Neighborhood Change after Investment in Light-rail Transit (LRT)

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Abstract

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Recent decades saw renewed interest in alternatives to automobiles from both citizens and policymakers alike, with new investments in light-rail and other transit following as a result. While a growing literature outlines housing appreciation that investments may exogenously induce, no study has yet identified if projects impact the demographic composition of households in nearby neighborhoods. This research takes Seattle's LightLinkRail as a case study with which to describe the trajectories of newly transit-rich neighborhoods and test if the light-rail system's construction altered demographic trends. Using difference-in-difference analysis, models of pre- and post-treatment rates of change suggest a negative treatment effect for the population of black residents after the transit line opened. However, the only notable factor for trends in the proportion of white residents was time (i.e. all sample cases saw upticks in their trend relative to their pre-treatment levels).

As a natural unit of social interaction, neighborhoods provide insight into the social processes through which individuals' lives can bear significant differences based on the socioeconomic, demographic or environmental composition of the place itself. The overall vitality of a neighborhood relates to the population of residents as well as factors like crime and geographic location, and as parts within a greater city or metropolitan area, neighborhoods also operate in relation to each other and actions at higher levels of governance. Public decisions regarding infrastructure or housing "play out" in this more localized context, e.g. designating where new public housing or park funding ought to go, or deciding what neighborhoods a transit corridor should run through. Although the state may not explicitly be acting to influence neighborhood composition through investment, indirect effects via housing supply and demand imply that a given project's impact is not totally independent of its neighborhood context.

A renewed demand for public transportation in American cities generated a handful of light-rail transit projects, funded by a mix of Federal, state and local dollars. Usually, local leaders promote these substantial capital outlays by highlighting how projects provide an opportunity to revitalize neighborhoods, reduce traffic congestion and promote access to opportunity. The aforementioned rationales demonstrate how the scope of transit investments rarely concerns transportation alone, with new transit instead acting as anchors onto which growing "urban villages" (as the city of Seattle calls them, for example) might develop. On the one hand, new and expedited access to the central business district (CBD) might itself make neighborhoods receiving new transit more desirable to potential movers. Although this perspective helps explain how public investment in transit alters the distribution of demand for particular neighborhoods, the role of transit as a magnet for new development requires giving consideration to how the housing supply might also change accordingly. Taken together, both factors speak to how investment in infrastructure may induce changes to the population of residents in a newly transit-rich neighborhood. If such investments proceed through previously disinvested neighborhoods, then a concomitant change in the housing market in favor of mobility to these places might manifest itself in higher housing prices and rents.

Investment into neighborhoods with lacking infrastructure unquestionably brings much needed

capital for both residents to utilize directly and for businesses and organizations to benefit from indirectly. In considering these consequences alone, public investments in transit would seem to be a boon to all potential riders in affected neighborhoods, and for all others simply a nuisance during construction. However, studies of previous transit investments and suburbanization note the racially disparate benefits that these state interventions in housing and transit yielded, in addition to new purely-economic justifications for racial segregation that widespread homeownership among whites facilitated (Jackson 1987, Freund 2010). This history of entrenched racial stratification as a function or byproduct of state policy justifies a discussion of whether more recent transit projects do in fact bring racially equitable benefit. Although modern transit investments certainly dispose of the patently racist intentions of previous eras, the persistent disadvantages that racial minorities face in housing markets means that the absence of a state policy to keep housing affordable or neighborhoods integrated constitutes a tacit policy of being ”hands off” in spite of the noted history of interaction between transit policy and neighborhood trajectories.

Although previously-disinvested neighborhoods need capital projects to help restore economic activity and fight the byproducts of disinvestment like crime and poverty, the very process of revitalization might sustain racial neighborhood inequalities if long-time residents move out in only to be replaced by more affluent, largely white residents. Extant studies document the association of modern transit investments with rising property values and broader socioeconomic change, but none identify whether investment also impacts neighborhood racial composition as a consequence (e.g. Lin 2002, Grube-Cavers and Patterson 2014). If projects attend to the housing market dynamics of new public transit investments, shared desirability of new transit across across race and ethnicity implies the potential for cities to create durably integrated, resource-rich communities. Conversely, if a project alters trajectories of neighborhood change such that fewer black residents and greater shares of white residents live in neighborhoods near rail transit corridors, then eventually these places might solidify as mostly-white in spite of their previously integrated composition. Overwhelmingly white and increasingly expensive neighborhoods might yield changes for the city-wide measures of residential segregation even, and the possibility of relocation of African-

Americans to the suburbs potentially puts these households in areas with less availability of transit access, city services and resources (cf. McKenzie 2013, Allard and Roth 2010). Using this framework for the rest of the paper, I explain how transit outlays (which for the present paper will mean light-rail) can prompt demographic change by measuring the impact of one such project on its proximate neighborhoods' racial composition. As a whole, this research finds continued significance for transportation in shaping the composition of neighborhoods and the growth of cities.

THEORETICAL AND EMPIRICAL BACKGROUND

The literature investigating the effects of transit investment on neighborhoods remains limited, but a handful of studies observe a positive association between project construction and housing value appreciation (Bajic 1983, Lin 2002). Specifically, this research finds that gentrification (measured in terms of housing value) was more common when network access offered connections beyond the direct periphery of the line, and also that the induced change started around stations and diffused outward. Ultimately, the results demonstrate how modern public investments in transit can alter market trends in nearby residential areas, though the authors' operationalization of gentrification possesses a narrow definition. Discussions of this concept typically concern more than housing values alone, and the socially and politically charged connotation this idea carries seemingly follows from the implications for displacement more than for housing appreciation in and of itself.

A descriptive study of demographic change in so-called newly transit-rich neighborhoods observed some differences in nearby neighborhoods minority populations (compared to the overall city's composition), but stopped short of empirically testing their relationship to the transit project (Pollack, Bluestone, and Billingham 2010). Additionally, an analysis of transit-related gentrification in Toronto and Montreal found evidence of significant socioeconomic change in neighborhoods' proximity to new fixed-rail train lines (Grube-Cavers and Patterson 2014). No study heretofore, however, has considered the intersection of race and class when assessing the impacts of transportation investment on neighborhoods. The inherent complexity of studying gentrification, both theoretically and methodologically, makes this gap understandable. However, this specific litera-

ture and studies of neighborhoods more generally would benefit from clarifying how these projects might change not only the socioeconomic status but also the diversity of communities nearby.

Although light-rail investment may proceed through racially homogenous neighborhoods in some cases, transit lines operate through central city corridors and historically, central city neighborhoods possess more heterogenous populations. This informal observation suggests that race might be a significant dimension in relation to the outcomes these scholars point to. Indeed, historical commentary on the suburbanization of housing capital and the middle-class notes that transportation investments had a prominent role in creating and sustaining racial differences in neighborhood quality between central city and suburban neighborhoods, so precedent also supports this reasoning (Jackson 1987). Electric streetcars and highways alike became impeti for housing development catering to affluent (and later, middle-class) white households' new preferences for riding to work and living outside the city. Decades of investment in transportation modes facilitating outward mobility to less dense and greener suburbs prompted stagnation and disinvestment in many urban neighborhoods' built environment. Even in a housing market where equal opportunity is now the stated rule, the interplay of transportation and housing capital may bring more than just the promised "revitalization" if less affordable housing replaces an the old housing stock or demand puts pressure on residents through rising rent. A sudden investment back into neighborhoods previously glossed over by capital will render positive effects in terms of amenities, but may also have further reaching effects on the housing market and neighborhood composition if private investment seizes upon affluent households' new demand for housing in these places in particular.

Studies of neighborhood demographic trajectories date back to the earliest authors of the Chicago School who observed the non-random distribution of social groups into particular neighborhoods throughout the city. This foundational contribution shed light on how patterns of residential mobility shape urban change and social structure within a metropolis in a partially, and many times very, systematic fashion (Park and Burgess 1925; Shaw and McKay 1942). Even in these early studies, the role of transportation in urban social structure was noted: neighborhoods around railways and industrial centers appeared to be structurally different than bedroom neighborhoods, given their

higher prevalence of poverty and crime as well as larger concentrations of immigrant households. While some scholars consequently focus on the differential outcomes that neighborhood structural conditions like concentrated poverty or racial residential segregation produce—finding differences related to risks and opportunities for crime, cultural norms and even gender expectations—others describe how differences in neighborhood social structure formed and then crystallized, particularly in the American case, racial and economic stratification according to place (Matsueda, Kreager, and Huizinga 2006; Anderson 2000; Jones 2009). With special attention to the dimension of racial segregation, authors like William Julius Wilson find that the "neighborhood effects" detailed above follow fault lines created by broader processes of economic change and urban growth (Wilson 2011). Through the greater crime, poverty and continued social marginalization that disinvestment and isolation entails, this literature suggests a consonant theme: "place matters".

Massey and Denton's now-classic *American Apartheid* documented how the consequent evolution of American cities throughout most of the 20th century differed dramatically by race: suburbanization granted millions of white Americans access to homeownership and quality neighborhoods, and left blacks largely isolated and segregated in urban cores (Massey and Denton 1993). Although more recent studies observe that levels of segregation declined from their high levels in the mid-to-late 20th century, the admittedly slow rate of change implies that residential segregation and neighborhood inequality will likely remain a salient issue for at least another half century (Logan 2013, Vigdor 2013). More substantial declines in segregation of blacks from non-blacks, as documented by Vigdor and colleagues, mean that isolation of African-Americans from *all* other groups significantly improved in recent decades; however, the alternative use of Black-White dissimilarity and P-Star indices by Logan cautions against optimism as these measures show only minor change or no difference between 1980 and 2010 (ibid). Disagreement also prevails regarding proximate factors to the recent decline in residential segregation, with internal migration to the Sun Belt, "global neighborhoods" with integrated racial and ethnic groups, Civil Rights Era homeownership legislation and gentrification-related mobility of whites all as offered as at least partial explanations (ibid).

The interaction of residential preferences and state homeownership policies contributed significantly to the overall trends discussed above, i.e. both the creation of residential segregation and its more recent softening. Regarding neighborhood preferences, research finds support for integrated places among blacks, while whites favor predominantly-white neighborhoods on average (Krysan et al. 2009). The more recent trend in some younger, upwardly-mobile whites moving ”back to the city” suggests that favorability for integrated neighborhoods is growing at least among some whites—even if claims of gentrification related to these individuals generally follow these individuals' arrivals (Lees, Slater, and Wyly 2013). Other theorized preferences among these individuals are access to the urban core and proximity to vibrant arts and culture (Zukin 1987). Relevant to the present discussion, the literature on gentrification suggests that this demographic group would be particularly motivated to move to newly rail-accessible neighborhoods. Despite transportation investments traditionally serving to open up more distal suburban areas for housing capital, the implication of new preferences for urban living by some individuals and families suggests LRT projects partially invert this logic.

Although post-Civil Rights Era housing policy like the 1968 Fair Housing Act may have contributed some to declines in segregation, the opposite role that ”redlining” and discriminatory zoning had in creating such segregated cities and contributing to racial disparities in wealth looms large (Meyer 2001). These policies facilitated the selective mobility of whites through improved access to credit, enabled outward mobility of housing capital and eventually employment, and contributed to the phenomenon of ”white flight” discussed frequently in residential attainment literature (Charles 2003, Crowder 2000). In some respect, the implications of whites' preference for white neighborhoods and these policies align with the so-called *political economy of place* described by Logan and Molotch in their classic treatment of urban politics and growth (Logan and Molotch 2007). Given homeowners' general pursuit of maximum use and exchange value even at the cost of others (i.e. amenities and property value, in other words) and capital investors' motivations for continued profit, opposing forces like real estate ”blockbusting” and discriminatory housing covenants served to simultaneously spur white mobility outward for new home construction while

at the same time re-constituting the benefits of capital investment on a smaller, racially exclusive neighborhood within the suburbs (Logan and Molotch 2007, Freund 2010). These factors reified the differences in resources and location generally observed between white and black neighborhoods that some authors conceptualize as the *racial-spatial divide* (Peterson and Krivo 2010).

Although the dynamics of neighborhood investment have no doubt shifted towards consideration of equal opportunity for all (e.g. grant funding rubrics giving additional consideration to projects aiming to help minorities), the effect of prior eras of state policy still manifests itself through the persistent disinvestment that many central city neighborhoods face in their housing stock and employment centers. Perhaps due to this very lack of capital investment, a typology of gentrifying neighborhoods includes government intervention as a "likely process of ascent" by which minority urban neighborhoods might follow a course of neighborhood change (Owens 2012). The potential for housing investment facilitated by transit infrastructure, therefore, provides an opportunity for rectifying racial neighborhood inequalities while simultaneously putting the same areas at risk for intensified competition over newly desirable yet still relatively affordable property. A survey of residential preferences for redeveloped neighborhoods found that African Americans favored these places significantly more than whites and Latinos, and also that their most commonly reported reasons for wanting to live in such neighborhoods were city services, affordable housing and racial mix (Bader 2011). The literature altogether indicates that African-Americans and young white professionals alike should favor living in the redeveloped neighborhoods created by "transit-oriented development"—perhaps, if and only if, the housing remains affordable and the neighborhood composition integrated.

The present research takes demographic change as one lens through which to measure the effect of transportation investment on neighborhood change, using Seattle's LightLinkRail project as a case study towards that end. The purpose of this research is two-fold: 1.) to describe the residential composition associated with neighborhoods selected for investment (i.e. receiving a new train stop); 2.) to estimate the "treatment effect" of the transit project on nearby neighborhoods' trajectories in years following its inauguration. Although other dimensions like on crime or social

organization might change in response as well, this study privileges population change as the outcome most fundamental to the concept of neighborhood change. Importantly, the analytical design gives due consideration to what trajectory "treated" neighborhoods might have followed, if not for the rail project (i.e. the counterfactual).

Using descriptive statistics as well as two difference-in-difference models to estimate the "treatment" effect, this study provides evidence of the types of neighborhoods that became newly-transit rich, and how neighborhood trajectories changed post-investment. Since the residential composition of South Seattle and the Rainier Valley differ from the mostly-white neighborhoods the characterize most of the city, I first describe the average compositions of both the treatment and control groups before and after treatment to contextualize what trends generally affected these areas in between the end points of the study's temporal span. The remainder of the analyses model pre- and post-construction rates of change in proportion black and proportion white to estimate the *average treatment effect on the treated* (alternatively, ATT) of the LRT project on neighborhood trajectories. The models parameterize the variance of the data in order to identify what factors contributed to the considerable heterogeneity in outcomes observed between the transit line's termini. Cumulatively, this research proceeded with the hypothesis that light-rail investment associated with a negative impact on the rate of change in terms of proportion black, but positive impacts on trends in proportion white.

DATA AND METHODS

The data employed for analyzing neighborhood change were a combination of decennial Census data from 1990, 2000 and 2010 along with the most recent American Community Survey 5-year estimates covering 2009-2014, all standardized to 2010 TIGER lines (1990 data provided by Geolytics, 2000 and 2010 via NHGIS[1] and ACS data directly from the Census Bureau). Using blockgroups as the unit of analysis and as an approximation of a neighborhood, a sample of all King County blockgroups was reduced to only cases within the Seattle-Tukwila-SeaTac area (i.e. the three cities through which LightLinkRail runs). In comparison with the rest of the Seattle, the

neighborhoods through which the light-rail project travels have larger shares of racial minorities, a lower median income and lower median home value (ACS 2009-2014). Due to their demographic and socioeconomic dissimilarity from neighborhoods affected by the investment and the Southern region of the city more generally, North Seattle cases were removed from the sample. These clipped cases tended to have larger shares of white residents and more affluent households compared to South and West Seattle, meaning that their pre-treatment trajectories likely differ. Overall, the sample used for this analysis consists of two time periods each with 340 cases, resulting in a grand total of 680 observations.

Excluding North Seattle neighborhoods due to their dissimilarity implies a smaller sample size for testing effects, so the study proceeded with a restricted definition of light-rail investment "treatment". The fixed effect for the investment includes blockgroups whose centroids were within a quarter mile of a LRT station. Although this decision means that the models assume the effect of transit investment was isolated to just those locations immediately next to stations, the limited time frame with which a response is being measured within suggests that any effects will be concentrated around the stations. Using the next most proximate neighborhoods to stops as the control group approximates the treated cases' counterfactual conservatively, if anything, since any transit-related change in these control neighborhoods within the studies' timeframe would effectively dampen the estimated treatment effect. Important to the assumptions of difference-in-difference models, the use of a geographically-restricted sample and the aforementioned operationalization of treatment ensures that the study groups have approximately equal trends prior to the point of investment. Moreover, the small literature on housing change after transit investment finds that stations are the epicenters from which value appreciation flows, an observation which supports the present definition of what places might change within the first 5 years of opening (Lin 2002). While neighborhood change might extend such that the present definitions of "treatment" and "control" bleed together over time, measuring more diffuse impacts from light-rail will require expanding the sample and alternative methods for teasing out this effect.

The following models assume normally distributed variation to obtain the difference-in-difference

estimator (DD) for the average treatment effect on the treated (ATT) on neighborhood trajectories in proportion black and proportion white. Anticipating that the data would not meet the OLS assumption of homoskedastic errors, these models specify variance for each case according to a vector of covariates $\mathbf{z_i}$. Because of this additional parameterization, I used maximum likelihood estimation to estimate two heteroskedastic-normal models specified according to the following formulae:

$$y_i \sim f_{\mathcal{N}(\mu_i, \sigma_i^2)}$$

$$\mu_i = \mathbf{x_i}\beta$$

$$\sigma_i^2 = \exp(\mathbf{z_i}\gamma)$$

The outcome y_i measures either annualized rate of change in proportion black or proportion white, while vectors of covariates $\mathbf{x_i}$, $\mathbf{z_i}$ explain association with the mean and variance of the outcome through their respective coefficients in terms of β and γ. In addition to the standard DD fixed effects parameters for $time$, $treatment$ and the interaction of these covariates ($time \times treatment$), the vector $\mathbf{x_i}$ includes a dummy variable for blockgroups in Seattle, since the effects of neighborhood change should be more pronounced for cases within the primary urban area according to general theory about "back to the city" mobility. These covariates constitute the parameters for isolating the average differences between groups, with the DD estimator (the interaction of $time$ and $treatment$) capturing the average treatment effect of light-rail investment in each model. The vector of variance parameters $\mathbf{z_i}$ includes a fixed effect for the stop a given blockgroup is closest to, as well as a measure of proportion black from 1990. The stop-specific fixed effects for the variance follow from the expectation that the stations closest to the city will experience the most uniform trends while distal stations will have more variation, and places with greater heterogeneity before investment hypothetically might experience less consistent effects than those with compositions around the average.

RESULTS

Figure 1 depicts the rates of change post-treatment between neighborhoods proximate to light-rail stations and more distant ones, with greater magnitudes of change clustered around some stations—particularly in neighborhoods around the middle of the transit line. This map provides descriptive evidence that treated neighborhoods may have followed different trajectories than otherwise-similar nearby neighborhoods. Towards the southern end of the line, there appear to be a greater share of neighborhoods with increases in their black population in the post-treatment period, suggesting that distance from the city center associated with more heterogeneity in trajectories. This observation fits with existing literature which finds proximity to the urban core to be a factor in determining which areas' housing values appreciate after transit investment (Lin 2002). Of the sample neighborhoods located outside of Seattle (proximate to the last two stops), the average post-treatment rate for proportion black was roughly $.5\frac{\%}{yr}$. While these observations are purely descriptive, they suggest a potential movement of black residents outward to Seattle's neighboring suburbs (Tukwila and SeaTac).

[Figure 1 about here]

Table 1 describes the study groups across four dimensions relevant to neighborhood change—total population, proportion black, proportion white and proportion owner-occupied housing. Notably, both groups experienced pretty substantial average increases in their total population throughout the analyses' time horizon, in addition to experiencing moderate changes in their proportion black. The evidence in terms of proportion white indicates modest decreases in the average composition and heterogeneity among both groups. Overall, these neighborhoods have a greater average proportion of black residents relative to Seattle's overall population (7.3% according to the 2010-2014 ACS), with some cases majority Black across the temporal span. While the proportion of owner-occupied households remained fixed for control cases, the treatment group saw a modest

increase.

[Table 1 about here]

Estimated beta and gamma coefficients for the models of annual change in proportion white and black are detailed in Table 2. Estimates from Model 1 describe the difference-in-difference analysis using annual change in proportion white as the outcome. Notably, the only covariate associated with an average difference in trajectory was the linear term for time, meaning that all cases in the post-treatment period had upticks in annual change in their proportion white relative to pre-treatment. However, the lack of difference between treatment and control groups in either time period suggests this change in trajectory for proportion white occurred not as a geographically-confined treatment effect, but rather as a general phenomena throughout the study area.

[Table 2 about here]

For yearly neighborhood change in proportion black, Model 2 indicates treated blockgroups experienced a modest difference in trajectory ($-0.005/yr$, alternatively, $-.5\frac{\%}{yr}$) after light-rail inauguration. For a hypothetical neighborhood with a black composition around 20% (the pre-treatment average for treated cases), the difference-in-difference analysis predicts the average treatment effect of receiving transit constitutes about a 2.5% year-over-year change relative to pre-treatment composition. Since all Seattle blockgroups independently experienced about the same magnitude of change compared to those outside the city, treated neighborhoods in the city had the greatest average change in their trends for black neighborhood composition according to these estimates.

In terms of variance, it is first worth noting that the stations are listed in the table from most proximate to the city center to those most distant. The central-city terminus (Westlake Station) from inauguration until just recently is the reference group for the closest-stop covariate. According to

both models, there were significant effects for some stops—particularly those further away from the city center—producing additional variation in outcomes. In other words, as distance increases from the CBD, the point estimates for mean differences characterize a wider variety possible trajectories (static and even positive in some cases). For reference, estimates from Google Maps indicate that a ride from the southern terminus at SeaTac Airport takes about 40 minutes to reach the CBD, while trips from Mount Baker (the median stop) take 15 minutes. With about a 5% year-over-year change expected for treated Seattle neighborhoods (relative to pre-treatment levels) and greater heterogeneity in trends for those more distant, these results suggest a divergent path for treated neighborhoods' black populations based on proximity (and likely, consequent desirability) for would-be transit commuters to the urban core. These variance covariate estimates fit with the descriptive evidence of greater heterogeneity associated with distance shown above in Figure 1.

The relevance of 1990 measure of black composition for the variance estimate in both models means that starting composition did influence the range predicted demographic outcomes, such that places with the greatest proportion of African-Americans also have a wider range of possible trends post-treatment. This observation suggests that solidly-black neighborhoods did not experience as consistent of a treatment effect than those with relatively integrated composition before investment took place. Altogether, the models indicate a divergence of trajectories for residential composition based off of proximity to transit as well as location within the central-city. Even without an average treatment in terms of proportion white, these analyses do not support a conclusion of racially equitable development—particularly if black residents' primary option for living proximate to rail is moving further from the urban core.

DISCUSSION AND CONCLUSION

Popularity of this form of public investment makes sense: light-rail has the capacity to bring improvements to residents nearby in the form of new transit access and diffuse benefits to those further away via reduced traffic congestion and alternatives to driving. As a means to invest in neighborhoods and residents' quality of life, these projects do hold promise as a way to reduce dispari-

ties across race and socioeconomic status in neighborhood quality. However, the results of this study preclude overly optimistic conclusions that projects are exclusively beneficial to those living nearby. While not direct evidence of pricing out or conclusive signs that these neighborhoods gentrified in all senses of the word, the significant difference in post-treatment trajectory for proportion black in treated cases still suggests that the project spurred changes in these places' housing, whether by development or by market competition, such that measurable differences emerged in recent demographic trends. This research shows that transportation projects have consequences for households themselves, so these projects must account for the ways neighborhood contexts may interact with the process of "revitalization". Whether or not neighborhood change was anticipated, these data force future consideration and action by policymakers to proactively mitigate the market appreciation that disadvantages racial minorities in particular. Although a transit project such as this does not constitute housing policy in an explicit sense, the impact that LRT might have via mechanisms like induced residential preferences and prohibitively expensive redevelopment complicates thinking about transit as wholly independent from the neighborhood composition that the new market conditions might produce.

While these models support the conclusion that this investment, on average, impacted neighborhood demographic trends (at least in terms of proportion black) there are caveats to the design that must be kept in mind. First, the source of the most recent data (i.e. American Community Survey 2009-2014 5YR estimates) is less than ideal since these estimates are moving averages across a 5 year period. While this means that the estimate of the 4th time point is likely conservative in the direction of being similar to the 2010 estimate, this facet of the data reduces the models' overall capacity to tease out the "true" ATT. Additionally, the variability modeled through $\mathbf{z_i}$ shows how the present light-rail project associated with an average difference in trends for proportion black but not an entirely divergent trajectory from control cases, especially as distance increased from the CBD. Variation in outcome according the chosen parameters indicates that neighborhood change around light-rail is not a given after investing in transit, but instead may additionally depend on geographic and neighborhood-level factors. This study must tread carefully and avoid judgment about

what individuals' decisions may have contributed to the measured differences, since the aggregate data employed in the analyses offer no insight towards such questions. While the present evidence coupled with theory about housing appreciation after investment provide reason to believe pricing out is a plausible scenario, adequately testing such a proposition nonetheless requires micro-data.

Additionally, trends in neighborhood composition measured through proportions may correspond to changes in the number of residents of a particular group as well as changes in the absolute number of residents in a given neighborhood. Notably, these results suggest that white residents appear to be responding with in-migration to all neighborhoods around the new light-rail corridor, amidst no gains for neighborhoods' black residents except for some places at the urban periphery. Such findings evince a racial disparity in benefit from these projects, regardless of whether the numerator or denominator of the proportion drives the trend. In spite of the aforementioned desirability of redeveloped neighborhoods among African-Americans in particular, the data suggest limited success for black residents in satisfying this residential preference post-treatment. Cumulatively, the case of Seattle provides evidence that light-rail projects likely impact both the places and the populations of neighborhoods nearby, even with these noted limitations.

Altogether, the present research contributes to sociological and demographic literature on neighborhood change by widening the scope of salient factors to include a novel form of urban growth. In light of the legacy that transportation projects like the Interstate Highway Act had in shaping both the growth and decay of particular places in the urban landscape, research and policy should be cognizant of how modern capital outlays—even when planned and organized in an equitable fashion—can still potentially yield unanticipated consequences in terms of residential composition. While this paper is not a study of gentrification in an explicit sense, there is a notable silence regarding the role of race in the small literature on the *transit investment-gentrification* dynamic, in spite of considerable treatment of socioeconomic outcomes. The findings of this paper justify the continued relevance of race when studying the dynamics of neighborhoods and urban growth, and in discussing the concept of gentrification more generally. New investments in transportation, regardless of location, should consider how development and market pressures that follow tran-

sit investment may disadvantage low-income and minority residents if new construction replaces previously affordable housing with pricier units. In assessing the impacts and overall value of transit projects, this study's findings support a new calculus that accounts for how these interventions partially aiming to bring access and resources to communities in need might also impact the composition of households.

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A Footnotes

[1] Minnesota Population Center. National Historical Geographic Information System: Version 2.0. Minneapolis, MN: University of Minnesota 2011.

B Referenced Figures and Tables

Figure 1: Annualized Rate of Change in Proportion Black, 2010-2014

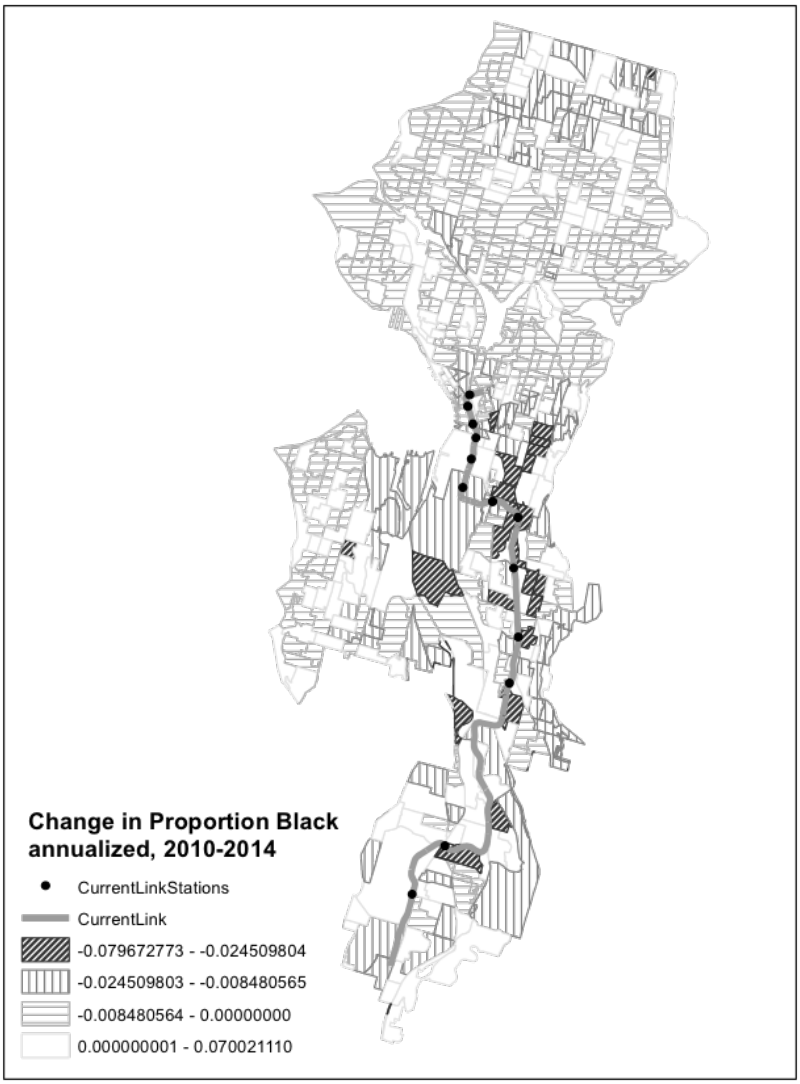

Table 1: Descriptive Statistics

Variable		Mean	SD	Min	Max
Total Population 1990:	Treatment	988.33	401.34	5.00	2439.00
	Control	1053.48	340.20	31.00	2982.00
Total Population 2014:	Treatment	1398.29	578.25	500.00	3134.00
	Control	1324.82	397.93	261.00	3104.00
Proportion Black 1990:	Treatment	0.21	0.14	0.03	0.50
	Control	0.13	0.18	0.00	0.85
Proportion Black 2014:	Treatment	0.18	0.16	0.00	0.57
	Control	0.10	0.12	0.00	0.60
Proportion White 1990:	Treatment	0.45	0.28	0.10	0.90
	Control	0.73	0.25	0.10	1.00
Proportion White 2014:	Treatment	0.41	0.22	0.06	0.94
	Control	0.66	0.23	0.04	0.99
Proportion of Owner-Occupied HH 1990:	Treatment	0.34	0.27	0.00	0.84
	Control	0.51	0.26	0.00	0.95
Proportion of Owner-Occupied HH 2014:	Treatment	0.38	0.27	0.00	0.91
	Control	0.51	0.24	0.00	0.98
	N Treatment	48			
	N Control	292			

Table 2: Heteroskedastic-Normal Models of Annual Change in Proportion White and Black

	Model 1: ΔWhite	Model 2: ΔBlack
μ *Parameters:*		
Time	0.005^{**}	-0.000
	(0.001)	(0.001)
Treatment	-0.001	-0.000
	(0.003)	(0.002)
Time × Treatment	0.005	-0.005^{*}
	(0.004)	(0.002)
Seattle	0.003	-0.005^{*}
	(0.003)	(0.002)
β Constant	-0.008^{*}	0.005^{*}
	(0.003)	(0.002)
σ^2 *Parameters:*		
University St.	0.183	-1.134^{**}
	(0.450)	(0.412)
Pioneer Square	0.617	-0.295
	(0.346)	(0.346)
International District	0.236	0.245
	(0.345)	(0.313)
Stadium	-0.316	1.160^{*}
	(0.523)	(0.517)
SODO	0.021	-0.157
	(0.175)	(0.174)
Beacon Hill	0.415	0.032
	(0.370)	(0.367)
Mt. Baker	0.625	-0.138
	(0.404)	(0.416)
Columbia City	0.632^{**}	0.727^{**}
	(0.263)	(0.262)
Othello	0.528^{*}	0.451
	(0.242)	(0.238)
Rainier Beach	1.389^{**}	0.790^{**}
	(0.184)	(0.189)
International Blvd./Tukwila	1.749^{**}	1.249^{**}
	(0.235)	(0.233)
SeaTac	1.547^{**}	1.427^{**}
	(0.230)	(0.227)
Proportion Black_{90}	1.651^{**}	4.267^{**}
	(0.452)	(0.472)
Γ Constant	-8.923^{**}	-9.827^{**}
	(0.107)	(0.105)
LL	2433.858	2684.693

Note: $N = 680$, $df = 661$; $^{*}p < .05$; $^{**}p < .01$ (two-tailed)