Streetcars and Equity:
Case Studies of Four Streetcar Systems Assessing Change in Jobs, People and Gentrification

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Abstract

Where it occurs, the economic development that accompanies streetcar investments is the result of synergies between the public investment in the transit infrastructure and private investment in real estate development and redevelopment. In this article, we ask: If streetcars promote economic development, do the benefits of that economic development accrue to existing residents of the neighborhood, or is the degree of change so great that the neighborhood experiences extensive population turnover? Ideally, new investment in a neighborhood would result in new economic advantages for residents, in the form of new jobs or business opportunities, greater mobility due to transit improvements, and higher real estate values. Alternatively, the change associated with the streetcar project may be so profound that pre-existing residents are unable to hang on and are forced out due to increasing rents and/or cost-of-living. We apply these questions to analyses of streetcar stations in Portland OR, Seattle WA, New Orleans LA, and Salt Lake City UT. We use demographic and employment data to study neighborhoods surrounding streetcar stops in our four cities before and after the streetcar project, in comparison with control sites, and in a shift-share analysis. Overall, we see profound shifts occurring at most of our streetcar study sites. The patterns vary, but these locations are certainly loci of demographic change, and at many of them the data are in line with some classic indicators of gentrification, including shifts toward more white and Asian, highly-educated and higher-income populations.

The Effect of Streetcars on Jobs, People and Gentrification

Until Portland, Oregon's North-South streetcar line in 2001, streetcars in North America were a novelty – a charming relic of a bygone era found only in a handful of cities, such as Philadelphia and San Francisco, which had not paved over their tracks decades ago. Today, new streetcar projects are popping up all over North America, with about 25 either in operation, under construction, or planned. Like other forms of fixed guideway public transit systems, streetcars are expected to attract both jobs and people though in attracting people, streetcars can also lead to gentrification. Here we introduce the rationale for both outcomes.

Jobs

The relationship between fixed guideway transit systems such as light and heavy rail on land use and economic development is one of the most-researched topics in urban planning. As such, we do not believe it is necessary to review the entire field but rather offer some key perspectives. Nelson et al. (2009) lay out a series of economic arguments in favor of transit investments, including facilitation of economic growth through agglomeration economies, increased real estate values, and enhanced connectivity between people and locations of economic opportunity. Higgins and Kanaroglou (2015) point out that it has become a widely accepted belief that investments in transit such as light rail generate positive economic outcomes – in particular, increases in land values in close proximity to stations. The authors provide a comprehensive review of four decades of research on the effects of rapid transit on land values. They found considerable variation across cities and even stations, and end with a constructive critique of the assumptions and methodology associated with this particular body of literature.

It is important to note that transit investments are not seen as a sole causal factor of economic development, however, but rather as part of a policy package that also directs land use and facilitates desired change." The relationship between transit and surrounding land values and densities depends both on how businesses and residents value proximity to transit and on public-sector decisions about zoning, land use, and other incentives for transit-oriented development." (Kolko 2011, p22)

Nelson et al (2013) carried out a single case study of the Eugene-Springfield, Oregon BRT system, finding growth in employment relative to the rest of the metropolitan area within 0.25 miles of BRT stations. In contrast, Kolko (2011) examined 204 rail transit stations in California and found unpredictable growth in employment, with statistically significant decreases found in more stations than statistically significant increases. Both of these studies also provide a useful review of the research on the economic outcomes associated with transportation investment.

An under-studied aspect of transit's effect on job location is that kind of jobs are attracted to transit stations. Belzer et al. (2011) found that station area growth was not consistent across job sectors, attracting mostly office, education and knowledge-based jobs. Even less studied is the kind of jobs attracted to station areas based on wages. Fan et al. (2012), for instance, find that residential proximity to light rail stations and bus stops offering direct connection to rail stations are associated with statistically significant gains in accessibility to low-wage jobs.

The concern about the role of transit in providing access especially to low-wage jobs is as follows. A limiting factor in gaining access to lower-wage jobs is that the income from such jobs is often insufficient to buy and operate an automobile to access those jobs in the first

place. Sanchez (1999) and Sanchez et al. (2004) note that it is difficult for public transit to reduce the spatial mismatch between lower-income jobs and residential options for a number of reasons. One problem is that bus systems often do not provide sufficient service for the kinds of working hours that make low-skill/entry-level, temporary, and evening/weekend shift-work jobs feasible (Giuliano, 2005). Fixed-guideway transit systems—if they are more rapid and reliable than conventional buses—may be one way to connect lower-income workers from their lower-income neighborhoods to lower-wage jobs (Fan et al. 2012).

In sum, there are no studies showing the relationship between fixed-guideway transit systems and wages differentiated by lower, middle and upper categories. Our article helps to close this gap in the literature with respect to streetcars.

People and Gentrification

Transit systems offer many promises related to people and housing. However, for the most part there is very little research assessing whether transit and the stations serving them are effective in attracting new residents and influencing housing choices. Some studies address mostly individual station areas but not of metropolitan areas as a whole (Cervero and Seskin, 1995; Cervero et al., 2004; Kolko, 2011). In particular, no studies systematically analyze the change in population associated with fixed guideway transit systems such as streetcars in the U.S. The only metropolitan-scale studies addressing the influence of BRT systems on population and housing are from outside the U.S. (Carrigan et al., 2013; Cervero, 2013). This article will contribute to this transit and land use planning literature with respect to streetcars.

But there is another aspect: If fixed guideway transit systems such as streetcars attract people can they also lead to gentrification?

Gentrification is a phenomenon in the constant slow cycle of building, decay and revitalization that occurs in human settlements. The body of literature on gentrification is a mature one, with numerous articles and books published on the topic during the 1970s and 1980s, then with another wave in the 2000s. Most authors attribute the term gentrification originally to Glass (1964) who described a process by which middle-class households moved into working-class neighborhoods in London, rehabilitating old buildings and displacing working-class households. It is currently studied within disciplines ranging from sociology to economics to political science and urban planning. It is understood to be a complex process of urban restructuring that consists of the interplay of the dynamics of the built environment, with political, economic, and social factors (Smith and Williams 1986). In the United States, the topic of gentrification is often deeply entwined with 20th century history of race struggle and housing policies (Revington 2015, Metzger 2000), whereas Glass' perspective relates it to class in the United Kingdom.

As a phenomenon, gentrification has two clear aspects: a "positive" side and a "dark" side. On the positive side, it is seen as a natural and potentially positive economic phenomenon. Freeman (2005) describes it simply as "the process by which decline and disinvestments in inner-city neighborhoods are reversed" (Freeman 205: 463). Similarly, Smith (1979) views gentrification as urban inner-city redevelopment, a product of economic forces that are driven by a combination of consumer preferences and real estate economics. Indeed, who is to say that reinvestment in declining infrastructure and buildings is a negative thing? However, for many the word gentrification has almost exclusively negative connotations.

In a 2004 guest editorial for a special issue on gentrification in *Environment and Planning A*, Slater, Curran and Lees offer a critique of late 20th century gentrification research that has focused too much on the drivers of gentrification such as city governments, developers and the middle class, and not enough on the effects of the process on the poor and powerless who are displaced. Displacement is the dark side of gentrification and anyone who has studied the 20th century attempts at "urban renewal" of "blighted" areas in the United States, resulting in not just loss of home, but loss of neighborhood structure and community ties – social capital – when a neighborhood is disbanded. Wyly and Hammel (2003) argue that revitalization of urban downtowns in recent decades has resulted in patterns of intensified segregation and discrimination. However, the displaced are often hard to follow; what becomes of displaced households, and what drivers actually displace them? Freeman (2005) used a unique nationwide longitudinal study of households to attempt to detect displacement associated with gentrification, but in the end found a weak relationship between gentrification and forced displacement as measured by households. In the picture painted by Freeman, in general, demographic shifts are due to in-movers, who are more likely to be white, better-educated, and have higher incomes. Out-movers are slightly more likely to be black and lower-income and gentrifying neighborhoods had lower levels of intra neighborhood mobility than non-gentrifying neighborhoods. Thus, in a gentrifying neighborhood, lower-income movers simply found themselves with fewer within-neighborhood options over time. However, the data analyzed by Freeman were not designed to detect gentrifying neighborhoods, nor the processes that create them, so the effects detected were diffuse.

Gentrification can happen with a wide range of intensity, resulting in varying degrees and/or rates of displacement. A couple of studies have helped to shed light on this variation. Podagrosi, Vojnovic and Pigozzi (2011) studied gentrification processes in three different Houston neighborhoods, ranging from essentially complete emptying and razing of the neighborhood, to the more gradual parcel-by-parcel upgrading of homes. The first is an organized top-down process involving city government and business interests; the latter is a more organic process driven by the real estate market and consumer desires. In an older study, Beauregard (1990) examined four Philadelphia neighborhoods, and found similar stories – the degree of government investment versus organic turnover household-by-household.

While multiple authors have developed methodologies for identifying and quantifying gentrification based on interpretations of the processes underlying the phenomenon, we do not attempt to wade into the debate with this current research. Both qualitative and quantitative approaches have been used to identify and describe gentrification (Barton 2016, Hammel and Wyly 2013). Indices have been developed (Voorhees Center 2014) and a variety of statistical and clustering techniques employed to detect gentrifying neighborhoods. In this study we work within an analytical framework that recognizes the dynamism of urban neighborhoods and the potential for major infrastructure investments to dramatically influence the rate and direction of change in neighborhoods. The sudden influx of investment will certainly bring about changes in both the built and social environments of the area. The near-universal demographic indicators of gentrification in neighborhoods are: increases in average income, increases in education levels, and shifts in racial composition (decreasing black, increasing white). We do not attempt to label our study neighborhoods in terms of

gentrification, rather, we look at change in the population over time and consider whether 1) the rate and nature of the change differ from other areas in the same city and 2) the kind of change aligns with gentrification processes as observed in the many studies cited above.

Gentrification and Transit Investment

Unlike the broader literature on gentrification, there are relatively few studies that look specifically at the impact of transit investments on gentrification. However, given that gentrification is spurred by an influx of investment in neighborhoods, generally after a period of disinvestment it is reasonable to posit that transit investment could act as a gentrification catalyst, as it makes the neighborhood more attractive for both business and residential development. Furthermore, Kolko (2007) identifies neighborhoods that are closer to the city center as more likely to gentrify, and streetcar projects are generally targeted at urban core locations, thus adding to the probability that gentrification will accompany streetcar investment. After all, modern streetcar projects not solely transit investments, but represent a strategy to spur economic growth and redevelopment in aging urban core areas (Brown, Nixon and Ramos 2015). From this perspective, *a successful streetcar project results in gentrification, by design*.

To frame the potential gentrification impacts of streetcars, we must turn to the literature on other transit investments, primarily light rail. Perhaps the most obvious approach is to go to the literature on the impacts of transit investment on land values. If transit investment results in rising land values, so-called “transit-induced gentrification” (Dawkins and Moeckel 2014) is likely to occur. The relationship between light rail and land values is a well-

trodden path in the literature, although the findings are not universally consistent. Because there are several key distinctions between streetcar and other light rail that may limit comparability, we will not venture too deeply into this literature, except to say that there is evidence that light rail stations generally have positive effects on both commercial and certain types of residential land value, although commercial benefits more frequently and at closer distances to stops, and the relationship depends on other factors such as the type of rail service, proximity of other land uses and transportation modes, etc. (Grube-Cavers and Patterson 2015, Debrezion, Pels and Rietveld 2007, Cervero and Duncan 2001, 2002a, 2002b). Despite the exceptions and nuances, this effect has become widely accepted in practice, so that cities have begun to calculate the increased property tax revenue into their strategies for financing rail transit investments (Smith and Gihring 2006).

The other fundamental component of gentrification is displacement of existing lower-income residents out of gentrifying neighborhoods and an influx of higher-income residents. This is the approach we take in this study, to detect the level and character of demographic changes relative to our focal streetcar systems. Foth (2010) used a demographic shift-share analysis, as we do, to examine population shifts near Vancouver, British Columbia's SkyTrain stations, finding overall increases in income level and educational attainment in these areas. Zeringue (2012) found similar results in neighborhoods close to Dallas' DART (light rail) stations, although the effects were stronger in downtown neighborhoods, reflecting an influx in the downtown of white and Asian, educated, higher-income residents. These two recent examples pave a methodological and theoretical path for our work, as both use demographic shift-share, and both look at the effects of light rail investments on neighborhoods. If light rail is associated

with demographic shifts that may be indicators of gentrification, we expect streetcars to have similar, perhaps stronger, effects.

Streetcars differ from other light rail in important ways. First, they run in streets rather han in a dedicated right-of-way, they run more slowly, stop more frequently, carry fewer cars and generally blend into dense urban environments in ways that light rail, generally speaking, does not. Streetcars are often preferred because of their "charm", which is a term seldom used to describe light rail, and they bring a sense of uniqueness to the districts through which they run. Streetcars are neighborhood-scale rail transit. It is quite possible that the land use value effects of streetcars in urban centers may be more consistently positive than with light rail especially since streetcar projects tend to target urban areas with low land values to begin with – those areas targeted for revitalization. A 2012 report created for Washington DC lays out the positives and negatives of streetcars quite clearly: huge potential benefits accruing from increases in property taxes, weighed against (in the "Challenges" section) housing affordability issues and potential loss of small businesses (Clancy 2012).

Research Design

In this article we aim to draw the following connections.

- The extent to which streetcars attract jobs to their station areas based on wage categories;
- Whether the demographic composition of people living within streetcar station areas change after streetcars are introduced;
- Whether demographic changes can be characterized as gentrification;

- The extent to which gentrification leads to job displacement by wage level; and
- The extent to which demographic changes and changes in jobs by wage level are significantly different than expected for the metropolitan area as a whole and for control "control" station areas based on bus stops of roughly comparable economic and demographic characteristics as streetcar station areas.

We do not claim that inferences in each respect are causal. Our research design is presented next, followed by results for each of four streetcar systems.

Our study is a pre-post, quasi-experimental design. We apply it to four streetcar systems that were new streetcars, not "heritage" lines, carrying modern trains and developed primarily to serve transit functions for the local community rather than tourists. The four study systems were Seattle's South Lake Union line, Portland's Central Loop, New Orleans Rampart-St. Claude, and Salt Lake City's S Line. Our approach involves tracking changes in employment around focal streetcar stops over time against a set of comparable non-streetcar control sites, with the Metropolitan region as a whole, and within industry sectors. For each study system, we determined a "before" date, specified as 3 years prior to the beginning of construction, and an "after" date, specified as one year after the line opening, or in some cases, the most recent available data.

Study locations and controls

For each streetcar study system, we selected three focal stops, each far enough apart that quarter-mile buffers around each stop would not overlap significantly with one another. Each "site" therefore consists of a quarter-mile radius walkshed area centered on the selected stop. Guerra, Cervero and Tischer (2011) find support for a quarter mile catchment as

appropriate for employment-transit studies. Each walkshed had a different socioeconomic profile and we needed to select a set of control sites with similar profiles for comparison. We used an automated multidimensional similarity algorithm to select up to 10 control sites for comparison with each study stop; these control sites were located within the same metropolitan area and shared similar socioeconomic characteristics (population, employment, housing units, households, median household income) as reported at the Census block group level prior to the streetcar project development's Before date. A similar conceptual framework, with slightly different methodology, may be found in Kolko (2011). The process of selecting comparable sites consisted of two steps: first, creating a large set of candidate points, and second, assessing each candidate point for similarity with the actual streetcar locations. For the first step, we assume that bus service follows corridors similar to those considered by planners when designing streetcar alignments, and we create a large number (n=1000 in our work to date) of points randomly distributed along this network of bus routes.

The second step uses census measures of population, employment, housing units, households, and median HH income, at the Census block group level from our identified "before" treatment year. These variables were chosen because they are available at annual intervals going back to the earliest year considered in our study (2003; the Seattle line); the block group is dictated as the spatial unit of reporting as this is the finest unit for which the Census Bureau reports the income variable.

For each treatment point and candidate control point (i.e. selected streetcar location and randomly generated location on the bus network, respectively) we estimate values for each of the five variables for the area within one-quarter mile of the point, allocating block-

group level measures proportionately to the fraction of the block group falling within this area. The quarter-mile buffer approximates the operational definition of a station-area walk-shed used in the qualitative portion of this study. The distributions of the five measures are checked for normality and, if necessary, transformed to normalize them; individual measures are then standardized (to z-scores). Taking each treatment point individually, we compute the distance in the standardized 5-dimensional space between the treatment point and each candidate control point. This distance is proportionate to dissimilarity, and we select the ten candidate controls with the smallest distances as the control points for each treatment point. For most of the rest of the article, we use the term "control station areas" to represent the control protocol.

Statistical Techniques

We use two techniques to explore the various relationships outlined above. The first are z-scores to test for the null hypothesis that there is no statistical difference in economic (in terms of jobs by wage group), demographic and gentrification changes in the before and after years compared to the metropolitan area as a whole. We do this for both the streetcar and control station areas. Second, for just the economic and demographic changes, we use shift-share analysis to apportion the share of the change attributable to the streetcar and control station area controlling for "metropolitan area" and "sectoral mix" effects in the manner described as follows:

With our study design, each station area—defined as the quarter-mile buffer from the streetcar or control station area—is compared with itself over time (before-after), and with a set of similar control sites, also over time. In addition, as in other recent studies on light rail

(Zeringue 2012, Foth 2010), we used shift-share analysis to examine economic and demographic trends at each of the streetcar and control station area sites. Our shift-share approach looks at economic and demographic measures within each area at the before and after dates, compared with broader trends in the metropolitan area as a whole, and within the economic and demographic sectors in the metropolitan area. This allows us to determine whether changes at each study site are attributable to broader trends within the metropolitan area as a whole and/or within employment sectors or demographic categories, or are due to local factors at the study site which we call the Station Area. (See Nelson et al. 2013 for a review of the shift-share approach applied to transit.)

Economic Assessment

We use Longitudinal Employer Household Dynamics (LEHD) data from the US Census Bureau, for the "before" and "after" years at the Census Block and Metropolitan Area levels. We combine LEHD economic sectors into wage groups reflecting roughly comparable shares of jobs in low, middle and upper wage categories (see Hinners and Larice for analytic details)

Demographic Analysis

In this article, we track the change over time relative to comparable control sites, and in a shift-share analysis, focusing this time on neighborhood residents in terms of overall population change, racial composition, and educational attainment. We use z-scores and shift-share analysis for this part of the analysis.

Gentrification Analysis

Literature suggests that perhaps two of the most important indicators of gentrification are change in median household income and in median home value (for owner-occupied units). We use z-scores for this part of the analysis.

Data Sources and Limitations

Our data for employment in streetcar and control station areas by wage groups are from the Census Bureau's LEHD database for discrete years reported later. All of our other measures are drawn from the census or the American Community Survey (ACS). We note the relatively short time periods over which we are conducting our study. Demographic shifts are gradual, and may be most appropriately studied over decadal (at least) time scales, whereas we are looking at shifts over just a few years in most cases. Because of these limitations, we present this research more as a framework that may be used in the future as more reliable data become available, and also with the insight that these streetcar neighborhoods are neighborhoods in the midst of a transition process that has not yet played out.

Details of the station-specific analysis with corresponding comparisons to control station areas are provided in Hinners and Larice (2016). For brevity, results are reported for the combination of streetcar (treatment) and control (control) station areas.

Results

We report results, respectively, for Portland's Central Loop Line; downtown Seattle's South Lake Union Line; Salt lake City's S Line; and New Orleans' Rampart-St. Claude Line. Results will be reported for the change in the distribution of jobs by wage group; followed by demographic

changes including population and race; and concluding with such gentrification "markers" as educational attainment, median household income and median home value. Insights from each analysis will be shared.

Portland, OR – Central Loop Line

The Portland Phase II streetcar, known as the Central Loop, opened in 2012. Table 1 reports descriptive and shift-share resultsKey changes are as follows:

- Overall jobs increased significantly within station areas but not in control areas;
- Lower-wage jobs increased significantly in the station areas but did not keep pace with regions in the control station areas;
- While change in middle-wage jobs in station areas roughly matched proportionate gains in the metropolitan area as a whole, they increased significantly in the control areas;
- Upper wage jobs in station areas increased at a pace three times faster than the metropolitan area but fell in the control areas; and
- Station areas gained share of change in metropolitan area jobs overall and in each wage category—especially upper wages—while the control areas lost regional share of job change overall and gained regional share only among middle wage jobs.

We speculate that streetcar station areas are attractive to firms dominated by upper wage jobs that may outbid firms with middle wage jobs that are forced to locate elsewhere. That lower-wage jobs also gained share was unexpected though reasonable: Upper wage workers likely spend more on food, drink, sundries and services near where they work so they

increase the demand for low wage jobs. This apparently is not the case with respect to control station areas.

As for demographic changes, station areas lost population as a whole and across all racial groups reported, and lost share of regional population change as well. In contrast, control areas gained population and share of metropolitan population change overall and among all races. It would seem that at least during the study period, new jobs displaced people in the streetcar station areas.

We observe from Table 2 that as jobs have moved into the streetcar station areas—especially upper wage jobs, people have been displaced though gentrification does not appear to have emerged, at least during the study period.

Table 1
Descriptive and Shift-Share Results for Portland Streetcar Change in Jobs by Wage Category, and Change in Population and Race

Wage Category	Control Station Area 2006	Control Station Area 2013	Metro Area 2006	Metro Area 2013	Control Station Area Change	Metro Area Change	z	Control Station Area Shift-Share
Lower	4,099	4,124	320,281	338,343	1%	6%	*	(206)
Middle	5,874	6,724	483,832	517,502	14%	7%	*	441
Upper	2,445	2,418	403,151	425,412	-1%	6%	*	(162)
Total	12,418	13,266	1,207,264	1,281,257	7%	6%		73

Wage Category	Streetcar Station Area 2006	Streetcar Station Area 2013	Metro Area 2006	Metro Area 2013	Streetcar Station Area Change	Metro Area Change	z	Streetcar Station Area Shift-Share
Lower	2,639	3,099	320,281	338,343	17%	6%	*	311
Middle	4,116	4,530	483,832	517,502	10%	7%		128
Upper	5,976	7,966	403,151	425,412	33%	6%	*	1,660
Total	12,731	15,595	1,207,264	1,281,257	22%	6%	*	2,099

Race	Control Station Area 2005-2009	Control Station Area 2009-2013	Metro Area 2005-2009	Metro Area 2009-2013	Control Station Area Change	Metro Area Change	z	Control Station Area Shift-Share
White	21,479	24,399	1,808,019	1,857,416	14%	3%	*	2,333
Black	1,226	1,856	58,959	64,958	51%	10%	*	505
Asian	1,884	2,681	113,828	132,990	42%	17%	*	480
Other	3,929	4,251	182,630	205,227	8%	12%		(164)
Total	28,518	33,187	2,163,436	2,260,591	16%	4%	*	3,154

Race	Streetcar Station Area 2005-2009	Streetcar Station Area 2009-2013	Metro Area 2005-2009	Metro Area 2009-2013	Streetcar Station Area Change	Metro Area Change	z	Streetcar Station Area Shift-Share
White	4,809	4,265	1,808,019	1,857,416	-11%	3%	*	(675)
Black	406	402	58,959	64,958	-1%	10%		(45)
Asian	176	172	113,828	132,990	-2%	17%		(34)
Other	407	373	182,630	205,227	-8%	12%	*	(84)
Total	5,798	5,212	2,163,436	2,260,591	-10%	4%	*	(839)

* Z scores are p <0.05.

Table 2
Change in Gentrification Markers for Portland Streetcar: Income and Home Value

Marker	Control Station Area 2005-2009	Control Station Area 2009-2013	Metro Area 2005-2009	Metro Area 2009-2013	Control Station Area Change	Metro Area Change	z
HH Income	$28,633	$30,385	$63,896	$61,016	6.1%	-4.5%	*
Home Value	$269,359	$238,140	$378,026	$328,871	-11.6%	-13.0%	*
Marker	**Streetcar Station Area 2005-2009**	**Streetcar Station Area 2009-2013**	**Metro Area 2005-2009**	**Metro Area 2009-2013**	**Streetcar Station Area Change**	**Metro Area Change**	**z**
HH Income	$55,938	$58,660	$63,896	$61,016	4.9%	-4.5%	*
Home Value	$468,636	$416,501	$378,026	$328,871	-11.1%	-13.0%	*

* Z scores are p <0.05.
"HH income" means median household income and "Home Value" means median home value of owner-occupied homes.
Note: Values in 2015 dollars based on middle year of ACS range (2007 and 2011, respectively).

Seattle, Washington – South Lake Union Streetcar

The South Lake Union streetcar in Seattle started operation in 2007, connecting the South Lake Union neighborhood to downtown. Descriptive and shift-share results are reported in Table 3. Overall, the streetcar station areas lost total jobs and lost share of regional change in jobs across all wage groups over the study period. In contrast, the control station areas gained jobs overall and gained regional share of job change in the lower and upper wage group. It would seem that jobs are not attracted to streetcar station areas in downtown Seattle. However, the streetcar station areas gained nominally across all population measures as well as in share of regional growth. In contrast, the control station areas gained only slightly with respect to share of regional growth.

It seems that while jobs did not change much within station areas, population gained importantly. For the most part, it would seem that there was little if any new nonresidential development within station areas while new residential development dominated. In effect, the persons to jobs ratio improved over the decade, though the ratio remains clearly imbalanced.

Compared to control station areas, Table 4 offers no evidence to support the presumption that gentrification is occurring within streetcar station areas at least during the study period.

We find that streetcar station areas in downtown Seattle have attracted new residential development that does not seem to have displaced existing residents. If anything, such development may have displaced some jobs that would have located within those station areas though this conclusion would be speculative.

Table 3
Descriptive and Shift-Share Results for Seattle Streetcar Change in Jobs by Wage Category, and Change in Population and Race

Wage Category	Control Station Area 2003	Control Station Area 2013	Metro Area 2003	Metro Area 2013	Control Station Area Change	Metro Area Change	z	Control Station Area Shift-Share
Lower Wage	11,711	33,216	490,221	547,411	184%	12%	*	20,139
Middle Wage	33,474	34,555	468,115	593,394	3%	27%	*	(7,877)
Upper Wage	23,448	38,010	613,897	720,092	62%	17%	*	10,506
Total	68,633	105,781	1,572,233	1,860,897	54%	18%	*	22,767

Wage Category	Control Station Area 2003	Streetcar Station Area 2013	Metro Area 2003	Metro Area 2013	Streetcar Station Area Change	Metro Area Change	z	Streetcar Station Area Shift-Share
Lower Wage	17,408	14,206	490,221	547,411	-18%	12%	*	(5,233)
Middle Wage	14,148	15,653	468,115	593,394	11%	27%	*	(2,281)
Upper Wage	28,597	29,822	613,897	720,092	4%	17%	*	(3,722)
Total	60,153	59,681	1,572,233	1,860,897	-1%	18%	*	(11,236)

Race	Control Station Area 2000	Control Station Area 2010	Metro Area 2000	Metro Area 2010	Control Station Area Change	Metro Area Change	z	Control Station Area Shift-Share
White	19,126	18,910	2,819,296	2,474,896	-1%	-12%	*	2,120
Black	4,193	4,647	165,938	191,967	11%	16%	*	(204)
Asian	2,968	3,433	280,696	392,961	16%	40%	*	(722)
Other	2,515	6,200	140,920	379,985	147%	170%	*	(582)
Total	28,802	33,190	3,406,850	3,439,809	15%	1%	*	613

Race	Streetcar Station Area 2000	Streetcar Station Area 2010	Metro Area 2000	Metro Area 2010	Streetcar Station Area Change	Metro Area Change	z	Streetcar Station Area Shift-Share
White	5,478	8,497	1,808,019	1,857,416	55%	3%	*	2,869
Black	862	1,158	58,959	64,958	34%	10%	*	208
Asian	491	1,331	113,828	132,990	171%	17%	*	757
Other	401	986	182,630	205,227	146%	12%	*	535
Total	7,232	11,972	2,163,436	2,260,591	66%	4%	*	4,370

* Z scores are p <0.05.

Table 4
Change in Gentrification Markers for Seattle Streetcar: Income and Home Value

Marker	Control Station Area 2000	Control Station Area 2010	Metro Area 2000	Metro Area 2010	Control Station Area Change	Metro Area Change	z
HH Income	$32,489	$46,530	$70,012	$71,286	43.2%	1.8%	*
Home Value	$290,319	$360,782	$335,494	$457,303	24.3%	36.3%	*
Marker	**Streetcar Station Area 2000**	**Streetcar Station Area 2010**	**Metro Area 2000**	**Metro Area 2010**	**Streetcar Station Area Change**	**Metro Area Change**	**z**
HH Income	$53,529	$70,844	$70,012	$71,286	32.3%	1.8%	*
Home Value	$643,401	$663,543	$335,494	$457,303	03.1%	36.3%	*

* Z scores are p <0.05.
"HH income" means median household income and "Home Value" means median home value of owner-occupied homes.

Salt Lake City, UT – S Line

The S Line is the first modern streetcar line in Utah. It serves Salt Lake City's "second downtown", Sugar House. Table 5 reports descriptive and shift-share change Clearly, overall and across all wage categories, the station areas performed poorly, in fact the worst proportionately of all four systems studied. In contrast, the control areas performed exceedingly well overall and also across all wage groups—in fact the best proportionately of all four systems studied. In direct contrast with employment, demographic changes for station areas are positive overall with gains relative to the regional share, as well as with White-only and Asian populations. While the control areas also gained share, the magnitude was half that for station areas.

The gentrification markers are shown in Table 6. Here we see very little evidence of gentrification within streetcar station areas compared to control station areas.

Our overall assessment is that Salt Lake City's S Line may not have been designed or even intended from the beginning as an economic development investment but rather as a mostly residential-serving transit option. As such, it is losing share of jobs relative to the region and the control areas while gaining share of population compared to the region as well as control areas. We concede it is too early to tell whether the S Line will facilitate gentrification.

Table 5
Descriptive and Shift-Share Results for Salt Lake City Streetcar Change in Jobs by Wage Category

Wage Category	Control Station Area 2009	Control Station Area 2013	Metro Area 2009	Metro Area 2013	Control Station Area Change	Metro Area Change	z	Control Station Area Shift-Share
Lower	560	1,606	171,656	182,959	187%	7%	*	1,009
Middle	1,006	1,359	290,439	317,453	35%	9%	*	259
Upper	344	524	240,517	256,778	52%	7%	*	157
Total	1,910	3,489	702,612	757,190	83%	8%	*	1,425
Wage Category	**Streetcar Station Area 2009**	**Streetcar Station Area 2013**	**Metro Area 2009**	**Metro Area 2013**	**Streetcar Station Area Change**	**Metro Area Change**	**z**	**Streetcar Station Area Shift-Share**
Lower	1,676	1,675	171,656	182,959	-0%	7%	*	(111)
Middle	916	962	290,439	317,453	5%	9%		(39)
Upper	1,497	1,384	240,517	256,778	-8%	7%	*	(214)
Total	4,089	4,021	702,612	757,190	-2%	8%	*	(365)
Race	**Control Station Area 2007-2011**	**Control Station Area 2010-2014**	**Metro Area 2007-2011**	**Metro Area 2010-1014**	**Control Station Area Change**	**Metro Area Change**	**z**	**Control Station Area Shift-Share**
White	23,124	21,203	968,161	942,595	-8%	-3%	*	(1,310)
Black	734	900	16,458	17,983	23%	9%	*	98
Asian	1,040	1,123	34,256	38,110	8%	11%		(34)
Other	4,798	8,071	90,505	124,955	68%	38%	*	1,447
Total	29,696	31,297	1,109,380	1,123,643	5%	1%	*	200
Race	**Streetcar Station Area 2007-2011**	**Streetcar Station Area 2010-2014**	**Metro Area 2007-2011**	**Metro Area 2010-2014**	**Streetcar Station Area Change**	**Metro Area Change**	**z**	**Streetcar Station Area Shift-Share**
White	5,568	6,073	968,161	942,595	9%	-3%	*	652
Black	162	111	16,458	17,983	-31%	9%	*	(66)
Asian	735	1,017	34,256	38,110	38%	11%	*	199
Other	588	534	90,505	124,955	-9%	38%	*	(278)
Total	7,053	7,735	1,109,380	1,123,643	10%	1%	*	508

* Z scores are p <0.05.

Table 6
Change in Gentrification Markers for Salt Lake City Streetcar: Income and Home Value

Marker	Control Station Area 2007-2011	Control Station Area 2010-2014	Metro Area 2007-2011	Metro Area 2010-2014	Control Station Area Change	Metro Area Change	z
HH Income	$33,304	$30,067	$65,923	$63,375	-9.7%	-3.9%	*
Home Value	$206,364	$185,066	$323,753	$277,740	-10.3%	-14.2%	*
Marker	**Streetcar Station Area 2007-2011**	**Streetcar Station Area 2010-2014**	**Metro Area 2000-2014**	**Metro Area 2010-2014**	**Streetcar Station Area Change**	**Metro Area Change**	**z**
HH Income	$54,895	$53,507	$65,923	$63,375	-2.5%	-3.9%	*
Home Value	$259,641	$235,417	$323,753	$277,740	-9.3%	-14.2%	*

* Z scores are p <0.05.
"HH income" means median household income and "Home Value" means median home value of owner-occupied homes.
Note: Values in 2015 dollars based on middle year of ACS range (2009 and 2012, respectively).

New Orleans, LA - Rampart-St. Claude Streetcar

New Orleans' Rampart-St. Claude Streetcar line opened in 2013. As this is the newest system studied, there may not be enough time for the market to respond to the streetcar system. On the other hand, among all the systems, this may be the one with the most advance planning as it came on the heels of Hurricane Katrina recovery planning and investment.

Table 7 reports descriptive and shift-share change. The station and control areas are a study in contrasts. Where the station areas gained jobs overall and share of regional change overall plus lower and upper wage jobs, control areas lost jobs and share of jobs overall. For the most part, demographic changes mirror changes in jobs by wage category. Control areas gained a substantial share of the region's population growth overall and across all racial groups. In contrast, the streetcar station areas gained population overall roughly proportionate to the region but lost share among Black and Other races, though gained among White and Asian populations—the latter remarkably so.

Table 8 however shows some evidence of gentrification. One reason may be that station areas gained share of higher-earning White and Asian populations proportionately higher than control areas, while control station areas gained lower-earning Black population proportionately higher than station areas.

Table 7
Descriptive and Shift-Share Results for New Orleans Streetcar Change in Jobs by Wage Category

Wage Category	Control Station Area 2008	Control Station Area 2013	Metro Area 2008	Metro Area 2013	Control Station Area Change	Metro Area Change	z	Control Station Area Shift-Share
Lower	5,799	5,577	194,588	215,300	-4%	11%	*	(840)
Middle	2,740	3,519	281,731	301,256	28%	7%	*	590
Upper	6,348	5,389	163,927	168,019	-15%	2%	*	(1,117)
Total	14,887	14,485	640,246	684,575	-3%	7%	*	(1,367)

Wage Category	Streetcar Station Area 2008	Streetcar Station Area 2013	Metro Area 2008	Metro Area 2013	Streetcar Station Area Change	Metro Area Change	z	Streetcar Station Area Shift-Share
Lower	7,458	10,577	194,588	215,300	42%	11%	*	2,325
Middle	7,033	7,348	281,731	301,256	4%	7%		(172)
Upper	8,772	9,326	163,927	168,019	6%	2%	*	335
Total	23,263	27,251	640,246	684,575	17%	7%	*	2,488

Race	Control Station Area 2006-2010	Control Station Area 2009-2013	Metro Area 2006-2010	Metro Area 2009-2013	Control Station Area Change	Metro Area Change	z	Control Station Area Shift-Share
White	3,032	4,035	664,402	706,845	33%	6%	*	809
Black	19,486	24,526	363,344	418,024	26%	15%	*	2,108
Asian	1,014	1,198	30,551	33,800	18%	11%		76
Other	1,024	1,206	46,723	50,570	18%	8%	*	98
Total	24,556	30,965	1,105,020	1,209,239	26%	9%	*	3,091

Race	Streetcar Station Area 2006-2010	Streetcar Station Area 2009-2013	Metro Area 2006-2010	Metro Area 2009-2013	Streetcar Station Area Change	Metro Area Change	z	Streetcar Station Area Shift-Share
White	2,863	3,348	664,402	706,845	17%	6%	*	302
Black	2,360	2,319	363,344	418,024	-2%	15%	*	(396)
Asian	100	265	30,551	33,800	165%	11%	*	154
Other	235	222	46,723	50,570	-6%	8%		(32)
Total	5,558	6,154	1,105,020	1,209,239	11%	9%	*	28

* Z scores are p <0.05.

Table 8
Change in Gentrification Markers for <u>New Orleans</u> Streetcar: Income and Home Value

Marker	Control Station Area 2006-2010	Control Station Area 2009-2013	Metro Area 2006-2010	Metro Area 2009-2013	Control Station Area Change	Metro Area Change	z
HH Income	$55,183	$52,554	$52,412	$49,708	-4.8%	-5.2%	*
Home Value	$167,332	$162,831	$242,317	$226,788	-2.7%	-6.4%	*
Marker	**Streetcar Station Area 2006-2010**	**Streetcar Station Area 2009-2013**	**Metro Area 2006-2010**	**Metro Area 2009-2013**	**Streetcar Station Area Change**	**Metro Area Change**	**z**
HH Income	$67,351	$69,922	$52,412	$49,708	3.8%	-5.2%	*
Home Value	$372,279	$364,603	$242,317	$226,788	-2.1%	-6.4%	*

* Z scores are p <0.05.
"HH income" means median household income and "Home Value" means median home value of owner-occupied homes.
Note: Values in 2015 dollars based on middle year of ACS range (2008 and 2011, respectively).

Discussion and Implications

Employment growth is occurring at some, but not all of our streetcar sites. However employment, as a proxy for economic activity more generally, is only part of the picture of a neighborhood. What about the residents? What is it like to live there? And, can residents with fewer resources find a lasting home there? Our study has attempted to understand our streetcar neighborhoods from the perspective of residents and to understand the nature and degree of change occurring there relative to the rest of the city within which each is embedded. We have looked for indications of demographic change that may indicate that processes of gentrification are under way.

Since we cannot, unfortunately, trace individual households and their movements, we have instead used census data to look at changes in the overall demographic picture of these streetcar neighborhoods before and after streetcar construction. No one measure tells us all that we want to know, so we have looked at many: overall population, resident employment sectors, racial composition, educational attainment, household income, and house value. The data we have analyzed in this report has certain consistent trends. First, it is clear that all of our streetcar study sites were behaving differently than their Metropolitan Areas, and most were also distinct from their matched control sites—the control station areas. Having a streetcar does catalyze change. In some cases, we see population losses. This may be due to land use shifts from residential to commercial uses, and it certainly indicates population displacement. The harder cases to analyze are the ones that have population growth, because the growth may easily mask displacement. Are the new households added in addition to pre-existing ones, or are they replacing them and then some? Unfortunately we can't discern this

from the data, but there are numerous sites where we see telltale signs of shifts in the direction of gentrification: increases in white and Asian population relative to other groups, and increases at the upper end of the educational attainment and household income spectra.

Of our four study cities, the Seattle streetcar system is the one where we might most expect to see indications of displacement caused by gentrification. Seattle is the city where we have the longest time span to study, so changes have presumably had more time to play out here as well. Indeed, we see growth among the streetcar station areas that we studied in Seattle. The population growth we see in Seattle is relatively higher income and includes increases primarily in white and Asian populations. So, while there may be demographic change, and it may bear some cultural markers of gentrification, we cannot tell from the data whether there is displacement along the Seattle streetcar line and the new growth appears to be somewhat equitable at least in terms of income.

In Portland, we have seen population decreases among the streetcar station areas but considerable gains in jobs. The data in Portland seem to indicate a shift from residential to commercial land use, which almost certainly indicates some population displacement. It remains to be seen how that story plays out in future years. Salt Lake City, too, is too soon to tell how the streetcar will ultimately affect the local residential areas. And in New Orleans, again we see a mixed set of indicators. While gentrification appears to be emerging among the streetcar station areas based on comparisons with changes in the metropolitan area and control station areas, it is too early to conclude affirmatively.

Our study lays the conceptual groundwork for future research to determine whether and the extent to which streetcars influence job location, the distribution of people, and the potential for gentrification.

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