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TOXIC COMMUNITIES: EXAMINING THE RELATIONSHIP BETWEEN RACE, MARKET FORCES, AND ENVIRONMENTAL HAZARDS USING ELEMENTARY SCHOOLS AS COMMUNITY LOCUS

A Dissertation
Presented for the
Doctor of Philosophy
Degree
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Stephanie Joy Gonzales
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DEDICATION

This dissertation is dedicated to my mother, Mary Hester, my greatest role model and to my daughter, Xandra Gonzales, for being the greatest inspiration of my life. I could not of done this without your unconditional love and support. You are both my heroes.

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ABSTRACT

The purpose of this study is to examine the complex relationship between race, pollution, and market forces using elementary school zones as community locus within California. This analysis examines the relationship between race and toxic facility sites using the Toxic Release Inventory (TRI), census data, and California school data. This research improves on past research in several important ways. First, the community is defined by giving attention to literature on environmental grassroots movements and the formation of informal social networks using local elementary schools as an organizational locus. Second, the migration of Black, Hispanic, and White populations away from and towards toxic facility sites over a 20-year period is measured to help address the issue of market forces as a contributing factor in the disproportionate distribution of toxic facility sites in minority neighborhoods. Third, each toxic facility is measured on its potential harm to the community by assessing the relative toxicity of chemicals released into the local environment. Toxic Equivalency Potentials (TEP scores) provided by Scorecard are used to rate the relative toxicity of each facility.

Several conclusions can be drawn from this study. First, even after controlling for market forces, measuring the mobility of the White populations away from toxic facility sites, there remains strong evidence of environmental racism. Predominately Black and Hispanic communities are located almost 4 times closer to TRI facilities than are predominately White communities. Second, the evidence suggests that White populations are moving away from TRI facilities, whereas Hispanic populations are settling near TRI facilities. There is no evidence to suggest that Black populations are moving towards TRI facilities. Finally, TRI facilities located within 2-miles of predominately Black or Hispanic communities are no more toxic than TRI facilities located within 2-miles of predominately White communities.

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CHAPTER 1: THE RESEARCH PROBLEM

Introduction

Beginning with the Civil Rights movement in the 1950's and 1960's, national attention has surrounded the plight of African-American and other minority populations in the United States and around the world. Typically, this attention has focused on conditions that directly impact the daily lives of minority groups such as desegregation, housing, education, crime, neighborhood safety, unemployment, and public health. Under the leadership of Civil Rights leaders such as Martin Luther King, Jr., Malcolm X, and Rosa Parks, great strides were made in improving the conditions for many Black Americans throughout the country. Following desegregation and the passage of civil rights legislation in the decades to follow, greater access to amenities opened up for many minorities in the United States.

Despite these legislative improvements a large number of Blacks and other minority groups have been left behind in increasingly forgotten and abandoned in inner city ghettos and barrios. With the passing of civil rights legislation, American culture receding into a myopic view of the persistent patterns of segregation and social injustice facing a majority of minority persons in the United States. More than a hundred years after slavery and more than 40 years after segregation, conditions for Black Americans remain bleak. Unemployment, neighborhood safety, segregation in the housing market, and crime remain pervasive and enduring issues for Black and Hispanic persons in American society.

Nearly a decade after the civil rights movement in the 1960's, a new element of social injustice and racism surfaced to public attention following a protest movement in Warren County, South Carolina. It began with the proposal of a sanitary landfill for PCB's in a majority Black neighborhood of Warren county. In 1979, African American homeowners from the community launched a concerted effort to block the sanitary landfill from being built in their neighborhood. Residents formed the Northeast Community Action Group (NCAG), and with their attorney Linda McKeever Bullard, filed a class action lawsuit to block the facility from being built. Filled with rhetoric and strategies from the civil rights movement, resident protests led to some five hundred arrests. While being an intrinsically civil rights issue, activists drew from the environmental movement to frame their argument. Drawing national attention, the civil rights activists in Warren county were able to reassert themselves once more by drawing on resources and rhetoric from the environmental movement.

While the protest in Warren county was limited to a single facility siting, Black, Hispanic, and other minority residents in communities throughout the country began to identify a form of racism that targets the health and well-being of minority's living in predominately minority communities. Industries that pollute the air, water, and soil of local ecosystems and pose health risks to local residents are accused of targeting highly segregated minority communities for placement. What culminated in the years to follow was the emergence of a grassroots Environmental Justice Movement that sought to draw a definitive link between the siting of polluting industries and the presence of racism. Drawing on more provocative terminology, activists also refer to the phenomenon as environmental racism. The primary objectives of activists involved in the movement is to

remediate the injustices of pollution and environmental contamination targeted towards minority populations.

The Environmental Justice Movement activists assert that low-income and minority neighborhoods are disproportionately exposed to various environmental hazards. This disproportionate exposure, putting minority communities at greater life and health risks, is viewed as an extension of the pervasive forms of racism endemic in American society and around the world. Since this form of racism was first identified following Warren county in the early 1980's, a plethora of research has been conducted to specify the relationship between race and exposure to environmental risk. The research was aimed at definitely describing the link between race and pollution as the first step towards remediating perceived injustices. This research, while quite extensive, has not been able to draw any clear conclusions to date. While initial studies indicated a clear and distinct presence of environmental racism, other studies, after making corrections to the methodology, have drawn competing conclusions.

Critiques of the expansive body of literature suggest that many theoretical and methodological weaknesses exist in the research, making it difficult to clearly delineate the relationship between race and pollution. First, without a clear guiding theoretical principle on the dynamics of segregation patterns in the siting process, the relative role of racial discrimination or market forces have not been discerned. A broader, more theoretical understanding of race and discrimination is needed to guide the research. Second, the analytical unit or community size has generally been defined by statistical convenience, rather than the social networks of community residents who protest the proposed placement of toxic facilities. Third, much of the literature makes the erroneous

assumption that all toxic facilities are created equal and hence all communities with a toxic facility are equally exposed and equally at risk to various toxins.

This study attempts to address these problems. Elementary school zones in California are used as the analytical unit to define community composition. Residents tend to identify their community boundaries through various social organizations, with schools being paramount. This research contributes to a greater theoretical understanding of community in the environmental racism literature, as elementary schools are used as the unit of analysis. Second, the potential harm to the community of each toxic facility is measured by assessing the relative toxicity of chemicals released into the local environment. Third, changes in community composition overtime are used as measures of migration patterns among Whites and minorities to clarify the role of racism in the outcome of the inequitable distribution of environmental hazards. These variables of change are guided by a broader, more theoretical understanding of racism and its role in the economic and housing markets.

Chapter I provides an extensive literature review in the field of environmental justice, highlighting the most recognized research projects and their conclusions. Chapter II describes the problem with defining a community and creating a statistical unit of analysis that is compatible with a theoretical conception of community. In this chapter, it is recommended that elementary schools can be utilized as a theoretical conception and a statistical analysis. Chapter III describes two pervasive problems in the research, comparing facilities and describing market forces. Methodological solutions for handling these problems are described. Chapter IV describes the methodology for this research.

In Chapter V, the findings are described in depth. Final conclusions for this research are made in Chapter VI.

CHAPTER 2: LITERATURE REVIEW

Environmental Racism

Environmental Justice activists assert that low-income and minority neighborhoods are disproportionately exposed to pollution and other environmental hazards. Robert Bullard in his book *Dumping in Dixie* provided one of the leading pieces of academic work highlighting the disproportionate burden of noxious facilities on Blacks and other minorities (1990). As past studies of poor and Black communities have traditionally focused on a milieux of social problems such as crime, family issues, poverty, drugs, and unemployment, Bullard highlighted the heavy toll that pollution is exacting on these neighborhoods.

Environmental injustice first came to national prominence with the 1982 controversy over the proposal to build a hazardous waste landfill in a predominately Black and poor neighborhood of Warren County, North Carolina. Warren County is one of the poorest counties in North Carolina, indeed one of the poorest counties in the country, with 65% of the population African-American (Bullard 1990). The people of Warren County organized to oppose the construction of the landfill, creating the first nationally recognized environmental justice movement. In a dramatic show of civil disobedience, reminiscent of the civil rights movement, activists from Warren county laid down in front of trucks carrying PCP contaminated soil. Although the people of Warren County were unable to prevent the placement of the hazardous waste site in their community, they were successful in bringing the issue of environmental racism into the

national spotlight and onto the political agenda. Drawing from the rhetoric and tactics of the civil rights movement, the people of Warren county were successfully able to reframe the environmental movement into racial equality and environmental justice terms. The question became, not whether environmental pollution exists, but whether that environmental pollution is disproportionately and unfairly distributed throughout the population.

Before preceding, it is important to define some common terms used in the environmental justice movement. The Reverend Dr. Benjamin F. Chavis, Jr., Executive Director of the United Church of Christ Commission for Racial Justice, coined the phrase 'environmental racism.' Environmental racism is defined as:

> those institutional rules, regulations, and policies or government or corporate decisions that deliberately target certain communities for least desirable land uses, resulting in the disproportionate exposure of toxic and hazardous waste on communities based on certain prescribed biological characteristics. (Bunyan 1995 p. 5)

Environmental justice is broader in scope than environmental racism and is defined as:

> Those cultural norms and values, rules, regulations, behaviors, policies, and decisions to support sustainable communities, where people can interact with confidence that their environment is safe, nurturing, and productive. (Bunyan 1995 p. 6)

The struggle in Warren county, having deep roots in both the civil rights and environmental movement, not only led to national attention, but precipitated a series of studies seeking to establish the connection between race and pollution. Two important studies conducted in 1983 helped to galvanize the environmental racism movement. The first of these studies was prompted by US Congressman Walter Fauntroy who requested the United States General Accounting Office (GAO) study to address the issue of

environmental inequity. Focusing strictly on the eight states in the Southeast, the GAO identified four offsite hazardous waste sites in EPA region IV. The GAO concluded that three of the four sites were located in communities where Blacks constitute a majority of the population (1983). Although this study was limited in scope, analyzing only eight states in the Southeast, it was the first to highlight a correlation between race and hazardous waste sites.

Bullard conducted another early and politically influential study in 1983, using quantitative data on demographics and solid waste disposal systems in the Houston area. Bullard attempted to address the issue of whether Black Houston residents were more likely to live near a waste disposal site than non-Black residents by identifying 25 hazardous sites and collecting data on the percentage Black in their vicinity. Comparisons of the percentage of Black and non-Black residents in several neighborhoods indicated that of 25 waste sites in Houston, 21 were located in Black neighborhoods. Furthermore, while blacks made up only 28% of the Houston population in 1980, 6 of the 8 incinerators and 15 of the 17 landfills were located in predominately Black neighborhoods.

Probably the most widely known study and most influential in the environmental justice movement was the report released in 1987 by the United Church of Christ Commission for Racial Justice (CRJ) on their study of distribution of hazardous waste sites in the United States. The CRJ study was the first study in environmental justice with a national scope, comparing ZIP code areas containing a hazardous waste treatment, storage or disposal facility (TSDF) to ZIP code areas without such a facility. They found that ZIP codes with at least one TSDF had twice the percentage of minorities than ZIP

codes with no facility. ZIP codes with either more than one facility or one of the five largest facilities had the highest percentage of minorities at 37.6%. This percentage compares to the average of 12.3% minorities in all United States ZIP codes. Even when controlling for income, race was found to be a significant factor. Furthermore, 3 out of every 5 Blacks or Hispanics lived in a community with "uncontrolled toxic waste sites." CRJ concluded that "race has been a factor in the location of commercial hazardous waste facilities," subsequently giving prominence to the term environmental racism (CRJ 1987).

The studies conducted in the 1980's following the Warren County incident were not the first attempt to pinpoint an inequitable distribution of pollution. During the 1970's a series of important studies were conducted analyzing the relationship between air pollution and poverty levels (CEQ 1971, Freeman 1972, Harrison 1975, Kruvant 1975, Zupan 1975, Burch 1976, Berry et al. 1977, Handy 1977, Asch and Seneca 1978, Gianessi et al. 1979, Gelobter 1987, Gelobter 1992). These studies differed somewhat from the GAO, CRJ, and Bullard studies in that they focused on poverty rather than race. Preceding the environmental racism movement, these earlier studies were focused on demonstrating the greater health risk due to environmental contamination among the poor. These studies were ignited in the literature as researchers attempted to draw a more complete picture of the dynamics between race, poverty, and pollution.

Mohai and Bryant (1992) produced an article analyzing 15 of these earlier studies in the 1970's along with the GAO, CRJ, and Bullard studies. Of the 11 studies that examined the effects of race, 10 studies concluded that the distribution of pollution was inequitable by race. Eight of the 15 studies provided an analysis that compared the

relative strength of race and income; five of those studies concluded that race was the stronger determinant. The greatest difference between these earlier studies and the GAO, CRJ and Bullard studies was the focus on intent. The air pollution studies were attempting to describe differential and inequitable *exposure* of pollution, whereas the 1980's studies were attempting to prove differential and inequitable *targeting* of pollution. While this differentiation in the purpose of the two series of studies does not seem significant on the surface, it has serious ramifications for addressing and remediating the inequitable exposure to environmental hazards in the court and political system.

Studies in the 1990's

While these studies conducted in the 1970's and 1980's seemed to confirm that pollution is distributed inequitably by race, regardless of income, some important studies conducted in the 1990's concluded that this inequitable distribution of pollution solely by race is not the case. The 1990's experienced a rapid proliferation of studies with many challenging the conclusions of GAO, CRJ and Bullard studies.

Anderton et al. (1994) conducted the most widely known of these studies, known as the SADRI study. With a national focus, analyzing the 48 contiguous states, Anderton et al. used the census tract as their unit of analysis. A census tract is substantially smaller in size than a ZIP code area. It also has the further advantage of having roughly an equivalent population size of approximately 4,000 for each tract. This consistency in population size, however, creates an analytical problem, because for each census tract to have similarly sized populations, the tracts themselves must vary greatly in

area. A tract in a densely populated urban area will be much smaller sized than a tract in a sparsely populated rural area. Similar to the CRJ study, SADRI used commercial TSDFs as the dependent variable. They found that the average percentage of Black persons in census tracts containing at least one TSDF (14.54%) was not significantly different from the average percentage of Black persons in census tracts with no TSDF (15.2%). They did find, however, a modest difference in the percentage of Hispanics in tracts with a TSDF (9.41%) and the percentage of Hispanics in tracts without a TSDF (7.74%). They concluded, based on their analysis, that income and availability of workforce were the strongest predictors of a TSDF within a census tract. In contrast to these findings, when they limited their comparison to tracts in the 25 largest standard metropolitan statistical areas (SMSA), they found a significant relationship between race and TSDF's. For Hispanics they found an average of 13.88% in census tracts with a TSDF, compared to an average of 10.05% in census tracts without a TSDF. For Blacks, the findings were surprising and differed drastically from prior studies. They found an average of 12.23% Blacks in tracts with a TSDF, and 16.43% in tracts without a TSDF. They concluded that for large metropolitan areas, Blacks are actually *less* likely to live in a census tract with a TSDF.

After concluding that no racial inequality exists, the authors of the SADRI study extended their analysis to analyze the distribution of TSDF sites for contiguous census tracts. They questioned whether the difference in results from their study and the CRJ study resulted from differences in the size of the units of analysis. Census tracts are substantially smaller sized than ZIP codes. To determine if the differences in the results were indeed due to differences in the size of the unit of analysis, Anderton et al.

aggregated all host census tracts with all contiguous surrounding census tracts for all SMSAs, making the geographic area under analysis much larger in size. They then compared these tracts with all remaining census tracts. Their findings produce results similar to those of prior studies. Host tracts and their surrounding areas have higher concentrations of Blacks (24.72%) than non-host tracts (13.57%). Similarly, host and surrounding tracts have higher concentrations of Hispanics (10.67%) than non-host tracts (7.27%).

Anderton et al. concluded that the findings in the second analysis fail to support a charge of environmental racism. They argued that using a larger unit of analysis may simply capture the residential structure of cities inherent to growth patterns of urban areas, in essence, capturing "residential patterns largely unaffected by and ineffective on decisions of where to locate TSDF's." (Anderton et al. 1990 p. 34)

Following the SADRI study, it became apparent that the issue of intent in environmental racism is far more complicated than originally believed. The SADRI study suggested that inequitable distribution of pollution may rather be a byproduct of residential segregation patterns as opposed to direct discrimination. The issue of intent is further complicated by the lack of longitudinal studies examining the demographic and socioeconomic characteristics of communities at the time of siting. Not a single study, up until this point, adequately addressed the issue of intent in the siting process by examining demographics at the time of siting and comparing them to current demographics. The contradictory findings of studies in the early 1990's highlighted the need to improve the methodology in the literature to demonstrate more definitively the existence of environmental racism. Additionally, researchers also began to see a need to

understand the economic and social dynamics that contribute to the inequitable distribution of pollution.

A study conducted in the early 1990's supported the conclusion of the SADRI study by finding no significant relationship between race and pollution. John Hird in 1993, conducted a national study on superfund sites on the National Priority List, using the county as the unit of analysis found no relationship between race and Superfund sites. Although his study found differences at the bivariate level, this relationship did not exist for the multivariate analysis when controlling for other factors such as income, education, and quantity of hazardous waste. Furthermore, he found that the promptness of cleanup was related to the potential for hazard, not socioeconomic or demographic characteristics.

In 1993, Rae Zimmerman also conducted a national study of Superfund sites on the National Priorities List (NPL), using census places as the unit of analysis. Initially her findings suggested no evidence of racial discrimination, except in the South, for either Blacks or Hispanics. When adjusting the analysis by comparing weighted means, averages adjusted by minority percentages across all census places, the findings suggested that Blacks are 50% more likely to live near a NPL site than Whites. The weighted means were computed by aggregating the total Black population across all communities with an NPL, computing the Black percentage, then comparing that percentage to the total percentage of Blacks in the United States.

Zimmerman also concluded that minority communities were less likely to have a Record of Decision (ROD) at controversial sites. Her findings suggested that many studies may have underestimated the percentage of Blacks living near toxic facilities because a larger percentage of Blacks live in a small number of densely populated

communities that are disproportionately located near environmental hazards. This phenomenon is known as the Ecological Fallacy and exists when taking data analyzed at the community or group level and applying those findings to the individual level. Hence, an Ecological Fallacy occurs in most of the environmental justice research because evidence from the community level is being used to reach conclusions about individuals.

Methodological and Theoretical Improvements

Following the studies in the early 1990s, researchers began to pay more attention to the methodological issues in their research in response to critiques of their findings. A movement also transpired to address some of the more complex issues surrounding environmental racism. The environmental racism debate centered on the issue of intent: whether inequitable distribution of pollution was consciously created by decision makers in the industrial sector or was a byproduct of market forces and segregation patterns. To address this issue, longitudinal studies that examine the demographics of communities at the time of the siting are necessary to estimate bias and malicious intent during siting decisions.

Three competing theories surfaced to explain the inequitable distribution of pollution and the complexities of the issues. In an article by James Hamilton (1995) these three theories were identified, all of which stem from economic theory. The first is Pure Discrimination theory, which states that decision makers target minority neighborhoods for placement or expansion of toxic facilities because of racist attitudes and beliefs. Racism and discrimination guide the decision making process even when it conflicts with economic considerations.

The second of the theories is Coase theorem that argues the primary motivation for decision makers is placing facilities in locations where economic costs and compensation are minimized. In their quest to maintain profitability, decision makers consider a variety of neighborhood demographic, physical and economic characteristics of a neighborhood that could influence the total potential cost to the company. The primary consideration to decision makers is cost of land as measured by property values and the number of people affected. Although considering economic variables at the time of placement may inadvertently impact racial variables because minorities tend to be disproportionately located in poorer communities, the full association between race and pollution does not arise until after the facility has been located. Over time, the placement of that facility may depress the value of the land, as economically secure families "vote with their feet and leave the community" (Hamilton 1995 p.110). Minority residents without the economic means to move will be left behind in an environment that is increasingly deteriorating. Discrimination in the housing market may further restrict the ability of minorities to move to environmentally cleaner neighborhoods, through disproportionate denial of home loans, steering of minority residents into restricted neighborhoods, and refusal to rent in predominately White neighborhoods. According to Coase theory, the inequitable distribution of pollution by race is a byproduct of market forces as discrimination in the housing market exacerbates discrimination that may have occurred in the siting process. Economic variables such as median income are hypothesized to be stronger predictors of Toxic Facilities than are racial variables.

The final theory, the Logic of Collective Action, argues that decision makers seek to avoid political resistance when placing a toxic facility. Political resistance incurs

hidden costs to the company through court costs, lawyers, and lawsuit settlements. Compensation to communities for any potential or actual environmental damage is usually realized through the political process. Communities vary in their ability to collectively organize and solicit political and financial resources. To minimize compensation liabilities, decision makers, according to the Logic of Collective Action, target communities where the potential for political organization is minimal and political apathy is greatest.

A $33,000 study prepared by Cerrell Associates Inc. (1984), a Los Angeles public relations and political consulting firm, concluded that builders of waste management sites will face less opposition if they place plants in poor neighborhoods rather than middle-class and wealthy neighborhoods. Providing a profile of neighborhoods least likely to organize effective resistence to incinerator placement, the report concluded that:

> All socioeconomic groupings tend to resent the nearby siting of major facilities, but middle and upper socioeconomic strata possess better resources to effectuate their opposition. Middle and higher socioeconomic strata neighborhoods should not fall within the one-mile and five-mile radius of the proposed site. (Cerrell Associates Inc., 1984 p. 43)

Collective power requires access to a variety of social resources such as education and knowledge, money, and political representation. Voting patterns as a measure of political participation have generally been used as an indicator of collective power. Political apathy has generally been measured by the percentage of homeowners vs. renters in a community. It has been argued that the number of homeowners living in a community may greatly affect the desire of community members to organize. Renters may be more apathetic than homeowners about the environmental conditions of a community because their net worth is not intricately tied to the community. Insofar as

percentage of voters is a general indicator of collective organization and the percentage of homeowners is an indicator of political apathy, toxic facilities are hypothesized to be disproportionately located where percentage of voters and percentage of homeowners living in community is minimal. In this scenario, while race may be a significant variable for the location of toxic facilities, voting patterns and homeownership are hypothesized to be the greatest predictors of the presence or absence of a toxic facility.

In the study conducted by Hamilton (1995), the evidence suggested the strongest support for the Logic of Collective action. Conducting a national study, using ZIP codes as the unit of analysis, Hamilton analyzed TSDR sites in which a proposal for expansion of preexisting sites has been sought. Hamilton argued that by analyzing expansion of already existing sites, rather than the original siting decisions, a more credible study would be conducted. Because census data are not always available for the first half of the century when a large number of facilities were established, any longitudinal study that examines demographics of communities at the time of siting will be severely constrained by lack of data. Expansion of sites, while subject to the similar decision making forces primarily occurred in decades where census data are readily available. While Hamilton did find a difference in race as measured by the percentage of nonwhites, for the bivariate analysis, the relationship did not hold in the multivariate analysis lending no support for the theory of direct racial discrimination. Median income was not a significant factor, lending little support for Coase theorem. Percent of residents who voted in the last election, however, was significant, lending the strongest support for the Logic of Collective Action. Hamilton concluded that decision makers are probably motivated by

the potential for public resistance in communities when making decisions to either expand or place facilities.

In the same year, Vicki Been (1995) also conducted a study to determine whether market forces had a strong influence on the demographics of communities with toxic facilities. With the use of census data from 1970 - 1990, she conducted a national study analyzing whether TSDFs were disproportionately located in minority census tracts at the time of the siting. She argued that if race was a crucial variable for decision makers when siting a facility, a relationship between race and environmental hazards would exist at the time of siting, ruling out the impact of market forces on differential outcomes. Conversely, if market forces led to the disproportionate distribution of toxic facilities in minority neighborhoods a change in the demographics of the communities with a facility would occur over time. Been found that for Blacks, no evidence of direct discrimination exists. The percentage of Blacks in census tracts with a facility was not significantly different from all other census tracts at the time of siting. Been did find a significant difference for the percentage of Hispanics. Been concluded that barrios, rather than ghettos are being disproportionately targeted for toxic facilities.

Following this analysis, Been analyzed the same relationship controlling for population density. She argued that the desire for decision makers to avoid communities with a high concentration of residents to avoid exposure to large numbers of individuals, could have a significant impact on the findings. Been found that, after controlling for population density, race was a significant variable for both Blacks and Hispanics. These findings suggest that many studies may not find a relationship between Blacks and toxic facilities because of population density. Poor Black communities tend to be

characterized by high density and crowded living conditions. Low-income housing and cheap rental structures are built to accommodate large numbers of families in as little space as possible. These neighborhoods may avoid the presence of toxic facilities in their community because decision makers desire to site the facilities in less densely populated neighborhoods.

To further support this argument, Been found a U shaped curve describing the relationship between toxic facilities and income for predominately Black communities. For predominately Black neighborhoods, as the median income rises, the odds of having a facility in the community increases to a certain point. As the median income continues to rise, the odds of having a facility in the neighborhood then begin to decline. This U shaped relationship could suggest that as the median income for predominately Black neighborhoods increases, the population density decreases, increasing their risk for having a toxic facility in their community compared to economically similar White communities. This same U shaped pattern does not describe the relationship between toxic facilities and income for White communities. These findings are provocative, but are not fully explored in the current literature to draw any definitive conclusions. These findings suggest dynamics between race, density, income and Toxic Facilities operate in ways not sufficiently explored by researchers.

Another study conducted in 1995 by Polluck and Vittas produced findings that differed quite drastically from the studies by Been and Hamilton. Been and Hamilton found a strong relationship for Hispanics, but not for Blacks; Polluck and Vittas found the opposite. The study conducted by Polluck and Vittas was not a national study, only analyzing TRI sites in Florida using census blocks as their unit of analysis. Their study

also differed from Been and Hamilton in that they were not analyzing the presence of a facility, but instead calculated the average distance between a census block and the nearest TRI facility. Their study found that predominately Black communities are closer to TRI facilities, even when controlling for other variables. Interestingly, Hispanics lived closer for the bivariate analysis, but further for the multivariate analysis, which controlled for other variables such as population density, manufacturing jobs, and median value of homes. Whereas Been and Hamilton found a stronger relationship for Hispanics than Blacks, Polluck and Vittas found the strongest relationship for Blacks and the weakest relationship for Hispanics.

Making direct comparisons across these three studies is not possible because of the substantial differences in their methodological design. The Hispanic population in Florida is drastically different in composition, education, and income than the Hispanic population of other regions, particularly the southwest. The southwest Hispanic population is predominately poor Mexican immigrants seeking economic stability, whereas the Hispanic population in Florida is predominately middle class Cubans seeking political refuge. Because Cubans tend to have higher levels of education and income, they are better able to politically organize for their benefit than are poor immigrant Mexicans. The differences in the Hispanic populations are drastic enough to make comparisons tentative at best.

Been and Gupta (1997), attempting to analyze the role of the economy and the housing market analyzed the effects of market forces on the racial and economic demographics of communities with and without toxic facilities. Building on their previous research, they followed the demographics of communities at the time of the

siting into the 1990's. They were specifically addressing the issue of change over time. Previous research has not settled the debate on whether the sites were chosen in a discriminating manner, or whether changes in the demographics of the communities following the siting led host neighborhoods to become disproportionately populated by minorities and the poor. They argued that delineating whether racism or market forces was the primary determinant of inequitable distribution of environmental pollution was essential for addressing the issue in public policy. The issue of intent must be determined. Inequitable distribution based on racism in the siting decision requires a different governmental response to redress the issue than does inequitable distribution based on market forces. Making policy changes and enforcing corporate accountability in the siting process will not correct the inequitable distribution of pollution if the true source of the distribution lies with discriminatory practices in the housing market.

Been and Gupta, funded by the EPA, launched the task of attempting to settle the debate on market forces versus discrimination in their 1997 study. With the use of census tracts as their unit of analysis they conducted a nationwide study of 544 communities that hosted an active commercial hazardous waste treatment storage and disposal facility in 1994. They examined the demographics of these communities following them through the 1970, 1980, and 1990 censuses. Been and Gupta compared host tracts to all non-host tracts in the United States. This methodology differs from the SADRI study in which host tracts were only compared to non-host tracts in the same metropolitan area. Been and Gupta concluded that bias toward Blacks was not a determining factor in the siting process. Some evidence suggests that bias toward Hispanics did occur during the siting process. For tracts that became hosts during the 1970's, the percentage of Blacks was not

significantly higher for all other tracts. The percentage of Hispanics was 42% higher for tracts that would come to host a tract compared to all other tracts. The multivariate analysis showed no significant effect of race. Only the variables percentage of the work force employed in manufacturing and population density were statistically significant in the multivariate analysis. For tracts that became hosts during the 1980's produced almost identical results. There was no difference in the percentage of Blacks for host and non-host sites, but there was a substantial and statistically significant difference in the percentage of Hispanics in host and non-host tracts. The multivariate analysis remained similar to the 1970's analysis. A comparison of host and non-host tracts was not performed for facilities sited in the 1990's because of the small number of facilities sited in that time period.

To address the issue of whether inequitable distribution currently exists between all host and all non-host tracts, they conducted a cross-sectional analysis comparing the demographics of the 544 host tracts to all non-host tracts in the nation. In contrast to the previous findings, they found that the "percentages of African Americans and Hispanics both are significant positive predictors of the presence of a facility" (Been et al. 1997 p. 24). In addition, median family income is a positive and significant predictor of the presence of a facility.

These findings produced a conundrum for the researchers because in each decade analyzed, no discrimination was found in the siting process; however, a substantial and significant relationship was found among communities with TRI facilities in the present. There are several explanations that may explain this contradiction in the findings. First, a large percentage of facilities were sited prior to 1970 suggesting that the percentages of

Blacks in communities that received a site before 1970 may be much higher than for communities receiving a facility after 1970. In other words, racism in the siting process may have existed in the decades prior to 1970, which have created the current inequitable distribution of pollution. The analysis by Been and Gupta did not address this issue because of the lack of census data on communities earlier than 1970. Second, Been and Gupta left out of the analysis communities that were not tracted in 1970 and 1980. These communities were predominately rural communities. Only for the 1990 census did the Census Bureau tract every community or residential area in the United States. Been and Gupta argue that leaving these communities out of the analysis should not affect the results significantly because minorities tend to be disproportionately located in metropolitan areas. They concede, following the discrepancy in their analysis, that by ignoring facilities and communities in untracted rural areas they may have under represented the relationship between race and pollution in the 1970 and 1980 analysis. Consequently, the study was incomplete in its attempt to fully address these issues.

Expanding on Been's study, Liu (1997) conceived of a new way of analyzing the impact toxic waste sites have on the dynamics and economic decline of communities. Liu's primary goal was to analyze the effect hazardous sites have on the deteriorating housing values of homes in a host neighborhood. He tested a variety of alternative hypothesis, including invasion-succession and neighborhood life cycle. Specifically, he tested whether the change in the percent black and the percent median family income in census tracts with a hazardous facility would experience greater changes than census tracts without a hazardous facility. Similar to Been's 1994 study, he defined hazardous facilities as the nine mini-incinerators and landfills in the Houston area. His control

group was census tracts similar in minority composition and demographic change prior to the siting decision. Differences in community composition during the 1960 to 1970 were taking as the presiting changes, while differences in community composition between 1970 and 1980 were taken as the postsiting changes. He hypothesized that greater changes would occur in the host communities during the post-siting years than in the control group. Specifically, host communities should expect to see a greater decline in median family income, coupled with greater increases in the percent Black. The results indicated no significant difference between the socioeconomic characteristics of communities with a host facility compared with the control group. His findings concluded that facilities did not contribute significantly to the decline of host communities. While his study is well designed and is the first to assess the direct impact of change, it was limited by examining only a 10-year period of change in the decade following placement of the nine hazardous facilities. The housing market does not immediately respond to economic forces, often taking decades for demographic transitions to significantly impact communities.

Bullard (1996) noted the lack of research focusing on the quantity and toxicity of pollution released into the environment for poor minority neighborhoods vs. middle class White neighborhoods. The previous research assumes that all facilities are equal in their potential damage and exposure to the community. To address this issue, Rinquist (1997) conducted a national study looking at the weight of pollutants released into the environment for industries on the Toxic Release Inventory (TRI). With the use of ZIP codes as the unit of analysis, he found a strong relationship between Black and Hispanic communities with the presence of a TRI facility. Furthermore, the relationship was also

strong when looking at the number of TRI facilities in a community. The greater the percentage of minorities, the greater the number of TRI facilities in the community. Not only are predominately Black communities more likely to have the existence of a TRI facility, but they are more likely to have several TRI facilities in their community. The assumption is that the more facilities in the area, the greater the exposure to environmental pollution. Rinquist also found that the weight of total pollution released into the environment was positively related with the percentage of Blacks and Hispanics. The percentage of individuals living in poverty was a strong predictor of the presence of a facility, the number of facilities, and the weight of pollution released. Rinquist concluded that minorities and the poor share an inequitable burden of environmental pollution compared to middle-class Whites. While this study attempted to correct for some limitations in the research by incorporating environmental releases, it erroneously assumes that all chemicals are equal in potential harm pound for pound.

Liam Downey in 1998 conducted a similar study designed to ascertain the relationship between race and income and the total weight of toxins released into the environment. Downey argued that institutional racism is the primary cause of inequitable distribution of pollution. Structural barriers in the housing and job market limit the opportunity of Blacks to relocate and organize political power to fight against local pollution create an inequitable distribution of pollution by race. Concentrating specifically on the siting process by facilities ignores the institutional barriers that often create and maintain modern segregation. Distributing pollution inequitably is founded on the reality of segregation, and to ignore the structural and institutional causes of segregation is to ignore the root causes of the issue. Downey argues that income and race

are so intertwined in the segregation process, that the targeting of low-income communities for financial savings is synonymous with targeting communities due to racial differences. Separating communities by class and incorporating differential treatment is inherently a racist process.

Focusing on Michigan, its urban areas and Detroit he looked at the relationship between race and TRI sites. He used only two independent variables: median household income and the ratio of Whites to Blacks. The $\log^{10}$ of each of these variables was used because the distributions were highly skewed. He found that when he focused strictly on urban areas of Michigan, race was not a significant predictor of the weight of total environmental releases into the local environment. Downey did, however, find that for the entire state of Michigan, race was a significant predictor. Although Downey found that income was a stronger predictor in every analysis, he concluded that income does not need to be controlled for when arguing for inequitable distribution as a result of institutional racism. The question of intent becomes an irrelevant point.

Of interest in this study, is that no relationship was found when analyzing strictly urban areas; however, the relationship did exist when comparing every community in the entire state of Michigan. These findings conflict with assumption made by Been (1994) that leaving out untracted rural areas could not and did not have a profound impact on the findings. Been argued that rural areas are not likely to contribute to a finding of environmental racism because minorities live predominately in urban areas, not rural areas. This research demonstrates the relationship is actually strengthened when non-metropolitan areas are included in the study.

Geographically Limited Studies in the late 1990's

The latter part of the 1990's a switch occurred from larger national studies to geographically smaller studies focusing on the issues of toxicity of chemicals and changes in neighborhood demographics over time. Getting historical demographic data on communities with a toxic facility cited earlier than 1970 is extremely difficult and time consuming forcing researchers interested in longitudinal studies to limit their studies to smaller localized areas as opposed to larger national studies. The tremendous amount of work associated with longitudinal studies makes large national studies virtually impossible. Stretesky and Hogan (1998), interested in conducting a longitudinal study, analyzed superfund sites on the National Priorities List (NPL) in Florida. With the use of census tracts as their unit of analysis they examined the extent of environmental racism over three decades: 1970, 1980, and 1990. They also examined contiguous tracts to address the issue highlighted by Been, that is, many sources of pollution are located on the periphery of a census tracts. By examining contiguous census tracts they could analyze communities with a superfund site adjacent but not within the tract borders. Stretesky and Hogan concluded that Blacks and Hispanics were more likely to live near a NPL superfund site.

In 1990, Mitchell et al. examined TRI sites in South Carolina. To address the issue of toxicity of sites they focused strictly on TRI sites that have been listed as a TRI site for at least six years and have an output of pollution that exceeds 100,000 pounds. Their unit of analysis was incorporated areas and counties giving them a unit of analysis much larger than that of either census tracts or ZIP codes. Conducting a longitudinal

study, they examined the demographics of a community at the time of the siting to current. Mitchell et al. concluded that no income or racial differences existed at the time of the siting. They found that for suburban and urban areas, the percentage of Blacks was a significant predictor in 1990. This relationship did not hold true for rural areas.

Analyzing the demographics of communities in Santa Clara County, California, one of the most recent studies in the field of environmental justice was conducted by Szasz and Meuser (2000). With the use of census tracts as their unit of analysis, they focused on TRI sites. Because they wanted to address the issue of market forces versus direct discrimination, they examined the demographics of census tracts dating back to 1960. This created a problem for them because TRI information was not available in 1960. To circumvent this problem they analyzed the percent of the tract zoned for industrial land use. They found a very strong relationship exists between the presence of a TRI site and the percentage of a tract zoned for industrial land use. They concluded this is a reasonable assumption for their analysis. Szasz and Meuser concluded in their study that while a high proportion of Hispanics live near TRI facilities in the 1990's, these differences occurred over time as class differences sorted the population by race. They found no evidence of environmental racism.

CHAPTER 3: UNIT OF ANALYSIS: COMMUNITY, WOMEN, AND TOXIC FACILITIES

Defining Boundaries

A major concern in the literature of environmental racism is the definition and conceptualization of the community. Community becomes a pivotal issue in the research because the definition of community, with its size and composition, is the analytical unit under investigation. How community is defined has implications for the theoretical assumptions, methodology, and findings of any research in the environmental justice literature. The primary argument in the literature is the discussion over scale. What is the appropriate size of a community? The environmental justice movement itself is defined by geographic scale. As community members protest incinerators and other locally unwanted land uses in their communities, implicit in the protest is an assumption of what defines their community.

As the literature in environmental justice has grown in response to the growing awareness of environmental racism, researchers' attempts to quantifiably determine the extent of injustice across socioeconomic and racial communities have focused on the need to adequately define community boundaries. From the researchers perspective, defining the analytical unit is crucial because it is the basis for which findings are evaluated and conclusions are drawn.

Each individual's world-view, when protesting local toxic facilities, is constructed with a perception of social boundaries and their inclusion in the local community affected

by local sources of pollution. These boundaries exist and manifest themselves in their everyday experiences drawing from various interactions among community members. These interactions include various formal and informal networks to establish relationships and provide access to resources among individuals. They may include simple interactive networks involving children playing in the street or at local parks, to more structured networks involving church organizations, workplace environments, local schools, or local political bodies.

In the last three decades, the research has employed a variety of operational definitions of the community. Findings from this wealth of research have yielded divergent conclusions, often directly conflicting with one another. Even when comparing studies employing the same unit of analysis, findings across units of analysis have been inconsistent. This is generally the result of differences in other aspects of the research methods such as geographic location of the study, type of toxic facility, etc. Table 1 summarizes the findings for Unit of Analysis:

Table 1: Findings from the Research for Different Units of Analysis

Geo Unit for Community	Yes Environmental Racism Found	No Environmental Racism Not Found
ZIP Code	3[i]	1[ii]
County		2[iii]
Census Tract	4[iv]	4[v]

i United Church of Christ 1987; Rinquist 1997; Downey 1998
ii Hamilton, 1995
iii Hird 1993; Mitchel, Thomas, Cutter 1999
iv GAO 1983; Zimmerman 1993; Polluck and Vittas 1995; Stretsky and Hogan 1998
v Anderton et al. 1994; Been 1995; Been and Gupta 1997; Szasz and Meuser 2000

Much of the research in environmental racism use statistically quantifiable definitions of community, generally because of the availability of the data in predefined units of analysis by the Census Bureau. The scale generally ranges from as large as a county or metropolitan area to as small as a census track or census block. The choice of unit of analysis is generally determined by the researchers' goals, the availability of data, or the specific concerns the researcher wants to explore. The various definitions of community in the literature are generally framed in the following analytical units: (1) as a social nexus and place of cultural identity such as a neighborhood; (2) approximated and constructed by readily available observational units such as counties, ZIP codes areas and census tracts; or (3) composed of statistical space aggregated together such as radial zones created by the Geographic Information System (GIS) around a predefined distance from the toxic site (Williams 1999).

Because the literature has been so varied in its operational definition of a community, it has been difficult for researchers and policy makers to make any real sense of the research in the field of environmental justice. Each new piece of research only compounds the issue further. Researchers universally choose pragmatic methods, using units of analysis for which data are available rather than attempting to reach concensus theoretically as to what is the best analytical unit.

A common analytical unit employed in many studies is the ZIP code, which serves as a convenient unit of analysis because ZIP code data are readily available. The use of ZIP code as a unit of analysis has received extensive criticism from researchers, as they question its validity as an appropriate definition of community. ZIP codes often cover a very large geographical area created for the convenience of the postal service

without regard to community identity. Critics of studies that employ ZIP codes as a unit of measure argue that ZIP codes are too large to capture a single homogeneous community. Due to their size, they often capture a mix of ethnically diverse communities. Furthermore, ZIP code boundaries are not formulated along cultural lines, but are instead sized and created for the convenience of postal delivery.

In response to these criticisms, many studies began using census tracts, primarily because of their smaller size and zoning designed to reflect actual community dynamics. Despite these changes in the methodology census tracts have been critiqued as a unit of analysis for a variety of reasons. First, boundaries vary over time. Because the Census Bureau wants to maintain approximately 4,000 persons within a census tract, as metropolitan areas change in size and density from one census to the next, census tracts are continually being resized smaller. This continual resizing makes comparisons of demographics over time inconsistent.

Second, studies employing census tracts have produced inconsistent findings. Some studies find a relationship between race and pollution; others find no pattern of environmental racism. Much of the differences in findings across each study can be attributed to changes in the methodology. Each researcher defines the problem for their unique purposes, slightly altering their study design from previous research conducted in the field. Changes in methodology range from differences in independent variables and geographic location, to changes in the comparison groups. For example, Anderton et al. (1994) in the SADRI study compared communities with a toxic facility to only those communities without such a facility in the same metropolitan area. Other studies compared communities with a facility to all communities in the United States without

such a facility. Limiting the comparison group to only those communities in the same metropolitan area resulted in markedly different results compared to prior studies.

Third, the borders of census tracts do not necessarily define community boundaries. Bullard, in a 1996 published article, outlined his criticisms of much of the research and their methodology for defining community. As Bullard (1996) argued, social landmarks such as schools, churches and businesses more appropriately define of the boundaries of a community. Individuals and families do not decide where to move or rent based on census tract boundaries, but on their proximity to various community centers. Bullard argues that ethnic communities define their own boundaries often based on social and physical landmarks such as rivers, railroad tracks, schools, and parks. Governmentally defined borders are often designed for the convenience of analysis, not the reality of communities.

Fourth, census tracts, because they are limited in population size for the convenience of the census bureau, may not be inclusive of an entire community. Exclusion of community members outside the tract boundaries may be particularly problematic for urban Black neighborhoods that tend to be relatively large and densely populated. Three or four contiguous census tracts may in fact be better represented as a larger single community. While selecting smaller units of analysis, such as census tracts, has been generally accepted among many researchers, it runs the risk of balkanizing and dissecting culturally rich and cohesive communities into convenient but statistically disparate units of analysis.

Bullard criticized census tracts as the unit of analysis because they are not necessarily homogeneous or equivalent in size, proximity to toxic facilities, or population

density. Enclaves of minority neighborhoods can and do exist within the borders of a predominately White neighborhood. In some cases, these minority enclaves may be homes closest to the landfill site or toxic facility. In addition, no attention is given to how close the tract is to the nearest facility. Many studies have pointed out that most facilities are on the borders of the community boundaries. These adjoining tracts, while being adjacent to a facility are analyzed as non-host neighborhoods in the studies. Very little attention has been given to these adjacent neighborhoods.

Whereas large definitions of communities such as ZIP codes are problematic in that they often include a multitude of ethnically divergent communities, census tracts often divide ethnically homogeneous communities. This division of communities could have implications for the research by portraying a large number of minority census tracts as without a toxic facility when they are in fact located near a facility and intricately tied to the contiguous census tract with a toxic facility within its borders. For example, the Watts community in Los Angeles is considered its residents a single community; however, because of its large population size the community is sub-divided into more than one census tract. Similar communities in which a toxic facility is present may produce misleading results. Only one census tract in the community will be recorded as having a toxic facility, whereas the other census tracts in the same community will be recorded as without a toxic facility. By reporting many census tracts without a toxic facility, when they do in fact belong to a larger community with a facility, the final results will be biased by showing little or no relationship where in fact a much stronger relationship exists. Past research has shown that when contiguous census tracts are

analyzed, a relationship between race and pollution becomes more prominent (Anderson et al. 1994).

To correct for the inadequacies of units of analysis used in prior studies, a definition of community needs to be developed in line with how community groups have traditionally organized themselves in response to local toxic-related hazards. Many communities define themselves as small, while others define themselves as much larger. By forcing all communities into consistently populated geographic areas, this inherent self-definition of community size is ignored. Research in the field of environmental justice needs to move from a geographic or statistical definition of community to a social definition of community.

Defended and Defeated Neighborhoods

Before entering a discussion of what constitutes the most appropriate unit of analysis it is important to evaluate the theoretical premises assumed by the research as well as conceptual theories emerging from the political geography of scale. Of primary concern is the scale selected as the primary unit of analysis. How big is the neighborhood? Theorists in the production of space posit that the development of communities as interconnected networks of social relationships and social structures is fundamental to the success of capitalism (Soja 1980; Smith 1984; Lefebvre 1991). Synthesizing this research is the premise that uneven development of social classes among communities, through the process of class and race segregation, allows capitalists to shift investment to more vulnerable communities capitalizing on their scale of dependence (Smith 1984). This ability to mobilize their capital investment allows them

to seize the benefits from differing labors' rights and wage scales that develop among diverse but socially dependent communities. Intrinsic to this argument is the assumption that minorities are bound to their communities through the process of segregation. By increasing minorities' dependence on local communities, they become vulnerable to market forces.

The degree to which residents can relocate has implications for the ability of communities to defend themselves against unwanted encroachments. A distinction is made in the literature regarding the ability and wherewithal for communities to defend themselves against unwanted encroachments: the defended and the defeated neighborhood (Suttles 1972). The defended neighborhood is one in which residents have resources and strategies to defend themselves against a wide range of unwanted amenities. Individuals in defended neighborhoods can draw on two primary strategies to defend themselves. First, they can simply move to an area in which the perceived amenities are far greater. This strategy, of course, depends on the ability to mobilize. Second, when the ability to relocate is weaker, they can cultivate one another's neighbors to help ward off the encroachment of unwanted land uses (Suttles 1972). The success of this strategy is dependent on the resources and cultural cohesiveness of community members and their ability to draw on governmental, legal, and financial resources. When residents of a neighborhood are unable to draw on either tactic the community can be defined as a defeated community. The defeated neighborhood can be described as follows:

> Properly speaking, however, it is not that the residents of such areas lack the impulse to defend their areas but that they lack the wherewithal to do so. They might better be called defeated neighborhoods than undefended ones. The

> defeated neighborhood is in some ways the reverse of that which is defended by a combine of political, administrative, and business interests. It is subject to insufficient or quixotic enforcement of building standards, zoning rules, police protection, and wide disparities in the delivery of all the available community services. (Suttles 1972 p. 239)

The conception of the defeated neighborhood is the premise for which environmental racism can take a foothold in communities across the United States. The lack of power to either move or mobilize resources make poor and minority neighborhoods more vulnerable to toxic facilities, with less of an ability to sustain an effective opposition.

Constructing Space

Through the literature within the political geography of scale, we can begin to develop a theoretical understanding of how community boundaries develop in accordance with interpersonal identity and collective space. The political geography of scale is axiomatic because it begins with the premise that the production of space is socially constructed. As community members interact with one another in social networks, the definition of community boundaries are created. This construction of social space is not merely the outcome of social interaction, but is the process of a dialectic tension between space itself and the social networks embedded in that space (Soja 1980). As social interactions create a community of social networks, this space in turn helps to create the boundaries and dynamics of those networks. With this understanding of community development, communities are created through a dialectic process by which people create social networks while these social networks interact back on community members by defining their meaning and understanding of community. "'Created space' is locked in a

'socio-spatial dialectic': it is not solely the outcome of social process but the medium for social practice as well" (Towers 2000 p. 26). This dialectic involves the meaning actors attribute to their social environment as well as the impact regulation, in the form of government and private businesses, have on those social networks. These two forms of content within social space, *meaning* and *regulation*, have evolved as pivotal issues for establishing how communities are defined within the field of political geography of scale (Towers 2000).

Based on these theoretical premises, scale is not a methodological given, but is dependent on the actors relevance of meaning and regulation to an issue at hand. For instance, the creation of social space can remain as small as a neighborhood when meaning is attributed to a local business that define the identity of community members. This form of social space is common among mining and fishing towns. Identity revolves around a distinct entity that shapes the lives and interactions of all actors within that space. Vice versa, when examining the deep ecology and other global environmental movements the creation of social space can be enlarged to include the global planet. Focusing on forces common to all individuals on the planet becomes the focal point of identity and commonality. Meaning is enlarged to include the global planet.

The emphasis on meaning tends to focus research on interactional networks and local usage patterns as a means for defining the localized web of interpersonal interactions and business practices that form the core of community integration. The local community, following this interpretation of the community, can be seen as a "gradual, aggregate by-product of individual action." (Suttles 1972 p. 12) Communities, then, are a constructed meaning of actors forming a cognitive or psychological model of

community rather than a geographic space delimited in space. By examining community as constructed by community members along cultural rather than physical boundaries, we can see the differentiation between conceptualizing community boundaries as enacted or natural. "Enacted limits to a community are simply those imposed on the urban landscape as an arbitrary line marked off on a map by organizational proclamations" (Suttles 1972 p.242).

The problem with enacted limits to a community is the dependence on a mosaic of constantly changing administrative, corporate, and physical localities each serving a fluctuating and inconsistent population. In contrast to the enacted community is the natural community, forming along cultural lines in response to a cohesive identity. The natural community can be viewed as a grassroots conception, forming from the ground up through a network of interpersonal interactions. Communities serve as a form of social identity, in which individuals seek to interact with people of similar social, economic, educational, racial, and cultural backgrounds. Community is hence a communion of souls, of individuals collectivity; however, this communion is dependent on the degree to which individuals choose their local environment. Individuals in society with a greater degree of latitude when choosing a residence will have a greater level of connection and investment among their neighbors.

Regulation also has an impact on the social scale as political and private agencies seek to manipulate the economic market across differing political boundaries to capitalize on market investments. Tax laws and industry regulation extend from the federal level down to local political entities. At each level of political influence, individuals and

community centers are differentially impacted by regulation, creating a sense of commonality among members.

This double influence of meaning and regulation on the scale of community dependence relates to the environmental justice movement by clarifying how community members establish meaning of group interdependence and seek to impact regulation of toxic facilities through local and federal laws. Meaning and regulation surrounding the location of a toxic facility directly impact the scale of dependence as community members frame their debate in order to serve their political purposes. "Agents struggle for scalar hegemony, campaigning to convince decision makers at contested scales to accept their representations of reality" (Towers 2000 p.27). The result is a debate of scale between toxic facilities and local communities. Community members frame their debate by emphasizing the potential health and environmental effects to individuals with the greatest risk and threat of harm, emphasizing smaller definitions of scale around meaning. Similarly, decision makers for toxic facilities frame the debate around the economic benefits to the larger economy, emphasizing larger definitions of scale around regulation, while minimizing the negative impact on the local community. This generally results with many firms portraying opposing communities as NIMBYs (not in my backyard), who are selfishly preoccupied with their immediate communities needs, often at the expense of the larger economic and environmental needs of the nation (Towers 2000). Consequently, the definition of community and its scale of dependence are dialectically connected to this debate between toxic facilities and communities as they fight to frame the issues according to their own interests. Hence, the definition of community and its associated scale should be developed in accordance with the concepts

of meaning and regulation attached to actors involved in local environmental grassroots movements.

Within the environmental justice movement, communities seek to redress perceived environmental injustices by coming together in protest of potential or actual toxic facility sitings. Community members establish definitions of community as they come together in protest under a common interest. The literature suggests that women are far more active than men at the local level, expressing a greater level of concern for local environmental issues than men, making them more predisposed to perceive grievances (Krauss 1993). Because of their roles as mothers they have a greater sensitivity to illness and its effects. It is in their informal social networks as mothers that women discuss health issues such as miscarriages, birth defects, and illness while making the link between toxic-related hazards and their children's health. Because women tend to be more active in the environmental justice movement, the role of women becomes the frame of meaning for defining the community.

The definition of community, because it is a dialectic process constantly reshaped through actors' experiences, is inherently arbitrary and subjective. But the definition should not be arbitrarily defined by researchers needs and conveniences, it should be defined by the subjective experiences of actors involved in the environmental justice movement. Given the literature on the role of women in these protest movements, it is logical to define the unit of community so as to reflect the experiences and issues of women's private and public lives vis a vis the protest of local toxic facilities.

The research demonstrates how women frame their protests of toxic facilities in the traditions of motherhood and family (Krauss 1993). For women, the connection

between family and community is interconnected. It is the issues of health and family that bring their attention to public life in opposition to perceived threats. The organization of social movements in protest of these facilities is viewed as an extension of these relationships surrounding motherhood. Whereas men create networks through work and politics, women establish networks through organizations connected to their roles as mothers, such as schools and churches. Feminist theory challenges the dominant paradigm of social and political thought that separates the public world of economy and power from the private world of everyday experiences. The dominant theoretical perspectives miss the connection between everyday experiences of motherhood from the political realm of policy and economy. It is by examining the networks of women involved in the environmental grassroots movement that we can begin to develop a clearer definition of community as it relates to meaning and regulation.

Studies of the mobilization process in grassroots movements demonstrate how the recruitment process occurs through women's social networks, attached to organizations related to family (Cable 1992; Krauss 1993). Once a health problem related to local-hazardous facilities has been identified, these women's extended networks are used as a resource to connect with other community members to help spread information and to recruit members in the protest movement. While these networks are informal in nature, they are precipitated by organizational institutions, which have strong ties to families; such as schools and churches.

Community Definition and Local Schools

It is by using these organizational institutions that can help researchers define communities uniformly across a wide variety of cities and towns as well as making the link between how communities organize through women's social networks. It is my contention that schools, as places where women and mothers come together in the interests of their children and the informal social networks that develop, serves the best organizational structure to help define the boundaries of a community. In an a 1992 article by Sherry Cable, the role of schools for helping to mobilize and define definitions of community is clearly illustrated:

> Cultural balkanization originating in the coal-camp era kept residents from interacting beyond their own communities. The situation changed somewhat in the 1970s when rural public schools consolidated, as the younger generation no longer identified with their small communities of origin, but the more inclusive Yellow Creek valley. Their children's nascent network ties revealed the shared grievances of their families to the founders' wives. Each then urged her husband to meet the other, which, after goading and daring, occurred….After the first meeting, the women founders recruited through the fragile ties their less parochial children forged, since cultural balkanization had restricted friendship networks to the boundaries of the isolated communities. (p.42)

This piece of research demonstrates how the informal networks of women in their role as mothers, is precipitated by the informal networks of children, generally forged in the local schools. Subsequently, it is the organizational institution of schools that define the boundaries and interconnected networks of communities.

A study conducted in three L.A. neighborhoods by Pebley and Vaiana (2002) investigated the personal definitions community members develop of neighborhood boundaries. They found that while residents had "very clear ideas about the boundaries of their neighborhoods, …they didn't necessarily agree about where those boundaries lie"

(p.17). Generally, individual residents tended to define neighborhood boundaries by the informal networks that define their daily lives. Boundaries were often defined by "where they shop, where their kids go to school, or where they go to religious services." (Pebley et al 2002 p.17) This piece of research demonstrates the amorphous nature of community boundaries, while at the same time providing a link to local schools. Residents with children, tend to develop networks based on relationships that originate in the local school setting.

Similar research has demonstrated the perceptions of quality associated with schools in some geographic areas compared to other areas. A study conducted by Levy, Meltsner, and Wildavsky (1974) quoted residents in California cities as they identified and clarified this differentiation.

> The hill schools were the best. They are 'newer and get top quality teachers… 'Miller (a hill school) is a good school but the rest of them are bad, bad, bad'; or 'The schools are poorly administered and good in some areas, depending on how good the PTA is and how good the home is at supplementing the school.' (p. 15)

This differentiation among schools as perceived by residents demonstrates the degree to which residents identify neighborhoods as associated with particular schools, but also how residents qualify quality of life issues in a neighborhood with a local school. Differences in perception of quality lead to differences in residence and mobilization patterns.

Schools also serve as an accurate measure of how communities organize against toxic facility placements. Because of this pattern of environmental justice organization it seems logical to define a unit of analysis that follows the historical pattern of environmental justice organization at the grassroots level. I argue that using elementary

schools as a center of a community and defining demographic patterns of a community defined by elementary schools a unit of analysis that not only serves as a more accurate definition of a community, but also follows patterns of organization against local environmental pollution at the grassroots level. Elementary school zones also has the additive advantage of being automatically sized to the social boundaries of the community, rather than following population parameters defined by the Census Bureau. They are automatically adjusted to the socially defined size of the community.

The use of elementary schools to form a definition of community boundaries is not without its problems. First, some communities have a high number of children attending local private schools. Because private school attendance is generally dominated by the wealthy and the White, it may impact the demographics of many communities Demographic information used solely on public school children could make the community appear as if the minority population is proportionately larger than it actually is. To compensate for this weakness, school data does provide information on the number of elementary school children attending private schools or being home schooled that can be used to supplement demographic information. By comparing the school demographic information to the census demographic information, any differences in the financial and racial status of a community can be corrected if that difference is based on private school attendance.

Second, obtaining information that is only provided by the census bureau such as median value of homes, number of renters, and population density will be problematic. That information is not available through the census data in units that correspond directly to school zoning boundaries. This difference in community boundaries can be remedied

to a degree by matching the information available by the school data to the information available by census tract data for that community. It will be assumed that when the racial and poverty level numbers are similar, the other variables will be representative of the community.

Conclusion

The environmental justice movement as a grassroots movement is often formed through informal social networks centered on community activities and functions. Research about grassroots environmental movements have shown that organization against environmental pollution in communities begins primarily with women, and more specifically mothers. Because mothers are in daily or weekly contact with other mothers through school activities, patterns of health problems related to local pollution are generally recognized first by them. In addition, they have the greatest interest in maintaining environmentally healthy communities for the health of their children. As mothers talk to other mothers while dropping off and picking up their children from school, school functions, or during PTA meetings they recognize patterns of health that may be directly or indirectly linked to local toxic facilities and pollution sites.

It is through these networks, that local environmental grassroots movements form. Subsequently, defining communities based on the social networks that develop in response to toxic facilities provides the best social definition of community. Local schools serve a valuable role in helping families share ideas and recruit members to the movement.

CHAPTER 4: WEAKNESSES OF EXISTING RESEARCH

Introduction

In 1996, Bullard published an article criticizing many of the methodological assumptions in the literature. In this article, Bullard highlighted many weaknesses in the existing research, ranging from problems with the definition of community and comparisons of facilities. Bullard also argued that many of the previous studies limited the dependent variable to waste facility sites, ignoring other sources of environmental pollution such as pesticides, lead poisoning, and workplace exposure. Avoiding other sources of exposure to environmental contamination ignores the true extent of environmental racism. It was also argued that many of the previous studies eliminated many facilities and communities from the analysis for methodological and statistical purposes, heavily biasing the results. Many communities in which a toxic facility was sited were eliminated because demographic data were not available. For example, Anderton et al. (1994) focused strictly on metropolitan areas leaving out many commercial hazardous waste landfills in rural areas. Bullard argued that many of these studies were letting the methodology "preselect their sample" (Bullard 1996 p.495).

Relative Toxicity of Facilities

One of the most widely recognized criticisms of the research was launched by Bullard in a 1996 article, in which he identifies the major flaws in the existing research. Bullard's essential argument was that not all toxic facilities are created equal, meaning

that comparisons across facilities which may vary dramatically in relative health risk posed to local community members imposes an inherent flaw in the methodology, making all conclusions circumspect. A majority of the studies did not include information on the "size, volume, type, and disposal capacity of the hazardous waste landfills included in the study and those dropped from the study" (Bullard 1996 p. 496). Even when a study did include information on the weight of toxins, the study assumed all toxins released are equal in toxicity levels. Some chemicals are known cancer-causing agents when released in trace amounts in the soil, air or water, whereas other toxins are relatively benign even in much larger quantities. The assumption of weight is not sufficient enough to adequately delineate the question of exposure. The question of environmental racism requires knowledge of who gets the pollution and what is their exposure to harm. A landfill or toxic facility site in a predominately White neighborhood may differ significantly from a landfill or toxic facility site in a predominately Black neighborhood if it is larger and allows more hazardous waste. Exposure to environmental contamination is not equal for danger of toxins, distance to facility, and amount of toxins, but the methodology of previous studies assumes equality of exposure and harm. These criticisms launched by Bullard forced researchers to question the guiding assumptions in a majority of the literature. Many researchers were forced to readdress the issues of environmental racism anew with updated and cleaner methodologies. Without addressing these weaknesses, no definitive statements could be made regarding the extent of environmental racism in the United States.

A primary weakness in the prior research is the assumption that all facilities are created equal in their potential to cause harm to the health of a community. Simply

because demographically dissimilar communities share an equal risk of being located near a facility does not mean they share an equal risk of exposure or an equal risk of health related illnesses. Although some studies have attempted to address this issue by examining the total weight of released chemicals, the issue of relative toxicity has not been addressed. It is known that many chemicals while unsafe and environmentally bothersome at elevated levels they still remain relatively benign to the general health of the community. Conversely, other chemicals are so toxic that even at much smaller levels the community may be at a much higher risk of certain types of cancer. Measuring weight alone does not differentiate between high-risk carcinogenic chemicals and other lower risk chemicals.

A format for transferring chemicals released from TRI facilities into a risk scoring system was developed by Drs. Edgar Hertwich and William Pease, in collaboration with colleagues at the School of Public Health at the University of California Berkeley. This risk scoring system allows released chemicals to be compared on a common scale that adjusts for differences in toxicity, exposure potential, and subsequent health risks (scorecard.org). Each chemical is converted into a Toxic Equivalency Potential by comparing the risk of one pound of a release chemical to the risk posed by one pound of a reference chemical (scorecard.org). Because some chemicals are known carcinogens while others are not, two different reference chemicals are used for the conversion. For those chemicals known to increase the risk of cancer, releases are converted into benezene-equivalents. For those chemicals that cause non-cancerous health effects, releases are converted into toluene-equivalents.

The risk scoring system was developed by taking into consideration geological factors that would affect the concentration of a chemical once it passes through the environment and poses actual risk to humans in its final form. Each chemical manifests itself differently in the environment. Some chemicals accumulate in sediments, while biological processes such as hydrolysis, oxidation, or biodegradation transform others. Some chemicals are relatively toxic in their original form, like formaldehyde, but quickly degrade when released to the air making them rather benign when exposed to human populations.

Because chemicals impact the environment differently depending on how they are released, via air or water, the TEP scores vary by the method of release to the environment. Some chemicals may quickly degrade when released by air, but remain relatively toxic when released by water. The TEP scores for each chemical take into consideration at least 23 different pathways a chemical may take once it enters the ecosystem to estimate the average daily dose of a person in the local community. It also assumes three possible forms of exposure to the local population: ingestion, inhalation, and dermal (skin) contact. Although many sites have other facts that could impact concentration outcomes based on geological processes limited to that site, the risk scoring system greatly improves on studies that merely examine the total weight of toxins released. The toxic equivalency potentials for each chemical used in the risk scoring system are multiplied by each chemical's release in quantity by pounds. These final scores provide a better indicator of potential risk for the community for any adverse health effects.

This risk scoring system is a great improvement on past studies but has its own limitations for defining risk in a particular community. First, not all of the parameters in the geological processes that impact the outcome of a chemical can be predicted. A variety of landscape characteristics vary by site such as precipitation, temperature, wind speed, and surface water depth that make the toxic equivalency potentials an imperfect system.

Second, the model to estimate the TEP scores assumes a closed model system, meaning that it is assumed chemicals released at the site are not transported out of the local community through environmental processes such as wind and water runoff. In most cases the community residing nearest to the release site will suffer the greatest exposure to the chemicals. In some cases communities down wind or down stream may suffer the greatest exposure. It is impossible to model situations like these without an individual analysis of each site and all surrounding communities.

Third, the risk scoring system does not take into consideration the qualitative differences with various types of cancer and other adverse health effects. It is known that some cancers are more virulent than others, with a greater risk of death than other types of cancers. In addition, some adverse health effects, not related to cancer, can be more cumbersome to an individual than others.

Fourth, the risk scoring system does not consider the strength of evidence linking a chemical as a carcinogen. Some chemicals are known carcinogens, whereas others are simply suspected.

Fifth, because pathways a chemical can take in soil are so varied with too many unknown parameters, TEP scores for land releases have not been developed.

Subsequently, TRI facilities with large amounts of land releases are underestimated as a source of pollution because the final rating system will excludes land releases.

Change in Community Composition

An additional weakness of the research is the pervasive treatment of environmental racism as a condition, resulting from a single, hostile, discriminatory act, while ignoring the larger hegemonic forms of racism that permeate throughout current culture. By reducing environmental racism to a discrete and isolated event, many researchers miss the role of structural economic and market forces in contributing to the inequitable distribution of toxic facilities. What is needed in the research is an analysis of environmental racism as a dynamic process, resulting from multiple economic and socio-cultural forces. The literature on racism, which has been largely absent from the research in environmental justice, provides a theoretical basis for a broader understanding of discriminatory practices that serve to perpetuate inequalities in a variety of institutional domains. Racism, in this context, is defined as "those practices and ideologies, carried out by structures, institutions, and individuals, that reproduce racial inequality and systematically undermine the well-being of racially subordinated populations" (Pulido 2000 p.15). In the environmental racism literature the distinction between prejudice (attitude/ideation) and discrimination (behavior) often is elided, as is the distinction between individual and institutional patterns of behavior. The notion of environment racism as often used by environmental justice researchers implies a pattern where ideologies and behaviors interact to produce unequal access to resources, benefits, and amenities as well as inequalities in exposure to harm and social injustice. Any instance

where racial differentials obtain in exposure to risk/harm is taken as prima facie evidence of environmental racism. Intent and discrimination simply are presumed. This perspective underpins accounts of inequitable distribution of toxic facilities.

Based on the assumptions of institutional racism as a model of environmental justice, it is argued that White families have greater latitude in relocating to different neighborhoods when environmental deterioration is discovered in their community. This concept has been defined by Pulido as a form of 'white privilege' that results from social meanings embedded in our cultural understanding race. The primary argument put forth by Bullard and others is that the unequal distribution of environmental risks is only possible because of continued institutional practices that maintain segregation and deterioration of Black communities. Institutional racism is defined as "those laws, customs, and practices which systematically reflect and produce inequalities in American society…whether or not the individuals maintaining those practices have racist intentions" (Jones 1972 p.131). The most obvious and salient forms of institutional racism concern discriminatory housing and lending practices. A 1991 report by the Federal Reserve Board found that Blacks are denied home loans at twice the rate of Whites (Bullard 1995). Eight out of every ten African-Americans live in segregated neighborhoods, defined as communities that are predominately Black (Bullard 1995). This trend does not decrease significantly with income or education. Adding to this already dizzying institutional segregation patterns are the deteriorating environmental and economic conditions in most of these predominately Black communities. Bullard (1995) argues that these apartheid conditions substantially contribute to the deteriorating

conditions for Blacks by reducing mobility, diminishing job opportunities, and decreasing environmental choices.

Our understanding of race is not manifested in society by single discriminatory acts, but permeates throughout our culture in our ideologies, psyche, language, and social institutions. What is important in this theoretical perspective of racism is the understanding that racism is a fluid, mobilizing force that differentially impacts the outcomes of the social order for minority groups. People and institutions create systems of inequality over time, through their daily patterns of racism, deeply embedded in society. Spatial segregation, the element of racism that makes the inequitable distribution of toxic facilities across minority groups possible, is created through the mobilization of Whites and minorities through the housing market. This movement in the housing market is the process of demographic change that segregates minority populations from White populations. It is perpetuated, through the racist ideologies that enable Whites to separate themselves geographically from minority populations. This process of movement and migration should be the focus of analysis when examining segregation patterns that create the larger pattern of environmental racism. Segregation should not be theoretically viewed as a single condition existing at any given moment in time, but as an outcome of demographic changes and mobilization patterns that result from a myriad of racist ideologies and behaviors.

Much of the literature has treated environmental racism as a single condition, existing in a single moment of time, created through a single hostile act of racism. Despite the prevalence of market forces theory in the literature, a theory that highlights the importance of the processes of racism that act through the housing and economic

market, researchers still limit their analysis to single moments in time, without ever measuring movement in the housing market as a process of racism. Researchers are analyzing and measuring a static condition, rather than a dynamic process. Some studies focused on the presence of inequitable distribution by race at the time of the siting to demonstrate the existence, or non-existence, of a single discriminatory act. No study has analyzed demographic changes and the mobilization of Whites in the community as a variable in and of itself. The presence of racist processes operating in the economic market to create the condition of environmental racism is inferred through the absence of a single discriminatory act. It is assumed that if differences in facility placement across minority groups did not exist at the time of the siting, any current existence of environmental racism must have resulted from economic processes. The weakness in this methodology is the assumption of a process that is only indirectly, never directly measured. The complexities of racist ideologies impacting the social order and patterns of segregation are reduced to an overly simplified chicken or the egg scenario. While Liu (1997) did analyze the movement of Blacks, he misses the theoretical nature of segregation as a process by which Whites use their status to isolate themselves from deteriorating housing and environmental conditions. In other words, segregation occurs because Whites move away, while Blacks are restricted in their movement in the housing market due to racist ideologies and are left behind in deteriorating and economically deprived communities.

To compensate for these limitations, the inclusion of variables that measure compositional change in the community will be included in this study. The change in White, Black, and Hispanic populations over a two-decade period between the years of

1981 (the earliest year for which data is available) and 2000 are calculated. The data is drawn directly from public school records. Positive values indicate a growth in the White population in any given community, whereas negative values indicate a decline in the White population in any given community. While this variable is limited because it does not analyze the change in the community from the time of the siting to the 2000 census, it will offer a better indicator of demographic changes in communities with toxic facilities vs. communities without toxic facilities than reported in past studies. The purpose of this variable is to measure the degree of exodus of the White population, in essence, the level of 'white privilege' accorded to Whites in the housing market. If communities with TRI facilities have a greater proportion of White community members leaving the area and relocating elsewhere, it is evidence that institutional racism factors in the housing market do differentially impact the outcome of exposure to local pollution. Finding evidence of 'white flight' lends credence to market forces theory demonstrating that the White population does indeed 'vote with their feet' when choosing neighborhoods of residence. It is essential to use a dynamic rather than a static variable to measure dynamics in the housing market and fully understand the role of race and market forces in the distribution of pollution in the United States.

To further analyze compositional changes of communities with toxic facilities as compared to communities without toxic facilities, variables that measure the change in median value of owner occupied homes and percentage of population in poverty will be included. Market forces theory argues that property values decline in value after the placement of a toxic facility, increasing the number of people living on marginal incomes. These economic and market changes, inevitably impact the racial and ethnic

composition of a community. By examining the changes of housing values and poverty levels in these communities, a better evaluation of market forces theory may be accomplished. Institutional and racist ideologies maintain patterns of segregation and the American apartheid system through the mobilization of Whites in the housing market. Without patterns of segregation, the inequitable distribution of toxic facilities across minority groups would not be possible. It is the purpose of this research to examine the patterns of segregation as a dynamic process and its influence on the nature and extent of environmental injustices in the United States.

CHAPTER 5: RESEARCH DESIGN

Scope of Study

Because a national study of this magnitude is beyond the time and resources available to the researcher, this study is limited to California. Accessing and compiling all the data files necessary to create a national database of TRI facilities and NPL superfund sites in accordance with school zoning boundaries would require more time, work, and money than available. California was chosen for several reasons. First, it has a large and diverse population including large numbers of Hispanics and Blacks. Very few states in the United States have such substantial numbers of both Hispanics and Blacks.

Second, the minority population has been steadily increasing during the last several decades at a rate that far surpasses the growth of the White population. This growth in the Hispanic population has resulted in a shifting of community composition over time. California also provides a unique opportunity to analyze how market forces in a population undergoing dramatic demographic changes mobilizes minority and White populations into separate and distinct housing markets. The changing demographics in California allow the analysis to address the following questions: Are minority populations, particularly Hispanic peoples, being shuffled into communities where the existence of TRI facilities and superfund sites are more likely? As knowledge of the environmental contamination from many industrial sites becomes available to the public, are White populations moving away from these same polluted communities?

Because this study is limited in scope to the state of California, findings will not be used to draw conclusions about the nature and extent of environmental racism in other parts of the United States. California has its own unique environmental, economic, and housing conditions that may not be representative of other regions and states. What can be used from this study is the ability to use the methodology to examine the unique characteristics of market forces and environmental conditions in other states. While the findings are only useful for interpreting the extent of environmental racism in California, the methodology can be used to expand the findings into other states and regions of the United States.

Unit of Analysis

The analytical unit for this project is elementary school zones as the primary definition of community boundaries. Previous studies are criticized for their methodology because census blocks, census tracks, and zip codes are not accurate measurements of a community. Following the assumption that schools define communities, the elementary school is the basic unit of analysis. A community is therefore defined as all residents living in an area for which all elementary school children are required to attend the same elementary school. The designated elementary school serves as the community nexus for which social networks form and provides the form of meaning and regulation to community members.

Source of Pollution

There is tremendous variation in the literature regarding the sources of pollution for analysis. The most commonly used sources of pollution are superfund sites on the National Priorities List, Hazardous Waste Treatment, Storage, Disposal and Recycling Facilities, and the Toxic Release Inventory. Still other studies have concentrated on non-point sources of pollution such as pesticides and air pollution. For this study, the main focus is the Toxic Release Inventory (TRI) reported through the Environmental Protection Agency (EPA).

In 1984, a cloud of methyl isocyanate was released into the environment in Bhopal, India, resulting in the death of thousands of local residents. Shortly thereafter, there was a serious chemical release at a sister plant in West Virginia. These incidents galvanized the request of environmental organizations and other public interest groups for greater public information on toxic chemicals being released at facilities around the country. What followed was the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986. Sections 311 and 312 of the EPCRA require businesses to report the locations and quantities of chemicals stored on-site to state and local governments. Section 313 of EPCRA requires the EPA to collect data annually on releases and transfers of certain toxic chemicals from industrial facilities, and make the data available to the public in the Toxics Release Inventory (TRI). Currently, almost 650 chemicals and chemical categories are included in the Toxic Release Inventory from industries including manufacturing, metal and coal mining, electric utilities, commercial hazardous waste treatment facilties, textile, printing and publishing facilities, among many others.

TRI data provides many benefits for the purposes of this study. First, the exact location of the facility by longitude and latitude is easily available, making it possible to pinpoint the location in relation to the nearest elementary school. Second, names and amounts of all reportable chemicals released into the environment are published making it possible to determine the relative toxicity of each facility.

TRI data serves as an adequate measure of environmental hazards, but several limitations obtain from using this data source. First, although the EPA has extended the list of reportable toxic chemicals, the EPCRA does not cover all sources of pollution, toxic chemicals, industry sectors, and waste management activities. Facilities that do not meet the quantity threshold levels or facilities with fewer than 10 full-time employees are not required to report. Consequently, only a portion of all toxic chemical releases are reported in the TRI data file.

Second, data are not included on toxic emissions from non-point sources such as cars, trucks, farmland pesticides, volatile organic compounds, fertilizers, and other non-industrial sources.

Third, much of the reported data are merely estimated release amounts. The EPA program does not mandate that facilities monitor their releases; so many estimation techniques are used to generate release quantities. Estimation techniques vary from facility to facility, creating problems with data accuracy and comparability.

Fourth, once chemicals are released into the environment there is no way to definitively monitor the fate or final destination of each chemical. The data file can indicate some measure of quantity and type of releases, but it does not provide a method for evaluating exposure to local community members as a result of those releases.

Data

Data for this research project are drawn from a variety of public access sources. All agency data are public and easily accessed on the Internet. Data files and variables were compiled for this research project are listed in table 2.

School Data

Information for demographic characteristics of elementary school communities were extracted from data available from the California Department of Education. Through these series of files, information for every public school in the state of California is provided. From these files, all schools not categorized as an elementary school or closed as of 2000 were eliminated. To prevent overlapping and double counting communities, all schools not beginning with Kindergarten or First grade were also eliminated. Due to the reduction in class sizes over the past several years and the structure of many districts, many districts separated the lower elementary grades from the upper elementary grades. Many districts further separated the elementary grades into three different elementary schools for grades K-1, 2-3, and 4-5. While all of these schools were categorized as elementary schools, they were in fact representing identical or overlapping communities. Including only those elementary schools that begin with either Kindergarten or First grade eliminated this problem. Finally, all charter schools were eliminated. After eliminating these schools, a total of 5,084 elementary schools remained for the final analysis.

All demographic and economic data for these schools were available in separate files and were merged into the final list of elementary schools. Ethnic and racial data

Table 2: Data Sources for Variables in Study

Variable	Data Source
School name School code Type of school Latitude Longitude Census block Census tract Urbanization	California Department of Education List of California Public Schools 2000 pubschls.dbf
School code Percent of CalWORKS or AFDC children of public and private school enrollment Percent of meal program children of public and private school enrollment	California Department of Education Free and Reduced Price Meals/CalWORKS 2000 afdc2000.exe 1990 afdc1990.exe
School code Total enrollment Percent Black Percent Hispanic Percent White Percent Other	California Department of Education Enrollment, by ethnic group, by school 1981, 1990, 2000 ethschnn.exe
Census Block Census Tract Percent Hispanic Percent Black Urbanization Percent high school graduate Median family income Percent Poverty Percent Manufacturing Percent Public Assistance Median value of owner-occupied housing units Percent Renter occupied	US Census Bureau 2000 Summary File 3 (SF3) California
Name Latitude Longitude Air Emissions Surface Water Discharges Underground Injection On-site Land Releases	Environmental Protection Agency 1998 Toxic Release Inventory Data ATRI RY98.pdf

Table 2: Continued

Variable	Data Source
Chemical	Scorecard
Cancer score – Air	Toxic Equivalency Potentials: TEP scoring system
Cancer score – Water	CSV file.txt
Non cancer score – Air	
Non cancer score – Water	

were available for every year beginning in 1981. For the purposes of this project, only the years of 1981, 1990 and 2000 were selected and merged into the final database. These files included a school identification variable (CDS_CODE), the total number of students, and the number of children enrolled as American Indian, Asian, Pacific Islander, Filipino, Hispanic, Black (non-Hispanic) and White (non-Hispanic).

Economic data were available every year beginning in 1988. Only the years of 1990 and 2000 were used for the analysis. These files included a school identification variable, the total school enrollment, the number of children known to be residing in the area, but not enrolled in school (private school enrollees, dropouts, and home schooled children), the percent children ages 5-17 residing in the attendance area receiving CALWORKS (or AFDC), and the percent of children ages 5-17 residing in the attendance area receiving free or reduced meals.

Because the location of the school, as measured with latitude and longitude coordinates, are used to calculate distance to the nearest TRI facility, some data integrity checks were used to improve the accuracy of the data. First, all schools were checked to make sure the coordinates did not duplicate the coordinates of any other school. This search turned up several schools with duplicate coordinates (64 total). In most of these

situations, the coordinates listed were the coordinates of the district headquarters and not the school site itself. By using geocoding services, all incorrect coordinates were replaced with the correct latitude and longitude designations. In several instances, the address listed in the file was incorrect, either listing the address of the district headquarters or reporting a mailing address separate from the physical location. To ascertain the exact physical location, all addresses were verified by cross checking with information available through the internet. If this procedure did not provide an accurate physical address of the school, a call was made directly to the school.

Second, all coordinates were checked to verify the latitude and longitude were carried out to at least 2 decimal places. All schools with insufficient coordinates were replaced with latitude and longitude coordinates obtained through geocoding services. Many schools did not report either the latitude or longitude, with several schools reporting no coordinates. Geocoding services were used to locate the correct coordinates.

Third, all schools within the Los Angeles area were geocoded to insure accuracy. Because of the dense population and significance of the Los Angeles area, it was necessary to ensure that all coordinates were carried out to the greatest degree of accuracy. After all data integrity procedures, all schools in California were located to within a ½ mile degree of accuracy using the correct physical location.

Census Data

Because of all of the control variables necessary to test all theoretical constructs were not included in the school data files, census data were used to supplement the data. The Census 2000 files were used available through the US Census Bureau website. All

variables were obtained from the Census 2000 Summary File 3. The variables pulled for analysis are: P1 (Total Population), P37 (Sex by educational attainment for the population 25 years and over), P49 (Sex by industry for the employed civilian population 16 years and over), P53 (Median household income in 1999 dollars), H34 (Median year structure built), H39 (Median year householder moved into unit by tenure), H84 (Median value in dollars for all owner-occupied housing units), Total Land Area, Latitude, and Longitude for center of census tract.

All variables pulled from the census files were only used as supplemental controls in the analysis, making it necessary to merge census variables with the school data file. Because an adequate variable on which to merge the files did not exist, the files were merged using latitude and longitude using GIS software. Approximately than 9,000 census tracts exist in California for the 2000 census. Of these census tracts, a few hundred were eliminated because the population was either zero, or less than 200 people. Of the remaining, 8,846 census tracts were left to merge with the school data. The files were merged using the nearest census tract to the school site. While this merging process creates some error in the data because census tracts are generally smaller in size than elementary school boundaries and almost 4,000 census tracts were not merged with the elementary school data file, the results were remarkably similar. The Person's correlation of .710 between Percent Black in the elementary school data file and Percent Black from the merged census files helped to verify the degree of accuracy between the two data files. A correlation comparing Percent Hispanic from the elementary school data file and the merged census files produced a value of .701. Both correlations were significant to less than .0001.

TRI Facilities

Toxic Release Inventory (TRI) data files for the reporting year of 1998 available through the United States Environmental Protection Agency were used to generate the dependent variables. The variables pulled from the TRI data file for analysis include Facility Name, Latitude, Longitude, a listing of each chemical, and quantities of air emissions, surface water discharges, underground injection, and on-site land releases for each chemical into the local environment. A total of 1,392 facilities are reported in the data file.

An explanation of on-site releases are explained below:

1. **Air Emissions**: quantities include both point source and fugitive emissions. Point source emissions occur through confined air streams such as stacks, vents, ducts, or pipes. Fugitive emissions include equipment leaks, evaporation, spills and other non-point sources from the facility.
2. **Surface Water Discharges**: includes releases to water systems such as streams, rivers, lakes, oceans, and other surface bodies of water. Quantities include releases from pipes, trenches, and runoff.
3. **Underground Injection**: includes the subsurface emplacement of fluids through wells. Includes all classes of wells from Class I through Class V, that range from deep, confined formations below potable water supplies to shallow drainage wells.

4. **On-site Land Releases**: disposal of toxic chemicals in landfills in which wastes are buried, waste is applied into the soil, surface impoundments into uncovered holding areas, waste piles, and other releases to land such as spills or leaks.

Once the data were downloaded from the website, data integrity procedures were used to help ensure their accuracy. Of prime importance was the precise location of each TRI facility. Geocoding procedures were used for unreliable facility locations, which included any facility with missing latitude and longitude information. Geocoding procedures were also used for any facility in which mapping the location placed the facility outside the boundaries of California.

After verifying the location of facility locations, the data were merged to the community data. With the use of GIS software, the school data and the TRI data were merged by locating the nearest TRI facility to each elementary school. The merge was completed using latitude and longitude for each elementary school and each facility. Because many more elementary schools exist in California than TRI facilities, each facility had the potential of being selected multiple times. Only a very small number of facilities were selected only once, meaning they were the closest facility to only one school. Conversely, the possibility obtains that some facilities were not selected by any elementary school. The final merge was only designed to describe characteristics of the nearest facility for each community, not to summarize all TRI facilities in California.

Toxic Equivalency Potentials

From the Scorecard website, a file is made available to delineate the health hazard of many toxic chemicals reported to EPA. The file contains cancer and non-cancer

scores for 345 toxic chemicals. The variables used are chemical name, air cancer score, water cancer score, air non-cancer score, and water non-cancer score. To help calculate the total cancer and non-cancer risk of each facility, the Toxic Equivalency Potentials (TEP) scores were merged with the TRI data.

To calculate cancer scores the quantity of air releases for each chemical was merged with that chemicals air cancer score. This procedure was then repeated for the chemicals water releases and underground injection releases using water cancer scores. Due to the unpredictability of land releases, land releases were excluded from this analysis. Because most facilities have many chemicals for which they have reported releases, this procedure was repeated for each chemical released by every facility. These resulting values were summed up across all chemicals to produce the final cancer score for each facility. As these TEP scores work very similarly to weights, the final cancer score represents the relative cancer risk for local community member, measured in the estimated volume of releases in benzene equivalents. This same procedure is then repeated for TEP non-cancer scores. The resulting value represents the relative risk of non-cancer health effects to each local community member, measured in the estimated volume of releases in toluene equivalents.

The two resulting variables, Cancer Risk and Non-Cancer Risk, for each chemical are continuously distributed and range from values of 0 to values of several million. Results are demonstrated in table 3 and table 4. Because many chemicals do not have a known cancer or non-cancer risk, adequately defined enough for converting to benzene or toluene equivalents, the associated risk for many chemical releases is 0. Consequently, a

Table 3: Description of Recoding TEP Non-Cancer Scores into Ordinal Variables.

Non-Cancer Scores	Ordinal Value	Frequencies from TRI file
0	0	556 (39.9%)
.01 – 1,000	1	185 (13.3%)
1,000.01 – 10,000	2	183 (13.1%)
10,000.01 – 100,000	3	174 (12.5%)
100,000.01 – 1,000,000	4	120 (8.6%)
1,000,000.01 – higher	5	174 (12.5%)
		1,392 TRI Facilities

Table 4: Description of Recoding TEP Cancer Scores into Ordinal Variables

Cancer Scores	Ordinal Value	Frequencies from TRI file
0	0	1060 (76.2%)
.01 – 1000	1	206 (14.8%)
1000.01 – 10,000	2	65 (4.7%)
10,000.01 – higher	3	60 (4.3%)
		1,392 TRI Facilities

large number of facilities had Cancer Risk scores and Non-Cancer risk scores of 0. Given the highly skewed nature of both variables, both variables were recoded into ordinal variables.

Variables and Analysis

Independent Variables

All independent variables were extracted from the 1981, 1990, and 2000 elementary school data files, and the 2000 census file. Using the elementary school data, five variables will be incorporated into the model using both racial and economic information. For the racial variables, I included percent Black and percent Hispanic calculated by dividing number of Black students and the number of Hispanic students by the total number of students respectively. These values are multiplied by 100 to give the final percentages for each community. If environmental injustices toward minorities exist, communities with higher percentages of Blacks and Hispanics should have a higher likelihood of having a toxic facility in their community and live closer to the nearest toxic facility than Whites.

As an economic control, the percent of students receiving free or reduced meals are included in the model, calculated by dividing number of students receiving free meals plus the number receiving reduced meals by the total number of students, and multiplying that value by 100. Higher percentages of students receiving free meals are indicative of poorer communities.

Also included in the model is a variable that measures change in the White population over a ten-year period from 1990 to the year 2000. This variable is generated

by first calculating the percentage of White students in 1990 and in 2000. These variables are calculated by dividing the number of White students in 1990 by the total number of students in 1990. This process is then repeated for 2000 by dividing the number of White students in 2000 by the total number of students in 2000. After these percentages are calculated, the proportion of White students in 1990 is subtracted from the proportion of White students in 2000. The final value is multiplied by 100 to give the percentage change in the White population from 1990 to 2000.

$$\left[\frac{White_{2000}}{P_{2000}} - \frac{White_{1990}}{P_{2000}}\right] * 100$$

In this way, a negative value demonstrates a decrease in the White population, while a positive value demonstrates an increase in the White population. Values of 0 demonstrate no change in the percentage of White students. Theoretically, values for this variable can fluctuate between values of –100 and +100. If it is shown that communities with TRI facilities have a greater change in the White population over time than communities without such a facility, it then may be argued that inequitable distribution of TRI facilities is in large part due to the consequences of white-flight. This value of white-flight serves as an indication that institutional racism works as a racial, economic, and social mechanism for sorting minority and White populations into segregated neighborhoods. This variable was also recreated, examining change in the White population between the years of 1981, the earliest year available on record, and 2000.

To control for economic influences impacting the change in the White population, the percent change in the welfare population from 1990 to 2000 will also be included as an independent variable in the model. This variable is generated by first dividing the

number of Aid to Families with Dependent Children (AFDC) recipients in 1990 by the total number of students in 1990. The number of Calworks (California's Temporary Assistance to Needy Families (TANF) program)[1] students in 2000 is then divided by the total number of students in 2000. The 2000 proportion of Calworks students is subtracted from the 1990 proportion of AFDC students. The final value is multiplied by 100. Similar to the variable measuring the change in the white population, possible values range from –100 to +100, with positive values representing an increase in the welfare population and negative values representing a decrease in the welfare population.

By incorporating these change variables into the analysis, a limitation is introduced into the study. Primarily, only those elementary school communities that existed in both 1981, 1990 and 2000 will be included in the analysis. All elementary school communities coming into existence after 1981 or 1990 will be excluded from any analysis utilizing these variables. By excluding these newer communities an inherent bias is incorporated into the analysis as newer elementary schools are generally built in younger and more financially secure communities. Analysis demonstrates these communities do have a disproportionate number of White students. Comparing the percentage number of White students in the 1,051 communities excluded from the analysis because they did not exist in 1981, to the 4,018 remaining schools, there is a significant difference. The mean percentage of White students in the 1,051 newly built schools is 47.40 percent compared with 36.81 percent in the elementary schools that existed in 1981. This bias is likely to make any findings more conservative because these 1,051 schools, with higher percentage of White students are less likely to be located in

[1] Following the welfare reforms of 1996, California's AFDC program was replaced with Calworks.

older more industrial areas. In other words, many predominately White communities not located near a toxic facility are excluded from the analysis making predominately White communities appear to be more exposed to hazardous sites than may actually be the case.

Because it has been argued that decision makers consider other variables such as economic cost, potential public liability, and availability of workers when placing facilities, a variety of community variables will be included in the model as controls. All of the following variables are pulled from the 2000 census data because similar information is not available directly from the elementary school data. To address the argument that firms may locate a facility where the cost of land is less expensive, median value for all owner-occupied housing units will be included as a control for cost of land. Similarly, to address the argument that firms may also consider available workforce when siting facilities, percent of residents working in the manufacturing industry will proxy for available workforce, serving as a control.

Firms may also consider potential for collective political opposition when selecting facility location. Firms may avoid areas where the potential for collective political action among the residents is greater because liability costs in the form of litigation and compensation are anticipated to be higher. Political efficacy and economic commitment residents have toward a community are often indicators of potential for political opposition. Percent of homes occupied by owners and percent moved in last 5 years will be used as a proxy for commitment or investment residents have towards the local community. The more mobile the residents and higher the percent of renters the less value residents may place on maintaining the environmental quality of the neighborhood. The percent of homes with residents who moved in the last 5 years is

calculated by summing the total number of homes in which the tenants or home-owners moved into the unit between the years of 1995 and 2000. This sum is then divided by the total number of housing units, and finally multiplied by 100 to give the final percentage.

The percentage of residents not graduating from high school will also be used to control for the potential for collective political action. This theory argues that many firms may target communities with lower educational levels, assuming they will be less likely to effectively organize against the placement of a toxic facility in their neighborhood. Other control variables used in the model are Median Household Income and Population Density, calculated by dividing the area of land by the total population.

Analysis

First Analysis

For the first analysis, the dependent variable is the distance of each school to the nearest TRI facility as measured in miles. Table 5 lists the independent variables to be used in the analysis and the expected direction of each relationship with the dependent variable.

The variables are anticipated to be inversely related to the dependent variable of distance, except percent change in the White population, median household income, median value of owner-occupied homes, percent of units occupied by owner, and median year house was built. These variables are anticipated to be positively related to distance to the nearest TRI facility. Because the dependent variable, distance to the nearest toxic facility site, is continuously distributed, the primary hypothesis, that Blacks and

Table 5: List of Independent Variables

Independent Variables	Expected Direction of Relationship
Percent Black	-
Percent Hispanic	-
Percent receiving Free or Reduced Meals	-
Percent change in the White population from 1990 to 2000	+
Percent change in the AFDC/CALWORKS population from 1990 to 2000	-
Percent of working population employed in the manufacturing industry	-
Median Household Income	+
Median value of owner-occupied homes	+
Percent of units occupied by owner	+
Median year house was built	+
Percent moved in the last 5 years	-
Percent with less than high school diploma	-
Population Density	-

Hispanics will live significantly closer to the nearest toxic facility, will be tested using a linear regression analysis.

Pure Discrimination will be supported as a theoretical construct if the percentage of Hispanics and percentage of Blacks are significant after controlling for all other variables. Coase or Market Forces Theory will be supported if percent change in the white population and percent change in the welfare population are significant after controlling for all other variables. The Logic of Collective Action Theory will be supported if the percentage of owner-occupied units, percent moved in the last 5 years, and percent graduated high school are significant after controlling for all other variables. The remaining variables in the analysis (percent receiving free or reduced meals, median household income, population density, percent working in manufacturing, and median value of owner-occupied units) will only serve as control variables and do not lend themselves to direct support of any of the three proposed theoretical frameworks. The primary expectation for this analysis is described in the following stated hypothesis.

HYPOTHESIS I: The greater the Black or Hispanic population, the closer the distance the elementary school is from the nearest TRI facility.

Second Analysis

To make comparisons with similar studies conducted over the last two decades, an analysis will be performed to determine the increased likelihood of Blacks and Hispanics having a toxic facility site within a 2-mile radius of the elementary school. The dependent variable will be a dichotomous variable indicating the presence or absence

of a toxic facility site. With the use of logistic regression, the analysis will seek to determine if the likelihood of a toxic facility is greater for Black or Hispanic neighborhoods after controlling for all other variables in the model. The independent variables used in the model are identical to the independent variables used in the first analysis. Because the dependent variable is now a dichotomous variable indicating a 0 (no TRI facility present) or 1 (TRI facility is present), the expected direction for each independent variable reverses itself. In other words, the percentage Black and percentage Hispanic are now anticipated to be positively related to the presence of a facility rather than inversely related.

HYPOTHESIS II: The greater the minority population, the higher the probability a toxic facility is located within a 2-mile radius from the elementary school site.

Third Analysis

To determine the differences in exposure to hazardous chemicals for race, an analysis of communities within a 2-mile radius of a toxic facility will be performed, using the TEP cancer and non-cancer scores as the dependent variables. Due to the highly skewed nature of these variables, the ordinal versions will used as the dependent variables. For this analysis, an ordinal logistic regression will be used. The purpose of this analysis is to address the argument that while Blacks and Hispanics may share a greater burden of environmental toxins by being located near facilities that release chemicals in greater quantities and of more toxic health effects.

HYPOTHESIS III: For communities with a toxic facility, the greater the minority population, the greater the cancer and non-cancer ranking of the facility.

For each of the three analyses, the three major theories in the literature of environmental racism will be tested: Pure Discrimination, Logic of Collective Action, and Coase theory (also Market Forces Theory). Findings that indicate race, measured with percent Black and percent Hispanic, is the strongest and most significant predictor of TRI facilities lends support for Pure Discrimination theory. Pure Discrimination theory suggests that race alone, is the primary determinant of siting Toxic Facilities. While economic variables such as median income may still be significant, inasmuch as minority communities tend to be poorer, they will be secondary to racial variables in strength and significance. Findings that suggest percent owner-occupied, percent moved in the last 5 years, and percent not graduated high school are the strongest predictors of TRI facilities indicate the greatest support for the Logic of Collective Action. The Logic of Collective action argues that siting decisions are made to avoid political repercussions and therefore decisions are made where political apathy among community members is believed to be the greatest.

The last theory, Coase or Market Forces theory, attempts to explain environmental racism as a dynamic process in which changes in community demographics enhance the inequitable distribution of pollution overtime. While racism may play a part in the actual siting decisions, economics and racism in the housing market sort wealthier White families into 'cleaner' environments and poorer minority families into 'polluted' neighborhoods. Variables that measure change in the White

population and change in the percentage of students receiving welfare from the period of 1990 to 2000 will be used to test Coase theory. Findings that indicate a decrease in the White population with an increase in welfare populations lend support to Coase theory by showing that communities with TRI facilities have experienced White flight and decreasing economic conditions after the placement of a facility. These dynamics demonstrate the roll of Market Forces in the housing market contributing to the inequitable distribution of pollution. Support of this theory does not suggest that environmental racism does not exist, but that the source of that racism is not localized to a single discriminatory act, but manifests itself throughout society in an undercurrent of racist attitudes, behaviors, and ideologies.

CHAPTER 6: FINDINGS

Distance to TRI Facilities

A first step for evaluating the relationship between minority groups and TRI facilities is to examine the bivariate relationships among each of the variables to distance. The correlations between the independent variables and the dependent variable of distance to nearest toxic facility were calculated using the Pearson's *r*. These correlations are displayed in table 6. As the results demonstrate, only the variables of percent change in the white population and percent change in the welfare population are not significant to the .01 level. Whereas percent change in the White population is not significant at all, the percent change in the welfare population is significant to the .05 level.

To get a clearer understanding of the relationship between the independent variables and distance, it is important to not only evaluate the strength of the relationship but the also the direction of the relationship. We must ask if each variable is related to distance in the theoretically expected direction. All variables behaved as expected, except: percent change in the welfare population, median household income, median value of owner-occupied homes, percent of homes owner-occupied, and population density. Subsequently, while these variables are significant, the direction of their relationship contradicts theoretical constructs. In contrast to the expected relationship, the closer a community to a toxic facility site, the higher the median household income, median value of owner-occupied homes, and percent of homes occupied by owners.

Table 6: Correlations Between Distance to nearest TRI facility and Race and Income Predictors used in Models. [2]

Correlations	Pearson's *r*	N
Percent Black	-.163 **	5069
Percent Hispanic	-.233 **	5069
Percent receiving free or reduced Meals	-.044 **	5073
Percent change in White population	.035	4459
Percent change in welfare population	.024 *	4449
Median household income	-.123 **	5084
Median value of owner-occupied homes	-.098 **	5084
Median year house was built	.054 **	5084
Percent employed in manufacturing	-.322 **	5081
Percent of homes owner-occupied	-.107 **	5082
Percent of households moved in the last 5 years	-.061 **	5082
Percent with less than high school diploma	-.115 **	5084
Population density	.256 **	5084

* Value is significant at the < .05 level
** Value is significant at the < .01 level

[2] Statistical significance is actually irrelevant in the analysis because the relationships are based on the entire population of communities, rather than just a sample. Consequently, any numbers or differences among variables are real, and do not incorporate sampling error due to sampling selection. The p values serve as a proxy for the impact of each variable on the dependent variable.

Upon examining the variables that are significant and significant in the direction predicted, only the following variables conform to theoretical expectations: percent Black, percent Hispanic, percent receiving free or reduced meals, median year house was built, percent employed in manufacturing, percent of households moved in the last 5 years, and percent with less than a high school diploma. Based on these bivariate relationships, there is evidence that Blacks and Hispanics are disproportionately closer to toxic facilities. The strongest bivariate relationship with distance is the percentage of adult community members employed in manufacturing. This finding is consistent with other studies that have found toxic facilities tend to be located in areas with higher levels of industrial employment. These findings, however, do not clarify whether facilities move to industrial employees or whether populations move to industrial locations while seeking employment.

Because these correlations do not demonstrate how much closer to toxic facilities predominately Black and Hispanic elementary schools are, the next step is to compare the distance between predominately minority and predominately white schools. The first question we must ask is, how do we define a predominately Black, Hispanic or White school? Although it appears statistically sound to simply define a community as predominately minority or White if the ethnic population exceeds more than 50 percent of the total population, this is method is severely flawed. First, the Black population in California is very small, constituting less than 10 percent of the total California population. This percentage has also been declining slightly over the last several decades as the Hispanic population has been climbing. Defining a community as predominately

Table 7: Mean and Standard Deviation for Whites, Blacks, and Hispanics in California Public Schools

	Percent White	Percent Black	Percent Hispanic
N	5069	5069	5069
Mean	39%	7.74%	40.72%
Standard Deviation	29.574%	11.951%	29.561%

Black if the population exceeds 50 percent ignores the compositional makeup of ethnic groups in California. If would be much easier for White and Hispanic neighborhoods to exceed the 50 percent mark because they constitute a much greater proportion of the California population.

To compensate for these variations in the ethnic populations in California, a community is defined as predominately Black, Hispanic, or White if the ethnic group is greater than one standard deviation about the California average. Table 7 lists the mean and standard deviation for the percentage of Whites, Blacks, and Hispanics in California elementary schools.

With reference to these values, an elementary school community will be defined as predominately White if the percentage of White students is equal to or greater than 68.574 percent. This value is based on the mean of 39 percent plus one standard deviation of 29.574 percent. A total of 1,135 schools are defined as predominately White. The average percentage of White students for schools defined as predominately

White is 80.58 percent. An elementary school community is defined as predominately Black if the percentage of Black students is equal to or greater than 19.691. A total of 558 elementary schools are defined as predominately Black. For these 558 communities, the average percentage of Black students is 35.05 percent. Finally, any school will be defined as predominately Hispanic if the percentage of Hispanic students meets or exceeds 70.281 percent. A total of 1,081 schools are defined as predominately Hispanic. The average percentage of Hispanic students for schools defined as predominately Hispanic is 85.77 percent. Using these designations, 2,322 elementary school communities do not meet the criteria for predominately Black, Hispanic, or White. Consequently, they are defined as mixed ethnicity. In addition, there were 28 elementary school communities that meet the criteria for both predominately Black and predominately Hispanic. These 28 schools are the most severely ethnically segregated schools in California. Note that all schools designated as predominately White did not have a designation of predominately Black even though the percentages could have allowed for it. No firm agreement obtains what percentage of Black, White, or Hispanics constitutes a 'predominately Black, White, or Hispanic neighborhood,' so it is difficult to draw absolute conclusions from this analysis. Using the distribution of ethnic groups across California to generate the criteria accommodates both the averages and variation of ethnic groups in California elementary school communities.

These designations were used to create the variable ethnic composition. This variable is a categorical variable with response categories of predominately White, predominately Hispanic, predominately Hispanic, predominately Black and Hispanic, and mixed ethnic composition. The next step is to evaluate the average distance to the

Table 8: Comparing Distance for predominately Black, Hispanic, White, and Mixed Elementary School Communities

Community Composition	N	Mean Distance
Black	530	2.04265
Hispanic	1053	2.28544
Black and Hispanic	28	.93793
White	1136	7.74632
Mixed	2322	3.60264

nearest toxic facilities for these communities. An analysis of variance was performed to assess the difference in distances for the 5 ethnic communities compositions. Table 8 demonstrates the findings. Mean distances are measured in miles.

The F value for the analysis of variance is 127.736 and is significant to less than .0001. An examination of these findings reveals a dramatic difference in the distance to the nearest toxic facility for predominately minority neighborhoods and predominately White neighborhoods. The 28 communities that are predominately Black and Hispanic have an average distance of less than one mile to the nearest facility. While Black and Hispanic communities both have average distances of approximately 2 miles, Black communities are slightly closer on average by approximately one quarter of a mile. Comparing these distances to the 1,136 predominately White schools, we find predominately White schools are almost 8 miles from the nearest toxic facility. Schools with mixed ethnic backgrounds fall in between Black and Hispanic communities and White communities, with an average distance of 3.6 miles. This analysis reveals stark disparities for racial composition and distance to the nearest toxic facilities.

Predominately Black and Hispanic communities are 3 to 4 times closer to a toxic facility than are predominately White communities.

Because these values are merely averages, only describing the relationship between race and distance to toxic facility, this analysis does little to describe the complex relationship between race, pollution, and income. A more complex model, incorporating economic and other variables can help draw a clear picture of the impact economic and market conditions have on the mediating the relationship between race and pollution. The primary question is whether Blacks and Hispanics are living closer to toxic facilities, even after controlling for economic conditions that may influence this relationship. A multiple linear regression was performed to address two issues. First, do Market Forces, measured through the change in the economic and ethnic composition of the community over the last decade diminish or eliminate the effect of race? This question is addressed with the variables of Percent change in the White population and percent change in the welfare population from 1990 to 2000. Second, do conditions that impact the political power of communities reduce or eliminate the effect of race? This question is addressed with the variables percent of homes owner-occupied, percent of households who moved in the last 5 years, and the percent not graduating high school. The final variables in the model are embedded to control for other factors that may impact each relationship. These additional variables address the question of how does the economic viability of community impact the relationship between race and toxic facility location issue of economic viability? This is addressed with the variables of median household income, median value of owner-occupied homes, and percent of students receiving free or reduced meals. The variables percent employed in manufacturing and

population density are used as controls for they have may have an impact on the location of toxic facilities, obscuring or heightening the relationship between race and pollution. Median year house was built was used as a control because research suggests that as communities age over time and homes begin to deteriorate, property values decline as Whites migrate to newer communities and minorities migrate in as they can afford the older homes.

Diagnostics were performed to check for multicollinearity, and issues of collinearity were evident among most variables. Primarily, percent Hispanic is highly correlated with percent receiving free or reduced meals, median income, and percent with less than a high-school diploma. These relationships were not unanticipated as race, income, and education are often highly interrelated. All variables are included in the model, despite the issues with collinearity to ensure a theoretical model of environmental racism is maintained.

As table 9 indicates, these results help to clarify the relationship between race, pollution, and market forces. All variables were significant in the model, except for the percent change in the White population, the percent of households who moved in the last 5 years, and the percent with less than a high school diploma. The percentage of Black students and the percentage of Hispanic students were both significant in the model even after controlling for all other variables, indicating that as the percentage of Black and Hispanic students in elementary school communities increases, the distance to the nearest toxic facility decreases. These results indicate that risk of exposure by ethnic composition exists after controlling for income, education, and White mobility.

Table 9: Multiple Linear Regression Using Distance as the Dependent Variable

Variable	B	S.E.	Beta
Percent Black	-13.737	.828**	-.236
Percent Hispanic	-10.032	.591**	-.422
Percent receiving free or reduced meals	7.105	.658**	.303
Percent change in the White Population (1990 – 2000)	1.391	.856	.022
Percent change in welfare population	3.271E-02	.009**	.072
Median household income	-1.270E-04	.000**	-.404
Median value of owner-occupied homes	8.737E-06	.000**	.186
Median year house was built	4.734E-02	.010**	.078
Percent employed in manufacturing	-17.691	1.352**	-.196
Percent of homes owner-occupied	7.727	.902**	.243
Percent of households moved in the last 5 years	1.050	1.225	.020
Percent with less than high school diploma	1.348	.942	.037
Population density	2.225E-06	.000**	.188

* Value is significant at the < .05 level
** Value is significant at the < .01 level

When we look at the multivariate results for the other variables in the model we find that the percent change in the White population is not significant, suggesting that for the years between 1990 and 2000, compositional change does not seem to account for the disparities in toxic facility placement. This finding suggests that market forces have not played a substantial role in explaining racial disparities by toxic facilities; in other words, environmental injustice cannot be explained definitively by market forces in this model. The model suggests that economic variation has played a role, but not in the direction expected by Market Forces Theory. The percent change in the welfare population suggests that communities located closer to a toxic facility site have experienced a decline in the number of recipients on welfare. According to Coase theory, or Market Forces theory, we would expect that communities located closer to toxic facilities would see a decline in economic viability and subsequently an increase in the number of residents receiving welfare. One explanation could be that facilities provide a source of employment and economic stability that reduces community member's dependence on government assistance. Another explanation could also be that not enough years pass from 1990 to 2000 to properly assess the dynamics of market forces. To compensate for this weakness, another multivariate regression model was run using the change in the White population from 1981 (the earliest year available) to the year 2000. Unfortunately, statistics were not kept on the number of students receiving welfare prior to the 1990's making it impossible to control for the change in the welfare population over the same number of years.

As Table 10 indicates in this second multivariate regression model, the percent change in the White population is significant and in the direction expected by Coase and

Table 10: Multivariate Regression using Distance as the Dependent Variable while Analyzing Change in the White population from 1981 to 2000

Variable	B	S.E.	Beta
Percent Black	-13.635	.828**	-.249
Percent Hispanic	-9.101	.596**	-.390
Percent receiving free or reduced meals	5.931	.616**	.303
Percent change in the White Population (1981 – 2000)	1.728	.627**	.022
Median household income	.000	.000**	-.381
Median value of owner-occupied homes	8.012E-06	.000**	.179
Median year house was built	.048	.011**	.076
Percent employed in manufacturing	-17.252	1.386**	-.198
Percent of homes owner-occupied	8.214	.960**	.261
Percent of households moved in the last 5 years	1.741	1.323	.033
Percent with less than high school diploma	1.016	.969	.028
Population density	2.114E-06	.000**	.189

$R = .549$, $R^2 = .302$ $F=144.230$ ($p<.000$)
* Value is significant at the < .05 level
** Value is significant at the < .01 level

Market Forces theory. Communities that are closer in distance to a toxic facility, experience a decline in the White population over a 19-year time span. These findings suggest that there is some impact from the housing market through the process of White flight that serve to influence the process of environmental justice. It is even more telling that after controlling for the processes of White mobility over a 19-year span, the percentage of Blacks and Hispanics are still significant and substantial variables in the model. These findings indicate that even though market forces do have an influence over the displacement of Whites away from toxic facilities, the presence of environmental racism remains as a significant phenomenon.

The final theory, the Logic of Collective Action, appears to have less statistical support in the model, displayed in tables 9 and Table 10. Of the three variables in the model used to test this theory, only the percent of homes owner-occupied is significant. Both the percent of households moved in the last 5 years and the percent with less than a high school diploma are not significant. The Logic of Collective Action suggests that communities with greater investment in their local communities and greater potential to collectively organize would have a greater ability to resist the placement of toxic facilities in the immediate area. It was anticipated that communities with higher levels of education, greater degree of home ownership, and greater number of years living within the community would have greater incentive, ability, and resources to resist placement. The regression models do not suggest this is necessarily the case.

By and large, these multivariate results for the relationship between racial and economic factors and the distance to the nearest toxic facility indicate environmental racism is very real even after taking into consideration the effects of economic factors

and market forces. Because most variables were significant in the model, it appears that the degree of environmental injustice is largely a result of the combined effect of environmental racism and market forces. Due to institutional forms of racism in the housing market and the forces of direct discrimination, Blacks and Hispanics are disproportionately located closer to toxic facility sites than predominately White communities.

Communities Within a 2-Mile Radius of a Toxic Facility

When we look at only communities within a 2-mile radius of a toxic facility, we can begin to see a much clearer picture of the relationship between race and pollution. For the first step, I compared the average percentage of Black, Hispanic, and White residents for communities with a toxic facility within 2-miles of the elementary school location to communities without a toxic facility within 2-miles. These findings are then compared with the average percentage of Black, Hispanic, and White residents in all of the California elementary school communities. The findings are presented in table 11

As demonstrated in Table 11, communities located within 2-miles of a toxic facility, the percentage of Black and Hispanic residents is higher than communities further than 2 miles and for all elementary school communities in California. This trend reverses itself for the percentage of White residents. This pattern is significant when comparing mean percentages for all three groups. For communities within 2-miles, the average percentage of Black residents is 3 percent higher than for communities further than a 2-mile radius. For Hispanics, the average percentage is more than 19 percent higher. When comparing the average percentage of White residents, we find that for

Table 11: Comparing the Percentage of Black, Hispanic, and White Residents in Communities within a 2-mile radius of a Toxic Facility Site

Variable		Community Means: Within 2-Mile Radius	Community Means: More than 2-Mile Radius	Community Means: California Average	F Test
Percent Black	%	9.21%	6.21%	7.74%	87.298**
	N	2592	2477	5069	
Percent Hispanic	%	50.17%	30.83%	40.72%	82.256**
	N	2592	2477	5069	
Percent White	%	27.08%	51.48%	40.72%	70.564**
	N	2592	2477	5069	

* Value is significant to < .05 level
** Value is significant to < .01 level

communities within a 2-mile radius the average percent of White residents is more than 24 percent lower. To see if the relationship still exists when examining a larger radius, the same table was produced using a 4-mile radius. When comparing communities within a 4-mile radius to communities further than 4 miles, the differences in the percentage of Blacks, Hispanics, and Whites become even more pronounced.

As demonstrated in table 12, only for Hispanics does the differences in mean percentages become less pronounced when comparing the 4-mile radius to the 2-mile radius. When comparing Black populations, the mean percentage of Black residents for communities within 4 miles of a toxic facility is almost 6 percent greater than communities further than 4 miles. For Hispanic populations, the mean percentage is more than 16 percent greater. For White populations, this trend reverses itself, and the mean percentage of White residents is almost 26 percent lower for communities within 4 miles compared to communities further than 4 miles.

Table 12: Comparing the Percentage of Black, Hispanic, and White Residents in Communities within a 4-mile radius of a Toxic Facility Site

	Community Means		Cases		
Variable	Within 2-Mile Radius	More than 2-Mile Radius	Within 2-Mile Radius	More than 2-Mile Radius	t Test
Percent Black	9.16%	3.28%	1222	3847	-15.331**
Percent Hispanic	44.60%	28.50%	1222	3847	-17.059**
Percent White	32.76%	58.67%	1222	3847	28.772**

* Value is significant to < .05 level
** Value is significant to < .01 level

To address the question of whether the role of market forces has an impact on these differences, I compared the change in the White population from the years of 1981 to 2000 for communities within 2 miles to the nearest toxic facility to communities further than 2 miles. The results are demonstrated in table 13.

While the White population in California has declined by about 20.61 percent over the last 2 decades, the decline has been larger in communities within 2 miles of a facility. Similarly, while the Hispanic population has grown by more than 16 percent over the last 2 decades, this growth has been more pronounced in areas close to a toxic facility site. These changes among the White and Hispanic populations from 1981 to 2000 have not had the same impact on Black populations. The percentage of Black Californians has remained relatively stable over the last 2 decades, experiencing less than a 1 percent decline, but this decline has occurred almost exclusively in communities within 2-miles of a toxic facility site. In other words, Black residents are actually moving away from toxic facility sites, while not to the same degree as White residents.

Table 13: Comparing Changes in the Black, Hispanic, and White populations for communities within a 2-mile radius over the last 2 decades

	Black % change	Hispanic % change	White % change
Within a 2 mile radius	-1.86%	19.39%	-22.21%
Further than a 2 mile radius	0.49%	13.41%	-18.75%
California	-0.78%	16.63%	-20.61%

Findings from this table suggest that White community members are using 'White privilege' to escape the environmental burden of living near a toxic facility site. Similarly, as the Hispanic population has grown over the last 19 years, most of this growth has occurred in industrial areas near toxic facility sites. This evidence suggests that market forces have worked to contribute to the current degree of environmental inequities, but not necessarily in the same way put forth by much of the literature. First, because only very small changes have been made among Black populations close to toxic facilities, and the changes that do exist have not been in the direction predicted by market forces theory, there is no evidence that Black populations are moving to areas with toxic facility sites. This finding suggests that market forces over the last 2 decades has had a significant impact on the relationship between White and Hispanic populations and the location of toxic facility sites, but not for Black populations. This finding may also explain why many studies have found a stronger relationship between Hispanic communities and pollution than for Black communities. When we examine changes in Black, Hispanic, and White populations within a 4-mile radius of a toxic facility site, the

Table 14: Comparing Changes in the Black, Hispanic, and White populations for communities within a 4-mile radius over the last 2 decades

	Black % change	Hispanic % change	White % change
Within a 4- mile radius	-1.06%	18.19%	-22.09%
Further than a 4- mile radius	0.21%	11.22%	-15.52%

pattern becomes much more prominent. Again, as table 14 demonstrates, White populations are becoming less concentrated in areas within 4 miles of a toxic facility, while Hispanic populations are becoming more concentrated. Similar to results from the 2-mile radius analysis, Black populations experience a small decline in communities within a 4-mile radius of a toxic facility.

To examine the complex relationship between race, market forces, economics, and pollution, a multivariate analysis was performed using the presence or absence of a toxic facility site within 2 miles as the dependent variable. Because the dependent variable is dichotomous, a multivariate logistic regression was used to analyze the impact of race while controlling for the effects of income and White mobility. The results are presented in table 15. Similar to the results comparing the effects of race on distance to the nearest toxic facility site, the percentage of Black and Hispanic residents are both significant in the model, even after controlling for all other variables in the model. As the percentage of Black and Hispanic residents increases, the probability of a facility being within 2 miles also increases. Not surprisingly, the strongest variable in the model is the percent employed in manufacturing. This finding is consistent with findings from other

Table 15: Logistic Regression using Presence or Absence of a Toxic Facility within a 2-Mile radius, while examining the Change in the White population from 1990 to 2000

Variable	Beta	S.E.
Percent Black	2.164	.352**
Percent Hispanic	2.216	.257**
Percent receiving free or reduced meals	-.150	.290
Percent change in White population (1990 – 2000)	1.083	.370**
Percent change in welfare population (1990 – 2000)	-.005	.004
Median household income	.000	.000**
Median value of owner-occupied homes	.000	.000**
Median year house was built	-.035	.000**
Percent employed in manufacturing	13.347	.678**
Percent of homes owner-occupied	-2.580	.386**
Percent of households moved in the last 5 years	-1.099	.523*
Percent with less than a high school diploma	-2.216	.391**
Population density	.000	.000**

Wald = 7.287 (p = 0.007) Chi-square 1592.041 (p = .000)
* Value is significant at the < .05 level
** Value is significant at the < .01 level

studies (Been 1995, Anderton et al. 1994.), which have found that toxic facility sites tend to be placed in industrial areas where an available manufacturing workforce exists. This analysis does not answer the question, however, whether manufacturing employees moved to these areas following job availability, or whether industry moved to location with an already available workforce. More research needs to be conducted to address this relationship.

These findings differ from the first analysis in that the percent change in the White population over a 10-year period is a significant variable in the model, although, not in the direction predicted by market forces theory. These findings suggest that after controlling for race and income measures, a greater decrease in the White population is actually associated with a lower probability of having a toxic facility within 2 miles. In other words, after all other variables are held constant, White populations are actually declining at a greater rate in communities without a toxic facility site within 2 miles than communities with a toxic facility site. When we examine the change in the percentage of residents on government assistance between the years of 1990 to 2000, we find no significant change.

Contrary to findings from the first analysis using distance as the dependent variable, the logistic model provides much stronger evidence in support of the Logic of Collective Action. The variables percent of homes owner occupied, percent of households moved in the last 5 years, and percent with less than a high school diploma were significant, indicating that communities with greater resources and investment have a much lower probability of having a toxic facility site within 2 miles. This supports the

research conducted by Hamilton (1995) who found that communities with greater financial investment in their local neighborhood pose much stronger threats to decision makers and are the most able to effectively organize against the placement of toxic facilities within their community.

Overall, the multivariate model is quite effective for predicting which communities are likely to have a facility within 2-miles. The model was able to successfully predict the presence or absence of a toxic facility for 74.5 percent of the elementary school communities. Because the percent change in the White population between the years of 1990 to the year 2000 did not behave in accordance with market forces or Coase theory, we are left with the question of whether examining the change in the White population over a longer time frame would alter these findings. To address this question, I performed a second multivariate logistic regression using the change in the White population between the years of 1981 to the year 2000. Results are demonstrated in table 16. The percent change in the welfare population over the same time frame was not included in this model due to the unavailability of the data.

When comparing these results to the first logistic analysis, we find that very little has changed. The percentage change in the White population over an almost 20 year time span is not significantly different in communities with a toxic facility site than communities without a toxic facility site. The overall model is comparable to the first model for predicting the presence or absence of a toxic facility site, making correct predictions for 75 percent of the elementary school communities. While both models do not find a significance impact of 'White flight' after controlling for all other variables, comparing the change in the White population over a much more extended period may

Table 16: Logistic Regression using Presence or Absence of a Toxic Facility within a 2-Mile radius, while examining the Change in the White population from 1981 to 2000

Variable	Beta	S.E.
Percent Black	2.296	.366**
Percent Hispanic	2.007	.259**
Percent receiving free or reduced Meals	.103	.267
Percent change in White population (1981 – 2000)	.156	.273
Median household income	.000	.000**
Median value of owner-occupied homes	.000	.000**
Median year house was built	-.034	.004**
Percent employed in manufacturing	13.513	.719**
Percent of homes owner-occupied	-2.594	.420**
Percent of households moved in the last 5 years	-1.383	.577*
Percent with less than a high school diploma	-2.023	.404**
Population density	.000	.000**

Wald = 24.190 (p = 0.000) Chi-square 1483.263 (p = .000)
* Value is significant at the < .05 level
** Value is significant at the < .01 level

find different results. A possible explanation may exist to explain why when examining the bivariate results, the percentage change in the White population declines much more dramatically in communities with a toxic facility site than communities without a toxic facility site, but not in the multivariate model. The first and most likely explanation is the effects of income and economic viability on mobility patterns. Community members of all ethnic backgrounds with the means and resources to relocate away from a toxic facility site will, in all likelihood, do so. After controlling for income, we find that White populations are no more likely to move away from polluted neighborhoods than Black or Hispanic populations. This explanation is circumspect, however, without really being able to control for changes in income for each community over the same time frame. Further studies need to be conducted to work out the complex relationship between race, mobility, and the housing market.

Comparing TEP Cancer and Non-Cancer Scores

The final step for evaluating the complex relationship between race and pollution is an examination of the toxicity levels for predominately Black, Hispanic, and White communities located near TRI facilities. After merging the ordinal versions of the TEP cancer and non-cancer scores with the 5084 elementary school communities, we get frequencies that differ slightly from the original frequencies listed in the TRI dataset. These differences result from the process of assigning single facilities to multiple elementary school communities. Similarly, some facilities, due to their location are not assigned to any elementary school community. Tables 17 and 18 describe the frequency

of each TEP cancer and non-cancer after merging with the 5,084 elementary school communities in southern California.

As we can see from tables 17 and 18, a substantial proportion of elementary school communities are assigned to a facility with cancer and non-cancer values of 0. This relatioinship is very dramatic when examining Cancer scores. More than 78 percent of communities are paired with a toxic facility site with a cancer score of 0. Because many of these communities are located more than 2 miles (many more than 4 miles), it is important to look at the frequency of TEP cancer and non-cancer scores for only those communities within a 2-mile and a 4-mile radius. Frequencies are demonstrated in tables 19 and 20.

Note that despite changing the universe of toxic facility sites to be described, the proportion of facilities in each level of TEP cancer and non-cancer scores remains consistent. This pattern means that no bias exists when only examining TEP scores for communities located within 2 miles or 4 miles of a facility. After examining the distribution of TEP scores across all communities located near a facility, the next logical step is to address whether cancer and non-cancer risks are disproportionately located near predominately Black and Hispanic communities.

The first question that needs to be addressed is the issue of whether predominately Black and Hispanic communities within a 2-mile radius of a toxic facility site have, on average, higher TEP cancer and non-cancer scores than predominately White communities. As we can see from Table 21, there is no significant differences between TEP cancer and non-cancer scores among predominately Black, Hispanic, and White communities. While predominately Black and Hispanic communities have greater odds

Table 17: Frequency of TEP Non-Cancer Ordinal Variable after Merging with Elementary Schools

TEP Non-Cancer Score	Ordinal Score	Frequency	Percent
0	0	1782	35.1%
.01 – 1,000	1	828	16.3%
1,000.01 – 10,000	2	688	13.5%
10,000.01 – 100,000	3	656	12.9%
100,000.01 – 1,000,000	4	501	9.9%
1,000,000.01 – higher	5	629	12.4%
		5,084 TRI Facilities	

Table 18: Frequency of TEP Cancer Ordinal Variable after Merging with Elementary Schools

TEP Cancer Score	Ordinal Score	Frequency	Percent
0	0	3992	78.5%
.01 – 1000	1	684	16.5%
1000.01 – 10,000	2	215	4.2%
10,000.01 – higher	3	193	3.8%
		5,084 TRI Facilities	

Table 19: Frequency of TEP Non-Cancer Ordinal Variable after Merging with Elementary Schools for Communities within a 2-mile and 4-mile Radius

Ordinal Non-Cancer Score	2-Mile Frequency	2-Mile Percent	4-Mile Frequency	4-Mile Percent
0	946	36.4%	1,358	35.2%
1	418	16.1%	649	16.8%
2	364	14.0%	531	13.8%
3	355	13.7%	512	13.3%
4	226	8.7%	375	9.7%
5	288	11.1%	432	11.2%
	2,579 TRI Facilities		3,857 TRI Facilities	

Table 20: Frequency of TEP Cancer Ordinal Variable after Merging with Elementary Schools for Communities within a 2-mile and 4-mile Radius

Ordinal Cancer Score	2-Mile Frequency	2-Mile Percent	4-Mile Frequency	4-Mile Percent
0	2,045	78.7%	3,033	78.6%
1	368	16.1%	534	13.8%
2	100	3.9%	173	4.5%
3	84	3.2%	117	3.0%
	2,597 TRI Facilities		3.857 TRI Facilities	

Table 21: Mean TEP scores for Predominately Black, Hispanic, and White communities

Community Type	N	Mean Cancer Score	Mean Non-Cancer Score
Mixed or Other	1224	6535.90	172694446.44
Black	332	1404.61	3823618.32
Hispanic	773	1462.97	11031970.02
Black and Hispanic	28	1345.20	497185.49
White	245	11550.30	1516866.92
Total	2592	4803.47	12068778.53

Cancer Scores F = .589 (p=.671)
Non-Cancer Scores F = .745 (p=.561)

of being located within 2 miles of a toxic facility site, the toxicity levels of those facility sites appears to be evenly distributed among communities.

These results suggest that for toxicity, facilities located near predominately Black or Hispanic communities pose no more of a health risk than facilities located near predominately White communities. The second question is whether communities located close to more toxic facilities exhibit a greater degree of 'White flight' than communities located close to less toxic facility. According to Coase or Market Forces theory, we would anticipate that facilities that pose a greater health risk to local populations will experience a greater decline in White populations, with corresponding increases in Black and Hispanic populations due to the changing economic structure of the area. Table 22 demonstrates the percentage change in Black, Hispanic, and White populations for communities located near facilities with higher non-cancer scores versus facilities with low non-cancer scores. Negative values indicate an average percentage decrease, whereas positive values indicate an average percentage increase.

Table 22: Percentage Change in Black, Hispanic, and White populations by TRI Facility Non-Cancer Ordinal Score

Ordinal TEP Score	N	White Change	Black Change	Hispanic Change
0	799	-23.46%	-1.07%	+19.43%
1	365	-20.30%	-2.46%	+18.05%
2	297	-21.25%	-1.54%	+19.13%
3	285	-22.41%	-1.43%	+19.51%
4	188	-22.69%	-3.31%	+21.10%
5	230	-21.49%	-3.42%	+20.14%
Total	2164	-22.21%	-1.86%	+19.39%

White Change F = 2.219 (p=.050)
Black Change F = 2.540 (p=.027)
Hispanic Change F = 1.026 (p=.400)

As we see from Table 22, there is little evidence to support the theory that Whites will move away from more toxic facility sites, as measured by non-cancer TEP scores, than any other facility. Similarly, there is little evidence to suggest that Blacks and Hispanics are moving to communities with higher TEP non-cancer scores. If any relationship exists, it appears that Blacks are more likely to move away from facilities with higher TEP non-cancer scores. While this relationship is significant to the .027 level, the differences are not dramatic enough to be completely confident this relationship would hold under different circumstances. When comparing percentage change in Black, Hispanic, and White populations for communities located near facilities with higher cancer TEP scores, a relationship does not exist. (See table 23)

The final step for examining the relationship between race and toxicity levels is an evaluation of the impact of TEP cancer and non-cancer scores on race after controlling

Table 23: Percentage Change in Black, Hispanic, and White populations by TRI Facility Cancer Ordinal Score

Ordinal TEP Score	N	White Change	Black Change	Hispanic Change
0	1702	-22.11%	-2.19%	+19.24%
1	315	-22.52%	-0.28%	+19.69%
2	86	-20.81%	-1.16%	+18.76%
3	61	-25.15%	-1.77%	+22.72%
Total	2164	-22.21%	-1.86%	+19.39%

White Change F = .907 (p=.437)
Black Change F = 2.572 (p=.053)
Hispanic Change F = .976 (p=.403)

for all other economic and market force variables. As discussed earlier, because TEP cancer and non-cancer scores were highly skewed with many outliers, values were recoded into two ordinal variables. Both variables include values of 0 as one category, with values of .01 to 1,000 as the second category, with each subsequent category increasing by a factor of 10. The final category for each variable included all extreme values. By recoding these TEP values into ordinal variables, it makes it possible to conduct an ordinal logistic regression for each variable. Also called a proportional odds model, this model has the ability to examine the odds of moving from one TEP level to another. This model is also useful when clear differences between levels are unclear or inconsistent. One requirement of this model is that a single parameter can be used to describe the effect of each independent variable on the odds of being in each TEP level versus a lower level.

This first model examined is the relationship between all predictor variables and TEP Non-Cancer Scores. The proportional odds assumption was met for this model with a Chi-Square statistic of 19.442 (df=12) p=.078. The likelihood ratio statistic for this model is 7157.009 (df=10803) p=1.000, indicating a poorly fitting model. Results for this model are demonstrated in table 24.

When examining the relationship between all predictor variables and TEP cancer scores, the assumption for the proportional odds model was not met with a Chi-Square statistic of 25.259 (df=12) p=.014. Similar to results from the first model, the model was poorly fitting with a likelihood ratio statistic of 3087.740 (df=6477) p=1.000. (See table 25)

While the variables percent Hispanic and percent with less than a high school diploma were significant, the model had such strong evidence of lack of fit that these results should be viewed with skepticism. Note that while there are no differences among communities that surround the most toxic facility sites, there are strong inequities among communities living near a facility. Only a small percentage of predominately White communities are located within 2 miles of a toxic facility site, whereas most predominately Black and Hispanic communities are located near a site. (See table 26)

As demonstrated in table 26, approximately half of all elementary school communities are located within a 2 mile radius, the universe of communities examined using TEP cancer and non-cancer scores. This relationship is not, however, evenly distributed across communities. Slightly more than 20 percent of all predominately White communities are located within a 2-mile radius, whereas more than 70% of predominately Hispanic communities and more than 60% of predominately Black

Table 24: Ordinal Logistic Regression using TEP Non-Cancer Scores as the Dependent Variable

Variable	Estimate	S.E.
Percent Black	.420	.341
Percent Hispanic	-.065	.263
Percent receiving free or reduced Meals	-.039	.277
Percent change in White population (1981 – 2000)	.062	.264
Median household income	-2.197E-06	.000
Median value of owner-occupied homes	-4.472E-08	.000
Median year house was built	-.004	.005
Percent employed in manufacturing	-.728	.611
Percent of homes owner-occupied	-.146	.424
Percent of households moved in the last 5 years	-.098	.581
Percent with less than a high school diploma	.462	.421
Population density	-1.276E-06	.000

Table 25: Ordinal Logistic Regression using TEP Non-Cancer Scores as the Dependent Variable

Variable	Estimate	S.E.
Percent Black	-.499	.503
Percent Hispanic	.982	.361**
Percent receiving free or reduced Meals	-.106	.377
Percent change in White population (1981 – 2000)	.198	.357
Median household income	-4.502E-06	.000
Median value of owner-occupied homes	-1.007E-07	.000
Median year house was built	-.008	.006
Percent employed in manufacturing	.008	.855
Percent of homes owner-occupied	-.057	.580
Percent of households moved in the last 5 years	.525	.798
Percent with less than a high school diploma	-1.727	.576**
Population density	-1.363E-05	.000

* Value is significant at the < .05 level
** Value is significant at the < .01 level

Table 26: Relationship between Race and Location within 2 Miles of a Toxic Facility Site

Community Type		Presence of Facility	Absence of Facility
Mixed or Other	N	1068	1224
	%	47.3%	52.7%
Black	N	208	322
	%	39.2%	60.8%
Hispanic	N	280	773
	%	26.6%	73.4%
Black and Hispanic	N	0	28
	%	0%	100%
White	N	891	245
	%	78.4%	21.6%
Total	N	2477	2592
	%	48.9%	51.1%

Chi-Square=655.258 (df=4) p<.000

communities are located within a 2-mile radius. When we look at predominately Black and Hispanic communities, 100 percent are located within a 2-mile radius. Enlarging the radius to examine differences among communities within a 4-mile radius, the relationship remains strong. The results are demonstrated in table 27.

A majority of all communities are located within a 4-mile radius of a toxic facility site, but again we find that predominately Black and Hispanic communities share a disproportionate burden of being located within a 4-mile radius. More than half of all predominately White communities are located further than 4 miles from a facility, whereas more than 90 percent of predominately Black communities and more than 86 percent of predominately Hispanic communities are located within a 4-mile radius. These findings suggest that using TEP cancer and non-cancer scores to determine the presence or absence of environmental racism may be misleading because not all communities have an equal probability of being located near a facility.

A limitation to the results of the TEP cancer and non-cancer scores is the impact on populations residing in communities with multiple facilities located nearby. For this study, only one facility, the nearest facility measured in miles using latitude and longitude was matched with each elementary school community. For many communities living near industrial areas, more than one facility may be present within a 2-mile radius. This has strong implications for examining the risk of exposure to pollution using TEP scores, because the toxicity level of all facilities located nearby will have an impact risk of exposure to environmental toxins. Future research could examine the impact of race, income, and market forces on the combined toxicity levels for all nearby TRI facilities.

Table 27: Relationship between Race and Location within 4 Miles of a Toxic Facility Site

Community Type		Presence of Facility	Absence of Facility
Mixed or Other	N	460	18862
	%	19.8%	80.2%
Black	N	40	490
	%	7.5%	90.2%
Hispanic	N	140	913
	%	13.3%	86.7%
Black and Hispanic	N	0	28
	%		100%
White	N	582	554
	%	51.2%	48.8%
Total	N	1222	3847
	%	24.1%	75.9%

Chi-Square=635.897 (df=4) p<.000

CHAPTER 7: CONCLUSION

Contributions to the Literature

Over the last two decades, literally dozens of published articles on environmental justice have attempted to discern the complex dynamics between race, income, housing market forces, and pollution. Despite this tremendous amount of research that indelibly hints at the existence of environmental racism, the research has not been definitive enough to demonstrate that predominately Black and Hispanic communities are targeted for polluting sites at a greater rate than White communities. William Bowen (2000) clarified the current state of research in the field of environmental racism with the following paragraph:

> A fairly small and largely heterogeneous body of research hints or perhaps even indicates (but by no means demonstrates) that in some specific areas, some ostensibly indentifiable groups in the population may in some instances live closer to some selected environmental hazards. Simply stated, on balance the evidence regarding disproportionate distributions is mixed and inconclusive. (p. 179)

Criticisms launched at the current body of research can be summarized across several defining and repetitive weaknesses. First, definitions of community follow governmentally defined boundaries, varying in size and form from research to research, without recognizing the social meaning of community attributed by local residents. Second, little understanding has been accrued from the research on the role of market forces in the form of 'White privilege' to creating the current state of environmental injustice. While some studies have explored the degree of environmental racism at the

time of siting, and other studies have explored the changing economic structure prior to siting and following the siting, they have not examined how different racial groups redistribute themselves differentially in the housing market. Third, essentially all of the research has assumed the notion that all toxic facilities are created equal, and hence all communities residing near a facility are equal in actual exposure and associated health effects.

This current piece of research has attempted to redress many of these weaknesses in the environmental justice literature in several important ways. By examining community development as a dialectic process, evolving from various interactions between community members, government organizations, and protest movements, a social definition of community was used to evaluate the existence of environmental racism. Drawing from the literature in the political geography of scale and from lessons learned in the literature of grassroots movements about the formation of protest groups, a theoretical understanding of community definition was formulated. Because the scale and definition of community provides the basis of any conclusions drawn for any study about environmental racism, it is imperative that the definition conforms to a meaning attributed by actors within a community. Elementary schools serve as a community center that provides the basis for networking residents together, enabling community to be treated as a socially constructed entity, not a geographically imposed entity. This study is the first to examine the existence of environmental racism constructed around a socially constructed conception of community. Due to this theoretical conceptualization of community, it provides a framework for further research when analyzing the complex relationship between race and pollution.

This research also improved on prior research by enabling a more thorough understanding of how movement in the housing market, through the process of 'White privilege,' has contributed to the existence of environmental racism. Market Force theory or Coase theory argue that given a choice between two homes, identical in every respect, families will invariably choose a home further from a toxic facility site. Drawing from the notion of 'White privilege,' a greater understanding of this process is developed when limitations in the housing market serve to limit the choices of residence for Blacks and Hispanics to a greater degree than for Whites. 'White privilege' is the concept that White persons have an ideological and social advantage in society enabling them greater latitude in relocating to communities with better schools, cleaner air and water, and more amenities. Based in the social undercurrents of racism, Blacks are limited in their latitude to relocate to the same degree as Whites. This study has enabled a greater understanding of how this process works by examining the degree of White flight in areas located closest to a toxic facility site. By measuring the percentage change in the White population, while describing the percentage change in the Black and Hispanic populations near toxic facilities, we can obtain a greater understanding of how different racial groups capitalize on Market Forces to engender the outcome of environmental racism.

Finally, this piece of research is the first to address the relative toxicity of chemical releases from each facility to address the issue of exposure and health risks. The use ofTEP scores to rate the toxicity of a variety of chemicals reported to EPA means each facility can be rated by their toxicity level and the potential threat they pose to the surrounding community. The primary question in this research is whether communities

near a toxic facility are created equal. Primarily, do minorities face an additional environmental burden by being located near the facilities that pose the greatest health risks?

Discussion of Findings

Several conclusions can be drawn from the research. First, there does appear to be evidence of environmental racism. In every model tested, the percentage of Hispanic and Black residents was significant and among the strongest predictors in each model. Predominately White communites, defined as at least one standard deviation above the mean percentage of Whites, are almost 4 times further from the nearest toxic facility site than communities defined as predominately Black or Hispanic. Predominately White communities have elementary schools almost 8 miles from the nearest facility, whereas Black and Hispanic communities have elementary schools slightly more than 2 miles. The most racially segregated communities, those meeting the criteria for both predominately Black and Hispanic, have elementary schools less than one mile from the nearest toxic facility. Even when controlling for economic and market force factors, the relationship still remains the strongest predictors.

When examining the effects of White, Black, and Hispanic movement in communities located near a toxic facility, an interesting pattern emerges. First, as expected according to Market Forces and Coase theory, Whites do appear to be migrating away from communities closest to TRI facilities. While the White population has decreased almost universally in every community across California, the decline between the years of 1981 and 2000 has been the greatest in communities within a 2-mile radius of

a toxic facility. Corresponding to this finding is the increase in the Hispanic population in communities closest to TRI facilities. While the Hispanic population has been increasing in every community across California, this growth has been the greatest in communities within 2 miles. In contrast to this expected development, there has been no subsequent relationship among Blacks. While the percentage of Blacks in California has dropped by a few percentage points in all of California, this decline has actually happened more sharply in areas closest to a TRI facility. In other words, it appears that Black populations are actually moving away from toxic facilities, although at a much smaller rate than Whites, rather than towards them during the last 2 decades of the twentieth century.

These findings correspond to Market Force theory and current understanding of immigrant populations. As communities age, White populations recede to more pristine and newer housing developments while immigrant populations migrate into these abandoned neighborhoods. Black populations, however, as a stable underclass of American culture experience very little mobilization throughout the housing market. These findings can illuminate the research conducted by Been (1997) who found that Hispanic populations share the greatest burden of exposure to toxic facilities than any other racial groups. While these findings suggest that Black and Hispanic communities share a disproportionate burden of pollution, this relationship is exacerbated for Hispanic communities by the settlement of many Hispanic immigrants into communities located closest to toxic facilities. In summary, the findings from this research suggest that the relationship between race, class, and pollution is very complex. Evidence indicates that Market Forces, acted through the process of White flight in the housing market, can

explain why Hispanic communities have a greater likelihood of being near a TRI facility than Whites, but does not provide an adequate explanation for the increased likelihood of Black communities.

Drawing conclusions about the impact of the Logic of Collective Action is more difficult. In some models, communities with lower levels of education, combined with more stable residences, and higher levels of home ownership were good predictors of the location of TRI facilities; however, they were too inconsistent across different models to draw any definitive conclusions. Because these variables were drawn from the census data, limited by census boundaries, it becomes even more difficult to draw substantial conclusions. More research would need to be conducted focusing on communities collective ability to resist toxic facilities would need to be conducted to properly ascertain the dynamics within the Logic of Collective Action. Considering these variables were significant in some models it can be concluded that the collective ability of communities to resist placement has a small role, albeit a small role, in explaining environmental racism.

This research also made significant steps in addressing the issue of whether toxic facilities are not only disproportionately located in communities of color, but also whether facilities in minority neighborhoods pose a greater health risk to community members. The findings from this research suggest that while TRI facilities are unequally distributed in minority neighborhoods, those facilities are similar in toxicity level to facilities located in predominately White neighborhoods. In other words, TRI facilities placed in predominately minority neighborhoods are no more toxic, in either cancer risk

or non-carcinogenic health risks, than TRI facilities placed in predominately White neighborhoods.

In summary, it appears that environmental racism exists for a myriad of reasons, including racism in siting decisions, market forces, economic motivation, and collective resistance. Policy decisions that seek to ameliorate the conditions of inequitable distribution of pollution by focusing on a single causal focus will inevitably miss the larger and complex dynamic forces in operation. These forces do not just exist in single institutions, but permeate throughout our culture in a myriad of subtle ways. They are embedded in our psyche, ideologies, and choice decisions. To focus single mindedly on siting decisions by corporations will invariably miss the complex nature of racism, and will fail to solve the problem of environmental injustice. Similarly, by focusing single-mindedly on the housing market in policy decisions, the multiple ways that racism impacts institutional processes will be underscored.

Recommendations for Future Research

Research in environmental justice can expand on this piece of work in several key areas. First, a greater understanding of the processes of market forces can be developed by increasing the number of years for which change in the White, Black, and Hispanic populations is analyzed. While this research illuminated the mobilization patterns of different ethnic groups over a 2-decade period of time, it does not recede back enough time to when many toxic facility sites were actually sited. A study that focuses strictly on the movement of different ethnic groups as communities are built, age, and decline

may elucidate the true degree of market forces on the conditions of environmental injustice.

Finally, while this study examined the risk of each community to the nearest toxic facility site, it did not assess the potential risk of all TRI facilities located within a 2-mile radius. Because minority neighborhoods were located closer to the nearest toxic facility than White neighborhoods, and were more likely to have a facility within a 2-mile radius, it serves to reason that they would be more likely to have multiple facilities within a 2-mile radius. Many toxic facilities are not sited in isolation, but are placed in industrial areas surrounded by other toxic facilities. Therefore, communities exposed to the health risks from the closest toxic facility are also exposed to the health risks of every facility located in the immediate vicinity. By combining the TEP cancer and non-cancer scores for all TRI facilities in the immediate vicinity, a clearer understanding of the differential exposure to health risks can be developed.

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