

Where Households Move: Tracking Household Moves Associated with Rail Transit Station Openings in Los Angeles County

June 2018

A Research Report from the Pacific Southwest
Region University Transportation Center

Marlon Boarnet, University of Southern California

Raphael Bostic, Federal Reserve Bank of Atlanta

Seva Rodnyansky, Occidental College

Allen Prohofsky, California Franchise Tax Board

Andrew Eisenlohr, University of Southern California

Huê-Tâm Webb Jamme, University of Southern California



TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. PSR-19-SP83		2. Government Accession No. N/A		3. Recipient's Catalog No. N/A	
4. Title and Subtitle Where Households Move: Tracking Household Moves Associated with Rail Transit Station Openings in Los Angeles County				5. Report Date June 2018	
				6. Performing Organization Code N/A	
7. Author(s) Marlon Boarnet, https://orcid.org/0000-0002-0890-347X Raphael Bostic Seva Rodnyansky Allen Prohofsky Andrew Eisenlohr Huê-Tâm Webb Jamme				8. Performing Organization Report No. PSR-19-SP82; BA-17-137531	
9. Performing Organization Name and Address METRANS Transportation Center University of Southern California University Park Campus, RGL 216 Los Angeles, CA 90089-0626				10. Work Unit No. N/A	
				11. Contract or Grant No. USDOT Grant 69A3551747109	
12. Sponsoring Agency Name and Address California Community Foundation 221 S. Figueroa St, #400 Los Angeles, CA 90012				13. Type of Report and Period Covered Final report (1/1/17 to 6/30/18)	
				14. Sponsoring Agency Code USDOT OST-R	
15. Supplementary Notes Link to project web page: https://www.metrotrans.org/research/where-households-move-tracking-household-moves-associated-with-rail-transit-station-openings-in-los-angeles-county					
16. Abstract In this study we further expand the latter component—describing spatial patterns of residential moves—by providing a systematic account of households' destination flows after moving away from a transit station neighborhood. The study population includes all households who moved away from a Metro rail transit station between 1993 and 2013. We consider the five lines and 80 stations constitutive of the Metro system at the end of the study period.					
17. Key Words Rail stations; displacement; transit; land use; policy			18. Distribution Statement No restrictions.		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 20	22. Price N/A

Form DOT F 1700.7 (8-72)

Reproduction of completed page authorized

Contents

About the Pacific Southwest Region University Transportation Center	4
U.S. Department of Transportation (USDOT) Disclaimer	4
Disclosure	4
Executive Summary	5
1. Introduction	7
2. Data and Methods	8
2.1. Data, Geocoding, and Method	8
2.2. Categorizing Moves by Income and Distance	9
2.3. Pre and Post Rail Analysis	10
2.4. Sample Size and Restrictions	10
3. Results	11
3.1. Move Destinations and Distances	11
3.1.1. Overview	11
3.1.2. Move Destinations and Distances by Income	12
3.1.2. Move Destinations and Distances by Transit Line and Transit Neighborhood	14
3.2. Move Destinations and Transit Access	15
3.2.1. Overview	15
3.2.2. Move Destinations and Transit Access by Income	15
3.2.3. Move Destinations and Transit Access by Line	16
3.3. Pre- and Post-Rail Transit Move Destinations and Distances	16
4. Conclusion	18
References	19

About the Pacific Southwest Region University Transportation Center

The Pacific Southwest Region University Transportation Center (UTC) is the Region 9 University Transportation Center funded under the US Department of Transportation's University Transportation Centers Program. Established in 2016, the Pacific Southwest Region UTC (PSR) is led by the University of Southern California and includes seven partners: Long Beach State University; University of California, Davis; University of California, Irvine; University of California, Los Angeles; University of Hawaii; Northern Arizona University; Pima Community College.

The Pacific Southwest Region UTC conducts an integrated, multidisciplinary program of research, education and technology transfer aimed at *improving the mobility of people and goods throughout the region*. Our program is organized around four themes: 1) technology to address transportation problems and improve mobility; 2) improving mobility for vulnerable populations; 3) Improving resilience and protecting the environment; and 4) managing mobility in high growth areas.

U.S. Department of Transportation (USDOT) Disclaimer

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated in the interest of information exchange. The report is funded, partially or entirely, by a grant from the U.S. Department of Transportation's University Transportation Centers Program. However, the U.S. Government assumes no liability for the contents or use thereof.

Disclosure

Principal Investigator, Co-Principal Investigators, others, conducted this research titled, "Where Households Move: Tracking Household Moves Associated with Rail Transit Station Openings in Los Angeles County" at the METRANS Transportation Consortium at USC. The research took place from January 1, 2017 to June 30, 2018 and was funded by a grant from the California Community Foundation in the amount of \$65,000. The research was conducted as part of the Pacific Southwest Region University Transportation Center research program.

Where Households Move: Tracking Household Moves Associated with Rail Transit Station Openings in Los Angeles County

Executive Summary

Using year-to-year household location and income data from California State tax returns, we systematically analyze where households moved, and how far, when they moved away from a Los Angeles' Metro station between 1993 and 2013. The study addresses the following research questions:

1. Where do households move after moving away from neighborhoods near Los Angeles Metro rail stations? How far do they move?
 - a. Do locations and distances vary by income?
 - b. Do they vary by Metro line? By transit station neighborhood?
2. When households move away from Los Angeles Metro rail stations, do they move to other transit-rich areas?
 - a. Does this vary by income?
 - b. By Metro line?
3. Did move destinations and distances change over time? In particular, did they change after Metro stations opened?

Key Finding #1: Most households remain within the limits of Los Angeles County, tend to move short distances (a median of 3.5 miles), and their move destinations are concentrated in the zip code areas from which moves originated. The spatial distribution of move destinations peaks in the transit neighborhoods of origin.

Key Finding #2: Where and how far households move depends on income and transit line. Lower-income households tend to move shorter distances, on average. Higher-income households represent larger shares of long-distance moves. Move destinations of higher-income households—who presumably can afford to be more selective regarding their relocation—tend to concentrate in certain areas when they stay in the Los Angeles County, varying by transit line, such as Long Beach (Blue Line) or Pasadena (Gold Line).

Key Finding #3: Moving away from a L.A. Metro rail station means relocating near a L.A. Metro rail station for a rather small share of all moving households (21%). However, 62% of households move to High Quality Transit Areas (HQTAs), defined by SCAG as neighborhoods within 0.5 miles of higher-frequency bus or rail service (at least once every 15 minutes in peak / commute periods).

Key Finding #4: 24% of the lowest income households (annual household income below 30% of AMI) relocate near L.A. Metro rail stations and 68% in HQTAs, both larger shares than the system average.

Key Finding #5: Whether there was a visible change in move distances and in the spatial distribution of move destinations after transit line opened greatly depended on the Line. The pre- and post-rail distributions by income look very similar for the Red / Purple Line and Gold Line to Pasadena, whereas they look much different for the Green Line and Gold Line to Boyle Heights.

Key Finding #6: The Gold Line to Boyle Heights represents an exception to several of the general trends mentioned above. Median move distances decreased from all rail stations after they opened, by as much as 39% for Maravilla station (from 4.8 pre- to 2.9 miles post-rail), while they increased and/or stayed the same for each other line. At the same time, the move distance distribution did not change for lower and middle-income households (with annual incomes up to 120% of AMI), but the proportion of higher-income households (with annual incomes above 120% of AMI) moving very short distances (fewer than 2 miles) increased from 28-29% to 51-55%. Other lines saw mostly increases in the proportion of very short and short distance moves among lower-income households and decreases in the proportion of higher-income households after rail stations opened.

The Gold Line results mentioned above, concerning the Boyle Heights branch, are in some ways consistent with a gentrification hypothesis in which higher-income households are attracted by transit investments. However, the data does not generally indicate that lower-income households are moving farther away after stations open. However, the fact that only one specific branch of one Metro line reveals such a trend indicates that gentrification may be context specific, varying by neighborhood.

1. Introduction

This study is part of a broader effort supported by the California Community Foundation to understand the consequences of rail transit investments in terms of population displacement. It follows on a series of recent reports documenting station areas' demographics (Boarnet et al., 2015), measuring the effects of rail stations on neighborhood change (Boarnet, Bostic et al., 2018), and describing spatial patterns of residential moves from Metro stations (Boarnet, Bostic et al., 2017a; 2017b).

In this study we further expand the latter component—describing spatial patterns of residential moves—by providing a systematic account of households' destination flows after moving away from a transit station neighborhood. The study population includes all households who moved away from a Metro rail transit station between 1993 and 2013. We consider the five lines and 80 stations constitutive of the Metro system at the end of the study period.

Building on previous literature arguing that negative consequences of displacement disproportionately affect people of low-income and minority neighborhoods (Jelleyman & Spencer, 2008; Morris et al., 2018; Goldsmith et al., 2017; Cox et al., 2017), we specifically compare spatial move patterns by income group, Metro line, and transit neighborhood, defined as a 5-digit zip code area containing a Metro station. Furthermore, we assume that low-income households are prone to greater transit dependence (Giuliano, 2005) and that moving away from a transit station neighborhood might represent a loss in terms of transit access, unless households move to a transit-rich area. Therefore, we investigate whether move destinations, especially that of low-income movers, are located near transit. Finally, building on concurrent work showing evidence of significant displacement from most lines of the Los Angeles' Metro system (Boarnet, Bostic et al., 2018), we look at the evolution of move destinations and distances over time, and we compare the pre- and post-rail station opening periods.

The present report is organized as follows. Following a brief presentation of our data and method, we summarize and illustrate our key findings in response to the research questions mentioned above. Throughout the report we refer to the entire set of descriptive tables and maps we produced as an extensive output of this study (see Appendix).

2. Data and Methods

2.1. Data, Geocoding, and Method

We build a matrix of move origins and destinations for Los Angeles County households using anonymized state tax return data from the California Franchise Tax Board (FTB). The data included one record per household for each year they filed California State tax returns over the twenty-year study period, provided that they filed at least once in the Los Angeles County. Using a time period of 1993-2013, we identify households who move by noting changes in tax filing location. Over the 20 years of the study, we identify movers from over 100 million observations (number of households in the data times the number of years).

Whereas households' complete addresses were not available for confidentiality reasons, we extract the zip code information that households provided on tax returns. This information was sometimes available at the 9-digit zip code level, which corresponds to a fine-grained geography more or less at the block level, and other times at the 5-digit U.S. zip code level. Using geographic coordinates from Geolytics, Inc., and shapefiles of L.A. Metro rail station locations from the Southern California Association of Governments (SCAG), we identified households who lived within general walking distance (0.5 miles) of a L.A. Metro rail station.

From this subset of households who live near rail stations, we identified households as "movers" if their filing distance changed by at least 0.5 miles in consecutive tax filing years. Households who did not file taxes in two consecutive years were excluded from the analysis in that year, since we could not tell whether they moved or dropped out of the data. Move distances shorter than 0.5 miles were not used because these very short moves could not be verified to be different from year to year fluctuations in zip code location. The proportion of movers within Los Angeles County moved fewer than 0.5 miles was on average 1% (see Table 1 below).

We next mapped the destination 5-digit zip code for all households who lived near rail stations and moved. We georeferenced the 311 5-digit zip code boundaries using a shapefile obtained from the Los Angeles County GIS Data Portal. Most movers from L.A. Metro rail stations moved to one of 311 5-digit zip codes within Los Angeles County. By Metro Line, on average 6-19% of movers from L.A. Metro rail neighborhoods moved to zip codes outside of Los Angeles County. For confidentiality reasons, we do not map zip codes to which fewer than 10 households moved. This restricted the sample by an average of 2-8% by Line (see Table 1 below).

We map movers from 80 L.A. Metro stations that existed in 2013, including all the Blue Line stations (opened in 1990), all the Green Line stations (opened in 1993), and all the Red and Purple Line stations (opened between 1993 and 2000). For the Gold Line, we include stations to Pasadena (opened in 2003) and Boyle Heights (opened in 2009), but not the extension to Azusa (opened in 2016 after our data time period). For the Expo Line, we include Phase I from Downtown Los Angeles to Culver City (opened in 2012), but not Phase II to Santa Monica (opened in 2016 after our data time period).

In analyzing whether households moved towards transit-rich areas, we used two definitions provided by SCAG (2018) in their Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS):

- (i) Transit Priority Area (TPAs): locations where two or more high-frequency transit routes intersect;
- (ii) High-Quality Transit Area (HQTAs), defined as areas within one-half mile of a fixed guideway transit stop or a bus transit corridor where buses pick up passengers at a frequency of every 15 minutes or less during peak commuting hours. HQTAs represent only three percent of the total land area in the SCAG region, but according to SCAG's 2016 RTP/SCS, 46 percent of new housing and 55 percent of new employment should occur within HQTAs between 2012 and 2040.

The shapefiles georeferencing TPAs and HQTAs were downloaded from SCAG's website.¹ To analyze whether movers moved to transit-rich areas, we analyze whether households moving from L.A. Metro rail stations moved to within 0.5 miles of another L.A. Metro rail station, a TPA, and/or an HQTA.

Our compiled dataset enabled us to track movers' origins and destination from year-to-year in a way not possible using census data and other survey data conventionally used for studying population displacement.

2.2. Categorizing Moves by Income and Distance

Based on the income information collected from FTB data, we assigned each household one of the following income group categories defined in relation to the area median income (AMI) of the Los Angeles – Long Beach Metropolitan Statistical Area in 2013 (see Appendix, p.6 for list of AMI for each year):

- (i) Lowest-income (less than 30% of AMI, or less than \$15,000 in 2013),
- (ii) Low-income (30-50% of AMI, or \$15,000-\$25,000 in 2013),
- (iii) Lower-middle income (50-80% of AMI, or \$25,000-\$40,000 in 2013),
- (iv) Middle-income (80-120% of AMI, or \$40,000-\$60,000 in 2013), and
- (v) High-income (more than 120% of AMI, or more than \$60,000 in 2013)
- (vi) Highest income (more than 240% of AMI, or more than \$120,000 in 2013)

We use these categories consistently to map move destinations by income for movers from neighborhoods near each rail Line and for the whole L.A. Metro rail system.

We calculate move distances for each household's move using the Law of Cosines formula for the distance between two points on the Earth's surface, using the geographic coordinates of a

¹ Retrieved from https://gisdata-scag.opendata.arcgis.com/datasets/21262b1b31304b9da08860e094f7bed1_0, https://gisdata-scag.opendata.arcgis.com/datasets/1f6204210fa9420b87bb2e6c147e85c3_0

household's origin and destination 9-digit or 5-digit zip code centroid. We aggregate the distances by Line and for the whole system into the following categories:

- (i) Very short (0.5-2 miles)
- (ii) Short (2-5 miles)
- (iii) Short-to-medium (5-10 miles)
- (iv) Medium (10-25)
- (v) Long (25-100), and
- (vi) Very long moves (100+ miles).

2.3. Pre and Post Rail Analysis

Where possible, we look at differences in county-wide move destination trends before and after the opening of the rail station. This analysis applied to the Red/Purple, Gold, and Green lines, but was not applicable for Blue Line nor for Expo Line transit neighborhoods, given that all Blue Line stations opened before the beginning of the study period (no pre-rail data) and all the Expo Line stations considered opened at the very end of the period (no post-rail data).

2.4. Sample Size and Restrictions

The sample for this analysis includes all household movers who move from neighborhoods within 0.5 miles of an L.A. Metro Rail station. As explained above, we make several restrictions due to geocoding and data confidentiality. For confidentiality reasons, we do not map movers who move to destinations with fewer than 10 other movers during the timeline of the analysis. This reduces the possible sample size by 2-8%, depending on the Line (Table 1). We also exclude households who moved outside of Los Angeles County from our mapping analyses (9-19% of all eligible movers, see Table 1) though not from our move distance analyses. We also exclude households moving fewer than 0.5 miles for geocoding fidelity reasons, which restricts the possible sample by 1%. In all, we include 1,250,225 movers in our mapping analyses.

Table 1 - Sample size and restrictions by rail Line

L.A. Metro Rail Line	% of Moves to Zip Codes with Fewer than 10 Movers	% Moves outside of Los Angeles County	% Moves Fewer than 0.5 miles	Total Movers in the Analysis Sample
Blue Line	2%	19%	1%	419,486
Red/Purple Line	5%	11%	1%	382,761
Green Line	8%	9%	1%	82,663
Gold Line – Pasadena	7%	17%	1%	174,790
Gold Line – East L.A.	8%	11%	1%	81,039
Expo Phase I Line	6%	13%	1%	109,486
Whole System	2-8%	9-19%	1%	1,250,225

3. Results

3.1. Move Destinations and Distances

3.1.1. Overview

Households move almost anywhere within the limits of the Los Angeles County's boundaries. Indeed, Figure 1 below shows that nearly all zip code areas of the county constituted a destination for at least some of the households who moved away from a transit neighborhood between 1993 and 2013. The exceptions include the mountainous zip code areas located in the northern part of the county and a few zip code areas adjacent to the south-eastern and western borders. An additional 9-19% of movers moved outside of Los Angeles County boundaries and are not mapped on Figure 1.

However, households' destinations concentrated in zip code areas of origins, i.e. in the transit neighborhood from which moves originated. Most of these origin areas, highlighted in black in Figure 1 below, attracted the largest shares of all move destinations. In particular, each of the zip code areas of the Long Beach region attracted more than 5% of all movers. As destinations, zip code areas that were part of the origin areas constituted the end tail of the spatial distribution of move destinations, as each of them received less than 0.5% of all movers when they received any.

In terms of move distances, households generally tended to move short distances away from their transit neighborhood of origin, a median of 3.5 miles from a system-wide perspective, with all lines and all income categories considered, including both pre- and post-rail transit periods. The shares of very short moves (0.5-2 miles) together with that of short moves (2-5 miles) represented the majority of all moves across all times, throughout the study period. For more details, see pages entitled "distribution of move distance categories" in the Appendix.

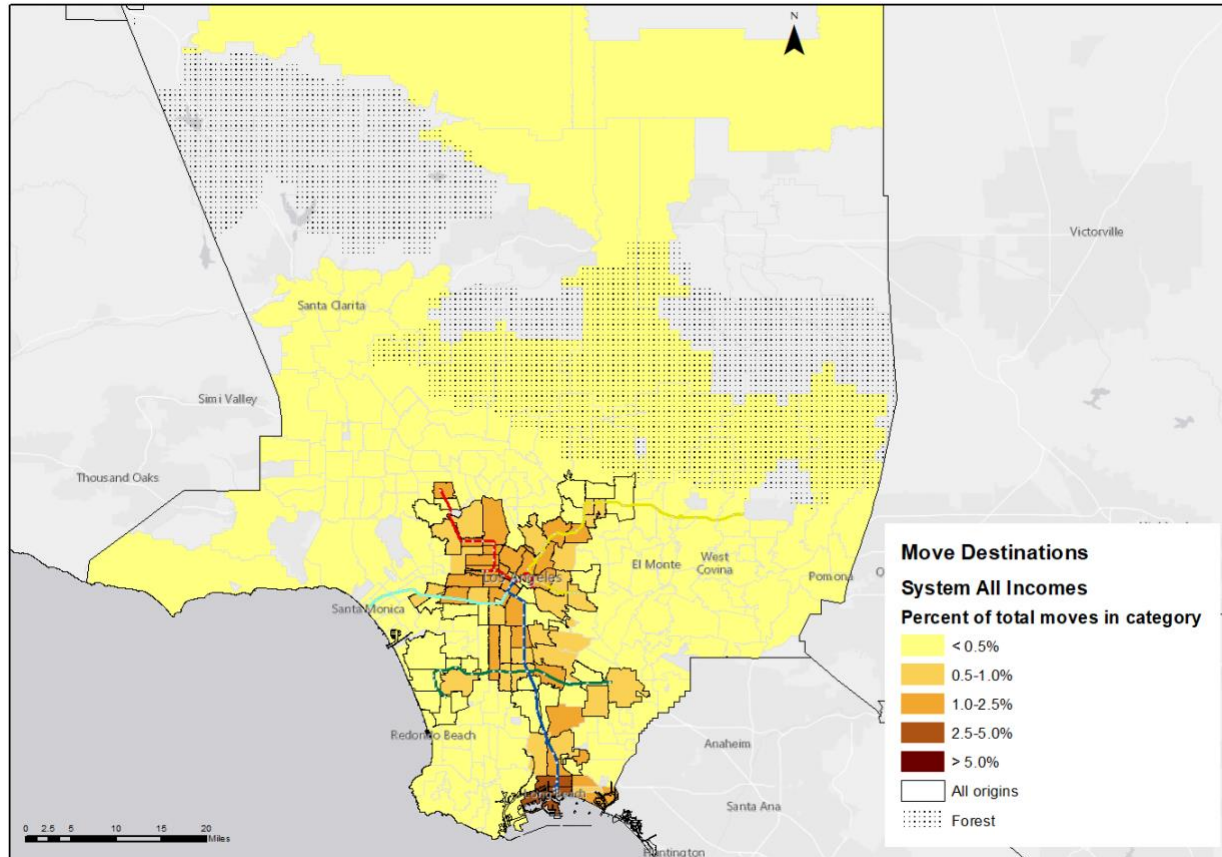


Figure 1 - Spatial pattern of all move destinations (1993-2013)

3.1.2. Move Destinations and Distances by Income

Move distances vary by income. Overall, lower income categories are associated with shorter move distances on average, whereas higher income groups are associated with longer average move distances (Table 2). Households who moved very long distances (100+ miles) were mostly higher-income.

Move destinations also vary by income. For a comparison between the highest- and lowest-income groups and their respective spatial distributions of household moves, see Figure 2a and 2b below. The spatial range of move destinations tends to be wider for lowest-income households (Figure 2a). Nearly all zip code areas in the Los Angeles County have received at least some lowest-income movers. Although move destinations are more or less evenly concentrated in zip code areas of origins, at least some low-income households have moved to every County zip code, except for forest and mountain areas.

In contrast, the spatial distribution of destinations looked different for high- and highest-income households together (Figure 2b). This group had two patterns of note. They either moved very close to their origin zip code, thus mostly to other transit-adjacent neighborhoods. Or, they moved outside of Los Angeles County at rates at least 5% higher than average by Line.

Not all transit-neighborhoods of origins received high shares of highest-income movers, only the zip code areas containing Gold Line stations to Pasadena, Red Line stations to Hollywood, and southern Blue Line stations located in Long Beach. Certain parts of the County consistently did not receive any higher income movers. This is the case for some zip code areas in South Los Angeles in particular.

Table 2 – Median move distances by income

Income	Median move distance
<30% of AMI	2.9 miles
30-50% of AMI	3.1 miles
50-80% of AMI	3.9 miles
80-120% of AMI	4.8 miles
120-240% of AMI	5.5 miles
>240% of AMI	5.9 miles

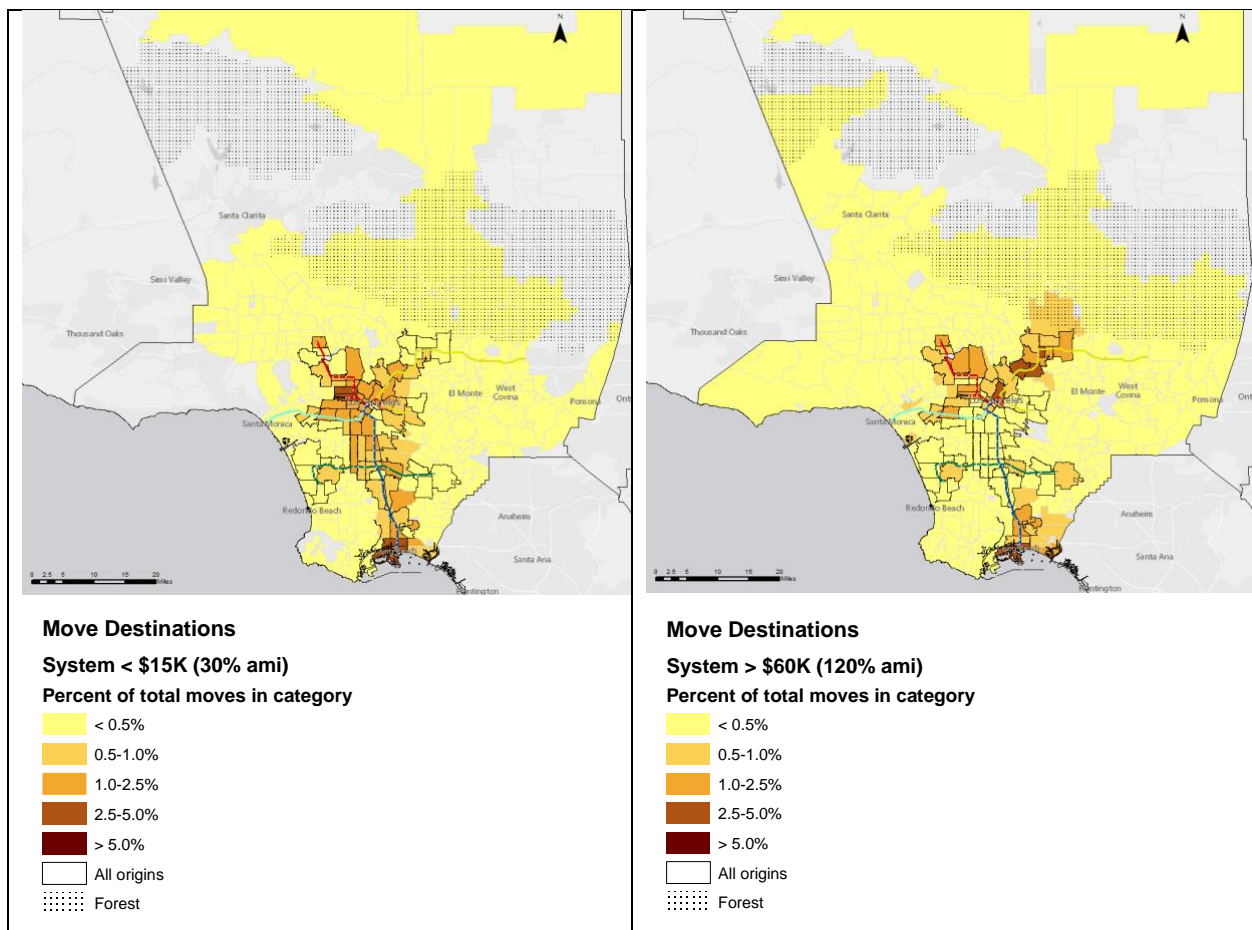


Figure 2 – Spatial distribution of move destinations for lowest-income households (<30% AMI) (2a – left) and high- and highest-income households (>120% AMI) (2b – right)

The Gold Line branch to Boyle Heights constitutes an exception to the general trend mentioned above. Higher-income households who moved away from one of these Gold Line stations while staying within Los Angeles County, stayed very close rail station neighborhoods, in contrast to high income movers for other Lines, who tended to move farther away. Higher-income movers on the Gold Line Boyle Heights branch concentrated in the zip codes of origin that contain a Gold Line station after transit service began.

3.1.2. Move Destinations and Distances by Transit Line and Transit Neighborhood

Move destinations vary significantly by Metro line. The alignment of the Line seems to correlate with that of households' move destinations. For example, households who moved away from Blue Line transit neighborhoods tended to relocate along a North-South axis of zip code areas, whereas households who moved away from a Green Line station tended to relocate along an East-West axis, and those who moved away from a Gold Line station to Pasadena generally moved towards northeastern zip code areas, in the same direction as the Metro Line.

Furthermore, the way the spatial distribution of move destinations vary by income depends on the transit line. For example, the Red Line shows very similar patterns of geographic distribution across income groups (see Appendix pp. 34-39)—destinations tend to remain concentrated in all zip code areas of origin for all income groups—whereas the patterns differ for the Blue Line, where high-income households concentrated their move destinations only in certain zip code areas, in and around Long Beach (see Appendix pp. 22-27).

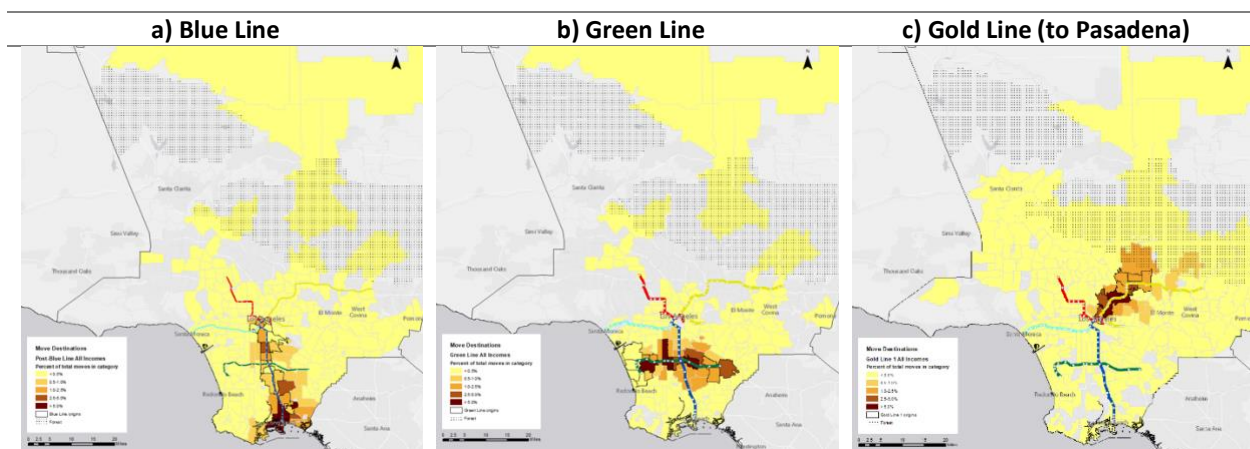


Figure 3 – Spatial distribution of all move destinations for a) Blue Line, b) Green Line, and c) Gold Line (to Pasadena)

Overall, move distances do not vary much by transit line (Table 3). Except for the Green Line, all the lines are associated with median move distances that are 0.1-0.3 miles of the 3.5-mile average. The Green Line is associated with much shorter median move distances (2.2 miles).

Table 3 – Median move distances by line

Line	Median move distance
Red / Purple	3.4 miles
Gold	3.6 miles
Green	2.2 miles
Blue	3.8 miles
Expo	3.3 miles
Whole System	3.5 miles

Nevertheless, at the line level, median distances varied by station. The variation seems to be linked to the type of neighborhood and land use rather than to the line. Moves away from Downtown locations were the longest in distance. Moves away from Blue and Expo Line stations located in Downtown Los Angeles (7th Street / Metro Center and Pico station) had medians of 4.5 miles, from Civic Center and Pershing Square stations on the Red/Purple Line medians were above 10 miles. Moves away from Downtown Long Beach stations had median distances as high as 5.9-mile long (1st Street station).

For more detail, see pages entitled “median move distances by station” of the detailed results presented by Line in the Appendix.

3.2. Move Destinations and Transit Access

3.2.1. Overview

Although zip code areas containing Metro stations generally showed relatively higher concentrations of move destinations (Figure 1), in fact only 21% of all households who moved away from a Metro station neighborhood relocated in one (Table 4).

However, whether households relocated in transit-rich areas greatly depends on the definition thereof. 21% of households having relocated near Metro correspond to 51% in TPAs and 62% in HQTAs as defined by SCAG. Considering that HQTAs are prone to expand with the implementation of SCAG’s RTP/SCS, 75% of relocated households would be living in an HQTA by 2040 if they were to remain in the same location.

3.2.2. Move Destinations and Transit Access by Income

The shares of households who moved to transit-rich areas were generally higher for households of lower-income groups, as illustrated by Table 4 below.

Table 4 – Percentage of move destinations near transit (by income)

Income Category	LA Metro Station	SCAG TPA	SCAG HQTA (2012)	SCAG HQTA (2040)	All Movers
< 30% of AMI	24%	57%	68%	79%	100%
30%-50% of AMI	22%	54%	66%	78%	100%
50%-80% of AMI	19%	48%	59%	73%	100%
80%-120% of AMI	18%	42%	52%	67%	100%
120-240% of AMI	17%	37%	47%	61%	100%
> 240% of AMI	18%	35%	46%	56%	100%
All Incomes	21%	51%	62%	75%	100%

3.2.3. Move Destinations and Transit Access by Line

The trend mentioned above, according to which relatively larger shares of lower-income households moved from Metro to Metro, was observed from all Metro lines, with the exception of the Gold Line to Boyle Heights. In this exceptional case, only 19% of households in the lowest-income category moved from Metro to Metro, contrasting with the 37% of all households the highest-income category (see Appendix, p. 87).

More generally, the shares of households who moved from an existing transit neighborhood to another varied by line, ranging from 7% for the Green Line to 24% for the Red and Purple Lines. The anticipated growth of the County's transit network creates a situation where a large majority of all these movers can be expected to be living in an HQTA by 2040 (provided that they stay in the same location), including for households who moved away from a Green line transit neighborhood (65%). However, the share would be significantly smaller for households who moved away from a Gold Line transit neighborhood along the Pasadena branch (56%).

3.3. Pre- and Post-Rail Transit Move Destinations and Distances

Comparisons between pre- and post-rail periods can only be made for the Green, Red / Purple, and Gold Lines for which there is data available both before and after opening.

One thing that all these lines have in common is the fact that the end tail of the spatial distribution of move destinations tended to expand farther away from the zip code areas of origins in the post-rail period. In other words, after the rail transit stations opened, a larger number of zip code areas received at least some movers, as few as less than 0.5% of all movers, but spreading over a larger area in the County. For more detail, see series of pre- and post-rail maps in for the above-mentioned lines in Appendix.

Furthermore, there is a noticeable difference by line in the way the spatial patterns of move flows changed after rail. The pre- and post-rail maps look very similar for the Red / Purple Line and for the Gold Line to Pasadena for example, whereas they look rather different in the two other cases. In the case of the Green Line, the overall footprint of move destinations expanded, whereas in the case of the Gold Line to Boyle Heights, it shrank on the contrary.

There was a noticeable change in the distribution of move distances, but the nature and magnitude of the change depended on the Metro line. On the one hand, the share of very short moves decreased for all lines, sometimes quite substantially as in the case of the Green Line where very short moves went from representing 58% of all moves before rail stations' opening to 45% after. However, it increased by a few percentage points after the Gold Line stations to Pasadena opened in 2003. On the other hand, the share of very long moves (100+ miles) increased by a few percentage points.

For most lines, median move distances either increased or decreased from each transit station neighborhood. Great changes occurred in the move distances away from Green Line stations, with some stations for which it decreased by -66% (e.g., El Segundo or Mariposa), and other for which it increased by +55% (Long Beach boulevard). Gold Line stations to Boyle Heights are the only ones from which median move distances have all decreased after opening.

4. Conclusion

We investigated where households moved, and how far, when they moved away between 1992 and 2012 from one of the 5-digit zip code areas containing a Metro station in 2013. We looked at the way move destinations and distances varied by income, transit line of origin, and period (pre- or post-rail in particular), and we explored whether households relocated near transit.

We found that move distances were rather short on average and that low-income households generally represented larger shares of very short moves. We also found that households across income categories prefer to relocate within the transit corridors of origin, as the spatial distribution of destination flows peaks in zip code areas containing a Metro station or the ones adjacent to them. This does not necessarily translate to large shares of households relocating near Metro stations (only 21% of all movers), although relative to other groups, low-income households have a greater tendency to relocate near a Metro station.

Yet, there are two major reasons to be careful when interpreting these results. First of all, while our method and data provide a unique opportunity to track households' moves over time, the major limitation is a potential underrepresentation of low-income or undocumented households who might be less likely to file tax returns. This concern is mitigated by the fact that California is known for a rather expansive tax collection coverage, as approximately 85 to 90% of all households (FTB 2006, FTB 2017), and at least 75% of low-income households, are estimated to file taxes each year in the State (IRS, 2013). Second, the results concerning the Gold Line to Boyle Heights, in popular accounts what might be a hot spot of gentrification in the Los Angeles area, contradict the general trends mentioned above in many regards. From this specific Line, low-income households tend to move farther away from their origin than their counterparts moving away from other lines, while higher-income households likely to relocate very close to these Gold Line stations. This suggests that low-income households moving away from Gold Line stations are more likely to lose access to rail transit than low-income movers from other neighborhoods. Further studies are needed to better understand the motivations and implications of moving away from a Metro station neighborhood, especially the impact on low-income households' lives.

References

- Boarnet M. G., Bostic R., Rodnyansky S., Prohofsky A. (2017a). Residential Moves near Red Line and Purple Line Stations from 1993-2013 in Los Angeles, CA. *California Community Foundation*.
- Boarnet M. G., Bostic R., Rodnyansky S., Prohofsky A., Burinskiy E., Eisenlohr, A., Webb Jamme H.T. (2018). The Effects of Rail Stations on Neighborhood Displacement in Los Angeles County, 1993-2013. *California Community Foundation*.
- Boarnet M. G., Bostic R., Rodnyansky S., Santiago-Bartolomei R., Williams D., Prohofsky A. (2017b). Mobility and Displacement: Assessing the Spatial Patterns of Residential Moves near Rail Transit in Los Angeles County. *California Community Foundation*.
- Boarnet M. G., Chakrabarti S., Bostic R., Rodnyansky S., Morrisson-Hawkins B., Santiago-Bartolomei R., Wang X. (2015). Housing Affordability and Transit-Oriented Development in Los Angeles: A Challenge and an Opportunity. *California Community Foundation*.
- California Franchise Tax Board (FTB). (2017). 2016 California Tax Rate Schedules. Retrieved from <https://www.ftb.ca.gov/forms/2016-california-tax-rates-and-exemptions.shtml>
- California Franchise Tax Board (FTB). (2006). Tax Gap Plan: A Strategic Approach to Reducing California's Tax Gap. Retrieved from <https://www.ftb.ca.gov/aboutftb/taxgapstratplan.pdf>
- Cox, R., Henwood, B., Rodnyansky, S., Wenzel, S., & Rice, E. (2017). Roadmap to a unified measure of housing insecurity. Washington Center for Equitable Growth. Washington, DC. Retrieved from <http://cdn.equitablegrowth.org/wp-content/uploads/2017/07/11133001/07112017-WP-unified-measure-of-housing-insecurity.pdf>
- Giuliano, G. (2005). Low income, public transit, and mobility. *Transportation Research Record: Journal of the Transportation Research Board*, (1927), 63-70.
- Goldsmith, P. R., Britton, M. L., Reese, B., & Velez, W. (2017). Will moving to a better neighborhood help? Teenage residential mobility, change of context, and young-adult educational attainment. *Urban Affairs Review*, 53(2), 305-337.
- Jelleyman, T., & Spencer, N. (2008). Residential mobility in childhood and health outcomes: a systematic review. *Journal of Epidemiology & Community Health*, 62(7), 584-592.
- Morris, T., Manley, D., & Sabel, C. E. (2018). Residential mobility: Towards progress in mobility health research. *Progress in Human Geography*, 42(1), 112-133.
- SCAG (2016). The 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy (RTP-SCS): A plan for Mobility, Accessibility, Sustainability, and a High Quality of Life.

Retrieved from <http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS.pdf> on June 12, 2018.

U.S. Internal Revenue Service (IRS). (2013). Exemptions, Standard Deductions, and Filing Information, 2013 (Publication 501). Retrieved from <https://www.irs.gov/pub/irs-prior/p501--2013.pdf>