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Trends in exposure to industrial air toxins for different racial and socioeconomic groups: A spatial and temporal examination of environmental inequality in the U.S. from 1995 to 2004

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ABSTRACT

In recent decades there have been dramatic declines in industrial air toxins. However, there has yet to be a national study investigating if the drop has mitigated the unequal exposure to industrial toxins by race and social class. This paper addresses this by developing a unique dataset of air pollution exposure estimates, by aggregating the annual fall-out location of 415 air toxins, from 17,604 facilities, for the years 1995 to 2004 up to census block groups (N = 216,159/year). These annual estimates of exposure were matched with census data to calculate trends in exposure for different racial and socioeconomic groups. Results show that exposure to air toxins has decreased for everyone, but African-Americans are consistently more exposed than Whites and Hispanics and socioeconomic status is not as protective for African-Americans. These results by race were further explored using spatially specified multilevel models which examine trends over time and across institutional boundaries.

1. Introduction

The study of how environmental hazards vary by race and class has grown substantially since the field of environmental inequality began in the 1980s (Taylor, 2014). Examination of the risk to industrial air pollutants, in particular, has drawn a great deal of attention from researchers. The majority of studies has shown that the location of industrial facilities (Campbell et al., 2010; Mohai et al., 2009; Pastor et al., 2001) and the emissions from industrial facilities (Grant et al., 2010; Downey and Hawkins, 2008) disproportionately affect poor and minority communities. However, much of this work has been cross-sectional and the potential that results might differ if another time frame were chosen is quite high in light of the fact that there have been large-scale declines in the amount and toxicity of air toxins. These declines can be traced back to the fact that over the past several decades there has been an increasing awareness, and concern, about the risk industrial toxins pose to human health. This concern has translated into increasingly restrictive environmental regulations (Kahn, 1999, 2003). In addition, over this time period macroeconomic trends like deindustrialization have dramatically reduced the number of manufacturing and other industrial facilities operating in the United States (Kahn, 1999, 2003). These changes raise a question heretofore unexamined in the literature: Has the downward trend in the amount and toxicity of industrial toxins over the past few decades mitigated environmental disparities?

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Now that the literature has had several decades to build, it is surprising that there have not been more longitudinal studies examining how environmental inequalities vary across time. Those few national studies that have been done have primarily focused on individual-level explanations. For example, Pais et al. (2013) used latent class growth analysis to group individuals associated with different residential trajectories into and out of polluted neighborhoods from 1991 to 2007. Pais and colleagues show immobile individuals, particularly African-Americans, were likely to see an increase in their exposure to Toxic Release Inventory (TRI) air pollutants. However, the researchers found that, on average, individuals' levels of exposure to industrial toxins have declined over time. They posit this decline might be due to the fact that individuals generally experienced upward mobility, but note this finding, "may also result from a general historical decline in reported TRI releases" (Pais et al., 2013, p. 11). Unfortunately data limitations did not allow the researchers the ability to distinguish between these two possibilities. The results of the Pais et al. study reflect the findings and data limitations of other such studies. For example, Crowder and Downey (2010) utilized longitudinal, individual-level, mobility data to examine the movement of individuals into and out of polluted areas. Importantly, they found support for the hypothesis that some of the differential exposure of pollution experienced by African-Americans might be due to variation in the propensity for African-Americans to move to, and stay in, more polluted areas (Crowder and Downey, 2010).

Those few studies that have examined macro causes of changing exposures have been limited in spatial scope and have had mixed results. Brajer and Hall (2005) focused on the South Coast Air Basin of California. The authors found that from 1990 to 1999, on average, the daily maximum exposure rates of ozone and particulate matter (PM 10) declined. However, ozone increased for counties with greater percentages of whites and declined for counties with greater percentages of Hispanics. They also found an increasingly positive association between the percentage of African-Americans and Hispanic population and particulate matter over time. The authors theorize that these mixed results might be explained by variations in overall declines in air pollution, stricter regulation, and changing demographic profiles. Unlike Brajer and Hall (2005), Downey's (2005) examination of demographic changes around manufacturing facilities in the Detroit metropolitan area from 1970 to 1980, and 1980 to 1990 found that the correlation between the presence of a manufacturing facility and the percentage of African-American residents weakened over time. The author argued that deindustrialization decreased the number of operating manufacturing facilities in the central city, where the African-American population was largely limited to living due in part to residential segregation.

It is clear that nationwide, industrial air pollution has been consistently declining over the past several decades. The EPA estimates that from 1980 to 2013 the emissions of the six criteria air pollutants regulated by the Clean Air Act decreased by 62% (EPA, 2014). These changes have been attributed to stricter environmental regulation over this period along with deindustrialization (EPA, 2014; Kahn, 1999; Maasoumi and Millimet, 2005). From 1980 to 2009 the United States lost almost 40% of its manufacturing jobs (Helper et al., 2010). Economists have termed this overall decrease in toxic exposure the "silver lining" of deindustrialization (Kahn, 1999; Maasoumi and Millimet, 2005). Because deindustrialization occurred disproportionately in central cities, it is logical that these areas have preferentially benefited from such declines and by extension the residents in these areas. Historically, America's racial and ethnic minorities have been concentrated in these same areas (Farley et al., 2000) leading to the hypothesis that as the industrial activity in these areas declines, the racial gap in exposure will be shrinking (Downey, 2005). The theory has yet to be tested at a national level, a gap which this paper addresses.

This paper also brings needed attention to how air pollution exposure varies by demographic groups that have grown substantially in the United States over recent years; most centrally, a booming Hispanic population (Guzmán, 2001) and a growing black middle class (Frey, 2003). The Hispanic population increased 50% from 1990 to 2000 (Guzmán, 2001) and 43% from 2000 to 2010 (Ennis et al., 2011). The black middle class has also grown substantially (Marsh et al., 2007; Frey, 2003). In 2010, roughly 36% of African-American households had an average household income of $50k or above. This is up from 27.4% in 2000, but still below the 56% of non-Hispanic Whites and 41% of Hispanics. The following analyses use Frey's indicator of middle-class status, an average household income of $50k or above, to examine trends in pollution exposure for the black middle class, as well as where they stand in comparison to Whites and Hispanics of similar economic standing. These results are compared to racial groups broken out by their educational attainment.

2. Background

Much of the research examining environmental inequality has examined exposure to industrial toxins (Pais et al., 2013; Crowder and Downey, 2010; Downey et al., 2008). In a meta-analysis of the canon of environmental justice literature, Mohai (2007) showed that, on average, people of color were one and a half times more likely to be in areas around polluting industrial sites. Theories to explain these environmental inequalities have been broken down into three complementary categories: rational choice, sociopolitical, and racial discrimination theories (Mohai et al., 2009).

Rational choice theories are based on the assumption that individual behavior can be explained by perceived self-interest. In keeping with this theory, it would be economically rational for industry actors to establish polluting facilities in areas that have cheaper land values, which are often in predominately minority and low-income communities (Pastor et al., 2001). It would also be economically rational for those with the resources to leave such areas, concentrating disadvantage around these sites. Results testing the rational choice model have been mixed. Some scholars have found that polluting facilities were placed in areas with higher percentages of minority and low-income populations (Pastor et al., 2001; Hamilton, 1993), while others found no evidence for disproportionate siting (Been and Gupta, 1997; Oakes et al., 1996). Moreover,