Environmental Hazards, Migration, and Race *

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Abstract

Most theory and much empirical research acknowledge that contextual characteristics matter in decisions about internal migration. Yet, we know surprisingly little about another category of contextual factors, those specific to the quality of the physical environment. This study contributes to our understanding of the association between migration and environmental factors, specifically environmental risk factors, through the development of models reflecting associations between internal migration, socio-economic characteristics, and environmental risk factors at the county-level nationwide. An additional focus is upon race-specific internal migration thereby yielding insight into the social demography of environmental hazards. Results provide evidence that 1) migration occurs within an environmental context as we can detect a migratory response to environmental risk indicators that persists in the face of a wide array of socioeconomic controls for labor force opportunity, climate, and demographic structure, and 2) that selective migration may play a role in contemporary variations in the social distribution of environmental hazards, as we find variation in migration-risk associations across racial groups.

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Most theory and much empirical research acknowledge that contextual characteristics matter in decisions about internal migration. For instance, as models of migration expanded beyond simple wage (cost) differential models, the migration decision has been seen to be responsive to a variety of locational social characteristics, such as ethnic composition. Yet, we know surprisingly little about another category of contextual factors, those specific to the quality of the physical environment. Just a handful of examinations have incorporated environmental characteristics, such as climate, as migration determinants or as correlates of aggregate migration streams (e.g. Graves 1980; Heaton and Lichter 1986; McGranahan 1999; Walters 1994). The association between migration and human-made environmental risks (e.g. hazardous waste facilities) has also been only rarely explored (e.g. Hunter 1998). This study contributes to our understanding of the association between migration and environmental factors, specifically environmental risk factors, through the development of spatial models reflecting associations between internal migration, socio-economic characteristics, and environmental risk factors at the county-level nationwide.

An additional arena of contribution from this study derives from our focus upon race-specific internal migration thereby yielding insight into the social demography of environmental hazards. Some studies on the distribution of environmental hazards suggest unequal distribution of risk since it appears that minority and low-income communities have greater than average observed and potential exposures to many pollutants (e.g., Hunter 2000; Rinquist 1997; Tiefenbacher and Hagelman 1999) although, notably, other research finds little disparity (e.g., Davidson and Anderton 2000; Oakes, Anderton, and Anderson 1996). Among research suggesting unequal risk distribution, selective migration is often implied to be a key dynamic leading to differential exposure to proximate environmental hazards. This research directly addresses this potential through examination of race-specific internal migration streams as associated with county-level presence of three forms of environmental hazards.

This project has been informed by two primary areas of literature: 1) contextual aspects of migration patterns, and 2) the social demography of environmental hazard distribution. Each is briefly reviewed below, followed by an explanation of our research methodology, research results, conclusions, and implications.

Contextual Aspects of Migration: Much demographic research has examined the associations between migration and contextual factors such as economic conditions and community social characteristics. Less often examined are the associations between migration and specific environmental factors, although even Wolpert's classic migration theory (1966) specifically incorporated "environmental stressors" as components of evaluation of place utility within the migration decision-making process. Another classic migration theory by Lee (1966) noted that both origins and potential destinations are characterized by attributes that either attract or repel migrants. Research on residential preferences suggests that proximate environmental hazards may represent a "stressor" and act to lessen the attractiveness of particular locales. Suggesting households exhibit partiality towards pollution-free residential surroundings, an early study of Arizona residents found 46 percent noted low levels of air and water pollution as essential for an "ideal" community (Blackwood and Carpenter 1978). Quality of the natural environment ranked ahead of population size (41.1%), proximity to relatives (2.7%), cultural opportunities (9.1%), and shopping (13.7%), although it ranked below the quality of schools

(48.3%), medical care (58.2%) and job opportunities (50.8%). More recently, making use of an experimental setting, Greenwood et al. (1997) provide evidence that a proximate nuclear waste repository may dissuade individuals from selecting that potential migration destination.

Further evidence for these types of preferences is provided by the public protest often surrounding proposals for new environmental hazards, "locally-unwanted land uses" (LULUs). In a study of public opposition to the siting of a recycling center, Lober (1995) demonstrates that behavioral opposition is motivated by both perceived costs from a facility and by perceptions of the fairness of the siting process. This increasing concern with proximate hazards is also reflected in the emergence of "popular epidemiology" -- or citizen involvement in issues of environmental risk (Brown and Mikkelsen 1990).

While the above research suggests individuals prefer residential environments free from risk, the studies do not *specifically* consider migration in response to these environmental concerns. McAuley and Nutty (1982) make this link in their examination of intra-state migration in relation to 47 residential characteristics. The researchers found that although housing costs rank consistently among the most important local factors, "healthiness of the local environment (clean air, water, etc.)" ranked second or third in importance among those in earlier stages of the life cycle. Also in support of the contention that environmental influences play a role in these longer-distance mobility decisions, Hsieh and Liu (1983) find environmental quality is an important factor explaining short-run (across 1-2 year periods) interregional migration.

While environmental pollution or other risks may represent negative locational characteristics, positive environmental attributes increase destination attractiveness. Research focusing on rural America has revealed that climate, topography, and water area are highly related to rural population change. Specifically, rural counties ranked low on an "amenities index" comprised of these positive environmental attributes experienced on 1 percent average 1970-96 population change as compared to 120 percent among counties high on the index (McGranahan 1999). Econometric migration models have also revealed associations with locational amenities (e.g., Knapp and Graves 1989) and some suggest that an indication of the societal value placed upon such amenities is reflected in wage differentials across locations (Knapp and Graves 1989). Certainly in the conventional economic model, population movement acts as an equilibrating mechanism reducing geographic wage differentials (DaVanzo 1981), yet these wage differentials are, themselves, often due to variation in location-specific amenities (e.g., Graves, 1983; Graves and Mueser 1993; Knapp and Graves 1989; Mathur et al. 1988; von Reichert and Rudzitis 1994). The existence of location-specific amenities (or disamenities) is important, because migration is the only way to consume (or avoid) them. To be more specific, individuals might accept somewhat lower pay to reside in a location with an attractive climate or other environmental amenities; conversely, individuals might have to receive higher compensation to continue to live in an environmentally unattractive locale.

As such, as an alternative to the notion of "flight" from environmentally risky areas, we might think of the tradeoffs that households consider in their quest for a satisfactory residential environment. The earliest economic frameworks posited that migrants tend to choose destinations that offer the highest level of benefits. As defined by Graves (1983:542), these benefits are, "at the most general level, the variations in utility that result from occupying alternative locations." The standard model posits that migrants calculate the present value of various alternative locations, netting future returns to human capital over the costs of moving (Greenwood 1985). Refinement to the standard model include taking into account "psychic" factors such as the possible emotional difficulties of relocating away from family members

(Sjaastad 1962). As the economic models of migration expanded, a revision of the cost/benefit analysis was proposed in which migrants consider the *expected* benefits of relocation, therefore factoring in the probability and timing of employment (Todaro 1969).

Another important consideration is the association between environmental risk and housing costs, another perspective from which to view tradeoffs. As an example, Nelson (1978) quantifies the value of air quality as the impact of air pollution on residential property values, and suggests that households more sensitive to the tangible and intangible effects of air pollution will take up residence in areas with relatively clean air. As such, households attach an implicit monetary value to air quality. Nelson's results do suggest that housing costs tend to be higher in areas characterized by high levels of environmental quality, thereby substantiating the claim that environmental quality is perceived as beneficial. These types of arguments suggest that socioeconomically disadvantaged households may be more willing to accept proximate environmental risk in order to achieve affordable housing.

Migration and the Social Distribution of Environmental Hazards: Related to the view that disamenities may play a role in tradeoffs in proximate environmental quality, several recent studies on the social distribution of environmental hazards suggest minority and low-income communities have greater than average observed and potential exposures to many pollutants (e.g., Rinquist 1997). Among research suggesting unequal environmental risk distribution, selective migration (particularly as influenced by housing cost) is often suggested or implied to be a key dynamic leading to differential exposure to proximate environmental hazards. Our research empirically examines the degree to which migration patterns of various racial groups are sensitive to the level of environmental hazards in the local area. The majority of existing research on the social distribution of environmental hazards considers static population measures; thus we extend our understanding of this issue through analysis of population *movement* in relation to environmental risks.

Academic research developed within the framework of “environmental equity” has been accumulating over the past 10 years, examining the social distribution of different forms of environmental risk, including air pollution, toxic releases, hazardous waste, and proximity to Superfund sites. The variation in exposures are the result of socio-economic factors, as well as settlement patterns, politics, commerce, geography, public land use decisions and other influences which play into individual residence and occupational decisions (EPA 1992). Two studies, one conducted by the U.S. General Accounting Office (1983) and the other by the United Church of Christ (1987) are often credited with providing the impetus for this growing body of equity research. The GAO undertook a cross-sectional study of four hazardous waste landfills in EPA Region IV, encompassing the southeastern area of the nation. The researchers determined that the majority of the population surrounding three of the four facilities was black. In a study of national scope, the UCC (1987) found that communities with hazardous waste facilities have nearly double the proportion of minority residents relative to communities lacking such facilities.

Much of the research following these two early studies relied on static population distributions to examine the association between socioeconomic factors and various environmental hazards, some finding unequal social distribution of hazards (e.g., Hunter 2000; Rinquist 1997; Tiefenbacher and Hagelman 1999), others not (e.g., Davidson and Anderton 2000; Oakes, Anderton, and Anderson 1996). These cross-sectional studies were followed by longitudinal investigations of the timing of facility placement as related to community socioeconomic factors, in order to better examine the processes that may potentially lead to unequal risk exposure. One current of thought underlying these longitudinal analyses of socioeconomic patterns and facility location relates to pre- and post-facility siting migration patterns. Many studies have implied, either directly or indirectly, that selective migration is a key dynamic leading to environmental inequalities, where market dynamics lead to lowered property values, socioeconomically-“advantaged” populations move out, while those unable to leave remain behind.

As examples of such studies, Shaikh and Davis (1999) found that, within the Denver metropolitan area, hazardous facility siting appears related to income, rent, and unemployment. They explored migration patterns in relation to market dynamics, finding that communities with one or more hazardous facilities experienced more rapid declines in white populations relative to communities without such hazards. Lowered property values as related to the social distribution of hazards are also mentioned by Brooks and Sethi (1997), as their cross-sectional analyses suggests that black communities experience higher pollution levels due to 1) inequitable siting practices that specifically target politically vulnerable communities, and 2) a housing market that selectively prevents members of such communities from escaping exposure through migration to less-exposed areas. Boer et. al. (1997) echo these findings within a Los Angeles County case study finding that communities most affected by facilities that treat, store, or dispose of hazardous waste are working-class communities of color. Migration patterns as related to areas of environmental risk are seen as directly related to a lack of choice over a broader residential market, leading to more minorities moving into areas with potential hazards than even Anglos of similar income levels. They argue that as hazardous waste facility placement drives down local property values, housing becomes increasingly occupied by households of lower socioeconomic status. As a final example, Mitchell et.al. (1999) compared community population composition at the time of siting with present compositions, finding increased socioeconomic disadvantage surrounding facility locations across time. The researchers attribute community contextual changes to housing market dynamics and selective migration patterns.

We test the proposition that socioeconomically disadvantaged populations are less responsive to levels of environmental risk from the perspective that lower SES populations possess less ability to "vote with their feet" by relocating to areas posing lower levels of risk. From another perspective, it is possible that socioeconomically disadvantaged groups may make tradeoffs, in the sense that housing prices tend to decline as housing quality and neighborhood amenities decrease. By contrast, the presence of environmental hazards should act as a substantial neighborhood disamenity, "pushing" socioeconomically *advantaged* groups from such risky locales. As such, this study aims to shed light on the migration factors embraced in the issue of environmental inequalities.

In sum, based on past research on migration decision-making, environmental context, and the social distribution of environmental hazards, we anticipate that areas with high levels of environmental risk lose more socioeconomically *advantaged* residents, as compared to socioeconomically *disadvantaged* residents. In other words, it is anticipated that environmental risk acts as a "push" factor for those most able to relocate or for those who are less likely to tradeoff concern with environmental risk for lower housing costs. Linking this expectation specifically to race, existing socioeconomic differentials by race and demonstrable racial differentials in basic migration patterns suggest that ethnic differentials will be manifest in environmentally migration patterns. Further, lack of information about environmental hazards in lower SES communities, and increasing sensitivity to environmental amenities and disamenities in advantaged and majority communities would further serve to produce and maintain inequalities in the social distribution of environmental quality. As such, our central hypothesis states that we expect counties with higher levels of environmental risk factors to lose relatively greater numbers of white residents relative to minorities.

Data and Methods: Our analyses are conducted with a nationwide, county-level dataset reflecting race-specific migration streams, socioeconomic characteristics, and the presence of three specific environmental risks. The choice of a study design which emphasizes the relationship between county-level environmental risk and aggregate out-migration is not meant to deny that more precise consideration of proximity of environmental risk may play an important role in household mobility decisions. Instead, it stems from the need to establish, with a comprehensive data source, a baseline relationship between environmental risk factors and long-distance movement, while adequately controlling for other social and economic contextual factors that are reported to impact out-migration. Another advantage of a nation-wide study conducted at the county level is that it enables investigation into the race-specific relationships between environmental risks and out-migration, thereby yielding insight into the social demography of environmental hazards.

Hazardous Waste: The hazardous waste data relate to the reporting year 1991 and are taken from the LandView II database. LandView II is a data product created through collaboration between the EPA, the Bureau of the Census, and the National Oceanic and Atmospheric Administration. The measure reflects the number of large quantity hazardous waste generators (LQGs), with "large quantity" defined as facilities generating over 100 kg of hazardous waste in any calendar month. Four indicators of large quantity hazardous waste facilities are included: those counties with one such facility, those with 2-4, those with 5-20 and those over 20. These classifications are based upon logical breaks in the data and those counties with no large quantity hazardous waste generators act as the reference category.

Toxic Releases: The county-level toxic release data are from the Toxic Release Inventory database obtained via the Right-to-Know Network (RTK-NET). OMB Watch, a non-profit public interest group, operates the RTK-NET in conjunction with the Unison Institute, a center for computer systems and software technology operated in the public interest.[1] The incorporated measure reflects average annual toxic releases, by county, for the years 1988 through 1990. Data from the first TRI reporting year, 1987, have been deemed unreliable by the EPA and are, therefore, not included in the analysis. Categories based upon quantiles of toxic release levels are included in the regression estimations. Those counties with no toxic releases act as the reference category.

Superfund Sites: The county-level Superfund data used in this research are from the EPA's CERCLIS database also obtained via RTK-NET. The data incorporated here reflect the number of sites, within a particular county, which were proposed for National Priority List (NPL) status during the time period 1985-1990.[2] NPL (Superfund) sites are those inactive hazardous waste sites that have been deemed to pose significant potential public health risks. Three categories of proposed Superfund sites are included in the regression estimates: those counties with one such site, those with two, and those with more than two. These classifications are based upon logical breaks in the data. Those counties with no Superfund sites therefore act as the reference category.

Socioeconomic Characteristics: Independent variables representing economic and social factors associated with migration are also included. In order to better reflect pre-migration

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1 OMB Watch advocates for the public's right-to-know and greater government accountability and provides public information specifically on the activities of the White House Office of Management and the Budget.

2 Sites *proposed* for Superfund status are included in the present analysis as opposed to those for which status was confirmed. This decision was based on the fact that the *proposal* of Superfund status tends to garner media and

conditions, the socio-economic variables reflect 1980 characteristics, with some indicators of change over the decade 1980-1990. We incorporate the log of total population (1980) in order to control for scale, with a metropolitan county dummy variable also included to capture some of these population effects. In addition, economic circumstances are measured through percentage unemployed (1980) and change in percentage unemployed (1980-1990), percentage employed in manufacturing industries (1980) and change in manufacturing employment (1980-1990). The proportion of occupied housing units within a county owner-occupied (1980) indicates the prevalence of homeownership, while measures of age composition (1980) are included to capture the employment-related migration of 18-34 age group and the retirement-related migration of those over age 65. Finally, environmental amenities are measured through the USDA's Environmental Amenities index a composite measure (18 point scale) of county physical characteristics (climate, typography, and water area) that are presumed to enhance area attractiveness (McGranahan 1999). Table 1 provides further descriptive information for all variables incorporated in the following analyses, including the measures of environmental risk presence.

(Table 1 about here)

Table 1 reveals the significant dispersion in outmigration numbers by county, reflecting both aggregate ethnic group size in the county (which will be controlled statistically) and the wide geographic variation in migratory experience. Review of the socioeconomic traits points to moderate variation in most of the characteristics, with maximum values indicating that some

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community attention, thus representing the time at which the public may become aware of the proximate hazard(s) and outmigration might be expected.

counties experience an extremely strong impact of, say, unemployment or elderly population. A review of the table's lower portion indicates that substantial numbers of counties have zero or one of the environmental risks (not necessarily zero on all); the zero value will form our reference category.

Analytical Strategy: Each race-specific model incorporates independent variables that represent previously outlined explanations for internal out-migration, and in addition, variables that measure environmental risks. The dependent variable, for each race-specific model, is the natural logarithm of the number of outmigrants between 1985 and 1990 reported in the 1990 U.S. Census. To control for the association between number of outmigrants and size of population, the natural logarithm of the race-specific county population reported in 1980 is included as an explanatory variable. A more conventional form of the model might use the natural logarithm of the race-specific out-migration rate as the dependent variable. This form is equivalent to the form chosen here except the former constrains the coefficient on the natural logarithm of population size to be unity. The more general form we have chosen allows each race group to be differentially responsive to aggregate size of the population in the county. Another advantage of this form is that each estimated coefficient can be interpreted as the expected percentage change in the number of outmigrants per unit change in the regressor.

In order to clearly interpret the effects of the environmental risks, we specify them as categories, with zero as the reference group. We do this for two reasons. First, as Table 1 shows, these indicators take the value zero for many counties. The choice of the particular categories for each of the three environmental risks was determined after careful review of the distributions of the risk variables themselves and some exploratory multivariate work under alternative specifications. Again the functional form has a distinct interpretation: the coefficient represents the percentage change in county outmigration for the presence of an environmental risk in that category. Such effects are, of course, net of population size in the county.

Estimation of the models deviated from classical regression techniques on three counts. First, in ordinary least squares (OLS) estimation there is an assumption of equal error variances across all observations. In this situation, counties with small race-specific populations are necessarily more unstable in reported outmigration than those with a larger representation of a race group. Consequently, these counties should be devalued relative to the counties with larger race-specific populations. For this reason, we weighted counties in increasing proportion to the size of the race-specific population, using a weighted least squares (WLS) approach. Second, significant unexplained spatial correlation was found in all four race-specific models. This was true for adjacent counties as well as for counties within a 100-mile radius. Spatially correlated errors were confirmed by LaGrange Multiplier tests and other procedures available in *SpaceStat, A Software Program for the Analysis of Spatial Data, Version 1.80* (Anselin, 1995). Third, significant correlation was also found in the residuals across the race-specific models. Each of these three conditions violates the classical OLS assumptions, and, if ignored, will still produce unbiased estimates. However, the estimates of standard errors will be inefficient and will invalidate hypothesis testing (Anselin, 1988; Zellner 1962; Greene 2000).

The strategy used to gain reliable standard errors of the estimates, i.e. not influenced by the heterogeneity of error variances, the spatially correlated errors, or the correlated errors across models, was to use WLS to obtain the estimated effects of the explanatory variables and then to use bootstrapping techniques to generate the standard errors for each of the WLS regression parameter estimates. Ten thousand samples were drawn from the 3067 counties with replacement. As a result of the bootstrapping analysis there was confirmation that the WLS estimates are unbiased and that the WLS standard errors are generally smaller than those revealed by the empirical distributions. The WLS coefficients are reported in Table 2 along with the results of the hypothesis tests based on the standard errors generated from the bootstrapped distributions.

Finally, in order to compare environmental risk effects across race groups, standard t-tests for mean differences, were conducted. The unbiased estimated parameters reported in Table 2 are the means used in the tests, and the standard deviations were derived empirically from 1,000 bootstrapped samples. Because conducting multiple tests necessarily increases the probability of rejecting the null hypothesis, the Bonferroni adjustment for multiple comparisons (Winer, Brown, Michels, 1991: 158-166) was used to adjust the significance level. There are four race groups or six paired comparisons for each of the eleven environmental risk variables, or a total of sixty-six comparisons. Assuming a .05 probability of falsely rejecting equality for a single pair of means, the Bonferroni adjustment provides a more appropriate alpha level of .05/66 or 0.000757.

Results: In the remaining discussion, we first review the models' estimates for the demographic, economic, and geographic control variables. Following is a discussion of racial differences in outmigration by hazard type: 1) toxic releases, 2) proposed Superfund sites, and 3) hazardous waste TSDFs. Finally, and particularly important, we briefly review the statistical significance of differences across racial groups in the association between environmental risk and outmigration.

County population characteristics contribute substantially to predict outmigration of all racial groups, with only slight variation across racial categories. The total population of racial groups within a county contributes significantly to prediction of outmigration of that racial group for all categories considered, although counties with larger overall populations tend to lose relatively greater numbers of minority residents as compared to whites. Counties with younger and older age structures tend to experience lower levels of outmigration, while areas of immigrant concentration tend to lose relatively lesser proportions of Asians.

Economic factors demonstrate anticipated associations, with areas characterized by greater unemployment experiencing relatively greater levels of outmigration. In addition, concentrations in manufacturing employment are associated with lesser outmigration. Also as anticipated, homeownership dampens outmigration for all racial categories. Greater housing value is associated with greater outmigration, except in the case of Hispanics where median housing value demonstrates a negative association with loss of Hispanic population.

As for the geographic control variables, counties larger in areal extent lose relatively less population, while metro areas tend to lose more, excepting Hispanics. New England and the Mid Atlantic Census Divisions lose relatively less population than do Western counties, while the West South Central and Mountain regions tend to lose more. The environmental amenities scale exhibits a statistically significant association only with Asian outmigrants, with the coefficient suggesting higher amenity areas lose relatively fewer Asians as compared to areas lacking desirable natural features.

Toxic Releases: As for toxic releases, we find little association between outmigration and the measured amount of toxic releases for blacks and Hispanics, but statistically significant associations for white and Asian outmigration. Interestingly, however, the associations are in opposite directions for whites and Asians, with greater white outmigration at higher levels of toxic releases but lesser Asian outmigration across all levels of toxic releases relative to those counties with no such releases. Here, we predict about 4 percent greater white outmigration for those counties in the second, third, and fourth quartiles of toxic release levels, as compared to those counties with no such releases. The coefficient does not change substantially across these quartiles, suggesting that it is the presence rather than the measurable amount of toxic release that is associated with the geographic mobility of whites. As for the Asian population, outmigration is significantly less from counties with any releases relative to those with none, again suggesting that it is the presence rather than the measurable amount of toxic release that is associated with the geographic mobility of Asians.

Proposed Superfund Sites: In the case of Superfund sites the results reveal no significant associations with white outmigration. On the other hand, rates of black outmigration are lower (although not statistically significant) for counties with proposed Superfund sites, but higher for Asians and Hispanics. The pattern apparent for each racial group is consistent across levels. For instance, we would predict 4 percent less black outmigration from counties with 1 proposed Superfund site relative to counties with no such sites, 4 percent less from counties with 2 proposed Superfund sites, and 7 percent less from those with greater than two. In the case of Asians and Hispanics, greater outmigration is anticipated from counties with such risks.

Hazardous Waste Large Quantity Generators: Finally, as for the presence of hazardous waste facilities, it is interesting that again no association is apparent between the environmental risk and white outmigration. On the other hand, some (but few) statistically significant effects appear for each racial minority group, typically positive, therefore suggesting greater outmigration is related to facility presence. It is important to note, however, that no strong patterns exist in this association. For instance, we predict 13 percent greater outmigration of Asians from counties with more than 20 LQGs as compared to counties without such facilities, and 7 percent greater outmigration of Hispanics from counties with 2-4 facilities relative to those without.

Differences in Association with Environmental Risk Across Racial Groups: Tests for statistical differences in the associations between environmental risk across racial groups were conducted as outlined in the Analytical Strategy above, with results presented in Table 3. Overall, significant racial differences are the rule rather than the exception -- of the 66 possible pairs of racial differences in environmental risk associations, 61 are statistically significant. Further, of the 5 pairs of associations that are not statistically different, 1 comes from the association with the lowest level of toxic release and 3 others are found in the associations with the fewest number of large quantity generators. As such, the results suggest racial differences are more likely where environmental risks are higher.

As reported in Table 3, the association between the lowest level of toxic release and Black out-migration (-0.0375) is **not** significantly different from that between this risk category and Hispanic outmigration (-0.0346). The reported association between the presence of one large quantity generator and white outmigration is 0.0120, which is **not** significantly different from the association between one LQG and Hispanic outmigration (0.0162). This same level of environmental risk showed **no** significant difference for Blacks (0.0259) and Asians (0.0214), and between Hispanics (0.0162) and Asians (0.0214). The final non-significant difference between racial groups occurs in the association between migration and the presence of greater than 20 large quantity generators. Here the association between this high level of LQG presence and white outmigration (-0.0146) is **not** statistically different from the that between LQGs and Black outmigration (-0.0097).

(Table 3 about here)

Conclusion: This study has examined the association between race-specific outmigration and environmental risk levels with the intention of contributing to our understanding of the environmental context of migration and the dynamics underlying the social distribution of environmental hazards. The results have yielded two key findings. First, we can detect a migratory response to environmental risk indicators that persists in the face of a wide array of socioeconomic controls for labor force opportunity, climate, and demographic structure. As such, in a general sense internal population redistribution may, indeed, be impacted by such environmental stressors.

Second, although statistically significant associations are apparent between outmigration and environmental hazards, the results point to variation in migratory response by ethnic group and by type of environmental risk. With respect to toxic releases, we find that whites are responsive through outmigration, with increasing levels of white population loss from areas with higher levels of releases. On the other hand, Asians experience lesser outmigration from counties with toxic releases. With respect to proposed Superfund sites, we find that Asians and Hispanics are responsive through greater outmigration, while blacks experience less outmigration from areas with inactive industrial sites placed upon the National Priority List. Results for large quantity hazardous waste sites are the least consistent, where only occasional risk categories demonstrate statistically significant associations with outmigration, typically suggesting greater outmigration from areas of risk. In general, we find partial support for our anticipation that areas with high levels of environmental risk lose more socioeconomically advantaged residents, as compared to socioeconomically disadvantaged residents. Considering all risk variables, the **only** statistically significant coefficients for whites are positive, net of the influence of other demographic, economic, and geographic characteristics, suggesting greater outmigration from risky areas. Yet in only one case do we estimate significant negative coefficients for a minority racial group suggesting dampened outmigration from risky areas -- Asians appear least likely to leave areas characterized by high levels of toxic releases. No other substantial patterns become apparent.

There are several reasons to expect that segments of the population might be less likely to respond to proximate environmental risk through relocation. First, migration has costs. As such, only those willing and able to pay such costs will see outmigration as a potential answer to concern with community characteristics. Second, environmentally-risky facilities often offer economic benefits. As stated by Yandle and Burton (1996:490), there have been situations in which communities "would welcome heavy industry, and the accompanying waste disposal problems, in return for growth and high-paying industrial jobs." As such, the economic benefits accompanying some environmental risk may act to retain population. Regardless, the results presented here do provide evidence that migration occurs within an environmental context and that selective migration may play a role in contemporary variations in the social distribution of environmental hazards.

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Table 1:
Descriptives of Included Variables

Unit of Analysis: U.S. Counties within 48 contiguous states

	Mean	Min	Max	S.D.	Obs
Outmigrants by Race, 1985-1990					
White (non-hispanic)	11834	1	918043	33371	3067
Black	1233	0	138691	5986	3067
Asian	356	0	92042	2510	3067
Hispanic	885	0	279288	6585	3067
Population Characteristics					
1980 population	72570	0	7477503	236968	3067
1980 white population	71859	90	5607021	200582	3065
1980 black population	9792	0	1316564	50754	3065
1980 asian population	2290	0	979894	22167	3065
1980 hispanic population	7207	0.00	3215235	70236	3065
proportion population less than age 18, 1980	0.29	0.00	0.53	0.04	3067
proportion population age 65 and over, 1980	0.13	0.00	0.34	0.04	3067
proportion population (age 25+) college graduates, 1980	0.11	0.00	0.48	0.05	3067
proportion foreign-born, 1980	0.02	0.00	0.37	0.03	3067
change in proportion foreign-born, 1980-1990	0.00	-0.05	0.13	0.01	3067
Economic Characteristics					
proportion civilian labor force unemployed, 1980	0.07	0.00	0.28	0.03	3067
change in proportion CLF unemployed, 1980-1990	0.00	-0.12	0.14	0.03	3067
proportion employed in manufacturing, 1980	0.21	0.00	0.62	0.12	3067
change in proportion employed in manufacturing, 1980-1990	-0.02	-0.24	0.20	0.04	3067
Housing Characteristics					
proportion housing units owner-occupied, 1980	0.68	0.08	1.00	0.11	3067
change in proportion housing units ownef-occupied, 1980-1990	0.10	-0.25	1.78	0.17	3067
median housing value, 1980	34910	10600	200001	13656	3067
change in median housing value, 1980-1990 (dollars)	18306	-16700	394300	22337	3067
Geographic Characteristics					
Land Area	2498087	63923	52000000	3385798	3067
Metropolitan county	N=697				
New England	N=65				
Mid Atlantic	N=149				
East North Central	N=437				
West North Central	N=618				
South Atlantic	N=552				
East South Central	N=364				
West South Central	N=470				
Mountain	N=280				
Environmental Amenities					
USDA Amenity Scale	0.06	-6.40	11.17	2.29	3067
Environmental Risk Categories					
Toxic Releases (log million pounds released)					
Zero toxic releases	N=855				
Quartile 1	N=559				
Quartile 2	N=555				
Quartile 3	N=547				
Quartile 4	N=549				
Proposed Superfund Sites					
Zero proposed Superfunds	N=2488				
One proposed Superfund	N=340				
Two proposed Superfunds	N=108				
Greater than 2 proposed Superfunds	N=129				
Hazardous Waste Large Quantity Generators (LQGs)					
Zero LQGs	N=1276				
One LQG	N=490				
2-4 LQGs	N=549				
5-20 LQGs	N=546				
Greater than 20 LQGs	N=204				

Table 2: Multivariate Estimations of Outmigration by Race, U.S. Counties, 1985-1990.

	Model 1 White Outmigrants	Model 2 Black Outmigrants	Model 3 Asian Outmigrants	Model 4 Hispanic Outmigrants
Population Characteristics				
log 1980 population	-0.0093	0.0459 *	0.0299	0.1071 *
log 1980 white population	0.9476 *	---	---	---
log 1980 black population	---	0.8277 *	---	---
log 1980 asian population	---	---	0.8470 *	---
log 1980 hispanic population	---	---	---	0.7628 *
proportion population less than age 18, 1980	-0.0646	-0.6329 *	-1.9661 *	-0.8883
proportion population age 65 and over, 1980	-0.8137 *	-1.7060 *	-1.7797 *	-1.4981 *
proportion population (age 25+) college graduates, 1980	0.9175 *	0.4070	0.2490	0.5462
proportion foreign-born, 1980	-1.1060 *	0.2820	0.5498	-0.0669
change in proportion foreign-born, 1980-1990	1.3157 *	1.8577	-2.6430 *	0.2741
Economic Characteristics				
proportion civilian labor force unemployed, 1980	0.6712	3.3230 *	3.5213 *	0.6439
change in proportion CLF unemployed, 1980-1990	0.7439 *	1.6080 *	4.6088 *	1.6925 *
proportion employed in manufacturing, 1980	-0.9130 *	-0.5812 *	-0.2171	-0.7019 *
change in proportion employed in manufacturing, 1980-1990	-0.8078 *	-0.1486	-0.6083	-0.3454
Housing Characteristics				
proportion housing units owner-occupied, 1980	-0.8324 *	-0.4186 *	-0.3939	-0.8747 *
change in proportion housing units owner-occupied, 1980-1990	-0.5706 *	-0.4377 *	-0.5877 *	-0.5676 *
median housing value, 1980 (dollars)	9.93E-07	1.29E-06	-2.55E-08	-3.70E-06 *
change in median housing value, 1980-1990 (dollars)	1.44E-06 *	2.01E-06 *	1.46E-06 *	3.22E-06 *
Geographic Characteristics				
arealand	-2.22E-09	-6.87E-10 *	6.04E-10	-2.95E-09
metropolitan county	0.0152	0.0460	0.1079 *	-0.0268
New England	-1.1115 *	-0.0977	-0.1426	-0.6016 *
Mid Atlantic	-0.0810	-0.0298	-0.0867	-0.2230 *
East North Central	0.0530	-0.0686	-0.0012	-0.2663 *
West North Central	0.0968 *	0.2147	0.1691	-0.2240 *
South Atlantic	0.0427	0.0072	0.0997	-0.2702 *
East South Central	-0.0497	-0.1606 *	0.0287	-0.2116 *
West South Central	0.1371 *	0.0390	0.2994 *	0.0158
Mountain	0.1521 *	0.1822	0.2497 *	0.0610
Environmental Amenities				
USDA Amenity Scale	-0.0057	-0.0027	-0.0130 *	-0.0119
Environmental Risks				
Toxic Releases (log million pounds released) (zero = ref category)				
Quartile 1	-0.0102	-0.0375	-0.2404 *	-0.0346
Quartile 2	0.0446 *	-0.0092	-0.1531 *	-0.0210
Quartile 3	0.0399 *	0.0090	-0.1751 *	0.0564
Quartile 4	0.0413 *	-0.0028	-0.2255 *	0.0257
Proposed Superfund Sites (zero = ref category)				
One proposed Superfund	0.0156	-0.0417	0.0472	0.0324
2 proposed Superfunds	0.0096	-0.0371	0.1278 *	0.0873 *
Greater than 2 proposed Superfunds	0.0073	-0.0704	-0.0021	0.0387
Hazardous Waste Large Quantity Generators (LQGs) (zero = ref category)				
One LQG	0.0120	0.0259	0.0214	0.0162
2-4 LQGs	-0.0015	0.0639 *	-0.0083	0.0724 *
5-20 LQGs	-0.0182	0.0159	0.0352	-0.0275
Greater than 20 LQGs	-0.0146	-0.0097	0.1385 *	-0.0518
Constant	0.0178 *	-0.4838 *	-0.0178	0.2742 *
R^2	0.9916	0.9860	0.9901	0.9925

* Coefficient is more than 1.65 times its standard error.

Table 3: Comparisons of Environmental Risk Effects across Race Groups

Within each risk category, estimates sharing a symbol (*,^,+) are NOT significantly different

	Model 1 White Outmigrants	Model 2 Black Outmigrants	Model 3 Asian Outmigrants	Model 4 Hispanic Outmigrants
Toxic Releases (log million pounds released) (zero = ref category)				
Quartile 1	-0.0102	-0.0375 *	-0.2404	-0.0346 *
Quartile 2	0.0446	-0.0092	-0.1531	-0.0210
Quartile 3	0.0399	0.0090	-0.1751	0.0564
Quartile 4	0.0413	-0.0028	-0.2255	0.0257
Proposed Superfund Sites (zero = ref category)				
One proposed Superfund	0.0156	-0.0417	0.0472	0.0324
2 proposed Superfunds	0.0096	-0.0371	0.1278	0.0873
Greater than 2 proposed Superfunds	0.0073	-0.0704	-0.0021	0.0387
Hazardous Waste Large Quantity Generators (LQGs) (zero = ref category)				
One LQG	0.0120 *	0.0259 ^	0.0214 ^+	0.0162 *+
2-4 LQGs	-0.0015	0.0639	-0.0083	0.0724
5-20 LQGs	-0.0182	0.0159	0.0352	-0.0275
Greater than 20 LQGs	-0.0146 *	-0.0097 *	0.1385	-0.0518

*Uses .00114 as significance level provided by Bonferroni correction for multiple comparisons.