Refinement of Production: Ecological Modernization Theory and the Chemical Industry*. Van Arkel.

Nadeau, Louis. 1997. "EPA Effectiveness at Reducing the Duration of Plant-Level Noncompliance." *Journal of Environmental Economics and Management* 34(1):54-78.

Palmer, Donald, P. Devereaux Jennings and Xueguang Zhou. 1993. "Late Adoption of the Multidivisional Form by Large U.S. Corporations." *Administrative Science Quarterly* 38(1):100-31.

Paternoster, Raymond, and Sally Simpson. 1996. "Sanctions, Threats and Appeals to Morality: Testing a Rational Choice Model of Corporate Crime." *Law & Society Review* 30(3):549-83.

Pearce, Frank, and Steven Tombs. 1993. "U.S. Capital versus the Third World: Union Carbide and Bhopal." Pp. 187-211. *Global Crime Connections*. Frank Pearce and Michael Woodiwiss, editors. University of Toronto Press.

Pellow, David N., Adam Weinberg and Allan Schnaiberg. 2001. "The Environmental Justice Movement: Equitable Allocation of the Costs and Benefits of Environmental Management Outcomes." *Social Justice Research* 14(4):423-39.

Perkins, Richard, and Eric Neumayer. 2009. "Transnational Linkages and the Spillover of Environmental-Efficiency into Developing Countries." *Global Environmental Change* 14(4):375-83.

Perrow, Charles. 1997. "Organizing for Environmental Destruction." *Organization & Environment* 10(1):66-72.

Pfeffer, Jeffrey, and Gerald Salancik. 1978. *The External Control of Organizations*. Harper & Row.

Polanyi, Karl. 2001[1944]. *The Great Transformation: The Political and Economic Origins of Our Time*. Beacon Press.

Prechel, Harland. 1990. "Steel and the State: Industry Politics and Business Policy Formation, 1940-1989." *American Sociological Review*, 55:648-68.

______. 1994. "Economic Crisis and the Centralization of Control over the Managerial Process." *American Sociological Review* 59(5):723-45.

______. 2000. *Big Business and the State: Historical Transitions and Corporate Transformations, 1880s-1990s*. State University of New York Press.

______. 2010. "Political Capitalism and Organizational-Political Structure: Pollution in the U.S. Electrical Power Industry." Pp. 121-42. *Sustainable Development – An Integrative Paradigm? A Transatlantic View on Politcs, Economy and Society*, Michael Meimeth and John Robertson, editors. Nomos.

Prechel, Harland, and John Boies. 1998. "Capital Dependence, Financial Risk, and Change from the Multidivisional to the Multilayered Subsidiary Form." *Sociological Forum* 13(2):321-62.

Prechel, Harland, and Theresa Morris. 2010. "The Effects of Organizational and Political Embeddedness on Financial Malfeasance in the Largest U.S. Corporations." *American Sociological Review* 75(3):331-54.

Rabe-Hesketh, Sophia, and Brian Everitt. 2004. *A Handbook of Statistical Analyses Using Stata, 3rd Edition*. Chapman & Hall/CRC.

RiskMetrics Group. 2001. Corporate Environmental Profiles Database. Rockville, MD: RiskMetrics Group.

Rudel, Thomas. 1993. *Tropical Deforestation: Small Farmers and Land Clearing in the Ecuadorian Amazon*. New York: Columbia University Press.

Ruggie, John Gerard. 1992. "Multilateralism: the Anatomy of an Institution." *International Organization* 46(3):561-98.

Saha, Bobin, and Paul Mohai. 2005. "Historical Context and Hazardous Waste Facility Siting: Understanding Temporal Patterns in Michigan." *Social Problems* 52(3):618-48.

Schnaiberg, Alan. 1980. *The Environment: From Surplus to Scarcity*. Oxford University Press.

Simpson, Sally. 1986. "The Decomposition of Antitrust: Testing a Multi-Level, Longitudinal Model of Profit Squeeze." *American Sociological Review* 51(6):859-75.

Soden, Dennis, and Brent Steel. 1999. "Evaluating the Environmental Presidency." Pp. 313-54. *The Environmental Presidency*. Dennis Soden, editor. State University of New York Press.

Stavins, Robert. 2000. "Market-Based Environmental Policies." Pp. 31-76. *Public Policies and Environmental Protection*. Paul Portney and Robert Stavins, editors. Washington, DC: Resources for the Future.

Stiglitz, Joseph. 2002. *Globalization and Its Discontents*. W.W. Norton & Company.

Stretesky, Paul. 2006. "Corporate Self-Policing and the Environment." *Criminology* 44(3):671-708.

Stretesky, Paul, and Michael Lynch. 2009. "A Cross-National Study of the Association between Per Capita Carbon Dioxide Emissions and Exports to the United States." *Social Science Research* 38(1):239-50.

Sutherland, Edwin. 1949. *White Collar Crime*. Holt.

Sunstein, Cass R. 1996. *Legal Reasoning and Political Conflict*. Oxford University Press.

Useem, Michael. 1993. *Executive Defense*. Harvard University Press.

______. 1996. *Investor Capitalism: How Money Managers are Changing the Face of Corporate America*. Basic Books.

Vermeer, Daniel, and Robert Clemen. 2009. "Why Sustainability is still Going Strong." Available at: http://sustainableink.org/2009/02/17/financial-times-why-sustainability-is-still-going-strong.

Yeager, Peter. 1987. "Structural Bias in Regulatory Law Enforcement: The Case of the U.S. Environmental Protection Agency." *Social Problems* 34(4):330-44.

______. 1991. *The Limits of Law: The Public Regulation of Private Pollution*. Cambridge University Press.

York, Richard, Eugene Rosa and Thomas Dietz. 2004. "The Ecological Footprint Intensity of National Economies." *Journal of Industrial Ecology* 68:279-300.

Zald, Mayer. 1970. "Political Economy: A Framework for Comparative Analysis." Pp. 221-61. *Power in Organizations*. Mayer Zald, editor. Vanderbilt University Press.