



# Mega freight generators in my backyard: A longitudinal study of environmental justice in warehousing location

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## ABSTRACT

Environmental impacts of warehousing activities have attracted increasing attention from the governments, the public and the academia. While a few studies have confirmed the cross-sectional spatial coincidence between warehousing facilities and minority population, little is known about the causal relationship behind the co-location pattern. Using data of the Los Angeles Combined Statistical Area in 2000–2010, this paper estimates a two-equation simultaneous model of the location choices of warehousing facilities and the minority population. Results show that, all else equal, changes in the percentage share of minorities significantly and positively affect the changes in warehousing activity density during the same period, but *not vice versa*. Thus, the environmental justice problem in warehousing location is found to be *solely* from the disproportionate siting of warehouses in minority-dominated areas, rather than from the movement of minority population towards warehousing. Furthermore, the variants of the model suggest that contrary to Latinos and Asians, the inflow of Blacks into a neighborhood would not lead to an increase in warehousing activities. And a neighborhood with more ethnic churning would be more likely under the pressure of warehousing expansion. The government and the public need to work together to facilitate an effective regulation of warehousing related externalities and a fair distribution of related environmental disamenities.

## 1. Introduction

With the explosion of global trade, people and firms in the world today are highly interconnected regardless of physical distance. After one clicks on the “Place Order” button at home, the items the customer just bought will possibly be sent out from a warehouse located thousands of miles away. The rise of E-commerce further stimulates the demand for goods movement and drives the proliferation of warehousing facilities. Warehouses and distribution centers (W&Ds) have been extensively developed in the major metro areas, especially in those regional trade gateways. These facilities consume large tracts of land, attract high volumes of truck movement, and greatly affect the built environment. As local residents become increasingly aware of the environmental externalities generated by logistics activities, the environmental justice (EJ) problem in warehousing location arises. Warehouses are found disproportionately located in communities dominated by minorities in a few recent quantitative studies (e.g. Yuan, 2018), but the research on this topic is still very limited, and the mechanisms behind such environmental injustice are largely unknown and untested. Longitudinal research, in particular, could help improve our understanding of environmental disparities related to warehousing location and further provide policy implications for mitigating these disparities.

Why is longitudinal analysis important? Although the literature has extensively discussed the causes of environmental inequity, more longitudinal analyses are needed to track the dynamics that result in the inequity and justify these causes, especially in the case of warehousing location. As Mohai and Saha (2015a) argued, much of the EJ research tests the existence of environmental disparities using cross-sectional data, but lacks a careful examination of the processes by which the disparities are created. Specifically, most existing studies focus on whether locally undesirable land uses (LULUs) are disproportionately located in minority or poor neighborhoods *at a certain point in time*. They nonetheless fail to show how the hypothesized socioeconomic dynamics contribute to such co-location patterns. Therefore, cross-sectional snapshots may help identify the spatial imbalance of environmental burdens, but provide no answers to the classic “which came first” question. First raised in the 1990s (Hamilton, 1993; Been, 1994), this question asks whether LULUs are sited *before* people of color or poor population reside in the same neighborhoods or *after* that. By testing the sequence of these two processes, researchers would be able to understand the behaviors of the agents involved and identify who or what social structures are responsible for the problem.

This study aims to explore how socioeconomic dynamics may result

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in the coincident relationship between warehousing facilities and minority population using longitudinal data. The Los Angeles region, where a massive growth in the logistics industry has been occurring for decades, is selected as the study area. The period of the Year 2000–2010, when globalization drove another wave of warehousing expansion, is selected as the observation period. Using the Simultaneous Equation Model, this study shows how different factors are involved in the location choices of both W&Ds and people of color, and on top of that, whether W&Ds follow people of color or vice versa. Results reveal that the disproportionate siting of warehouses in minority neighborhoods is the *only* dominant process that leads to the environmental inequity. The findings verify the existence of environmental justice problem in warehousing location, and further suggest that the disparities are more related to unregulated logistics expansion, rather than the housing choice of vulnerable population groups.

The paper is organized as follows. Section 2 contains a literature review of recent research progress on relevant topics. Section 3 covers research approach and methodology. Data is described in Section 4, results are presented and discussed in Section 5, and conclusions are included in the final section.

## 2. Literature review

### 2.1. Contradictions in longitudinal studies on environmental justice

Before examining the environmental justice problem in warehousing location, I chose to conduct a careful review of the broader literature on environmental justice to see how longitudinal studies have helped understand the problem. The literature has extensively discussed the three categories—economic, sociopolitical and racial—of explanations for environmental inequity (see review papers: Mohai et al., 2009; Mohai and Saha, 2015b). For example, the path dependence of zoning regulations (Cole and Foster, 2001), racial discrimination in the housing market (Bullard et al., 1994), or simply the low land rent (Ringquist, 2003) all possibly contribute to the spatial disparities in environmental impacts. The explanations are closely linked to multiple socioeconomic processes including firm location choice, housing location choice, community collective actions, and public policy making. These processes demonstrate why environmental burdens may be disproportionately placed in certain neighborhoods. While the spatial relationship between LULUs and different types of communities, as a status quo, has been explicitly identified in the previous studies (see Ringquist, 2005), it is nonetheless more difficult to distinguish the roles of those various socioeconomic processes when they are likely to be interdependent.

To address this endogeneity problem, researchers have more frequently used longitudinal data in the environmental justice research. Indeed, longitudinal data may be used to observe the behaviors of relevant agents in the socioeconomic processes and further justify the theoretical explanations. However, the findings in many longitudinal studies are nonetheless contradictory, suggesting the necessity to systematically evaluate the contexts, research design, and data sources in those studies. Such an evaluation is particularly helpful for developing a reliable methodology to assess the environmental disparities in warehousing activities across places.

Locally undesirable land uses impose substantial environmental impacts on host neighborhoods. The siting of LULUs is found to follow the “*path of least resistance*” and would probably end up in neighborhoods where the opposition to the siting is weak (Taylor, 1992; Bullard and Wright, 1993; Bullard, 2000). The political power to avoid LULUs is usually subject to the racial composition or the socioeconomic status, so the host communities are more likely to be low-income or minority-dominated ones (Mohai et al., 2009). The increasing environmental burden on those vulnerable communities thus may be ascribed to both the spatial expansion of environmental externalities and the disparities in political and organizational resources. As Saha and Mohai (2005)

pointed out, the behaviors of relevant agents in these dynamics including facility developers and public policy makers have been changing over time. The environmental justice patterns are therefore highly subject to the historical context of siting. For instance, the patterns of disparate siting of hazardous waste facilities in Michigan were only significant after 1970, at which time uneasiness about these facilities began to arise (Saha and Mohai, 2005).

Moreover, it could be difficult to statistically recognize environmental disparities when the siting of the LULUs is a “rare event”. Most quantitative analyses require statistical interpretation of data, and the verification of hypotheses largely relies on the statistical significance of coefficients. However, even if real disparities exist in the spatial distribution of LULUs, such disparities may not be of statistical significance when the observed siting of locally undesirable facilities is very infrequent. For example, a study of Oakes et al. (1996), among many others (e.g. Hamilton, 1993; Anderson et al., 1994; Pastor et al., 2001), examined environmental inequity related to the location of Hazardous Waste Treatment, Storage and Disposal Facilities (TSDFs). In this nationwide study, out of all 35,681 tracts, there are only 473 tracts that contain waste facilities. With over 98% of the observations receiving a value of “0” in the dependent variable (DV) of the logistics model, it is methodologically unlikely for the authors to statistically identify the existence of environmental inequity in this case.

Apart from these considerations on research contexts, researchers use diversified methods in the longitudinal studies and the various ways they understand and manipulate data may also lead to contradictory conclusions. First, statistical results are sensitive to the choice of geographic scope. Compared to the nationwide longitudinal studies, regionwide ones generally provide more support for the existence of environmental disparities (Mohai and Saha, 2015a). Why do they generate different results? Nationwide data hardly covers detailed localized factors such as zoning and land use regulations. The failure to control for these factors might undermine the validity of model estimates. Studies focusing on a single region, however, may have more methodological choices to address such problems. For example, dummies that represent detailed jurisdictional variances can help control localized factors to a large degree. Second, the estimated relationship between environmental hazards and population groups is equally subject to spatial units researchers choose for analysis. According to Mohai and Saha (2007, 2015b), the distance-based method has been increasingly prevalent, as it measures this relationship more accurately than the unit-hazard coincidence method. The distance-based method effectively accounts for all spatial units (e.g. census tract) within a certain distance to an undesirable facility, while the unit-hazard coincidence method may not sufficiently estimate the impacts of the LULU, especially when the facility is located near the boundary of the unit. Third, some of the recent studies tested both location choice hypothesis and the demographic change hypothesis, but few of them considered the interrelationship between both hypotheses. In these studies (Oakes et al., 1996; Been and Gupta, 1997; Shaikh and Loomis, 1999), the changes in the distribution of LULUs and the changes in the concentration of minority or poor population were estimated in separate models, and thus their potential mutual effects are ignored. Pastor et al. (2001), on the contrary, emphasized the necessity to account for these effects. All of these distinctions in research design contribute to the inconsistent results in the literature. Thus a carefully designed longitudinal analysis that considers the advantages and disadvantages of various research settings and methods would be helpful for clarifying the confusing contradictions.

A growing number of studies have examined the environmental threats to local population from extensive warehousing development. Widespread warehousing structures with large flat roofs can contribute to strong urban heat island effects (Voogt, 2007) and risks of storm-water runoff (Yang and Li, 2013). The frequent truck movement to and from warehouses generates substantial air pollutants (Dablanc, 2013), noise (Dong et al., 2014), and pavement damage (Cidell, 2015).

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