



# Transit investments and neighborhood change: On the likelihood of change

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## ABSTRACT

This paper is focused on the identification of, and the dynamics associated with, neighborhoods that are more prone to undergo socioeconomic and demographic changes following rail transit investments. Utilizing data from 9 metropolitan areas that have invested in light rail between 1980 and 2010, a *k*-means clustering approach is used to construct discrete multivariate neighborhood typologies. Together with Markov chains, we are able to examine transitions between neighborhood types before and after the opening of a station. Results for affected neighborhoods are compared to city-wide transitions to uncover differences. Our findings suggest that there is a significant difference in transit and non-transit neighborhood transitions. There also appears to be a difference in trajectories between Walk-and-Ride and Park-and-Ride neighborhoods. While neighborhoods are largely stable over time, impoverished neighborhoods are most likely to experience changes (such as gentrification) following the opening of a transit station. The most affluent neighborhoods are the least likely to experience change but are associated with the most probable trajectory of change featuring densification. Finally, there is little evidence that socioeconomic ascent following station openings is associated with significant changes in racial composition. Knowledge about neighborhood dynamics associated with transit investments can aid policy makers and planners in achieving socioeconomic goals of transit investments.

## 1. Introduction

Public transportation offers the promise of linking low-income residents with employment, social services, and other opportunities that may increase their likelihood of moving up the socio-economic ladder. Increasingly, the social goals of providing mobility for the auto-less have arguably taken a back seat to economic goals associated with transit investments such as spurring development or revitalizing declining urban areas (Bernick and Cervero, 1997; Grengs, 2005). This is particularly true in the case of rail stops utilizing a Transit-Oriented Development (TOD) strategy. TODs blend high density, mixed-use, and pedestrian friendly land uses around transit stations. Academics and planners formally conceptualized TOD in the late 1980s, however, the implementation and construction of TOD projects was initially slow (Loukaitou-Sideris, 2010). Since the turn of the twenty-first century, the number of TODs across the country has risen in tandem with a rise in overall investments in rail transit infrastructure (Loukaitou-Sideris, 2010; Rayle, 2014; Zuk et al., 2015). According to a classification of all fixed-rail transit stations in the United States based on density and walkability surrounding stations, Renne and Ewing (2013) estimated that close to 33% of all stations nationwide were considered transit-oriented with the remaining stations classified as either hybrid (meeting some density or walkability criteria) or transit-adjacent.

The two objectives of linking low-income residents with urban opportunities and simultaneously fostering economic development can be viewed as competing, or, even mutually exclusive. As an urban area revitalizes, existing low-income residents may move out because of rising rents, in response to its changing social fabric, and/or the residents' preference for public goods (Pollack et al., 2010; TCRP, 2004; Tiebout, 1956). This potential disparity has spurred some resistance to transit plans, especially TODs, for fears of the potential displacement effects associated with revitalization (Rayle, 2014).

While debates over transit plans and their potential unintended consequences are currently unfolding across urban areas, there remain a number of unanswered questions that are key to this discussion. For example, how probable is neighborhood-scale revitalization in areas following the construction of transit stations? Besides gentrification, what other types of changes are expected in neighborhoods around transit stations and which types of neighborhoods are most prone to these changes? How do neighborhood dynamics differ around stations characterized as transit-oriented as compared to non-TOD stations, and how do they differ across metropolitan areas? While a rather large literature has been devoted to the analysis of property values surrounding transit investments (see Debrezion et al., 2007 and Mohammad et al., 2013 for reviews), there is less of a consensus on how neighborhoods change according to a more comprehensive bundle of

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attributes describing their socioeconomic, demographic, and housing characteristics. The purpose of this article is to differentiate the types of changes that occur to a neighborhood's multivariate complexion, of which gentrification represents one potential pathway. In this sense, our focus is broader and complementary to those seeking to establish a link between transit and gentrification specifically (*i.e.*, Baker and Lee, 2017; Dong, 2017; Grube-Cavers and Patterson, 2015).

To study these temporal patterns, we combine a *k*-means clustering approach to construct discrete multivariate neighborhood typologies of neighborhoods with Markov chains to examine transitions between classes. First, neighborhoods (proxied by census tracts) are clustered into a set of classes at each time period based on their socioeconomic, demographic and housing characteristics. Second, we estimate transition probabilities to identify which types of neighborhoods near transit stations are more likely to change class and what class they are most likely to change into. Third, we compare these results to transition patterns among all other neighborhoods in each city to determine if neighborhood dynamics differ around transit stations as compared to the rest of the metropolitan area. Finally, we examine changes in the racial and ethnic makeup of neighborhoods that have undergone socioeconomic ascent. We perform our analysis on nine cities across the United States that constructed or extended light rail lines between 1980 and 2010.

The results of our analysis demonstrate that: (1) for all types of neighborhoods, the probability of changing classes following the construction of a transit station is low; (2) impoverished neighborhoods are most likely to follow a pathway of change featuring increases in aggregate educational attainment and home values coupled with decreases in median age and an influx of recent in-movers and multifamily housing; (3) while the most affluent, single-family neighborhoods are largely resilient to changes in their character following any type of transit station placement, their most probable trajectory of change features an increase in multifamily housing; (4) overall, compared to city-wide dynamics, all neighborhood types around transit stations have a heightened probability transitioning into a class characterized by a high share of multi-family housing, renters, few children, and a relatively high share of college-educated residents; (5) while not being able to determine the difference statistically, there appears to be a difference in transition patterns between TOD and Park-and-Ride neighborhoods; and (6) neighborhoods undergoing socioeconomic ascent do not experience dramatic racial and ethnic changes.

Our findings contribute to the current literature by increasing our understanding of what types of neighborhoods are more likely to experience socioeconomic and demographic change following transit investments, and what kind of changes they undergo (*i.e.*, changes along a wide range of variables). Knowledge about what neighborhoods are more susceptible to changes can aid policy makers and planners in achieving socioeconomic goals associated with transit investments.

The remaining structure of the paper is as follows. Section 2 reviews the relevant literature on transit investments and neighborhood change. The study area, data, and methodology are discussed in Section 3; results in Section 4, and Section 5 concludes.

## 2. The role of transit investments in neighborhood change

While the majority of the gentrification literature has focused on the private sector's role in neighborhood transformation, the public sector is also an important actor in neighborhood improvement. By investing in physical infrastructure projects such as rail transit, schools, parks and highways, governments at various levels have the potential to change the socioeconomic and demographic makeup of neighborhoods (Zuk et al., 2015).

Public transit offers the promise of linking low-income residents with employment, social services, and other opportunities (Pendall et al., 2014). However, investments in public transit (particularly rail transit) are also often associated with goals of reversing

decentralization trends (“smart growth”) and supporting the revitalization and growth of cities (Giuliano and Agarwal, 2010). Together with TOD, such rail transit investments have become a popular urban redevelopment strategy to revitalize declining urban areas around the placement of transit stops (Bernick and Cervero, 1997; Rayle, 2014; Zuk et al., 2015). Light rail transit (LRT), in particular, has become increasingly popular as it accommodates a range of environments (*e.g.*, streets, freeway medians, railroad rights-of-way, underground, aerial structures, *etc.*), a characteristic that makes it less costly to build and operate than other rail modes (TRB, 2000). In fact, the majority of LRT systems in the U.S. began operations after 1980 with several billions of dollars spent on construction of new rail transit by local and federal governments (Billings, 2011; Kahn, 2007).

Accessibility is the main amenity associated with neighborhoods that have rail transit. While there are also a number of disamenities associated with rail transit (*e.g.*, nuisances from the actual operation, parking congestion from riders and greater opportunity for crime), researchers argue that these accessibility benefits (of living near transit) outweigh potential nuisance effects (Billings, 2011; Wardrip, 2011). Theoretically, as the attractiveness of neighborhoods increases with the amenities that rail stations and transit oriented development provide, demand increases and through a bidding process property and land values increase (Debrezion et al., 2007). Hence, one should expect to see property values increase with the introduction of rail transit access. Public choice theory predicts that as the provision of public goods changes, there will be a sorting of households across communities according to their willingness and ability to pay for these public goods which ultimately results in residential segregation by characteristics associated with the demand for public goods (*e.g.*, income, socioeconomic status and number of children) (Corcoran, 2014; Tiebout, 1956). Therefore, in conjunction with rising property values, we should expect to see changes in the sorting of residents according to their economic characteristics and ability to pay for the increased demand associated with rail transit. Empirical studies on residential movements into gentrifying neighborhoods more broadly have shown that in-movers tend to be of a higher socioeconomic status than existing residents (McKinnish et al., 2010). Beyond impacting the socioeconomic characteristics of neighborhood residents, the demand for transit and transit-oriented development may serve to attract residents of a particular demographic profile, reflecting a preference for transit usage and/or higher density dwellings. In particular, families with children are less likely to reside in TODs than single or child-less couples (Cervero, 2007). Racial or ethnic differences in transit preference may also exist owing to cultural variations in travel preferences. Asian-Americans and Hispanics have also been shown to be more drawn to rail neighborhoods (Cervero, 2007).

While there is a large literature focused on the impact of transit investments on property values (which is highly linked to the socioeconomic status of residents), comparatively few studies have looked at the impact of transit on a broader set of neighborhood socioeconomic and demographic characteristics (Debrezion et al., 2007; Zuk et al., 2015). Some studies that have explored these types of changes have uncovered increases in neighborhood-level income, educational attainment, and housing prices, or those indicators most typically associated with gentrification (Pollack et al., 2010; Kahn, 2007; McKenzie, 2015; Deka, 2016). Kahn (2007) found heterogeneous effects within and across cities resulting from the introduction of new transit stations. While TOD stations were more likely to cause increases in average home prices and the share of college graduates, Park-and-Ride stations were often associated with price declines. In some cities, he found no instances of gentrification. Baker and Lee (2017) reached a similar conclusion, that while gentrification and TOD effects were prevalent in some cities, such as San Francisco and Denver, other cities, including Portland, Los Angeles, and Buffalo saw counter gentrification trends including increases in poverty and a decline in the share of educated residents. The lack of gentrification along light rail lines in Portland was

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