ENVIRONMENTAL JUSTICE IN GOVERNMENT PERFORMANCE? TESTING FOR INEQUITIES IN ENVIRONMENTAL ENFORCEMENT

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Abstract

This paper examines whether state governments perform systematically less environmental enforcement of facilities in communities with higher minority and low-income populations. Although this is an important claim made by environmental justice advocates, it has received almost no attention in the scholarly literature. Specifically, I analyze state regulatory enforcement of three U.S. pollution control laws – the Clean Air Act, the Clean Water Act, and the Resource Conservation and Recovery Act – over the period of 1985-2000. To test for disparities in enforcement, I estimate a series of count models, and find strong evidence across each of the three environmental laws that states perform less enforcement in low-income counties, but no evidence of race-based disparities.

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Introduction

Environmental justice issues have been at the forefront of the environmental policy agenda for nearly two decades. Mass mobilizations of minority groups in the 1980s protesting the siting of hazardous waste and other unwanted land uses in communities such as Warren County, North Carolina and Kettleman City, California garnered widespread attention. A nationwide study by the United Church of Christ's Commission for Racial Justice (CRJ) (1987) brought further awareness to possible environmental inequities. The CRJ study investigated the relationship between the location of hazardous waste treatment, storage, and disposal facilities and poor and minority communities, and demonstrated that as the percentage of these groups increased in communities, so too did the probability of there being a hazardous waste facility in their area.

The growing environmental justice movement led governments at all levels to respond with initiatives to address environmental inequities (real and perceived). At the federal level, the Clinton Administration made environmental justice issues a top environmental policy priority, creating an Office of Environmental Justice within the U.S. Environmental Protection Agency (EPA) and signing Executive Order 12898 which required all federal agencies to address any environmental inequities resulting from their policies, programs, and activities. State and local governments also responded to environmental justice concerns, advancing many initiatives aimed at remedying racial and class inequities in the distribution of environmental hazards.

Scholars have conducted scores of empirical studies evaluating whether areas with larger numbers of minority and lower income populations are disproportionately

subjected to environmental burdens. On balance there is now good evidence to support claims of inequities in both the location of polluting facilities and aggregate pollution levels (Ringquist 2005). Advocates of environmental justice have also claimed that there is bias in government implementation and enforcement of environmental laws. However, scholarly research examining this claim is nearly missing from the literature (Atlas 2001; Lavelle and Coyle 1992; Ringquist 1998 are exceptions).

Regulatory enforcement is a useful context to examine environmental justice. Presumably, if facilities have adequate pollution control strategies in place, risks to adjacent populations should be small (or, at minimum, in accordance with regulatory limitations). To verify such systems are in place, the EPA and state agencies are supposed to regularly inspect facilities and to address any instances of noncompliance. Thus, enforcement is a useful set of measures to use in a study of environmental inequity, since the location of facilities will matter only to the extent to which government agencies effectively (and equitably) enforce pollution control laws.

The objective of this paper is to test whether there are racial- and/or class-based disparities in government enforcement of environmental laws. I evaluate the pattern of state government enforcement of three federal pollution control programs – the Clean Air Act (CAA), the Clean Water Act (CWA), and the Resource Conservation and Recovery Act (RCRA) – over the period from 1985 to 2000. Specifically, I examine state enforcement behavior at the county level, using a series of count models to test whether states conduct less enforcement in counties with higher minority and low-income populations.

The paper makes several additional contributions to the environmental justice literature. First, much of the current literature only considers a single environmental program (Hird and Reese 1998 is a noteworthy exception) or a single type of facility, with hazardous waste facilities being the archetype. In fact, many studies have examined only a small number of facilities (400-500). More recent work has extended the analysis of environmental equity concerns to all facilities emitting toxic substances, but the analysis here has even a broader temporal and substantive focus. I consider state enforcement of hundreds of thousands of facilities (of which RCRA hazardous waste facilities and TRI facilities are a subset) under the three primary U.S. pollution control programs over the period of 1985-2000. Second, the extant literature is largely cross-sectional. Most of the work in this literature considers a single time period,[1] which can be problematic if there are unaccounted for temporal changes within jurisdictions. The panel structure of the data analyzed here enables examination of cross-sectional variation as well as variation within areas over time.

To summarize the results, I demonstrate strong evidence that states conduct fewer regulatory enforcement actions in counties with higher levels of poverty. This finding is robust across the CAA, the CWA, and the RCRA, and the effects are significant, ranging from about 2% to 6% reduction in the amount of enforcement for each percentage increase in poverty. The results are similar for median household income in counties in the case of the CAA and the RCRA. There is no evidence, however, of racial disparities in state regulatory enforcement. Controlling for income levels, the percentage of minorities in the county does seem to have an effect on enforcement patterns.

The balance of the paper proceeds as follows. In the next section I review the existing environmental justice literature, and discuss the few studies that have directly considered government enforcement. I then describe the data I analyze and the empirical approach. Subsequently, I report the results of the analysis. I conclude with a discussion of the implications of my findings and areas for future research.

Environmental Justice Literature

The scholarly literature examining potential race- and class-based environmental inequities has proceeded in primarily two empirical directions. First, researchers have examined whether polluting facilities are disproportionately located in minority and low-income neighborhoods. Although the context and data for these studies vary, they share a common research design. Scholars typically examine the correlation between the presence of a facility handling hazardous materials or emitting pollution and the racial and class composition of the surrounding population. The more sophisticated studies rely on multivariate regression to analyze the probability of a site being located in a high-minority or low-income area, relative to a predominantly non-minority or higher income area. Building on the work of the CRJ (1987), numerous researchers have demonstrated positive correlations between areas with high-minority and low-income populations and the location of commercial hazardous waste facilities (e.g., Been 1995; Been and Gupta 1997; Bullard et al. 2007), federal Superfund sites (Hamilton and Viscusi 1999; Hird 1993, 1994; Zimmerman 1993), and sources of toxics and other pollution (e.g., Atlas 2002; Cutter et al. 1996; Ringquist, 1997; Pollack and Vittas 1995). The evidence is not uniform (Anderton et al. 1994; Davidson and Anderton 2000; Hamilton 1995), but on

balance supports a conclusion that facilities imposing or potentially imposing environmental harms are disproportionately located in minority and low-income areas.

The second direction of empirical work on environmental inequities examines the potential linkage of pollution levels and exposure to minority and low-income groups. This is an important extension of the location studies, since the location of facilities only matters to the extent to which it leads to increased environmental risks (or potential risks). Several studies have found that minority and low-income communities are exposed to higher levels of air and water pollution than are lower-minority and higher-income communities (Asch and Seneca 1978; Ash and Fetter 2004; Hird and Reese 1998; Pastor et al. 2006; Sexton et al. 1993). Scholars have also examined the distribution of toxic emissions using data from the U.S. Toxic Release Inventory. Here, too, there is growing evidence of at least modest race- and class-based inequity in the location of these releases (Daniels and Friedman 1999; Downey 1998; Lester et al. 2001; Perlin et al. 1995; Pollock and Vittas 1995), although Holmes et al. (2000) find some evidence to the contrary.

While there is accumulating evidence of disproportionate race- and class-based environmental burdens in the areas of facility location and pollution levels, there exists very little empirical research testing for such inequities in government implementation and enforcement of environmental laws and regulations. Of the forty-nine studies Ringquist (2005) examined in a meta-analysis of the environmental justice literature, *none* considered inequities in government performance.

Yet, the grassroots environmental justice movement has made explicit claims that environmental inequities are due, not just to the decision of private actors (e.g.,

companies making siting decisions), but also government behavior. Robert Bullard, one of the leading voices of the movement, has suggested that "environmental racism" extends to the enactment and enforcement of environmental and land use regulations (Bullard 1993). Writing with a colleague, Bullard has noted that: "From New York to Los Angeles, grassroots community resistance has emerged in response to practices, policies, and conditions that residents have judged to be unjust, unfair, and illegal. Some of these conditions include (1) unequal enforcement of environmental, civil rights, and public health laws . . ." (Bullard and Johnson, 2000 p.557). Collins (1993 p.111) also suggests that environmental racism encompasses government enforcement, defining the concept as "race-based discrimination in environmental policy making; race based-based differential enforcement of environmental rules and regulations . . ."

To date, three studies directly consider environmental justice concerns in the context of government behavior.[2] In each study, scholars have examined civil judicial enforcement actions, and specifically, the amount of civil penalties levied as part of federal district court decisions from litigation in response to violations of federal environmental laws. Lavelle and Coyle (1992) found sizeable differences in average fines with regard to both race and class – that is, levels of fines were lower (on average, by approximately $50,000) in high minority and poor areas around violating facilities. This result was widely-cited by environmental justice advocates and received considerable media coverage, but subsequent work by Ringquist (1998) and Atlas (2001) strongly rejected the Lavelle and Coyle's core findings. Each of these studies used multivariate analysis to control for factors related to penalty amounts omitted in the Lavelle and Coyle study, and found only negligible and generally statistically

insignificant differences in court outcomes based on the demographic and socioeconomic composition of the area in which the violating facility was located.

As Ringquist (1998) points out, however, despite findings that federal district court outcomes are not biased against poor and minority communities, there may still be disparities at other stages of the environmental regulatory enforcement process. These disparities may include fewer inspections and less stringent responses to instances of noncompliance. Moreover, less stringent enforcement of facilities in poor and minority areas may, in part, help explain higher observed levels of pollution in these communities. This paper analyzes these earlier stages of the enforcement process.

What might explain racial- and class-based distributional inequities in environmental burdens? In the context of facility siting decisions (and, by extension, aggregate pollution levels), there are four common explanations.[3] The first explanation is intentional discrimination. Some in the environmental justice advocacy community suggest that minority and low-income communities face disproportionate environmental risks due to deliberate decisions made by private and public actors (Bullard and Johnson 2000). There are a couple of case studies that reveal instance of intentional discrimination (Pellow 2002), but it has not been empirically demonstrated on a large scale.

A second explanation is that siting decisions are based on market conditions, most notably factors such as inexpensive land, cheap labor, access to transportation and other infrastructure. To the extent to which companies are more likely to find these desirable locational factors in areas with larger minority and low-income populations, this might explain the disproportionate siting of locally unwanted land uses such as hazardous waste

landfills and storage facilities. If this is the case, correlations between race and class and facility location would be spurious. Many empirical studies, however, have found race- and class-effects, even after controlling for economic factors.

Neighborhood transition is a third possible reason that polluting facilities are more likely to be located in minority and low-income communities. This explanation holds that companies originally located their facilities in urban, working-class communities for the types of economic factors discussed above. Over time, the presence of these facilities led to declines in property values, and as wealthier individuals moved to suburban areas, they were replaced by poor or minority groups. Sorting out the sequencing inherent in the neighborhood transition explanation is difficult since it first requires historical data on neighborhood characteristics at the time firms made facility siting decisions, and second information on alternative locations that the firm considered. A few studies have compiled such data with mixed results (Been and Gupta 1997; Oakes et al. 1996; Pastor et al. 2001; Saha and Mohai 2005).

Last, a fourth reason why there might be racial- and/or class- based inequities in environmental burdens is based on the logic of collective action. Communities with high levels of political capacity (i.e., wealth, education, group organizational skills) are more likely to overcome free rider problems and mobilize against the siting of locally unwanted land uses. Firms interested in locating a hazardous waste facility in a community, for example, will assess the likelihood that residents of that community will engage in collective action in opposition. Minorities and low-income individuals tend to have less of these political resources, and tend to participate less in the political process (Rosenstone and Hansen 1993). Studies not accounting for these political resources may

be ascribing effects to race and class which actually reflect political capacity. A few studies have demonstrated that political mobilization resources are correlated with lower pollution levels (Hird and Reese 1998), decisions by companies about where to locate new facilities or where to expand capacity at existing locations (Hamilton (1993, 1995), and with the environmental cleanup decisions (Hamilton and Viscusi 1999).

In the context of regulatory enforcement, two of these explanations are most relevant. The problem of collective action is just as pertinent. To the extent that government behavior is affected by the political capacity of potentially affected populations, enforcement might be less in areas with high-minority and low-income populations. Specifically, government may consider the potential of community residents to respond in opposition to lax regulatory enforcement. For this reason, I include controls of community political resources in the analyses that follow to capture this alternative explanation. Intentional discrimination is also a possibility. It is plausible that public officials deliberately perform less enforcement of facilities located in minority and low-income jurisdictions. Detecting such behavior, however, requires information about individuals' motivations and decision-making that is in almost all cases unobservable.

Research Design

The empirical strategy in this paper is to examine the pattern of state environmental regulatory enforcement to determine whether states perform less enforcement in areas with comparatively higher minority and low-income populations. For reasons discussed below, I examine state enforcement at the level of counties. Several studies in the literature test for race- and/or class-based environmental inequities

at the county level, with mixed results. A few studies examine aggregate pollution levels. For example, Hird and Reese (1998) demonstrate that counties with more racial and ethnic minorities face disproportionately higher levels of pollution, but find some evidence that counties with higher income also face higher aggregate pollution levels. Perlin et al. (1995) and Lester et al. (2001) also find that counties with more minorities confront higher levels of TRI emissions, but have inconsistent results regarding class inequities. Several studies also consider the location of polluting facilities. Hird (1993) considers the location of federal Superfund sites and finds that these sites tend to be located in counties with larger minority populations, but that they also are more likely to be in counties with higher average incomes and lower poverty.[4] Bowman and Crews-Meyer consider the location of hazardous waste treatment, handling and storage facilities in a set of southern states, finding little evidence of race and income disparities (Bowman and Crews-Meyer 1997).

One of the reasons for the mixed results summarized above may reflect studying the county-level as the geographical scale. Testing for disparities in environmental regulatory enforcement at the county-level does have several disadvantages. First, counties are unequal in geographic size which means at times comparing large rural areas with small urban areas. Second, there may be significant within county heterogeneity in enforcement patterns that cannot be disentangled. Third, county-level analysis neither accounts for the exact location of the hazards within jurisdictions (i.e., the location of facilities), nor the proximity of affected populations to these hazards. Scholars have developed more precise distance-based methods to better link hazards to affected populations (Mohai and Saha 2006), but there is not sufficient data on the hundreds of

thousands facilities regulated under the CAA, the CWA, and the RCRA considered in this study to adopt this methodology.[5]

Notwithstanding these limitations, a county-level analysis is necessary due to limitations in EPA enforcement data. The facility location information contained in the EPA enforcement data is often incomplete when available, and sometimes missing altogether.[6] The difficulty of linking hazards to specific populations, moreover, is less of a concern in this study. Unlike traditional environmental justice analyses, I am not making direct claims about the environmental risks associated with either the location of hazardous facilities or pollution levels. Rather, I am examining the pattern of government behavior across different jurisdictions, to test whether state agencies enforce environmental laws less in areas with higher percentages of minorities and low-income populations.

Dependent Variables

To test the claims of race- and class-based inequities in government enforcement of environmental laws, it is necessary to have direct measures of government performance. I analyze data on state enforcement of three federal pollution control programs: the CAA, the CWA, and the RCRA. State regulatory enforcement of these programs is the appropriate level of analysis for several reasons. First, each of these programs is designed within a model of regulatory federalism and partial preemption, under which the EPA generally establishes national regulatory standards and defines the procedures by which these standards are to be implemented. States are then invited or required (depending on the statute) to develop regulatory programs that are at least as

stringent with federal standards as a condition for being delegated the authority to implement the program within their borders. All states currently have authority to enforce the CAA, while the EPA has delegated authority to nearly all of the states to run the CWA and the RCRA programs. Second, although EPA guidance to the states attempts to mandate uniform enforcement procedures, state enforcement varies considerably due to the discretion states have to determine how they want to implement the federal programs (Sigman 2003).

The dependent variables I consider are the unweighted sums of actions taken by authorized state environmental agencies to enforce the federal laws. I compiled these data from the EPA's Integrated Database for Enforcement Analysis. For each program, I sum the annual number of inspections and other compliance monitoring activities, informal enforcement actions such as phone calls, written letters, and official notifications of violation, and formal enforcement actions to move violators back into compliance such as administrative orders, consent decrees, and civil penalties. I consider all facilities regulated under the CAA and the RCRA, whereas for the CWA I only consider major dischargers that are currently active. I present descriptive statistics for these variables and the other measures I consider in Table 1.

The unit of analysis, therefore, is a county-year, and I analyze the time period from 1985 to 2000. The actual number of observations varies by each county for a couple of reasons. First, I only include counties in the states for which the EPA had delegated authority to implement the program. Second, in the case of the CWA and the RCRA, there are not data available on the total number of regulated facilities so I only consider state enforcement behavior for the counties that had a facility (i.e., counties for

which there was a non-zero probability of observing an enforcement action). In the case of the CAA, I consider all counties since the EPA does not maintain a record of the number of facilities falling within the jurisdiction at any given time. As explained below, I address the fact that some counties may have had no state enforcement actions simply because there are no facilities through statistical modeling.[7]

Measuring Race and Income

I measure the racial composition of each county in a couple of ways, using data compiled by the U.S. Census Bureau. First, I consider the percentage of the county population that is nonwhite. I then separately consider the percentage of the African-American and Hispanic population in the county to evaluate whether there are differential effects across these specific groups. The primary measures of county-level income I use are the percentage of the county population living below the poverty line and the median household income.[8] The hypotheses consistent with claims of race- and class-based inequities in environmental regulatory would suggest a negative relationship between percent poverty and percent minority and state enforcement and a positive relationship between median household income and state enforcement.

One of the challenges of studying counties is the lack of annual data. Detailed data are available for decennial years, and although the Census Bureau does compile estimates on some measures for intra-census years, the lack of annual data necessitates creation of estimates for missing years. I use linear interpolation to impute the racial and income indicators, which makes the assumption that changes in between decennial censuses are linear and occur at equal annual increments. This may be a source of

measurement error, but any bias will be toward a null finding so any effects of race and income on government enforcement will be understated.

Control Variables

I consider two sets of control variables that are frequently used in environmental justice studies. The first set of variables measure the political capacity of county residents. As noted above, there is some evidence to suggest that communities with more political capacity face fewer environmental burdens (Hamilton 1993, 1995; Hamilton and Viscusi 1999; Hird and Reese 1998). I include three measures of political capacity: voter turnout, levels of education, and levels of home ownership.[9] To measure voter participation I use the percentage of the county of voting-age population that voted in the preceding presidential election.[10] To control for varying levels of education, I include a variable measuring the percentage of the county population twenty-five years and older that has at least a college education. Finally, to capture levels of home ownership, I include the percentage of housing units in the county that are owner-occupied. The expectations are that state environmental regulatory enforcement will be greater in counties that vote more often, have better educated residents, and have higher levels of home ownership, since these counties are comparatively more able and more likely to overcome collective action problems to mobilize politically to demand government action.

The second set of control variables is contextual. County economies differ in important ways that will influence the level of state enforcement. Most notably, counties vary in their types of economy from those that are primarily rural and agricultural to

those that are primarily urban and manufacturing and/or service-oriented. To account for these differences, I include a measure of the percentage of the county labor force employed in manufacturing positions. In addition, to account for basic differences in county demographic patterns, I include measures of population density, land area, and population.[11]

In the analyses of the CAA, I also control for the nonattainment status of the county and for whether the county is located on the border of another jurisdiction. The CAA requires that states perform more stringent enforcement in counties failing to meet ambient air quality standards for criteria air pollutants (particulate matter, ground-level ozone, carbon monoxide, sulfur dioxide, nitrogen oxides, and lead), and each year the EPA designates each county as being in either attainment or nonattainment with these standards (there is no regulatory analog to nonattainment status in the case of the CWA or the RCRA).[12] To control for annual, county nonattainment status, I include a dummy variable coded one if the county is in nonattainment for any one criteria air pollutant and zero otherwise. I also control for whether a county is located next to another political jurisdiction (state or country) or an ocean or a Great Lake. Previous research has shown that states have incentives to perform less enforcement in areas in which they can export pollution to neighboring areas (Helland and Whitford 2003; Konisky and Woods 2007).

Because EPA oversight of state enforcement varies considerably, it is also necessary to include a measure of EPA monitoring activity. A common approach which I adopt here is to include a lagged value of the number of EPA inspections. For each program, I include a variable measuring the number of oversight inspections the EPA

performed in the county in the previous year, with the expectation that more federal oversight would lead states to conduct more enforcement actions in the current year.

Last, I include state fixed effects to capture any state-level, time-invariant factors that influence enforcement behavior across the sixteen year time period.[13] I also cluster the standard errors at the state level, since county observations are unlikely to be independent within each state. Specifically, states have different orientations toward enforcement which will influence their enforcement strategy across the counties. I also include year fixed effects to capture any national-level time trends in enforcement patterns.

Count Models

I estimate several different count models to analyze the effects of county racial and class composition on state environmental regulatory enforcement. These models are appropriate because the enforcement data are counts (i.e., the number of inspections; the number of punitive actions) and take only discrete and non-negative values.[14] In the cases of the CWA and the RCRA, I use a negative binomial regression model (NBRM). The NBRM model is preferred to the Poisson regression model (PRM) because it is not possible to assume the independence of observations within each county; it is possible (in fact, likely) that state inspections of a facility lead to more/less inspections of the same facility in a given year as well as follow up punitive actions when an inspection uncovers a violation. Moreover, each of the dependent variables indicates overdispersion, which violates the assumption of the PRM that there is equality between the conditional variance and the conditional mean.[15]

In the case of the CAA, I use a zero-inflated negative binomial regression (ZINB) which is appropriate because it accounts for the two reasons that we might observe zero counts with these particular enforcement data. Dissimilar to the CWA and the RCRA, I neither have data on all CAA-regulated facilities, nor do I have a high quality estimate of the number of facilities falling under the jurisdiction of this federal environmental statute.[16] Therefore, we only observe government behavior at facilities at which there has been an enforcement action. As a result, counties with no enforcement actions in a year may reflect truly no state enforcement of regulated facilities, or alternatively counties that have no facilities regulated by the pollution control program (i.e., there is a zero probability of enforcement). The ZINB specification explicitly models each reason we might observe no enforcement,[17] and the Vuong (1989) test indicates that the model is more suitable for these data than a single equation negative binomial model that fails to account for the multiple processes for generating zeros. (In the results summarized below, I do not report the inflation model.)

Results

To assess the effects of the race and income on state environmental regulatory enforcement, I estimate two models for each of the three federal environmental programs. The first models consider the income measures and the percentage of the county population that is nonwhite, whereas the second models consider the percentage of the county population that is African-American and Hispanic, specifically. As the results below demonstrate, measuring the racial composition of the counties in each of these two ways does not change the principal findings.

The results across the three programs are quite similar. In this analysis, I am mostly interested in the effects of race and class, since these are most relevant for environmental justice concerns, but I will discuss other covariates when interesting systematic relationships appear. In Table 2, I report the coefficients from the count models, but because of the nonlinearity of the count specifications, it is not easy to interpret the coefficients beyond overall directions of relationship and statistical significance. I say more about the magnitude of the effects below.

Considering first the ZINB models of state enforcement under the CAA, there is strong evidence that enforcement declines as the percentage of the county population below the poverty line increases. The relationship between median household income and state CAA enforcement is also consistent with an environmental inequity hypothesis. As the median household income of the county increases, so too does the number of enforcement actions performed by the state, which suggests that there is more enforcement of the CAA in wealthier counties. In each of the CAA models, the percentage of minority residents in the population is not related to state enforcement patterns.[18]

The control variables generally support the expected relationships, with the exception of the measures of political resources in the county. Voter participation rates and the percent of the county population with a college education do not affect levels of state enforcement when controlling for race, income and other county-level factors, and the percentage of home ownership reflects an unanticipated relationship – the number of state enforcement actions decreases as home ownership increases. Several of the demographic controls help explain state CAA enforcement effort as does the

nonattainment status of the county, whether or not the county borders another jurisdiction, and level of federal oversight inspections in the prior year, with the latter three all indicating positive relationships.

Turning next to patterns of state enforcement under the CWA, the results are similar but not identical to the CAA program. Again, there is a strong relationship between poverty and state enforcement – controlling for other county-level phenomena, states conduct less enforcement of facilities in counties with more residents below the poverty line. Dissimilar to the CAA models, there is a negative relationship between median household income and state CWA enforcement – that is, as median household income increases, there is less state enforcement of water pollution regulations. This finding is contrary to expectations and works against the results for poverty. One possible explanation is that studying enforcement patterns at the county-level may mask potentially important within-county variation. Specifically, there may be concentrations or pockets of poverty in particular geographical sections of counties, while the remaining parts of the county have above average household incomes. An example might be a large county that has both a poor inner-city and wealthy suburban areas. Because it is not possible to precisely locate facilities within counties, we are limited to aggregate level inferences, which may produce these contradictory results.

State enforcement of the CWA does not appear to be related to the racial composition of counties, controlling for income and other factors. This result holds both when measuring minorities in terms of the percentage of the county population that is nonwhite, and when considering the percentage of African-Americans and Hispanics separately. (When this model is estimated with the income measures omitted, each of the

coefficients on each of these measures is negative and statistically significant.) The control variables in the CWA models have similar effects as in the CAA models reported above. The primary difference is that number of facilities with NPDES permits is positively associated with the total number of state enforcement actions..

Tests of the principal environmental justice hypotheses suggest a similar pattern for state enforcement of the RCRA. The results for the indicators of county level income closely reflect the results for the CAA models. Percent poverty and median household income have effects consistent with the argument that there are class-based inequities in government enforcement. States perform systematically fewer inspections and punitive actions in counties with higher percentages of residents living in poverty. In addition, median household income levels are positively associated with levels of enforcement; facilities in counties with higher household incomes receive more enforcement attention from state environmental agencies than do counties with lower household incomes. Once again, there does not appear to be relationship between race and state regulatory enforcement of the RCRA, once controlling for income. This result, consistent across all three federal pollution control programs, undermines claims of racial bias in government enforcement of federal environmental laws.

The results with respect to the control variables are generally consistent with the results for the CAA and the CWA. One noteworthy difference is the finding for voter turnout. Counter to expectations, higher levels of voter participation in the preceding presidential election were associated with less state enforcement of the RCRA. Although this result was not robust across the three programs, when considered collectively with the negative relationship between home ownership and enforcement, there is little

evidence in these analyses to support the argument that political capacity leads counties to get more enforcement from state environmental agencies. This finding conflicts with those of Hamilton (1993, 1995), Hamilton and Viscusi (1999) and Hird and Reese (1998), each of whom found results to the contrary. It is possible that measures of turnout, college education, and home ownership only measure potential political capacity, and it may be the case that counties with these resources have not utilized them to demand more regulatory enforcement of these programs from their states.

What is the degree of the class-based effect on state regulatory enforcement? Because of the nonlinearity of the models, the coefficients reported in Table 2 are difficult to interpret in terms of the magnitude of the effects. To facilitate such an analysis, I have converted the coefficients into substantively meaningful quantities in Table 3. The first column in this table shows the percent change in the expected number of annual state enforcement actions in a county for each unit change in the covariate, holding all of the other variables at their means. The second column expresses this percentage change in terms of a standard deviation change.

The data presented in the top panel of Table 3 show that the effects of poverty on state enforcement are sizeable. For each percentage increase in county poverty, there is 2.4% decrease in the number of actions conducted by states to enforce federal clean air regulations. When considered in terms of a standard deviation shift, this equates to a 16% decrease in the number of actions conducted. The effects are about the same for the CWA, but much larger on state enforcement of the RCRA. For each percentage increase in poverty in the county, there is a 5% to 6% decrease in the amount of enforcement effort by the state, which amounts to a 35% decrease for a one standard deviation change.

The effects of median household income are even more substantial. For each increase (decrease) of $1,000 in median household income, there is 3.3% increase (decrease) in the number of state CAA. For a one standard deviation change, this amounts to a 32% difference. The magnitude of the effect is the same for the RCRA. With respect to the CWA, for each increase (decrease) of $1,000 in median household income, there is about a 1% decrease (decrease), which comes to about a 10% to 11% for a one standard deviation change in county income levels.

Figures 1 and 2 graphically represent the effects of poverty and median household income on state enforcement, by considering the relationship across the full distribution of these variables (again, holding the rest of the variables at their means). Figure 1 clearly demonstrates the sharp decline in the predicted number of state enforcements as the percentage of county population living in poverty increases. Bearing in mind that the mean number of enforcement actions at the county-level are about 14, 2, and 8 for the CAA, the CWA, and the RCRA, respectively, the drop in predicted enforcements for high-poverty counties compared to low-poverty counties is substantial. Figure 2 shows the even larger substantive effect of median household income. There is a sharp increase in the predicted number of state enforcement actions under the CAA and the RCRA as a county's median household income rises, particularly for very wealthy counties.

Conclusion

The analysis presented in this paper represents the first large-scale assessment of whether class- and race-based disparities in environmental protection extend to government behavior, and in particular regulatory enforcement. I find clear evidence that

state enforcement behavior is strongly associated with class at the county-level, but there does not appear to be a similar relationship between enforcement and race. These findings are consistent across three of the primary U.S. pollution control programs over a sixteen year period. These findings conflict with much of the extant literature on environmental justice, which has demonstrated a clear relationship between race and the location of hazardous and other polluting facilities and aggregate pollution levels. While the findings in this paper are robust, they should be interpreted with caution. It is distinctly possible that studying state regulatory enforcement patterns at the county level is masking race effects, which may still exist at smaller geographical scales.

For this reason, this analysis represents just a first step in evaluating class- and race-based inequities in government enforcement behavior. Data constraints limited this study to the county-level, which required reliance on the unit-hazard coincidence method. Although this is the method traditionally employed in environmental justice studies, some have argued that is may understate minority and income disparities in environmental burdens (Mohai and Saha 2006), and there is some recent empirical evidence to suggest that this might be the case (Bullard et al. 2007). The next step in this research is to estimate more precisely the relationships between enforcement and race and class, using distance-based methods to identify the composition of populations most proximate to the facilities. This type of analysis will require examining state enforcement for a smaller set of facilities, since it requires the correct geo-coding of facility location. Such an analysis will answer questions about whether the patterns found in this paper hold when moving down to smaller geographical scales.

In addition, the class-based disparities identified here in state regulatory enforcement of the CAA, the CWA, and the RCRA, do not tell us anything about how enforcement patterns have changed over time. Specifically, many policies were put in place during the 1990s by the federal government and state and local governments to remedy inequities. Were these initiatives successful? Future studies should investigate the efficacy of these initiatives.

The answers to these questions are important. After two decades, environmental justice remains as one of the most salient items on the environmental policy agenda. Past research as shown that poor and minority communities often face disproportionate environmental risks, but robust evidence that these risks stem (if even only in small part) from differential government enforcement of environmental laws and regulations, adds a new dimension to the problem. Environmental injustices would no longer be only a matter of private sector decision-making, but also a matter of government behavior.

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Table 1. Descriptive Statistics

Variable	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
CAA enforcement	13.6	34.3	0	1272
CWA enforcement	1.72	5.72	0	352
RCRA enforcement	8.22	22.7	0	553
% Poverty	15.8	7.35	2.12	63.1
Median household income ($1000s)	26.8	8.63	7.63	82.9
% Nonwhite	14.9	16.5	0	95.0
% Black	8.66	14.4	0	86.1
% Hispanic	4.93	11.3	0	98
% Voter turnout	57.3	10.7	2.58	99.8
% College educated	9.88	4.54	1.82	43.3
% Owner occupied housing	73.3	7.59	12.9	89.9
No. Manufacturing establishments	118.8	499.9	0	19898
No. NPDES major dischargers	2.97	3.46	1	158
No. RCRA facilities	207.6	653.3	1	18198
% Manufacturing employment	22.0	16.7	0	93.1
Population ($1000s)	81.3	272.3	0.354	9519
Land area (sq. miles)	950.7	1301.2	2	20064
Population density	223.0	1529.3	0.271	67346
Nonattainment status	0.132	0.339	0	1
Border county	0.457	0.498	0	1
EPA CAA inspections$_{t-1}$	0.241	1.26	0	54
EPA CWA inspections$_{t-1}$	0.115	0.848	0	64
EPA RCRA inspections$_{t-1}$	0.346	2.78	0	149

n = 49,248. The actual number of observations in the analyses varies by program. The data presented here for the variable appearing in all of the models are for the case of the CAA, where there are 3078 counties measured over 16 years.

Table 2. Count Models of State Enforcement Actions, 1985-2000

	Clean Air Act (ZINB)		Clean Water Act (NBREG)		RCRA (NBREG)	
	(1)	(2)	(3)	(4)	(5)	(6)
% Poverty	-0.024*	-0.025*	-0.022**	-0.023**	-0.058**	-0.059**
	(0.011)	(0.010)	(0.009)	(0.008)	(0.011)	(0.011)
Median household	0.032**	0.031**	-0.012*	-0.013*	0.031*	0.032*
income ($1000s)	(0.010)	(0.011)	(0.007)	(0.007)	(0.013)	(0.013)
% Nonwhite	-0.003		-0.003		0.003	
	(0.004)		(0.003)		(0.003)	
% Black		-0.002		-0.004		0.005
		(0.004)		(0.003)		(0.004)
% Hispanic		-0.002		-0.002		0.002
		(0.003)		(0.003)		(0.004)
% Voter turnout	-0.003	-0.003	0.001	0.001	-0.026**	-0.026**
	(0.004)	(0.004)	(0.003)	(0.003)	(0.005)	(0.006)
% College	-0.018	-0.018	0.004	0.004	0.023	0.023
educated	(0.013)	(0.013)	(0.008)	(0.008)	(0.014)	(0.014)
% Owner occupied	-0.051**	-0.050**	-0.019**	-0.019**	-0.070**	-0.069**
housing	(0.007)	(0.007)	(0.004)	(0.004)	(0.008)	(0.008)
No. Facilities	-0.000	-0.000	0.186**	0.186**	0.000*	0.000**
	(0.000)	(0.000)	(0.018)	(0.018)	(0.000)	(0.000)
% Manufacturing	0.005*	0.005†	0.004*	0.004*	0.018**	0.001**
employment	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)
Population (1000s)	0.002**	0.002**	-0.000**	-0.000**	0.002*	0.002*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Land area (sq.	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
miles)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Population density	-0.000*	-0.000*	0.000**	0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Nonattainment	0.505**	0.504**				
status	(0.100)	(0.100)				
Border county	0.117**	0.117*				
	(0.045)	(0.046)				
EPA inspections$_{t-1}$	0.122**	0.121**	0.058**	0.058**	0.051	0.051
	(0.019)	(0.019)	(0.012)	(0.011)	(0.053)	(0.053)
n	49248	49248	25634	25634	43431	43431
Log likelihood	-147219.4	-147223.2	-43936.7	-43936.0	-102284.0	-102275.9
Chi-square (d.f.)	39173.7**	39166.1**	15644.0**	15644.0**	28622.5**	28678.7**
	(79)	(80)	(26)	(27)		
Vuong test	29.2**	29.1**				

All models include state and year fixed effects, with standard errors clustered at the state level. Significance levels: † p<.10, * p<.05, ** p<.01.

Table 3. Estimated Effects of Class on State Environmental Enforcement

Program	***Percent Change***	***Percent Change for Standard Deviation Change***
Percent Poverty		
Clean Air Act	-2.4	-16.0
Clean Water Act	-2.2	-13.5
RCRA	-5.6	-35.0
Median Household Income		
Clean Air Act	3.3	31.9
Clean Water Act	-1.2	-10.5
RCRA	3.2	31.7

Figure 1. Effect of Poverty on State Enforcement Actions

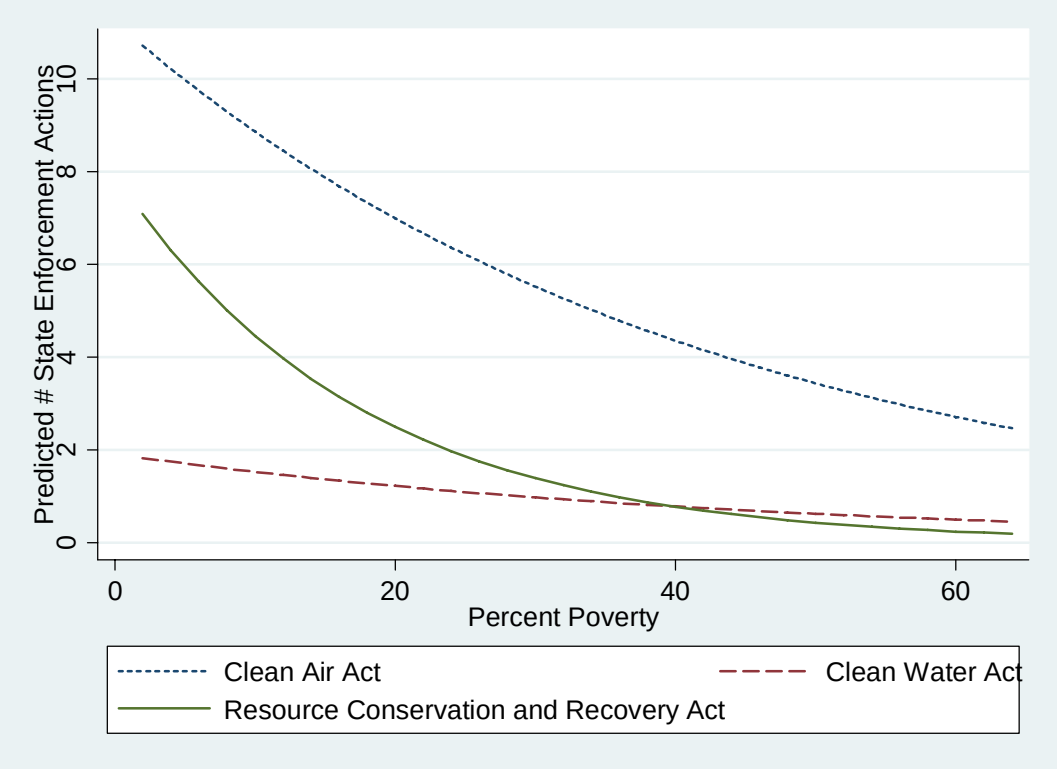
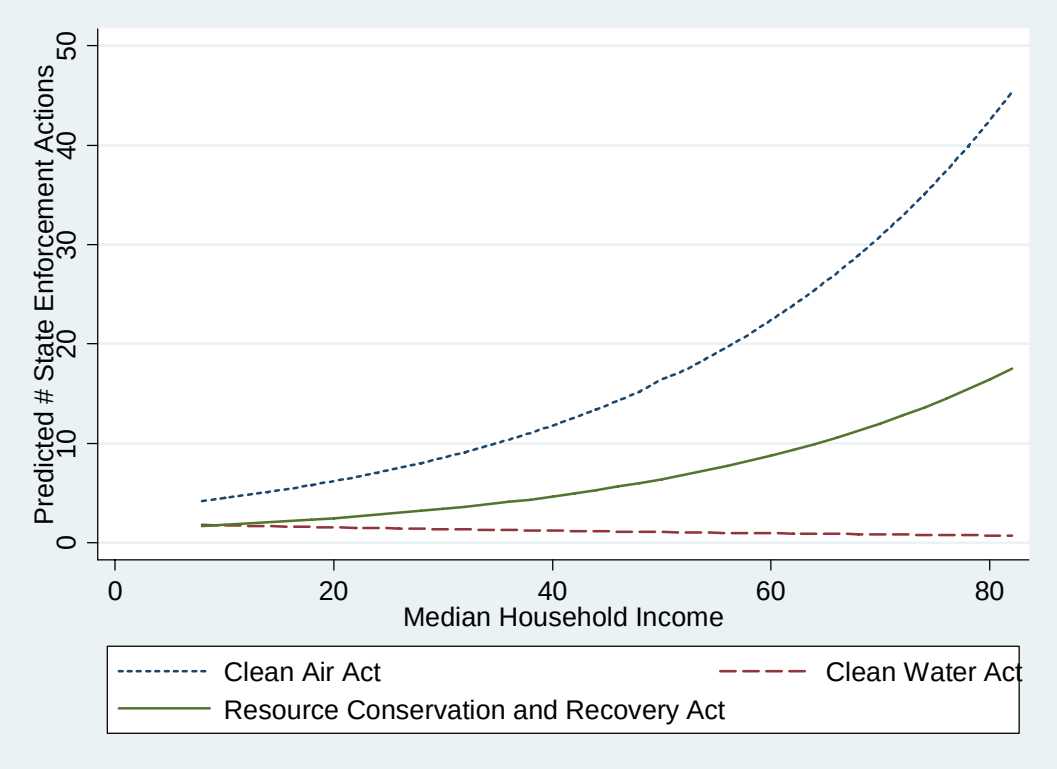


Figure 2. Effect of Median Household Income on State Enforcement Actions



Notes

[1] There are a few notable exceptions. Been and Gupta (1997), Oakes et al. (1996), Pastor et al. (2001), and Saha and Mohai (2005) each examine the neighborhood transition hypothesis to sort out whether present disparities in facility siting are due to historical patterns of disproportionate siting, or changes in community demographics after facilities have been sited.

[2] Gray and Shadbegian (2004) found government performed more CWA inspections and less punitive enforcement actions at 400 pulp and paper facilities located in poor communities (and the opposite for facilities in communities with large numbers of minorities), but their study did not focus on environmental justice issues.

[3] Ringquist (2006) provides a nice summary of the main explanations for possible race- and class-based disparities in environmental burdens.

[4] This latter result is not entirely surprising. Communities often want polluted sites to be added to the federal Superfund National Priorities List (NPL), since they then become eligible for public funding for remediation. In addition, the federal EPA actively pursues potentially responsible parties to recoup cleanup costs, saving the states the costs of such legal action.

[5] Distance-based methods require that facilities can be precisely located in space, which requires longitude and latitude data. Although, the database from which I compiled the enforcement data – the Integrated Database for Enforcement Analysis (IDEA) – does contain some longitude and latitude data, these fields in the database are not well-populated. The EPA is beginning to make such data available, but currently there are only data for a small universe of facilities regulated under federal environmental statutes.

[6] In fact, just getting county-level information was a significant challenge for facilities regulated under the CWA and the RCRA. The data I compiled from the IDEA system did not contain county identifiers. In the case of the CAA, the county FIPS code was embedded within facility identifiers. In the case of the RCRA program, I was able to match facilities in the IDEA dataset with facilities in a separate EPA database (Locational Reference Database). In the case of the CWA, I located facilities by merging the facilities in the IDEA dataset with those in recently released EPA geospatial data, but this was only possible for major dischargers, which tend to facilities with large amounts of effluent.

[7] I also exclude a small number of counties for which there were missing data.

[8] Some environmental justice studies also include a measure of unemployment. The U.S. Bureau of Labor Statistics has county level data beginning in 1990, but their data prior to this year are no longer official and are not consistent with the more recent time series.

[9] Jim Snyder provided the data on the presidential vote, while I compiled data on college education and home ownership from the U.S. Census Bureau.

[10] To estimate a county's voting age population, I used census data on the number of county residents that were 18 years and older.

[11] I compiled the manufacturing data from the U.S. Bureau of Economic Analysis, and the other data from the U.S. Census Bureau.

[12] The EPA can designate a whole county or part of a county as being in nonattainment. In this paper, we code partial nonattainment counties as being in nonattainment.

[13] I do not use county fixed effects in the models, since their inclusion would likely wipe out the effects of the key explanatory variables due to their slow rate of annual change.
[14] OLS regression of count data is inappropriate because it will generate negative predicted values (King 1988; Long 1997).
[15] Likelihood ratio tests of the alpha parameters also indicate overdispersion.
[16] The EPA does not maintain these data on a historical basis.
[17] The ZINB model estimates the probability of observing a specific number of state-initiated enforcement actions in a county by combining a logit and a negative binomial distribution. The ZINB model includes a logit regression model to predict the probability of there being no opportunity for the state to enforce the CAA. I estimate this model using a set of demographic variables as well as the number of manufacturing establishments, but for conciseness of presentation do not report the results.
[18] There may be some multicollinearity in the first model between percent of the population that is nonwhite and the percent of the population that is below the poverty line. These two variables have a correlation of about .78, and when I estimated the ZINB model without the percent poverty variables, the coefficient on the percent nonwhite variable was negative and statistically significant at the .05 level.