Ecological Economics 107 (2014) 494–509

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

Regional variation in environmental inequality: Industrial air toxics exposure in U.S. cities ☆

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ARTICLE INFO

Article history:
Received 28 February 2014
Received in revised form 13 June 2014
Accepted 2 September 2014
Available online 8 October 2014

JEL Codes:
I14
Q53
Q56
R11

Keywords:
Environmental inequality
Environmental justice
Air pollution
Risk-Screening Environmental Indicators

ABSTRACT

This paper analyzes how racial and ethnic disparities in exposure to industrial air toxics in U.S. cities vary with neighborhood income, and how these disparities vary regionally across the country. Exposure is estimated at the census block-group level using geographic microdata from the Risk-Screening Environmental Indicators of the U.S. Environmental Protection Agency (EPA). We find that racial and ethnic disparities in pollution exposure are strongest among neighborhoods with median incomes below $25,000, while income-based disparities are stronger among neighborhoods with median incomes above that level. We also find considerable differences in the patterns of disparity across the ten EPA regions. In the two regions with the highest median exposure (the Midwest and South Central regions), for example, African-Americans and Hispanics face significantly higher exposures than whites, whereas in the region with the next highest exposure (the Mid-Atlantic), the reverse is true. We show that the latter result is attributable to intercity variations – minorities tend to live in the less polluted cities in the region – rather than to within-city variations.

1. Introduction

This paper analyzes industrial air toxics exposure disparities by income, race and ethnicity in U.S. cities, here defined as urbanized areas within Core-Based Statistical Areas (CBSAs). Exposure estimates are obtained from the geographic microdata of the Risk-Screening Environmental Indicators (RSEI) of the U.S. Environmental Protection Agency (EPA). We merge the exposure data with U.S. Census data at the block-group level to obtain income and demographic variables. The fine level of geographic resolution provided by these data allows us to investigate two questions that have not been addressed in the literature on environmental inequality.

First, how do racial and ethnic disparities in exposure vary across neighborhoods with different levels of median income? Specifically, we test the hypothesis that racial and ethnic disparities in exposure decline with rising incomes. Because race and ethnicity are correlated with income, this could yield the result that racial and ethnic disparities in exposure are large across neighborhoods in the income strata where most people of color reside, but less pronounced across neighborhoods at the strata where most non-Hispanic whites reside.

Second, are there significant variations across the ten EPA regions in patterns of environmental inequality? Although bound by US EPA's common regulations, policies, and guidance to help ensure a consistent approach nationwide in the implementation of environmental requirements, the EPA regions are distinct administrative units with different bureaucratic cultures, state regulations, and data sources. A GAO (2000) report found that variation in enforcement across regions exceeded the desired and expected level. In explanation of the variation, the report cites "(1) differences in the philosophical approaches among enforcement staff about how to best achieve compliance with environmental requirements; (2) differences in state laws and enforcement authorities, and in the manner in which regions respond to these differences; (3) variations in resources available to both state and regional enforcement offices; (4) the flexibility afforded by EPA policies and guidance that allow states a degree of latitude in their enforcement programs; and (5) incomplete and inadequate enforcement data which, among other things, hamper EPA's ability to accurately characterize the extent of variations." (GAO, 2000, p. 6).

☆ Funding from the National Science Foundation under Grant No. SES-1060904 and OeNB Anniversary Fund under Grant No. 15330 is gratefully acknowledged. We thank Anita Milman, Simon Sturn, Owen Thompson and two anonymous referees for helpful comments on an earlier version, and Alexis Doyle for assistance in completing this study. All remaining errors are of course ours.

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http://dx.doi.org/10.1016/j.ecolecon.2014.09.013
0921-8009/

Regulatory differences among US EPA regions do not exist in a vacuum. Differences in demographic, political, economic, and environmental history and geography dictate the circumstances under which regulators regulate. At the local level, Gray and Shadbegian (2009) find that plant inspections and enforcement actions are strongly affected by political factors (such as politically active, liberal neighborhoods) and weakly affected by demographic characteristics. At the state level, Fredriksson and Millimet (2002) and Konisky (2007) find that state regulations may influence those of neighboring states. This may partly explain the strong regional clustering in environmental regulation[1] (see Appendix Fig. A.3) as well as the regional disparities in weighted median exposure (see Appendix Fig. A.4). Segregation, a profound and enduring feature of the U.S. landscape (Massey, 1993), creates opportunities to locate hazards in neighborhoods disproportionately inhabited by ethnic or racial minorities. The historical timing of industrialization and de-industrialization and the racial and ethnic construction of urban space, e.g., through migration, immigration, redlining, blockbusting, and urban renewal projects, create different potentials for environmental justice or injustice.

Sicotte (2013) and Pellow (2000) make a strong case for the geographical and historical specificity of patterns of environmental injustice. The RSEI dataset draws from a single, consistent national data source, creating an opportunity to assess the variation of the US EPA regions in fostering environmental justice. We do not have a prior hypothesis as to better and worse performance among US EPA regions. However, the US EPA regions correspond, at least loosely, to regions with distinct environmental and economic histories. For example, EPA Region 5, comprising Ohio, Indiana, Michigan, Illinois, Wisconsin, and Minnesota corresponds nearly exactly to the Old Northwest Territory. These states share a similar history going back to the early days of the Republic and, perhaps more relevantly, similar experiences during early-twentieth century industrialization, mid-twentieth migration – especially of African Americans and poor whites from the U.S. South – and late-twentieth century deindustrialization. Analogously, EPA Region 9, comprising California, Arizona, Nevada, and Hawaii, can be classified as Southwestern Sunbelt (with the exception of Hawaii) with much development occurring during and after the Second World War and longstanding and newcoming Hispanic populations. Appendix Figs. A.5 and A.6 suggest the existence of strong regional clusters of state-level environmental disparities, both between whites and minorities and between poor and non-poor households. For these reasons, we believe that the EPA regions provide a suitable starting point for regional investigation of patterns of environmental justice.

The paper is organized as follows. After a discussion of the literature in the next section, we describe the data in more detail in Section 3. Section 4 presents descriptive statistics on disparities in exposure at the national level and for the ten regions. Section 5 presents our model and estimation results, where we estimate the effects of income and minority status on exposure. Section 6 concludes.

2. Literature Review

After the release of the groundbreaking report by the Commission for Racial Justice (1987), which found strong racial disparities in proximity to hazardous waste facilities in the United States, national-level analysis of environmental disparities by race, ethnicity and income has generated a large and growing literature. A number of studies have analyzed the demographic correlates of proximity to treatment, storage and disposal facilities (Anderton et al., 1994; Been and Gupta, 1997; Bullard et al., 2008; Mohai and Saha, 2007) or other environmental hazards (Hird and Reese, 1998; Mohai et al., 2009). Other studies have used information on proximity to industrial facilities in the EPA's Toxic Release Inventory, taking into account differences in emissions as well as residential locations (Arora and Cason, 1999; Brooks and Sethi, 1997; Perlin et al., 1995). An important methodological issue raised by these studies is the definition of proximity. When considering environmental hazards, how near is "near"? For example, Anderton et al. (1994) found that when proximity is defined very restrictively as residence in the same census tract in which a hazardous waste facility is located (these tend to be industrial tracts, with relatively low population density), there is no evidence of disproportionately high percentages of minorities. If, however, proximity is defined to include tracts within a 2.5-mile radius (which tend to be more densely populated), the percentages of minorities are significantly higher than average.[2]

More recent research has used data on exposure to pollution, rather than simple proximity to hazards (see for example Milman, 2006). By taking into account such factors as prevailing wind patterns, stack height and exit gas velocities, as well as the mass and toxicity of emissions, exposure-based analysis provides a more accurate picture of environmental inequalities, as well as a solution to the "how near is near" problem. National-level analyses of exposure disparities have relied mainly on data from the EPA's Risk-Screening Environmental Indicators (Ash and Fetter, 2004; Bouwes et al., 2003; Downey and Hawkins, 2008; Downey et al., 2008).[3]

Apart from these national-level studies, a number of researchers have analyzed environmental disparities in specific locations. For example, there have been studies of proximity to waste disposal sites in Houston (Bullard, 1983), metropolitan Detroit (Mohai and Bryant, 1992), Los Angeles county (Boer et al., 1997), Michigan (Saha and Mohai, 2005) and North Carolina (Norton et al., 2007). Others have examined proximity to industrial facilities covered by the Toxics Release Inventory in Ohio (Bowen et al., 1995), Southern California (Sadd et al., 1999), Minneapolis (Sheppard et al., 1999), Baltimore (Boone, 2002) and metropolitan Charleston (Wilson et al., 2012). Several exposure-based studies have also been conducted in specific locations: Sicotte and Swanson (2007) and Abel and White (2011) use RSEI data to examine industrial air toxics exposure disparities in Philadelphia and Seattle, respectively; Morello-Frosch et al. (2001) and Pastor et al. (2005) use National Air Toxics Assessment data to analyze exposure disparities in Southern California; Apelberg et al. (2005) use data from the same source in a study of Maryland; and Brochu et al. (2011) analyze disparities in exposure to airborne particular matter in the northeastern United States.

Notwithstanding differences in methodology and data sources, most of these studies have found evidence that racial and ethnic minorities and low-income communities tend to face disproportionate pollution hazards. However, there is some controversy about the causes of environmental disparities, which has become known as the "siting versus move in" debate in the literature. In theory, the causal paths that lead to correlations between income, race or ethnicity and proximity/exposure to environmental hazards could run in either or both directions. If private firms (and public agencies) are more likely to site hazards in disadvantaged communities and/or less likely to mitigate them by installing pollution control equipment, the causal pathway runs from neighborhood characteristics to pollution. However, pollution can also

[1] It is difficult to obtain a single indicator of state-level regulatory stringency or enforcement. States with high rates of high priority violations might be more effective in discovering violations or might have more firms with high priority violations to begin with. The same holds true for measures of enforcement action, timeliness and appropriateness of action, or penalty assessment and collection. The measure we report – the percent of major sources regulated under the Clean Air Act receiving full compliance evaluations – is a good indicator for inspection/compliance evaluation coverage. Fig. A.3 shows that inspection coverage in some states of the Midwest and South Central – the two regions with the highest median exposure – is comparatively low, whereas inspection coverage in Mid Atlantic states is generally much higher.

[2] In a more detailed analysis based on the same research project, Oakes (1997, p. 122) observes that in neighborhoods one mile from TSDF tracts, the percentage of blacks is about 30%—more than double the average, and that "past the two-mile point, the average [percentage black] falls fairly consistently until about five miles, when it becomes less than the mean percentage black for the whole sample." For discussion, see also Boyce (2007, pp.326–7).

[3] Exposure-based studies have also been conducted at the national level using EPA data on criteria air pollutants (Bell and Ebisu, 2012; Morello-Frosch and Jesdale, 2005).