Environmental Justice and US Clean Air Act Enforcement

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Acknowledgements

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1. Introduction

As climate change worsens, the federal government continues to invest in energy projects that contribute to air pollution, further warming the climate. Despite long-term negative impacts, polluting facilities remain critical to upholding the US economy. In an attempt to balance the competing goals of environmental protection and economic growth, the federal government, through the 1990 amendments to the Clean Air Act (CAA), set standards for maximum emissions from polluting facilities. CAA standards aim to ensure that the health of those living near facilities is protected. However, enforcement of those standards is mostly left up to state bureaucratic agencies. There is, therefore, considerable variation in how facilities are regulated in practice. In order to ensure that these projects cause minimal environmental harm, bureaucratic agencies must consistently and efficiently identify when polluting facilities exceed CAA standards. They must also take actions to bring those facilities back into compliance. This requires state governments to make strategic decisions about how to distribute services. As with other situations in which governments distribute services, there is reason to question whether services are distributed equitably to historically and presently marginalized communities. In this paper, I seek to explain variation in state-level enforcement of the Clean Air Act by examining the extent to which discrimination exists in enforcement and investigating whether discriminatory behavior is exacerbated by differences is state agency structures.

1.1 Background

1.1.1 Clean Air Act History

At the federal level, the 1970 Clean Air Act (CAA) was one of the first steps in regulating the extent to which polluting facilities could cause harm to the environment and to humans. Prompted in part by worsening air quality in cities throughout the US, this legislation established standards and plans to address the emission of greenhouse gasses and toxic chemicals (US EPA Clean Air Act Requirements and History). It mandated that states develop plans to ensure compliance with CAA standards (US EPA Clean Air Act Requirements and History). While the CAA sets standards for facility emissions, it requires states to establish plans to enforce them. Polluting facilities include coal-fired plants, plants that manufacture sulfuric and nitric acid, glass manufacturing plants, cement manufacturing plants, and petroleum refineries. Polluting facilities are required to report emissions to their state's environmental protection agency, which then reports them to the federal EPA. State environmental agencies are also required under the CAA to report all enforcement actions to the federal EPA. Enforcement actions include inspections to verify that facilities are in compliance with CAA standards, as well as all actions taken to correct facility behavior when they are found to be out of compliance. In this investigation, I examine formal actions, which are fines issued against facilities when they are found to be out of compliance (Bergquist 2019). Formal actions are different from informal actions, which constitute issuing a warning or taking less consequential action against a facility found to be out of compliance (Bergquist 2019).

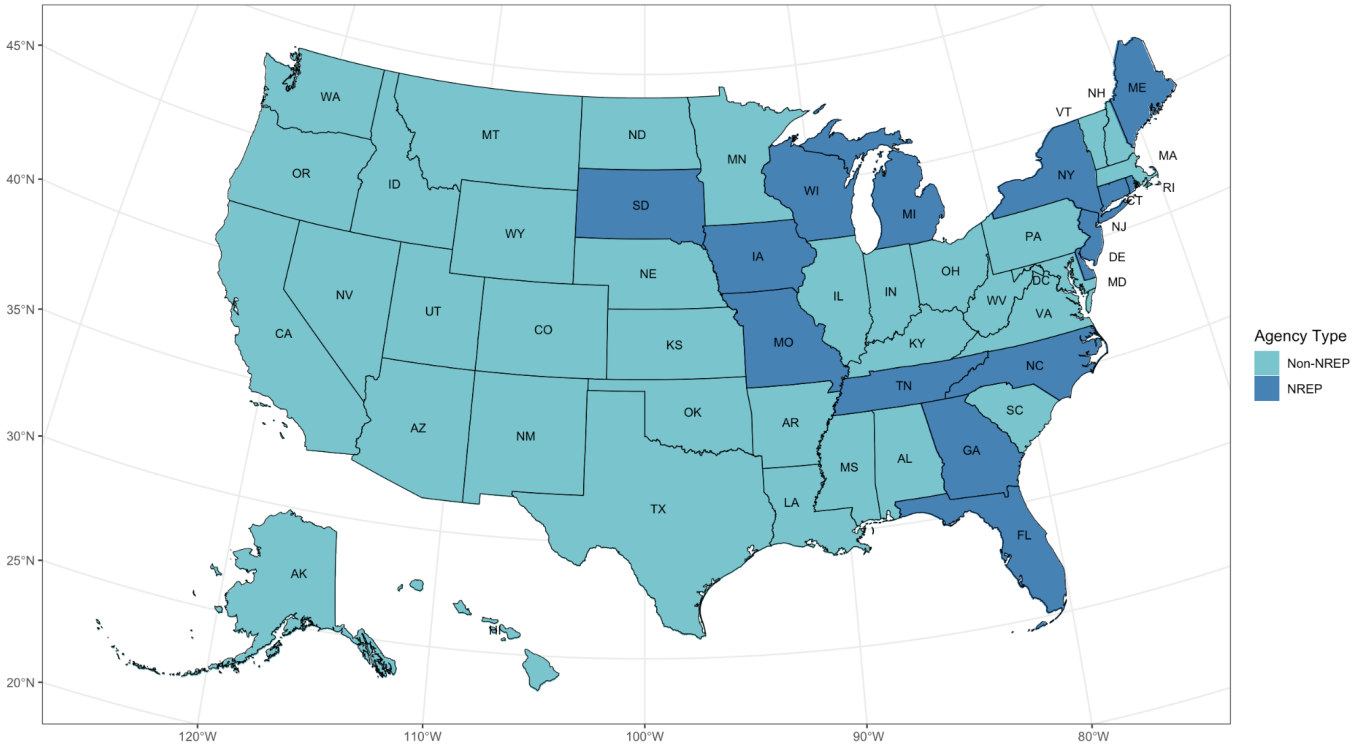
1.1.2 State Environmental Agency Structure

The CAA gave states a central role in conducting enforcement actions. In 2020, states, as opposed to the federal government, conducted 96 percent of enforcement actions where they had the opportunity to do so (Hopper 2020). Although states are tasked with adhering to the same enforcement standards, there are important differences in what such adherence looks like across states. In July of 1970, before the passage of the CAA, President Nixon's Environmental Quality Council issued a memo calling for the establishment of an environmental protection agency (Hopper 2020). In the memo, called the Ash memo after the council's leader Roy Ash, the Council laid out three possible structures an environmental protection agency could take (Hopper 2020). They gave President Nixon the option to either create an environmental protection and natural resources preservation department, create a bureau focused on environmental protection within the Department of Health, Education, and Welfare, or create a new agency dedicated solely to environmental protection (Ash et al 1970). The Council recommended that Nixon create an independent Environmental Protection Agency based on concerns that an agency with multiple mandates might not successfully set clear goals and execute plans around environmental protection (Ash et al 1970). In accordance with the Council's recommendations, Nixon established the US Environmental Protection Agency (EPA) (Hopper et al 2020). After the EPA's establishment, state governments were required to establish a statewide environmental protection agency and were given roughly the same options proposed to the federal government. That is, they could either create a new, independent agency or to nest an environmental protection agency within an existing agency (Hopper 2020). State governments ultimately followed one of three routes: they created independent agencies, nested environmental protection

within a public health agency to create a Public Health - Environmental Protection department (PHEP), or nested environmental protection within a natural resources agency to create a Natural Resources - Environmental Protection department (NREP) (Hopper 2020). Due to the high financial cost of creating a new agency, state liberalism and the prevalence of environmentally-related illnesses were two major factors in states' decisions for how to structure environmental agencies (Sinclair and Whitford 2013). More liberal states with more environmental need dedicated funds to establishing new, independent agencies, while more conservative states with less environmental need nested environmental protection within existing agencies (Sinclair and Whitford 2013). However, only one study has thoroughly investigated determinants of environmental agency structure, and there is very little documentation of the decision-making processes at the time of state agency reorganization (Hopper 2020). In rare cases where such documentation exists, reorganization is portrayed as having happened out of necessity, rather than through a contentious political process (Hopper 2020).

Today, 50 state agencies hold the primary responsibility for conducting CAA enforcement. Of those 50, four are PHEPs, 15 are NREPs, and the remainder are independent agencies (Hopper 2020). For the purpose of this study, NREPs are considered in isolation from independent agencies and PHEPs, which are studied together as non-NREPs. Figure 1 illustrates environmental agency structures across all states.

Figure 1. Agency Type by State



1.1.3 Environmental Justice

As with any public policy requiring the distribution of government resources (in this case, any resources that go toward enforcement) there is reason to be concerned that resources may not be distributed equitably across demographic groups. In the context of environmental policy, this uneven distribution has sparked advocacy and research around environmental justice, or the idea that exposure to environmental hazards should not change based on one's race or ethnicity. In a 1978 case seen as one of the first prominent legal battles over unequal distribution of environmental protection resources, residents of a predominantly Black neighborhood in Houston sued the Southwestern Waste Management Corp for operating a landfill in close proximity to houses and community services, including a public school (Bullard 2020). At the

time, 11 of the 13 landfills and incinerators owned by the city of Houston were located in Black neighborhoods (Bullard 2020). The court case that resulted, Bean v. Southwestern Waste Management Corp, drew attention to environmental injustices and motivated researchers to investigate the generalizability of government practices seen in Houston. Since this landmark case, environmental justice researchers have dedicated much of their effort to understanding the relationship between community demographics and the placement of hazardous waste facilities, landfills, and other government-sanctioned polluting facilities. Several investigations have uncovered that communities of color and economically disadvantaged communities live in closer proximity to polluting facilities and face disproportionate exposure to pollution (Bullard et al 2007, Bullard and Wright 2012, Mohai and Saha 2015, Mascarenhas and Bullard 2020). One recent study found that areas that were redlined in the 1930s have some of the highest pollution levels (Lane et al 2022). While it is possible that this is a result of lower property costs in formerly redlined areas, other studies have found disparities in exposure to pollution based solely on race. A 2008 study found that, on average, Black households making $50-$60 thousand annually live in more polluted areas than white households making under $10,000 (Downey & Hawkins, 2008).

Research like this, along with first-hand experiences, has motivated a growing environmental justice movement, based on the "principle that all people and communities have a right to equal protection and equal enforcement of environmental laws and regulations" (Bullard). This movement calls on governments to address racial and economic disparities in exposure to environmental hazards, while working to remedy the root causes of those disparities. There are generally two ways that these disparities could come about: governments may actively

discriminate against specific demographic groups, or governments may be less invested in representing the interests of groups with less political strength. Because it is impossible to fully understand which factor is more influential, both should be considered as theoretical reasons for the existence of disparities. In response to this growing body of research, some government entities, including the US EPA, have made efforts to incorporate environmental justice principles into their plans. On its Clean Air Act enforcement website, the EPA states that one of its top enforcement priorities is to "protect communities disproportionately affected by pollution" (Basic Information on Enforcement). Despite these priorities, analyses of federal government efforts to address environmental injustices have found that they were largely unsuccessful (Harrison 2019, Konisky 2015).

The remainder of this paper proceeds as follows: I first summarize important literature on the determinants of CAA enforcement. I identify gaps in that literature and propose three novel hypotheses. I then explain the theoretical connections between existing research and my hypotheses. I outline my analysis and present findings. Then I discuss limitations of this study and conclusions that can be drawn from my findings.

1.2 Literature Review

Landmark legislation such as the Clean Air Act and Clean Water Act dramatically changed the US environmental policy landscape. However, the federal government has left implementation to state agencies. There is, therefore, considerable variation in how these landmark laws are enforced across states, but there is no consensus on what the most influential determinants of this variation are. Political science scholars have investigated the determinants of

variation in the enforcement of environmental policy across states with a wide variety of hypotheses. In the existing literature, the main four determinants of landmark environmental policy enforcement that scholars have studied are state political characteristics, state and local demographics, influences from interstate competition, and state agency characteristics. While the limited literature on the topic of environmental enforcement has covered a number of possible explanations for differential enforcement across states, it has not thoroughly examined variation within states. There is especially limited study of whether there is discrimination in enforcement behavior.

1.2.1 State Political Factors

Most literature examining differences in state environmental policy enforcement gives some consideration to political factors. Scholars studying the effect of political factors on enforcement have given the most attention to the partisan affiliation of state governors and less attention to partisan breakdowns in state legislatures. Theoretically, governors' partisanship should have more influence than partisan breakdowns of legislatures on enforcement because governors appoint bureaucratic officials. Therefore, scholars have theorized that Democratic governors appoint bureaucratic officials who will enforce regulations more strictly whereas Republican governors appoint more lenient officials (Bergquist 2018, Konisky 2009b). In "Controlling the Regulators: How Party Control of Government Shapes Environmental Regulation in the 21st Century," author Parrish Bergquist finds a causal connection between the party affiliation of governors and enforcement of the Clean Air Act, measured as the number of formal and informal actions state agencies issue against polluting facilities. Bergquist finds no statistical connection between the partisan affiliation of state legislatures and enforcement

behavior (Bergquist 2018). Begrquist employs a regression discontinuity design here, limiting her study to governors who narrowly won office. Some scholars have found the same connection between gubernatorial partisanship and enforcement behavior (Konisky and Shario 2010, Konisky 2009b). Other scholars have found that, while there is a correlation between partisan control of governors' mansions, the effect is statistically insignificant (Hopper 2017, Konisky 2009a). Some have even found that governors' partisanship has no effect (Daley and Garand 2005, Konisky and Reenock 2013) or an inverse effect to what the theory suggests (Konisky 2007). Some of this disagreement could be due to variance in how scholars have measured enforcement. For example, Dr. JoyAnna Hopper (2016) finds that Republican control of state government has a somewhat statistically significant effect on the dollar amounts facilities are made to pay for CAA violations, but it has a statistically insignificant effect on the percentage of violations an agency classifies as severe. Scholars have also examined the impact of partisan control of state legislatures on enforcement behavior, with some finding that it has a weaker effect on enforcement than gubernatorial partisanship (Bergquist 2018, Konisky and Reenock 2013). Other scholars, however, have found that partisan control of the legislature has a statistically significant effect on enforcement, with more Democratic legislatures displaying more stringent enforcement behavior (Konisky and Shario 2010, Hopper 2016, Hopper 2017, Hopper 2020).

Given the lack of a clear conclusion about the relationship between state government partisanship and the strong theoretical connection between gubernatorial partisanship and environmental enforcement, this relationship requires further study. Much of the literature that has examined partisan control of state government as a determinant of enforcement behavior has

not directly addressed the theoretical reason for which a relationship should exist. Past research has shown that political appointees act on behalf of their political principles (Lewis 2007), and research on environmental enforcement rarely connects enforcement back to the interests of political principles. Future research should examine this connection specifically by studying cases where agency leadership remains the same between gubernatorial administrations or by studying other indicators of governors' priorities besides partisan affiliation.

1.2.2 State Agency Characteristics

More recent research has examined the effect of variation in agency structure on environmental policy enforcement. This approach has yielded promising results, with scholars finding both overall agency structure and internal management to influence enforcement behavior. In 2016, Dr. JoyAnna Hopper published her survey of bureaucrats in state environmental agencies with three distinct structures. Some are nested within natural resources agencies (NREPs), some are nested within departments of public health (PHEPs), and some are independent agencies that operate as "mini-EPAs" (Hopper 2016). Hopper constructed an enforcement sentiment score which indicated, based on bureaucrats' survey responses, the importance of strict CAA enforcement to staff in their agencies. She found that environmental agencies nested within public health agencies had lower enforcement scores than independent agencies, and natural resources agencies had lower enforcement scores than public health agencies. She also found that these enforcement scores mapped onto more lenient enforcement behavior in nested agencies than in independent agencies, and especially lenient enforcement behavior in NREPs. Here Hopper measured enforcement as the percentage of CAA violations an agency categorized as severe and the dollar amount agencies were made to pay as a penalty for

violating CAA standards. Hopper looked not only at bureaucrats' private opinions, but also at their public presentation. She used a similar scoring mechanism to that used in her interviews to analyze press release language and found that environmental agencies nested within natural resources agencies use less strict regulatory language and discuss relations with industry stakeholders more than other agencies. According to Hopper, nesting environmental agencies leads to weaker enforcement because the practice of nesting agencies "open(s) the door for neglect, especially the neglect of programs that do not align with the agency's dominant culture" (Hopper 2016). From her surveys, she finds that bureaucrats in nested agencies more often lack a complete understanding of environmental protection goals due to cultural differences between those working in the parent agency and those working in the environmental agency (Hopper 2016).

In her 2020 book, "Environmental Agencies in the United States: the Enduring Power of Organizational Design and State Politics," Hopper expands on her theory of agency design by inspecting the effect of agency capacity on enforcement behavior. She finds, unsurprisingly, that agencies with more staff and larger budgets tend to conduct more enforcement activity. However, this relationship varies from state to state depending on a variety of political factors and other agency design factors.

While Hopper's findings help explain the impact of agency design at the state level, she does not attempt to explain how agency structure might cause local variation in enforcement. Drs. David M. Konisky and Christopher Reenock study this relationship in their 2013 article "Compliance Bias and Environmental (In)Justice." Instead of studying the overall environmental agency structure, Konisky and Reenock examine variation in intra-agency decision-making

structures. Specifically, they look at the level at which enforcement decisions are made. They find that, when high-level bureaucrats are charged with decision-making about enforcement actions, more CAA violations go unnoticed than when decision-making rests with field officers. They find that this disparity is exacerbated in poorer regions and in areas where a higher percent of the population identifies as Hispanic or Latino.

Taken together, these studies make a compelling argument for the impact of agency structure on enforcement behavior. Theoretically, state agency structure and culture should significantly impact enforcement behavior, but its effects have been understudied in environmental enforcement literature. Further research is needed to fully understand how differences in agency structure affect state- and local-level enforcement patterns.

1.2.3 Interstate Competition

Several authors have explored the effect of interstate competition on enforcement of environmental regulations. In "Regulatory Competition and Environmental Enforcement: Is There a Race to the Bottom?" author David Konisky introduces and analyzes the Environmental Race to the Bottom Theory. This theory posits that, in order to maintain an economic advantage over other states, state governments will relax environmental regulations to make their states more attractive to industrial firms (Konisky 2007). Konisky asks whether state environmental agencies respond to changes in nearby states' environmental policies by changing their enforcement practices. According to the Environmental Race to the Bottom Theory, states should respond when neighboring states enact more relaxed environmental policies, but not when they enact more stringent policies. Konisky finds that agencies do respond with changes to enforcement practices. However, he finds that states respond to environmental policy changes in

neighboring states that economically advantage and that disadvantage them. States therefore do not respond asymmetrically to policy changes that disadvantage them, as the "race to the bottom" theory suggests (Konisky 2007).

Konisky's article "Assessing US State Susceptibility to Environmental Regulatory Competition" builds on his earlier article by investigating whether states that are theoretically more likely to respond to environmental policy changes from neighboring states alter their Clean Air Act, Clean Water Act, and Resource Conservation and Recovery Act enforcement behavior (Konisky 2009a). To quantify states' likelihood of responding to environmental policy changes in neighboring states, Konisky creates a "susceptibility index" based on "overall growth, unemployment, manufacturing growth, and manufacturing employment" (Konisky 2009a). He does not find strong evidence that states which are theoretically more susceptible to policy changes in neighboring states change their enforcement behavior.

Konisky also examines the role of horizontal federalism in an article co-authored by Neal D. Woods, "Exporting Air Pollution? Regulatory Enforcement and Environmental Free Riding in the United States." In this article, Konisky and Woods theorize that state environmental protection agencies conduct less strict enforcement of the Clean Air Act and Clean Water Act against polluters near interstate or international borders (Konisky and Woods 2010). This enforcement pattern might occur because polluting facilities near interstate and international borders mostly emit into other states or countries, whose population and resources that state agency is not responsible for protecting. They find support for their hypothesis near international borders but not near interstate borders (Konisky and Woods 2010).

Taken together, these three articles suggest that pressure from neighboring regions may play a role in environmental regulation enforcement, but this relationship only exists in specific circumstances, and it does not always push states to enforce in the same way. Studies investigating the role of federalism in environmental policy enforcement have contributed to enforcement literature by analyzing enforcement data at a granular level with the understanding that both statewide and local factors may influence enforcement. Future research should address influences from vertical federalism, such as how state agencies alter enforcement in response to federal policy changes.

1.2.4 Local Demographics

Many studies on environmental policy enforcement have given consideration to local-level population demographics, such as racial, ethnic, and economic characteristics, as well as urban-rural distinctions. These studies often apply theories from environmental justice literature and question whether local demographics impact enforcement behavior in regions of US states.

Attempts to answer this question have yielded mixed results. Some have found weaker enforcement in localities with proportionately larger poor, Latinx, or Black populations (Konisky 2013, Lynch et al 2004, Mennis 2005, Ringquist 1998). Some have found a correlation between economic characteristics and enforcement behavior but not racial characteristics (Gray and Shadbegian 2004, Konisky 2009c). Others have yielded more complex results, finding weaker enforcement in Latinx communities but not Black communities (Konisky and Schario 2010, Konisky and Reenock 2013). Konisky and Reenock (2013) find that this correlation does not exist in Black communities due to the higher threat of political backlash in Black communities.

This idea is supported by Gray and Shadbegian (2004), who find that agencies conduct significantly more enforcement activity in areas with higher turnout rates. Gray and Shadbegian (2004) also examined urban areas in comparison to rural areas, and found that state agencies conduct less enforcement on facilities in urban areas.

Unequal enforcement of landmark environmental regulation such as the CAA is still a puzzle which requires deeper investigation. Scholars have theorized and found support for variation in political, bureaucratic, economic, and racial characteristics as determinants of enforcement. At the state level, there is reason to believe that state government partisanship, particularly partisanship of the governor, affects enforcement behavior. There is also evidence that state agency structure affects enforcement behavior. Population demographics seem to be relevant determinants of enforcement at the local level. Specifically, local economic and racial demographics have been shown to be influential. While some studies have addressed the question of local discrimination in environmental policy enforcement, there is a need for more research that directly addresses the question of discrimination in enforcement. Literature thus far is limited and inconclusive, and it has not considered all key demographic variables. My research supplements existing literature by investigating discrimination along racial, ethnic, and economic lines, as well as by adding population density as an independent variable.

Given the wide variety of possible ways to measure environmental regulation enforcement, there is still much room to investigate all of these relationships. So far, literature on environmental enforcement has examined relationships at either a local or state level, but scholars have yet to consider how state-level factors may interact with local characteristics to produce variation in enforcement behavior. This is exactly the gap I intend to fill. I will place

Hopper's work on agency structure in conversation with local-level environmental justice research to investigate the interaction of state agency structure with community racial and economic demographics.

2. Theory and Argument

In this paper I aim to answer the following questions: Does discrimination exist in CAA enforcement? How does enforcement differ across different agency structures? Does agency structure exacerbate discrimination in enforcement? I posit the three following hypotheses:

H1: State agencies will enforce less stringently in counties where a higher percentage of the population is Black, Latinx, or below the poverty line, and in counties with higher population density

H2: NREPs will enforce less stringently than PHEPs or independent agencies (non-NREPs).

H3: NREPs will conduct enforcement in a manner that is more discriminatory than that of PHEPs and independent agencies.

My theory has three primary components: I first explain why I expect to see discrimination across all state agencies. I then explain why I expect to see less enforcement from NREPs across all demographic groups. I subsequently develop a novel theory which explains why I expect to see more discrimination in NREPs than in non-NREPs.

2.1 Discrimination

Though previous research has yielded mixed results as to whether regulators enforce the CAA in a discriminatory way, there is a strong theoretical reason to suspect that such discrimination exists across all agency structures. Both inspections and formal actions require state agencies to distribute resources. Staff time is spent inspecting facilities, and agencies spend time and additional funds to execute formal actions. This draws on two possible reasons why discriminatory enforcement might exist: active discrimination on behalf of governments or disregarding concerns of communities with fewer political or financial resources. Active discrimination in state agencies could include refusal to send equivalent resources to communities against which agency staff hold personal biases or which are not reflected in staff demographics. It is also possible that agencies feel more responsibility to communities with more political and financial resources. State agency employees may feel more accountability to communities whose taxpayers contribute more to agencies' funding. State agencies may also be concerned about political backlash if facilities emit excessive amounts and damage the air quality of communities located near facilities. Although state agency employees are not subject to electoral consequences, they are likely concerned about their agency's reputation, which could be damaged if facilities emit over CAA standards and negatively impact air quality. State agency leaders may also be concerned about electoral consequences for their political appointers.

Although existing literature tends to support my theory, it is possible that I could see the opposite effect from what my theory predicts. Given the dramatic increase in attention paid to environmental justice in recent years, state agencies that support environmental justice may be

intent on protecting disadvantaged communities and therefore enforce more stringently in urban counties and counties with higher percentages of Black, Latinx, or economically disadvantaged residents. As is theorized in Gray and Shadbegian (2004) state agencies may conduct more enforcement in regions they believe will receive the largest marginal benefit from enforcement. This could include those who are most at risk of health consequences as a result of air pollution. Because higher asthma rates have been documented in Black, Latinx, low-income, and urban communities, they should receive the largest marginal benefit from enforcement (Nardone et al 2018, Flores et al 2009). It is also possible that I will find results which support my hypotheses, but for a different reason than what I theorize. Namely, it is possible that state agencies enforce more stringently against facilities that emit more. If facilities located in counties with values for my independent variables emit more, then state agencies might conduct more enforcement in those counties regardless of demographics.

2.2 Agency Type

In a second, separate portion of my theory I explain why I expect NREPs to conduct fewer enforcement actions than non-NREPs generally. This argument is similar to that made in Hopper's work on environmental agency structure. In her work, Hopper outlines two primary reasons for differences in enforcement styles of NREPs, PHEPs, and independent agencies. First, nested environmental agencies (NREPs and PHEPs) tend to prioritize the goals of the overseeing agency over environmental protection goals. Hopper refers to this as the "multiplicity of mandates" theory, and its origins can be traced back to the Ash memo and establishment of the US EPA. In the memo, Nixon's Advisory Council refers to the "inherent bias" of existing

bureaucratic agencies and the potential for that bias to influence standard-setting and enforcement of environmental regulations (Ash et al 1970). This bias should exist at the state level as well; agencies with multiple mandates (such as enforcement of environmental regulations and natural resource preservation) must choose how to balance distinct objectives. The goals of the overseeing agency can bleed into agency culture, in this case causing NREPs' enforcement decisions to hinge on a culture driven by the prioritization of natural resource protection.

Nested agencies, particularly NREPs, are also more interested in working with and accommodating for industry, whereas independent agencies and, to some extent, public health agencies, favor strict command-and-control style regulation (Hopper 2016). This, according to Hopper (2016) is due to differences in agency culture that cause bureaucrats to prioritize or downplay the importance of CAA enforcement. I expect both of these differences to affect enforcement behavior. Because environmental agencies have a finite amount of resources at their disposal, NREPs' prioritization of natural resource preservation should cause them to forgo dedicating resources toward environmental enforcement. Additionally, NREPs' interest in working collaboratively with industry should cause them to enforce in a manner that is more lenient, meaning they conduct fewer inspections of polluting facilities, and, when facilities are found to be out of compliance, punish them less harshly.

2.3 Discrimination and Agency Type

The third section of my theory combines the first two sections and introduces a novel hypothesis to the literature on CAA enforcement, that NREPs will enforce the CAA in a more

discriminatory manner than non-NREPs. In other words, structuring an environmental agency as an NREP exacerbates existing discrimination. This argument follows the logic of hypothesis 2 and is based on the two primary differences between nested and non-nested agencies identified in that argument. First is the theory that nested agencies prioritize the goals of the overseeing agency over environmental protection goals. I expect NREPs' interest in protecting natural resources to result in higher levels of enforcement in rural areas than in urban areas because less densely populated areas are generally in closer proximity to natural resources than more densely populated areas. I also expect to see NREPs enforce less stringently in lower-income areas because housing prices tend to be higher near natural resources and lower farther from them. Because the public health goals of CAA enforcement are similar to the environmental protection goals of CAA enforcement, I place PHEPs and independent agencies together in comparison with NREPs. The second explanation Hopper identifies for differences in enforcement is NREPs' stronger interest in working with and accommodating for industry. When governing bodies prioritize the interests of one group, they necessarily fail to fully consider those with conflicting interests. This is likely especially true when the groups with conflicting interests also have less political strength.

3. Research Methodology

This investigation aims to answer the following research questions: Does discrimination exist in CAA enforcement? How does enforcement differ across different agency structures? Does agency structure exacerbate discrimination in enforcement?

To answer these questions, I conduct linear regression analysis using state-level fixed effects and clustering error terms at the county level. In the following section, I describe my data and sources, and I illustrate my methodological approach.

3.1 Description of Data and Variables

The dataset used in this study combines raw data from the US Environmental Protection Agency, the US Census, the Council of State Governments, and the Environmental Council of states. The unit of observation in the data set is county-year, although analysis for hypothesis 2 is conducted at the state-year level. The primary independent variables in my analysis are the state agency structure, the percent of a county population living below the poverty line, the percent that is Black, the percent that is Latinx, and population density (measured as population divided by square miles of land). My primary dependent variable, conceptually, is the severity of enforcement of the CAA on polluting facilities. I operationalize this variable in two ways: the average number of inspections per facility and the average number of formal enforcement actions per facility. Both variables are averaged across county-years or across state-years, depending on the relevant unit of analysis. In the following section I explain the significance of each variable and how it is operationalized. I begin with my unit of analysis, then introduce dependent variables, independent variables, and control variables.

3.1.1 Unit of analysis

In my tests for hypotheses 1 and 3, I conduct analysis at the county-year level in order to understand variation within states and across counties and years. Because I use the same data set

for all analyses, the actual unit of observation used in hypothesis 2 analyses is county-year. However, the independent variables used in hypothesis 2 do not vary within state-years, making the practical unit of analysis the state-year. I therefore calculate all dependent and control variables at the state level and at the county level. My data set includes observations from 2012 through 2019, with data from 49 states, excluding Washington, DC. Nebraska is excluded from my analysis because it has a unicameral state legislature, making it impossible to calculate one political control variable. The data includes only those counties where polluting facilities are located, which is 654 out of about 3,000 US counties. Although this results in a nonrandom sample of US counties, I do have a complete sample of facilities. It is impossible to calculate my dependent variables in counties where facilities are not located, so it would not be beneficial to include a complete set of US counties.

The unit of analysis of county-year brings about some advantages and disadvantages. Most likely, all those affected by pollution from facilities live in the same county where facilities are located, which would not be the case if the unit of analysis were a smaller area, such as zip code or census tract. However, it is likely that a proportion of the population in some counties does not experience pollution emitted from facilities in the same county.

3.1.2 Dependent Variables

I operationalize my dependent variable, CAA enforcement, in two ways: inspections and formal actions. To calculate both dependent variables, I divided the number of inspections or formal actions by the number of facilities in each county-year. Unfortunately, EPA data does not list the years for which each facility was operational, so both dependent variables are calculated

using the number of facilities operational as of February 2022 in each county. Figure 2 shows the total number of polluting facilities in each county. This map reveals that, although the sample of counties included in this data is incomplete, it is relatively representative and includes counties from all 50 states. The map also shows the uneven distribution of facilities across counties. The county with the most polluting facilities, Weld County, CO, has 7455 facilities, and the county with the next largest number of facilities, Cook County, IL, has 4065. Most counties have fewer than 2000 facilities. Relevant dependent and control variables are standardized by the number of facilities in each county, meaning that this uneven distribution should not bias my results. Because my analysis for hypothesis 2 is conducted at the state level, figure 3 depicts the total polluting facilities in each state.

Figure 2. Total Polluting Facitilities by County

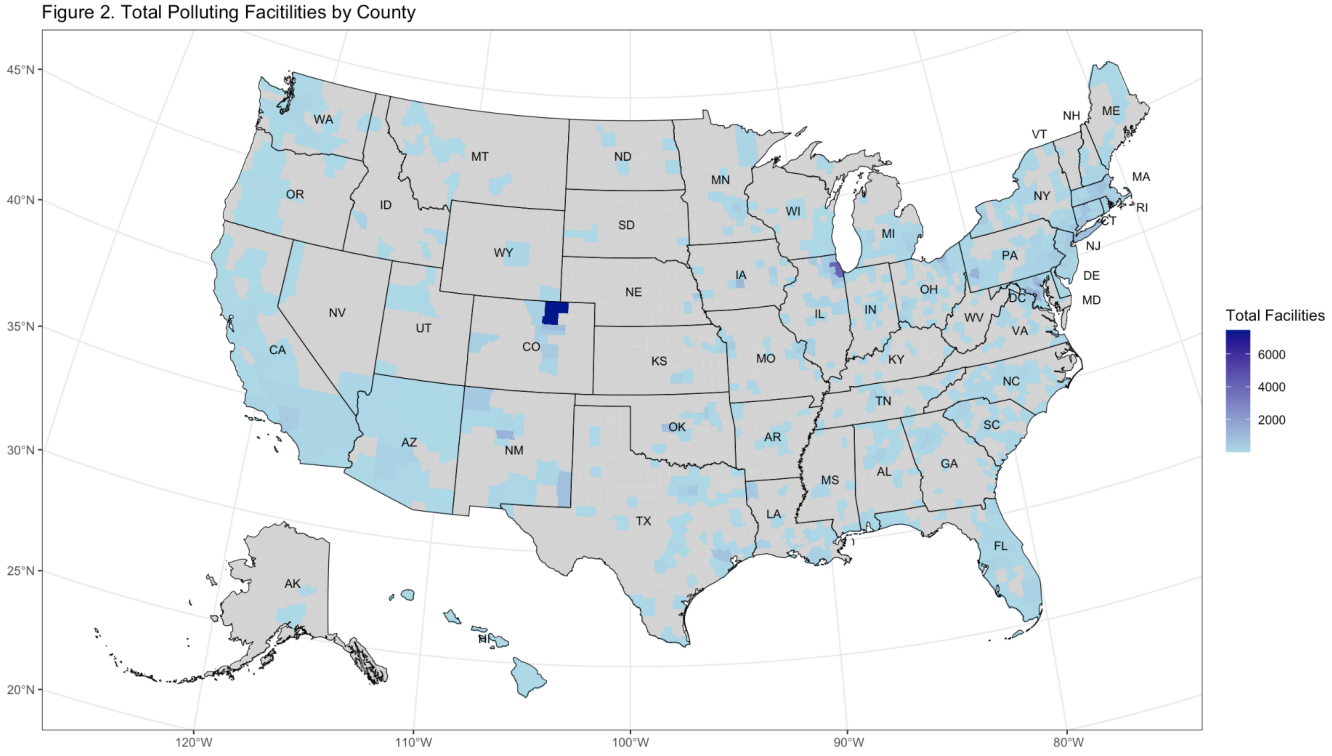
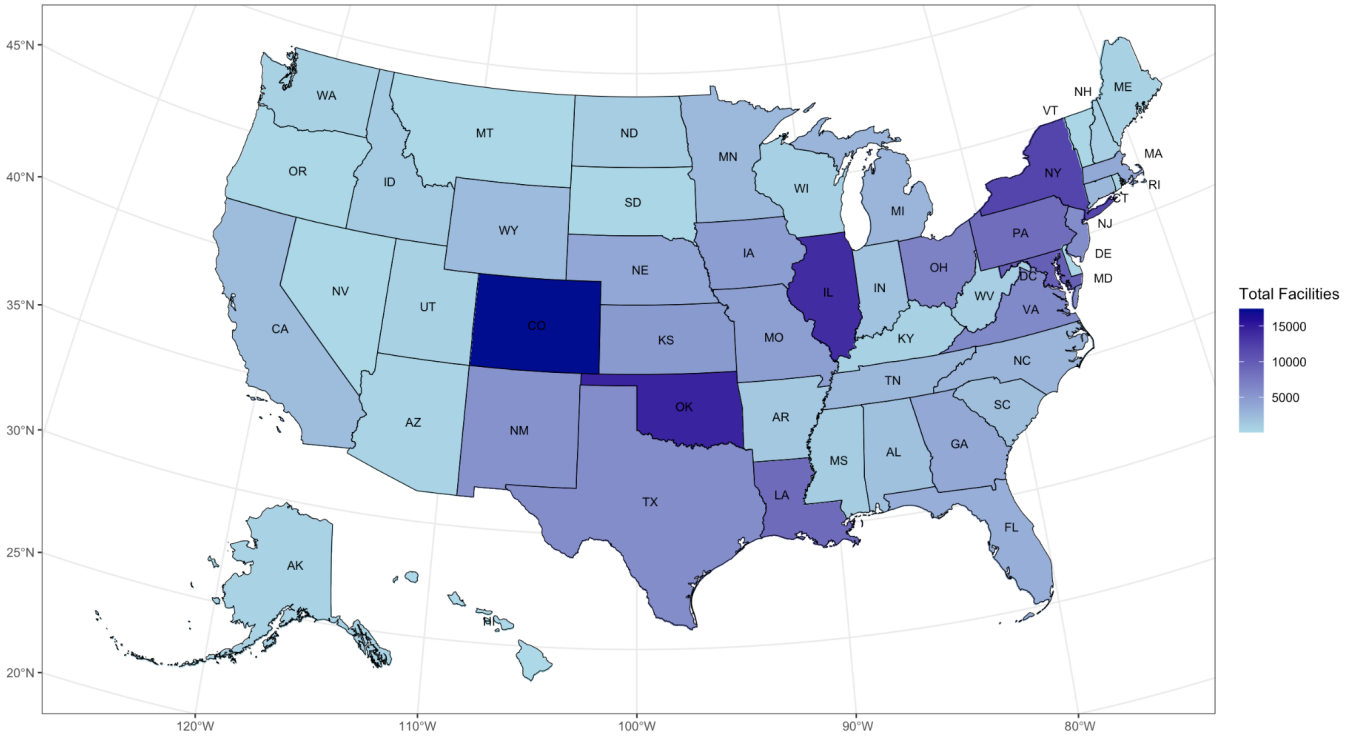


Figure 3. Total Polluting Facitilities by State



Average inspections per facility

Routine inspections are required under the CAA to ensure that polluting facilities are in compliance with CAA standards (Konisky and Woods 2010). Because the resource expenditure that inspections require is more or less standard across states, this variable is a good way to understand how valuable agencies perceive inspections to be and, by extension, how important they believe good air quality is in the area surrounding the facility (Konisky and Woods 2010). Inspections per facility are averaged over each county-year and each state-year present in my data. At the county level, this variable ranges from 0 to 11.708 in my data, with median 0.333 and mean 0.534. At the state level, this variable ranges from 0.01 to 5.032, with median 0.38842613 and mean 0.5081602. At the state level, this variable's lowest values come from New Mexico in 2017, 2018, and 2019, and its highest values come from Montana in 2011, 2012,

2013, and 2014. At the county-year level, this variable equals 0 in about 3.5 percent of all observations. Because the variable never equals 0 at the state level, 0s at the county level indicate that inspections were conducted in that state-year, but they were conducted in different counties.

Data for this variable comes from the US Environmental Protection Agency's "Enforcement and Compliance History Online" webpage. The site features documentation of all inspections and formal and informal enforcement actions, as well as geographic information for all registered polluting facilities and information about facility emissions. I calculated average inspections per facility by counting the number of facilities and the number of inspections documented in each county-year and in each state-year, then dividing the latter by the former. The data, unfortunately, does not list the years during which each facility is active. To accommodate for this, I subset the facilities data to facilities that are currently active. This means that calculations for both dependent variables may be calculated using facilities that were not active during all of the years present in my data, and there may be facilities that were active in the earlier years of my data but are no longer active and are therefore unaccounted for in my calculation. Although this could threaten the validity of both dependent variables, it is unlikely to significantly impact my findings. The number of facilities in a county is unlikely to vary significantly across years given the high costs associated with both establishing new facilities and closing existing ones. Another limitation in the measurement of this variable is that it is possible that states do not report all inspections conducted. Because this variable never equals 0 at the state level, I do not have a strong reason to be concerned about non reporting as a threat to validity. Analyses of projects whose emissions are required by the CAA to be entered have found that data entered by states is generally very reliable (EPA ECHO Frequently Asked Questions).

However, it is not impossible for states to only partially report inspections conducted in a given year, meaning that the values in my data may underestimate actual inspections conducted.

Average formal actions per facility

When state environmental agencies find facilities to be out of compliance with CAA standards, they are entitled to execute enforcement actions in order to bring the facility back into compliance or encourage them to comply in the future. Enforcement actions include any penalizing action an environmental agency takes against a polluting facility when it is found to be out of compliance (Konisky and Woods 2010). These actions range from informal warnings to high fines and are classified as either formal or informal depending on the severity of the punishment (Konisky and Woods 2010). I choose specifically to examine formal enforcement actions because they require significantly more time and money, and sometimes require the involvement of lawyers (Bergquist 2019). Agencies only execute formal actions in extreme cases when a facility is found to be in noncompliance to such an extent that a warning or other informal action would not be adequate to bring it back into compliance. This variable is therefore an indicator of cases where state agencies find facilities' lack of compliance to be so significant that it is necessary to sacrifice additional agency resources to bring the facility into compliance.

For my analysis I calculate the number of formal actions executed in a state-year or county-year, standardized by the number of facilities in that state or county. At the county-year level, formal actions per facility range from 0 to 4.087 in my data, with mean 0.03. The median value for this variable at the county level is 0, meaning that over half of the observations of this variable are 0. This is unsurprising, considering that formal actions are only used in extreme situations. Although it does create a challenge in identifying relationships in my data, the

variable is still valuable because it provides insight into the counties for which state environmental agencies are willing to exhaust the most resources. At the state level, average formal actions per facility range from 0 to 0.521. Most observations where this variable is near its maximum occur in California, possibly due to the state's large environmental budget and commitment to environmental preservation. The variable has a median of 0.008 and mean of 0.033. A one unit increase in the average formal actions per facility indicates a significant increase in a state's resource expenditure, making this variable a strong indicator of which states are invested in environmental protection efforts and where they direct those efforts.

I encounter the same challenges with this variable as with inspections. Namely, it is possible that states conduct formal actions but do not report them to the EPA. It is also possible that the denominator used to calculate this variable, total number of facilities, is not precisely accurate for all observations. For this variable, it is once again important to acknowledge that my data does not include a representative sample of US counties. figure 2 shows the number of polluting facilities located in each county included in my data. This figure clarifies that the data used in this analysis includes counties in all regions of the US. It also demonstrates where the facilities are concentrated.

3.1.3 Independent Variables

Percent Black

Percent Black represents the percent of the county's population that is Black, according to the US Census. Because demographic variables are only used to test hypotheses 1 and 3, this variable, along with all other demographic variables, is only measured at the county-year level.

Percent Black ranges from 0.2 percent to 73.7 percent, with mean 12.1 and median 7.6. My theory predicts that, as percent Black increases, both of my dependent variables will decrease across all agency types. I expect the decrease to be larger in states with NREPs than in states with non-NREPs. As other researchers have theorized (see Konisky and Reenock 2013), I expect percent Black to have a less negative affect on enforcement than other demographic variables due to the higher threat of organized political backlash in Black communities.

Percent Latinx

Percent Latinx represents the percentage of a county's population that is Hispanic or Latino, according to the US Census. Percent Latinx ranges from 02 to 95.5, with mean 11.8 and median 6.7. There is a high amount of heterogeneity among states where counties have low Latinx populations. Many counties with high Latinx populations are located in Texas and California. My theory predicts that, as percent Latinx increases, both of my dependent variables will decrease across all agency types. I expect this relationship to be more negative in states with NREPs than in non-NREP states.

Percent below the poverty line

Percent below the poverty line represents the percentage of a county's population living below the poverty line, according to the US Census. Percent below the poverty line ranges from 5.2 percent to 66.8 percent, with mean 26.4 and median 25.5 percent. I expect that, as percent below the poverty line increases, CAA enforcement will decrease. I expect this relationship to be more negative than the relationship between racial demographics and enforcement because poverty is a more direct indicator of the resources a county has to organize political backlash against discriminatory enforcement practices.

Population Density

Population density is measured as the average number of people per square mile in each county-year of my data. This variable was calculated using land area and population data, the former of which was obtained from the Rand Corporation, and the latter of which comes from the US Census. I calculated population density using 2020 land area data for all observations. Although it is highly unlikely that county land area changed significantly enough in the years included in my data to influence results, it is possible that this variable is not precisely accurate for all observations. Population density ranges from 3.7 to 71413.9, with median 249.9 and mean 833.1. The mean is much higher than the median due to the low number of urban counties with very high population density. The counties with the highest population density include the four counties that make up New York City as well as San Francisco County. My theory predicts that, as population density increases, both of my dependent variables will decrease. While I expect this relationship to hold across all agency types, I predict that it will be more negative in states with NREPs.

Agency type

Agency type represents the structure of state environmental agencies. Again, state environmental agencies can either operate independently as "mini-EPAs," they can be nested within public health agencies (PHEP), or they can be nested within natural resources agencies (NREP). In my data agency type is presented as a binary variable representing whether a state agency is an NREP or not. Agency type equals 1 if a state has an NREP and 0 if it has a non-NREP. Data for this variable comes from Dr. Joyanna Hopper's 2020 book, Environmental

Agencies in the United States. 15 states in my data have NREPs. There are no cases in my data where states switched from having an NREP to a non-NREP or vice versa. My theory predicts that, as agency type increases (moving from a non-NREP to an NREP), both dependent variables will decrease. In other words, I expect NREPs to enforce less stringently than other agencies. I also expect NREPs to conduct enforcement in a more discriminatory manner than non-NREPs, meaning that the relationship between demographic variables and both dependent variables will be more negative in states with NREPs than in states with non-NREPs.

3.1.4 Control Variables

State-level political variables

I include the governor's political party, along with the percent of state house and senate members who are Republican, as control variables. Data for all three variables comes from the "Book of the States" publications, compiled by the Council of State Governments. Not only has previous literature identified all three of these variables as important in predicting CAA enforcement, but there is a strong theoretical argument for including all three. The governor's political party is likely to be the most significant because governors' appointment powers allow them to select agency leaders who will enact their preferred policies. I expect that, in states with Republican governors, state agencies will conduct fewer inspections and execute fewer formal actions than agencies in states with Democratic governors. Gubernatorial partisanship is operationalized as a binary variable which equals 1 if the governor is a Republican, 0.5 if they are an independent, and 0 if they are a Democrat. I also control for the political makeup of the state house and state senate. I operationalize this variable by creating one variable which

indicates whether a state legislature is controlled by Democrats (both chambers are majority democratic), controlled by Republicans (both chambers are majority republican) or split. In my data, this variable equals 0 for Democratic control, 0.5 for split, and 1 for Republican control. Both gubernatorial and legislative partisanship are important to consider because state legislatures have the ability to enact laws that dictate how state agencies enforce the CAA. In their 2000 study, "Designing State Clean Air Agencies: Administrative Procedures and Bureaucratic Autonomy," Authors Matthew Potoski and Neal D. Woods found that state legislatures generally influence implementation of the CAA using this strategy, rather than using a "fire alarm strategy" in which they establish rules that allow interest groups to track agency actions and independently hold agencies accountable. I expect this variable to affect my dependent variables in the same way that gubernatorial partisanship does, where the relationship between legislative partisanship and both dependent variables is negative.

State agency budget

I include the state agency budget as a control variable to account for wide differences across states in resources state agencies are capable of putting toward CAA enforcement. State agency budget is measured at the county level in tests for H1 and H3, and at the state level in tests for H2. At the county level, state agency budget represents a state environmental agency budget in a given year, divided by the number of facilities in that state and multiplied by the number of facilities in each county. Conceptually, the variable measures the funds a state agency would spend on each county if they distributed their total budget across counties based solely on the number of facilities in each county. At the state level, this variable measures the state agency budget divided by the total number of facilities in a state. At the county level, the agency budget

ranges from around three hundred thousand in several counties to about 96 billion in Los Angeles County in the later years represented in my data. California is disproportionately represented at the high end of the variable's range, with the highest 31 observations all coming from the state. The mean budget value is about 1.2 billion, and the median is about four hundred million. The large gap between the variable's median and mean is likely due in large part to California's immense environmental protection budget. At the state level, the agency budget per facility ranges from 4673 to about 300 million. At the state level this variable's highest values come from Hawaii and California, and its lowest values come from Colorado and Oklahoma. I expect that, as the budget per facility increases, inspections and formal actions will both increase because states will be able to dedicate more resources to enforcement.

3.2 Analysis

At a high level, my analysis follows the same trajectory as my theory. I first attempt to understand whether there is discriminationin CAA enforcement. Then I investigate the relationship between agency type and enforcement behavior. Based on my theory regarding the differential effects of demographic variables on enforcement in differently-structured agencies, I run tests which include an interaction between agency type and demographic variables.

My analysis consists of ordinary least squares regressions with varying independent and dependent variables. OLS regressions best match my argument, which states that, as important demographic variables increase and agency structure changes from non-NREP to NREP, enforcement will decrease proportionally. Although this methodology is the most logical given

my hypothesis, it is limited in that it is capable of predicting negative values for both dependent variables, which is realistically impossible. For each of the three big-picture steps of my analysis outlined in the previous paragraph, I run each regression once with the average inspections per facility as the dependent variable and once with the average formal actions per facility as the dependent variable. All regressions include controls for state environmental agency budget and state political factors.

The first set of tests I conduct investigates whether there is discrimination in enforcement generally. To explore this relationship, I run separate linear regressions with each dependent variable and with the full set of independent and control variables. For each dependent variable (inspections and formal enforcement actions) I also run a set of regressions which include all control variables and only one independent variable, such as percent Black or percent below the poverty line. These regressions can reveal whether some variation which appears to be caused by certain variables in the full model is actually a result of collinearity between variables. Due to historically discriminatory housing policies and residential segregation, there is reason to suspect that percent Black and percent Latinx would both display some degree of collinearity with percent below the poverty line and population density (Lane et al 2022). There is therefore uncertainty in whether it is truly possible to inspect the impact of a single demographic variable in isolation. I expect that regressions which only include one independent variable will overestimate that variable's causal power, because they will attribute variation actually caused by collinear demographic variables to that variable. Although, again, full regression models will be unable to precisely control for impacts from all demographic variables, they can serve as

robustness checks to support or caution against conclusions I draw from partial models.

Regressions to test H1 will be structured as follows:

Full models:

$$avg\ inspections\ per\ facility = \alpha + \beta_1(\%\ Black) + \beta_2(\%\ Latinx) + \beta_3(\%\ poor) + \beta_4(population\ density) + \beta_5(budget) + \beta_6(gov\ party) + \beta_7(legislature\ partisanship) + state + year$$

$$avg\ formal\ actions\ per\ facility = \alpha + \beta_1(\%\ Black) + \beta_2(\%\ Latinx) + \beta_3(\%\ poor) + \beta_4(population\ density) + \beta_5(budget) + \beta_6(gov\ party) + \beta_7(legislature\ partisanship) + state + year$$

Partial models:

$$avg\ inspections\ per\ facility = \alpha + \beta_1(demographic\ variable) + \beta_2(budget) + \beta_3(gov\ party) + \beta_4(legislature\ partisanship) + state + year$$

$$avg\ formal\ actions\ per\ facility = \alpha + \beta_1(demographic\ variable) + \beta_2(budget) + \beta_3(gov\ party) + \beta_4(legislature\ partisanship) + state + year$$

All regressions in my tests for H1 include fixed effects at the state and year level and error terms clustered at the county level. Fixed effects at the state and year level allow me to control for variation across states and years that is not accounted for in my control variables. I apply fixed effects at the state level rather than at the county level because fixed effects at the state level allow me to account for the fact that enforcement decisions are made at the state level, rather than the county level. Error terms are then clustered at the county level to account for variation across counties that exists due to factors not encapsulated in my control variables. I hypothesize that all demographic variables will be statistically significant with negative coefficients for both dependent variables.

My second hypothesis is that agency type causes changes in CAA enforcement. Specifically, I expect that NREPs will conduct fewer inspections and execute fewer formal actions than non-NREPs. To test this hypothesis I regress each dependent variable on agency type, including all controls. Because this analysis is conducted at the state level, rather than the county level, I change my measurement of agency budget to represent the total state agency budget divided by the number of facilities in the state. For these regressions I remove fixed effects at the state level, because state agency type correlates perfectly with state. I keep year-level fixed effects included in these tests because factors that vary across years could still impact enforcement behavior. I also cluster error terms at the state level, as opposed to the county level. This set of regressions is structured as follows:

$$avg\ inspections\ per\ facility = \alpha + \beta_1(agency\ type) + \beta_2(budget) + \beta_3(gov\ party) + \beta_4(legislature\ partisanship) + year$$

$$avg\ formal\ actions\ per\ facility = \alpha + \beta_1(agency\ type) + \beta_2(budget) + \beta_3(gov\ party) + \beta_4(legislature\ partisanship) + year$$

I proceed by testing H3, which posits that NREPs conduct enforcement in a more discriminatory manner than non-NREPs. The methodology for this set of regressions follows that of the first set, with the addition of agency type interacted with one or more independent variables. This interaction allows me to understand the effect agency type has on the relationships between county demographics and enforcement behavior. In these regressions I expect to see a more negative relationship between demographic variables and enforcement in states with NREPs than in states with non-NREPs. This set of regressions is structured as follows:

Full models:

$$avg\ inspections\ per\ facility = \alpha + \beta_1(\%\ Black\ *\ agency\ type) +$$

$$\beta_2(\%\ Latinx\ *\ agency\ type) + \beta_3(\%\ poor\ *\ agency\ type) +$$
$$\beta_4(population\ density\ *\ agency\ type) + \beta_5(\%\ Black) + \beta_6(\%\ Latinx) +$$
$$\beta_7(\%\ poor) + \beta_8(population\ density) + \beta_9(agency\ type) + \beta_{10}(budget) +$$
$$\beta_{11}(gov\ party) + \beta_{12}(legislature\ partisanship) + state + year$$

$$avg\ formal\ actions\ per\ facility = \alpha + \beta_1(\%\ Black\ *\ agency\ type) +$$
$$\beta_2(\%\ Latinx\ *\ agency\ type) + \beta_3(\%\ poor\ *\ agency\ type) +$$
$$\beta_4(population\ density\ *\ agency\ type) + \beta_5(\%\ Black) + \beta_6(\%\ Latinx) +$$
$$\beta_7(\%\ poor) + \beta_8(population\ density) + \beta_9(agency\ type) + \beta_{10}(budget) +$$
$$\beta_{11}(gov\ party) + \beta_{12}(legislature\ partisanship) + state + year$$

Partial models:

$$avg\ inspections\ per\ facility = \alpha + \beta_1(demographic\ variable\ *\ agency\ type) +$$
$$\beta_2(demographic\ variable) + \beta_3(agency\ type) + \beta_4(budget) +$$
$$\beta_5(gov\ party) + \beta_6(legislature\ partisanship) + state + year$$

$$avg\ formal\ actions\ per\ facility = \alpha + \beta_1(demographic\ variable\ *\ agency\ type) +$$
$$\beta_2(demographic\ variable) + \beta_3(agency\ type) + \beta_4(budget) +$$
$$\beta_5(gov\ party) + \beta_6(legislature\ partisanship) + state + year$$

4. Findings

I find varying levels of support for my hypotheses. I do not find support for H1. In fact, I find evidence that state agencies conduct more enforcement in some disadvantaged communities. I find some support for H2; NREPs clearly execute fewer formal actions than non-NREPs, but the relationship between agency type and inspections is statistically indistinguishable from 0. I also find some support for H3; While non-NREPs do not display more discriminatory behavior than NREPs, they do display less anti-discriminatory behavior. In the following section I illustrate the main takeaways for each hypothesis. I then summarize the main takeaways from all tests.

4.1 H1 Tests

4.1.1 H1 Tests – Inspections

Table 1. Demographics and Inspections

	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Latinx	0.0052+	0.0050+			
	(0.0031)	(0.0029)			
Percent Black	−0.0003		−0.0003		
	(0.0015)		(0.0012)		
Pct Below Poverty Line	0.0053**			0.0056**	
	(0.0020)			(0.0020)	
Population Density	0.0000				0.0000
	(0.0000)				(0.0000)
Budget (millions of dollars)	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Governor Partisanship	−0.0323*	−0.0321*	−0.0330*	−0.0322*	−0.0324*
	(0.0158)	(0.0157)	(0.0157)	(0.0158)	(0.0157)
Legislature Partisanship	−0.0462	−0.0498	−0.0426	−0.0550	−0.0501
	(0.0467)	(0.0457)	(0.0463)	(0.0461)	(0.0459)
Num.Obs.	6460	6489	6469	6489	6480
R2	0.285	0.281	0.279	0.280	0.276
R2 Adj.	0.278	0.274	0.272	0.273	0.269

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

In this set of regressions, I test H1 with inspections as the dependent variable. The tests presented above seek to explain whether state agencies exhibit discriminatory behavior in

enforcement. The results shown in Table 1 indicate no support for my hypothesis, and, in some instances, show findings counter to what my hypothesis predicted. Percent Latinx and percent below the poverty line display some level of statistical significance. However, for both variables, the coefficients point in the opposite direction of what I predicted. For example, my analysis demonstrates that, when the percentage of a county's population living below the poverty line increases by 1, average inspections per facility increase by about 0.0057. This value changes to 0.0054 when other demographic variables are included as controls. The decrease in the magnitude of the coefficient indicates that, in the model including only percent below the poverty line as an independent variable, some of the variance that appears to be caused by that variable is actually caused by other variables, such as percent Latinx or state house partisanship. Percent Black and population density both have negative coefficients, as I predicted. However, neither variable displays any level of statistical significance.

The effect of percent below the poverty line on inspections is significant in this model and can be used to motivate the development of new theories. The effect of percent Latinx on inspections is somewhat significant, but should be interpreted with caution. In both the full and partial models, the confidence interval for this variable's coefficient crosses zero, meaning that it is impossible to say with certainty that counties with proportionally larger Latinx populations receive more enforcement than other communities.

Partisan affiliation of governors and state legislatures both have the expected effect on inspections. Specifically, as both become more Republican, inspections decrease. State legislature, however, does not hold any statistical power in predicting the number of inspections per facility. Although this is counter to my theory, it is unsurprising given the relatively larger

influence governors have over state agency actions. Also counter to my theory is the coefficient and significance of the state agency budget. Although it is not visible in Table 1, the coefficient on this variable is actually slightly negative across all models (-7.421e-13 in the full model). In other words, agencies with larger budgets conduct fewer inspections. However, the impact of agency budgets on inspections is statistically indistinguishable from zero.

4.1.2 H1 Tests – Formal Actions

Table 2. Demographics and Formal Actions

	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Latinx	0.0017*	0.0016+			
	(0.0008)	(0.0008)			
Percent Black	0.0004		0.0003		
	(0.0003)		(0.0003)		
Pct Below Poverty Line	0.0007+			0.0009+	
	(0.0004)			(0.0005)	
Population Density	0.0000				0.0000
	(0.0000)				(0.0000)
Budget (millions of dollars)	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Governor	−0.0035*	−0.0034*	−0.0036*	−0.0035*	−0.0036*
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0016)
Legislature Partisanship	0.0033	0.0034	0.0037	0.0025	0.0032
	(0.0067)	(0.0066)	(0.0067)	(0.0066)	(0.0066)
Num.Obs.	6460	6489	6469	6489	6480
R2	0.188	0.184	0.174	0.176	0.174
R2 Adj.	0.180	0.176	0.167	0.168	0.167

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

This set of regressions acts as a secondary test for the effect of county demographics on enforcement behavior. In these tests, average formal actions per facility is the dependent variable. The results for these tests are similar to those from the first set, with percent below the poverty line and percent Latinx standing out as the two most statistically significant variables.

Again, the coefficients on both variables point in the opposite direction of what my hypothesis predicted.

Although these tests suggest similar findings to the first set, all findings should be interpreted with caution. Confidence intervals cross zero for nearly all coefficients which display some level of statistical significance. The exception to this rule is the coefficient on percent Latinx in the full model. Once other demographic variables are removed as controls, the confidence interval for this variable crosses zero. It is likely that this change is a result of the collinearity between percent Latinx and percent below the poverty line and that the coefficient in the first model is more reliable than that in the partial model. In the case of the percent below the poverty line, confidence intervals on the coefficients in both the full and partial models cross zero, so it is impossible to say with certainty how percent below the poverty line affects formal actions.

Taken together, the results from the first two sets of regressions indicate that percent Latinx and percent below the poverty line are the most significant county-level predictors of enforcement behavior. Across all models, when either variable increases, enforcement also increases. While percent below the poverty line is more influential for inspections, percent Latinx is more influential for formal actions. Population density and percent Black are insignificant across all models. Again, these results should be interpreted with caution in cases where confidence intervals cross zero. While these results are counter to my hypothesis, there are a few possible explanations for why they occurred. It is possible that pollution is simply worse in Latinx and poor communities, and, therefore, state agencies conduct more enforcement in those communities. If this is the case, however, I would expect to see the same effect in Black and

urban communities. These results might therefore indicate that state agencies conduct enforcement based on actual air quality and pollution in most instances, but not in Black and urban communities. In this case, controlling for an indicator of air quality or facility emissions would reveal lower enforcement in urban counties and in counties with larger Black populations, but not in communities with larger Latinx or low-income populations.

It is also possible that these results reveal true prioritization of enforcement in low-income and Latinx communities. This finding, therefore, might signal support for Gray and Shadbegian's 2013 theory that governments prioritize enforcement in communities that they believe will receive the largest marginal benefit from enforcement.

4.2 H2 Tests

Table 3. Agency Type and Inspections

	Model 1
NREP	−0.0985
	(0.1091)
Governor Partisanship	−0.2012
	(0.1200)
Legislature Partisanship	0.1737
	(0.1454)
Budget (millions of dollars	0.0038*
	(0.0009)
Num.Obs.	6489
R2	0.167
R2 Adj.	0.166
Std.Errors	by: state

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 4. Agency Type and Formal Actions

	Model 1
NREP	−0.0241*
	(0.0105)
Governor Partisanship	−0.0116
	(0.0087)
Legislature Partisanship	−0.0200
	(0.0181)
Budget (millions of dollars)	0.0011
	(0.0004)
Num.Obs.	6489
R2	0.535
R2 Adj.	0.534
Std.Errors	by: state

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

The regression results presented above display some support for my hypothesis. Specifically, they show support for hypothesis 2 when formal actions are the dependent variable, but not when inspections are the dependent variable. The coefficient on NREP is negative in table 4, meaning that, on average, NREPs execute fewer formal actions than non-NREPs. Formal

actions require agencies to exhaust more resources, so they are a good indicator of agencies' willingness to make financial sacrifices in order to ensure CAA compliance. At the state level, the third quartile value of average formal actions per facility is 0.023, and the minimum is 0. The results displayed in table 4 show that switching from a non-NREP state to an NREP state results in the number of formal actions per facility falling from approximately its third quartile value to its minimum value.

The high R^2 value in table 4 reveals that over half of the variation in formal actions is explained by the variables present in that model. This value empirically confirms theoretical reasoning for the importance of agency type and state political characteristics in determining enforcement behavior. This value cannot be placed in comparison with the R^2 value in table 2 because the unit of analysis here is state-year, rather than county-year. However, the high predictive power of agency type and control variables for state-level formal actions is still significant.

4.3 H3 Tests

Hypothesis 3 posits that NREPs will exhibit more discriminatory enforcement behavior than non-NREPs. In general, I find that non-NREPs conduct more enforcement in counties with larger Latinx and economically disadvantaged populations. This is similar to patterns shown in tables 1 and 2. However, demographic characteristics do not appear to have any statistically significant effect on enforcement behavior in states with NREPs. These results somewhat support my hypothesis because they illustrate that NREPs do not enforce stringently in disadvantaged communities in the same way that non-NREPs do. While it is not entirely accurate that

non-NREPs display more discriminatory behavior than NREPs, they do display less anti-discriminatory behavior.

Because of the wide variety in demographics and enforcement across states, it is important to first inspect patterns in the data within states. Tables 1 and 2 reveal that the percentage of a county population living below the poverty line and the percentage of a county's population that is Latinx are the two most influential demographic factors for states' enforcement actions. Figures 1 and 2 therefore illustrate inspections as a function of these two variables in all states and years represented in my data. I use inspections for both figures because there is significantly more variation in that variable than in formal actions, making it much easier to observe patterns in visualizations.

Figure 4. Percent Latinx and Inspections per Facility

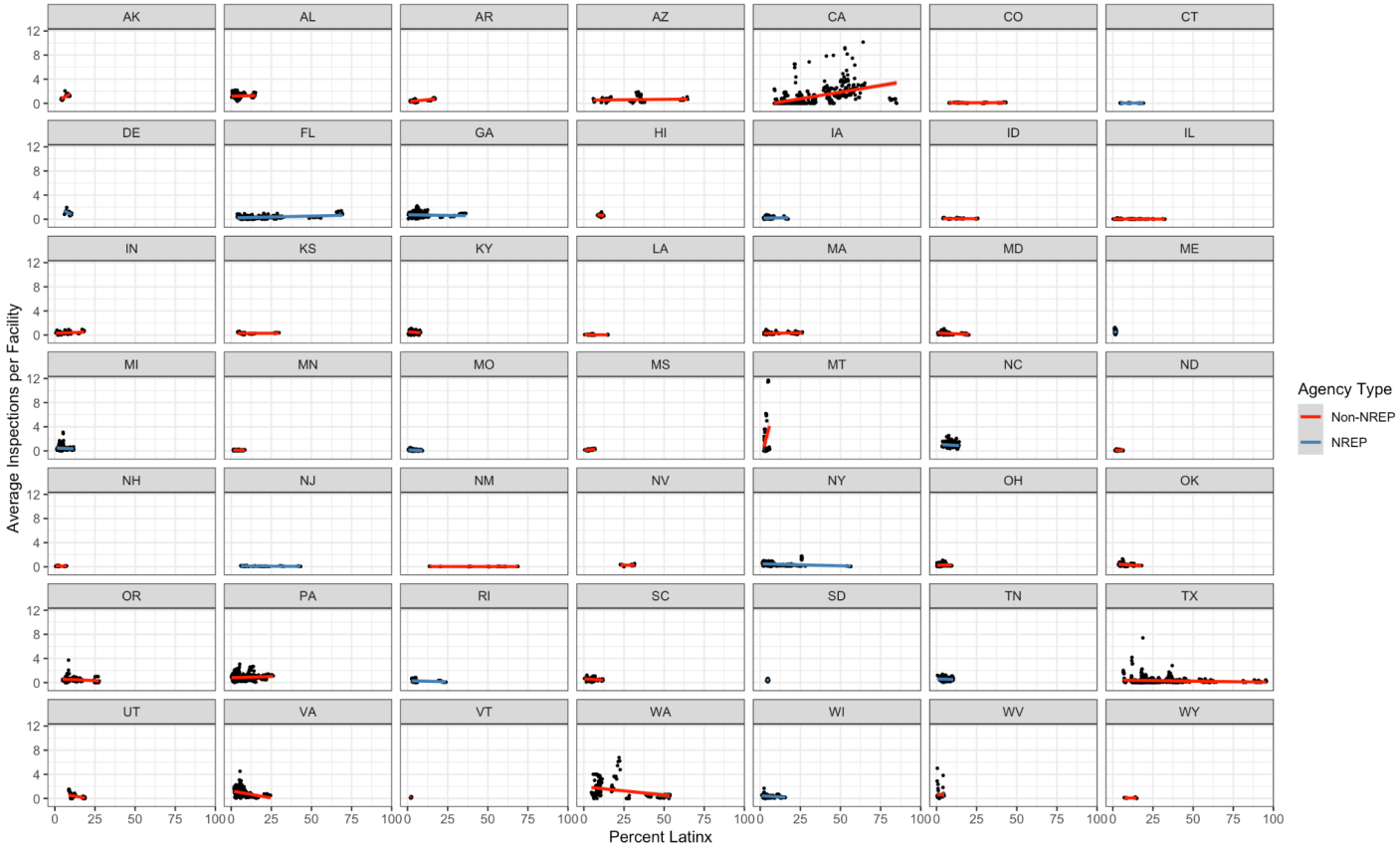
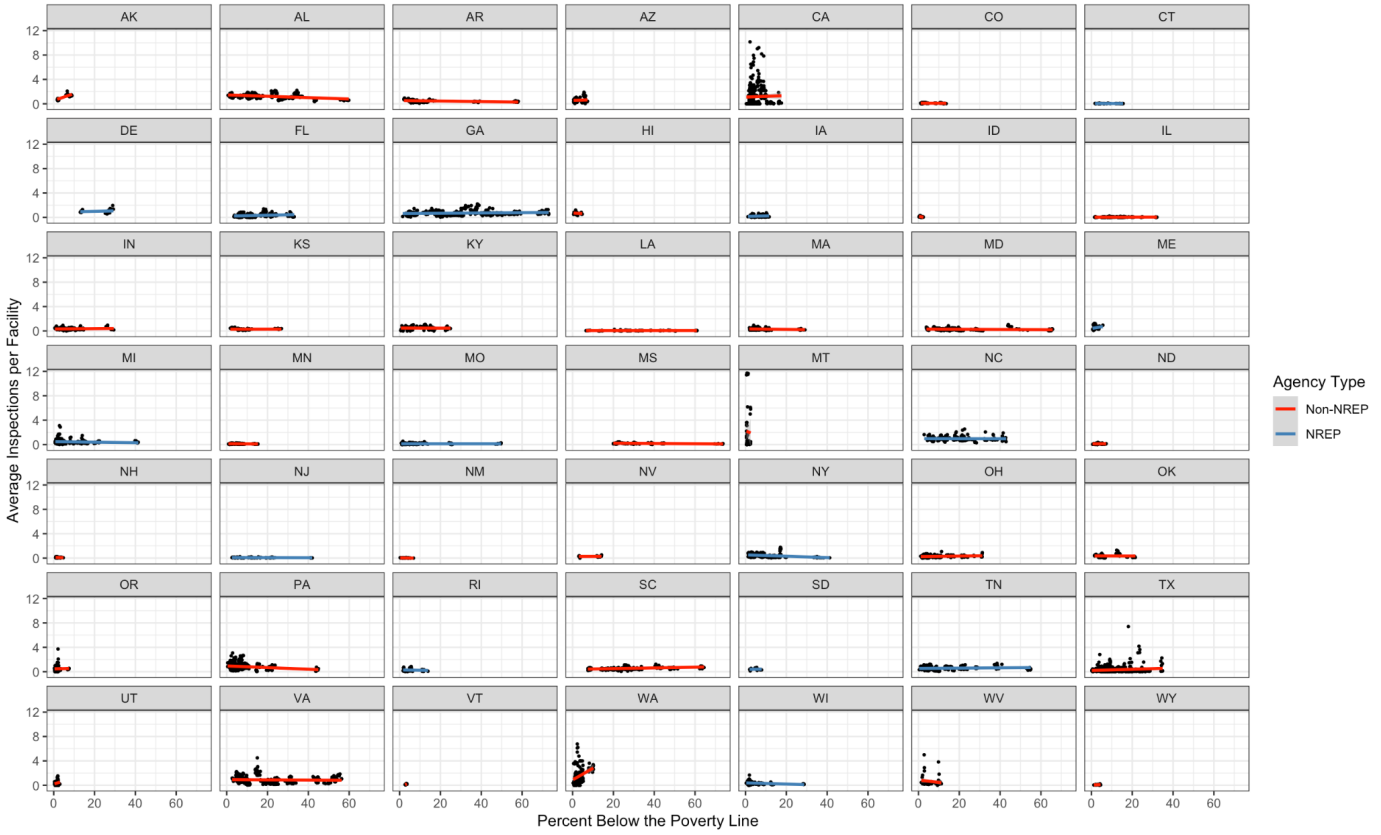


Figure 5. Percent Below the Poverty Line and Inspections per Facility



Figures 4 and 5 clarify the distribution of data across all states included in my analysis. Because of the large variation in the number of inspections conducted across states, it is challenging to identify patterns in many states. However, these figures reveal which states might be the primary drivers of the relationships found in the first set of regression tests. Specifically, the positive relationship between both independent variables and inspections in California may be a significant driver of positive relationships shown in Tables 1 and 2. The possibility that this relationship is driven by California is certainly important to consider; however, it is also important to consider the fact that California has the largest population of any state in the US. This study ultimately aims to understand the importance state agencies assign to protecting distinct demographic groups. Therefore, it is important to consider a complete sample of Americans living near polluting facilities, regardless of the states in which they are

geographically concentrated. With this in mind, I keep California's data included in my analysis and test my third hypothesis. The following table illustrates coefficients and standard errors when interaction terms are included and inspections are the dependent variable.

4.3.1 H3 Tests – Inspections

Table 5. Demographics, Agency Type, and Inspections

	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Latinx	0.0071+	0.0065+			
	(0.0037)	(0.0037)			
Percent Black	0.0025		−0.0007		
	(0.0019)		(0.0017)		
Pct Below Poverty Line	0.0049+			0.0069*	
	(0.0026)			(0.0028)	
Population Density	−0.0001**				−0.0001**
	(0.0000)				(0.0000)
Budget (millions of dollars	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Governor	−0.0330*	−0.0325*	−0.0329*	−0.0308+	−0.0327*
	(0.0159)	(0.0157)	(0.0157)	(0.0158)	(0.0158)
Legislature Partisanship	−0.0451	−0.0506	−0.0423	−0.0533	−0.0487
	(0.0467)	(0.0458)	(0.0462)	(0.0461)	(0.0459)
NREP x Percent Latinx	−0.0103+	−0.0074			
	(0.0058)	(0.0051)			
NREP x Percent Black	−0.0028		0.0011		
	(0.0024)		(0.0022)		
NREP x Percent Below Poverty Line	−0.0019			−0.0039	
	(0.0034)			(0.0035)	
NREP x Population Density	0.0001**				0.0001**
	(0.0000)				(0.0000)
Num.Obs.	6460	6489	6469	6489	6480
R2	0.297	0.282	0.279	0.280	0.285
R2 Adj.	0.289	0.275	0.272	0.273	0.278

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

The regression models depicted above test hypothesis 3, which posits that NREPs enforce in a manner that is more discriminatory than that of other agencies. With average inspections per facility as the dependent variable, I find limited support for and some evidence counter to my hypothesis. I find partial support for my hypothesis in the coefficients on percent Latinx and agency type x percent Latinx. The coefficient on percent Latinx in non-NREPs is positive, meaning that non-NREPs conduct more inspections in counties with larger Latinx populations. Specifically, a one unit increase in percent Latinx corresponds with a 0.07 unit increase in average inspections per facility. In states with NREPs, the coefficient on percent Latinx is slightly negative but insignificant, and its confidence interval crosses 0. This means that, while non-NREPs conduct more inspections in counties with larger Latinx populations, NREPs conduct inspections in a manner not dictated by county demographics. While these findings do not precisely support my hypothesis, they lend credence to the general idea that NREPs are less concerned with protecting disadvantaged communities than non-NREPs.

A similar pattern appears with percent below the poverty line. In non-NREPs, the coefficient on percent below the poverty line is positive and statistically significant; in NREPs, it is statistically indistinguishable from zero. Again, this suggests that non-NREPs prioritize protecting disadvantaged communities, while NREPs do not. This variable is slightly less informative than percent Latinx because the confidence interval on percent below the poverty line crosses zero in the full model. However, the interval ranges from -0.0002 to 0.01, with p value 0.0596, meaning that it is very unlikely that that the coefficient is actually negative, and the same relationship is likely present here as with percent Latinx.

These models also reveal some findings counter to hypothesis 3. Table 5 shows population density having the opposite effect on inspections from what I predicted. Specifically, non-NREPs conduct fewer inspections on average in more densely populated counties, and NREPs do not exhibit the same behavior. In other words, non-NREPs enforce in a way that is discriminatory against urban counties, but population density has no significant impact on enforcement in NREPs. The coefficient on population density is also notable because it is insignificant in table 1, which examines the effect of demographics on inspections across all state agencies. This reveals that, while environmental agencies generally do not enforce differently in urban and rural counties, non-NREPs do. Taken together, the results shown in Table 5 reveal a pattern of enforcement among non-NREPs where the protection of Latinx and low-income communities is prioritized, and protection of urban communities is not prioritized. All coefficients in NREP states are statistically indistinguishable from zero, meaning that no demographic characteristics have any effect on inspections in NREP states.

4.3.2 H3 Tests – Formal Actions

Table 6. Demographics, Agency Type, and Formal Actions

	Model 1	Model 2	Model 3	Model 4	Model 5
Percent Latinx	0.00211*	0.00198+			
	(0.00101)	(0.00100)			
Percent Black	0.00115**		0.00059+		
	(0.00038)		(0.00030)		
Pct Below Poverty Line	0.00081			0.00124+	
	(0.00058)			(0.00066)	
Population Density	−0.00001*				−0.00001
	(0.00000)				(0.00000)
Governor	−0.00354*	−0.00352*	−0.00364*	−0.00309*	−0.00362*
	(0.00158)	(0.00155)	(0.00155)	(0.00151)	(0.00156)
Budget (millions of dollars)	0.00000	0.00000	0.00000	0.00000	0.00000
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Legislature Partisanship	0.00339	0.00312	0.00359	0.00298	0.00336
	(0.00672)	(0.00660)	(0.00669)	(0.00660)	(0.00658)
NREP x Percent Latinx	−0.00227+	−0.00213+			
	(0.00112)	(0.00115)			
NREP x Percent Black	−0.00123**		−0.00070*		
	(0.00041)		(0.00032)		
NREP x Percent Below Poverty Line	−0.00070			−0.00113+	
	(0.00056)			(0.00064)	
NREP x Population Density	0.00001*				0.00001
	(0.00000)				(0.00000)
Num.Obs.	6460	6489	6469	6489	6480
R2	0.197	0.187	0.175	0.176	0.177
R2 Adj.	0.188	0.180	0.167	0.169	0.169

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

The regression results presented above test hypothesis 3 when average formal actions per facility is the dependent variable. In these models, percent Black and percent Latinx stand out as the most important in determining formal actions, and both variables partially support hypothesis 3. For both variables, an increase in the percent of a county's population that falls within that demographic group results in an increase in formal actions in non-NREP states. NREPs, however, do not appear to execute formal actions in a manner at all dependent on county demographics. This is consistent with patterns identified in table 5, where inspections are the dependent variable. These findings lend further support to the theory that non-NREPs conduct enforcement in a way that protects disadvantaged communities, but NREPs do not factor demographics into enforcement decisions. In partial models, the confidence intervals for coefficients on percent Black and percent Latinx cross zero, and p values are just over 0.05, so it is not possible to say with certainty that these relationships are positive. However, considering the low p values on both variables in the full model, it is very likely that they are.

The significance of the coefficient on percent Latinx is unsurprising, considering its significance in other models. The coefficient on percent Black, however, reveals a new relationship not previously observed. This variable has a much higher coefficient and lower p value than in Table 2, revealing a different relationship than that observed across all agencies. This means that, while state agencies generally do not execute more formal actions in counties with larger Black populations, non-NREPs do.

The results in tables 5 and 6, although not entirely supportive of my hypothesis, tell an important story about the impact of agency type on discrimination in enforcement behavior. Non-NREPs appear to enforce in a way that benefits disadvantaged communities over other

communities, while NREPs enforce evenly across communities with unique demographics. The one exception to this finding exists in the population density variable in table 5, where inspections are the dependent variable. In this case, an increase in population density results in a decrease in inspections. Though statistically significant, population density has much less influence over inspections than other demographic variables.

5. Conclusions

In this thesis, I posed three hypotheses. I hypothesized that discrimination would exist in CAA enforcement behavior along racial and economic lines and that urban areas would face discrimination. My second hypothesis proposed that state environmental agencies nested within natural resources agencies (NREPs) would conduct less enforcement than independent agencies or agencies nested within public health agencies (PHEPs). Thirdly, I hypothesized that NREPs would exhibit more discriminatory enforcement behavior than non-NREPs. For hypotheses 1 and 3, I defined discrimination as a negative relationship between a county's population density or the percentage of a county that is Black, Latinx, or below the poverty line and enforcement conducted in that county. Across all three tests, I operationalized CAA enforcement in two ways: the average number of inspections per facility and the average number of formal actions per facility.

My results indicate that states do not generally conduct enforcement based on county demographics. They do, however, appear to enforce more stringently in counties where a higher percentage of the population is Latinx or lives below the poverty line. Agency type affected

formal actions in the direction I expected, with NREPs executing more formal actions than non-NREPs, but it proved inconsequential in predicting inspections. When agency type and demographic variables are interacted, clear differences emerge between the enforcement styles of NREPs and non-NREPs. In non-NREPs the relationship between percent Latinx and enforcement is positive and significant. However, in NREPs the relationship is statistically indistinguishable from zero. This pattern is reversed in the case of population density when inspections are the dependent variable.

5.1. Limitations

Though my theory is sound and draws on theories from environmental justice and bureaucratic politics literature, several limitations arise that should be explored in future research. Reverse causality presents a possible threat to validity in this study. It might be the case that less enforcement results in worse regional air quality, which drives down housing prices and draws in economically disadvantaged people. In this case, enforcement would indirectly shape community demographics, rather than the other way around. Due to the theoretically high level of collinearity between percent below the poverty line and percent Black and percent Latinx, reverse causality could also threaten the validity of conclusions drawn about those variables. Another possible threat to the validity of some of my results is the possibility of nonrandom assignment of agency types. Other research has found state political factors to be determinants of how states chose to structure environmental agencies, meaning that my agency type variable may capture state government partisanship rather than internal bureaucratic culture. However, not enough is known about states' decisions to structure environmental agencies to establish this as a certain threat to validity. Decisions about how to structure state agencies were also, for the most

part, made in the 1970s (Hopper 2020). Even if decisions over how to structure agencies were politically motivated, state political factors have likely changed since. There are possible limitations in my choice of unit of analysis. It is possible that, especially when facilities are located near county borders, those bearing the burden of air pollution are not residents of the county in which the facility is located, but residents of an adjacent county. Bureaucrats might therefore choose to conduct more or less stringent enforcement due to the level of anticipated political backlash from residents of that adjacent county, rendering the demographics of the county in which facilities are located irrelevant.

5.2. Discussion and Suggestions for Future Research

Despite these limitations, this research is still a valuable contribution to existing literature on environmental regulatory enforcement. This work places research on state agency structure in conversation with environmental justice research and brings research on CAA enforcement and state agency structure to a localized level in order to understand variation within states.

Taken together, a new theory emerges from these findings. State environmental agencies generally are interested in protecting Latinx and low-income communities. When the analysis is broken down to differentiate between NREPs and non-NREPs, it is clear that non-NREPs drive this relationship, and NREPs do not conduct enforcement differently depending on county demographics. I theorized that Latinx and low-income communities would face the most discrimination because they often have less political capital. The fact that the exact opposite relationship exists here might show that state agencies, especially non-NREPs, intentionally enforce more stringently in communities with less ability to hold agencies accountable for not enforcing. NREPs enforce less stringently in general, and they do not factor county

demographics into enforcement decisions. These patterns could indicate that non-NREPs are simply more interested in protecting disadvantaged communities. They could also reflect higher pollution levels in Latinx and low-income communities, which should motivate agencies to enforce more stringently. If this is the case, then the differences in results between non-NREPs and NREPs reveal that non-NREPs' enforcement is motivated by pollution levels, while NREPs' enforcement is not. To fully understand this, future research should control for some indicator of pollution or air quality.

The importance of percent Latinx and percent below the poverty line is significant and can be used to motivate future research. Poverty is the most direct representation of communities' power to organize backlash against agencies that fail to enforce the CAA. It is also a strong representation of voter turnout, which agencies might factor into enforcement decisions. State agencies might also perceive counties with proportionately larger Latinx populations as less capable of organizing political backlash against discriminatory enforcement. Future research should test this theory thoroughly by controlling for an indicator of political participation, such as voter turnout or political campaign donations at the county level.

The results shown here partially support my hypotheses and can be used to motivate future research. Agency type does have a significant negative effect on overall enforcement and on discrimination in enforcement behavior. However, the effect of agency type on discrimination is not so significant that it definitely causes state agencies to actively discriminate against disadvantaged communities. Rather, movement from a non-NREP to an NREP brings states from conducting more enforcement in disadvantaged communities to conducting roughly equal enforcement in disadvantaged communities as they do in other areas. This finding motivates a

new theory: that state agencies, on average, enforce purposefully so as to compensate for historical and current harm done to disadvantaged communities. Natural resources agencies, on the other hand, enforce equally across communities regardless of their demographics. It is clear from these models that, regardless of their motivation, NREPs conduct less enforcement than non-NREPs. Because this same relationship has been shown in other research, it should be investigated further and in relation to other important environmental regulations, such as the Clean Water act and Resource Conservation and Recovery Act. This study can also be used to motivate future research into the health impacts of different enforcement patterns shown here. While much effort has been dedicated to understanding differences in enforcement behavior, few studies have investigated the effects of enforcement on human health.

Not only does this study yield informative and theoretically interesting results, but it can be used for practical purposes. State environmental agencies and policymakers can use this work as an indicator of how equitably enforcement is distributed across counties. They can use this study as one indicator that, across all state agencies, there is not a strong reason to be concerned about discrimination in enforcement. State agencies and policymakers, as well as federal policymakers, can also use this study as an indicator of the disadvantages of structuring agencies as NREPs. Given the urgency of addressing climate change and environmental injustices, it is imperative that governments consider how bureaucratic agencies should be structured in order to most effectively and equitably enforce environmental policy.

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