

Residential Moves near Red Line and Purple Line Stations from 1993- 2013 in Los Angeles, CA

July 2017

A Research Report from the Pacific Southwest Region
University Transportation Center

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TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. PSR-19-SP80	2. Government Accession No. N/A	3. Recipient's Catalog No. N/A	
4. Title and Subtitle Residential Moves near Red Line and Purple Line Stations from 1993-2013 in Los Angeles, CA		5. Report Date July 2017	
		6. Performing Organization Code N/A	
7. Author(s) Marlon Boarnet, ORCID ID: 0000-0002-0890-347X Raphael Bostic, ORCID ID: 0000-0002-7126-413X Seva Rodnyansky, ORCID ID: 0000-0002-7321-7572 Allen Prohovsky		8. Performing Organization Report No. PSR-19-SP80	
9. Performing Organization Name and Address METTRANS 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. CCF BA-18-147082	
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 (July 1, 2016 to July 31, 2017)	
		14. Sponsoring Agency Code USDOT OST-R	
15. Supplementary Notes Project webpage: https://www.metrotrans.org/research/residential-moves-near-red-line-and-purple-line-stations-from-1993-2013-in-los-angeles-ca			
16. Abstract Intra-urban household mobility has been a feature of U.S. metropolitan areas for over a century. This mobility may positively or negatively affect households. Positive or 'upward' mobility may reflect a move for a better job, better housing, a better neighborhood, toward homeownership, or to attain more education. ¹ Negative mobility, often termed displacement, may occur if a household is evicted or unable to pay increased rent. Both positive and negative mobility are included in the baseline mobility in a metropolitan area. While negative mobility is the primary interest of this study, we first establish a mobility baseline for Los Angeles County and then measure differential mobility (which we will call displacement going forward) in rail station areas along the Red and Purple Line Subway.			
17. Key Words Housing, housing market, residents, residential mobility, rent, rent stabilization, long term residents, rails, Los Angeles County		18. Distribution Statement No restrictions.	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 33	22. Price N/A

Form DOT F 1700.7 (8-72)

Reproduction of completed page authorized

¹ U.S. Census Bureau, Current Population Survey tables A5 and 24-2

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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, "Residential Moves near Red Line and Purple Line Stations from 1993-2013 in Los Angeles, CA" at the University of Southern California. The research took place from July 1, 2016 to July 31, 2017 and was funded by a grant from the California Community Foundation in the amount of \$75,000. The research was conducted as part of the Pacific Southwest Region University Transportation Center research program.

Acknowledgements

We gratefully acknowledge funding for this project from the California Community Foundation and *METRANS* Transportation Center. We thank Eugene Burinskiy for research assistance. We are grateful to the California Community Foundation's Advisory Board for helpful suggestions and comments.

Residential Moves near Red Line and Purple Line Stations from 1993-2013 in Los Angeles, CA

Executive Summary

1. Los Angeles is experiencing a boom in rail transit development. In parallel, public perception that rail stations cause an influx of high-income residents and an outflow of low-income residents is growing.
2. We analyze 15 stations that opened between 1993 and 2013 along Los Angeles Metro's Red-Purple Line to gauge the effect of rail-stations on out-mobility. Furthermore, we measure effects on four income brackets: below 30% of Area Median Income (AMI) (<\$15,000 in 2013), 30-50% of AMI, 50-80% of AMI and above 80% of AMI (>\$40,000 in 2013).
3. Residents living near Red-Purple line stations tend to be lower-income, foreign born, and/or minority households. Members of each of these demographic groups are less likely to own a vehicle and more likely to use public transit. This makes our study particularly salient.
4. Nationally, intra-county mobility has been steadily declining since at least the mid20th century. We confirm this for L.A. County for all incomes. In recent years, the decline in mobility has slowed or reached a plateau. In L.A. County, we see this plateau at about 20% annually.
5. Renters consistently move at least twice as often as home owners. Los Angeles has a particularly large renting population, which expectedly pushes up the mobility rate in L.A. County. This is particularly true around the rail stations along the Red-Purple line where we observe high percentages of lower-income individuals and renter proportions above 80%.
6. The population of households near the Red-Purple Line has grown by about 50% between 1993 and 2012; however, this growth has not been uniformly distributed. Most growth occurred around rail-stations with historically lower population densities where the proportion of higher-income households increased.
7. The out-mobility baseline estimate is high for Red-Purple Line corridor: 30% annually on average. This high rate likely reflects the high proportions of renters in these neighborhoods. Baseline mobility rates have been decreasing in the Red-Purple line corridor from 1993-2013, following national and County trends.
8. In comparison, new rail station openings increase out-mobility rates by 0-1% annually, especially among the lowest-income households. Yet, even this effect is not always statistically significant, possibly due to measurement errors resulting from tax-filing patterns.

Introduction: Residential Mobility and Rail Transit

Rail transit and its impact on neighborhoods have become linked in the public mind. Anecdotal examples of rail transit being associated with neighborhood gentrification abound. In Washington, D.C., the Green and Yellow lines, north and east of downtown, are associated with changes in residents' racial composition, from black to white, and retail and commercial changes from long-time neighborhood staples to those catering to a new, wealthier, professional consumer.² In Los Angeles, the Gold, Expo, and Red/Purple lines gentrification concerns are associated with ethnoracial changes, an influx of artists, and increases in housing prices.³ Research in the San Francisco Bay Area concludes that gentrifying neighborhoods are disproportionately near rail transit.⁴ The same concerns about gentrification are present in almost any large metropolitan area that is building or expanding rail transit.

More recently, the concern about gentrification has been refocused on two questions regarding mobility and displacement:

- Do rail transit stations affect residential mobility rates in surrounding neighborhoods?
- Are lower-income or long-term residents disproportionately displaced from the neighborhood?

This report uses mobility data and station openings of the Red and Purple Subway Lines in Los Angeles, CA, to attempt to answer these questions.

The Los Angeles metropolitan area presents an ideal study area for analyzing transit-oriented development (TOD) and potential displacement. From the TOD perspective, prior to 1990, Los Angeles had not had any intra-urban rail transit service for decades. Since then, 93 new rail-transit stations (see Figure 1 for map) have been opened by the Los Angeles Metropolitan Transit Authority (L.A. Metro) and an additional 17 are currently under construction.⁵ This buildout amounts to about half of the U.S. spending on new rail transit.⁶ Within L.A. Metro, 21% of its budget between 2005-2040 will go toward rail transit capital and operations expenditures.⁷ TOD development has come in conjunction with this building activity: regional and local plans anticipate over half of new housing and employment to occur within a half-mile of a well-served transit corridor, including rail.⁸

Los Angeles' new transit stops and TOD plans have emerged at the same time as the city and county experience a housing affordability crisis. Home prices and incomes diverge widely: a median income

² See for example: DiCaro (2012), Austermuhle (2017), and Hyra (2017)

³ For example, Zuk & Chapple (2015), Bader (2016), Miranda (2016), Mejia and Saldivar (2016), Lopez (2016)

⁴ Chapple (2009)

⁵ Boarnet et al. (2016)

⁶ L.A. Metro (2009), p.23

⁷ L.A. Metro (2009), p.23

⁸ L.A. Metro (2009), SCAG (2012) p.131

household in 2012 Los Angeles can afford a \$190,000 home yet home prices average \$400,000.⁹ Renters have not been spared: real rents have increased by more than 20% in real terms between 1990-2010, despite slightly decreasing real incomes.¹⁰ Politicians have reacted and these facts have spurred a mayoral pledge to add 12,500 housing units annually from 2014-2021.¹¹ These pledges, however, may be a stretch, given the gaps between policy and reality: Los Angeles has permitted an average of 7,500 housing units annually from 2000-2014.¹² Residential permitting has picked up steam, with over 10,000 units permitted annually since 2013, with over 16,000 in 2015 alone.¹³ Most of these units are in large, often high-rise and mid-rise developments of at least 50 units.

Figure 1: Los Angeles Metro Rail Transit System, 2017



The affordability crisis, the Great recession and its recovery, spatial changes in employment, and other factors have led to speculations about gentrification and displacement in the Los Angeles metropolitan area. Gentrification has made the news lately in a number of neighborhoods proximate to L.A. Metro rail stations. The causes differ by neighborhood: rent increases and conversions from rental to owner housing in Echo Park, income high-end artist

⁹ LADCP (2013)

¹⁰ Collinson (2011)

¹¹ Logan (2014)

¹² U.S. HUD (2015)

¹³ Abundant Housing L.A. (2017)

galleries in Boyle Heights, and changing ethnracial composition in Downtown to name a few.¹⁴ In Los Angeles County as a whole, the Urban Displacement Project has found that 44% of census tracts had the potential to gentrify over the 1990-2013 timeline, and 15% did end up gentrifying between either 1990-2000 or 2000-2013.¹⁵

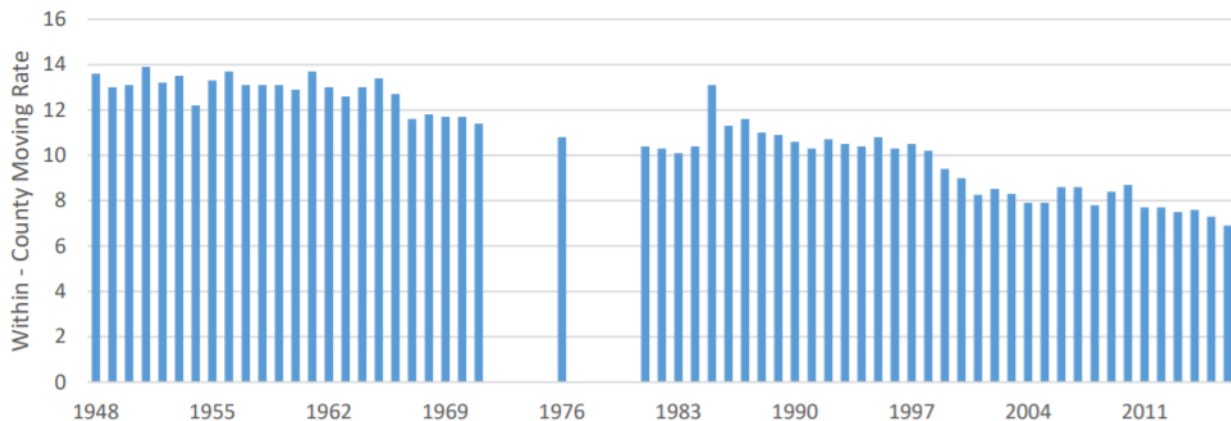
Intra-urban household mobility has been a feature of U.S. metropolitan areas for over a century. This mobility may positively or negatively affect households. Positive or ‘upward’ mobility may reflect a move for a better job, better housing, a better neighborhood, toward homeownership, or to attain more education.¹⁶ Negative mobility, often termed displacement, may occur if a household is evicted or unable to pay increased rent. Both positive and negative mobility are included in the baseline mobility in a metropolitan area. While negative mobility is the primary interest of this study, we first establish a mobility baseline for Los Angeles County and then measure differential mobility (which we will call displacement going forward) in rail station areas along the Red and Purple Line Subway.

Mobility Rates in the United States and in Los Angeles County, CA

National and Local Mobility Rates

Any study of residential mobility starts by establishing a baseline of how often people move to obtain a relevant comparison. The U.S. Census Bureau, through the decennial census, the Current Population Survey (CPS), and other methods, measures how often households move throughout the country, both across county lines and within county lines. The Census Bureau finds that within-county mobility has been decreasing steadily at the national level since the mid-20th century (Figure 2). In 1948, 13.6% of households reported moving within a county annually, while in 2016, the rate was 6.9%. However, the decrease has levelled off since 2008.

Figure 2: Within-County Move Rate Percentages Nationally, from 1948-2016.



Source: U.S. Census Bureau, Current Population Survey, 1948-2016

¹⁴ Bader (2016), Miranda (2016), Mejia and Saldivar (2016), Lopez (2016)

¹⁵ Author calculations of data from Zuk & Chapple (2015)

¹⁶ U.S. Census Bureau, Current Population Survey tables A5 and 24-2

Los Angeles County is the largest county by population in California and in the U.S., and it contains the city of Los Angeles and 87 other municipalities. Figure 3 shows the estimated mobility rates for Los Angeles County from 1993-2012, using administrative data from the California Franchise Tax Board.¹⁷ The Los Angeles County mobility rate on average is 21% annually. This rate has declined by 2.4% annually from 1993-2012, faster than the 1.5% national annual rate decline for a similar time period.

The 21% mobility rate in L.A. County is higher than the 11% national rate. There are several possible reasons for the difference between national and Los Angeles County rates. First, Los Angeles County (and city) is one of the largest renter markets in the United States with most households renting rather than owning their residence.¹⁸ Moreover, many neighborhoods near Los Angeles Metro stations have a very high proportion of renters.¹⁹ Second, according to the U.S. Census Bureau, renters have historically moved at much higher rates than homeowners (Figure 4). Figure 4 shows that renters’ and owners’ mobility rates routinely differ by 15-20 percentage points, nationally. Both renters’ and owners’ mobility rates have experienced steady declines over the past three decades. The Los Angeles County mobility rates thus follow the profile of its residents: more renters indicate a higher mobility rate.

Figure 3: Residential Out-Mobility Rates for Los Angeles County, 1993-2012

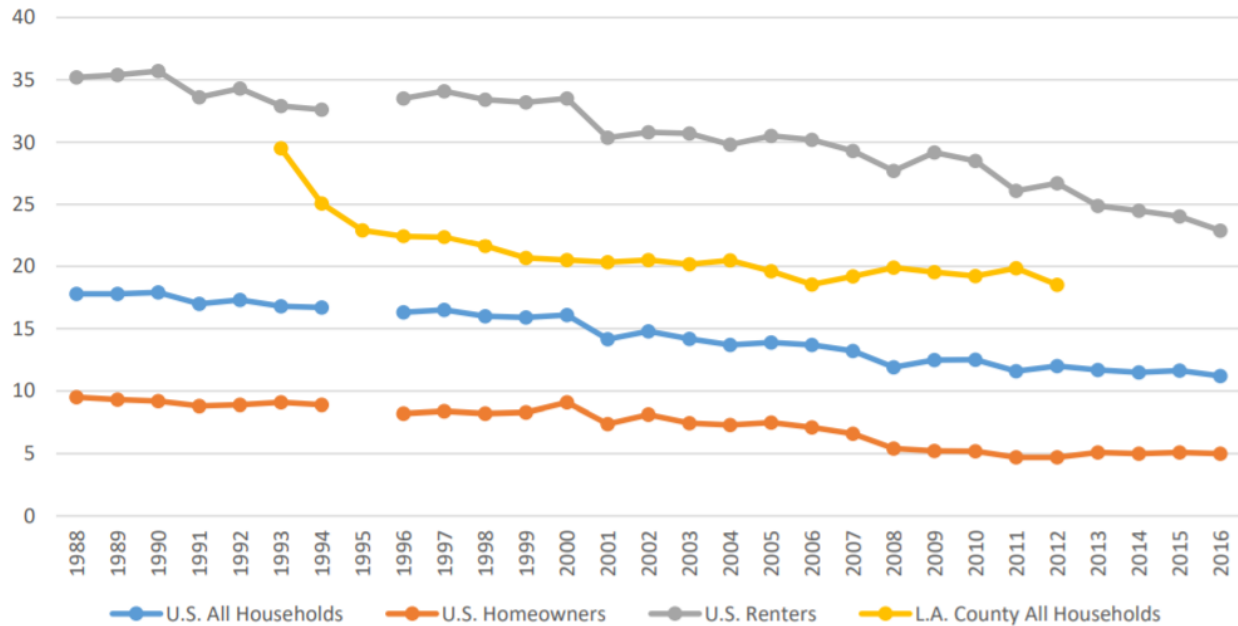


Source: Boarnet et al. (2017).

¹⁷ Please refer to Boarnet et al.’s (2017) California Community Foundation report: “Mobility and Displacement: Assessing the Spatial Pattern of Residential Moves near Rail Transit in Los Angeles County” for details on this dataset and method.

¹⁸ Abodo.com (2017)

¹⁹ Los Angeles Times (n.d.)

Figure 4: Mobility by Housing Tenure, 1988-2016

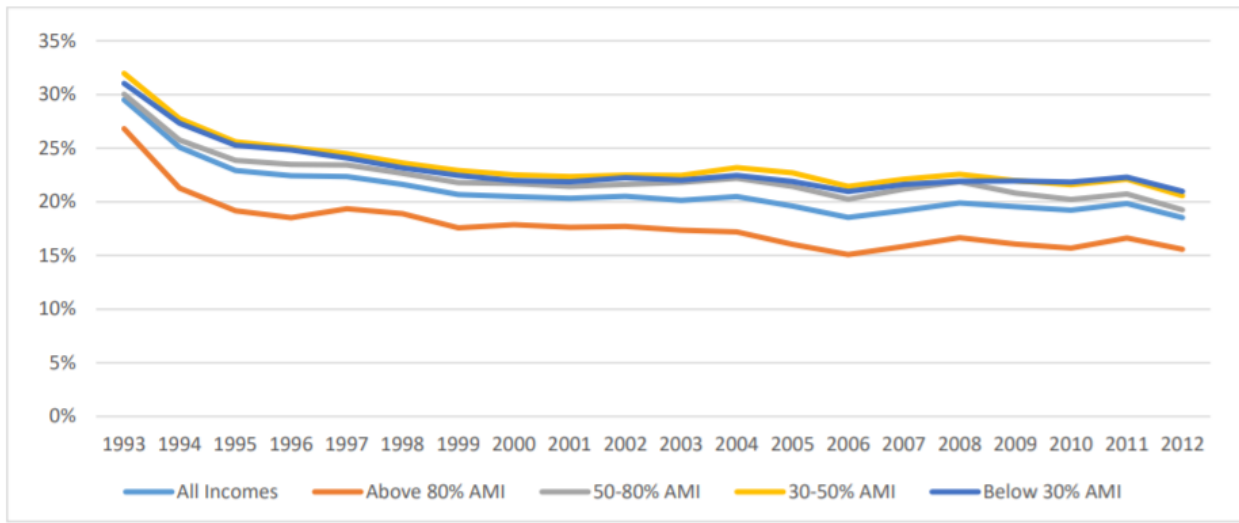
Source: U.S. Census Bureau, Current Population Survey, 1988-2016 and Boarnet et al. (2017).

Who moves, how far, and why?

In addition to renting versus owning, moving rates also vary by household income. In Los Angeles County, higher income households, who earn more than 80% of Area Median Income (AMI), or about \$40,000 in 2013, are least likely to move (Figure 5). When they do move, those above 80% of AMI, they are most likely to move longer distances (above 100 miles) and consequently out of the County (see Table 6). Households making less than 80% of AMI, or below \$40,000 in 2013, tend to move shorter distances and more frequently: the lower the income, the shorter distance are the moves. These findings square with national statistics: households making less than the Poverty Line tend to move more often and move within a county, compared to households making more than 1.5 times the poverty line, who move less often. The national data has a regional dimension: in the West of the US, for individuals below the poverty line 70% of moves are within county and the moving rate is almost double for those 100-149% of the poverty line.²⁰

²⁰ Table01-14 footnote 4, <https://www.census.gov/library/publications/2014/demo/p20-574.html>

Figure 5: Los Angeles County Mobility Rates by Income Group, 1993-2012



Source: Boarnet et al. (2017).

Table 6a: Average Mobility Rates by Income Group and Distance Moved, Los Angeles County

<i>Distance</i>	All incomes	Above 80% AMI	50-80% AMI	30-50% AMI	Below 30% AMI
<i>0.5-1 miles</i>	4%	3%	4%	4%	4%
<i>1-5 miles</i>	8%	7%	8%	9%	9%
<i>5-100 miles</i>	7%	2%	8%	8%	8%
<i>>100 miles</i>	2%	6%	2%	2%	2%
<i>Did Not Move</i>	79%	82%	78%	77%	77%

Source: author calculations from California Franchise Tax Board data

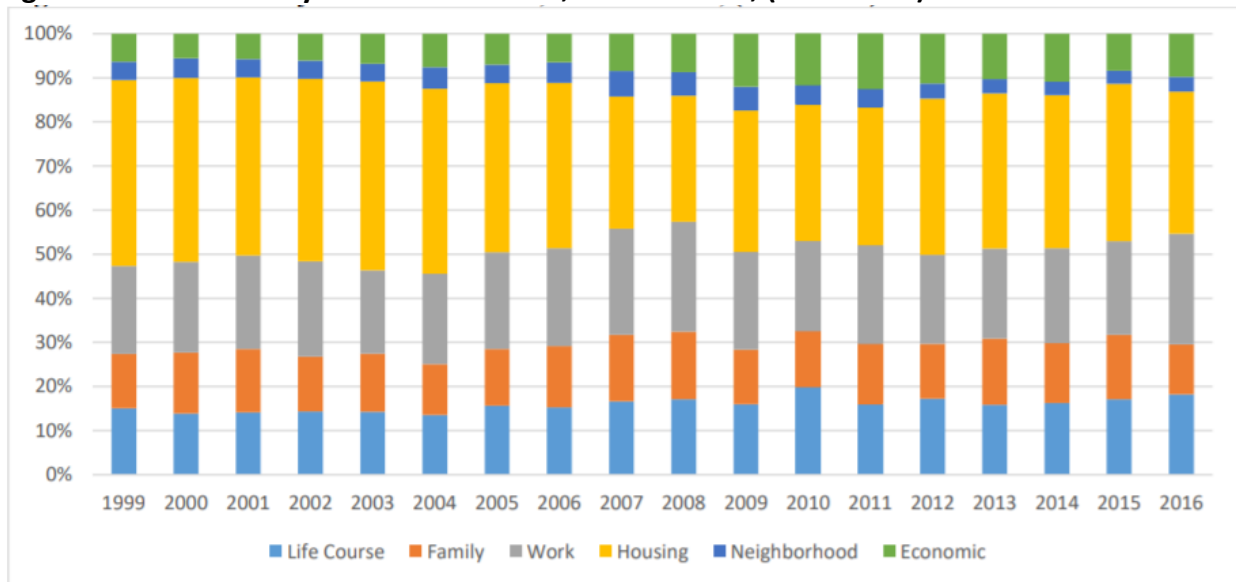
Table 6b: Average Mobility Rates by Poverty Status by Move Distance in the U.S. (2012-2013)

<i>Move Distance</i>	All incomes	Above 150% of Poverty Line	100-150% times Poverty Line	Below 100% of Poverty Line
<i>Within County</i>	9%	8%	12%	15%
<i>Within State</i>	2%	2%	2%	3%
<i>Within U.S. Region</i>	1%	1%	1%	1%
<i>To Different U.S. Region</i>	1%	1%	1%	1%
<i>Abroad</i>	0%	0%	0%	1%
<i>Did Not Move</i>	87%	88%	84%	79%

Source: U.S. Census Bureau, Current Population Survey Table 01-14

At a national level, U.S. households are most likely to move across county lines for housing-related reasons, followed by work and family / life course related moves (Figure 7a). This trend has been consistent over time, making housing a key component of mobility. Changes in the supply or affordability of housing from gentrification or from transit investments may thus be rightfully assumed to influence a household’s decision to move. For moves within a county, housing figures even more prominently as the reason to move: a recent Census Bureau report suggests that the majority (57.6%) of intra-county moves between 2012 and 2013 were for housing.²¹ Additionally, people with lower levels of education are more likely to move for housing reasons which suggests that lower-income households are more likely to move locally, just as our data. Moreover, those who hold at least a Bachelor's degree are more likely to make long-distance moves for jobs, college, or other non-housing reasons.²² Nationally, housing is the top cited reason to move within a county for households with annual incomes below \$10,000 and above \$60,000. Family and life course reasons are also important for lower and middle-income households.

Figure 7a: Reasons Why Households Move, U.S. National, (1999-2016)

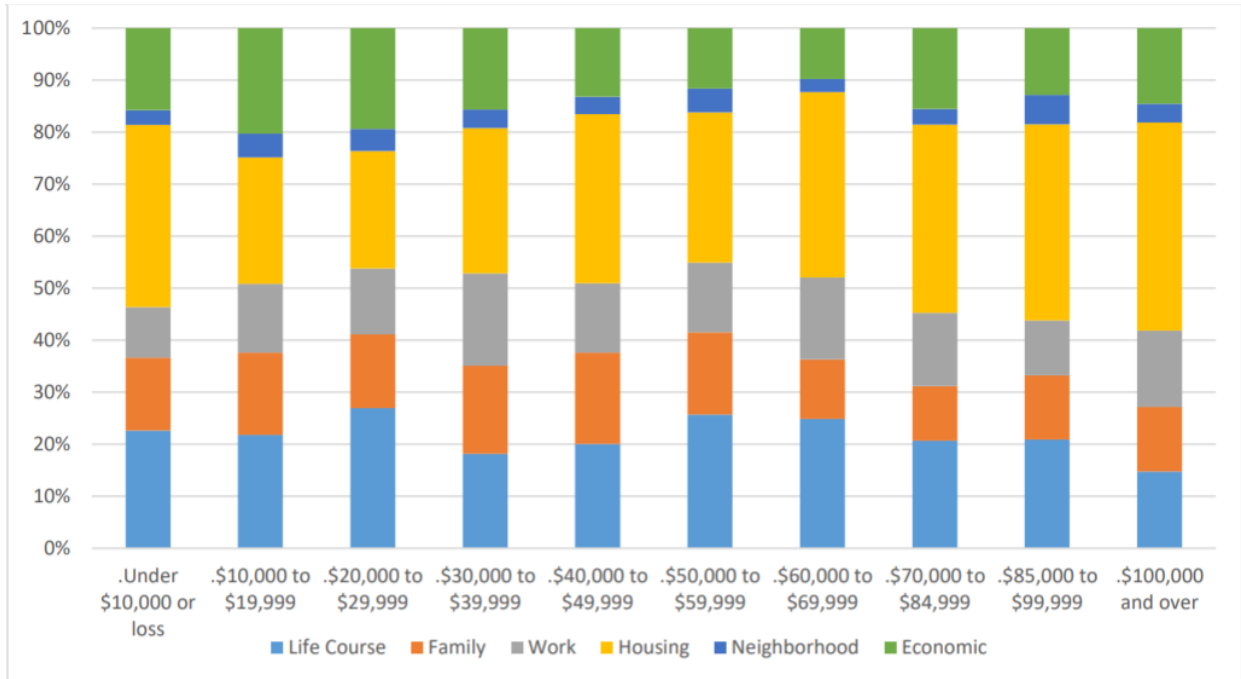


Source: US Census Bureau, Current Population Survey Table A-5

²¹ Table 1: <https://www.census.gov/content/dam/Census/library/publications/2014/demo/p20-574.pdf>

²² Irkhe (2014)

Figure 7b: Reasons Why Households Move within County, by Income, U.S. National, 2012-2013



Source: US Census Bureau, Current Population Survey Table 24-2

Effects of Rail Transit on Residential Mobility

Red and Purple Line Subway Neighborhood Demographics

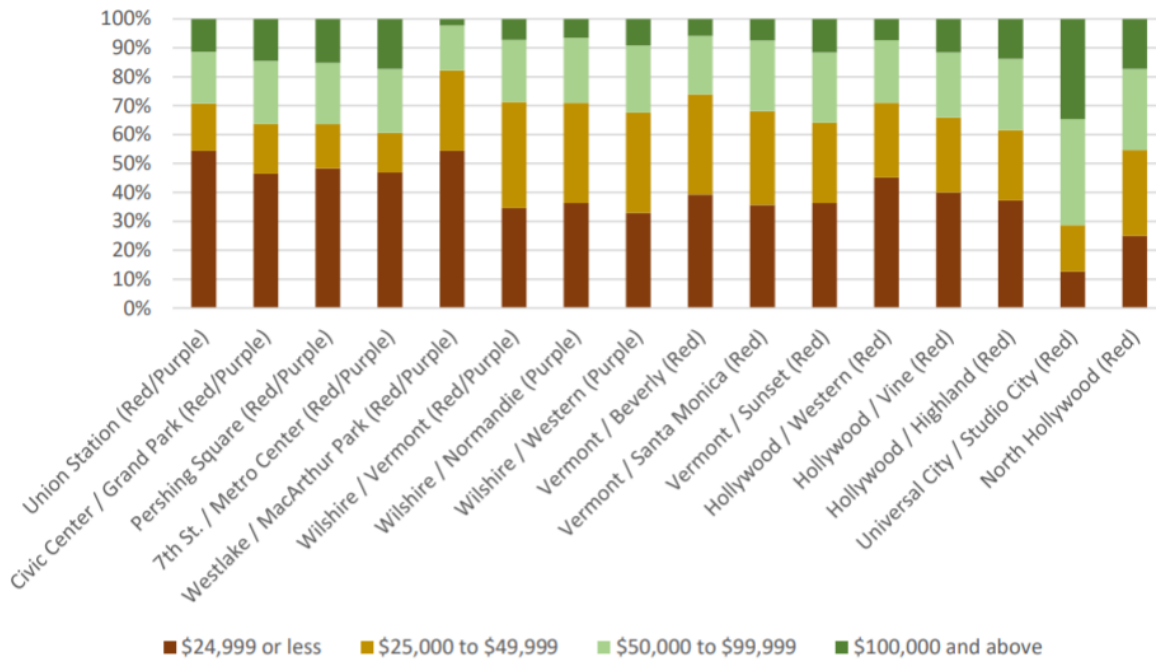
The Red and Purple Subway Line corridors pass through the Downtown, Westlake, Koreatown, East Hollywood, Hollywood, Studio City, and North Hollywood neighborhoods of Los Angeles (see figure 19 in appendix for map). Subway service first opened from Downtown to Westlake in 1993, then extended to Koreatown by 1996, to East Hollywood by 1999, and to Hollywood and to the San Fernando Valley by 2001. The next several charts characterize the demographics of the neighborhoods within 15-20 minute walking distance of each station area along these subway lines.²³

Median household incomes in the neighborhoods surrounding Red/Purple Line stations are below L.A. County median incomes, except for Universal City / Studio City. However, most neighborhoods have a mix residents by income, spanning the entire income distribution (Figure 8). The Red/Purple Subway Line corridor is a racially and ethnically diverse area. Latino households comprise more than half of the population in the Westlake, Vermont/Beverly, and Vermont/Santa Monica station areas, and more than 40% in Wilshire/Vermont and Wilshire/Normandie (Figure 9). The stations in Koreatown and in Downtown also have high

²³ Demographics charts (figures 8-12) drawn from Boarnet et al. (2015)

populations of Asian households, well above L.A. County medians. Downtown also has some African American households. Nearly every station area has a higher foreign-born population than the L.A. County average (Figure 10). The Koreatown and Westlake neighborhoods in particular have high proportions of immigrants. Lower-income households, minority households, and foreign-born households are all more likely to use transit and more likely to not own a vehicle.²⁴ A move away from neighborhoods served by a rail station will likely impact these groups more than the general population, making this study even more salient.

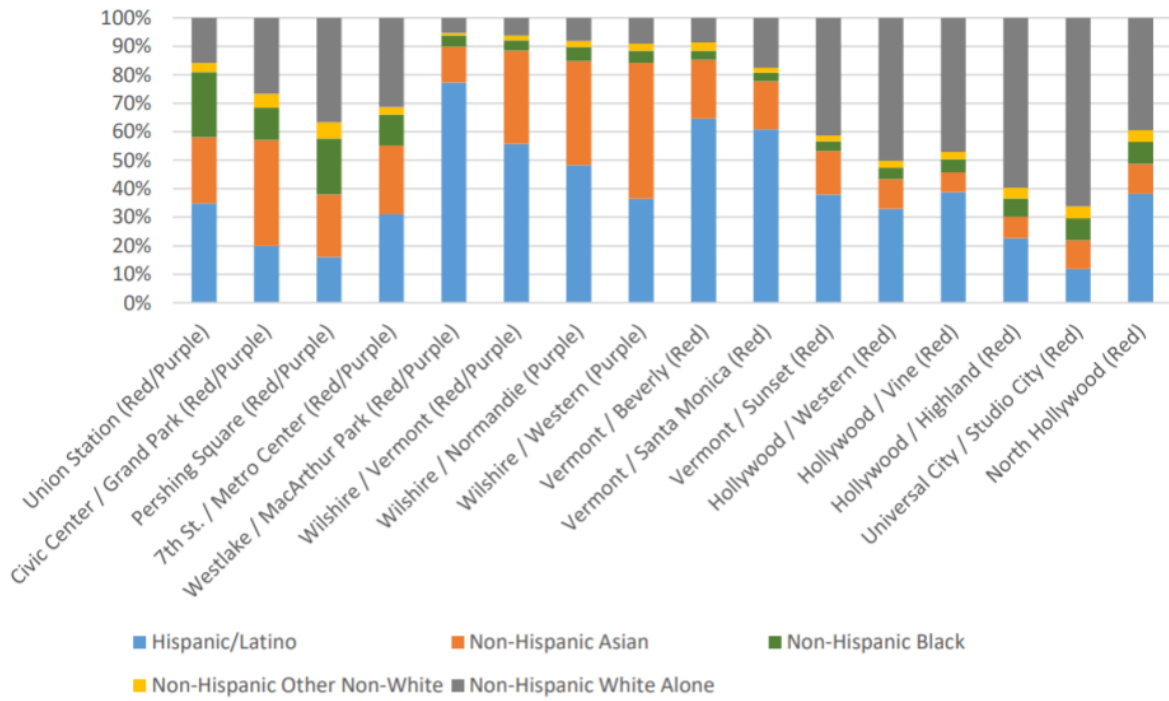
Figure 8. Red/Purple Line, Household Income Distribution, Half-Mile Station Areas



Source: American Community Survey (ACS) 2009-2013, Boarnet et al. (2015)

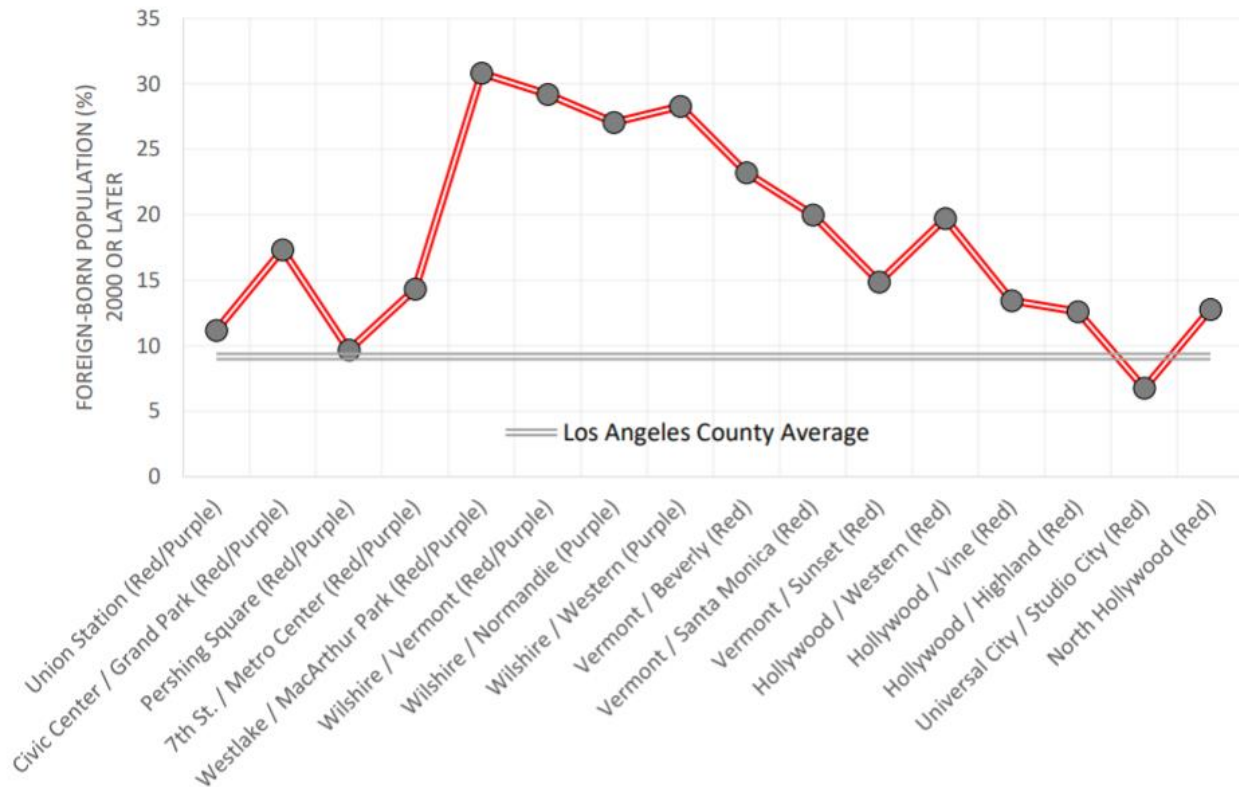
²⁴ Boarnet et al. (2015)

Figure 9. Red/Purple Line, Race/Ethnicity of Residents within Half-Mile of Stations



Source: American Community Survey (ACS) 2009-2013, Boarnet et al. (2015)

Figure 10. Red/Purple Line, Foreign-born Population (arriving in the U.S. after 2000) within Half-Mile of Stations

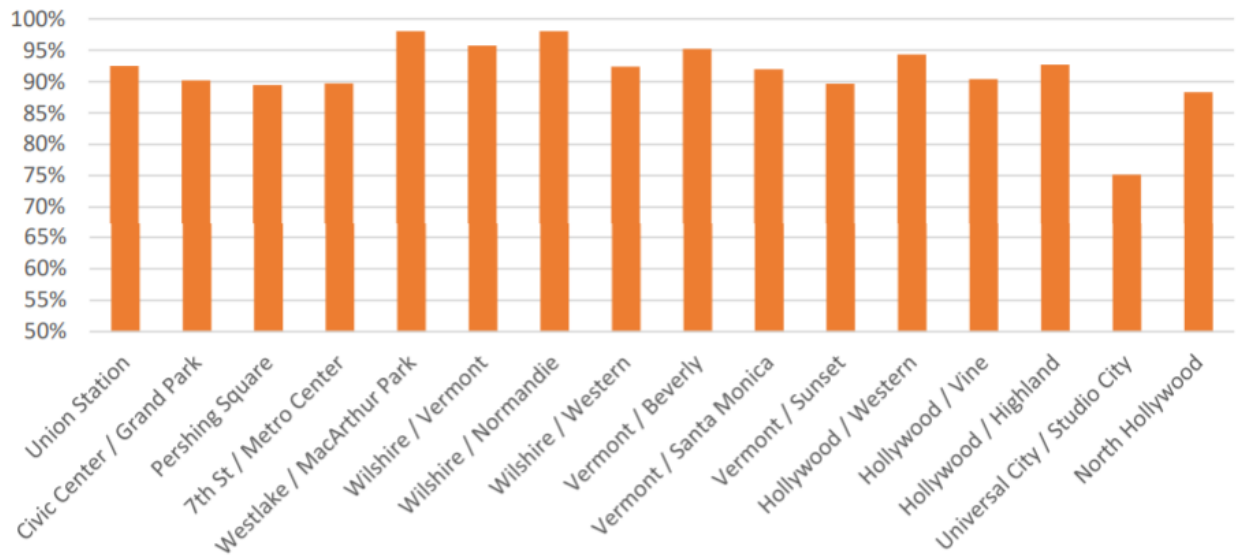


Source: American Community Survey (ACS) 2009-2013, Boarnet et al. (2015)

Over 80% of housing units within one half-mile of Red/Purple Line stations are rentals rather than owned homes (Figure 11)²⁵. This is a very high rental proportion for the city and county of Los Angeles and even more so for the United States. The high proportion of renters as well as the relatively low income of inhabitants likely increases the baseline mobility rates in these neighborhoods. Median rents range between \$800-\$1200 per month (Figure 12). This is lower for all stations than the Fair Market Rents for Los Angeles County calculated by the U.S. Department of Housing and Urban Development (HUD), except for University City / Studio City station. The Red and Purple Line stations opened between 1993- 2001. Since 2000, about half of stations have seen a significant increase in residential construction, both for renter-occupied and owner-occupied units (Figure 13). Rents for newly built units in Downtown and Koreatown are higher than median rents by \$400-\$800 per month, and in Hollywood, Studio City, and North Hollywood by \$600-800 per month (Figure 13). On the other hand, rents for new units in East Hollywood are very similar to neighborhood medians, though these neighborhoods have seen much less residential development than the other stations.

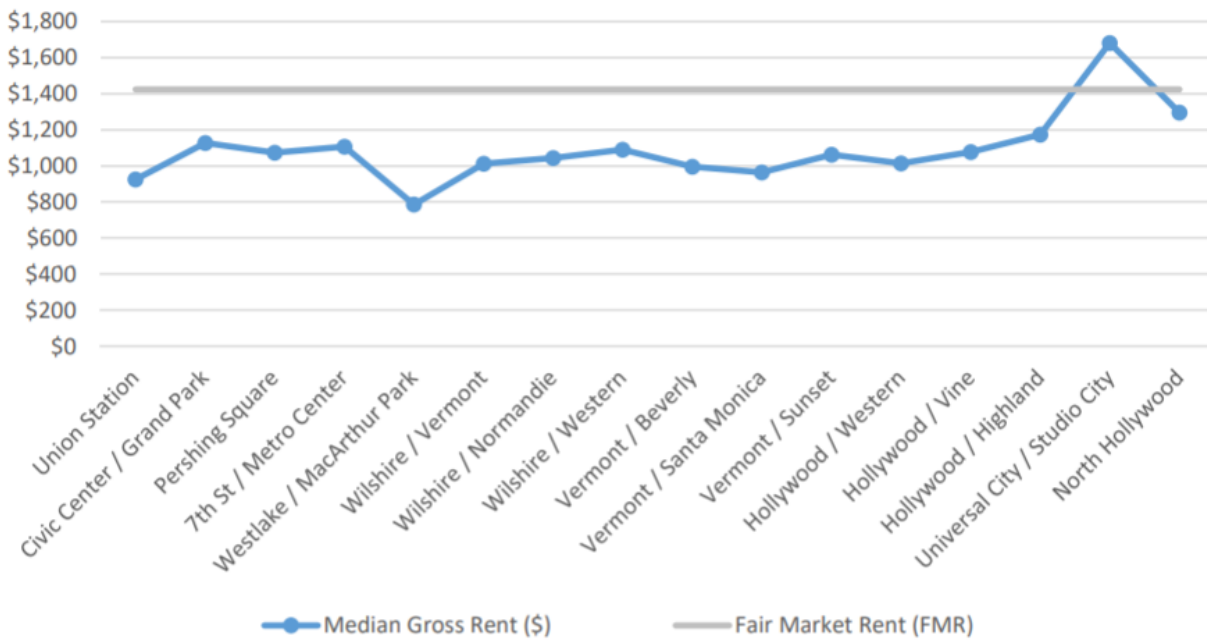
²⁵ except for University City/Studio City station, which has 75% renters

Figure 11. Red/Purple Line, Renter Occupied Units Percentage



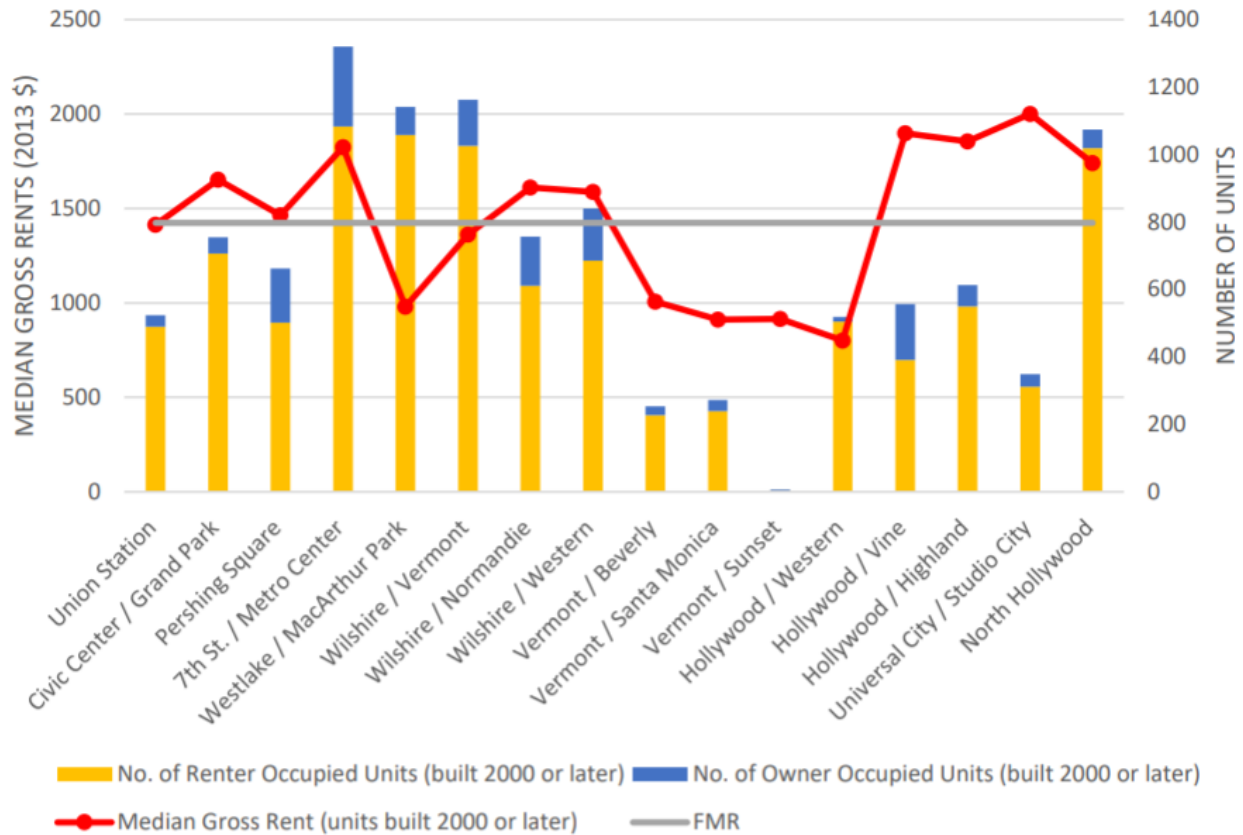
Source: American Community Survey (ACS) 2009-2013, Boarnet et al. (2015)

Figure 12. Red/Purple Line, Estimated Median Gross Rent (2013 \$) within Half-Mile of Stations



Source: American Community Survey (ACS) 2009-2013, Boarnet et al. (2015)

Figure 13. Red/Purple Line, Estimated Median Gross Rent of New Units (built 2000 or later) within Half-Mile of Stations

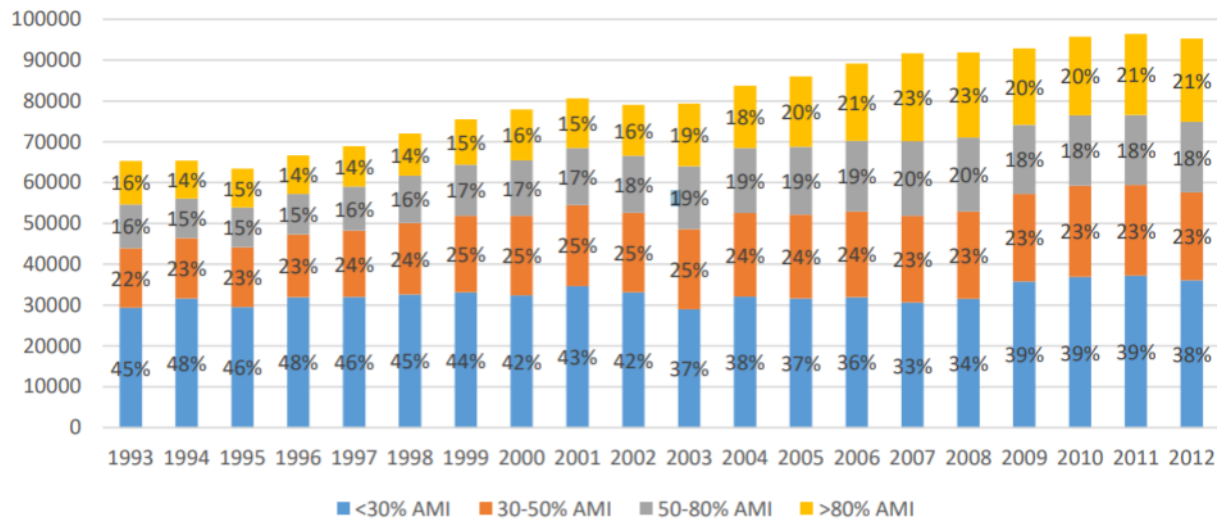


Source: American Community Survey (ACS) 2009-2013, Boarnet et al. (2015)

Measuring Mobility on the Red and Purple Subway Lines

The Red and Purple Subway Line corridors pass through several neighborhoods of Los Angeles city, including Downtown, Westlake, Koreatown, East Hollywood, Hollywood, Studio City, and North Hollywood. Since 1993, the number of households living within the Red-Purple Line corridor (within 15 stations and their surrounding neighborhoods) has increased from around 65,000 to 95,000, growing at an average annual rate of 2%. The growth has not been even by income group (Figure 14). The wealthier households (those with incomes above 80% of AMI) have grown the fastest (3.5% annually), followed by middle income (50-80% of AMI, growing at 2.6% annually), then lower-middle income (30-50% of AMI, growing at 2.1% annually), and finally low income (below 30% of AMI, growing at 1.1% annually). This reflects a compositional shift toward higher income in the population of households.

Figure 14: Number of Households²⁶ by Income Group, Red-Purple Line Station Neighborhoods, 1993-2012.



Source: Author calculations from FTB data.

Growth has not been even across Red-Purple Line station areas. Downtown-area stations, Wilshire/Vermont, and Hollywood/Western have seen the largest overall growth in households (Table 14, right-most column). In general, growth rates are higher for stations which had fewer than 5,000 households in 2012, likely reflecting more capacity for growth (more empty or low-zoned lots, more development potential) than some of the more populated station areas. Most stations saw more growth in higher income groups (Table 15), reflecting the broader corridor-wide trend in Figure 13. This trend was particularly pronounced in many station areas surrounding East Hollywood: Hollywood/Western and Vermont/Sunset; the eastern side of Koreatown: Vermont / Beverly and Wilshire / Vermont; and in Hollywood/Highland.

²⁶ This graph shows households who are in the data (anywhere) for at least two consecutive years. See Boarnet et al. (2017) for methodological details.

Table 15: Station-Area Household²⁷ Growth Rate by Income Group, by Income Group, Red-Purple Line Station Neighborhoods, 1994-2012²⁸

Stations West-to-East	Number of Households (2012)	<30% AMI growth rate	30-50% AMI growth rate	50-80% AMI growth rate	>80% AMI growth rate	All Incomes Growth Rate
North Hollywood	5,000-10,000	1%	1%	1%	2%	1%
Universal City / Studio City	<5,000	4%	4%	3%	5%	4%
Hollywood / Highland	<5,000	2%	3%	5%	7%	4%
Hollywood / Vine	5,000-10,000	0%	1%	3%	5%	2%
Hollywood / Western	<5,000	4%	5%	8%	8%	6%
Vermont / Sunset	<5,000	2%	3%	4%	7%	4%
Vermont / Santa Monica	5,000-10,000	0%	1%	2%	3%	1%
Vermont / Beverly	<5,000	2%	3%	6%	8%	4%
Wilshire / Western	>10,000	0%	1%	2%	3%	1%
Wilshire / Normandie	>10,000	1%	3%	4%	5%	2%
Wilshire / Vermont	<5,000	3%	4%	7%	9%	5%
Westlake / MacArthur Park	5,000-10,000	1%	2%	3%	2%	2%
Pershing Square	<5,000	0%	6%	8%	7%	5%
Civic Center / Grand Park	<5,000	2%	10%	11%	10%	7%
Union Station	<5,000	0%	0%	1%	2%	1%

Source: Author calculations from FTB data.

²⁷ This graph shows households who are in the data (anywhere) for at least two consecutive years. See Boarnet et al. (2017) for methodological details.

²⁸ For station-level growth rates, we use 1994-2012 growth rates rather than for 1993-2012 for data consistency purposes

The Effect of Rail Station Openings on Residential Mobility

To ascertain the effects of rail station openings on residential mobility, we compare neighborhood-level out-mobility rates before and after a station opens, within the 15 Red/Purple Line neighborhoods. However, there may be influences on mobility rates, other than rail station openings. To isolate the effect of the rail station opening from other possible influences, we select a comparison neighborhood for each Red/Purple Line stop, called ‘control’ neighborhoods. These ‘control’ neighborhoods have similar demographic characteristics and are near the Red/Purple Line neighborhoods but do not have rail stations in them.²⁹³⁰

First, we measure a baseline mobility which measures the annual out-mobility rate before rail stations open in Red/Purple Line station and control neighborhoods (represented by the Blue columns in Figure 16). On average, the out-mobility rate along the Red/Purple line is about 30% across all incomes, much higher than the county-wide 21% rate. Additionally, higher income households’ baseline out-mobility rate is about 25%, lower than that for lowest-income households.

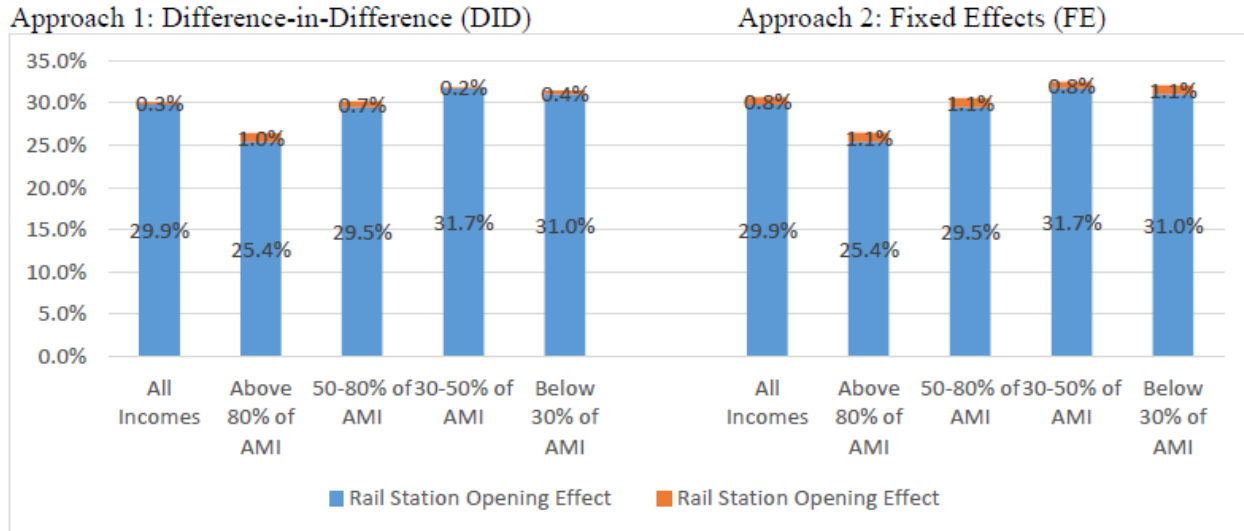
Next, we measure the effect of rail station openings using two approaches.³¹ Approach 1 measures the after-effect of rail-station openings in Red/Purple Line station neighborhoods and compares it to controls (Figure 16, left-hand side), using averages of the before- and after-opening time periods. The effects are very small 0-1% across income groups. The magnitude of this effect is dwarfed by the already-high baseline mobility rates. Approach 2 controls for other things that may influence out-mobility rates but are unrelated to the rail station opening, such as regional economic trends or neighborhood-specific idiosyncrasies. Here again the effect sizes are small, 0.8-1.1% annually. From a statistical perspective, only the effects on all incomes and on the lowest-income households in Approach 2 are significantly different from zero.

²⁹ See Appendix Figure 20 for a map and Appendix B for a more detailed explanation

³⁰ Using control neighborhoods as a comparison group is also helpful to thwart potential bias in rail-station neighborhood selection, since siting of rail stations is often of a political and planning nature, rather than a technical optimization based on ridership or other characteristics. See Schuetz et al. (2016) for a discussion.

³¹ see Appendix A for a more detailed explanation

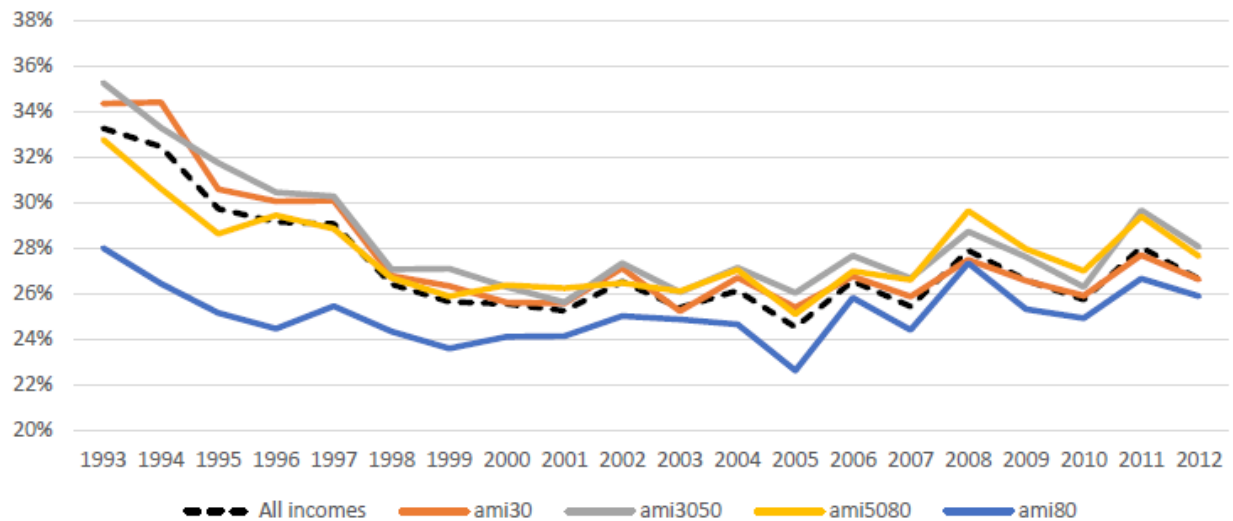
Figure 16: Out-Mobility Rate and Rail Station Opening Effect Estimates by Income Group for Red-Purple Subway Line Neighborhoods and Controls



Source: Approaches 1 and 2 predicted values calculated by author from FTB data.

Estimating the out-mobility trends annually gives a more nuanced picture (Figure 17). While the two-decade Red/Purple Line out-mobility average is 30%, it does follow a pattern similar to L.A. County and the U.S. overtime: decreasing mobility from about 33% through the 1990s and plateauing in the 2000s at around 26%. Interestingly, out-mobility from these neighborhoods increased slightly during and after the Great Recession. The various income groups follow a similar pattern over time. However, the mobility rates for lowest, lower, and middle-income households converge closer to the higher-income households in the 2000s.

Figure 17: Red-Purple Subway Line Mobility Rate Estimates by Year by Income Group³²



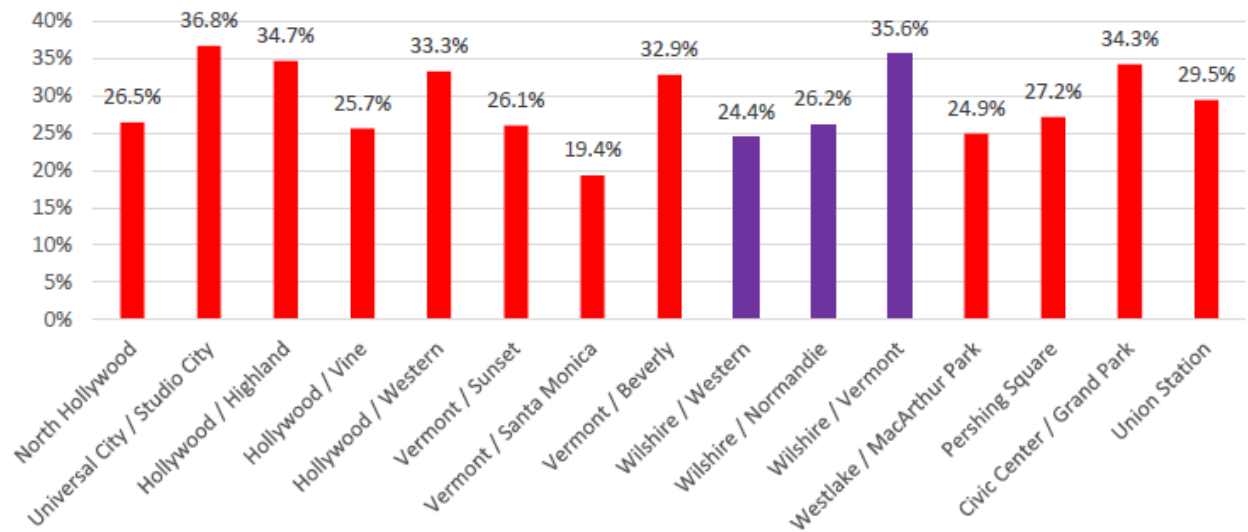
Source: Predicted values calculated by author from FTB data.

³² Predicted values for 'Alternative 2' – fixed-effects model

We compare each Red/Purple Line station out-mobility rate estimate to the 30 percent line-wide average to see trends in particular neighborhoods (Figure 18). Mobility rates vary across stations by as much as 18 percentage points. This variation does not seem to be correlated with demographic or development patterns described in figures 8-12: income, renter proportion, minority and foreign-born percentage, rents, or the number of new units built.

Digging deeper into each station area, Table 19 provides a breakdown of out-mobility rates per station by income group. Several patterns emerge. In ten out of fifteen stations, the lowest-income group has a higher-mobility rate than the highest-income group; some by as much as 10% higher (Vermont/Santa Monica, Universal City/Studio City, and Pershing Square). In the remainder, the highest-income group in fact has the highest mobility rate. Finally, several station areas have higher mobility rates in the lower-middle and middle-income groups, compared to either the lowest- or highest-income, including Hollywood/Western and Universal City / Studio City. This variety of patterns continues to underscore the diversity of experience for households of different income groups across these neighborhoods.

Figure 18: Out-Mobility Rate Estimates by Red/Purple Line Station Neighborhood³³ (Ordered West to East, Purple Line Stations in Purple, Red Line in Red)



Source: Approach 2 predicted values calculated by author from FTB data.

³³ Predicted values for 'Alternative 2' – fixed-effects model

Table 19: Out-Mobility Rate Estimates by Red/Purple Line Station Neighborhood by Income Group³⁴ (Ordered West to East, Purple Line Stations in Purple, Red Line in Red)

Station Neighborhood	<30% AMI	30-50% AMI	50-80% AMI	>80% AMI
North Hollywood	26.6%	26.8%	26.3%	26.1%
Universal City / Studio City	38.2%	40.8%	40.4%	33.7%
Hollywood / Highland	35.5%	35.6%	34.8%	32.8%
Hollywood / Vine	25.7%	25.6%	25.2%	26.2%
Hollywood / Western	33.2%	34.4%	34.3%	30.2%
Vermont / Sunset	26.5%	26.5%	25.7%	24.3%
Vermont / Santa Monica	19.7%	19.5%	19.2%	17.4%
Vermont / Beverly	33.2%	34.1%	30.9%	30.8%
Wilshire / Western	24.9%	24.2%	23.9%	23.9%
Wilshire / Normandie	26.2%	25.8%	26.2%	26.4%
Wilshire / Vermont	35.4%	36.3%	35.5%	34.2%
Westlake / MacArthur Park	24.4%	24.8%	26.1%	26.2%
Pershing Square	28.3%	28.6%	28.8%	25.3%
Civic Center / Grand Park	32.8%	33.1%	33.7%	34.2%
Union Station	27.9%	29.1%	31.9%	30.3%

Source: Approach 2 predicted values calculated by author from FTB data.

Discussion

This report examines out-mobility patterns in the Red/Purple Line subway corridor and situates them in the context of county-level and national trends. Our major finding is that the estimated average annual out-mobility rate is 30% in the Red/Purple Line corridor. This is comparable to the mobility rate for renters nationally, which makes sense since renters make up 80-90% of households living along the Red/Purple Line. Thirty percent is higher than the 21% out-mobility estimate for Los Angeles County, but the county only has 54% renters – more than the nation but less than the Red/Purple Line area.

A 30% out-mobility rate in transit-oriented neighborhoods indicates much flux. Possibly, the composition of a whole neighborhood could change in four years, with all new residents, though this scenario is not very likely. At the same time, the number of households in these neighborhoods has grown since from 65,000 in 1993 to 95,000 in 2013. This implies that the in-mobility rate is even higher than the out-mobility rate and indicates much turnover in the Red/Purple Line corridor over the past two decades. Together, these findings beckon at least three follow-up questions: why is there so much mobility, what are the outcomes for households, and what are the outcomes for neighborhoods?

Households across the U.S. move for many reasons, with housing chief among them. In this report, we examine whether the opening of a new rail station helps explain the high mobility in

³⁴ Predicted values for 'Alternative 2' – fixed-effects model

the Red/Purple Line corridor. We find that our estimated effect of a new rail station opening on the out-mobility rate is small, likely an increase of 0-1%. This 0-1% is dwarfed by the overall 30% mobility rate.

We believe there are several possible reasons for why the rail-station effect is low. Our use of California income tax data filing locations to measure household moves only considers those who file taxes and may not represent the full population, thus lowering the rail-station effect estimate. In California, households do not need to file taxes if they earn below \$8,000 for single persons and \$16,000 for families.³⁵ Though, about 75% of California households claim the Earned Income Tax Credit (EITC), a tax credit for low and lower-middle income working households often with children, which requires them to file a tax return.³⁶ Federal estimates of tax non-compliance (non-filing) range from 10 – 16% in the mid-2000s³⁷; in California, this is estimated at 11% during the same time period³⁸. A study of federal tax non-filers using 2005 data confirms that many households who do not file taxes may have annual incomes below \$20,000, an amount below which households are not mandated to file.³⁹ This may lower our rail-station effect estimates further, as we find that lower-income households move more frequently than higher-income households.

There are several other possible reasons why our estimates of the rail-station effect may be low. First, Los Angeles County has a high population of undocumented households, many of whom may not be filing tax, and thus would not be in our database. Second, the development effects and behavior change from new transit investments can be felt over a long period of time, often as much as a few decades. Half of the stations in this report have been open over twenty years, others a little less. Perhaps the effects of stations need to be measured over a longer time frame. Third, we exclude households who do not appear in the data in consecutive years. This may disproportionately affect lower-income households who may not be required to file every year. Together, all of these reasons possibly affect the low rail-station opening effect. Yet, we cannot overstate the importance of better understanding the causes and outcomes of the very high baseline mobility rates along the Red/Purple Line. Our future research is focused on better understanding the characteristics of movers, their destination neighborhoods, and in-mobility rates.

³⁵ California Franchise Tax Board (2017). “2016 California Tax Rate Schedules”.

³⁶ U.S. Internal Revenue Service. (2014). “EITC Participation Rate by States”.

³⁷ U.S. Internal Revenue Service. (2012); U.S. Internal Revenue Service. (2010)

³⁸ California Franchise Tax Board (2006)

³⁹ Lawrence et al. (2011)

Appendix

Regression Model Equations

Two regression models were utilized to attempt to isolate the effect of rail station openings on neighborhood-level out-mobility rates: 1) Difference-in-Difference (DID) model and 2) Fixed Effects (FE) model.

The Difference-in-Difference (DID) model measures the effects of an event on a population (called the treatment group) before and after the event, and compares it to a similar population (called the control group) that could have, but did not experience the event, also before and after the event occurred. In this case, the event is the opening of a rail-station, denoted by the binary variable *rail_open*, which takes the value of 1 if the rail station in question is open in that year and 0 otherwise. The treatment group is neighborhoods within one half-mile of the rail station and the control group are neighborhoods that are at least 1 mile from the rail station and have similar population density, minority proportion, and income (see Appendix B below for details). The variable *treatment* takes a value of 1 for the rail station neighborhoods and 0 for the controls. An underlying assumption of this model is that the trend in out-mobility rate is similar in direction before the event in both control and treatment groups.

Our dependent variable is the out-mobility rate by neighborhood, represented by *Y*. A baseline average level of out-mobility is represented by α , in Equation 1 below. Next, the DID model tests whether there is an initial difference in out-mobility between control neighborhoods and treatment neighborhoods, this is represented by β . The model also tests for the difference before and after the event occurs, for all stations, represented by γ . Finally, δ is our coefficient of interest, representing the effect on rail station neighborhoods once the station is open. ε represents unexplained error in the model.

Equation 1:

$$\text{Out Mobility Rate } (Y) = \alpha + \beta * \text{treatment} + \gamma * \text{railopen} + \delta * (\text{treatment} * \text{railopen}) + \varepsilon$$

The rail station-opening effect, δ , can also be obtained using by subtracting sample averages from each sub-group, as in Equation 2.

Equation 2:

$$\delta = (Y_{\text{treatment, post-event}} - Y_{\text{treatment, pre-event}}) - (Y_{\text{control, post-event}} - Y_{\text{control, pre-event}})$$

The Fixed Effects (FE) regression measures the effects of an event on a population controlling for non-changing characteristics of the population in question and controlling for external events which do not affect the event. The dependent variable is the out-mobility rate *Y* and the baseline level of out-mobility is represented by α , in Equation 3 below. Our coefficient of interest is again δ , representing the effect on rail station neighborhoods once the station is open. Additionally, we add two ‘fixed effects’: time and geography. The fixed effect *Year* is a variable that takes the value of 1 in a particular year, 1993-2012. This controls for external, city-wide, or economy-wide phenomena that may affect the out-mobility rate in all neighborhoods,

control and treatment, and that are not related to whether a station has opened or not. It is hence ‘fixed’ across all station areas. The second fixed effect, *Neighborhood_i*, takes the value of 1 for each neighborhood (treatment or control), across each year. This controls for neighborhood-specific idiosyncrasies that may affect the out-mobility rate but are not related to whether a station has opened there or not. These effects are things that generally do not vary year to year. ε represents unexplained error in the model.

Equation 3:

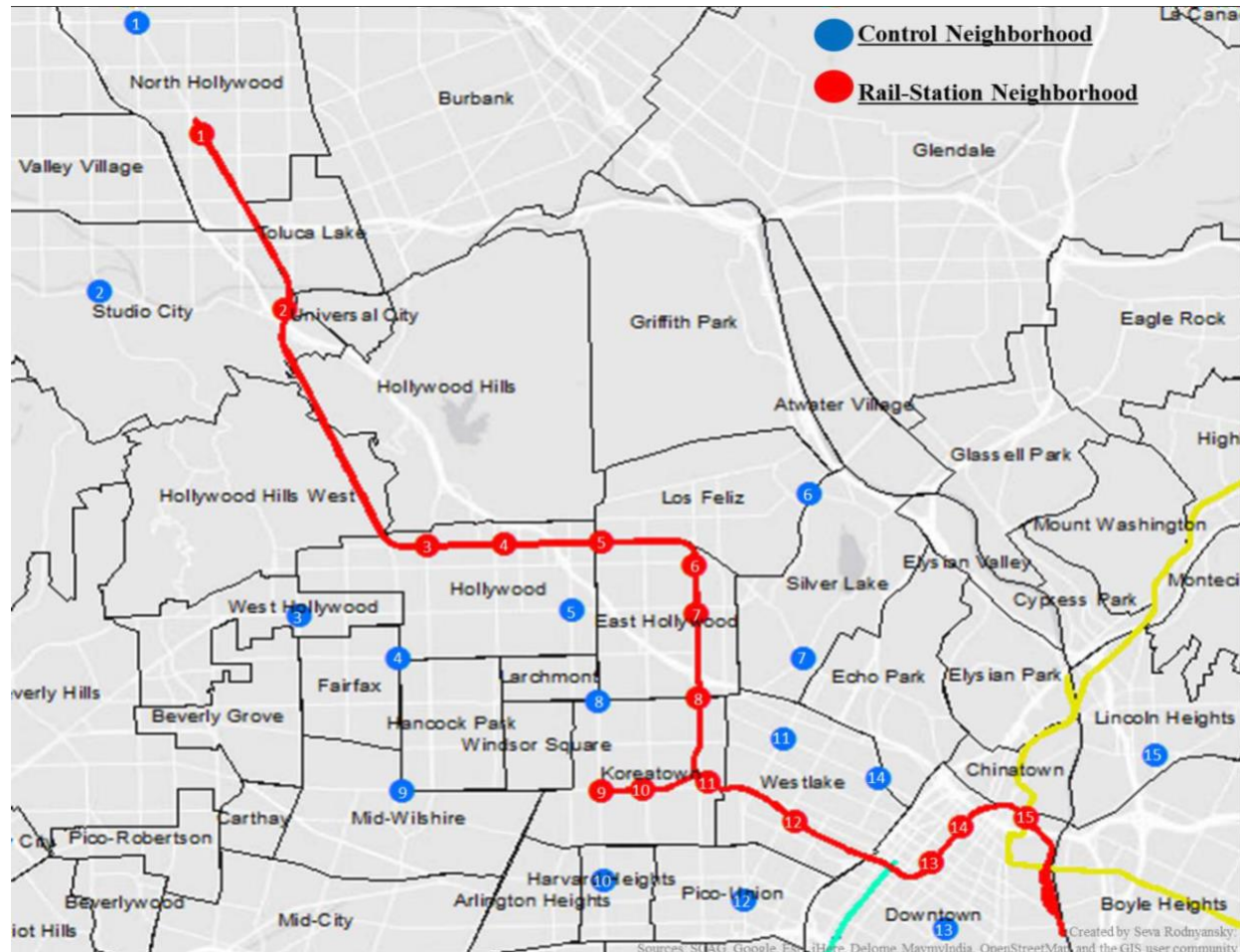
$$\text{Out Mobility Rate (Y)} = \alpha + \delta * (\text{treatment} * \text{railopen}) + \text{Year} + \text{Neighborhood}_i + \varepsilon$$

Control Neighborhood Selection

Control neighborhoods were selected to test whether mobility rates were affected by rail station openings or by other factors. Each rail station was paired with a control neighborhood, surrounding a major road intersection at least one mile away from the station itself. The control neighborhoods were picked to have similar population density, proportion of minority households, and income to the neighborhoods surrounding the rail station. Ostensibly, the control intersections could have received a rail station, but did not, due to political or planning processes. Neighborhoods were drawn as half-mile circles around the control intersections.⁴⁰ Table 20 shows the control pairs for Red/Purple Line subway stations.

⁴⁰ For more information on control neighborhood selection, see Boarnet et al. (2017).

Figure 20: Maps of Los Angeles City Neighborhoods and Red/Purple Subway Line Stations and Controls



Created by Seva Rodnyansky: Sources: SCAG, Google, Esri, iHere, Delorme, MaymyIndia, OpenStreetMap, and the GIS user community

Table 21: List of Rail Station Neighborhoods and Paired Controls (Ordered West to East)

Red/Purple Line Rail Station Neighborhood	Paired Control Neighborhood
North Hollywood	Victory / Lankershim / Colfax
Universal City / Studio City	Ventura / Laurel Canyon
Hollywood / Highland	Fairfax / Santa Monica
Hollywood / Vine	Melrose / La Brea
Hollywood / Western	Wilton / Santa Monica
Vermont / Sunset	Rowena / Hyperion
Vermont / Santa Monica	Sunset / Silver Lake
Vermont / Beverly	Western / Beverly
Wilshire / Western	Wilshire / La Brea
Wilshire / Normandie	Pico / Western
Wilshire / Vermont	Beverly / Rampart
Westlake / MacArthur Park	Venice / Hoover
Pershing Square	San Pedro / 8th St
Civic Center / Grand Park	1st / 2nd / Lucas / Beverly / Glendale
Union Station	Main / Griffin

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