Research Paper

Recipes for neighborhood development: A machine learning approach toward understanding the impact of mixing in neighborhoods☆

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HIGHLIGHTS

- Study relationship of four types of mixing and income growth.
- Effect of mixing depends on other neighborhood characteristics.
- Use novel estimation technique: kernel regularized least squares.
- Racial mixing is positively associated with average income in some contexts.
- Income mixing has a negative effect in low income neighborhoods.

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ABSTRACT

Scholars of New Urbanism have suggested that mixing along various dimensions in neighborhoods (e.g., income, race/ethnicity, land use) may have positive consequences for neighborhoods, particularly for economic dynamism. A challenge for empirically assessing this hypothesis is that the impact of mixing may depend on various socio-demographic characteristics of the neighborhood and takes place in a complex fashion that cannot be appropriately handled by traditional statistical analytical approaches. We utilize a rarely used, innovative estimation technique—kernel regularized least squares—that allows for non-parametric estimation of the relationship between various neighborhood characteristics in 2000 and the change in average household income in the neighborhood from 2000 to 2010. The results demonstrate that the relationships between average income growth and both income mixing and racial/ethnic mixing are contingent upon several neighborhood socio-demographic "ingredients". For example, racial mixing is positively associated with average income over time when it occurs in neighborhoods with a high percentage of Latinos or immigrants, high population density, or high housing age mixing. Income mixing is associated with worsening average household income in neighborhoods with more poverty, unemployment, immigrants, or population density. It appears that considering the broader characteristics of the neighborhood is important for understanding economic dynamism.

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1. Introduction

There is a long-standing interest in understanding the economic dynamism of neighborhoods (Galster, Hayes, & Johnson, 2005; Temkin & Rohe, 1996). Scholars have noted that although many neighborhoods maintain relative economic stability over time as measured by the average income of residents, smaller numbers of neighborhoods either experience economic declines over time or exceptional growth. Various theories have also been proposed to explain changes in neighborhoods, particularly as measured by average resident income. Among others, recently the New Urbanism perspective has emphasized the possible positive role of mixing along various dimensions for bringing about economic dynamism (Calthorpe, 1993; Calthorpe & Fulton, 2001). Specifically, it has been suggested that mixing based on land use or building age, or mixing based on such socio-demographic characteristics of residents as income or race/ethnicity, can have positive consequences for neighborhoods (Knaap, 2005).

A significant challenge, both theoretically and empirically, for studies in the New Urbanism tradition is that mixing along various dimensions may not have uniform consequences for neighborhoods depending on the particular context. For example, it is unclear whether combining different types of mixing (such as land use mixing, income mixing, etc.) in the same neighborhood will have similar consequences as when just one of these dimensions of mixing is present. Some language in the New Urbanism literature implies that there may be synergistic qualities from combining different types of mixing (Knaap, 2005; Roberts, 2007), however, some studies have found cautionary evidence calling this into question (Chapple & Jacobus, 2009). Furthermore, mixing based on various dimensions may have different consequences for the neighborhood depending on the socio-economic context, or the socio-demographic context. Certain dimensions of mixing may negatively impact economic dynamism when they occur in economically challenged neighborhoods.

The possibility that the impact of mixing on economic dynamism in a neighborhood can be moderated (or amplified) by various contextual factors or other dimensions of mixing has received limited empirical assessment in the literature, arguably because of the methodological difficulty of addressing such a question. These possible moderating effects on the effects of mixing imply the need for an analysis that includes a large number of multiplicative interactions when adopting the traditional modeling strategy. We instead address these questions with an existing machine learning technique that we argue is perfectly suited to these research questions. The Kernel Regularized Least Squares (KRLS) estimation approach, described in more detail below, allows us to flexibly assess nonlinear moderating effects among our variables of interest. We can assess whether the relationship between four dimensions of mixing – income, racial/ethnic, housing age, and land use – and average income appreciation in neighborhoods exhibit nonlinear interaction patterns. We next describe theories of neighborhood change, particularly focusing on the importance of mixing along various dimensions for economic dynamism.

2. Literature review

2.1. Theories explaining neighborhood change

A body of literature has explored how neighborhoods change over time, specifically how they change regarding their socio-economic resources. Whereas early research focused on human ecology theory in which neighborhoods operate in a larger system (Park, Burgess, & McKenzie, 1925), later research turned to subcultural theory which argued for important non-economic factors in neighborhoods (Pitken, 2001). In the 1970s the political economy approach gained in prominence and focused directly on the social relations of production and accumulation in which elites drove the economic processes (Molotch, 1976). Studies have empirically explored the relationship between various neighborhood characteristics and change in neighborhood income (Ellen and O'Regan, 2008; Jun 2016; Rosenthal, 2008).

More recently, there has been a rise in a perspective broadly characterized as New Urbanism. The New Urbanism perspective can be traced to the founding of the Congress for the New Urbanism in 1993 by a group of architects and planners (Leccese & McCormick, 1999). New Urbanist design theory focuses on creating neighborhoods and cities that foster a "sense of community" by organizing neighborhoods with diversity in use and population (Talen 1999; Talen, 2013). A primary design element of New Urbanism is high density, mixed use development to create vibrant public spaces (Calthorpe, 1993; Calthorpe & Fulton, 2001). A challenge is that density can come in different forms (Campoli, 2012; Campoli &

MacLean, 2007). In particular, mixing land uses, such as "jobs, housing, and food outlets, cross walks, bike racks" (Campoli, 2012) has been advocated as an effective means to promote social interaction and neighborhood vibrancy, and thus scholars have concluded that communities with a high density of population *and* a mix of land uses can help bring about this vibrancy. This implies considering the simultaneous impact of different types of mixing, an issue to which we turn next.

2.2. How mixing can help neighborhood dynamism

The desire for and emphasis on mixed neighborhoods, arguably, was born from the failure of public housing projects and the thinking that mixing might help the recipients of public housing (overwhelmingly low-income, poorly-educated urban minorities) to avoid the pitfalls of concentrated poverty and socioeconomic disadvantage. Socioeconomic mixing – particularly along income lines – is thought to promote social and economic integration as well as increased opportunities for low-income residents (Wilson, 1987). The positive idea of mixing is also linked to the more recent demographic trend of urban inversion and downtown renewal, whereby larger populations (most notably young adults or retirees) are moving "back" to central city neighborhoods (Ehrenhalt, 2012).

There is evidence that mixing income of residents may have positive consequences for neighborhoods. A body of research has focused on how mixed income areas can have various positive consequences for the lower income households living in such neighborhoods, including possible improved social networks for job contacts leading to better employment outcomes, mental health benefits, increased self-esteem, and behavioral and health improvements for children (for a review of this literature see Levy, McDade, & Dumlao, 2010). There are also proposed advantages for the neighborhood as a whole, including improved social control to address safety issues given that higher income residents might provide particular norms to increase safety (Fraser & Nelson, 2008) or economic advantages by increasing market demand for higher-quality goods and services that can then be enjoyed by all residents (Levy, McDade, & Dumlao, 2010). Nonetheless, there is also a possible long-term side effect in which income mixing brings about gentrification, which then can lead to increased income segregation over time, as was found in a study of rural settings (Golding, 2015).

The mixing of land uses, namely the accessibility of workplaces, schools, retail, and other services to residential areas follows a similarly-renewed emphasis on walkability. Much of this comes from the New Urbanist and Smart Growth movements that began in earnest during the 1990s (Knaap, 2005). A mixing of land uses can increase social interaction and decrease the need for long-distance transportation and thus cut carbon emissions. By putting jobs and housing close to each other, mixing land uses can also lead to better job outcomes, and hence economic dynamism; indeed, a study of Chicago found that a greater number of jobs within two miles of neighborhoods led to lower unemployment rates for residents (Immergluck, 1998).

Mixing is also related to gentrification, or the inflow of capital into a neighborhood. While increasing property values and vibrant communities are generally seen as positive outcomes, gentrification can also displace an area's original resident – and business – populations, raising the question of who is the recipient of neighborhood improvements (Newman & Wyly, 2006). Some believe social mixing policies to be veiled attempts at gentrification with minimal impact on upward mobility of struggling communities (Bridge, Butler, & Lees, 2012). Thus, although we will focus on average income appreciation in neighborhoods in this study, a caution to be heeded in all such studies is that it sidesteps the question of residential displacement. Similar to land-use mixing, urbanist