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Environmental Enforcement in Dire Straits: There Is No Protection for Nothing and No Data for Free

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While much of the world debates what our environmental laws should be,[1] the less esoteric question of whether the environmental laws we already have are being properly enforced continues to be insufficiently examined. As we approach the fortieth anniversary of modern environmental law, the answer to this "$64 billion question" still is not clear.

Numerous commentators have noted that the difference between environmental laws that actually protect the environment and those that do not is highly dependent on whether, and in what way, these laws are enforced.[2] Testing whether we are correctly and/or adequately enforcing our environmental laws, however, has proven remarkably difficult as measures of environmental quality have changed over time and differ between locations.[3] This makes the actual connection between enforcement actions and environmental improvements very difficult to ascertain.

Throughout much of the history of environmental law, the assumption has been that vigorous enforcement deters noncompliance with laws, and thus, brings about the desired outcomes.[4] This assumption is reflected in the very structure of the cooperative federalism model for the administration of environmental laws,[5] as well as the theories underlying citizen suit provisions.[6] However, merely examining the number of such state and private actions taken against noncomplying parties may not tell us much about the overall effectiveness of an environmental program.[7]

Additionally, recent "second generation" regulatory proponents have suggested that direct enforcement may not achieve effective compliance (and thus, environmental improvements), and that so-called cooperative mechanisms may work better.[8] As noted by Professors Clifford Rechtschaffen and David Markell,[9] "many states have actively championed this strategy," pushing towards market mechanisms for pollution control, and proposing to change environmental enforcement from primarily deterrence-based enforcement to a cooperative regime. Some of

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1. *See, e.g.*, Marcilynn A. Burke, *Green Peace? Protecting Our National Treasures While Providing for Our National Security*, 32 Wm. & Mary Envtl. L. & Pol'y Rev. 803, 805 (2008) (discussing requested changes to a host of federal environmental laws to accommodate national security); Charles de Saillan, *The Use of Imminent Hazard Provisions of Environmental Laws to Compel Cleanup at Federal Facilities*, 27 Stan. Envtl. L.J. 43, 205–06 (2008) (arguing that individuals and organizations should take a more proactive approach in using federal and state laws to initiate the cleanup of hazardous facilities); Robert V. Percival, *Environmental Law in the Twenty-First Century*, 25 Va. Envtl. L.J. 1, 2–4 (2007) (suggesting a history of partisan politics delayed the implementation of cohesive environmental reform).
2. *See* William L. Andreen, *Beyond Words of Exhortation: The Congressional Prescription for Vigorous Enforcement of the Clean Water Act*, 55 Geo. Wash. L. Rev. 202, 211 (1987); Victor B. Flatt, *Spare the Rod and Spoil the Law: Why the Clean Water Act Has Never Grown Up*, 55 Ala. L. Rev. 595, 596 (2004); Robert L. Glicksman & Dietrich H. Earnhart, *The Comparative Effectiveness of Government Interventions on Environmental Performance in the Chemical Industry*, 26 Stan. Envtl. L.J. 317, 319–21 (2007); *see also* Joel A. Mintz et al., Environmental Enforcement 5–15 (2007) (discussing the various theories and objectives of environmental enforcement).
3. Robert W. Adler, *The Two Lost Books in the Water Quality Trilogy: The Elusive Objectives of Physical and Biological Integrity*, 33 Envtl. L. 29, 49 (2003); Clifford Rechtschaffen & David L. Markell, *Improving State Environmental Enforcement Performance Through Enhanced Government Accountability and Other Strategies*, 33 ELR 10559, 10565 (Aug. 2003).
4. Glicksman & Earnhart, *supra* note 2, at 320.
5. *See* Richard J. Pierce Jr., *Issues Raised by* Friends of the Earth v. Laidlaw Environmental Services*: Access to the Courts for Environmental Plaintiffs*, 11 Duke Envtl. L. & Pol'y F. 207, 234 (2001) (arguing that the environmental federalism standard allows no or very little second guessing of state enforcement decisions).
6. Peter A. Appel, *The Diligent Prosecution Bar to Citizen Suits: The Search for Adequate Representation*, 10 Widener L. Rev. 91, 91 (2004).
7. Michael P. Vandenbergh, *Beyond Elegance: A Testable Typology of Social Norms in Corporate Environmental Compliance*, 22 Stan. Envtl. L.J. 55, 66 (2003) (citing Clifford Rechtschaffen, *Deterrence vs. Cooperation and the Evolving Theory of Environmental Enforcement*, 71 S. Cal. L. Rev. 1181, 1219 (1998)); *see also* Victor B. Flatt, *A Dirty River Runs Through It (The Failure of Enforcement in the Clean Water Act)*, 25 B.C. Envtl. Aff. L. Rev. 1, 17–19 (1998).
8. *See* Rena I. Steinzor, *Myths of the Reinvented State*, 29 Cap. U. L. Rev. 223, 231–32 (2001).
9. Clifford Rechtschaffen & David L. Markell, Reinventing Environmental Enforcement & the State/Federal Relationship 2 (2003).

the cooperative-based enforcement literature propounds the theory that in addition to better results, cooperative-based enforcement may cost less, and thus, be a more cost-efficient form of effective environmental enforcement.[10]

Theories regarding different environmental policies and enforcement strategies are important to making environmental protection efficient and responsive to societal needs, but what is really needed is an empirical examination of which kinds of environmental enforcement strategies work successfully.

This Article seeks to gather data and conduct statistical analyses that can take the discussion even further. By using data painstakingly culled from the states and combining that data with newly available EPA enforcement data, we put forward some important new conclusions regarding the resource allocation necessary for effective environmental enforcement strategies.[11] Just as importantly, we use the knowledge gained from the process, and results of data collection to propose ways that data can be improved to make future analyses of environmental enforcement and progress both easier and more useful.

I. Prior Empirical Analyses

From 2005 through 2008, a research group at the University of Kansas surveyed opinions of major National Pollutant Discharge Elimination System[12] (NPDES) permit holders to determine which types of enforcement mechanisms were believed to be most effective, and also sought to see what happened to source compliance following various enforcement actions.[13] Their findings have been an important source of new information, particularly about the effectiveness of state enforcement versus federal enforcement.

Although most of the data examining the effectiveness of either deterrence- or compliance-based enforcement are industry specific, a 1996 through 1998 statistical analysis by one of the authors of this Article looked at state enforcement of the Clean Water Act (CWA) in two states and examined enforcement across all industrial groups for that program.[14] The study found that although enforcement actions may have been occurring at the same rate, the individual nature of each state's enforcement actions meant that actual compliance achievement was not uniform even for similarly situated sources.[15] This finding challenged the assumption that "enforcement" automatically leads to compliance and focuses us more on the type or kind of enforcement that is occurring.

Despite prior empirical analyses, we still have no real idea how we determine to what extent resource allocation is necessary for effective enforcement, or whether cooperative- or deterrence-based enforcement is more effective. We know that states are required to meet the same federal standards and implement the same federal statutes.[16] The states are also increasingly responsible for primary enforcement of the environmental laws, which means that their ability to effectively enforce the standards and the laws determines whether our environment is protected.[17] As a result, examining the effectiveness of various state programs might be a good way to determine optimal enforcement strategy.

The following are the interrelated stories of the construction of possible statistical methods for testing our findings, and the attempt to gather data to provide the raw inputs for such analyses.

II. Research Background, Methodology, and Data Collection

A. *Outcome Measurement Issues*

The underlying issue in trying to conduct the statistical analysis of the effectiveness of any variable, such as different environmental enforcement strategies, is determining an outcome measurement. In the environmental arena this is particularly problematic because, in general, there is no direct measurement of environmental quality.[18] Therefore, there must be some effective substitute for environmental markers that replicates or comes close to replicating the actual state of the environment.

One can try to test whether enforcement actually alters the way that pollution sources comply with the law[19] by measuring the average length of time violators are out of compliance and comparing it to the actual harm that the environment is undergoing.[20] This is an appropriate measure because, even when the enforcement strategy changes, the sources themselves must still self report technical compliance with the standards on a monthly basis. Its use is limited though, as it fails to capture those sources that are outside the regulatory net altogether and so it cannot test whether we are regulating the correct things or not.[21] Nor does it determine whether the permit terms themselves are consistent with the legal requirements of the federal regulations, which is another concern with administrative discretion.[22] It simply tells us the effects of various regulatory strategies on the legal compliance issues.

Nevertheless, as the structure of the environmental laws suggests that compliance effectuates the goal of a clean environment, we propose the use of noncompliance with

10. Steinzor, *supra* note 8, at 233.
11. *See* 85 Notre Dame L. Rev. 55, 84-86; *see also* sources cited *infra* note 30.
12. *See* Federal Water Pollution Control Act, 33 U.S.C. §§1251–1387 (2006). Section 402 of the CWA established the NPDES. *Id.* §1342.
13. Glicksman & Earnhart, *supra* note 2, at 329–32.
14. *See* Flatt, *supra* note 7, at 21–26.
15. *Id.* at 26–27.
16. *See* William W. Buzbee, *Asymmetrical Regulation: Risk, Preemption, and the Floor/Ceiling Distinction*, 82 N.Y.U. L. Rev. 1547, 1550 (2007).
17. *See* Flatt, *supra* note 7, at 20.
18. *See* Adler, *supra* note 3, at 49.
19. Flatt, *supra* note 7, at 24.
20. *Id.* Courts have affirmed the assumption that violating congressionally mandated standards can be reasonably assumed to harm the environment. *See, e.g.*, Friends of the Earth, Inc. v. Laidlaw Envtl. Servs., 528 U.S. 167, 184–85 (2000).
21. Flatt, *supra* note 7, at 22.
22. Glicksman and Earnhart attempt to measure this. *See* Glicksman & Earnhart, *supra* note 2, at 504–09.

permits history, which are self reported, as the output variable to test the effects of various enforcement strategies. In addition, we also examine the amount of fines levied against facilities for environmental violations as a second means to gauge compliance. While this second measure is somewhat crude, it is nonetheless useful because monetary fines can potentially act as a deterrent to polluting activities and thus encourage facilities' compliance with environmental laws.[23] This proxy for enforcement thus assumes that facilities fined for environmental violations are more likely to come into compliance with environmental regulations as a result of this enforcement strategy.

B. Data

Below, we discuss for comparison the issues regarding federal data from the EPA concerning pollution sources and individual state data concerning environmental funding and enforcement policies.

1. Federal Data From the EPA Concerning Pollution Sources

In response to continuing difficulties in tracking enforcement, the EPA introduced its Integrated Data for Enforcement Analysis[24] (IDEA) in the early 1990s. Nevertheless, the introduction of IDEA has still not generally enabled outside examinations of enforcement effectiveness. The current online version allows one to search for permitted sources using several factors such as location, compliance, and history[25]; however, this is not in a format that allows for the downloading of data to conduct comparisons across state variables.[26]

Compliance data is presented to the public through the system known as Enforcement and Compliance System Online (ECHO); however, data available on ECHO do not contain a description of the permitted source that would allow a researcher to control for source differences in making comparisons of compliance of sources between states.[27] Additionally, through a blocking program, the EPA prevents data from being downloaded from the ECHO site by a computer system, thus requiring manual entry of data.[28]

We learned that it was possible for the public to directly access the IDEA data, but to do so, one would need to obtain an EPA mainframe user ID and account and obtain remote access via a web browser.[29] The description of the data fields in IDEA seemed to indicate that if we could obtain the compliance data for three major federal environmental laws—the Clean Air Act (CAA), the CWA, and the Resource Conservation Act (RCRA)—we could meet our research needs. With respect to the air data, the number of quarters that a source is noncompliant—one of our proposed dependent variables—is listed for the two years preceding the date of a facility's inspection.[30]

There were also data fields that would help us to control for differences between sources.[31] With respect to the use of number of quarters a source is in noncompliant status, there are variables that describe the kind of noncompliance more specifically. This indicated that we could separate reporting violations from permit violations. There are also fields that assist in testing the dependent variables that we have at issue, and those that show the amount of penalty, the action taken, and the date of a completed compliance action.[32]

Our empirical analyses focus only on the following dependent variables: (1) the penalties assessed against facilities for violations of CWA regulatory requirements; (2) the penalties assessed against facilities for violations of CAA regulatory requirements; and (3) the number of quarters (in the two years preceding the inspection date) that facilities were in violation of compliance with CAA regulatory requirements. In other words, due to a lack of data availability, we exclude compliance with RCRA requirements from our empirical analyses.

2. Data From States for Comparison Purposes

Because we are examining attitudes about environmental enforcement, at least loosely correlated with political orientation and possibly with regional differences,[33] we felt

23. *See, e.g.*, Mark A. Cohen, *Empirical Research on the Deterrent Effect of Environmental Monitoring and Enforcement*, 30 ELR 10245, 10250 (Apr. 2000) (suggesting that public awareness of sanctions may damage the value and reputation of sanctioned firms, helping to increase general environmental deterrence); Surabhi Kadambe & Kathleen Segerson, *On the Role of Fines as an Environmental Enforcement Tool*, 41 J. Envtl. Plan. & Mgmt. 217, 218, 224–25 (1998) (developing a model for analyzing the effect of fine amounts on regulatory compliance); Dorothy Thornton et al, *General Deterrence and Corporate Environmental Behavior*, 27 Law & Pol'y 262, 278-83 (2005) (questioning the "explicit" deterrent effect of fines but suggesting that they "implicitly" reinforce the general deterrence of other informal sanctions). *But see* Montserrat Viladrich Grau & Theodore Groves, *The Oil Spill Process: The Effect of Coast Guard Monitoring on Oil Spills*, 10 Envtl. & Resource Econ. 315, 322–24 (1997) (noting that relatively low fines had no significant effect on the frequency or size of oil spills).

24. *See* Peter J. Fontaine, *EPA's Multimedia Enforcement Strategy: The Struggle to Close the Environmental Compliance Circle*, 18 Colum. J. Envtl. L. 31, 57–58 (1993).

25. *See* U.S. EPA, *Enforcement & Compliance History Online, Compliance Data (Air Program)*, *at* http://www.epa-echo.gov/echo/compliance_report_air.html (last visited Sept. 20, 2009).

26. *See id.*

27. *See* Memorandum from Victor B. Flatt to Member Scholars of the Ctr. for Progressive Reform on Sufficiency of IDEA Data for Proposed Analysis (May 1, 2005) (on file with the author) [hereinafter Flatt Memorandum].

28. *Id.* This is ostensibly because of the large computer time costs the EPA would incur through such a download. Because our study has hundreds of thousands of pieces of data, this would make analysis virtually impossible.

29. *See* U.S. EPA, *Integrated Data for Enforcement Analysis*, *at* http://www.epa.gov/compliance/data/systems/multimedia/idea (last visited Sept. 24, 2009).

30. *See* Professional Homepage of Victor B. Flatt, Clean Air Data, http://www.law.uh.edu/faculty/vflatt/cleanair.pdf (last visited Oct. 2, 2009) [hereinafter Clean Air Data] (providing a publically accessible, permanent link to EPA's data); Professional Homepage of Victor B. Flatt, Clean Water Data, http://www.law.uh.edu/faculty/vflatt/cleanwater.pdf (last visited Oct. 2, 2009) [hereinafter Clean Water Data] (same).

31. *See id.*

32. *See id.*

33. *See*, *e.g.*, Riley E. Dunlap, Chenyang Xiao & Aaron M. McCright, *Politics and Environment in America: Partisan and Ideological Cleavages in Public Support for Environmentalism*, 10 Envtl. Pol. 23, 28–33 (2001); David M.

that it was important to select states with different political orientations. The states selected were Alaska, Arizona, California, Colorado, Connecticut, Florida, Georgia, Indiana, Kansas, Maryland, New Jersey, New Mexico, New York, North Carolina, Ohio, Oregon, Tennessee, and Texas. Though we originally hoped to obtain data for ten years, we focused on the overlapping time in the states searched.

The states' budget numbers did not exactly match up with one another. For example, states might report budgets based on authorizations or expenditures, and the budgets might be subdivided by medium (air, water) or by expense category (personnel, fines, etc.).[34] It seemed that the best option we had for comparing budget numbers was to start with the largest common categories that were informative. We decided that this would be total environmental expenditures, assuming that most states categorized "environmental" similarly.

3. State Per Capita Environmental Spending

A cursory examination of the state budget data seemed to indicate wide swings in per capita environmental spending,[35] so the authors revisited each state's budget data to see how the budget was broken down. In several cases, we discovered that the state budget numbers were not comparable due to common differences in whether broad health, agriculture, or recreation programs were included in the state's "environmental" or "natural resource" category. We made adjustments to the figures of some of the states per capita environmental studies as appropriate.

Ultimately, though we contacted sources in Georgia multiple times, we received no return calls or information; therefore, Georgia was dropped from consideration. With this data in hand, our measure of *State per Capita Environmental Spending* represents each of the seventeen states' per capita environmental spending, calculated by year. This variable allows us to examine the relationship between state environmental spending and compliance with CAA and CWA regulatory requirements.

4. State Ideology

As noted above, we were also interested in whether the choice between cooperative versus deterrence-based enforcement strategies has a significant effect on source compliance. After conducting research on such state policies, we could find no uniform legislative or regulatory marker indicating whether cooperative versus deterrence-based enforcement strategies was dominant in a particular state.

We did find, however, a *State Elite Ideology* proxy capable of capturing the nuances between the political ideologies of the American states, provided by William Berry and his coauthors.[36] Their measure, calculated yearly for each state, is based on three points of information: interest group ratings of a state's members of Congress, the power division among Republicans and Democrats in a state's legislative chambers, and the ideology of a state's governor.[37]

These scores have been shown to have substantial face validity and are able to capture the differences between the underlying ideologies of the major political parties that vary between states.[38] Given the power offered by the Berry et al. scores, we utilized them to operationalize our measure of *State Elite Ideology*.

III. Empirical Results

Table 1: OLS Regression Estimates of the Penalty Assessed Against a Facility in Violation of Clean Water Act, 2000–2003

Variable	Coefficient
State per Capita Environmental Spending	17.94*** (8.43)
State Elite Ideology	–14.32*** (3.74)
Constant	–443.06 (649.1)
R^2	0.075
N	101,498

Entries are ordinary least squares regression coefficients. Numbers in parentheses indicate robust standard errors, clustered on facility. *** $p < .05$ (two-tailed tests).

Model includes 94 dummy variables controlling for the Enforcement Action Code of the facility, 31 dummy variables controlling for the Inspection Type Code of the facility, and 97 dummy variables controlling for the Standard Industrial Code clusters of the facility (results not shown).

Sample includes the following states: Alaska, Arizona, California, Colorado, Connecticut, Florida, Indiana, Kansas, Maryland, North Carolina, New Jersey, New Mexico, New York, Ohio, Oregon, Tennessee, and Texas.

Konisky, *Regulator Attitudes and the Environmental Race to the Bottom Argument*, 18 J. Pub. Admin. Res. & Theory 321, 323 (2007); Eugene S. Uyeki & Lani J. Holland, *Diffusion of Pro-Environment Attitudes?*, 43 Am. Behav. Sci. 646, 658–60 (2000).

34. For full breakdowns of the states' budgets from each year, see Professional Homepage of Victor B. Flatt, *State Budget Data*, *at* http://www.law.uh.edu/faculty/vflatt/state-budget-data (last visited Oct. 2, 2009) [hereinafter State Budget Data].

35. *See* Federal Water Pollution Control Act, 33 U.S.C. §§1251–1387 (2006), ELR Stat. CWA §§101-607. Section 402, 33 U.S.C. §1342, of the CWA established the NPDES.

36. William D. Berry et al., *Measuring Citizen and Government Ideology in the American States, 1960–93*, 42 Am. J. Pol. Sci. 327, 330–31 (1998). These ideology scores have subsequently been updated through 2006. *See* Richard C. Fording, *State Citizen & Government Ideology*, *at* http://www.uky.edu/~rford/stateideology.html (last visited Sept. 20, 2009) (containing updated ideology scores through 2007).

37. Berry et al., *supra* note 36, at 330-31.

38. *Id.* at 341–43.

Table 1 reports the results of the model that captures the penalty assessed against a facility in violation of compliance with CWA regulatory requirements. As our dependent variable,[39] the monetary penalty levied against a facility is a continuous variable, and we utilize ordinary least squares regression (OLS) to model the influence of *State per Capita Environmental Spending* and *State Elite Ideology* on the penalty assessed against a facility.[40] This table reveals that the more a state spends per capita on its environmental budget, the higher the fines levied against polluters for violations associated with the CWA. In substantive terms, for each $1 per capita increase in state environmental spending, the fine levied against a facility increases by about $18, holding all else constant. The results of our proxy for *State Elite Ideology* indicates that as a state's political elite become more liberal, the fines levied against polluters for violations of CWA regulatory requirements decrease. All else equal, a one-unit increase in the liberalism of the state's political elite corresponds to a $14 decrease in the monetary penalty levied against a polluter.

Table 2 presents the results of the model that captures influences on the penalty assessed against a facility for violations of compliance with CAA regulatory requirements.[41] The results of the CAA model indicate, unlike the results of the CWA model, that neither *State per Capita Environmental Spending* nor *State Elite Ideology* influences the monetary penalty assessed against a facility. This is evidenced by the fact that the coefficients associated with these variables fail to obtain statistical significance at conventional levels.

Table 2: OLS Regression Estimates of the Penalty Assessed Against a Facility in Violation of Clean Air Act, 2000–2003

Variable	Coefficient
State per Capita Environmental Spending	–2.59 (31.90)
State Elite Ideology	–2.83 (6.86)
Constant	8855.30 (10,435.90)
R^2	0.007
N	99,428

Entries are ordinary least squares regression coefficients. Numbers in parentheses indicate robust standard errors, clustered on facility.

Model includes 12 dummy variables controlling for the Air Program Code of the facility, 15 dummy variables controlling for the National Action Type Code of the facility, and 113 dummy variables controlling for the Standard Industrial Code clusters of the facility (results not shown).

Sample includes the following states: Alaska, Arizona, California, Colorado, Connecticut, Florida, Indiana, Kansas, Maryland, North Carolina, New Jersey, New Mexico, New York, Ohio, Oregon, Tennessee, and Texas.

Table 3 reports the results of the model that captures the number of quarters that a facility was in violation of the CAA regulatory requirements. As this dependent variable[42] is a non-negative count, we utilized a negative binomial regression model.[43] Table 3 also reports the percentage change in the number of quarters a facility is in violation of CAA regulatory requirements corresponding to a one-unit change in each independent variable. This Table reveals that for each $1 per capita increase in state environmental spending, the number of quarters a facility is in violation of the CAA decreases by 0.6%, *ceteris paribus*. For example, compared with a state that spends $28 per capita

39. The mean of the dependent variable in Table 1 is 903.8 (standard deviation = 15,159.87; range = 0 to 792,000). The data used in Table 1 include facilities that were assessed monetary penalties for violations of CWA regulatory requirements, as well as those facilities that were not assessed monetary penalties. The data contain 25,282 unique observations of facilities, meaning that, on average, facilities appear in the data 3.93 times. To account for this non-independence of observations, we estimate the regression model employing robust standard errors, clustered on facility. *See generally* M. Arellano, *Computing Robust Standard Errors for Within-Groups Estimators*, 49 Oxford Bull. Econ. & Stat. 431, 433 (1987) (explaining a formula for calculating robust standard errors).

40. Damodar N. Gujarati & Dawn C. Porter, Basic Econometrics 55–80 (5th ed. 2009) (explaining the methodology behind and relative simplicity of the OLS regression model). *See generally* Christopher H. Achen, Interpreting and Using Regression 18–34 (John L. Sullivan & Richard G. Niemi eds., 1982) (providing an overview of OLS regressions).

41. The mean of the dependent variable in Table 2 is 2250.3 (standard deviation = 60,139.4; range = 0 to 8,000,000). The data used in Table 2 include facilities that were assessed monetary penalties for violations of CAA regulatory requirements, as well as those facilities that were not assessed monetary penalties. The data contain 15,407 unique observations of facilities, meaning that, on average, facilities appear in the data 6.59 times. To control for the non-independence of observations, we estimate the regression model utilizing robust standard errors, clustered on facility.

42. The mean of the dependent variable in Table 3 is 1.55 (standard deviation = 2.01; range = 0 to 8). The data used in Table 3 include facilities that were in violation of CAA regulatory requirements, as well as those facilities that were not in violation of CAA regulatory requirements. The data contain 25,282 unique observations of facilities, meaning that, on average, facilities appear in the data 3.93 times. To account for this non-independence of observations, we estimate the negative binomial regression model employing robust standard errors, clustered on facility.

43. The negative binomial regression model (NBRM) is preferable to the OLS regression model given the makeup of our dependent variable. The NBRM is distinct from the most obvious alternative, the Poisson model, in that the NBRM does not make the assumption that the variance is equal to the conditional mean of the dependent variable. Rather, the NBRM estimates a parameter, α, that accounts for the unobserved heterogeneity among observations in the data. In order to test for the appropriateness of the NBRM as compared with the Poisson model, we estimated a log likelihood test for over-dispersion in the data, which indicates that the NBRM is the more appropriate modeling strategy. For a general discussion of the NBRM, see, for example, A. Colin Cameron & Pravin K. Trivedi, Regression Analysis of Count Data 70–77 (1998) (discussing generally the use of the NBRM) and J. Scott Long & Jeremy Freese, Regression Models for Categorical and Limited Dependent Variables Using Stata 372–75 (2d ed. 2005) (explaining the advantages of NBRM compared to the Poisson regression model).

on the environment, in a state that spends $68 per capita, the number of quarters a facility is in violation of the CAA decreases by 0.2 quarters.

Table 3 also indicates that for each one-unit increase in state elite liberalism, the number of quarters a facility is in violation of the CAA increases by 0.2%, all things being equal.

Table 3: Negative Binomial Regression Estimates of the Number of Quarters a Facility Is in Violation of Clean Air Act, 2000–2003

Variable	Coefficient	Δ%[a]
State per Capita Environmental Spending	–.006*** (.003)	–0.6***
State Elite Ideology	–.002*** (.001)	+0.2***
Constant	.513 (.225)	
α	3.98 (.290)***	
Wald χ^2	34,651.06***	
N	99,428	

Entries are negative binomial regression coefficients. Numbers in parentheses indicate robust standard errors, clustered on facility. *** p < .05 (two-tailed tests).

[a] Indicates percentage change in the number of quarters a facility is in violation of compliance with Clean Air Act Regulatory Requirements corresponding to a one-unit change in the independent variable.

Model includes 12 dummy variables controlling for the Air Program Code of the facility, 15 dummy variables controlling for the National Action Type Code of the facility, and 113 dummy variables controlling for the Standard Industrial Code clusters of the facility (results not shown).

Sample includes the following states: Alaska, Arizona, California, Colorado, Connecticut, Florida, Indiana, Kansas, Maryland, North Carolina, New Jersey, New Mexico, New York, Ohio, Oregon, Tennessee, and Texas.

IV. Summary of Empirical Results

Our most important finding is that with regard to the CAA, the more a state spends per capita on its environmental budget, the shorter time a permitted source is in violation of the Act. This finding supports the conclusion that funding of environmental programs plays a very important role in how successful an agency is in avoiding, catching, and/or ending violations.

To the extent that support for cooperative-based enforcement has been premised on accomplishing compliance at a cost savings, we show that "cost savings" in environmental programs are very strongly associated with less compliance, and thus, should be removed as a supporting reason for using more cooperative types of enforcement. While this finding does not reject the idea that cooperative enforcement may assist compliance in some circumstances, or that it can be productively paired with deterrence-based enforcement in certain circumstances,[44] it does indicate that any effective cooperative enforcement that has been used would not have resulted in significant cost savings.

We have also shown that increased state environmental spending translates into better compliance, thus potentially improving the quality of the environment. Unfortunately, with regard to the CWA data, we were not able to show the same correlation because the EPA incorrectly entered the data for the important variable that measures how many quarters a source is noncompliant. We also do not know how splitting environmental budgets into different categories in each state might help in more efficient enforcement. Nevertheless, this result is important.

We also found that for administration of the CWA, the more a state spends per capita on its environmental budget, the higher the fines levied against polluters. Though we cannot make any definitive conclusion about how this relates to noncompliance times, if the CAA results were replicated in the CWA context, it might indicate that higher fines spur compliance, or that higher per-capita-spending states support higher fines.

Our results indicate that facilities are assessed larger fines for violations of the CWA and remain out of compliance with the CAA for shorter periods of time in states governed by conservative political elites. To the extent our other results suggest that cooperative-based enforcement is not particularly effective, this result might seem surprising, particularly if we believe that conservative political ideologies are more likely to be associated with cooperative-based enforcement.

Because we do not know how ideology actually relates to cooperative- versus deterrence-based enforcement, we can draw no real conclusions. However, the CWA finding could suggest that conservative ideologies allow polluters to reach worse violations, which in turn support higher fines. Conversely, the CAA finding may suggest that conservative state ideologies foster better compliance, perhaps through the use of more cooperative methods. It is possible that *adding* the carrot of cooperative schemes for enforcement in certain circumstances to the stick of deterrence-based enforcement may improve results overall.

V. Implications for Enforcement Policy

Resources do matter. For purposes of enforcement policy, this is the most important finding in our research. The strong relationship between per capita spending on state environmental programs and shorter noncompliance times in the CAA across many states of different sizes, environmental challenges, and political governance, demonstrates this. That "resources do matter" means that states cannot adequately do their jobs in enforcing environmental laws without necessary resources.

Our study shows that a lack of spending creates noncompliance rates outside what the American public would

44. Rechtschaffen & Markell, *supra* note 9, at 251–52.

assume or expect for enforcement of environmental programs. Presumably, this implication applies to federal environmental enforcement as well. Coupled with the results demonstrating that more resources lead to higher fines, the study also suggests that deterrence-based enforcement is important in actually creating effective compliance.

The efficacy of cooperative-based enforcement, either alone or in combination with deterrence-based enforcement, is harder to evaluate. We can see that at least during the time of our study, no cooperative-based enforcement was able to successfully produce effective environmental compliance at a significantly lower cost.

The substantive effect of elite ideology is not as strong as the effect of per capita state spending on the environment, but it is provocative. As noted above, it might suggest that some combination of cooperative- and deterrent-based enforcement is the optimal formula. We do know that one cannot get compliance on the cheap and that whether one uses cooperative- or deterrence-based enforcement, one still must spend money to protect the environment.

Data is important to understanding the effectiveness of environmental policies. The other important implication from our four-year study is related to the acquisition and reporting of the data. Though we believe that this study goes further than some previous studies, it does not answer more subtle questions directly. These questions can only be answered by an improvement in the availability of relevant data. For instance, to test the efficacy of cooperative-based enforcement more thoroughly, we would need to procure data from each state about how money in environmental enforcement is spent in each arena.

Of course, it is likely that data problems are themselves related to money spent on environmental programs. According to research done on EPA enforcement by Professor Joel Mintz, budget shortfalls are directly linked to poor data keeping and record collection.[45] According to Professor Mintz, "[W]hen faced with tight budgets, enforcement managers tend to cut record keeping first rather than contract the size and principal responsibilities of their staffs of inspectors, engineers, attorneys, etc."[46]

The time has come for the EPA to tackle this head on. To really understand which state programs promote better compliance, the EPA needs to receive enforcement data and information about resources in a uniform manner. This could be accomplished without impinging on federalism. States can create and operate their budgets in any manner they see fit, but they should be required to report data on delegated programs in a uniform manner. One option could be to require states to organize their data to show how much money was spent on environmental programs, how much went to enforcement, and of that, how much went to different kinds of enforcement. States already have this information, and changing to uniform reporting should not be too difficult.

Although the EPA has moved in the direction of providing more data to the public, the current publicly available database, ECHO, is difficult to use. Moreover, longstanding flaws in the data suggest that there is no effective mechanism to ensure correct reporting and entry of data.[47] Without these corrections, it will continue to be difficult to understand enforcement.

VI. Conclusion

Although our modern environmental programs have been in existence for decades, we have not learned all we need to know about which ways of enforcing these programs work and which do not. In our study, we were not able to put to rest the question of which is "better"—cooperative- or deterrence-based enforcement. In fact, sweeping generalizations may never be possible because most every state conducts its programs in a unique way.

However, we were able to empirically demonstrate that higher per capita spending by states on environmental enforcement programs is strongly associated with better program compliance, and thus, presumably better environmental results. This important finding should spur reexamination of theories about how cheaper enforcement can still provide adequate environmental protection. The study also creates interesting questions regarding state ideology and program effectiveness that will have to wait for more comprehensive data in order to more fully untangle these relationships.

Just as importantly, our study demonstrates the incredible difficulty in answering such questions, primarily because of the lack of data in usable form or the failure to effectively monitor and give attention to the data support systems. Given these ongoing problems in understanding how well environmental programs work, it is difficult to avoid reaching the conclusion that the lack of adequate and uniform data is a partial function of the contentious nature of American politics in which public officials, corporations, and interest groups may profit from this state of affairs. This Article should be a call to action in finally making the EPA compel uniform data reporting or, in the alternative, explain why it should not.

45. *See* E-mail from Joel Mintz, Professor of Law, Nova Southeastern University, to Victor B. Flatt, A.L. O'Quinn Chair in Environmental Law, University of Houston Law Center (Dec. 26, 2008, 2:11 EST) (on file with author).

46. *Id.*

47. *See, e.g.,* 85 Notre Dame L. Rev. 55, 72 n.96 (2009) (describing Clean Water Data, *supra* note 30, and discussing NPDES Data Codebook's incorrect display of numbers for quarters of noncompliance with CWA regulations).