ACHIEVING ENVIRONMENTAL JUSTICE? THE IMPACT OF STATE POLICY ON NEIGHBORHOOD LEVELS OF ENVIRONMENTAL INEQUALITY

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ABSTRACT

KAY JOWERS: Achieving Environmental Justice? The Impact of State Policy On Neighborhood Levels of Environmental Inequality
(Under the direction of Neal Caren)

Researchers have extensive documentation showing the presence of environmental inequality in the United States and have explored its causal mechanisms, which are still up for debate. Yet very little research exists examining the effect of the policies and legislation adopted to alleviate the disproportionate pollution burdens placed on disadvantaged neighborhoods. This study examines the moderating effect of state environmental justice policies on the relationship between neighborhood racial composition and neighborhood pollution levels. The impact of differing policy approaches is investigated by categorizing state environmental justice policies into unenforceable policies, procedure-based legislation, and substantively restrictive legislation. Data from the US Census Bureau and the US Environmental Protection Agency's Toxic Release Inventory is used in the analysis to determine the effects these different categories of policies have on environmental inequality levels.

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TABLE OF CONTENTS

INTRODUCTION……...……..... 6

BACKGROUND AND THEORETICAL APPROACH…...…….…….....8

STATE APPROACHES TO ENVIRONMENTAL JUSTICE……...11

DATA AND METHODS...…….…….…….. 14

Dependent Variable ……..…..…..……..…. 15

Explanatory Variables …….……...…….. 16

Analytic Strategy. ……..….. 19

RESULTS……...……..... 20

Descriptive Results. ……..…..……..…. 20

Pooled Cross Sectional Modeling Results……...…….. 22

Difference-in-Differences Modeling Results…….…….. 24

DISCUSSION AND CONCLUSION……...……..... 26

TABLES……..……..……..... 29

REFERENCES…….……..……..... 37

LIST OF TABLES

Table

1. Descriptive Statistics for Variables in the Analysis of Industrial Pollution Levels in Census Tracts, 1990 -2006…….29

2. Proximate Industrial Pollution Over Time By Neighborhood Race/Ethnicity……...……33

3. State Level Characteristics Over Time…… ……...……..35

4. State Policies and Year of Adoption……. …….……... 37

5. Pooled cross sectional models showing relationship between proximate industrial pollution and neighborhood demographics…..…..38

6. Difference-in-differences models showing relationship between proximate industrial pollution, neighborhood demographics, and environmental justice policies……40

Introduction

In the 1980s, advocates for minority and low-income communities and policymakers began to push back against the notion that environmental laws were providing equal protection for all. Based on the work of public health researchers (e.g., Brunekref and Holgate 2002; Currie et al 2007), social scientists (Ash and Fetter 2004; Downey 2005, 2007), and legal scholars (e.g., Godsil 1991; Kaswan 1997; Bullard 2000; Roberts and Toffolon-Weiss 2001), policymakers now have access to ample evidence documenting the existence of environmental inequality. The research shows that environmental hazards are more likely to be located in neighborhoods with predominantly minority populations. The residents of these neighborhoods often lack the political power to push back against government institutions and industry already located or seeking to locate nearby (Marshall 2006). As awareness of this issue increased, state governments have responded with policies intended to insure better protections for communities whose members are disproportionately exposed to pollution and health hazards. The purpose of this study is to evaluate the efficacy of these policies for achieving environmental justice.

Environmental inequality occurs when disadvantaged neighborhoods bear disproportionate burdens of industrial pollution (Ringquist 1997). When industrial facilities are located more frequently near low-income and minority neighborhoods, it leads to health disparities due to certain vulnerable populations being exposed more often than others to environmental pollution and may also have an impacts on psychological health and educational achievement (Sadd, Pastor, Boer, and Snyder 1999; Pastor, Sadd, and Morello-

Frosch 2002, 2004; Downey and Van Willigen 2005). The causes of environmental inequality are subject to debate among academic researchers but the issue has been aptly described as an “ambiguous and complicated entanglement of class, race, educational attainment, occupational patterns, relationships between the metropolitan areas, … and possibly market dynamics” (Been 1995:21-22).

Environmental justice is "the principle that all people and communities are entitled to equal protection of environmental and public health laws" (Bullard 2000:493). Over the last twenty years, a variety of public policies and statutes that purport to help achieve environmental justice have been adopted at both the federal and state levels. The most heralded of these policies was adopted in 1994 when President Clinton signed an executive order requiring that all federal agencies review their policies and develop strategies to incorporate measures to address environmental justice concerns (Rhodes 2003; Executive Order 12898). The 1994 Executive Order provided direction for “identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of [federal] programs, policies, and activities on minority populations, and low-income populations” (Executive Order 12898). It also became a model for state governments to follow in extending these federal-level measures to state-level activities. Since the early 1990s, fifteen states have adopted policies similar to Clinton’s order for state activities, sixteen states have adopted statutes that provide greater procedural rights for citizens in minority and/or low-income communities to allow them more opportunities to participate in environmental decisions that may affect their community, and two states have adopted statutes that provide substantive rights to address the unequal distribution of environmental hazards such as through buffer zones around vulnerable communities (Public Law Research

Institute 2010). In the two decades that have passed since environmental justice policies came into existence, we might expect that levels of environmental inequality have been reduced. So far the few studies that have assessed the implementation of the federal order (Murphy-Green and Leip 2002, O'Neil 2007) and the effectiveness of four early-adopter states (Caren and Schoolman 2008) find little evidence that they have resulted in greater environmental equity.

In this study, I build on Caren and Schoolman's work to evaluate the moderating effect of state environmental justice approaches on the relationship between neighborhood racial composition and neighborhood pollution level across the contiguous United States. As of 2006, twenty-eight of the thirty-three states mentioned above had adopted some form of policy to address environmental inequality, yet the effect of these policies has not been comprehensively examined. The main questions I seek to answer in this study are 1) have state environmental justice policies reduced the disproportionate pollution burden on minority and low-income communities, and 2) do the different policy approaches adopted by states create different results? To answer these questions, I use multilevel longitudinal data on the neighborhood pollution levels, neighborhood demographics, state environmental movement strength, and state political and legal environments. This evaluation provides important information for the study of and public debate over environmental inequality and comprehensively assesses the efficacy of environmental justice policies.

Background and Theoretical Approach

Two bodies of scholarship inform my project: studies of environmental inequality and the causal mechanisms that lead to it and studies of environmental justice remedies and policy effectiveness. There is no dearth of social science research on environmental

inequality but much of the research is focused on the causal mechanisms that lead to it. Several explanations have been offered in the scientific literature for the existence of environmental inequality. According to the political and social capital inequality perspective, racial environmental inequality persists because predominantly minority neighborhoods lack the social capital to prevent polluting industries from locating or expanding nearby (Mohai and Bryant 1992; Hamilton 1995; Bullard 2000; Roberts and Toffolon-Weiss 2001). According to the income inequality perspective, environmental inequality exists due to differences in socioeconomic resources and mobility. People with fewer economic resources tend to live in areas where they will experience higher levels of pollution exposure because they lack the resources to avoid locating in these areas (Ringquist 1997, Mohai and Bryant 1992; Downey 2005). According to the racial discrimination perspective, environmental inequality is the result of the intentional discrimination against minority communities by the business community and government officials in decisions regarding the siting of hazardous facilities (Szasz 1994; Mohai and Bryant 1992; Crowder and Downey 2010). Thus, the positive relationship between minority presence and the level of pollution in a neighborhood results because facilities are more often sited in minority communities (Pastor et al. 2001, Downey 2005).

There is also a broad literature discussing environmental justice policy approaches and legal strategies. Scholars have explored various ways that public policy and the legal system could work to achieve environmental justice. Kaswan (2003) examined the different ways that governments could incorporate the affected communities into environmental decision-making processes and adopt substantive restrictions on facilities locating near low income and/or predominantly minority communities. In addition, Kaswan (1997) criticized

the role of traditional environmental laws in achieving distributional justice for disadvantaged communities and argued that environmental laws can actually increase environmental inequality. Environmental laws often place greater restrictions on new sources of pollution while allowing older facilities to continue using technologies that may generate more pollution. Thus, communities near older existing facilities may be exposed to more pollution than those near newer facilities. As a result, many legal scholars have called for substantive criteria, such as requiring pollution retrofits on older facilities located near disadvantaged communities, that have the potential to achieve distributional justice for minority communities (Lazarus 1993; Cole 1992; Bullard 1994, 2004). Krieg and Faber (2004) argue that even with substantive criteria, policies that identify communities by whether the predominant race or ethnic group are not ideal because the policy or legal protections may not apply to mixed race communities even though significant environmental hazards may face these communities as well. Instead, environmental impact assessments should be completed for all major environmental decisions. Still others have suggested using existing civil rights laws to advocate on behalf of affected communities and suggest that abandoning legislation and policy for legislation is a viable option (Godsil 1991).

As helpful as these analyses have been at helping us understand the predictors, causal mechanisms, and potential interventions, few studies have explored how well our existing policies are at actually redressing environmental inequality. Murphy-Green and Leip (2002) assessed whether the federal policy was effective as it applied to the regulation of pesticides in Florida and found that "the goals of the Executive Order 12898 are not being achieved by the U.S. Environmental Protection Agency." O'Neil (2007) evaluated the impact of the Executive Order on "environmental cleanup justice" and found that contaminated sites near

minority and low-income areas were less likely to be designated as Superfund sites (and thus eligible for resources to clean up contamination) after the Executive Order was in place (1088). Caren and Schoolman (2008) analyzed the impact of four environmental justice policies adopted from 1992 to 1994. Finding little improvement in distribution of the pollution burden, they concluded that these policies are relatively ineffective at reducing environmental inequality. No studies have taken the full range of policy approaches into account and compared the environmental inequality levels across the United States among those different approaches to see how effective they are for achieving environmental justice. In this study, I intend to expand our current knowledge and understanding by examining the moderating effect of state environmental justice policies, procedure-based environmental justice statutes, and substantively restrictive environmental justice statutes on neighborhood pollution levels.

State Approaches to Environmental Justice

Because the particular form of policy state actors adopt may have a significant impact on the efficacy of their approach (French, Gumus, & Homer 2010), it is important to distinguish between them in this analysis. By aggregating all forms of policy into one overarching category, researchers may be glossing over important differences in policy approaches. For example, North Carolina's Environmental Equity Initiative identifies the state environmental agency as more of a mediator between communities and industry and incorporates the following statement: "low income and minority communities often believe that they are burdened with a disproportionate share of [the] state's environmental risks. This belief in some instances may be well founded. However, these beliefs can also create a hostile environment in which good faith efforts to resolve disputes address concerns, and

seek consensus solutions are nearly certain to fail" (NC DENR 2000). In contrast, Maryland regulations designate "environmentally stressed communities" as environmental benefit districts and owners of nearby facilities are legally required to install pollution retrofits (Md. Code Ann. § 13-1502(b)(2) (2005)). These approaches are significantly different and should be considered separately.

Government efforts to achieve environmental justice can take the form of guidance, policy, or law. The primary differences between each form are who administers them and how enforceable the enactments are (Gupta 2001). Guidance documents contain a set of recommendations or suggestions about things that should be considered when making decisions. Policies are basic statements outlining plans and goals as well as the courses of action to follow in making decisions. Policies are typically internally developed often with no public input. As such, they are generally not enforceable in the court system. Legislation is the external directive from the elected body that often gives authority to agencies to create regulations to carry out the goals of the legislation. Each of these three types of enactments has been used by states to address environmental inequality. The enactments themselves can differ in significant ways as well.

Environmental inequality policies can focus on creating substantive standards to regulate industries operating near overburdened communities or on creating procedures to address community political and social capital limitations (Kaswan 1997). The former are referred to herein as substantively restrictive and the latter as procedure-based. By far, the most common way states address environmental inequality is through procedure-based enactments. Since minority communities are often under-represented in the political process, the purpose of these policies is to insure that there is meaningful community involvement and

participation in environmental decision-making processes. For instance, the procedures adopted by the state of California require that developers of new facilities must solicit the opinions of minority community members and provide the community members with information about the proposed facility (Cal. Pub. Res. Code §§ 40912, 41701, 44004 and 71114). Other states have created community advisory councils to make recommendations to legislative bodies about ways to address environmental inequality (e.g., Del. Code Ann. tit. 29 § 8016A (2005)). Although such procedure-based laws are enforceable by the courts, they confer rights to information and participation only and do not guarantee a redistribution of the pollution burden. In other words, these laws may achieve political justice by facilitating greater access to the decision-making process but may not achieve environmental justice by lessening the environmental burden on a community.

Two states have adopted statutes creating substantive standards that must be followed when pollution-generating activities are permitted near disadvantaged neighborhoods. The first to adopt substantive restrictions was Maryland, whose approach is discussed above. The second was Arkansas. Arkansas' approach creates a rebuttable presumption that any new landfill constructed within twelve miles of a minority community should not be permitted (Ark. Code Ann. § 8-6-1504(a)(1) (2008)). The substantive standards adopted in Arkansas and Maryland define the rights of these communities and the relationship between them and nearby pollution-generating facilities.

In this study, I review each state's approach to environmental justice policy and classify them as no policy or law, environmental justice policy, procedure-based environmental justice law, or substantively restrictive environmental justice law. Environmental laws, policies, and regulations that are not necessarily directed at

environmental justice have no doubt been successful at reducing the amount of pollution emitted overall. Therefore, I expect to find that the level of pollution in neighborhoods is decreasing over time. I also expect to find that environmental justice policies are reducing the disparities between the amount of pollution experienced in historically disadvantaged neighborhoods and neighborhoods with no disadvantage due to sociodemographic characteristics. The positive relationship between the minority racial composition of the neighborhood and the level of pollution in the neighborhood should be weaker in states with environmental justice policies and should become progressively weaker over time once the policies are in force. Furthermore, this relationship will be progressively weaker in states adopting procedure-based environmental justice laws as compared to states adopting unenforceable state policies. The presence of a substantively restrictive state environmental justice law should result in an even weaker relationship between neighborhood racial composition and neighborhood pollution level than state procedure-based laws do.

Data and Methods

This study uses longitudinal state and neighborhood level data for the contiguous 48 states. The neighborhood level data consist of sociodemographic and regional characteristics and proximate industrial pollution levels in census tracts, which I use as a proxy for neighborhoods. To assess the impact of environmental justice policies on the relationship between neighborhood racial composition and neighborhood pollution levels, I use data on state political environments. Both sets of variables are time varying and include observations for each year from 1990 to 2006. The 1990-2006 timeframe is determined primarily by the availability of reliable proximate industrial pollution data. However, since many environmental justice policies were first adopted in the early 1990s through the early 2000s, this timeframe works well for the hypotheses tested.

Dependent Variable

The dependent variable is a continuous, tract-level measure of proximate industrial pollution developed by Crowder and Downey (2010). It is based on tract proximity to an industrial facility and the total amount of air pollution released by the facility. The data is weighted to account for the potential effect of each facility according to its distance from the center of each census tract. The base data is from the US Environmental Protection Agency's Toxic Release Inventory ("TRI") Program. Pursuant to the Emergency Planning and Community Right to Know Act (42 U.S.C. §116, et seq.), facilities meeting certain thresholds for the release of hazardous substances must collect and report data on their toxic emissions to the Environmental Protection Agency on an annual basis. The reported data include the quantities of chemicals that each facility disposed of, released to the environment, or managed (i.e., treated). This information is then compiled in a database to track each facility's releases over time. The proximate industrial pollution measure was created first by overlaying the facilities' latitude/longitude coordinates onto a map that divides the census tracts into 400 square foot grids. Each grid cell was given a score based on the distance-weighted sum of the pounds of air pollution released that year by all TRI facilities located within 1.5 miles of the grid. These cell scores were then used to create an average grid cell score for each census tract. The resulting proximate industrial pollution estimates can only be interpreted relative to one another. The data were originally created based on the 2000 census tract boundaries but normalized to the 2010 census tract boundaries for this analysis.

As a measure for environmental inequality, there are limitations to using proximity estimates. They are not pollution concentration estimates nor do they capture the health risks that environmental hazards may have on communities. Proximity estimates do, however, represent the impacts on quality of life from the visibility of facilities and odors or noise

associated with facilities (Chakraborty and Maantay 2011).

Explanatory Variables

The data for ethnic and racial composition are taken from the US Census Bureau's 1990, 2000, and 2010 decennial censuses. In order to account for differences in the geographical areas within the 1990, 2000, and 2010 census tracts, I use the Longitudinal Tract Data Base (LTDB) (Logan, Xu, and Stults 2010) to normalize the 1990 and 2000 census data to 2010 tract boundaries for comparison between censuses. The race and ethnicity variables are the percentage of people in each tract reporting Hispanic ethnicity, non-Hispanic white race (hereafter "whites"), and non-Hispanic black race (hereafter "blacks"), and all other races. Estimates for the racial and ethnic composition for census tracts during intercensal years are interpolated (and for all tract-level explanatory variables).

I include other tract-level explanatory variables to account for socioeconomic characteristics that may bear on the pollution burden experienced. As outlined previously, there is a split among researchers regarding whether environmental inequality is better explained by socioeconomic status or by the racial composition of the neighborhood. Therefore, I include a measure for income to examine the potential effect that socioeconomic status may have on the relationship between neighborhood racial composition and the level of pollution. I use household income (adjusted for inflation using 2010 as the baseline), the percentage of people 25 years or older with a high school degree, and the percentage of people 25 years or older with a college degree or higher as measures of socioeconomic status. These data are taken from the US Census Bureau's 1990 and 2000 decennial censuses and the 2006-2010 American Community Survey 5-Year Estimates.

I also include explanatory variables to account for the type of industry in the tract. The nature of industrial activity located near a neighborhood has important implications for

environmental inequality. Manufacturing facilities are more likely to produce pollution than office parks that are occupied by law firms, management offices, and other professional services. Variables for the percentage of individuals employed in manufacturing occupations and for the percentage employed in professional/managerial occupations are included to account for variations in environmental inequality levels due to the type of industry in the census tract. These data are also taken from the US Census Bureau's 1990 and 2000 decennial censuses and the 2006-2010 American Community Survey 5-Year Estimates. Because these measures are not a direct measure of the industry present, I must make an assumption that people live close to their jobs and that these measures are good proxies for the type of industry located nearby. I also control for census region because different regions of the country attract different types of industries.

The measures for the type of environmental justice policy are based on a comprehensive review of environmental justice policies and laws compiled by the Public Law Research Institute (PLRI) at the University of Hastings College of Law (2010). Researchers at PLRI canvased legal and public databases for all state laws, regulations, and policies that relate to environmental inequality and environmental justice issues. The state reports were then shared with the respective state officials responsible for environmental justice issues for feedback and peer review (PLRI 2010). I review each state's entry in the PLRI report to determine which policies and statutes address environmental justice. I then turn to state regulatory and legislative histories to determine the date of adoption and whether any other policies (possibly less or more stringent than the current one) existed previously. After a thorough review of each policy and its history, I categorize a state's approach by year as no policy, an unenforceable state policy, a procedure-based statute, or a substantively

restrictive statute. In order to qualify as an environmental justice policy, the policies have to clearly intend to remedy environmental inequalities based on race and ethnicity and/or socioeconomic status. I create a series of dummy variables based on these categories.

To better isolate the effect of environmental justice policy on environmental inequality, I include controls for overall political environment in the states that could affect permitting decisions and/or have an influence on support for environmental justice issues. The first variable is a measure of the partisan breakdown in the state legislature using the percentage of seats held by Democrats. While the orientations of Democrats will vary across states, it seems reasonable to assume that they will be more likely than Republicans in promoting policies that regulate business interests and protect public health. This variable is constructed based on data in the *United States Statistical Abstract* (US Census Bureau 2011) and from the National Conference of State Legislators, a bi-partisan nonprofit organization that provides research assistance to state legislators. Other variables capture the racial composition of the state legislature using the percentage of seats held by black officials and the percentage of seats held by Hispanic officials. Research indicates that the racial/ethnic identity of legislators has an impact on policy outcomes. There is a positive relationship between the number of minority elected officials and the number of policies adopted that promote minority interests (Lublin 1997; Preuhs 2006). The variable for the percentage of seats held by black officials is based on data collected by the National Conference of State Legislatures and the Joint Center for Political and Economic Studies. The variable for the percentage of seats held by Hispanic officials is based on the National Association for Hispanic Elected Official's *National Directories of Hispanic Elected Officials* 1990 – 2007 editions. Finally, I include a variable to capture the strength of the environmental movement

in each state. For this measure, I use state-level membership data for the Sierra Club as a proxy for the environmental movement.

The final database is both multilevel and longitudinal in scope and includes observations for 71,681 census tracts over time for a total of 1,215,973 observations.

Analytic Strategy

I begin by analyzing the overall characteristics of proximate industrial pollution over time and the relationship between neighborhood sociodemographic characteristics. I start with an analysis of pollution means over time and by the predominant neighborhood racial characteristics over time. I then use pooled cross sectional modeling to assess the level of pollution that can be explained by sociodemographic characteristics. Next I estimate difference-in-differences models within a multilevel framework to examine the effects of environmental justice policies.

Although cross-sectional models are useful for describing the overall distribution of pollution at the neighborhood level, difference-in-differences models are more appropriate for analyzing the amount of change in pollution levels that can be attributed to particular interventions. The strength of this approach is that it allows me to estimate the differences between state policy approaches in the within-census tract pollution level changes. By measuring the within-census tract change, this method also controls for unmeasured tract-level effects that may also impact pollution levels. Thus, I can analyze the impact of a particular policy intervention even when the tract-level pollution level trajectories may be systematically decreasing over time due to other policy interventions. Environmental justice policies were not being implemented in a policy vacuum. Other pollution interventions that are not based on environmental inequality were also enacted. For example, significant amendments were made to the Clean Air Act in 1990 and were being implemented over the

same time period as the environmental justice policies examined herein were being adopted and implemented. Therefore, neighborhood pollution levels are likely to be decreasing overall due in part to these other policy interventions. By analyzing the change trajectories of census tracts in states with differing policy approaches, I can better determine what portion if any of the change in pollution level can be attributed to environmental justice policies versus the downward shift overall for neighborhood pollution levels. This difference-in-differences modeling strategy has many of the same benefits as fixed-effect models. The key difference is that in the difference-in-differences context the fixed effect is the estimate of the mean tract-level pollution score at the starting point (1990) whereas in the fixed-effect models the fixed effect would be the overall mean tract-level pollution score. Furthermore, by subtracting the value at the starting point from the current value for each tract for each variable, I am able to control for tract-specific unmeasured factors.

Results

I first present a descriptive analysis of all census tracts and then the changes in key variables across time. Next, I present the models establishing the relationship between neighborhood pollution level and racial composition. Finally, I present the difference-in-differences models comparing the average change in pollution level in neighborhoods with different environmental justice policy approaches.

Descriptive Results

Census tract level: Table 1 summarizes the descriptive statistics for all variables. At the census tract level, the mean proximate industrial pollution level is 3.844 but the standard deviation is 4, which illustrates the wide variation in neighborhood pollution levels across all

census tracts and the need to further investigate what causes the variation. The average census tract has a population density of .02% and its population is 11.276% Hispanic and 12.69% black. Overall, the average tract-level household income for this period is approximately $42,177. The average census tract has 30.17% of its workers employed in managerial or professional occupations and 14.74% in manufacturing occupations. On average, 50.44% of persons 25 or older have high school diplomas and 22.92% have some college education.

[Table 1 about here]

Table 2 breaks down proximate industrial pollution levels by the predominant racial composition of the census tracts at four points in time: 1990, 1995, 2000, 2006. I classified tracts with greater than eighty-percent of a particular racial/ethnic group as a predominantly white, black, or Hispanic neighborhood. Notably, predominantly white neighborhoods have consistently lower pollution levels than predominantly Hispanic or black neighborhoods. The average pollution level is 4.539 for white neighborhoods in 1990 whereas black neighborhoods score 7.584 and Hispanic neighborhoods score 6.503. Overall, average pollution levels are decreasing during this period. Yet in 2006, white neighborhoods still have lower average pollution levels at 2.607 versus scores of 4.371 for black neighborhoods and 3.759 for Hispanic neighborhoods. Interestingly, in states with environmental justice policies, the overall trend for Hispanic neighborhoods is the same as that of white neighborhoods: lower levels than states with no policies but a slight increase in the pollution score for 2000 only to decrease again by 2006. The slight increase in scores as of 2000 is likely a result of four additional states adopting policies between 1995 and 2000.

[Table 2 about here]

State level: Table 1 also summarizes key differences in the state political environments. Approximately 17% of the census tracts were located in states with environmental justice policies in place (across all 768 state years). Another 14.5% were located in states with procedure-based environmental justice statutes. Only 1.6% of the tracts were located in states with substantively restrictive environmental justice statutes. States across this period had on average 30,187 Sierra Club members. State legislatures across this period were comprised on average of 53.9% registered Democrats, 5.24% Hispanic legislators, and 9.3% black legislators. Table 3 presents these same state level characteristics over time. Notably, most states had relatively stable levels of representation for Democrats. The two states with substantively restrictive laws had much higher Democrat Party and black representation than the other states. Table 4 lists the states by their particular policy approach and notes the year each policy was adopted.

[Tables 3 & 4 about here]

Pooled Cross Sectional Modeling Results

Table 5 presents the results of pooled cross sectional models that I use to establish relationship between proximate industrial pollution and neighborhood demographics. Model 1 analyzes the overall differences in pollution levels for black and Hispanic populations as compared to census tracts with no blacks or Hispanics. Consistent with the expectation that pollution is decreasing overall over time, the coefficients for the year dummy variables show a drop in the pollution level and are all statistically significant. The average pollution level in the reference category, census tracts with no black or Hispanic population, is 4.327. Controlling for the concentration of Hispanic residents in the area, the level of industrial pollution increases by 3.234 points for each additional percentage-point difference in the

tract percent Hispanic. Controlling for the concentration of black residents in the area, the level of pollution increases by 2.463 for each additional percentage-point difference in the tract percent black. The results in Model 1 highlight important differences in exposure to neighborhood pollution for black and Hispanic populations versus other racial and ethnic populations. This supports the overall hypothesis that there are positive and statistically significant ($p < .001$ for both Hispanic and black populations) associations between neighborhood racial composition and neighborhood pollution level. Approximately 6.3% of the variability in neighborhood pollution levels is explained by racial composition in Model 1.

Model 2 is a critical step in isolating the true relationship between racial composition and neighborhood pollution levels as it controls for the effects of income, population density, regional variation, and the percentage of persons employed in manufacturing and professional industries. Controlling for these other variables in the model, the neighborhood pollution level decreases by 0.318 points for every $10,000 increase in average household income in the tract. By including variables for different regions of the country, the model shows that as compared to the reference category (the Northeast), census tracts in the Midwest have pollution levels that are 0.437 lower, census tracts in the South have pollution levels that are 1.762 lower, and census tracts in the South have pollution levels that are 1.368 lower. Controls for the type of industry in a census tract show that the neighborhood pollution level will increase by 3.237 for a one percentage point increase in persons employed in professional and managerial occupations and will increase by 14.035 for a one percentage point increase in persons employed in manufacturing occupations. The final control in Model 2 is for population density and shows that as population density increases

by one percentage point, the pollution level decreases by 0.026 but this effect is not significant. After isolating the impacts of these other predictors, the coefficients for the main focal relationship between racial composition and neighborhood pollution levels still show statistically significant ($p < .001$ for both groups) higher exposure levels for Hispanics and blacks versus other groups. Specifically, the model shows that the neighborhood pollution level increases by 3.355 for an increase of one percentage point in the Hispanic population and increases by 3.543 for an increase of one percentage point in the black population. These results are consistent with the race-based environmental inequality thesis that neighborhood pollution levels are causally linked to the racial composition of the neighborhood. After controlling for the effects of income, density, regional variation, and the percentage of persons employed in manufacturing and professional industries, approximately 16.2% of the variability in neighborhood pollution levels can be explained by racial composition. The next step, however, is to assess the conditioning effect of environmental justice laws and policies over time on the association between neighborhood racial composition and pollution levels.

[Table 5 about here]

Difference-in-Differences Modeling Results

Table 6 presents difference-in-differences models showing the effects of neighborhood racial composition on neighborhood pollution levels across states with different types of environmental justice laws over time. Model 1 shows the basic difference-in-differences model including all tract and state level controls with the exception of the environmental justice policies. After accounting for education, income, employment, regional differences, minority and Democratic Party representation in the state legislature, the relationship between race and neighborhood pollution level still holds true and is

statistically significant: in any given year, a one-percent increase in the black and Hispanic populations in a tract increases the pollution level by 0.934 and 0.811 respectively over the baseline pollution score in 1990. Professional employment, income, Sierra Club membership, as well as minority and Democratic Party representation all decrease the pollution levels over baseline and are statistically significant. Model 2 includes a control for the existence of any environmental justice policies and shows that such policies decrease the neighborhood pollution level by 0.078 and this relationship is statistically significant ($p < .001$). In Model 3, the environmental justice policy variable is interacted with black and Hispanic. Overall, environmental justice policies reduce the neighborhood pollution level by 0.105 but for every one-percent increase in the black and Hispanic populations in these neighborhoods the pollution level will increase by 0.6 and 0.54 respectively ($p < .001$). In Model 4, the different types of environmental justice policies are considered. Of the three approaches, the only statistically significant relationship is for the non-binding policy or guidance approach, which will reduce the pollution level by 0.184. Finally, in Model 5, the different types of environmental justice laws are interacted with percent Hispanic and percent black. When the policy approaches are interacted with the percent black and Hispanic variables, we see that guidance approaches increase the pollution level by 0.776 for blacks and by 1.156 for Hispanics and this effect is significant ($p < .001$). For blacks, there is a significant ($p < .10$) and positive effect on neighborhood pollution levels in tracts where the state has adopted a procedure-based environmental justice statute. The only policy approach that is both significant and reduces pollution loads for a vulnerable population is the substantively restrictive statute which reduces the amount of pollution by 1.95 for every one percent increase in the Hispanic population in a census tract.

The results of this analysis are somewhat surprising given that I expected to find that environmental justice policies resulted in a weaker relationship between neighborhood industrial pollution levels and the percentage of the population that is black or Hispanic. Overall, the policies are reducing neighborhood pollution levels but are not always having the intended effect for the two vulnerable populations studied herein. The only policy approach that results in a significant decrease in the relationship between pollution and race is the substantively restrictive approach.

[Table 6 about here]

Discussion and Conclusion

This study investigates the ability of state environmental justice regulations to reduce environmental inequality levels for blacks and Hispanics. This study is the first full assessment of the conditioning effects of different state approaches to environmental justice policy. I expected to find that across all types of environmental justice policies, the relationship between racial composition and neighborhood pollution levels would be weakened. Furthermore, I expected to find that substantively restrictive statutes reduce this relationship by the largest amount. Instead I find that while the existence of environmental justice policies reduce pollution level in a tract overall, the effect is to actually increase the pollution level for blacks and Hispanics. When the policy approaches are disaggregated and analyzed separately, I find that guidance leads to a stronger relationship between neighborhood pollution and the percent of black and Hispanic persons. Procedural-based statutes lead to an increase in pollution for black populations as well. Substantively restrictive statutes work as expected and the effect is strongest for Hispanics.

These findings are somewhat surprising but may be the result of higher than average existing levels of environmental inequality in the states that adopt these policies. It is

possible that these policies are adopted in response to a major disaster (such as the recent Gulf Oil spill) or adopted to appease an interest group lobbying for environmental justice. Decision-makers can use this analysis, however, to show that substantively restrictive measures to address environmental inequality are the most effective and work as intended for at least one vulnerable population, Hispanics.

This project aimed to measure the overall effectiveness of environmental justice policies but is not without its limitations. As described above, there are many approaches to achieving environmental justice. Some approaches attempt to achieve justice by insuring that the affected community is more fully integrated into the decision-making process and is provided political justice. The dependent variable used in this project is an indirect measure of the success of these types of procedure-based policies. Presumably, if these procedures work, then the communities' pollution burdens will ultimately be reduced. But a better measure of the procedure-based statutes would be a measure of political participation or protest activities that are facilitated by the environmental justice law. In addition, only two states have adopted substantively restrictive environmental justice statutes. As a result, the findings may not accurately reflect the moderating effect of substantively restrictive laws.

Despite these limitations, this project makes significant contributions on a practical and theoretical level. My findings will have practical implications for policymakers and environmental justice advocates who wish to address environmental inequality in their communities and may suggest policy directions that will be most effective to achieving environmental justice. On a theoretical level, my findings show that there is value in disaggregating policy approaches by their level of enforceability and their legal mechanisms. The results of this study show that aggregating statutes and policy into one broader category

may mask the more nuanced effects of these policies and overestimate their effect.

Table 1.

Descriptive Statistics for Variables in the Analysis of Industrial Pollution Levels in Census Tracts, 1990 - 2006

Variables	Description	Mean	S.D.	Min.	Max
Dependent Variable					
Proximate Industrial Pollution Level	Spatially weighted Toxic Release Inventory-based pollution level in census tract	3.84419	4	0	17.7011470
Explanatory Variables at Census Tract Level					
Population Density	Total population in a particular census tract divided by the total area of the census tract	0.02	1.9169	0	13.2705
Percentage Hispanic	The total number of Hispanic persons divided by the total number of persons	11.2755	18.4638	0	0.9924495
Percentage Black	The total number of non-Hispanic black persons divided by the total number of persons	12.6883	21.9569	0	100
Average Household Income	The total aggregate household income divided by the total households (adjusted for inflation	42177	20157.10	229.06	230001
Percentage Below Poverty	The total number of persons living under the poverty line divided by the total number of persons whose poverty status was determined	13.2108	11.1337	0	100
Percentage High School Educated	The total number of persons with a high school education divided by the total number of persons	50.4401	18.6449	0	100
Percentage College Educated	The total number of persons with some college education divided by the total number of persons	22.9247	16.2583	0	100
Professional/Managerial Occupations	Represents the percentage of the population in professional or manage occupations in the census tract	30.1712	13.2613	0	100
Manufacturing Occupations	Represents the percentage of the population in manufacturing occupati in the census tract	14.7432	8.4994	0	100
Region	Census region (1 - 4)	…	…	…	…

Explanatory Variables at State Level

State EJ Policy	Dichotomous variable indicating whether the state a particular census t is located in has adopted a policy to address environmental inequality that goes beyond the federal minimum requirements (*1 = yes*)	16.95383	…		
Procedure-based State EJ Law	Dichotomous variable indicating whether the state a particular census t is located in has adopted a procedure-based law to address environmental inequality that goes beyond the federal minimum requirements (*1 = yes*)	14.5481	…		
Substantively-restrictive State EJ Law	Dichotomous variable indicating whether the state a particular census t is located in hasadopted a substantively-restrictive law to address environmentalinequality that goes beyond the federal minimum requirements (*1 = yes*)	1.58688	…		
Sierra Club Membership	Total members of state-level Sierra Club organization	30,187	46,277	5	175026
Percentage of Hispanic Legislators	Percentage of state legislators self-identifying as hispanic	5.23739	7.33698	0	40.1
Percentage of Black Legislators	Percentage of state legislators self-identifying as black	9.30046	5.62309	0	27
Percentage of Democrat Legislators	Percentage of state legislators self-identifying as members of the Democratic Party	53.8959	11.7631	11.4	91.1

Total Observations = 1,215,973
N = 768 (state years)
Census tracts = 71681

Table 2

Proximate Industrial Pollution Over Time By Neighborhood Race/Ethnicity

	Hispanic Neighborhoods		Non-Hispanic Black Neighborhoods		Non-Hispanic White Neighborhoods	
	Mean	SD	Mean	SD	Mean	SD
National						
Pollution in Tract in 1990	6.502738	5.098396	7.584314	4.274903	4.362594	4.538941
Pollution in Tract in 1995	5.451467	4.68551	6.540659	4.38869	3.48518	4.159787
Pollution in Tract in 2000	4.990295	4.337651	5.502519	4.24738	3.230969	4.003359
Pollution in Tract in 2006	3.759018	3.966883	4.371382	4.108321	2.607084	3.671799
No EJ Policies/Statutes						
Pollution in Tract in 1990	6.502738	5.098396	7.584314	4.274903	4.362594	4.538941
Pollution in Tract in 1995	7.113082	4.302263	6.493117	4.403704	3.554683	4.187659
Pollution in Tract in 2000	6.022662	4.375526	6.05282	4.281254	3.483358	4.100691
Pollution in Tract in 2006	5.325277	3.846194	4.685524	4.222764	2.628206	3.663385
EJ Policies						
Pollution in Tract in 1995	2.97887	4.109336	5.579199	3.95248	2.528553	3.66702
Pollution in Tract in 2000	3.034915	3.975465	5.260106	3.731028	3.275602	3.936801
Pollution in Tract in 2006	2.181719	3.508362	4.617448	3.841643	2.876532	3.762149
EJ Procedural Laws						
Pollution in Tract in 1995	…	…	8.832986	3.972279	3.012939	4.013914
Pollution in Tract in 2000	6.350948	3.999732	5.2217722	4.615775	2.499643	3.728729
Pollution in Tract in 2006	4.662211	3.922512	3.898616	4.447137	2.049653	3.442873
EJ Substantively-Restrictive Laws						
Pollution in Tract in 1995	…	…	9.862203	1.76213	3.915674	3.964275
Pollution in Tract in 2000	…	…	3.239809	3.84815	2.712922	3.755005
Pollution in Tract in 2006	…	…	2.79461	3.642935	2.002828	3.325564

Table 3

State Level Characteristics Over Time

	Percent Democrat		Percent Black		Percent Latino		Sierra Club Membership	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
National								
1990								
1995	52.14014	11.17659	9.41866	5.399226	4.208884	6.164345	27464.69	41858.2
2000	52.71396	11.28362	9.431959	5.79487	5.742119	7.612683	30544.72	46835.58
2006	53.20317	11.43905	10.21425	6.346477	7.073648	8.883077	33549.45	46791.43
EJ Policies								
1995	57.00311	6.42541	7.74591	1.707229	15.41392	6.057263	16925.74	4776.593
2000	53.77486	5.338241	10.02601	2.805215	7.346985	7.972828	21083.25	7867.578
2006	54.67208	11.18553	9.714206	4.105838	5.719844	7.408486	20653.19	10127.21
EJ Procedural Laws								
1995	52.9	0	10	0	0	0	10384	0
2000	52.82117	11.47499	8.808343	4.819004	10.55573	7.885951	75780.59	72146.25
2006	53.05648	10.73544	8.745897	5.691078	12.63141	10.77688	72184.46	69330.69
EJ Substantive Laws								
1995	85.9	0	12.5	0	0	0	1239	0
2000	73.70154	0.2823605	17.19007	4.282468	0	0	7771.029	4275.409
2006	75.53309	0.0470657	18.59372	5.271361	1.425145	1.0025	11061.09	5993.349

Table 4.

State Policies & Year Adoption

Policy	**Procedural Law**	**Substantively Restrictive Law**
Connecticut (1993)	Virginia (1995)	Arkansas (1993)
Texas (1993)	Louisiana (1997)	Maryland (2000)
New Hampshire (1994)	Oregon (1997)	
New York (1999)	New Jersey (1998)	
Pennsylvania (1999)	Florida (1998)	
Missouri (2000)	California (1998)	
North Carolina (2000)	Kentucky (2000)	
Minnesota (2001)	Montana (2003)	
Massachusetts (2002)	Rhode Island (2003)	
West Virginia (2003)	Washington (2004)	
Wisconsin (2004)	New Mexico (2005)	
Tennessee (2005)	Delaware (2005)	
Indiana (2006)		
Michigan (2006)		

Table 5.

Pooled cross sectional models showing relationship between proximate industrial pollution (logged) and neighborhood demographics

	Model 1		Model 2	
	b	SE	*b*	SE
Race/ethnicity[a]				
Non-Hispanic black……	3.2337161***	-0.017	3.5433159***	-0.018
Hispanic……..	2.4629273***	-0.021	3.3554851***	-0.022
Household Income ($)[b]……			-0.318	0
Percent Professional Employment…..			3.2373990***	-0.046
Percent Manufacturing Employment..			14.0353731***	-0.049
Population Density…….			-0.0259111	-0.185
Census Region[c]			.	
Midwest……..			-0.4373484***	-0.011
South……..			-1.7614958***	-0.01
West……			-1.3677157***	-0.012
y1991[d]…….	-0.2783247***	-0.022	-0.2145852***	-0.021
y1992……..	-0.3972466***	-0.022	-0.2697133***	-0.021
y1993……..	-0.6028183***	-0.022	-0.4114913***	-0.021
y1994……..	-0.8007055***	-0.022	-0.5455847***	-0.021
y1995……..	-0.9433902***	-0.022	-0.6244757***	-0.021
y1996……..	-1.1302490***	-0.022	-0.7475408***	-0.021
y1997……..	-1.2623792***	-0.022	-0.8158772***	-0.021
y1998……..	-1.1318131***	-0.022	-0.6215174***	-0.021
y1999……..	-1.2618078***	-0.022	-0.6877183***	-0.021
y2000……..	-1.3407923***	-0.022	-0.7031957***	-0.021
y2001……..	-1.4761774***	-0.022	-0.7738258***	-0.021
y2002……..	-1.6061896***	-0.022	-0.8381524***	-0.021
y2003……..	-1.7439822***	-0.022	-0.9102595***	-0.021
y2004……..	-1.8777954***	-0.022	-0.9783871***	-0.021
y2005……..	-1.9603641***	-0.022	-0.9952702***	-0.021
y2006……..	-2.1066062***	-0.022	-1.0758267***	-0.021
Constant……..	4.3270643***	-0.016	3.0021268***	-0.022
Model R-squared…….	0.0632		0.1615	
Observations……	1215973		1215973	

* p<0.05 ** p<0.01 *** p<0.001

[a] Omitted category is all other races

[b] Reported in $10,000

[c] Omitted category is Northeast

[d] Base year is 1990

Table 6.

Growth curve models showing relationship between proximate industrial pollution, neighborhood demographics, and environmental justice policies

	Model 1		Model 2		Model 3		Model 4		Model 5	
	b	SE	*b*	SE	*b*	SE	*b*	SE	*b*	SE
Proximate industrial pollution (logged)	0.698***	0.002	0.699***	0.002	0.698***	0.002	0.698***	0.001	0.697***	0.002
Race/ethnicity[a]										
Non-Hispanic black	0.934***	0.113	0.944***	0.113	0.384***	0.041	0.949***	0.113	0.38***	0.041
Hispanic	0.811 ***	0.118	0.827***	0.118	0.262***	0.057	0.831***	0.118	0.266***	0.057
Percent Professional Employment	-0.905***	0.098	-0.907***	0.098	-0.9***	0.098	-0.883***	0.098	-0.88***	0.098
Percent Manufacturing Employment	1.992***	0.09	1.982***	0.091	2.012***	0.091	2.05***	0.091	2.073***	0.09
Household Income ($)[b]	-0.088***	0.008	-0.087***	0.008	-0.088***	0.008	-0.09***	0.008	-0.09***	0.007
Population Density	-299.527***	23.543	-299.448***	23.538	-313.798***	23.618	-296.939***	23.546	-313.014***	23.665
Census Region[c]										
Midwest	0.245***	0.024	0.221***	0.024	0.219***	0.024	0.199***	0.024	0.195***	0.024
South	0.206***	0.027	0.207***	0.027	0.203***	0.027	0.164***	0.027	0.156***	0.027
West	0.023	0.029	-0.014	0.03	-0.028	0.029	-0.08**	0.03	-0.093**	0.029
Sierra Club Membership[d]	-0.009***	0.002	-0.007***	0.002	-0.009***	-0.002	-0.009***	0.002	-0.01***	0.002
Percent Hispanic Legislators	-0.014***	0.002	-0.013***	0.002	-0.013***	0.002	-0.008***	0.002	-0.01***	0.002
Percent Black Legislators	-0.011***	0.002	-0.012***	0.002	-0.012***	0.002	-0.011***	0.002	-0.01***	0.002
Percent Democratic Legislators	-0.003**	0.001	-0.003**	0.01	-0.003***	0.001	-0.003**	0.001	-0.004***	0.001
EJ Policy			-0.078***	0.016	-0.105***	0.017				
Guidance/Policy							-0.184***	0.02	-0.233***	0.022
Procedural Statute							0.03	0.021	0.027	0.025
Substantively Restrictive Statute							0.003	0.053	0.089	0.062
EJ Policy*Black					0.6***	0.017				
Guidance/Policy*Black									0.766**	0.248
Procedural Statute*Black									0.638+	0.332
Substantively Restrictive Statute *Black									-0.605	0.495
EJ Policy*Hispanic					0.54**	0.178				
Guidance/Policy*Hispanic									1.156***	0.288
Procedural Statute*Hispanic									-0.032	0.226
Substantively Restrictive Statute *Hispanic									-1.945*	0.96
y1991[e]	-0.265***	0.006	-0.265***	0.006	-0.265***	0.006	-0.265***	0.006	-0.265***	0.006
y1992	-0.371***	0.007	-0.371 ***	0.007	-0.371***	0.007	-0.37***	0.007	-0.371***	0.007
y1993	-0.563***	0.008	-0.556***	0.008	-0.554***	0.008	-0.548***	0.008	-0.546***	0.008
y1994	-0.749***	0.009	-0.741***	0.009	-0.74***	0.009	-0.732***	0.009	-0.731***	0.009
y1995	-0.879***	0.01	-0.869***	0.01	-0.868***	0.01	-0.863***	0.01	-0.863***	0.01
y1996	-1.053***	0.01	-1.043***	0.01	-1.042***	0.011	-1.037***	0.01	-1.037***	0.01
y1997	-1.171***	0.011	-1.159***	0.011	-1.159***	0.011	-1.157***	0.011	-1.158***	0.011
y1998	-1.027***	0.012	-1.008***	0.012	-1.008***	0.012	-1.015***	0.012	-1.017***	0.012
y1999	-1.143***	0.012	-1.107 ***	0.014	-1.108***	0.014	-1.114***	0.014	-1.115***	0.014
y2000	-1.208***	0.012	-1.164***	0.015	-1.166***	0.015	-1.169***	0.015	-1.172***	0.014
y2001	-1.329***	0.013	-1.285***	0.015	-1.289***	0.015	-1.288***	0.015	-1.291***	0.015
y2002	-1.449***	0.013	-1.403***	0.016	-1.408***	0.016	-1.404***	0.016	-1.408***	0.016
y2003	-1.574***	0.013	-1.526***	0.016	-1.533***	0.016	-1.527***	0.016	-1.532***	0.016
y2004	-1.696***	0.013	-1.646***	0.017	-1.654***	0.017	-1.647***	0.017	-1.653***	0.017

y2005	-1.767***	0.014	-1.714***	0.017	-1.724***	0.017	-1.714***	0.017	-1.722***	0.017
y2006	-1.901***	0.014	-1.844***	0.018	-1.856***	0.018	-1.837***	0.018	-1.847***	0.018
Constant	1.263***	0.126	1.266***	0.126	1.855***	0.064	1.287***	0.127	1.891***	0.066
Model R-squared	0.637		0.637		0.637		0.637		0.0637	
Observations	1206952		1206952		1206952		1206952		1206952	

+p<0.10 * p<0.05 ** p<0.01 *** p<0.001

[a] Omitted category is all other races

[b] Reported in $10,000

[c] Omitted category is Northeast

[d] Reported in 10,000

[e] Base year is 1990

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