# Is Just Growth Smarter Growth?

## The Effects of Gentrification on Transit Ridership and Driving in Los Angeles' Transit Station Area Neighborhoods

Prepared for the Bus Riders Union

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# 1. Executive Summary

Los Angeles in is in the midst of a dramatic transformation of our transportation systems and land use patterns. In 2008, the county passed Measure R, which will pump $16 billion dollars into 11 new transit lines and more than 70 light rail stations over the next several decades[1]. This investment will catalyze striking changes for the neighborhoods surrounding these stations. The private sector, the City of Los Angeles, and Metro, the region's transit operator, have targeted station areas for new, dense, mixed-use development, or transit-oriented development (TOD). By placing more people within close walking distance of transit and making non-automotive travel more attractive, planners contend that TOD can increase transit ridership, decrease automobile trips, and build toward a more sustainable city.

While these environmental goals are admirable, there is mounting empirical evidence nationally that TOD, as typically practiced, can have significant human and environmental costs. Recent research suggests that transit stations appear to be contributing to the gentrification of surrounding neighborhoods,[2] forcing current residents to move away from their current neighborhoods, schools, work and social and cultural networks. In addition, it appears that gentrification can decrease transit ridership in the neighborhoods around transit stations. As communities increase in value, they tend to show decreases in low-income transit riders and influxes of new, wealthier residents—many of whom bring and use cars.[3]

To date, no work has been done in Los Angeles to assess whether these national trends are taking place here. Additionally, I am aware of no researchers in this country have used statistical methods to quantify the relationship between station area gentrification and travel. This report aims to fill these gaps, asking: Over the past two decades, has gentrification had an effect on commute mode for residents living near rail stations? Specifically, has it increased or decreased driving and/or transit use?

### Research Question

*Over the past two decades, has gentrification had an effect on commute mode for residents living near rail stations? Specifically, has it increased or decreased driving and/or transit use?*

## Methodology

This study seeks to clarify the relationship between gentrification and transit station area residents' commute mode choices. While it is possible to draw some conclusions about this relationship simply by measuring travel pattern trends in gentrifying and non-gentrifying neighborhoods, socioeconomics are only one of the many factors that influence travel patterns.[4] If other factors such as location, density, and the availability of transit are not taken into account, they may obscure or distort the true relationship between gentrification and travel. This analysis, then, uses a statistical technique called linear multiple regression, which controls for these other variables in order to isolate the effects of gentrification on travel behavior. It also allows me to explore the relative influence of a variety of factors that may be shaping travel in Los Angeles transit station areas.

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[1] Metro. (2011). *Measure R.* Los Angeles. Retrieved from: http://www.metro.net/projects/measurer/.
[2] Pollack, S., Bluestone, B., & Billington, C. (2010). *Maintaining diversity in America's transit-rich neighborhoods: Tools for equitable neighborhood change.* Dukakis Center for Urban and Regional Policy. Boston, MA.
[3] Ibid.
[4] See Literature Review.

My analysis is focused on the census tracts within a walkable distance (1/2 mile) of trunk-line transit services (heavy rail, light rail, and bus rapid transit) stations operated by Metro. I utilize data from the 1990, 2000, and 2010 decennial censuses, the 2006-2010 American Community Survey (ACS), and the 2000 Census Transportation Planning Package, as well as transit maps, schedules, and reports from Metro and other transit agencies.

I have measured gentrification using two income variables (added high- income households and lost low-income households), as well as changes in race/ethnicity, occupation, and education. Because gentrification occurs specifically in low-income areas, I created an index of these variables weighted by the percentage of households considered low-income in 1990. Variation in travel behavior is expressed as the numerical change in the number of residents who travel to work on transit or drive to work alone. I also include a number of other variables in my analysis in order to control for variations that may mask the effects of neighborhood change and increase the usefulness of these models to policymakers.

To explore this question in detail, I constructed six regression models. Two illustrate the effects of gentrification and other factors on transit commuting and driving alone. The other four break gentrification into its component parts—focusing particularly on changes in household income—in order to provide specific information for decision makers concerned with maximizing transit use near transit stations.

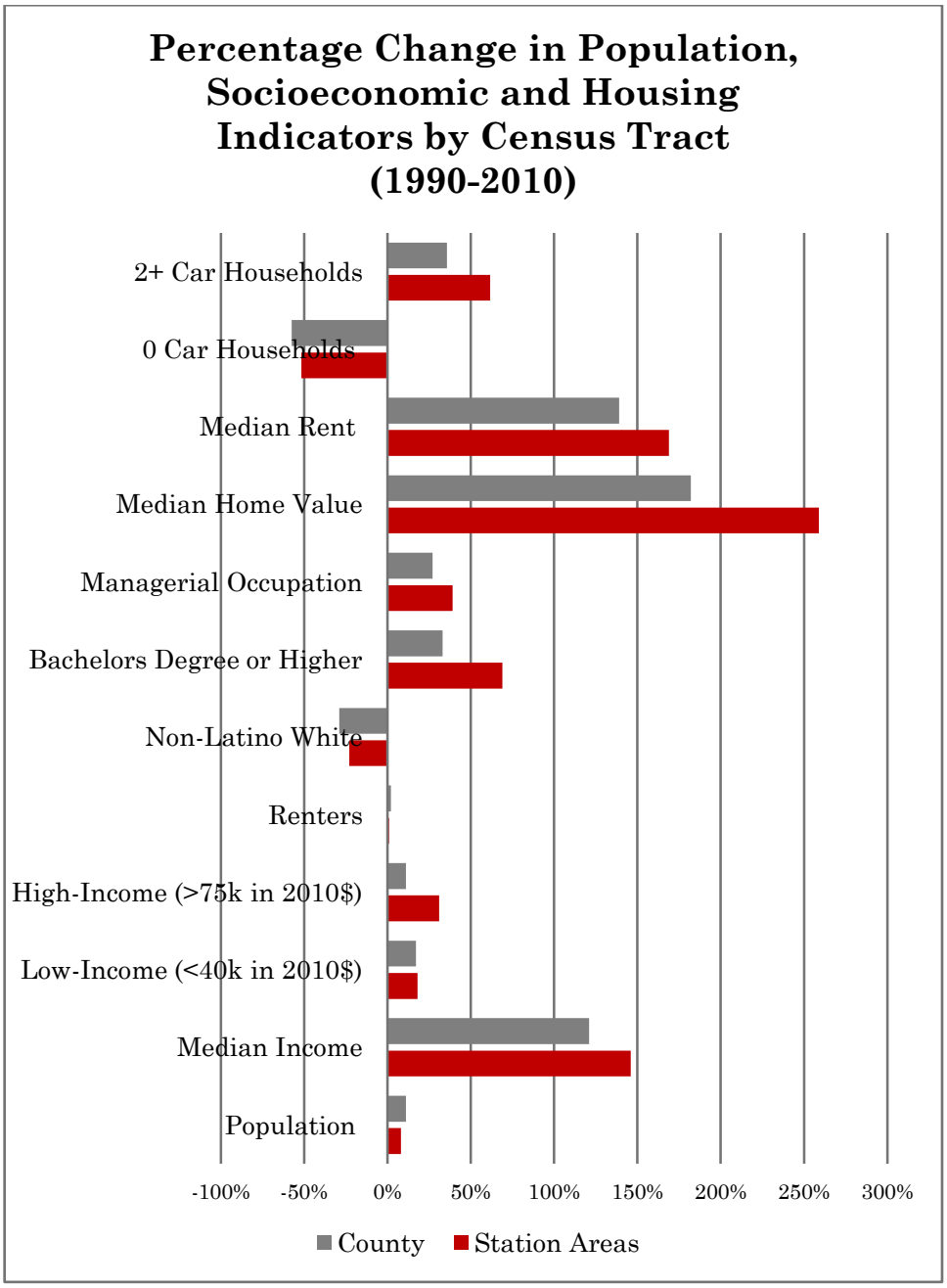
## Findings

### 1. Station areas have added high-resource households much faster than the county overall.

In 1990, Los Angeles station areas were disproportionately resource poor. Households located in station areas had dramatically lower incomes (a median of $20,000 vs. 30,000), a higher percentage of low-income households (44 vs. 31%) and a lower percentage of high-income households (17 vs. 33%) than the county overall. Station area residents were also disproportionately likely to be renters and people of color, and far less likely to have high educational attainment or work in a managerial occupation.

Over the past two decades, it appears that there has been shift in the geographic distribution of wealth and privilege in Los Angeles County—in which higher-income residents are increasingly locating in areas close to transit. Station area housing costs have grown faster than the county overall, and these neighborhoods have added higher-income, vehicle owning households faster than the county. Figure 1 at right illustrates these changes.

**Figure 1: Percentage Change in Station Area Population, Socioeconomic and Housing Indicators (1990-2010)**

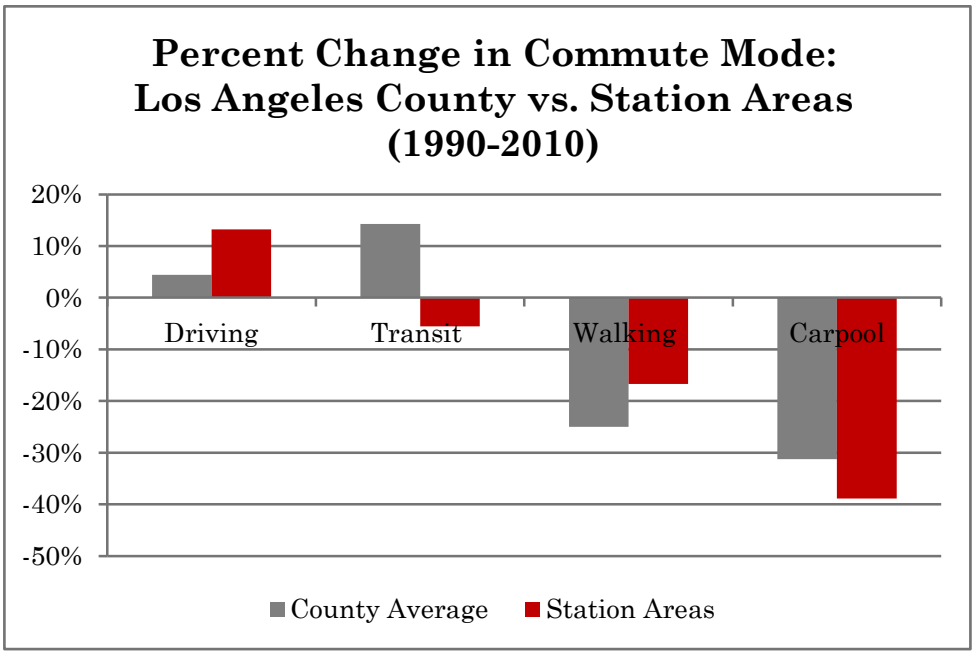



*Data Source: U.S. Census Bureau. 1990, 2000 and 2010 Decennial Census and 2006-2010 Five Year ACS.*

## 2. Not all transit stations gentrified, but many did.

Socioeconomic change has not been uniform. Many station areas, such as the Blue and Green line stations to the south of downtown, changed little over the last two decades. Other neighborhoods saw significant gentrification. Nearly all red line stations through Hollywood changed quite dramatically. While several stations downtown, such as Union Station, Pershing Square, and Grand Station have clearly gentrified, others have not changed appreciably.

**Figure 2: Percent Change in Commute Mode (1990-2010)**




### 3. Station areas lost transit riders, and gained drivers much faster than the county overall.

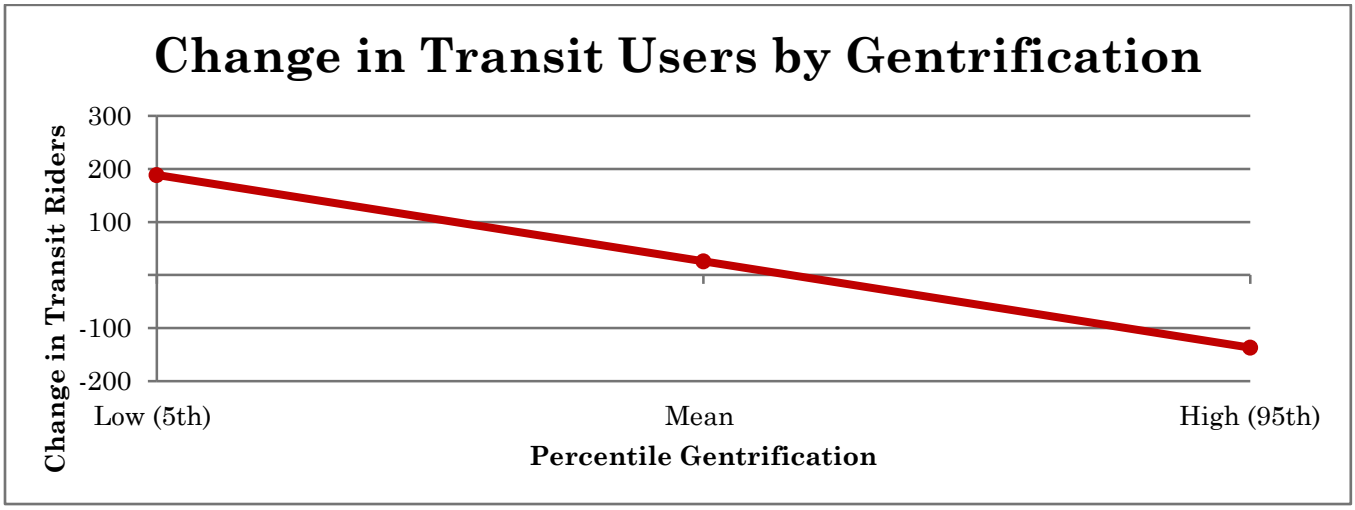
Station areas have seen dramatic change in commuting behavior in the past two decades. These areas lost transit riders and gained drivers much faster than the rest of the region. Walking and carpooling fell in both station areas and the county overall.

*Data Source: U.S. Census Bureau. 1990, 2000 and 2010 Decennial Census and 2006-2010 Five Year ACS.*

## 3. Gentrification has a strongly negative and statistically significant relationship with station area transit ridership.

The statistical models described in Section 7 indicate that gentrification—or the cumulative effects of changes in class, race/ethnicity, and social status—is significantly related to transit use, and that these effects are most pronounced in formerly disinvested neighborhoods. Controlling for other factors, tracts with the least gentrification (5$^{th}$ percentile) gained approximately 190 transit riders, while those with the most (95$^{th}$ percentile) lost approximately 140 transit riders.

**Figure 3: Change in Transit Riders by Gentrification (1990-2010)**




4. New low-income households (below $40,000) are associated with increases in transit riders, while new moderate and high-income households are associated with decreases in transit riders.

Controlling for other factors, for every 100 households earning less than $40,000 a neighborhood added, it gained on average 7 to 32 transit riders.

Those neighborhoods that gained 100 higher-income households saw on average 26 to 45 person decreases in transit riders.

**Table 1: Predicted Transit Riders per 100 Households (1990-2010)**

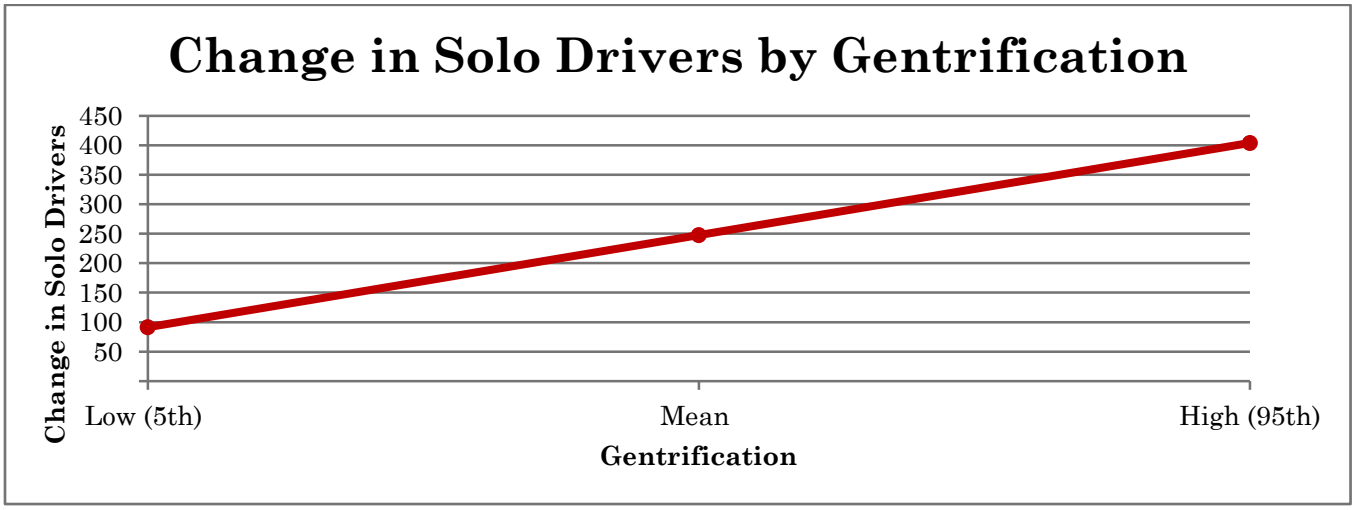
| 100 Additional | Yield | Predicted Change in Transit Users |
|---|---|---|
| Extremely Low-Income Households(<$25k) | | 7 |
| Very Low-Income Households ($25-40k) | | 32 |
| Lower-Income Households($40-60k) | | -26 |
| Moderate-Income Households ($60-75k) | | -45 |
| High-Income Households (>$75k) | | -30$_{\gamma}$ |

Notes: $_{\gamma}$ Not Significant at the .05 Level. P= .115.

5. Gentrification is associated with increased driving.

The statistical models shown in Section 7 indicate that gentrification—or the cumulative effects of changes in class, race/ethnicity, and social status—is significantly related to the number of solo drivers and that these effects are most pronounced in formerly disinvested neighborhoods. Controlling for other factors, tracts with the least gentrification (5$^{th}$ percentile) gained approximately 90 drivers, while those with the most (95$^{th}$ percentile) gained approximately 400 drivers. This effect is statistically significant, but less robust than the relationship between gentrification and transit use.

**Figure 4: Change in Solo Drivers by Gentrification (1990-2010)**




4. New low-income households (below $40,000) are associated with decreases in the number of solo drivers, while new moderate and high-income households are associated with increased driving.

Controlling for other factors, for every 100 households earning less than $40,000 a neighborhood gained, it lost on average 10 to 35 solo drivers. Those neighborhoods that gained 100 higher-income households saw on average 16 to 61 person increases in solo drivers.

**Table 2: Predicted Solo Drivers per 100 Households (1990-2010)**

| 100 Additional | Yield | Predicted Change in Solo Drivers |
|---|---|---|
| Extremely Low-Income Households(<$25k) | | -10$_{\gamma}$ |
| Very Low-Income Households ($25-40k) | | -35 |
| Lower-Income Households($40-60k) | | 38 |
| Moderate-Income Households ($60-75k) | | 61 |
| High-Income Households (>$75k) | | 16$_{\text{ɪ}}$ |

Notes: ɪ Not Significant at the .05 Level. P= .102. $_{\gamma}$ Not Significant at the .05 Level. P= .098.

5. Metro's joint development real estate activities are strongly correlated with decreased transit use.

Controlling for other factors, those station areas where Metro has partnered with private developers to facilitate development have seen decreased transit ridership. While it is not clear that joint development is directly *causing* these losses, it is clear that the joint development program is not meeting its goals. Metro should critically assess the effects of their real estate development program on transit use, as their policies are predicated on the assumption that transit-oriented development will increase patronage.

## Policy Implications

This study has dramatic implications for policymakers concerned with social equity, the efficiency of our transit system and our environmental future. The results presented above indicate that those Los Angeles County station areas that have gentrified have seen significantly decreased transit commuting and increased driving relative to those that have not. Since transit riders in Los Angeles are overwhelmingly low-income people, immigrants and people of color, it is perhaps not surprising that where these groups are displaced, transit use has declined.

These findings lead to the conclusion that in order to support station area transit use, it will be necessary to stabilize station area neighborhoods and residents. The recommendations in Section 9 outline a variety of strategies the city of Los Angeles and Metro can use to achieve these ends. These strategies are not new. A number of authors have already suggested an array of strategies to slow the process of neighborhood change.[5, 6, 7,8,9,10]

Although the suggestions in Section 9 owe much to this previous work, they differ in both specificity and scale. First, prior studies recommend policy mechanisms to preserve and build affordable housing, but largely remain agnostic as to what constitutes affordable. "Affordability" covers a wide spectrum, and many affordable units are well beyond the means of most station area residents. The results of this study suggest that it is extremely important to make station areas affordable to households earning $40,000 or less.

Second, this study differs from prior work in suggesting that these policies need to be implemented on a mass scale. Station areas are the primary engines of the region's transit ridership, housing one third (92,000) of the region's daily transit commuters, and a third (65,000) of zero car households.[11] If significant gentrification takes place in these neighborhoods, station areas stand to lose tens of thousands of transit riders. Conversely, increasing transit ridership will require preserving and building hundreds of thousands of affordable units.

Overall, this study should prompt policymakers to rethink their support for the dominant paradigm of transit-oriented development. Specifically, these findings suggest that current TOD practice, with its emphasis on attracting wealthier residents to new, mixed-income development, is entirely counterproductive. Indeed, if TOD is to be at all successful as a green development paradigm, it will need to

[5]Center for Transit-Oriented Development (2007).Finding the balance: A look at regional efforts to create mixed-income communities near transit.
[6] Rodney H., Brooks, A., & Nedwick, T. (2009). Preserving affordability and access in livable communities: Subsidized housing opportunities near transit and the 50+ population. Washington, DC: American Association of Retired Persons. 21; LA Toolkit, 21.
[7] Carlton, et al. (2012). *Mixed-Income Transit-oriented Development Action Guide*. Center for Transit-oriented Development and Reconnecting America with Funding Transit Administration.
[8] Chapple, K. (2007). Transit-oriented for all: the case for mixed-income transit-oriented communities in the Bay Area. *Great Communities Collaborative framing paper.* Berkeley, Ca.
[9]Pollack, S., Bluestone, B., & Billington, C. (2010). *Maintaining diversity in America's transit-rich neighborhoods: Tools for equitable neighborhood change*. Dukakis Center for Urban and Regional Policy. Boston, MA.
[10]Belzer, et al. (2007). The case for mixed-income transit-oriented development in the Denver region.The Center for Transit-oriented Development.
[11] See: Metro. *Joint Development Program*: http://www.metro.net/projects/joint_dev_pgm/ and Office of the Mayor, City of Los Angeles: *Frameworks of Sustainable Transit Communities*: http://www.reconnectingamerica.org/resource-center/browse-research/2011/frameworks-of-sustainable-transit-communities/

totally reconceived as housing for those who we know actually take transit—primarily low-income people and people of color.

Similarly, this study should encourage decision makers to think critically about the transit needs of station area residents. While policymakers tend to view TOD as a strategy to increase rail patronage, rail riders comprise only 1 percent of station area commuters, and only 6 percent of station area transit riders. The other 94 percent of station area transit commuters rely on bus service. Over the past several decades, Metro has used bus service cuts to finance new rail construction, despite the weak cost effectiveness of these new investments.

New rail investments are increasingly justified based on their capacity to catalyze new, dense development. This study suggests that new rail stations can have contradictory land use effects—stimulating both density increases and gentrification. When gentrification occurs, it is likely to erase ridership gains due to density. In this light, policy-makers should judge rail investments based on their (weak) cost-effectiveness and the opportunity costs of retaining much needed bus service, rather than on their often counterproductive land-use effects.

## Recommendations

The results of this study suggest that in order to stabilize and grow station area transit ridership, Los Angeles will need to:

1. **Preserve** housing affordable to households earning less than $40,000 on a mass scale
2. **Stabilize** existing households earning less than $40,000.
3. **Build** new housing affordable to households earning less than $40,000 on a mass scale
4. **Plan Ahead** and stabilize station areas before they change.
5. **Support Transit**. Put the T back in the OD.
6. **Rework** Metro's joint development program to ensure it meets its goals.

The next several years will establish whether Los Angeles sets itself on a path toward increasing transit use or continues to displace the low-income households that sustain our transit system. A number of planning processes are currently underway that will determine how transit stations will be developed in the future. It is my hope that this report will encourage policymakers to think carefully about the direction that transit-oriented development should take in Los Angeles. Will we prioritize the transportation needs of low-income neighborhoods, and in doing so move toward environmental and economic sustainability, or will we build a city in which transit is underused, inefficient and inequitable?

# 2. Introduction

In recent years, both California and Los Angeles have taken significant steps to increase transit use and decrease driving in the name of environmental sustainability. In particular, decision makers have targeted sprawling land use patterns and inefficient transportation systems, arguing that compact cities well served by transit will significantly lower driving and green house gas emissions. In 2008, California passed SB 375, a landmark bill that mandates coordinated land use, housing and transportation planning to control emissions. Across the state, regions are now working to ensure that new growth is focused in areas with ample transit service, where residents will not have to depend on polluting cars to meet their travel needs.

Los Angeles is no exception. Our region is in the midst of a dramatic transformation of our transportation and land use patterns. In 2008, the County passed Measure R, which will pump $16 billion dollars into 11 new transit lines and more than 70 light rail stations over the next several decades[12]. This investment, together with $14 billion already spent,[13] will catalyze dramatic changes for the neighborhoods surrounding rail stations.

Indeed, both the private and public sectors have identified these neighborhoods as sites of investment, development and growth. The City of Los Angeles intends on directing significant new development to these areas and a number of plans and policies to do so are already in the works.[14,15,16] Metro, the region's transit operator, currently oversees approximately $5 billion in new development at transit stations.

This focus is supported by the concept of Transit-oriented Development, or TOD. While in practice TOD has been interpreted in many ways, it is typically understood to mean new, dense, mixed-use development built in close proximity to rail transit stations.[17] By placing more people within close walking distance of transit and making non-automotive travel more attractive, planners contend that TOD can increase transit ridership, decrease automobile trips, and build toward a more sustainable city.

While these environmental goals are admirable, there is mounting empirical evidence that TOD, as typically practiced, can have significant human and environmental costs. Researchers have long found that development adjacent to transit stations tends to show land value premiums.[18] More recently, a national study from Northeastern University suggests that transit stations appear to have furthered the gentrification of their surrounding neighborhoods.[19] This report analyzed demographic change in forty two neighborhoods around the country that were newly served by rail transit between 1990 and 2000. They found that in many of these neighborhoods, gentrification took place as wealthier, car-owning families moved in and lower-income, transit-riding families moved out.

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[12] Metro. (2011). *Measure R.* Retrieved from: http://www.metro.net/projects/measurer/
[13] Analysis conducted by the author based on Metro budgets. 2006-2012.
[14] City of Los Angeles, Office of the Mayor (2008). Housing that works. *Housing Plan, 2008-2013.*
[15] City of Los Angeles, Planning Department (2012) . Transit-oriented districts in South Los Angeles. *Staff report to the planning commission.*
[16] The Los Angeles TOD cabinet is currently drafting a TOD Strategic Plan and Policy directed at new growth near transit stations.
[17]Calthorpe, P. (1993). The next American metropolis: ecology, communities and the American dream. New York, Princeton Architectural Press.
[18]Cervero, R.( 2008). Transit-oriented development in America: Strategies, issues, policy directions. In: Tigran Haas, Ed. *New urbanism and beyond: designing cities for the future*. New York: Rizzoli. Page 126.
[19] Pollack, S., Bluestone, B., & Billington, C. (2010). *Maintaining diversity in America's transit-rich neighborhoods: Tools for equitable neighborhood change*. Dukakis Center for Urban and Regional Policy. Boston, MA.

A number of low-income communities in Los Angeles have reported that this process is active here as well, and that friends, neighbors and family members are being forced to leave their homes.[20] Many are finding housing far from their current neighborhoods, schools and work, and social and cultural networks. In this way, the promises of smart growth and expanded transit service may ring hollow for many of Los Angeles' low-income neighborhoods.

This situation is only likely to intensify. The vast majority of planned TOD is in neighborhoods such as Little Tokyo, Chinatown, Pico Union/Westlake, Boyle Heights, the Figueroa Corridor near USC, South LA, and parts of the San Fernando Valley that are home to many of the region's low-income communities of color and immigrant communities.[21] As a recent market study completed for the Los Angeles Planning Department notes, "The same features that are likely to attract new demand to the study area may also cause displacement of existing residents. By attracting households with higher incomes, the potential increases for existing residents to be displaced as housing prices and the cost of living increase".[22]

These displacement pressures will be exacerbated by expiring affordable housing contracts. According to a 2009 report by the AARP Public Policy Institute, 80 percent of federally subsidized affordable housing units within a half-mile of transit stations are under contracts that will expire by 2014.[23] Many Los Angeles neighborhoods thus stand at a crossroads. Some, like Boyle Heights are already sites of conflict, as residents challenge development plans made without their input. Others, such as the communities along new Expo Line in South LA, have the opportunity to intercede early in the planning process, responding to the 68,915 new housing units which planners believe could be accommodated in the corridor.[24]

In addition to its human toll, displacement can have significant environmental costs, potentially negating the benefits of TOD. Indeed, the Northeastern report suggests that as transit station area neighborhoods have gentrified, they have seen decreases in low-income transit riders and influxes of new, wealthier residents—many of whom bring and use cars.[25] In doing so, new development at transit stations may have the perverse effect of increasing adjacent car travel. While it is possible that some displaced transit riders will continue to use public transportation in their new homes, preliminary research from the Association of Bay Area Governments (ABAG) suggests that many likely do not. During the 1990s and 2000s, ABAG found that 5-10,000 households a year left transit rich Alameda and San Francisco counties for areas with worse or no transit service.[26]

## Research Question

*Over the past two decades, has gentrification had an effect on commute mode for residents living near rail stations? Specifically, has it increased or*

[20]Association for Community Transit – Los Angeles.*Metro Working Group.*
[21]Los Angeles Mayor's Office. (2008). *Housing that Works (2008-2012).*
[22] IBI Group ,Meléndrez and Strategic Economics, (2011). *Los Angeles plans and market studies: Final report.* Submitted to the Los Angeles Planning Department.
[23]Harrell, R, Brooks, A Nedwick, T. (2009). Preserving affordability and access in livable communities: Subsidized housing opportunities near transit and the 50+ population. AARP.
[24] IBI Group ,Meléndrez and Strategic Economics, (2011). *Los Angeles plans and market studies: Final report.* Submitted to the Los Angeles Planning Department.
[25] Pollack, S., Bluestone, B., & Billington, C. (2010). *Maintaining diversity in America's transit-rich neighborhoods: Tools for equitable neighborhood change.* Dukakis Center for Urban and Regional Policy. Boston, MA.
[26]Cravens et al. (2009).*Development without displacement, development with diversity.* Association of Bay Area Governments. Oakland, Ca.

*decreased driving and/or transit use?*

No work has yet been done to assess whether these national trends are taking in Los Angeles. Additionally, I am aware of no published research that has used statistical methods to quantify the relationship between station area gentrification and travel. This report aims to fill these gaps, asking: Over the past two decades, has gentrification had an effect on commute mode for residents living near rail stations? Specifically, has it increased or decreased driving and/or transit use?

# 3. Understanding Gentrification

This section provides a quick overview of gentrification. I first explore the meaning of the term, clarifying what gentrification is and differentiating it from other types of neighborhood change. I then outline some of dominant theories that explain why and when gentrification takes place. I conclude by summarizing the lessons we can apply to neighborhood change around Los Angeles transit stations. For a more rigorous discussion of the specific techniques used to measure gentrification, see Section 6.

## KEY POINTS

- The meaning of gentrification is contested, but is generally understood as the process whereby higher-income individuals migrate to lower-income neighborhoods, ultimately changing the economic and cultural character of the area.
- Gentrification is often accompanied by displacement, in which low-resource households are pushed out by evictions, rising rents or other factors, or in which new low-resource households are systematically unable to move in because of housing costs.
- Gentrification is driven by both shifts in demand (changing preferences, lifestyles, and needs of households), and in supply (as developers or the state remake neighborhoods to capitalize on undervalued property).
- Since the 1990s, gentrification is increasingly supported by public sector investments and policies—such as transit construction and transit-oriented districts.
- Gentrification is likely at Los Angeles transit stations that: are currently disinvested, near to the city center or job centers, provide fast transportation connections to high-wage jobs, and where state or private institutions provide a credible commitment that future investment will occur.

## What is Gentrification?

Since Ruth Glass coined the term in 1964 to describe the influx of upper middle class Londoners to the city's disinvested East End,[27] scholars, policymakers and activists have debated the meaning of gentrification, as well as the dynamics that drive the process. Responding, rightly, to the critical class analysis implicit in the term, developers, urban boosters and gentrifiers themselves have largely avoided its use altogether,[28] preferring rather to describe their interests as revitalization, renewal, reinvestment, or regeneration.[29] As Tom Slater notes, the word itself has been gentrified through its association with the refurbishment of decrepit neighborhoods. For instance, Andres Duany, one of the patriarchs of New Urbanism, proclaimed "Three cheers for gentrification", painting it as the "rising tide that lifts all boats" and "rebalances" central-city poverty.[30]

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[27] Glass, R. (1964) Introduction: Aspects of change. In *London: Aspects of Change*, ed. Centre for Urban Studies, London: MacKibbon and Kee, xiii–xlii.
[28] Slater, T. (2011). Gentrification of the city. In G. Bridge & S. Watson (Eds.). *The new blackwell companion to the city (Uncorrected Proof)* (Vol. 24, pp. 571-585). West Sussex,U.K.: Blackwell Publishing Ltd.
[29] Newman, K., &Wyly, E. (2006). The right to stay put, revisited: gentrification and resistance to displacement in New York City. *Urban Studies*, *43*(1), 23-57.
[30]Duany, A. (April/ May 2001) . Three cheers for gentrification. *American Enterprise,* 36-39.

Both scholars and activists, however, have drawn sharp distinctions between the physical or economic upgrading of a neighborhood and the replacement of its residents through gentrification.[31, 32] By most definitions, gentrification refers specifically to neighborhood change in which higher income individuals migrate to lower-income neighborhoods, ultimately changing the economic and cultural character of the area.[33, 34] It is important to stress the centrality of migration in this definition. Although it happens far less frequently than we might like, low-income neighborhoods do sometimes succeed in raising the economic fortunes of their current residents. This "incumbent upgrading" or revitalization is conceptually and materially separate from gentrification because changes are not primarily driven by migration.[35]

Another important distinction is between gentrification and displacement. Indeed, an intense debate has raged as to the exact connection between gentrification and the displacement of former residents. Some scholars suggest that only "direct displacement"—or forced relocations due to such factors as rising rents and increasing eviction rates—should be considered as displacement.[36] They also contend that the majority of change is not displacement at all, arguing that households naturally move with some regularity. In gentrifying neighborhoods, some low-income households move out naturally, but as rents climb, fewer move back in.[37] In this way, these scholars posit that a neighborhood may change without necessarily forcing individual households out. Other researchers have found quite different results, identifying strong flows of displaced residents from gentrifying neighborhoods.[38]

While the debates concerning the empirics of direct displacement continue to rage, they are largely irrelevant to the current project. At issue is not whether households are being forced out of a neighborhood per se. Neighborhood change, whatever the causes, is nonetheless likely to affect the travel behavior of the remaining residents, perhaps dramatically. Additionally, in the case of station areas in Los Angeles where public resources are being invested in a neighborhood, we should ensure that these resources do not disproportionately benefit wealthier newcomers, and instead serve the low-income station area communities who have largely been excluded from public investment. For these reasons, I follow Marcuse in arguing that both direct displacement and exclusionary displacement—whereby future low-income families are prevented from moving to a neighborhood—should be considered as processes of gentrification, and are relevant to this study.[39]

Since race, class, and central city residency are so highly correlated in this country, gentrification is nearly always racialized. While in most cases, gentrification involves white residents moving into communities of color,[40] scholars have noted that it may involve more complicated webs of identity, power and privilege.

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[31] Various Participants. (2008) *Study into action study group.* Oakland, Ca.
[32] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink, 6.
[33] Atkinson, R., &Wulff, M. (2009). Gentrification and displacement: A review of approaches and findings in the literature. *Australian Housing and Research Institute (AHURI) Positioning Paper*, (115). Australian Housing and Urban Research Institute.
[34] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink.
[35] Atkinson, R., &Wulff, M. (2009). Gentrification and displacement: A review of approaches and findings in the literature. *Australian Housing and Research Institute (AHURI) Positioning Paper*, (115). Australian Housing and Urban Research Institute.
[36]Freeman, L. &Braconi, F. (2004) Displacement or succession? Residential mobility in gentrifying neighborhoods, *Urban Affairs Review*, 40(4), pp. 463–491.
[37]Ibid.
[38] Newman, K., &Wyly, E. (2006). The right to stay put, revisited: Gentrification and resistance to displacement in New York city. *Urban Studies*, 43(1), 23-57.
[39] Marcuse, P. (1985) To control gentrification: anti-displacement zoning and planning for stable residential districts. *Review of Law and Social Change,* 13: 931–45.
[40] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink.

Taylor [41] and Patillo,[42] for instance, examine the role of the Black middle class in remaking Harlem, N.Y. and South Side Chicago, Kennedy and Leonard find a large proportion of Asian households amongst newcomers to the Bayview/Hunters Point in S.F., and Castells and Rothenberg describe the role of queers in gentrifying the Castro in S.F. and Park Slope N.Y. Nonetheless, racial and ethnic changes form essential elements of gentrification in the U.S.

## What Causes Gentrification?

A variety of explanations have been advanced for the gentrification process. In general, these explanations fit into two broad categories.[43] Demand-side theories understand gentrification as primarily a response to the changing preferences, lifestyles, and needs of households. Supply-side theories look at the economic conditions which make downtown housing development or refurbishment profitable, emphasizing "the role of capital and its institutional agents (public and private) in creating gentrifiable spaces".[44] Some of the dominant representations of these two types of explanations are outlined below:

### Demand-Side Theories:

*Changing customer preferences:* The simplest demand side theories contend that, from the 60s or 70s on, changing household preferences have encouraged new generations of people to either move to the central city, or refrain from moving outward to the suburbs as previous generations had done.[45]

*Demographic Change:* Household preference may change because households themselves change. For instance, empty-nester baby boomers may choose to move from suburbs in search of central-city amenities. [46]

*Economic restructuring:* More structural approaches argue that the above changes in customer preferences follow economic shifts that have created new classes of workers (such as managers and the creative class) for whom downtown living is increasingly feasible and attractive.[47]

*Job booms:* Empirical evidence suggests that gentrification can occur during periods of sustained economic activity, which place pressure on overall housing markets,[48]or when central city job growth increases the attractiveness of down-town housing.[49]

*Lengthening commutes:* As traffic congestion causes commutes to take longer, households may choose to settle in the central city in order to be close to down-town jobs, or to minimize total commutes for two-worker households with differing job location.[50, 51] Some scholars have noted that lengthening commutes have

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[41] Taylor, M. (2003). *Harlem: Between heaven and hell.* Minneapolis: University of Minnesota Press.
[42]Pattillo, M. (2007). Black on the block: The politics of race and class in the city. Chicago: University of Chicago Press.
[43] Slater, T. (2011). Gentrification of the city. In G. Bridge & S. Watson (Eds.). *The new blackwell companion to the city (Uncorrected Proof)* (Vol. 24, pp. 571-585). West Sussex,U.K.: Blackwell Publishing Ltd.
[44] Ibid,574.
[45]Smith, N. (1979). Toward a theory of gentrification: a back to the city movement by capital not people. *Journal of the American Planning Association*, *45*(4), 538–48.
[46] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink. 12.
[47] Ley, D. (1986). Alternative explanations for inner-city gentrification: a Canadian assessment. *Annals of the Association of American Geographers* 76 (4): 521–35.
[48] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink. 10.
[49]Kolko, J. (2009). Job location, neighborhood change, and gentrification. *Unpublished Manuscript*.
[50] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink.

helped drive a collective process of urban re-settlement under the banner of "smart growth" or "new urbanism".[52]

*Demand-supply mismatches:* Rapid job and population growth are likely to lead to gentrification when tight housing markets, zoning, or other factors do not allow housing supply to adequately meet rising demand.[53, 54]

## Supply-Side Theories:

*Rent Gap Theory:* Proposed in 1979 by Neil Smith, the rent gap theory remains the most persuasive and enduring supply side explanation for gentrification. Smith argues that gentrification occurs when a gap develops between the value of current uses, and the value that could potentially be generated under another ("highest and best") use.[55] This gap tends to develop in central city neighborhoods as older, smaller housing units adjacent to the city center are progressively abandoned by higher-income households who prefer newer, larger houses further afield. Over time, this housing naturally degrades, and while reinvestment is possible, racism, redlining and blockbusting have historically made it difficult or unlikely.

In addition, reinvestment poses a collective action problem. Since land values are heavily determined by overall neighborhood quality, if a neighborhood's housing stock is physically deteriorating, a single landowner has a disincentive to upgrade unless they can be sure that surrounding landowners will do the same. Smith suggests that this cycle of physical decay and disinvestment continues until a neighborhood is A) sufficiently devalued that a large gap emerges between current land values and those possible following renovation; and B) investors (including owner-occupiers) have some degree of insurance that capital spent on refurbishment/upgrading is likely to turn a profit.

Smith notes that this latter condition is often the result of actions by the state, financial institutions, or large developers capable of investing at a scale sufficient to resolve the collective action problem and set an area on an upward value trajectory. This condition helps to explain why gentrification often emerges adjacent to neighborhoods already undergoing investment.[56] It also illuminates the spatial structure of gentrification in many U.S. cities. Smith notes that land values typically peak in the central business district (CBD), where investment and upgrading in the physical infrastructure remains strong. Land values then fall off sharply in the oldest neighborhoods adjacent to downtown, rise again outward into the newer housing of the suburbs, and slowly decline into the hinterland.

*Speculation:* Following Smith's rent gap theory, Wyly argues that the deregulation of housing finance, in particular federally-backed mortgage programs, has increased the ease with which speculators may reinvest and gentrify disinvested neighborhoods.[57] Kennedy and Leonard suggest that local tax policies can have a similar effect.[58]

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[51]Skaburskis, A. (2011). Gentrification and risk society. *Wharton Real Estate Review*. Fall.
[52]Smith, N. (2002). New globalism, new urbanism: gentrification as global urban strategy. *Antipode*, *34*(3), 427-450.
[53] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink.
[54]Kahn, M. (2007). Gentrification trends in new transit-oriented communities: Evidence from 14 cities that expanded and built rail transit systems. *Real Estate Economics*, *35*(2), 155-182. 173.
[55]Smith, N. (1979). Toward a theory of gentrification: a back to the city movement by capital not people. *Journal of the American Planning Association*, *45*(4), 538–48.
[56]Smith, N. (1979). Toward a theory of gentrification: a back to the city movement by capital not people. *Journal of the American Planning Association*, *45*(4), 538–48.
[57]Wyly, E. and Daniel J. H. (1999). Islands of decay in seas of renewal: Housing policy and the resurgence of gentrification. *Housing Policy Debate*, Vol. 10 No. 4, pp. 711-771.
[58] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper

*Government Policy:* A variety of government programs including economic development and urban renewal zones, public transit investment, and public and subsidized housing redevelopment can "solve" the collective action problem by convincing investors that a neighborhood will return a profit. Some commentators suggest that since the 1990s, the state has taken a prominent role in facilitating the gentrification process.[59] Hackworth and Smith site declining tax revenues, the rise of the entrepreneurial state, increasingly footloose capital, and the saturation of easily flipped neighborhoods as conditions driving increased state involvement. Building off this work, Immergluck contends that state officials are now using large transit projects, such as Atlanta's Beltline, to catalyze neighborhood change. [60] As discussed in a latter section, Pollack and Blueston's recent national study found that most new light rail projects were built in high-rental, low-income neighborhoods, and appear to have accelerated demographic shifts in these areas.[61]

In this section, I have provided an overview of the meaning and dynamics of gentrification. A number of points should be reiterated. First, gentrification refers specifically to the in-migration of higher-income households, and is conceptually distinct from incumbent upgrading where households grow wealthier in place. Second, gentrification usually involves the displacement of lower-income households. In some cases, households may be directly displaced by rising costs, landlord harassment, or other expulsive forces. As neighborhoods change, they may also begin to exclude low-income households who are unable to pay increased housing costs. Both forms of displacement can impose large costs on low-income households, particularly if they prohibit them from benefiting equitably from public investments.

I have also outlined some of possible explanations for gentrification—exploring both demand and supply-side theories. Demand-side theories focus on the changing preferences, lifestyles, and needs of households, while supply-side theories understand gentrification to be primarily the result of underlying economic conditions—such as rent gaps in disinvested neighborhoods.

The scholarship on the nature and causes of gentrification is useful because it helps us to understand what form gentrification may be taking near transit stations in Los Angeles, and to begin to identify conditions under which it may be taking place. From demand-side theories, we can conclude that neighborhoods are likely to gentrify when they match the preferences of wealthier households. Station areas might gentrify when they are near to booming job centers, or provide new transit connections to these centers. Supply-side theories suggest that gentrification is also probable in undervalued station areas. These areas may have rent gaps that speculators can capitalize by remaking a neighborhood. However, developers are unlikely to invest unless they can be assured that property values will trend upwards. Therefore, gentrification is most likely where state or private institutions provide a credible commitment that future investment will occur. This assurance may come in the form of transit investments or other improvements to the built environment, such as those associated with TOD. Thus, we may expect gentrification in those station areas where state actors commit to neighborhood improvements.

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Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink. 12.

[59] Hackworth, J. & Smith, N. (2001). The changing state of gentrification. *TijdschriftvoorEconomische en SocialeGeographie,* 92(4) 464-477.

[60] Immergluck, D. (2009). Large redevelopment initiatives, housing values and gentrification: The case of the Atlanta beltline. *Urban Studies*, 46(8) 1723-1745.

[61] Pollack, S., Bluestone, B., & Billington, C. (2010). *Maintaining diversity in America's transit-rich neighborhoods: Tools for equitable neighborhood change*. Dukakis Center for Urban and Regional Policy. Boston, MA.

# 4. What Determines Transit Use?

## KEY POINTS

- Nearly all (85%) of person trips in this country are made by private car.
- Nationally, income is an excellent predictor of car-ownership. Those with the lowest incomes (below $20,000) are by far the least likely to own cars.
- Car ownership, in turn, is an excellent predictor of transit use nationwide. Households without a car make six times more trips by transit than those with a car.
- Nationally, people of color use transit at much higher rates than non-Latino Whites (2-6 times higher).
- Nationally, the share of trips made by rail transit is declining among low-income people, and rising for those with the highest incomes. Some experts think this may be due to rail station area gentrification.
- In Los Angeles, households earning less than $35,000 make up the vast majority of metro's transit riders.
- In Los Angeles, Blacks and Latinos are dramatically over represented on metro buses and trains, while Whites and Asians are underrepresented.

## How do People in the United States Travel?

While transit use is the primary focus of this report, trips by public transportation comprise a very small percentage of travel in this country. This is largely due to the growing ubiquity of the private automobile. Ownership rates have grown steadily in the past few decades. By 2001, 92 percent of U.S. households owned at least one automobile, and nearly 60 percent owned two or more.[62] While car ownership is high across income groups, it does fall off sharply for the lowest income households. Only 5 percent of those making $20,000 to $40,000 had no car, while a full quarter of households earning less than $20,000 had no car.[63] It appears that most households with access to a car use it for most trips—nearly all travel in this county (85%) is done by car.

These rates are do vary by trip purpose however. A significantly higher proportion of work (92.5%) and shopping trips (91.5%) rely on the private automobile rather than social (84.1%) and school/church (72.9%) trips.[64] This variation suggests the importance of looking beyond commuting to gain a full picture of travel behavior. Non-work travel is often not included in research because data are not available in the census, and perhaps because of patriarchal bias toward economically productive actors and activities.[65] Yet four fifths of trips are for non-work purposes.[66] Similar variation by trip purpose is evident in other modes as well. Heavy and commuter rail transit tends to be used almost exclusively for work-travel, while bus and light rail is used

[62]Pucher, J., &Renne, J. L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, *57*(3) 50.
[63]Ibid, 50.
[64]Ibid, 53.
[65]Blumenburg, E. (2002). Reverse commute transit programs and single mothers on welfare: A policy mismatch? *Tech Transfer*. Winter, pp. 4-6
[66]Pucher, J., &Renne, J. L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, *57*(3), 51.

more evenly (although still primarily for work-travel). Travel by foot and bicycle, by contrast, tends to be used more for non-work purposes.[67]

## Who Uses Transit?

Car ownership in the United States is an extremely strong predictor of a household's propensity to use transit. Households with a car make six times fewer trips by transit than those without. However, the addition of cars beyond the first to a household has far less significant effects on travel behavior than the first household car.[68] Given rising automobility, transit is used by a small and shrinking minority of travelers (3% in 1969 and just under 2% by 2001), although these figures are higher for large metropolitan areas like Los Angeles.[69]

The vast percentage of transit travel (70%) occurs by bus, and is heavily concentrated among the lowest income groups.[70] Income has a dramatic effect on overall transit usage rates, although almost entirely at the lower end of the income distribution. Households making less than $20,000 a year are 15 percent less likely to drive and 3 times more likely to ride transit than those making $20,000 to $40,000.[71] Above $40,000, the chances of driving alone remain fairly constant or even fall with income. Overall, transit use is somewhat bimodal by income, with the lowest income households using it the most, few middle income households riding, and a small uptick for the highest income households.

This uptick is primarily due to the influence of commuter and metro/subway/heavy rail which serve a disproportionate percentage of higher-income riders (although it should be noted that metro/subway/heavy rail is also used by a large proportion of very-low-income households).[72] However, the percentage of low-income households that use rail has declined precipitously in recent years. Analyzing the 1995 and 2001 National Household Transportation Surveys, Pucher notes that while rail use by the wealthiest households grew significantly, rail use by the least affluent dropped by almost half during this same period. Pucher attributes this change directly to gentrification, noting that it has  noting that it has "reduced the accessibility of low- income households to rail transit, and appears to have lessened their use of both metro and commuter rail."[73]

Transit usage also varies considerably according to race and ethnicity. Whites use transit for less than 1 percent of trips, only about half of which are made by bus. By contrast, Blacks use transit for about 5 percent of trips, Asians for 3 percent and Latinos for 2.5 percent. While Latinos use transit in fairly low numbers, it is worth pointing out that they carpool far more than any other group.[74]

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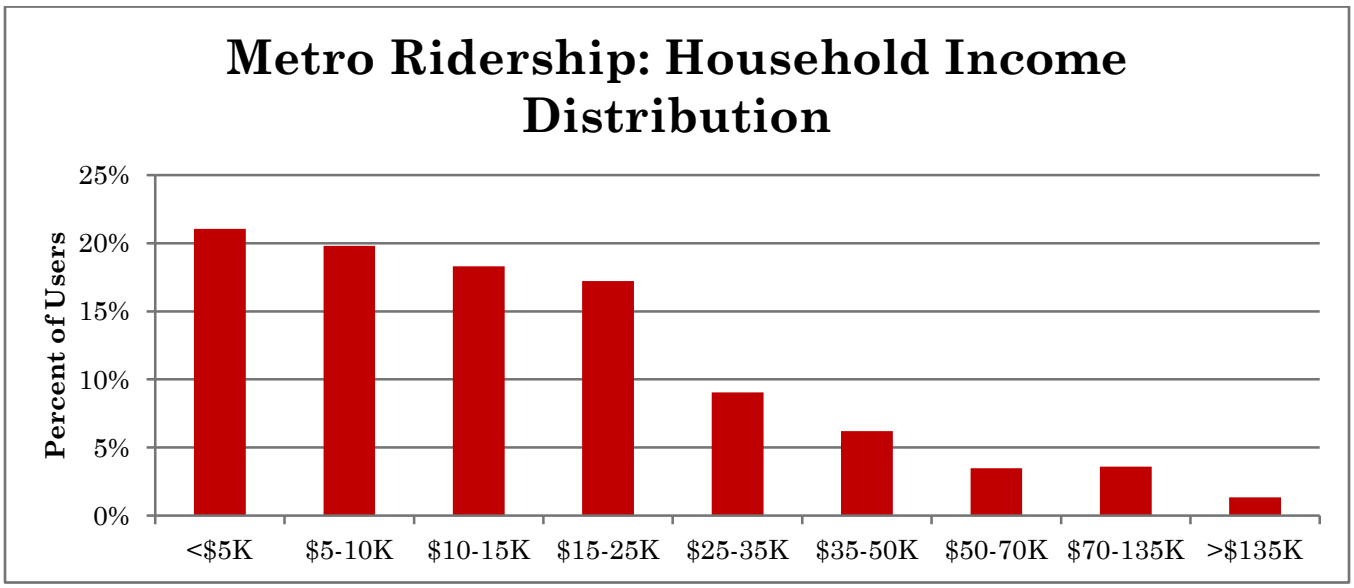
[67]Ibid, 53.
[68]Ibid, 57.
[69]Ibid, 59.
[70]Pisarski, A.(2006). Commuting in America. *NCHRP Report 550* and *TCRP Report 110*. Transportation Research Board: Washington D.C.
[71]Pucher, J., &Renne, J. L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, *57*(3), 59.
[72]Ibid, 59.
[73] Ibid, 61.
[74]Ibid, 67.

## Transit Use in Los Angeles

These national trends are echoed in Los Angeles. Figures 5 and 6 below illustrate the demographic characteristics of riders on Metro, the region's largest transit operator.[75] Figure 5 shows transit ridership (a weighted average of bus and rail) by income group. Note that the vast majority of riders come from households earning $35,000 or less, and ridership drops off steeply among income groups over $25,000. Unlike the nation overall, Metro's ridership does not appear bimodal by income—that is, we do not see much of an uptick at the higher end of the income spectrum. This could be due to the fact that Metro does not operate the region's commuter rail service, which tends to serve the highest-income transit riders.

**Figure 5: Metro Ridership by Household Income (2011)**

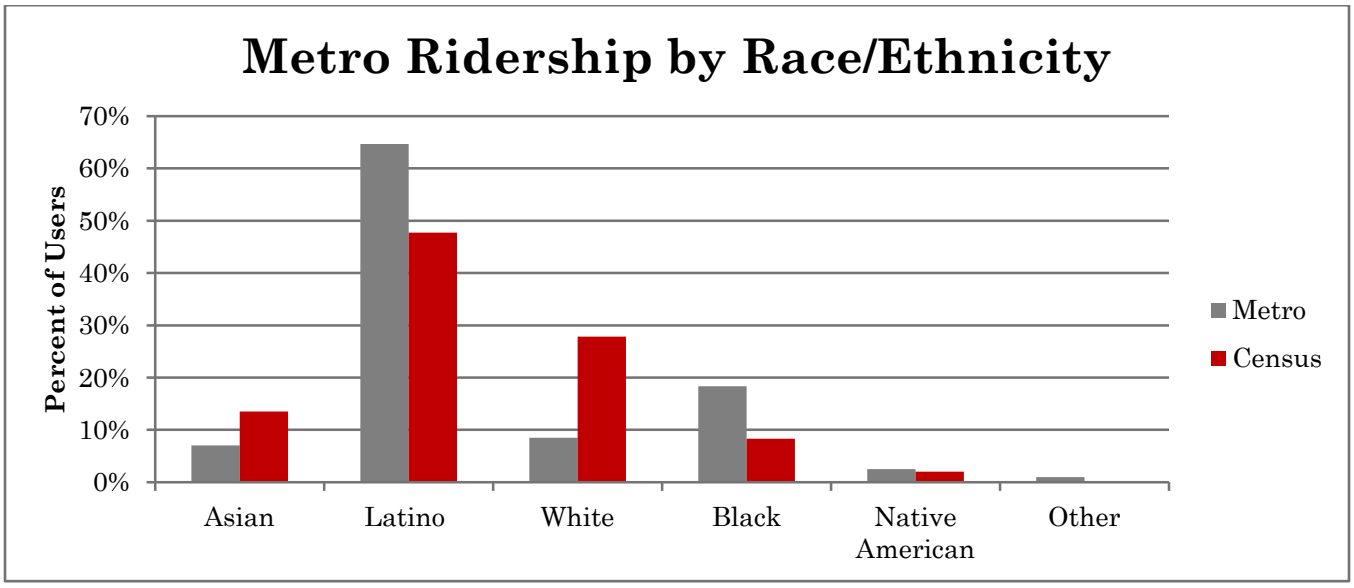



*Data Source: Metro. (2011). System-wide on-board origin-destination study. Los Angeles.*

Metro's ridership echoes national racial/ethnic trends, although it also reflects Los Angeles' diverse demographics. Figure 6 below shows a breakdown of Metro's ridership by race/ethnicity relative to census data for the County overall. From this graph, it is clear that Blacks and Latinos are heavily over represented on Metro, while Whites and Asians are underrepresented. Native Americans ride Metro in approximate proportion to their overall representation.

[75] Metro. (2011) System-wide on-board origin-destination study. Los Angeles.

**Figure 6: Metro Ridership by Race/Ethnicity (2011)**

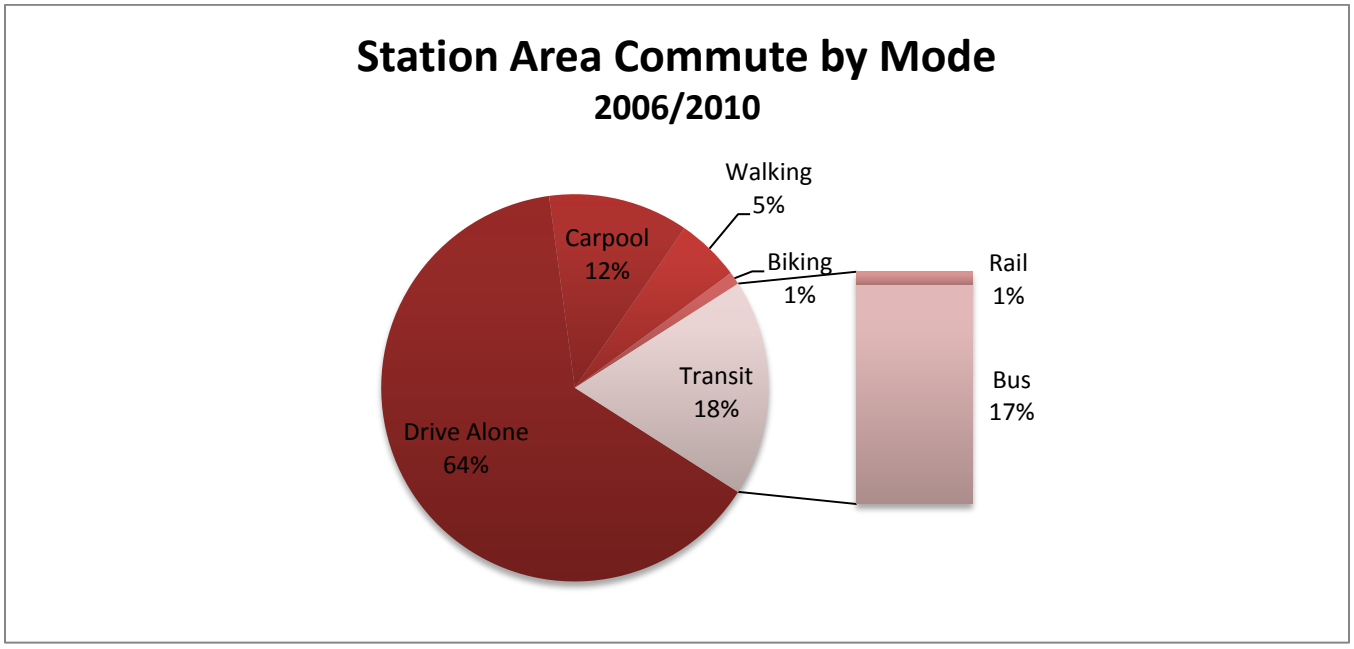



Metro. (2011). *System-wide on-board origin-destination study*. Los Angeles.

At both the national level and here in Los Angeles it appears that transit use is heavily influenced by a number of socioeconomic characteristics. Race, class and car ownership are all extremely strong predictors of transit use. It is important to note that both income and car-ownership have particularly strong effects at the bottom ends of their ranges (adding the first car, or going from very low to middle income), and these effects become weaker as households gain additional cars or income. Thus we can expect that changes in transit use will be magnified in gentrifying neighborhoods with high percentages of extremely low-income households.

Despite their proximity to rail stops, very few station area commuters actually take rail to work (in 2006/2010). Indeed the vast majority of rail station area transit commuters rely on buses. Figure 7 below illustrates the modal split for station area residents. While the private automobile dominates, transit serves a modest percentage of trips (17%), far more than the county overall (7%). As noted above, nearly all (94%) of transit trips are made by buses. Those not driving alone or on transit tend to carpool (12%), although a few commuters do use non-automotive modes.

**Figure 7: Rail-Station Area Commute Mode (2006/2010)**




*Data Source: U. S. Census Bureau. 2006/2010 5 Year American Community Survey.*

In our automobile dominated society, it is often quite difficult to access destinations without a private car. Accordingly, those with the resources typically buy and use automobiles. This means that the vast majority of transit use is by those with few other options—typically very-low income people and people of color. In Los Angeles, most transit riders come from households earning less than $35,000, and are disproportionately likely to be people of color. Both nationally and in Los Angeles, there is a very clear correlation between income and travel behavior. Given this strong relationship, it is quite reasonable to assume that gentrification would lower transit use and increase driving. And indeed, some prominent scholars attribute declining rail use among low-income people to this phenomenon. In the next section, I begin to explore this connection, evaluating past work on neighborhood change and travel behavior.

# 5. Literature Review

## KEY POINTS

- Transit-oriented development is generally understood to mean dense, mixed-use, pedestrian-friendly development built in close proximity to transit stations.
- In practice, TOD is a highly specific development paradigm. It is typically new development constructed around rail stations, often through coordinated agreements between the public sector and private developers. It is usually intended to attract middle class or higher-income residents, although varying amounts of affordable housing are often included as well.
- TOD is intended to increase transit ridership and decrease driving among new residents by attracting them to areas amenable to non-automotive modes.
- Characteristics of the built environment, such as density, distance to the city center, urban design and pedestrian amenities, shape travel behavior—although socioeconomic factors typically have larger effects.
- Households with a propensity to use transit tend to self-select by moving close to public transportation. These households typically have low-incomes and few or no automobiles.
- As the monetary and time costs of various types of commuting change, households are likely to redistribute themselves geographically. When the costs of taking transit fall, or of driving increase, some higher-income households will move closer to transit—potentially displacing current low-income residents.
- Transit investments often appear to trigger gentrification, particularly when they provide a viable alternative to the car for higher income households, or when they signal reinvestment in a neighborhood at a scale capable of reversing cycles of disinvestment.
- In cases where gentrification occurs near transit stations, changes to the socioeconomic makeup of the neighborhood are likely to yield decreased transit use and increased driving. These changes will be most intense in neighborhoods in which gentrification is largely driven by speculation rather than increased transit accessibility.
- Little research has yet been conducted assessing the effects of gentrification on travel behavior. The research that has been conducted is weak methodologically, uses relatively old data, and does not specifically examine Los Angeles.

## Introduction

In this section, I present a review of the exiting literature with two goals in mind. First, I situate my research within the context of past empirical work on gentrification and travel behavior. Second, drawing on a wider literature, I establish a theoretical framework with which to understand the interactions between TOD, neighborhood change, and transportation choices.

Unfortunately, very little work has examined the effects that gentrification may have on travel behavior. Indeed, only a few scholars have approached this question. In 2007, Danyluk and Ley assessed the impact of gentrification on travel behavior in three Canadian cities.[76] A year later, Kushto and Schofer at Northwestern University examined the transportation effects of neighborhood change from 1980 to 2000 in

[76]Danyluk, M., & Ley, D. (2007). Modalities of the new middle class: Ideology and behaviour in the journey to work from gentrified neighbourhoods in Canada. *Urban Studies*, *44*(11), 2195-2210.

Chicago, IL, although this paper was never published.[77] Most recently, researchers at Northeastern University conducted a national study of demographic and travel behavior changes around rail station areas in the 1990s.[78] Despite using similar methods, these studies have shown mixed results. In some cases, it appears that gentrification is associated with decreased driving and increased travel by transit and other modes. In others, it seems that incoming gentrifiers bring more automobiles and drive more than the residents they displace.

In order to understand the dynamics that may be behind these contrasting results, it is helpful to turn to the broader literatures associated with the topic. Later in this section, I will return to these three studies, armed with a more developed theoretical expression of the interrelated dynamics driving neighborhood change and travel. Toward this end, I will examine scholarship from a variety of fields.

I first explore the scholarship on TOD, the built environment, and travel behavior, contending that while this literature contains key lessons about neighborhood change and travel, these lessons have been largely ignored. Second, I discuss several contributions from economic geography that provide a theoretical understanding of how households decide where to live and how these decisions relate to transportation access. I then synthesize these disparate literatures in an attempt to understand the interactions of neighborhood change and travel behavior. Finally, I apply these insights to the existing literature evaluating the effect of gentrification on mode choice, and draw conclusions to inform my own research.

## Transit-oriented Development, the Built Environment and Travel Behavior: A Myopic Literature

In the last several decades, the concept of transit-oriented development, or TOD, has electrified the planning profession. Indeed TOD's boosters make bold and captivating claims. By carefully locating new development near transit nodes, they contend we will "relieve traffic congestion, improve air quality, cut down on tailpipe emission and increase safety in transit-served neighborhoods by coaxing travelers out of their cars and into trains and buses."[79] These claims are (somewhat) supported by a rich and quickly evolving literature that seeks to understand and quantify the relationship between the built environment and travel behavior. In this section, I present a brief overview of the concept of transit-oriented development and the supporting built environment literature. I contend that this literature has become myopic, developing methodological sophistication but ignoring key lessons about neighborhood change and travel. Specifically, this literature tends to use statistical methods to control for the influence of socioeconomic factors, ignoring their importance in shaping travel behavior and their complex interactions with the built environment. Additionally, I suggest that the built environment literature has failed to grasp the implications of self-selection (the process whereby transit using households locate near transit) as they relate to gentrification.

There is no single, all encompassing definition of transit-oriented development.[80, 81] Most scholars look to the definition put forward by Peter Calthorpe in the early 90s, which describes TOD as dense, mixed-use,

[77]Kushto, E., & Schofer, J. (2008). Travel and transportation impacts of urban gentrification: Chicago, Illinois Case Study. *Unpublished*.
[78] Pollack, S., Bluestone, B., & Billington, C. (2010). *Maintaining diversity in America's transit-rich neighborhoods: Tools for equitable neighborhood change*. Dukakis Center for Urban and Regional Policy. Boston, MA.
[79]Cervero, R. (2008). Transit-oriented development in America: strategies, issues, policy directions. In: Tigran Haas, Ed. *New urbanism and beyond: designing cities for the future*. New York: Rizzoli, 126.
[80]Dittmar, H. & Ohland, G. eds. (2004). The new transit town. Best practices in transit-oriented development. Island Press: Washington, DC.

pedestrian-friendly development built in close proximity to transit stations.[82] However, questions abound and TOD practice and theory often diverge. For instance, while TOD can theoretically exist along any type of transit, in practice it is generally not applied along bus corridors since developers are loath to build around lines that could be easily cut or moved.[83] Similarly, it is not clear whether preexisting dense, walkable neighborhoods with high transit patronage should be considered TOD. Indeed, while many older urban neighborhoods—particularly those with highly transit-dependent populations—fit the definition of TOD, planners are generally averse to applying the TOD label.

However contested its definition, in practice TOD is a highly specific development paradigm. Transit-oriented development is nearly always built around rail stations,[84] although some cities such as Los Angeles are experimenting with TOD near bus rapid transit stations.[85] It is constructed on top of or adjacent to transit stations, typically through "joint development," or formal agreements between private developers and transit agency land holders,[86] and is often made attractive to the private sector through public subsidies, land-markdowns or loosened zoning requirements.[87] TODs are also generally built with an eye to a specific demographic. While acknowledging the need for affordable housing, TOD's boosters tend to view it as a response to, and catalyst for, "the hoped-for middle-class migration back to the city,"[88] housing "childless couples, Generation-Xers, and empty-nesters."[89] More recently, advocates have proposed that TODs should explicitly include a range of household incomes.[90]

TOD's goals are more straightforward—namely to decrease driving and increase travel by transit and other modes. The theory is simple. By placing more people within easy access of transit, and in dense environments with lots of destinations easily reached by public transportation, TODs should increase transit use, walking and biking. This theory is supported by a vast literature that attempts to quantify the roles that transit accessibility and the built environment play in shaping travel behavior. Indeed, a lively debate exists as to the exact weights and interactions of the so called "five D's", or density, diversity, design, destination accessibility and distance to transit.[91] While this literature is too large to summarize here, a number of reviews and meta-analyses have already done so.[92, 93, 94, 95, 96, 97] Three main points emerge from this scholarship.

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[81] Wander, Madeline. (2008). An equity agenda for transit-oriented development. Planning for sustainable growth in Los Angeles' inner city. *Urban &Environmental Senior Comprehensive Project.* Occidental College: Los Angeles, CA.
[82]Calthorpe, P.(1993). The next American metropolis: ecology, communities and the American dream. New York, Princeton Architectural Press.
[83] Center for Transit-oriented Development and the Federal Transit Administration.(2011). *Webinar on Value Capture and Transit.*
[84] Ibid.
[85] Moliere, R. (2011). *Bus Rapid Transit: The Next Opportunity for TOD.* Presentation to the Urban Land Institute. Los Angeles, CA.
[86]Transit-oriented development in America: strategies, issues, policy directions. In: Ed. Tigran Haas, New urbanism and beyond: designing cities for the future. New York: *Rizzoli, 124*.
[87]Cervero, R. (2008). Transit-oriented development in America: strategies, issues, policy directions. In: Ed. Tigran Haas, New urbanism and beyond: designing cities for the future. New York: *Rizzoli, 124*.
[88]Calthorpe, P.In: Dittmar, H. & Ohland, G. eds. (2004*). The new transit town. Best practices in transit-oriented development.* Island Press: Washington, DC.
[89]Cervero, R. (2008). Transit-oriented development in America: strategies, issues, policy directions. In: Ed. Tigran Haas, New urbanism and beyond: designing cities for the future. New York: *Rizzoli, 124*.
[90] See For Instance: Reconnecting America and the Center for Transit-oriented Development: http://www.mitod.org/home.php
[91] Ewing, R & Cervero, R. (2010). Travel and the built environment: a meta-analysis. *Journal of the American Planning Association.*76:3.
[92] Crane, R. (2000). The influence of urban form on travel: an interpretive review. *Journal of Planning Literature.* 15:3.
[93]Ewing, R & Cervero, R. (2001). Travel and the built environment: a synthesis, *Transportation Research Record.* 1780: 87-114.
[94] Ewing, R & Cervero, R. (2010). Travel and the built environment: a meta-analysis. *Journal of the American Planning Association.*76:3.
[95]Badoe, D. & Miller, E. (2000). Transportation-land-use interaction: empirical findings in North America, and their implications for modeling. *Transportation Research Part D.* 235-263.
[96] Cao, X, et al. (2009). Examining the impacts of residential self-selection on travel behaviour: a focus on empirical findings. *Transport Reviews,* Vol. 29:3, 359–395.

First, these studies generally confirm that the built environment does have a statistically significant, if small, effect on travel behavior. In reviewing the literature, a recent study commissioned by the National Academies suggests that residents of compact (twice as dense as average), walkable and transit accessible neighborhoods drive 5 to 25 percent less than average.[98] A meta-analysis conducted by Cervero and Ewing found elasticities of 7 to 29 percent of transit use in relation to density, diversity of land uses, design and distance to transit, meaning that we can expect a 7 to 29 percent change in transit use for each 100 percent change in these variables.[99] Overall, these studies suggest that TOD can modestly influence travel. If we are willing to make large scale changes to the built environment, which will take years and many billions of dollars to accomplish, we can expect modest change in travel behavior.

Second, much to its detriment, the built environment literature pays scant attention to socioeconomics, resulting in skewed implications for policy. Most studies attempt to isolate the effects of the built environment using statistical techniques that control for other possible influences on travel behavior. Across the board, socioeconomic characteristics are included as control variables. Since socioeconomic factors are not the concern of this body of research, few researchers report the significance of their effects relative to other variables. However, in those studies that do, socioeconomic characteristics appear to have more (and sometime far more) influence than built environment factors.[100, 101, 102] As Cao, et al point out, "the contribution of the BE [built environment] is, in most cases, relatively small relative to the contributions of socio-demographics and unmeasured variables."[103]

If this is indeed true, it suggests that scholars and practitioners may be overly focused on built environment variables, while ignoring the socioeconomic factors that actually drive travel behavior. Methodologically, this suggests that the standard approach wherein socioeconomics function merely as a statistical control may be deficient. Instead, researchers might consider modeling the interactions of socioeconomics and changes to the built environment, in order to gain a better understanding of their joint effects on travel behavior. [104, 105] As Badoe and Miller note, "different people will respond to different density levels/urban designs in different ways."[106]This raises graver concerns for the real world. TOD, as it is typically practiced, often involves improvements to the built environment and explicit attempts to attract middle or upper-class residents. Both practices have the potential to stimulate gentrification in low-income neighborhoods. In this way, built environment and socioeconomic variables may be far more linked than is accounted for by

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[97]Brownstone, D. (2009). Key relationships between the built environment and VMT. Special report 298: Driving and the built environment: The effects of compact development on motorized travel, energy use and, CO2 emissions. Prepared for the Committee on the Relationships Among Development Patterns, Vehicle Miles Traveled, and Energy Consumption. Transportation Research Board and the Division of Engineering and Physical Sciences.

[98]Committee on the Relationships among Development Patterns, Vehicle Miles Traveled, and Energy Consumption. (2009). *Special report 298: Driving and the built environment: The effects of compact development on motorized travel, energy use and, CO2 emissions.*. Washington, DC: National Academy of Sciences/National Research Council. (http://www.nap.edu/openbook.php?record_id=12747&page=144)

[99] Ewing, R & Cervero, R. (2010). Travel and the built environment: a meta-analysis. *Journal of the American Planning Association.*76:3.
[100]Rajamani, J. (2003). Assessing impact of urban form measures on nonwork trip mode choice after controlling for demographic and level-of-service effects. *Transportation Research Record.*1831: 03-3392. 158-165.
[101] Ewing, R & Cervero, R. (2001). Travel and the built environment: a synthesis, *Transportation Research Record.* 1780: 87-114.
[102]Badoe, D. & Miller, E. (2000). Transportation-land-use interaction: empirical findings in North America, and their implications for modeling. *Transportation Research Part D, 235-263.*
[103] Cao, X, et al. (2009). Examining the impacts of residential self-selection on travel behaviour: a focus on empirical findings. *Transport Reviews,* Vol. 29:3, 359–395.
[104] Ibid.
[105]Badoe, D. & Miller, E. (2000). Transportation-land-use interaction: empirical findings in North America, and their implications for modeling. *Transportation Research Part D, 254.*
[106]Badoe, D. & Miller, E. (2000). Transportation-land-use interaction: empirical findings in North America, and their implications for modeling. *Transportation Research Part D, 254.*

academic studies or by planning practice. The dominance of socioeconomic factors in shaping travel behavior suggests that where gentrification does take place, it is likely to counteract any transit ridership gains resulting from improvements to the built environment.

The third insight that we can borrow from the built environment and travel behavior literature concerns the importance of accounting for the choices that households make about where to live. While many early studies of the built environment looked simply at the travel of residents in dense or transit-served neighborhoods in comparison to other neighborhoods without these characteristics,[107] it soon became apparent that the higher levels of transit use in these neighborhoods was in least partly due the in-migration of those with a propensity to use transit (or self-selection). For instance, in a 2007 study using the Bay Area Travel Survey, Cervero estimated that approximately 40 percent of the increase in rail commuting near rail stations was the result of residents self-selecting to live near transit.[108]

Researchers have identified two aspects of self-selection. As we might expect, socioeconomics play a significant role in households' decisions to locate near transit. In Cervero's 2007 study, he found that socioeconomic factors such as income and race had the greatest power among socio-economic variables to explain why households chose to live near rail transit. Some researchers have also tried to understand the effects of households' attitudinal preferences for various types of urban environments and travel modes on their location choices and subsequent travel behavior. However, these studies have had a difficult time unraveling the various interactions between demographics, attitudes, and neighborhoods and findings remain mixed. [109] Interestingly, as Brownstone notes, "recent studies with disaggregate data find no impact of self-selection after controlling for rich sociodemographics,"[110] suggesting that attitudes may be heavily mediated by socioeconomic variables. In practice, these findings imply that stated preferences for transit-friendly living (for instance, by incoming TOD residents who choose to move toward transit) may shape travel behavior far less than these household's demographic characteristics. In other words, whatever their preferences, people who can afford to own a car typically own one, and those with cars typically drive them.[111]

The built environment and travel literature thus provides a number of lessons for our purposes. First, it is clear that the built environment can modestly influence travel behavior. While the exact weights of the various factors that influence transit ridership remain somewhat unclear, it is also evident that socioeconomic factors have large effects that are likely stronger than that of the built environment. This suggests that scholars should develop a clearer understanding of the interactions of socioeconomic change, urban form, and travel behavior, and that decision-makers should be skeptical of policies that purport to change travel behavior yet may lead to gentrification. Finally, it appears that transit ridership depends heavily on households' ability to sort themselves such that those most likely to use transit (determined largely by socio-economics) are able to live near transit.

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[107]Cervero, R. (2007). Transit-oriented development's ridership bonus: a product of self-selection and public policies. *Environment and Planning* A 39(9) 2068-2085.
[108]Ibid, 23.
[109] Cao, X, et al. (2009). Examining the impacts of residential self-selection on travel behaviour: a focus on empirical findings. *Transport Reviews,* Vol. 29:3, 359–395.
[110]Brownstone, D. (2009). Key relationships between the built environment and VMT. Special report 298: Driving and the built environment: The effects of compact development on motorized travel, energy use and, CO2 emissions. Prepared for the Committee on the Relationships Among Development Patterns, Vehicle Miles Traveled, and Energy Consumption. Transportation Research Board and the Division of Engineering and Physical Sciences. 4.
[111] See Section 4, Travel in the United States and Los Angeles.

## Urban Spatial Structure, Gentrification and the "Dark Side" of Self-Selection

These findings from the self-selection literature are echoed by a number of other studies that suggest low-income households have a propensity to locate adjacent to transit. This section briefly discusses these studies, focusing specifically on the economic models the authors developed regarding the interactions of transportation accessibility and household location. These models are useful in understanding how travel and gentrification may shape one another.

Perhaps the most relevant study is that by Glaeser, Kahn, and Rappaport, which attempts to answer the question of why low-income people live in cities.[112] The authors theorize that low-income people tend to live in cities—particularly central cities—because they self-select to be near transit. The article contains both a critique and refinement of classic models of urban spatial structure and income distribution based on the work of William Alonso. These models imagine a flat plain with a point at the center to which all workers commute. Workers choose how far to live from the center by trading off the costs of commuting (in both time and money) with what they must pay for housing. Housing costs in this model are highest near the middle, and fall toward the periphery.

Traditionally, theorists have sought to explain the affluence of the suburbs relative to the central city by assuming that wealthy people are willing to trade increased commute times for larger houses.[113] Testing this assumption empirically, Glaeser, et al. found that the demand for spacious housing is far too low to explain the centralization of poverty.[114] Another classic theory proposes that low-income people live primarily in the central city because the housing stock is older, more decrepit, and therefore cheaper. This theory is very similar to the idea of "filtering" upon which Smith builds his theory of gentrification.[115] Glaeser, et al. concede that this process likely has an effect and ultimately, "view this theory as complementary" to their own, but contend that it is not sufficient to explain low-income peoples' concentration in central cities.

The authors offer an alterative explanation, in which lower-income people locate in the central city because of transit availability. They provide a somewhat exhaustive empirical defense of this contention, using national evidence as well as specific examples from New York City subway expansions. Ultimately, their hypothesis is well supported, reasonable, and is quite consistent with the self-selection literature. The article also offers a refinement of traditional economic models that is useful for my purposes.

Specifically, they suggest that the Alonso model is deficient because it assumes everyone uses the same commute mode. By contrast, they propose a model in which households have access to automobiles, transit, and walking. Since many low-income people cannot afford to purchase an automobile they will tend to live where transit is accessible or walking is reasonable. They are thus willing to pay a premium for housing that minimizes transportation costs. By contrast, higher income households can afford cars and therefore have a comparative advantage in living further afield where they are able to buy a larger house than would be possible at the city center. In economic terms, the bid rent curve for transit users is far steeper than that of drivers.

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[112]Glaeser, E., Kahn, M., & Rappaport, J. (2008). Why do the poor live in cities: The role of public transportation. *Journal of Urban Economics*, *63*(1), 1-24.
[113]Heilbrun, J. & McGuire, P. (1987). Site rent, land-use patterns, and the form of the city. *Urban Economics and Public Policy*. Third Edition, New York: Saint Martin's Press.
[114]Glaeser, E., Kahn, M., & Rappaport, J. (2008). Why do the poor live in cities: The role of public transportation. *Journal of Urban Economics*, *63*(1), 1- 24.
[115]Smith, N. (1979). Toward a theory of gentrification: a back to the city movement by capital not people. *Journal of the American Planning Association*, *45*(4), 538–48.

Glaeser, et al.'s arguments are quite helpful in understanding the interactions of transit and neighborhood change. Empirically, they lend support to the idea that low-income households self-select to be near transit, and that living near transit helps people economize on their total housing and transportation costs.

The piece is also theoretically rich. The author's model yields an urban spatial structure very similar to that which Smith elaborates, and Glaeser, et al. view their model as complementary to the filtering dynamics that Smith describes. Combined, these models help us to understand the formation of low-income, disinvested neighborhoods near transit-rich city centers. They also help us understand the potential for these neighborhoods to gentrify. Glaeser, et al.'s model suggests that as the costs of various transportation options change, geographic distributions of low and high-income people are likely to emerge.

For instance, they note that, as the costs of driving rise or the costs of transit fall, cities are likely to develop a pocket of wealthy residents near the city center for whom transit or walking provides an economical alternative.[116] This situation would likely lead to the gentrification of formerly working class areas adjacent to transit. In Smith's language, it could potentially increase the gap between the existing land value, and that possible under a "higher and better" use (in this case housing directed toward wealthier people who prioritize transit connections or pedestrian environments).

Changes to the costs of driving and transit, need not be monetary. Similar effects can be inferred from a related piece by Kahn and Baum-Snow examining rail transit expansions.[117] They suggest that in areas where the total time and monetary costs of rail commuting fall below driving, some residents may switch from driving to rail use. This in turn drives up the land values adjacent to rail stations. While the authors do not talk about self-selection, it is reasonable to assume that some wealthier households are likely to migrate to these newly more accessible areas, and also that other lower-income households might be forced to leave.

It is also reasonable to assume that changes in congestion levels, or rates of central city employment (which could lengthen driving times from the suburbs), would yield similar results.[118, 119] This is consistent with some of the demand-side factors identified in the gentrification literature.[120, 121, 122] It also supports Pucher's contention that changing station area demographics may be behind the increases in rail commuting by the wealthiest households, and the corresponding decreases by the lowest-income households he observes in the 2000 National Household Travel Survey.[123]

Pucher's findings concretize the above discussion, illustrating the "dark side" of self-selection. As the costs and benefits of various transportation options rise and fall, low-income residents who formerly minimized their transportation costs by living close to transit, may be outbid and displaced by new residents self-selecting to live near transit. This raises normative questions of distributive justice, as transit-dependent households are forced to live further from transit. It might also yield unfortunate declines in ridership since

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[116]Glaeser, E., Kahn, M., & Rappaport, J. (2008). Why do the poor live in cities: The role of public transportation. *Journal of Urban Economics*, *63*(1), 8.
[117] Kahn, M. E., & Baum-Snow, N. (2006). Effects of urban rail transit expansions: Evidence from sixteen cities, 1970-2000. *Brookings-Wharton Papers on Urban Affairs*, 2005(1), 147–206. Brookings Institution Press.
[118]Giuliano, G., & Small, K. (1993). Is the Journey to Work Explained by Urban Structure? *Urban Studies*, *30*(9), 1485-1500.
[119] Kahn, M. E., & Baum-Snow, N. (2006). Effects of urban rail transit expansions: Evidence from sixteen cities, 1970-2000. *Brookings-Wharton Papers on Urban Affairs*, 2005(1), 147–206. Brookings Institution Press. 20.
[120] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink.
[121]Skaburskis, A. (2011). Gentrification and risk society. *Wharton Real Estate Review.* Fall.
[122]Smith, N. (2002). New globalism, new urbanism: gentrification as global urban strategy. *Antipode*, *34*(3), 427-450.
[123]Pucher, J., & Renne, J. L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, *57*(3), 61.

higher income households are more likely to use transit sparingly and only for work trips, than lower-income households who depend on transit for other trip purposes.[124]

## Does Transit Investment Cause Gentrification?

The literature outlined above helps illuminate the somewhat contradictory findings of research attempting to understand the links between transit investments and neighborhood change. Given Glaeser, et al.'s findings that transit serves to attract low-income families, we might infer that rail stations would do exactly the opposite of cause gentrification. And indeed, some studies have found this to be true. Anas, for instance found that transit investments tend to lower central-city property values.[125] In a national study, Kahn found that rail stations with park and ride facilities tend to lower the rates of college-educated station area residents.[126] Nelson, studying a Metropolitan Atlanta Rapid Transit Authority (MARTA) expansion, found significant negative influences on property values in an adjacent high-income neighborhood (as well as positive influences in a neighboring low-income neighborhood).[127] Yet the majority of studies find that new rail investment increases property values and can alter the demographic composition of the surrounding neighborhood.[128, 129, 130] Some even find that transit expansion plans themselves drive increases in property values.[131]

How do we make sense of these disparate findings? Drawing on the literature surveyed thus far, it is reasonable to join Chapple,[132] Diaz & Mclean[133], Cervero[134] and Loukaitou-Sideris& Banerjee[135] in suggesting that the economic effects of transit facilities are deeply contextual. In some instances, they may serve to attract carless low-income households, while in others they may facilitate investment, upgrading and/or gentrification. Below I outline some of the forces upon which station area gentrification may depend. While these echo those elaborated in the preceding gentrification chapter, here I focus specifically on those related to transit investment.

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[124]Giuliano, G., Hu, H., & Lee, K.. (2001). The role of public transit in the mobility of low income households: Final Report. METRANS Transportation Center.

[125]Anas, A. (1979). The impact of transit investment on housing values: a simulation experiment. *Environment and Planning A*11(3) 239 – 255.

[126]Kahn, M. (2007). Gentrification trends in new transit-oriented communities: Evidence from 14 cities that expanded and built rail transit systems. *Real Estate Economics*, *35*(2), 155-182.

[127]Nelson, A. (1992). Effects of elevated heavy-rail transit stations on house prices with respect to neighborhood income. . *Transportation Research Record* 1359, pp. 127 – 132.

[128]Diaz, R. B., & Mclean, V. (1999). Impacts of rail transit on property values. *American Public Transit Association Rapid Transit Conference Proceedings*, 1-8.

[129]Cervero, R. and Duncan, M. (2002) Benefits of proximity to rail on housing markets: Experiences in Santa Clara County. . *Journal of Public Transportation* 5(1) (2002): 1-18

[130]Lin, J. (2002). Gentrification and transit in northwest Chicago. *Journal of the Transportation Research Forum.* 56(4) (2002): 175-191.

[131]Knaap, G. J., Ding, C., & Hopkins, L. D. (2001). Do plans matter?: The effects of light rail plans on land values in station areas. *Journal of Planning Education and Research*, *21*(1), 32-39.

[132]Chapple, K. (2007). Transit-oriented for all: the case for mixed-income transit-oriented communities in the Bay Area. *Great Communities Collaborative framing paper.* Berkeley, Ca.

[133]Diaz, R. B., & Mclean, V. (1999). Impacts of rail transit on property values. *American Public Transit Association Rapid Transit Conference Proceedings* , 1-8.

[134]Cervero, R.( 2008). Transit-oriented development in America: Strategies, issues, policy directions. In: *New urbanism and beyond: designing cities for the future*, Tigran Haas, Editor. New York: Rizzoli. Pages 124-129

[135]Loukaitou-Sideris, A., & Banerjee, T. (2000). The Blue Line blues: Why the vision of transit village may not materialize despite impressive growth in transit ridership. *Journal of Urban Design*, 5:2, 101-125.

Factors likely to cause gentrification near transit:

**Demand Side Factors:** Overall, transit is likely to cause gentrification when it provides a viable alterative to the car for higher income households. This might occur because of:

- Demographic and cultural changes that increase the desirability or social acceptance of using transit;[136, 137]
- Declining speed and/or increasing monetary costs of automobile use;[138, 139, 140, 141]
- Increases in accessibility such as new or faster transit service. This becomes particularly relevant when access is improved relative to cars, and to managerial or professional jobs; and [142, 143, 144, 145]
- Pedestrian friendliness**,** which may increase the accessibility of commercial property, and consequently its value. [146, 147]

**Supply-Side Factors:** Overall, transit is likely to cause gentrification when it resolves the collective action problem of disinvestment. Formerly disinvested neighborhoods in proximity to a hot market are therefore ripe for gentrification.[148 , 149] Gentrification around transit investments is likely to occur when there is:

- A credible commitment to large scale investment: reinvestment in a disinvested neighborhood is likely when it appears that an actor (a state agency, financial institution or large land-owner) demonstrates a commitment to refurbish the physical environment at a scale capable of influencing

[136]Danyluk, M., & Ley, D. (2007). Modalities of the new middle class: Ideology and behaviour in the journey to work from gentrified neighbourhoods in Canada. *Urban Studies*, *44*(11), 2195-2210.
[137]Chapple, K. (2007). Transit-oriented for all: the case for mixed-income transit-oriented communities in the Bay Area. *Great Communities Collaborative framing paper*. Berkeley, Ca.
[138]Glaeser, E., Kahn, M., & Rappaport, J. (2008). Why do the poor live in cities: The role of public transportation. *Journal of Urban Economics*, *63*(1), 8.
[139]Kahn, M. E., & Baum-Snow, N. (2006). Effects of urban rail transit expansions: Evidence from sixteen cities, 1970-2000. *Brookings-Wharton Papers on Urban Affairs*, *2005*(1), 147–206. Brookings Institution Press.
[140] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink.
[141]Smith, N. (2002). New globalism, new urbanism: gentrification as global urban strategy. *Antipode*, *34*(3), 427-450.
[142]Kolko, J. (2009). Job location, neighborhood change, and gentrification. *Unpublished Manuscript*.
[143]Glaeser, E., Kahn, M., & Rappaport, J. (2008). Why do the poor live in cities: The role of public transportation. *Journal of Urban Economics*, *63*(1), 8.
[144]Kahn, M. E., & Baum-Snow, N. (2006). Effects of urban rail transit expansions: Evidence from sixteen cities, 1970-2000. *Brookings-Wharton Papers on Urban Affairs*, *2005*(1), 147–206. Brookings Institution Press.
[145]Loukaitou-Sideris, A., & Banerjee, T. (2000). The Blue Line blues: Why the vision of transit village may not materialize despite impressive growth in transit ridership. *Journal of Urban Design*, 5:2, 101-125.
[146]Kahn, M. (2007). Gentrification trends in new transit-oriented communities: Evidence from 14 cities that expanded and built rail transit systems. *Real Estate Economics*, *35*(2), 155-182.
[147]Diaz, R. B., & Mclean, V. (1999). Impacts of rail transit on property values. *American Public Transit Association Rapid Transit Conference Proceedings* , 1-8.
[148]Smith, N. (1979). Toward a theory of gentrification: a back to the city movement by capital not people. *Journal of the American Planning Association*, *45*(4), 538–48.
[149] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink.

the area's land or housing market.[150, 151] Large transit investments appear to have been used successfully and intentionally to demonstrate this type of commitment.[152]

## Gentrification Should Lower Transit Use and Increase Driving

Having examined the relevant contributions from a variety of literatures, it is now possible to make some conjectures about the likely effects of gentrification in transit station areas. First, by its definition, gentrification involves the replacement of lower-income people by higher income people. It is well documented that in the U.S. overall and in Los Angeles, wealthier and whiter communities own and use cars far more than lower-income groups and communities of color. Large changes in travel behavior are therefore likely as an area becomes wealthier and whiter. These effects will be particularly significant as a neighborhood loses its lowest-income residents, many of whom are quite unlikely to have cars.

As neighborhoods change, modes upon which lower-income people depend, such as buses, should see the greatest declines, while modes used by the wealthy (such as driving and commuter rail) might see growth. Overall however, transit use should decline steeply, particularly in cities like Los Angeles where nearly all transit riders have very low incomes and most ride buses. Since low-income people are more likely than wealthier people to use modes other than the private auto for non-work trips, it is likely that non-work travel by car will increase more dramatically than for work-trips.[153]

Glaeser, et al., Kahn and Baum-Snow's work suggests that changes to the cost of various travel modes may alter households' location and travel choices. Where transit is faster than, or competitive with, driving, it is reasonable to expect that some higher-income households will begin to use transit and/or choose to locate adjacent to transit stations. We may therefore see higher rates of use on modes like rail with exclusive rights-of-way than we would otherwise expect. Similarly, it is possible that walking and biking rates may increase adjacent to job centers as higher income residents relocate to avoid traffic congestion.

If gentrification near transit stations is driven primarily by demand-side factors—reflecting wealthier residents self-selecting to take advantage of rail transit—new transit riders are likely to partially offset the lost trips of displaced lower-income residents. However, if gentrification is largely due to supply-side factors, little to no transit ridership offset is likely to occur. In this scenario, it is the quality of development investment rather than the quality of transit that drives the decision to move to a neighborhood (at least for owner-occupiers). Thus areas with a high degree of speculation are likely to see the greatest declines in transit service.

Finally, if demand for housing adjacent to transit rises at a scale sufficient to affect the property market, households will be forced to adjust the tradeoff they make between housing and transportation costs. Some of these transit riding households will likely reduce housing costs by moving further from transit and purchasing or resurrecting a decrepit automobile or carpooling. Thus it is possible that new car trips will be generated by some of those who are displaced.

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[150]Knaap, G. J., Ding, C., & Hopkins, L. D. (2001). Do plans matter?: The effects of light rail plans on land values in station areas. *Journal of Planning Education and Research*, *21*(1), 32-39.
[151]Smith, N. (1979). Toward a theory of gentrification: a back to the city movement by capital not people. *Journal of the American Planning Association*, *45*(4), 538–48.
[152] Pollack, S., Bluestone, B., & Billington, C. (2010). *Maintaining diversity in America's transit-rich neighborhoods: Tools for equitable neighborhood change*. Dukakis Center for Urban and Regional Policy. Boston, MA.
[153]Giuliano, G., Hu, H., & Lee, K.. (2001). The role of public transit in the mobility of low income households: Final Report. METRANS Transportation Center.

## How Does Gentrification Relate to Travel Behavior?

With these theoretical assumptions in mind, we can now critically assess the few articles that have sought to understand the affects of gentrification on travel behavior. Danyluk and Ley's paper examines the effects of gentrification on travel behavior in Toronto, Vancouver and Montreal, Canada.[154] Unfortunately, their piece is both theoretically and methodologically weak. While the authors do outline some of the economic forces underlying gentrification, they largely ignore their likely effects on travel behavior. They also ignore the relationship between socioeconomics and mode share. Instead, they posit that gentrifiers' liberal, green, political ideologies should yield lower rates of non-automotive travel in gentrifying areas. To test this hypothesis, they correlate gentrification (as proxied by occupation and educational attainment) with various travel modes. Strangely, Danyluk and Ley do not attempt to assess changes in travel mode shares over time. Thus it is impossible to tell whether gentrifiers are using non-automotive modes, or simply moving to neighborhoods where these modes are popular.

The authors find that, controlling for distance from the city center, gentrification is correlated with higher rates of cycling and walking, lower rates of driving, and lower rates of transit use. While cycling and walking rates conform to their expectations, they are somewhat confounded by low transit use and high driving in gentrifying tracts. They go as far as to suggest that transit use rates might be artificially low due to the statistical influence of the "more conservative urban professionals" of one upscale neighborhood, who subscribe to a more "mainstream ideology that equates the status and convenience of driving a fashion-able car with a cosmopolitan lifestyle."[155] In doing so, they miss the large influence that socioeconomic characteristics have on mode choice, and collapse gentrification into a cultural phenomenon devoid of an economic basis.

Kushto and Schofer's unpublished paper is somewhat more rigorous, but is nonetheless methodologically weak.[156] The authors study the gentrification and travel behavior in Chicago between 1980 and 2000, using both aggregate and disaggregate data. To assess changes at the neighborhood scale, Kushto and Schofer classified census tracts as gentrifying when four conditions were met: aggregate family income increases, *and* the percentage of rental units decreased, *and* the percentage of families with children increased, *and* the percentage of adults with bachelors degrees increased.

The authors note that the pattern of gentrification changed significantly between the 80s and 90s, with more recent change occurring closer to the city center. Comparing the gentrifying tracts to a random sample of non-gentrifying tracts, the authors note that gentrifying tracts had a lower percentage of car ownership, and a higher rate of transit use. However they also note that non-gentrifying tracts were, on average, far further from the central business district (CBD) than gentrifying tracts. Since travel behavior in general, and transit use in particular, tends to vary considerably with distance from central business districts, it is likely that the observed difference between gentrifying and non-gentrifying tracts was due to spatial location rather than neighborhood change. It is not clear why the authors did not control for distance from the CBD.

This study also examined household level data from the Chicago Metropolitan Agency's 2007-2008 household travel survey. The researchers identified a set of households who had moved recently, owned their home, had a college degree, and earned 25 percent more than the survey's mean income, classifying these households as gentrifiers. Kushto and Schofer found that gentrifying households tended to be less

[154]Danyluk, M., & Ley, D. (2007). Modalities of the new middle class: Ideology and behaviour in the journey to work from gentrified neighbourhoods in Canada. *Urban Studies*, *44*(11), 2195-2210.
[155]Ibid, 2208.
[156]Kushto, E., &Schofer, J. (2008). Travel and transportation impacts of urban gentrification: Chicago, Illinois Case Study. *Unpublished.*

auto-reliant, and more likely to use transit soon after a move than did non-gentrifiers, but that over time these differences disappeared.

The authors conjecture that since these cross-sectional data capture successive periods of gentrifiers, the lower automobile dependence of recent movers could signal an increasing pattern of transit based self-selection. While the household level patterns that Kushto and Schofer identify are too sporadic and inconsistent to tell a coherent story, it is certainly possible that affluent households are increasingly likely to move close to transit, particularly if Chicago is seeing increased congestion, increased central city job growth or transit improvements.

The most recent and robust examination of the interactions of gentrification and travel behavior is Pollack et al.'s 2010 national study. The authors present a cogent analysis of neighborhood change and travel behavior adjacent to rail stations built during the 1990s.[157] The authors used block group level data from the 1990 and 2000 censuses, examining changes in demographic and travel variables relative to regional changes in these variables. The study found considerable evidence of gentrification in station areas nationwide. On average, population, housing units, income, rents and home prices all increased in new rail station areas relative to the region.

Researchers also found significant changes in transit use and auto-ownership. Overall, car ownership increased over time in station areas, likely reflecting the influx of wealthier migrants. Changes to transit use were uneven. While the majority of station areas had higher growth (or a lower decline) of public transit use than the surrounding region, a significant percentage saw transit use drop faster than the region. This raises serious concerns about the efficacy of new stations in promoting residents' transit use.

In order to understand why the observed changes occurred, the authors split their findings by type of rail. They found that both the socioeconomic and travel behavior changes were magnified for light rail stations. Light rail station areas grew far more rapidly and became whiter and higher-income than other rail station types. Additionally, light rail stations saw much faster increases in owner-occupancy rates, and faster growth in home values relative to rents, suggesting a speculative housing market. Since the majority of the light rail stations studied began as low-income neighborhoods with high percentages of renters, it is likely that these areas developed significant rent gaps, which were capitalized following transit investment.

It was in these light rail areas that researchers found the poorest transit performance—ridership actually declined relative to the regions in which they were situated. This supports the theoretical assumption that ridership should be lowest when the neighborhood change is driven by supply-side factors rather than self-selection. By contrast, new commuter rail stations, which are designed to compete with the private car, yielded the largest increases in transit ridership, and the lowest rates of gentrification. It should be noted however, that these stations were primarily built in already high-income neighborhoods with few transit riders.

While Pollack et al.'s study is well researched and thorough, a number of questions remain unexplored. First, their analysis used relatively old data, which makes it difficult to determine what kinds of neighborhood change occurred during the most recent decade. Second, while the authors describe two simultaneous phenomena (increasing gentrification and decreasing transit use) they do not statistically test the relationship between these processes. Consequently, we know that these trends sometimes occur together, but not whether they are necessarily linked. Additionally, the researchers' inclusion of only a few travel behavior variables (omitting for instance rates of driving or use of other modes) limits the usefulness of their findings.

[157] Pollack, S., Bluestone, B., & Billington, C. (2010). *Maintaining diversity in America's transit-rich neighborhoods: Tools for equitable neighborhood change*. Dukakis Center for Urban and Regional Policy. Boston, MA.

In particular, it would be helpful to see what types of transit modes are losing ridership in light rail station area neighborhoods, as well as to explore the effects of new stations on walking, biking and carpooling.

## What Questions Remain to be Explored?

As the foregoing discussion makes clear, much work remains to be done to untangle the relationship between gentrification and travel behavior. In fact, I found no studies with acceptable methodologies that statistically evaluated this connection, although Pollack et al.'s report presents compelling descriptive evidence from which a link can be inferred.

While a number of previous authors have sought to evaluate the statistical connections between gentrification and travel behavior, their analyses have not effectively demonstrated changes in travel behavior over time. Nor have other studies utilized adequate statistical controls for built environment variables such as density or distance from the CBD. While not explicitly focused on the question at hand, the built environment and self-selection literature can be reverse-engineered to provide insights regarding appropriate controls and methods. These will be discussed further in the methodology section.

Studies to date have also not utilized an adequate theoretical understanding of the mechanisms that drive gentrification. Such a framework would allow researchers to identify the divergent paths that gentrification might follow, and their interconnections with travel behavior. Research should explore for instance, the effects of housing speculation on travel. Noting Glaeser, et al. and Kahn and Baum-Snow's work on urban spatial structure and changing commute patterns, it would also be useful to consider changes to the relative costs and convenience of various travel modes at a regional level, in order to better understand how these affect households' location and transportation decisions.

Finally, both the scholarship on gentrification and travel, and the built environment and self-selection literature focus on the travel patterns of those moving into a neighborhood. Little work takes into account both in and outmigration, and no research examines the travel of those who leave a neighborhood. This brings to mind Atkinson's statement that studying the displacement of residents is akin to "measuring the invisible".[158] Future research should be directed at understanding who must leave, where they go, and how they travel in new neighborhoods.

[158] Atkinson, R. (2000) Measuring gentrification and displacement in Greater London, Urban Studies, 37(1), pp. 149–165.

# 6. Methodology

## Approach

This study seeks to clarify the relationship between gentrification and public transit station area residents' commute mode choices. While it is possible to draw some conclusions about this relationship simply by measuring travel pattern trends in gentrifying and non-gentrifying neighborhoods, many other factors influence travel patterns.[159] Indeed, a neighborhood's location in the region, its density, the type of development that has taken place there, the amount of transit or parking available, and other factors are all likely to affect residents' choices to drive, take transit, or commute by other means. If these factors are not taken into account, they may obscure or distort the true relationship between gentrification and travel. This analysis, then, uses linear multiple regression to control statistically for these other factors in order to isolate the effects of gentrification on travel behavior. It also allows me to explore the relative influence of a variety of factors that may be shaping travel in Los Angeles transit station areas.

This analysis is focused on the census tracts within a walkable distance (1/2 mile) of trunk-line transit services (heavy rail, light rail and bus rapid transit) stations operated by Metro. I utilize station area data from the 1990, 2000 and 2010 decennial censuses, the 2006-2010 American Community Survey (ACS), and the 2000 Census Transportation Planning Package, as well as transit maps, schedules and reports from Metro and other transit agencies.

Gentrification is a loose term that describes not a static state, but a process of change. To reflect the essence of this change, I have chosen six variables to capture its key components. These include two income variables (additions of high- income households and losses of low-income households), and changes in race/ethnicity, occupation, and education. Because gentrification occurs specifically in low-income areas, I created an index of these variables weighted by the percentage of households considered low-income in 1990.

Variation in travel behavior is expressed as the numerical change in the number of residents who travel to work on transit or drive alone. I also include a number of other variables in my analysis in order to control for variations that may mask the effects of neighborhood change and increase the usefulness of these models to policymakers.

To explore this question in detail, I constructed six regression models. Two illustrate the effects of gentrification and other factors on transit commuting and driving alone. The other four break gentrification into its component parts—focusing particularly on changes in household income—in order to provide specific information for decision makers concerned with maximizing transit use near transit stations.

[159] See Literature Review.

## Data

This study relies on demographic and commute data from the 1990, 2000, and 2010 decennial censuses and the 2006-2010 American Community Survey. I assembled data at the census tract level, in order to maximize geographic specificity, without unduly limiting sample sizes. In Los Angeles County, census tracts are typically approximately two square miles in area and are home to approximately 4500 people in 1500 households. Several limitations should be noted regarding these data. First, while the decennial census provides reasonably robust samples, variables such as commute mode are only available in the ACS. Since the ACS surveyed fewer than 1 percent of Californians, data are subject to high margins of error at smaller geographic scales such as census tracts. These high margins of error are compounded for travel modes that account for a small percentage of commute trips, such as rail, walking, and biking. Since it is impossible to statistically describe rail or non-automotive travel after 1990 with much confidence, I have limited my analysis to total transit use and solo driving. Second, the census asks respondents only about their travel to work, omitting the other 80 to 85 percent of trips to non-work destinations.[160] Therefore, my analysis includes only a small proportion of the trips station area residents actually make. This limitation is exacerbated by the fact that people's travel to work is often quite different from non-work travel. Overall, people use both transit and the private automobile more for work than for non-work travel, while people are far more likely to walk or bike for non-work travel.[161]Transit use varies significantly as well. While buses are used for a variety of purposes, rail use tends to be primarily commute-related.[162] Thus, my analysis is likely to yield somewhat skewed results such that changes in both transit use and driving may be overstated.

Since census tract boundaries changed significantly between 1990 and 2010, it was necessary to adjust census data accordingly. Utilizing the Census Geography Assignment & Conversion Files made available through the Redistricting Database of the State of California,[163] I was able to assign census 1990 data to census 2000 geographic boundaries. I performed a similar translation from 2010 to 2000 boundaries using 2010 Census Tract Relationship Files from the Census Bureau.

I used a variety of other data sources to define additional variables. These included File Two of the Census Transportation Planning Package, which contains the employment locations for workers, and transit maps, schedules and reports from Metro and other agencies. These sources are discussed in more detail below.

## Geography

This analysis is focused on the areas surrounding trunkline transit stations (heavy rail, light rail, and bus rapid transit) operated by Metro, Los Angeles County's transit operator. At the time of writing, there were 82 such stations in operation on five lines. These include two heavy rail lines (Red and Purple), two light rail lines (Blue and Green) and one Bus Rapid Transit line (Orange).

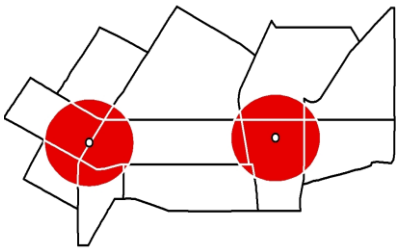
Since this study is concerned with neighborhoods with transit stations, I have included in my analysis only stations which have had transit service in operation for at least half of the study period (2000 or before). These stations, and the lines that serve them are shown below in Figure 8. More details are provided in Appendix G. The first of Metro's rail transit routes, the Blue Line, began operation in 1990. By 2000, a total

[160]Pucher, J., &Renne, J. L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, *57*(3), 54.
[161]Ibid, 53.
[162]Ibid, 53.
[163] Files Retrieved From: http://swdb.berkeley.edu/conversion.html.

of 50 stations were in operation on the Blue, Green, Red and Purple Lines. Another 32 stations were completed by 2010.

I defined *station areas* as all census tracts within a half mile of stations. While this half mile figure is somewhat arbitrary, it is the distance commonly used by researchers studying the determinants of ridership.[164, 165, 166] This methodology is shown schematically at below.

**Figure 9: Station Areas**

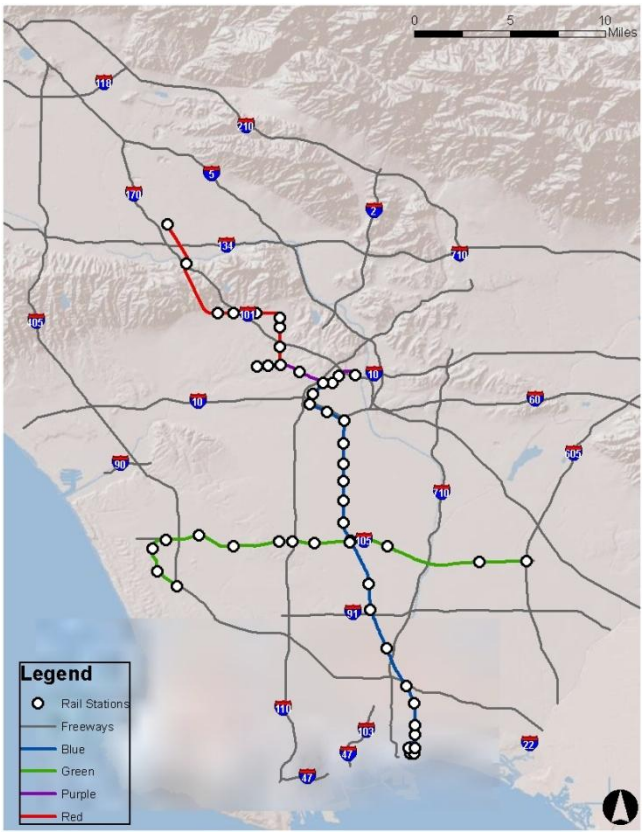


## Measuring Gentrification

While scholars have utilized a wide variety of methods to identify and quantify the process of gentrification, a number of variables are used constantly across the literature. I proxy gentrification using six of these metrics.

First, since gentrification, by definition, refers to an influx of higher-income individuals into a neighborhood, changes in aggregate income levels are usually a central measure of gentrification. While researchers typically use median income, or occasionally per-capita income,[167, 168, 169] I have instead included in my analysis numerical changes in households by income category because it allows a closer look at changes by household.

**Figure 8: Metro Lines and Stations Completed by 2000**




*Data Source: Metro Developer, 2011.*

[164]Cervero, R. (2007). Transit-oriented development's ridership bonus: A product of self-selection and public policies. *Environment and Planning A*. 39(9), 2068 – 2085.
[165]Kuby, M. (2004). Factors influencing light-rail station boardings in the United States. *Transportation Research Part A: Policy and Practice*, *38*(3), 223-247.
[166] Arrington, G. B., & Cervero, R. (2008). Effects of TOD on housing, parking, and travel.*Transit Cooperative Research Program*, *128*.
[167]Hudspeth, N. (2003). Gentrification and decline in Chicago: Defining neighborhood change with census data. *Interpreting Neighborhood Change Conference*. Chicago: Nathalie P. Voorhees Center for Neighborhood and Community Improvement.
[168] Atkinson, R., &Wulff, M. (2009). Gentrification and displacement: A review of approaches and findings in the literature. *Australian Housing and Research Institute (AHURI) Positioning Paper*, (115). Australian Housing and Urban Research Institute.
[169] Walks, R. A., &Maaranen, R. (2008). The timing, patterning, & forms of gentrification & neighbourhood upgrading in Montreal, Toronto, & Vancouver, 1961 to 2001. *Research Paper 211 Centre for Urban and Community Studies Cities Centre, University of Toronto*.

I utilized income categories set by the California Department of Housing and Community Development for determining housing affordability:

- Extremely Low-Income (less than $25,000)
- Very Low-Income ($25-40,000)
- Lower-Income ($40-60,000)
- Moderate-Income ($60-75,000)
- High-Income ($75,000 and up)[170]

In some models, I evaluate each income category separately. In others however, I have combined declines in the lowest-income households (extremely and very low-income) and increases in those with the highest incomes (high-income) with change in three other demographic variables to develop a composite proxy for gentrification.

As noted in Section 3, while gentrification may occur without racial/ethnic change, or as one population of color replaces another, in this country it generally results in an influx of new white residents.[171] For this reason, I include the percentage of non-Latino Whites as a proxy for racial/ethnic change.

With the exception of race/ethnicity, the variables above could potentially indicate a community that is growing wealthier over time without necessarily seeing in-migration. Measuring gentrification, therefore, necessitates including indicators differentiating this "incumbent upgrading" of already existing households from wealthier newcomers. Measuring changes in race and ethnicity can serve as one method of parsing these processes, but will fail to capture racially homogenous change. Gentrification scholars therefore typically include variables, such as occupational status and educational attainment, which can indicate larger shifts in class and cultural capital, and are unlikely to change significantly without migration.[172, 173, 174] In accordance with previous research on this topic, I include the percentage of residents with a college education (bachelors or more) and those employed in managerial occupations in my analysis.

The variables above effectively measure the degree to which a neighborhood may be undergoing the socioeconomic changes associated with gentrification. In the analysis below, I have combined these variables into a single index of socioeconomic change. This index equally combines the effects of each variable.[175] This construction of this index is shown in Appendix C, and the results are shown graphically in Appendix B.

While many studies of gentrification identify any upward movement in economic or cultural privilege as gentrification, some scholars insist that gentrification, by definition, is only possible in predominantly low-income neighborhoods.[176] This distinction is especially pertinent when considering transit use, which tends

[170]Based on 2010 limits, adjusted for 1990 and 2000 based on the local CPIU. Categories are approximate. I should note that I used categories as defined for a family of four, because it is the household size typically used in defining housing affordability. However, this household size is higher than that of the study area, which is closer to three.

[171] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink.

[172] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink.

[173] Atkinson, R., &Wulff, M. (2009). Gentrification and displacement: A review of approaches and findings in the literature. *Australian Housing and Research Institute (AHURI) Positioning Paper*, (115). Australian Housing and Urban Research Institute.

[174]Hudspeth, N. (2003). Gentrification and decline in Chicago: Defining neighborhood change with census data. *Interpreting Neighborhood Change Conference*. Chicago: Nathalie P. Voorhees Center for Neighborhood and Community Improvement.

[175] Based on the number of standard deviations (z-scores) each data point is from the county mean. Socioeconomic Change= Z (Change in High-Income HHs) + Z (Change in Highly Educated Adults) + Z (Change in Managers) – Z (Change in Low-income HHs).

[176]Bourne, L. (1993). The myth and reality of gentrification − A commentary on emerging urban forms. *Urban Studies*. 30 (1):

to be used primarily by the lowest –income households.[177] I have therefore constructed a variable for gentrification that captures this dynamic. Specifically, I proxy gentrification with a variable that tests whether the effects of socioeconomic change on commute mode are amplified for neighborhoods that were low-income in 1990. This variable (an interaction term) is given by multiplying the socioeconomic change index by the percent of households classified as very low or extremely low-income in 1990 (shown in Appendix C, and Graphically in Appendix B).

## Housing Variables

While gentrification is ultimately a socioeconomic phenomenon, it is driven by changing housing prices. Accordingly, I have included three variables to capture changes in housing market conditions. These are shown in more detail in Appendix C. Changes to median rents and median home sale values both indicate the increases in housing demand associated with gentrification.[178, 179] I have also included changes in tenure (ownership/rental ratio), another measure commonly found in the literature.[180, 181] A shift from rental to ownership may express an increase in investment activity and also of households capable of making such an investment. It also suggests potential pressures on the rental market which may make it difficult for low-income families to find housing they can afford.

## Policy Variables

It is likely that a number of policy decisions made by Metro and the city of Los Angeles influence station area residents' mode choices. In order to understand better the effects of public policies on these decisions, I have included a number of variables describing station area characteristics. Nationally, Kahn found that station area parking provision can affect the ways in which neighborhoods change. Using data from Metro, I test both the presence of a park and ride lot and the number of parking spaces at a given station.[182] I have also included a dummy (yes or no) variable for whether a station has been developed by Metro's Joint Development Program, which partners with private developers to build new housing or commercial space around stations. These policy variables are shown in Appendix C.

## Control Variables

183−18

[177]See Section 4.

[178] Atkinson, R., &Wulff, M. (2009). Gentrification and displacement: A review of approaches and findings in the literature. *Australian Housing and Research Institute (AHURI) Positioning Paper*, (115). Australian Housing and Urban Research Institute.

[179]Hudspeth, N. (2003). Gentrification and decline in Chicago: Defining neighborhood change with census data. *Interpreting Neighborhood Change Conference*. Chicago: Nathalie P. Voorhees Center for Neighborhood and Community Improvement.

[180] Kennedy, M. & Leonard, P. (2001). *Dealing with neighborhood change: A primer on gentrification and policy choices.* A Discussion Paper Prepared for The Brookings Institution Center on Urban and Metropolitan Policy and PolicyLink.

[181] Atkinson, R., &Wulff, M. (2009). Gentrification and displacement: A review of approaches and findings in the literature. *Australian Housing and Research Institute (AHURI) Positioning Paper*, (115). Australian Housing and Urban Research Institute.

[182]Kahn, M. (2007). Gentrification trends in new transit-oriented communities: Evidence from 14 cities that expanded and built rail transit systems. *Real Estate Economics*, *35*(2), 155-182.

While the importance of socioeconomic factors in mediating transit use suggests that gentrification will have a large effect on mode choice,[183] there are a variety of other variables that are also likely to have significant effects. Many of these factors, such as metropolitan economic patterns, geography, and transit fares,[184] function at a larger scale (regional) than can adequately be captured in my more micro-area analysis, and are thus controlled for by the limited scale of this study. However, since other factors influencing ridership vary considerably by neighborhood, it is necessary to control for them statistically. In this study I control for the influence of both changing transit service levels, and the spatial characteristics of a neighborhood.

## Transit Availability

As one might expect, studies have found that transit availability is one of the primary determinants of transit ridership.[185, 186] More buses tend to mean more riders. Since transit service varies considerably by neighborhood and time period, it is crucial to control for its influence on ridership. While it would be ideal to include service availability for each census tract in Los Angeles County, it is impractical to do so since digitized service information is not available for years prior to 2007.

Therefore, I computed service availability only for the area within half a mile of a rail station, and limited my analysis to the set of census tracts containing these areas. Using schedules and maps provided by Metro and other transit operators, I calculated transit service provision as the change in the total transit passenger capacity moving through a station area during Metro's busiest hour (7:30 to 8:30 AM). This variable is shown in Appendix E, and a far more detailed explanation is provided in Appendix D.

## Spatial Variables

An extensive literature confirms the influence of the built environment on mode choice. Indeed, a lively debate exists as to the relative weights and interactions of the so called "five D's" – density, diversity, design, destination accessibility, and distance to transit.[187] While it is not feasible to include a full representation of these variables in this analysis, it is nonetheless worthwhile to account for their effects to the extent possible. Therefore, I have included three relatively broad spatial variables. In their synthesis of the built environment literature, Ewing and Cervero identify densities (both residential and employment) as a primary determinant of mode choice.[188] Other scholars have found mixed results concerning the effects of densities on mode choice, particularly after controlling for other factors.[189] It seems that perhaps rather than directly affecting mode choice, "density is an intermediate variable that is often expressed by the other Ds."[190] In this case, this imprecision is not a problem, since I am seeking to control for features of the built environment to the maximum extent feasible, rather than parse the exact causal influence of each of the five Ds on travel.

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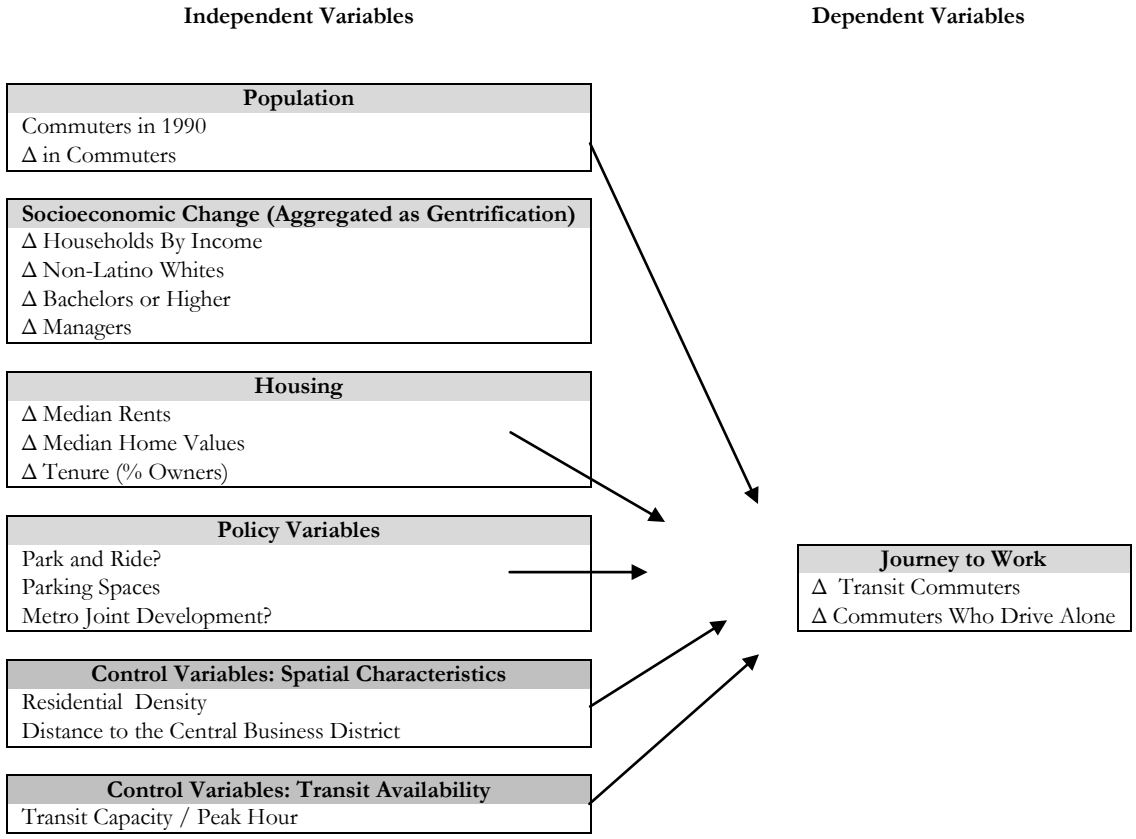
[183] See Section 4.
[184] Taylor, B. D., Miller, D., Iseki, H., & Fink, C. (2008). *Nature and/or nurture? Analyzing the determinants of transit ridership across US urbanized areas*. University of California Transportation University of California.
[185] Ibid.
[186] Ewing, R & Cervero, R. (2010). Travel and the built environment: a meta-analysis. *Journal of the American Planning Association.*76:3.
[187] Ibid.
[188] Ibid.
[189]Badoe, D. & Miller, E. (2000). Transportation-land-use interaction: empirical findings in North America, and their implications for modeling. *Transportation Research Part D.* 235-263.
[190] Ewing, R & Cervero, R. (2010). Travel and the built environment: a meta-analysis. *Journal of the American Planning Association.*76:3. 276.

Regional destination accessibility (what destinations are within easy reach by car or transit) is another determinant of travel behavior routinely cited in the built environment literature—particularly for its efficacy in predicting vehicle miles traveled (VMT).[191] While scholars employ a number of specific metrics to evaluate accessibility, many studies simply measure distance to the central business district, or CBD. Like densities, this relatively crude measure has the advantage of being heavily correlated with a number of features of the built environment and can serve as a proxy for more detailed analysis.[192] Nationally, residential distance to the CBD also correlates closely with public transit use, suggesting it may also be important to control for in this study.[193]

## Figure 10: Conceptual Schema of Regression Models




[191] Ibid.
[192] Ibid, 275.
[193] Kahn, M. E., & Baum-Snow, N. (2006). Effects of urban rail transit expansions: Evidence from sixteen cities, 1970-2000. *Brookings-Wharton Papers on Urban Affairs*, *2005*(1), 147–206. Brookings Institution Press.

# 7. Findings

This section presents an analysis of the socioeconomic and travel characteristics of residents of Metro station areas in relation to Los Angeles County at large between 1990 and 2006/2010. I begin by reviewing the socioeconomic characteristics of these areas during 1990 and by describing the differing growth patterns between station areas and the county overall. I should note that this analysis is purely descriptive—simply describing the overall changes that have taken place. I do not intend to draw conclusions about whether socioeconomic changes or gentrification are *caused* by transit stations, nor will I make any claims to this effect. Following this description of socioeconomic changes, I then present a similar analysis of mode choice for work trips during this period.

Having established a clear picture of the changes that have taken place in residents' characteristics and their travel choices adjacent to LA area transit stations, I use a number of statistical models to draw inferences about the relationships between these changes.

## KEY FINDINGS

- Station areas have added high-resource households much faster than the county overall.
- Station areas have added high-resource households much faster than the county overall.
- Not all transit stations gentrified, but many did.
- Station areas lost transit riders, and gained drivers much faster than the county overall.
- Gentrification shows a strongly negative and statistically significant relationship with station area transit ridership.
- New low-income households (below $40,000) are associated with increases in transit riders, while new moderate and high-income households are associated with decreases in transit riders.
- Gentrification is associated with increased driving.
- New low-income households (below $40,000) are associated with decreases in the number of solo drivers, while new moderate and high-income households are associated with increased driving.
- Metro's joint development real estate activities are strongly correlated with decreased transit use.

## Socioeconomics and Neighborhood Change

Have transit station areas experienced significant neighborhood change relative to the county as a whole during the last two decades? Figure 11 below illustrates the rates of change of key socioeconomic and housing indicators from 1990 to 2010 for the county at large and for census tracts within a half mile of a transit station. More detailed information is shown in Appendix F.

From this table, it is clear that station areas differ significantly from the rest of the county. In 1990, these areas were disproportionately resource-poor. Census tracts located close to stations had dramatically lower median incomes ($20,000 vs. 30,000), a higher percentage of low-income households (44 vs. 31%) and a lower percentage of high-income households (17 vs. 33%). Station area residents were also disproportionately likely to be renters and people of color, and far less likely to have high educational

attainment or work in a managerial occupation. While housing (rents and home values) was less costly in station areas than the rest of the county, it was still relatively high relative to residents' incomes.

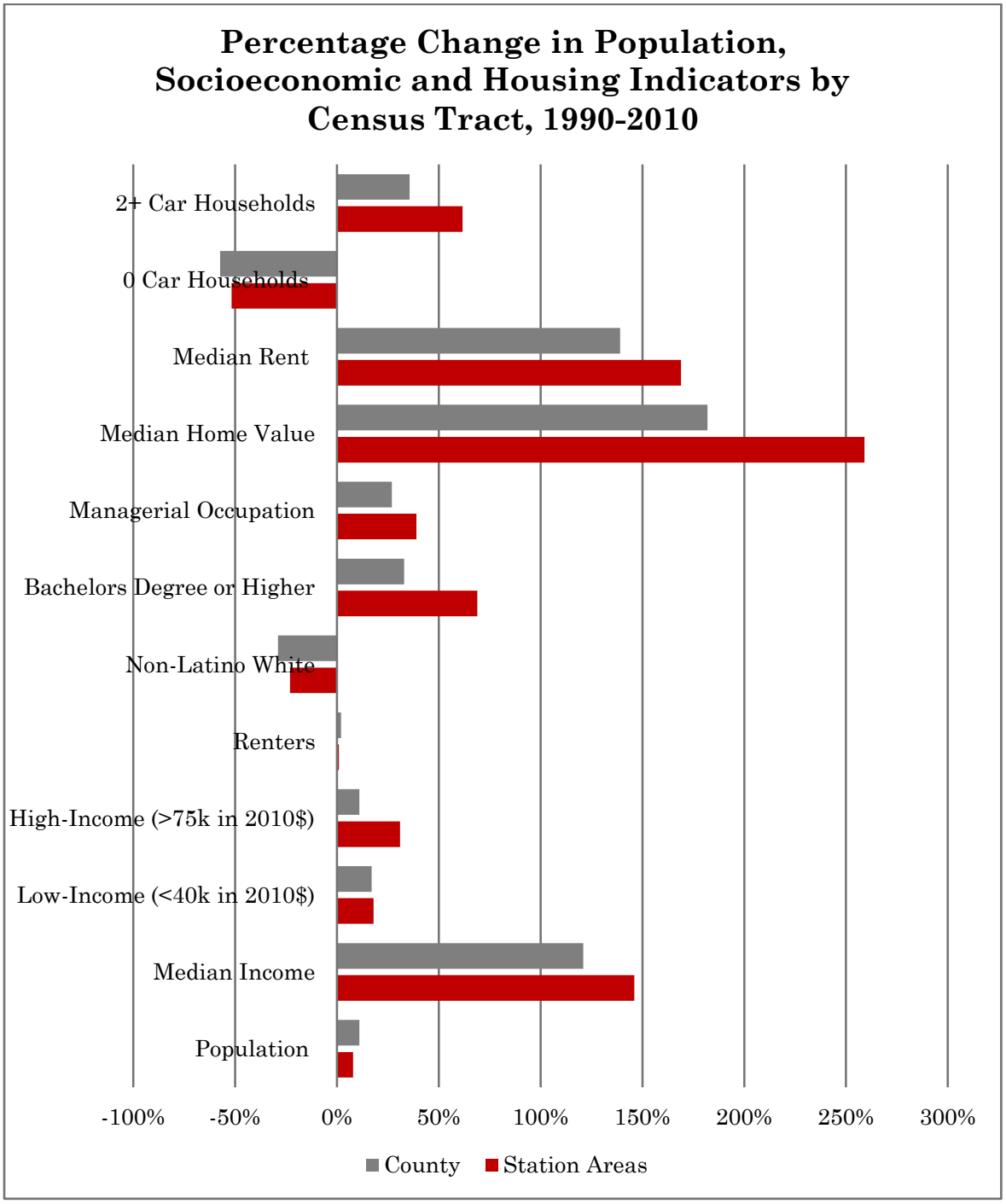
These areas have exhibited significantly different patterns of growth from the rest of the county over the last two decades. While still significantly lower-income than the rest of the county, station areas appear to have added a disproportionate number of higher-income, higher-resource households—suggesting that a process of gentrification may be occurring in some neighborhoods.

The percentage of higher-income households in station areas increased at nearly three times the rate as the county, as did the proportion of highly educated adults (a 69% change). These areas also saw disproportionate increases in the percentage of those with managerial occupations (39 vs. 27%). While the proportion of non-Latino Whites declined county-wide, this decline happened slightly faster outside of station areas (-29 vs. -23%). These changes are shown below in Figure 11.

Housing costs in station areas have grown quickly in the past two decades. Rents rose by 169 percent (relative to 138% elsewhere) and home values grew by 259 percent (relative to 182%), making the median home in station areas almost as expensive as the county median by 2010.

Overall, these changes suggest a shift in the geographic distribution of wealth and privilege in Los Angeles County, in which higher-income residents are increasingly locating in areas close to transit. Housing costs have mirrored, and often outpaced, these socioeconomic changes. Again, it should be noted that these changes are not necessarily driven by the presence of transit stations. I will leave this thorny question of causality for other researchers.

**Figure 11: Population, Socioeconomic and Housing Indicators. Station Areas vs. LA County**

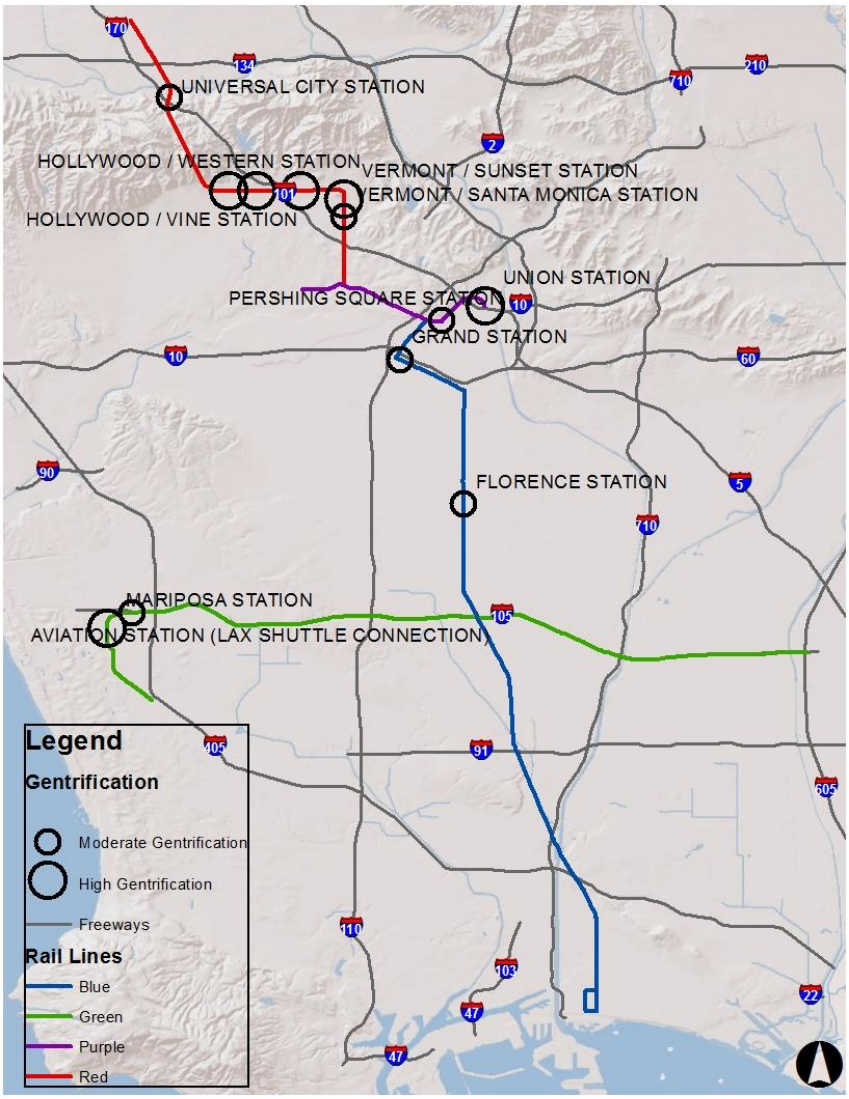



*Data Source: U.S. Census Bureau. 1990, 2000 and 2010 Decennial Census and 2006-2010 Five Year ACS.*

## Gentrification?

The figure above shows that many of the indicators of gentrification, such as household income, race/ethnicity, education and occupation are changing relatively quickly in station areas. As described in Section 6 above, I have aggregated these indicators into a single gentrification index. Figure 12 below illustrates the results of this index aggregated by station area.

**Figure 12: Station Area Gentrification (1990-2010)**




*Data Source: U.S. Census Bureau. 1990, 2000 and 2010 Decennial Census and 2006-2010 Five Year ACS, and Metro Developer.*

Small circles indicate station areas that have shown moderate gentrification, while the larger circles indicate intense gentrification. For detailed information by station, see Appendix G.

Socioeconomic change has not been uniform. Many station areas, such as the Blue and Green line stations to the south of downtown, changed little over the last two decades. Other neighborhoods saw significant gentrification. Nearly all red line stations through Hollywood changed quite quickly. While several stations downtown, such as Union, Pershing Square, and Grand Stations have clearly gentrified, others have not changed appreciably.

## Commute Patterns

Station areas have seen dramatic change in commuting behavior in the past two decades. Given that researchers typically find a strong connection between socioeconomic factors and travel, we would expect to see significant changes in residents' travel patterns between 1990 and 2010. Has this been the case?

Table 3 below shows the percentage of residents of station areas and the county at large (including station areas) who commuted by selected modes in 1990 and 2006/2010. In 1990, residents of station areas exhibited markedly different travel behavior from other Angelenos. Only about half of residents drove to

work (relative to two-thirds elsewhere) and nearly 20 percent took transit (relative to 7% countywide). Station area residents also walked at higher rates than those in other parts of the county. Carpooling, biking and rail use to work was not significantly different inside or outside of the station areas.

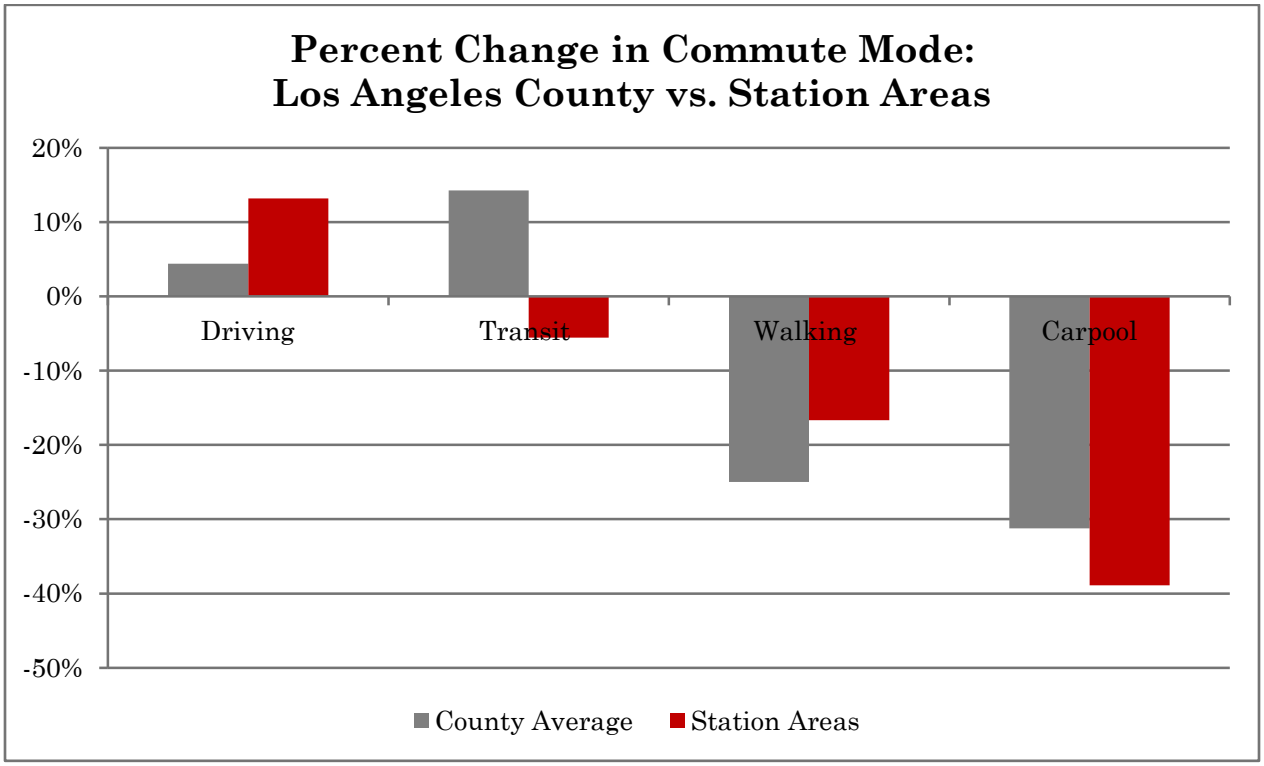
**Table 3: Commute by Selected Modes (1990-2010)**

| | County | | | Station Areas | | |
|---|---|---|---|---|---|---|
| | Average (1990) | Average (2006/10) | %Change | Average (1990) | Average (2006/10) | %Change |
| Drive Alone | 68% | 71% | 4% | 53% | 60% | 13% |
| Carpool | 16% | 11% | -31% | 18% | 11% | -39% |
| Transit | 7% | 8% | 14% | 18% | 17% | -6% |
| Bus | 6% | 6% | 0% | 17% | 16% | -6% |
| Walking | 4% | 3% | -25% | 6% | 5% | -17% |
| Biking | <1% | <1% | γ | <1% | <1% | γ |
| Rail | <1% | <1% | γ | <1% | 1% | γ |

Notes: γ=Overly High Margin of Error.

Commuting in Los Angeles has shifted considerably in the past two decades, with changes in station areas being especially pronounced. Figure 13 below illustrates these changes graphically. From relatively low initial driving rates, station areas have added solo drivers rapidly and are now reasonably close to the county average (60% vs. 71%). Transit use has exhibited the opposite pattern—growing overall but declining in station areas. Walking rates shrank in both areas, although faster outside of station areas. Carpooling also declined, particularly in station areas. Overall, it appears that commute mode choice in station areas has become more like the rest of the county over the last two decades, adding significant numbers of new drivers and losing transit riders and carpoolers.

**Figure 13: Percent Change in Commute Mode (1990-2010)**




*Data Source: U.S. Census Bureau. 1990, 2000 and 2010 Decennial Census and 2006-2010 Five Year ACS.*

## Are Gentrification and Commute Mode Choice Related?

It is clear that the demographics of station area neighborhoods have changed dramatically in the past two decades. These areas are now home to a significantly greater proportion of higher-income, higher-resource households than they were in 1990. The residents of these areas are also increasingly choosing to commute by private automobile and forswearing transit. Can we say that these phenomena are related? The remainder of this chapter explores the statistical relationships between socioeconomic variables and commute mode.

I first present two multivariate regression models that test the relationship between gentrification and commute mode, after controlling for a number of other factors. I then add two other models that break gentrification into its component parts—focusing particularly on changes in household income—in order to provide specific information for decision makers concerned with maximizing transit use near transit stations. Two further models are included in Appendices H and I. These are parsimonious (or slimmed down) models that are useful for predicting the specific influence of each variable.

### Model 1: Gentrification and Transit

This model tests the relationships between gentrification (and other control factors) on transit commuting. The B coefficients provide estimates of the number of additional transit commuters we can statistically expect (in relation to the mean) given a unit change in each variable. For instance, the coefficient of .026 for population density (people per sq mi) indicates that, after controlling for other factors, for each additional person per square mile, a tract was likely to see an additional .026 transit commuters. Put another way, density increases of 40 people per mile from 1990 to 2010 yielded an increase of one transit commuter. The asterisks next to the B coefficients indicate how confident we can be that a variable is indeed statistically significant. One indicates we can be 90 percent confident, two indicates 95 percent confidence, and three indicates 99 percent. The standardized coefficients indicate roughly the relative influence of each variable tested, regardless of the unit they are measured in.

I control for a tract's commuting population in 1990, as well as population growth that has occurred since. The variable "Index* % Low Income 1990" proxies gentrification. This is what is called an *interaction term*, or a variable that tests the relationship between two variables by estimating the collective influence of these variables on the outcome variable. In this case, this term indicates tracts in which significant socioeconomic change took place, weighted by the percentage of households with very or extremely low-incomes in 1990.

**Table 4: Model 1- Gentrification and Change in Transit Commuters by Census Tract (1990-2010)**

| Variable | Static or Change Variable | B Coefficient | Standardized Coefficient |
|---|---|---|---|
| **Population** | | | |
| Population (Commuters) | Change | 0.056 | 0.144 |
| Commuting Population in 1990 | Static | 0.004* | 0.023 |
| **Demographics** | | | |
| Socioeconomic Index | Change | 15.011 | -0.252 |
| % Low-Income in 1990 | Change | -3.039 | -0.003 |
| Index*% Low-Income 1990 (Gentrification) | Change | -75.746** | -0.552 |
| **Spatial Characteristics** | | | |
| Population/Square Mile | Change | 0.026*** | 0.430 |
| Ln Distance to the CBD | Static | 4.651 | 0.033 |
| **Policy Variables** | | | |
| Metro's Joint Development | Static | -86.157*** | -0.235 |
| Park and Ride Lot | Static | 14.653 | 0.050 |
| Parking Spaces at Station | Static | 0.005 | 0.013 |
| **Transit Provision** | | | |
| Transit Capacity/Hour | Change | -.003 | -.064 |

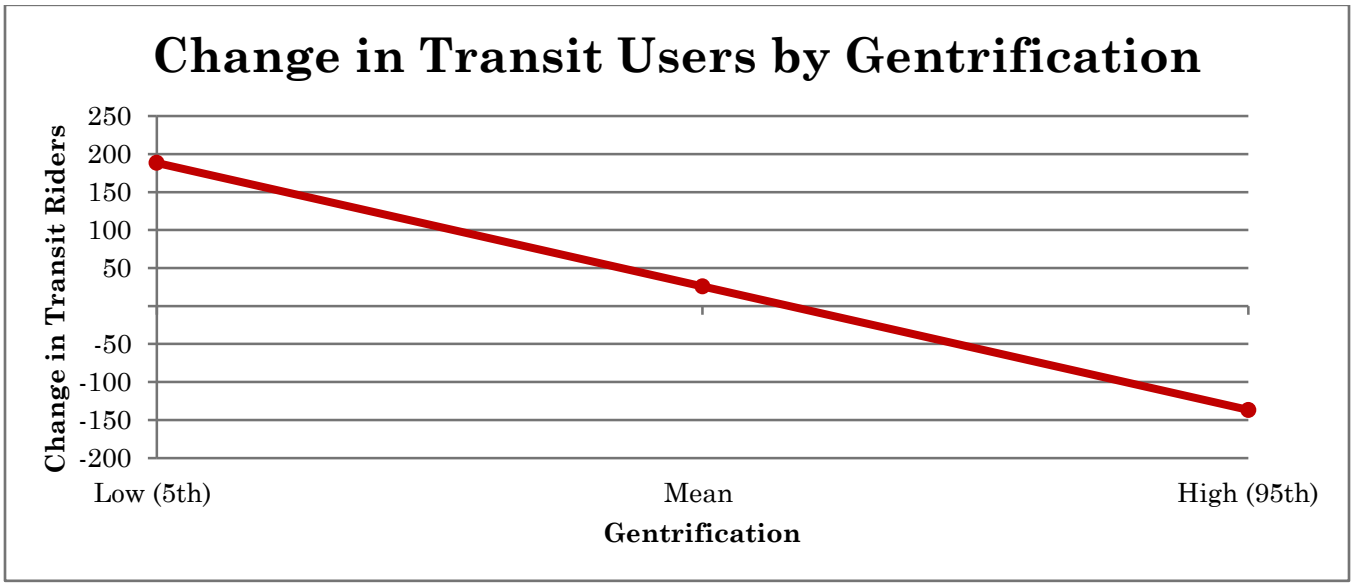
Notes: Adjusted R Squared = .397 *p<.1. **p<.05. **p<.01

Overall, this model has an adjusted R squared of .397, indicating that it explains approximately 40 percent of the observed variation in transit commuting. The interaction term, which represents gentrification, shows a significant, negative relationship with transit use, and is in fact the most powerful predictor of changes in transit commuting. Controlling for other factors, tracts with the least gentrification (5th percentile) gained approximately 190 transit riders, while those with the most (95th percentile) lost approximately 140 transit riders.

The association between changes in socioeconomic variables and transit ridership shown in this model is unambiguous. While it is difficult to say with certainty from these results that demographic change is

directly c*ausing* changes in transit use, this inference is consistent with previous studies that have found socioeconomic factors to be among the primary determinants of transit ridership.[194, 195]

**Figure 14: Change in Transit Riders by Gentrification (1990-2010)**




While the socioeconomic aspects of gentrification have clear relationships with transit use, the effects of housing costs are more ambiguous. Indeed, after controlling for socioeconomic change, housing costs (median rents and median home values) did not show a significant relationship to transit. While insignificant, these variables caused unexpected sign flips in variables of interest, and I consequently left them out of the model. However, since rising housing costs are positively correlated with socioeconomic changes, they likely have an indirect effect on commute mode. While housing tenure did show a significant relationship with transit use, I also removed this variable because it is highly collinear with the gentrification variables.

Second to gentrification, changes in population density had the largest relationship with transit use. As illustrated in Table 4 above, increases in population density were associated with significant gains in transit ridership. As elaborated in Section 5, this relationship is entirely consistent with the literature.

While the number of parking spaces at a given transit station and the presence of a park and ride lot were not significant, Metro's joint development real estate activities appear to have a significant, negative relationship with transit ridership. While it is possible that joint development is driving down transit ridership, it is difficult to establish causality. Indeed, it would seem that if joint development were causing decreases in transit ridership, it would do so by stimulating neighborhood change, which is largely controlled for in this model. Perhaps joint development has occurred largely in areas that are already undergoing changes not captured by this model. Since joint development depends on private market interest, it is reasonable to assume that it would occur largely in areas that are changing quickly (and hence highly profitably). This finding deserves further research, but does suggest that Metro should critically assess the

[194] Taylor, B. & Fink, C. (2003). The factors influencing transit ridership: a review and analysis of the literature. *UCLA Department of Urban Planning Working Paper.*
[195]Pucher, J., & Renne, J. L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, *57*(3).

effects of its real estate development program on transit use, as their policies are predicated on the assumption that transit-oriented development will increase patronage.

The effects of transit service levels on transit use are somewhat difficult to interpret. The model above finds no statistically significant relationship between transit provision and use. These findings are counterintuitive, contradicting the strong positive relationship typically found between these factors in the literature.[196] Upon closer inspection, it appears that many station areas (Union Station, Wilshire and Vermont, 7th Street, and Hollywood and Vine) have seen increases in capacity but dramatic ridership losses. Conversely, other stations such as Hollywood and Western, Vermont and Santa Monica and Pico, have seen large gains in ridership but no change, or negative change, in transit capacity.

A number of dynamics may be behind this finding. First, since GIS data were not available for 1990, I calculated transit capacity using paper maps and incomplete schedules. While care was taken to assemble data accurately, a certain amount of judgment and error were inevitable. Second, I have measured transit provision based on the number and capacity of transit vehicles passing through an area. However, this does not necessarily provide a picture of whether these vehicles are serving this neighborhood. Some areas may be hosts to routes, such as express bus service or rail transit, that move people through a neighborhood from origins and destinations elsewhere. Pico station in particular has lost a large number of express buses that serve downtown, yet has gained a large number of transit riders.

Similarly, many stations that have added capacity since 1990 serve places (like downtown) with high levels of employment relative to their populations. Since my analysis captures only trips made by area residents, and not employee trips *to* these areas, it seems likely that my analysis may understate overall transit ridership at some stations. This may, in turn, skew the observed relationship between transit capacity and use.

Finally, it is likely that other variables are obscuring the relationship between transit service and ridership. Modeled independently, transit capacity does have a positive (although weak) relationship with transit use at these LA County station areas. However, the addition of other independent variables, particularly population growth, density, and gentrification, made this relationship no longer statistically significant, and flipped the sign to negative. This is perhaps because planners generally add transit capacity in areas of high or growing demand—typically near transit-dependent people and in areas of high or increasing density. Thus the same factors that drive ridership also stimulate capacity expansion. Since, ridership and capacity are jointly determined by these factors—which I have carefully controlled for— it is perhaps no wonder that capacity does not show the expected relationship.

## Model 2: Gentrification and Driving

This model tests the relationship between gentrification and driving alone to work, using the same variables as the transit model above.

[196]Taylor, B. D., Miller, D., Iseki, H., & Fink, C. (2008). *Nature and/or nurture? Analyzing the determinants of transit ridership across US urbanized areas*. University of California Transportation University of California.

**Table 5: Model 2- Gentrification and Change in Commuters Driving Alone by Census Tract (1990-2010)**

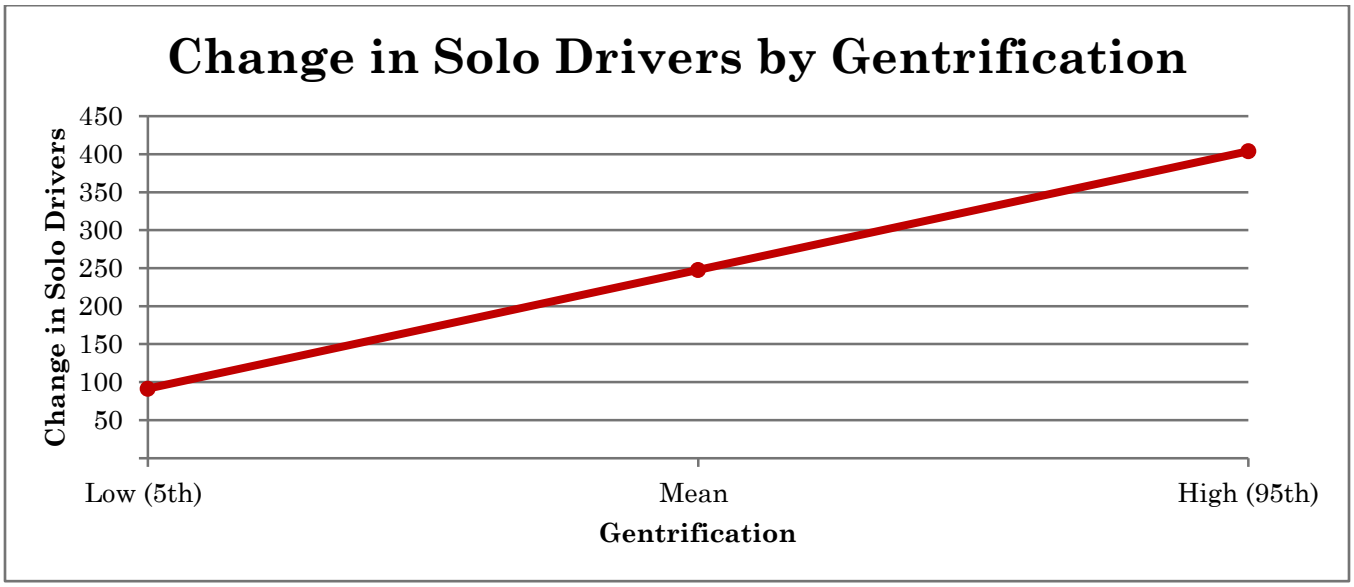
| Variable | Static or Change Variable | B Coefficient | Standardized Coefficient |
|---|---|---|---|
| **Population** | | | |
| Population (Commuters) | Change | 0.034** | 0.097 |
| Commuting Population in 1990 | Static | 0.730*** | 0.946 |
| **Demographics** | | | |
| Socioeconomic Index | Change | -19.320 | -0.163 |
| % Low-Income in 1990 | Change | 403.555*** | 0.169 |
| Index*% Low Income 1990 (Gentrification) | Change | 72.794* | 0.266 |
| **Spatial Characteristics** | | | |
| Population/Square Mile | Change | -0.030*** | -0.254 |
| Ln Distance to the CBD | Static | -40.929*** | -0.144 |
| **Policy Variables** | | | |
| Metro's Joint Development | Static | 31.242 | 0.043 |
| Park and Ride Lot | Static | 43.823 | 0.076 |
| Parking Spaces at Station | Static | -0.017 | -0.023 |
| **Transit Provision** | | | |
| Transit Capacity/Hour | Change | 0.001 | 0.010 |

Notes: Adjusted R Squared = .698 *p<.1. **p<.05. **p<.01

This model yields few surprises, closely mirroring the transit model above. Gentrification shows a positive relationship with driving, while population density and distance from the city center were both negative. Housing costs were again insignificant and removed due to their correlation with other variables. None of the policy variables were significant, or was transit provision.

While gentrification and driving show a weaker relationship than gentrification and transit use, the relationship is nonetheless significant (at the .1 level). Controlling for other factors, tracts with the least gentrification (5$^{th}$ percentile) gained approximately 90 drivers, while those with the most (95$^{th}$ percentile) gained approximately 400 drivers. This effect is statistically significant, but less robust than the relationship between gentrification and transit use.

**Figure 15: Change in Solo Drivers by Gentrification (1990-2010)**




This model does depart from the previous one in one respect. Here, the percent of the population that was considered extremely or very low-income in 1990 has a strong positive relationship with driving, whereas in the transit model this variable was eclipsed by the gentrification interaction term. In this case, even after controlling for gentrification, tracts that began the 90s with high populations of low-income people—who likely rode transit, carpooled, or walked far more than wealthier peers—added the most drivers. It is probable that this result is due to the fact that rates of auto ownership have increased quickly in recent decades, especially for low-income households.[197, 198]

## Model 3: Gentrification and Transit (Income and Demographics Model)

The two models above use an index comprised of household income and demographic factors to test the relationship between gentrification and commute mode. This index is a good proxy for gentrification because the phenomenon is by definition a multi-faceted and cumulative one. Neither income changes alone nor changes in race/ethnicity or occupation constitute gentrification. Rather, gentrification describes the overall process in which the migration of high-resource households to low-income neighborhoods changes the cultural and economic character of the area.

While this index is useful for testing the overall effects of gentrification, it is less helpful for understanding which elements of gentrification are the dominant drivers of changes in commute mode. The two models below seek to fill this gap by separately testing the influence of a variety of economic and demographic variables.

I should note that this endeavor is a challenge because race/ethnicity, class, education, and occupation are all highly correlated with each other (collinear in statistical terms). It is thus extremely difficult to pull apart and understand the independent effects of these highly interrelated factors. I have dealt with this issue to an extent by removing variables that interact poorly with one another, but the results below should nonetheless

[197]Pucher, J., & Renne, J. L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, *57*(3), 54.
[198]Pisarski, A.(2006). Commuting in America. *NCHRP Report 550* and *TCRP Report 110*. Transportation Research Board: Washington D.C.

be interpreted with some caution. I should also point out that the models below include each relevant variable that could feasibly be included (without overly problematic interactions). These are useful for understanding the relative influence of each variable, but less so for predicting their specific effects on transit use. In two additional models, shown in Appendix H and I, I have removed those variables that are not statistically significant, yielding parsimonious (or slimmed down) models that more reliably predict the effects of each variable.

**Table 6: Model 3- Gentrification (Income and Demographics) and Change in Transit Commuters by Census Tract (1990-2010)**

| Variable | Static or Change Variable | B Coefficient | Standardized Coefficient |
|---|---|---|---|
| **Population** | | | |
| Population (Commuters) | Change | 0.111*** | 0.287 |
| Commuting Population in 1990 | Static | -0.005 | -0.031 |
| **Income** | | | |
| Extremely Low-Income (<$25k) | Change | 0.108** | 0.119 |
| Very Low-Income ($25-40K) | Change | 0.280*** | 0.188 |
| Lower-Income ($40-60K) | Change | -0.208** | -0.191 |
| Moderate-Income ($60-75K) | Change | -0.434*** | -0.205 |
| High-Income (>$75K) | Change | -0.253*** | -0.218 |
| **Demographics** | | | |
| Non-Latino Whites | Change | -0.031 | -0.116 |
| Highly Educated | Change | -0.015 | -0.061 |
| **Spatial Characteristics** | | | |
| Population/Square Mile | Change | 0.022*** | 0.361 |
| Ln Distance to the CBD | Change | -3.256 | -0.023 |
| **Transit Provision** | | | |
| Transit Capacity/Hour | Change | -0.003 | -0.050 |
| Notes: R Squared =.326 *p<.1. **p<.05. **p<.01 | | | |

This model shows results quite similar to the transit model above. Again, the socioeconomic changes associated with gentrification have the strongest negative relationships with transit use, while population density has the strongest positive relationship. As noted above, many of the variables tested are highly correlated with one another. To address this, I removed a number of factors including housing hosts,

housing tenure and occupation, also leaving out all policy variables such as parking and joint development since they are not intended to act as controls.

Pulling apart the gentrification index reveals that its effects are primarily due to household income rather than other demographic factors. Increases in the number of households earning below $40,000 (in 2010 adjusted dollars) increased transit use while growth in the number of households earning $40,000 or more decreased transit use.

Beyond this simple statement, the parsimonious model shown in Appendix H allows us to determine the influence of additional households at each income level. Table 7 below shows the expected change in transit ridership (per census tract) over the last twenty years, given 100 additional households at each level.

**Table 7: Model 4- Predicted Transit Riders per 100 Households (1990-2010)**

| 100 Additional | Yield | Predicted Change in Transit Users |
|---|---|---|
| Extremely Low-Income Households(<$25k) | | 7 |
| Very Low-Income Households ($25-40k) | | 32 |
| Lower-Income Households($40-60k) | | -26 |
| Moderate-Income Households ($60-75k) | | -45 |
| High-Income Households (>$75k) | | $-30_{\gamma}$ |

Notes: $_{\gamma}$ Not Significant at the .05 Level. P= .115.

Additional extremely low and very low-Income households correlate with increases in transit commuters, although the effects are fairly small and less significant for extremely low-Income households—perhaps because their employment rates are lower. Additional households earning above $40,000 are associated with 26-45 person decreases in transit commuters.

### Model 4: Gentrification and Driving Alone (Income and Demographics Model)

This model is identical to the one above, except that it tests the relationship of changes in household income and demographics on driving alone. Again, I did not include policy variables and removed a number of variables including housing costs, housing tenure and occupation, which were collinear and/or insignificant.

**Table 8: Model 5- Gentrification (Income and Demographics) and Change in Commuters Driving Alone by Census Tract (1990-2010)**

| Variable | Static or Change Variable | B Coefficient | Standardized Coefficient |
|---|---|---|---|
| **Population** | | | |
| Population (Commuters) | Change | 0.702*** | 0.909 |
| Commuting Population in 1990 | Static | 0.022 | 0.065 |
| **Income** | | | |
| Extremely Low-Income (<$25k) | Change | -0.131* | -0.072 |
| Very Low-Income ($25-40K) | Change | -0.353*** | -0.118 |
| Lower-Income ($40-60K) | Change | 0.405*** | 0.186 |
| Moderate-Income ($60-75K) | Change | 0.636*** | 0.151 |
| High-Income (>$75K) | Change | 0.210* | 0.091 |
| **Demographics** | | | |
| Non-Latino Whites | Change | -0.024 | -0.046 |
| Highly Educated | Change | 0.041** | 0.081 |
| **Spatial Characteristics** | | | |
| Population/Square Mile | Change | -0.031*** | -0.259 |
| Ln Distance to the CBD | Change | -41.673*** | -0.148 |
| **Transit Provision** | | | |
| Transit Capacity/Hour | Change | 0.002 | 0.015 |
| Notes: R Squared =.707 *p<.1. **p<.05. **p<.01 | | | |

The results are roughly the inverse of the transit model above. The socioeconomic changes associated with gentrification show strong positive relationships with driving, again apparently influenced primarily by changes in income rather than demographics. Density and proximity to downtown are both negatively correlated with driving, while transit provision does not appear to have a significant effect.

The table below shows the income results of the parsimonious model, attached in Appendix I, which allows a more accurate prediction of the effects of each category.

**Table 9: Model 6- Predicted Drivers per 100 Households (1990-2010)**

| 100 Additional | Yield | Predicted Change in Solo Drivers |
|---|---|---|
| Extremely Low-Income Households(<$25k) | | -10γ |
| Very Low-Income Households ($25-40k) | | -35 |
| Lower-Income Households($40-60k) | | 38 |
| Moderate-Income Households ($60-75k) | | 61 |
| High-Income Households (>$75k) | | 16ɨ |

Notes: ɨ Not Significant at the .05 Level. P= .102. γ Not Significant at the .05 Level. P= .098.

Once again, there appears to be a split at household incomes of $40,000. All other things equal, tracts that added households earning less than $40,000 saw decreases in the number of commuters driving alone (10-35 per 100 households), while tracts that gained higher-income households gained drivers (16-61 per 100 households). These effects were least significant at the ends of the income spectrum, perhaps because of lower employment among extremely low-income households, and high-income households' ability to afford housing with easier walking or transit access to work.[199]

## Discussion

Los Angeles neighborhoods in the vicinity of transit stations have changed considerably in the past two decades. In 1990, these areas were home to a disproportionate number of low-income households and people of color, and had relatively low housing costs. They also had lower proportions of highly educated adults and workers in managerial positions. Station area residents drove far less, and took transit far more than those living elsewhere.

Since 1990, Los Angeles has seen a dramatic shift in the geography of wealth, privilege and mobility, and dramatic investments in trunkline rail and bus rapid transit lines. Transit station areas – reflecting explicitly transit-oriented development policies – are home to a growing number of high-income, high-resource households, and are growing more demographically similar to the rest of the county. Travel behavior is shifting as well, with more station areas commuters beginning to drive, and fewer taking transit.

My analysis indicates that the socioeconomic changes that have taken place in Los Angeles station areas over the last two decades are strongly tied to changes in the absolute number of drivers and transit riders. The demographic changes associated with gentrification have a significant, negative association with transit use and a significant positive relationship with rates of driving alone.

Gentrification is by definition a cumulative process, often involving changes in class, race/ethnicity, and social status. It is also by definition a process that affects working-class neighborhoods. It is thus meaningless to talk about the gentrification of Beverly Hills. Models 1 and 2 capture both of these aspects of gentrification by aggregating socioeconomic variables into a single index and testing the interaction of this index with a neighborhood's income distribution in 1990. These models indicate that—particularly for transit—the cumulative effects of changes in class, race/ethnicity, and social status are significantly related to mode choice, and that these effects are most pronounced in formerly disinvested neighborhoods.

[199]Pucher, J., & Renne, J. L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, *57*(3).

While it is theoretically and methodologically difficult to separate the effects of gentrification's component parts (income, race/ethnicity and social status), Models 3 and 4 suggest that income is the dominant driver of travel behavior. Specifically, they indicate that census tracts that added households earning below $40,000 gained transit riders and lost drivers, while those that gained higher income households lost transit riders and gained drivers.

It is difficult to state with certainty that the relationships identified above are necessarily causal. That is, these models do not demonstrate that gentrification is causing increased driving or decreased transit use. However, past empirical research on the determinants of travel behavior finds that socioeconomic factors are among the primary drivers of mode choice.[200]Drawing on past research and the analysis above, it is possible to say that it is extremely likely that gentrification is indeed causing decreased transit use, and increased solo driving in rail station areas.

It appears to be the demographic, rather than housing shifts associated with gentrification that are related to commute mode. Controlling for socioeconomic changes, variations in housing costs do not appear to have a significant effect on transit use or driving. However, since rising housing costs may drive demographic change, they likely still have an indirect influence on commute mode.

Changes to the built environment also appear to have a significant association with travel behavior. Increases in population density are strongly associated with higher transit ridership and negatively associated with driving. In both cases the magnitude of this effect is roughly comparable to that of socioeconomic change.

After controlling for other factors, most station area characteristics—such as parking spaces, park and ride lots, and the year a station was completed—do not appear to significantly affect transit use or driving. However, the presence of a joint development project initiated by Metro was associated with decreased levels of transit use. It could be that this real estate activity has a direct or proximal effect on commute mode, but it is difficult to establish causality. Joint development may also be occurring primarily in areas already undergoing changes in demographics and or travel patterns. This finding deserves further research.

## Limitations and Areas of Further Research

While the findings of the analysis presented here are for the most part unambiguous, several limitations to this analysis should be noted and a number of gaps remain for researchers to explore. First, this study was limited by the quality of the data available. As of 2010, the Census Bureau eliminated the long form on the decennial census. They have substituted the American Community Survey, which has significantly smaller sample sizes making analysis at small geographic scales (such as census tracts or station areas) problematic. Additionally, since some commute modes—such as rail use, biking, and to a lesser extent walking—are used by a small minority of people, it is impossible to draw accurate conclusions about these modes, even from the long form. Future researchers might explore alternative sources of data, such as Metro's rider surveys or the Los Angeles Bike Coalition's bike count, to paint a more accurate picture of other travel modes.

Census data are also misleading because they only cover work trips, omitting the other 80 to 85 percent of trips.[201] Since the mode choices and travel patterns of non-work trips are typically quite different from commute trips, this analysis does not accurately reflect the majority of travel.

[200]See Section 4.
[201]Pucher, J., & Renne, J. L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, *57*(3), 54.

I should also reiterate that the observed statistical relationships indicate correlation but not necessarily causation. While it seems likely that neighborhood change is in fact driving variations in commute mode choice, the direction of causality may be reversed. It could be that low-income, carless households are self-selecting to live in neighborhoods in which transit use is relatively easy. While it is possible, and in fact probable, that this phenomenon has occurred in Los Angeles over the last two decades, it is unlikely that it is the predominant cause of the observed relationship. Study after study, as well as Metro's ridership statistics, confirm the overwhelming relationship between income, race/ethnicity, and travel behavior[202, 203, 204] — suggesting that demographic changes are indeed causing variation in transit use.

This study found that changes to the built environment and socioeconomic change are each individually related to travel behavior. However, as Badoe and Miller note, "different people will respond to different density levels/urban designs in different ways."[205] Further study should be directed toward understanding the ways in which socioeconomic change, housing costs, and the built environment interact to influence travel behavior.[206, 207] Concretely, researchers in Los Angeles might investigate the negative relationship between Metro's real estate development activities and transit ridership.

Perhaps the most significant gap of this study is its limited geographic scope. I have intentionally focused only on station areas in order to dialogue with planning literature and practice focused on the potential ridership benefits of transit-oriented development. The majority of writing on this topic concerns the travel behavior of newly settled station area residents, typically comparing their transit use and driving before and after settling near a station. This research suggests that ignoring the outmigration and travel behavior of people that transit-oriented-development replaces could be a serious analytical omission.

However, for transit agencies and others concerned with promoting non-automotive travel, a more pertinent question is whether new residents drive more or less than the current residents of station areas, particularly if these residents are displaced as the area gentrifies. The research presented above seeks to answer this question, exploring the aggregate changes in an area considering both in- and out-migration. It does not however, help us understand the travel behavior of those who are displaced. Recent research suggests that as low-income households are priced out of centrally located neighborhoods, they are increasingly finding housing far from transit, jobs, and other amenities.[208] However, no study has yet to explore how these displaced residents get around their new neighborhoods. Are former transit riders displaced from station areas now purchasing and driving cars? Future research should take up this question.

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[202] See: Taylor, B. & Fink, C. (2003). The factors influencing transit ridership: a review and analysis of the literature. *UCLA Department of Urban Planning Working Paper. ,* Taylor, B. D., Miller, D., Iseki, H., & Fink, C. (2008). *Nature and/or nurture? Analyzing the determinants of transit ridership across US urbanized areas*. University of California Transportation University of California. And Metro. (2011) *System-wide on-board origin-destination study*. Los Angeles.

[203] Pucher, J., &Renne, J. L. (2003). Socioeconomics of urban travel: Evidence from the 2001 NHTS. *Transportation Quarterly*, 57(3) 50

[204] Taylor, B. & Fink, C. (2003). The factors influencing transit ridership: a review and analysis of the literature. *UCLA Department of Urban Planning Working Paper.*

[205]Badoe, D. & Miller, E. (2000). Transportation-land-use interaction: empirical findings in North America, and their implications for modeling. *Transportation Research Part D, 254.*

[206] Cao, X, et al. (2009). Examining the impacts of residential self-selection on travel behaviour: a focus on empirical findings. *Transport Reviews,* Vol. 29:3, 359–395.

[207]Badoe, D. & Miller, E. (2000). Transportation-land-use interaction: empirical findings in North America, and their implications for modeling. *Transportation Research Part D, 254.*

[208]Cravens et al. (2009).*Development without displacement, development with diversity.* Association of Bay Area Governments. Oakland, Ca.

# 8. Policy Implications

This study has implications for policymakers concerned with social equity, the efficiency of our transit system and our environmental future. The results presented above indicate that those Los Angeles County transit station areas that gentrified between 1990 and 2010 have seen significantly decreased transit commuting and increased driving relative to those that have not. Since transit riders in Los Angeles are overwhelmingly low-income people, immigrants, and people of color, it is perhaps not surprising that where these groups are displaced, transit use has declined.

These findings lead to the conclusion that in order to support station area transit use, it will be necessary to stabilize station area neighborhoods and residents. The recommendations below outline a number of strategies the City of Los Angeles and Metro can use to achieve these ends. These strategies are not new. A number of reports note that station area gentrification is socially unjust—making it harder for transit dependent people to access opportunity—and suggest an array of strategies to slow the process of neighborhood change.[209, 210, 211] More recently, other authors have concluded that retaining low-income people and other groups that disproportionately use transit is essential to boosting transit ridership in TODs, and have also offered a number of potential tools for doing so.[212, 213, 214] Although the suggestions below owe much to this previous work, they differ in both specificity and scale. First, these prior studies recommend policy mechanisms to preserve and build affordable housing, but largely remain agnostic as to what constitutes affordable. The results above suggest that it is important to be quite precise about what level of affordability is provided. Indeed, while increases in extremely low (less than $25,000/year in 2010 dollars) and very low-income households ($25-40,000) are correlated with increased transit use, every other income category ($40,000/year and up) is associated with decreasing transit usage. Therefore, if policymakers are concerned with increasing station area transit use, they must retain current households earning less than $40,000 a year, and create new opportunities for very and extremely low-income households.

Second, this study differs from prior work in suggesting that these policies need to be implemented on a mass scale. Empirical studies have found that low-income, carless people are often willing to pay a premium and self-select to be near the high frequency bus and rail that provides critical connections to jobs, healthcare, grocery stores, family and friends[215]. This appears to be the case in Los Angeles. While the census tracts within a half mile of transit stations currently house only 16 percent of the county's population, they contain approximately one-third (92,000) of the region's daily transit commuters, and a

[209]Center for Transit-Oriented Development (2007). Finding the balance: A look at regional efforts to create mixed-income communities near transit.
[210] Rodney H., Brooks, A., & Nedwick, T. (2009). Preserving affordability and access in livable communities: Subsidized housing opportunities near transit and the 50+ population. Washington, DC: American Association of Retired Persons. 21; LA Toolkit, 21.
[211] Carlton, et al. (2012). *Mixed-Income Transit-oriented Development Action Guide*. Center for Transit-oriented Development and Reconnecting America with Funding Transit Administration.
[212] Chapple, K. (2007). Transit-oriented for all: the case for mixed-income transit-oriented communities in the Bay Area. *Great Communities Collaborative framing paper*. Berkeley, Ca.
[213]Pollack, S., Bluestone, B., & Billington, C. (2010). *Maintaining diversity in America's transit-rich neighborhoods: Tools for equitable neighborhood change*. Dukakis Center for Urban and Regional Policy. Boston, MA.
[214]Belzer, et al. (2007). The case for mixed-income transit-oriented development in the Denver region. The Center for Transit-oriented Development.
[215]See Section 5.

third (65,000) of zero car households. Transit station areas thus constitute the primary engines of the region's transit ridership.

Maintaining the affordability of housing near transit ensures that transit-dependent households have access to the opportunities it provides. It also maximizes the efficiency of the transit system by placing users within close proximity. However, it appears that this crucial balance between transit service and its users is a tenuous one, easily destabilized by gentrification. Transit using households overwhelmingly have extremely low and low-incomes (approximately 80%)[216] and are highly vulnerable to displacement pressures.

While not all transit stations have gentrified since 1990, many have. Over the next several decades, many more neighborhoods are targeted intentionally for change under Metro's joint development program and the city's Sustainable Transit Communities program.[217] If significant gentrification takes place in these neighborhoods, station areas stand to lose tens of thousands of transit riders. Therefore, it is essential that policymakers take steps now to stabilize these areas before they change.

While many displaced households may use transit elsewhere, it is likely that many will not. Research from the Association of Bay Area Governments and the Center for Community Innovation at UC Berkeley found that during the late 2000s 5,348 very low-income and low-income households moved each year from transit-rich San Francisco and Alameda counties to areas with worse transit provision. This rate was almost doubled during the hot housing market of the 1990s. Twelve to 46 percent of these households moved to areas with poor transit service or no transit service whatsoever.[218] While Los Angeles certainly has different dynamics from the Bay Area, it is reasonable to assume that similar patterns of outmigration are occurring here. This would suggest that as station areas gentrify, a large portion of those displaced face severely constrained mobility or are forced to purchase cars—likely older, polluting models—they are little able to afford. Stopping this process will necessitate the retention of affordable housing on a massive scale.

It will take the addition of tens of thousands of housing units affordable to extremely low or very low income households to significantly boost transit ridership. Model 4 indicates that the addition of approximately 100 very low-income households is associated with an additional 32 transit riders. At this rate, even if we doubled the stock of federally-subsidized housing (30,490 units)[219] in station areas, ridership in these areas would only rise by only 11 percent. This implies that current housing production programs are completely inadequate if Los Angeles is truly interested in improving ridership in TODs.

Overall, this study should prompt policymakers to rethink their support for the dominant paradigm of transit-oriented development, particularly in low-income neighborhoods. Indeed, these results suggest that attracting wealthier residents to new mixed-income developments will not yield environmental or transportation benefits. In fact, the opposite outcome is probable as lower-income transit riders are forced to leave. If TOD is to be at all useful as a development paradigm , it will need to be totally reconceived as housing for those who we know actually take transit—primarily low-income people and people of color.

In practice, this will mean challenging current plans for new "mixed-income" housing in the many station areas that are now home to the region's lowest-income households. In recent years there has been a surge of interest in this concept, with proponents arguing that station areas should be developed with housing

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[216] MSA Estimate, National Household Survey (2009).
[217] See: Metro. *Joint Development Program*: http://www.metro.net/projects/joint_dev_pgm/ and Office of the Mayor, City of Los Angeles: *Frameworks of Sustainable Transit Communities*: http://www.reconnectingamerica.org/resource-center/browse-research/2011/frameworks-of-sustainable-transit-communities/
[218] Cravens et al. (2009). *Development without displacement, development with diversity.* Association of Bay Area Governments. Oakland, Ca.
[219] Harrell, R, Brooks, A Nedwick, T. (2009). Preserving affordability and access in livable communities: Subsidized housing opportunities near transit and the 50+ population. AARP.

affordable to a wide range of income levels.[220, 221, 222] The city of Los Angeles and Metro have also thrown their weight behind the idea in a number of local plans, studies and policies, [223, 224] suggesting that, "the development of affordable housing can preserve the place of a neighborhood's existing residents, even as new residents move in". [225]

At first glance this paradigm would seem to line up with the recommendations above. Increasing the stock or affordable housing in higher-income station areas would allow more households access to opportunity and improve transit ridership. However, when discussing affordability, it is crucial to ask two questions. First, we should ask—"affordable relative to what"? The majority of Los Angeles station area neighborhoods are already home to an extremely high proportion of households with very low-incomes. In 2010, station areas had a median[226] income of $54,000, well below the county median of $67,000. Half of station area tracts had a median income of less than $42,150 (very low-income) and 10 percent were below $25,300 (extremely low-income). In many neighborhoods, even "affordable" units may be well out of reach for most current residents. Thus, when policymakers speak of income diversity, it is more a matter of higher-income residents moving in than of adding options for lower-income households.

Second, we should be clear about the number and proportion of affordable units. While there is wide variation, subsidized mixed-income developments typically include 10-25 percent affordable units (at any level of affordability).[227] Inclusionary zoning policies, which are often put forward as a tool for mixed-income TOD, usually mandate a similar percentage of affordable units.[228] In Los Angeles, only 22 percent of units produced by Metro's joint development program have been affordable at any level, let alone for current residents or very low or extremely-low income households.[229] The findings of this report point to the inadequacy of these percentages. Indeed, models four and five suggest that current practice is likely to severely degrade station area performance. Mixed-income housing will only increase ridership when the percentage of truly affordable units greatly outweighs higher income units. Unfortunately, this is not the current practice, nor have mixed-income TOD advocates pushed for it to be.

This condemnation of the current TOD paradigm does not imply that Los Angeles should not invest in station area neighborhoods. Many of these communities have suffered from decades of public and private disinvestment, and certainly deserve their share of public resources. Neither is it an argument for increasing Los Angeles' already entrenched spatial segregation by income.

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[220] Center for Transit-Oriented Development,(2007). Finding the balance: A look at regional efforts to create mixed-income communities near transit.

[221]Center for Transit-Oriented Development, (2008). *Mixed-income transit-oriented development.* Retrieved from: http://www.mitod.org/home.php

[222] American Public Transportation Association, (Undated) *Creating mixed-Income transit-oriented development.* Presentation. Retrieved From: http://www.apta.com/resources/hottopics/sustainability/Documents/TOD-202-Creating-Mixed-Income-Communities.pdf

[223] City of Los Angeles, Office of the Mayor (2008). Housing that works. *Housing Plan, 2008-2013.*

[224]Metro.(2009).Joint Development Policies and Procedures. Los Angeles.

[225] City of Los Angeles, Planning Department (2012) . Transit-oriented districts in South Los Angeles. *Staff report to the planning commission.*

[226]Strictly speaking the average of each census tract's median income. While not a perfect measure, this is perhaps the most accurate way of reporting this information. See Page 1-18: http://www.gsd.harvard.edu/gis/manual/censuscd/ncdb_docs/SpecialIssues.pdf

[227]Ellickson, R. (2010). The false promise of the mixed-income housing project. *Yale Law School Faculty Scholarship Series.* Paper 401.

[228]Center for Transit-Oriented Development, (2009).*Mixed-income housing: Increasing affordability with transit.* Retrieved From: http://ctod.org/pdfs/tod201.pdf

[229]Pollack, M., & Kniech, R. (2010). *Making affordable housing at transit a reality: Best practices in transit agency joint development.* Front Range Economic Strategy Center (FRESC) and Enterprise Community Partners.Denver CO and Columbia, MD.

However, it does suggest that strategies to attract higher-income households to very-low income neighborhoods should be evaluated by economic and social equity considerations, rather than for any purported environmental or transit benefits. While it is beyond the scope of this report to weigh these considerations, it should be noted that there is little research to indicate that gentrification reliably improves the social or economic fortunes of neighborhood residents, and it can be devastating for the many families forced to leave.[230] Even gentrification's cautious academic proponents suggest that rising rents may hurt the poor in the long run.[231] Therefore, unless policymakers are prepared to retain all existing low-income households, the current TOD paradigm is a dangerous and inequitable economic development tool, and will likely have disastrous consequences for station area transit ridership.

Two other points emerge from this study. First, it suggests that policymakers should think more expansively and critically about the T in the TOD. TOD advocates have been woefully inattentive to the actual travel patterns of station area residents. In general, TOD has been promoted as a strategy to increase rail patronage, and focuses almost entirely on rail stations. Yet, as elaborated in Section 4, even immediately adjacent to rail stations, rail patrons comprise only 1 percent of station area commuters, and only 6 percent of transit riders. The other 94 percent relies on the extensive bus service that also serves these neighborhoods. Despite this fact, Metro has stripped away many of these bus routes over the last 20 years.[232] These reductions have intensified over the last five years following the expiration of federal civil rights oversight.[233] Additionally, many station area bus routes have been reconfigured as "feeder" service to rail, potentially undermining their efficacy in serving transit riders' travel needs.[234] The high rates of bus ridership in station areas should prompt policymakers to reconsider these service reductions, and improve the transit upon which the vast majority of transit commuters depend.

These findings should also encourage a critical reassessment of Los Angeles's ambitious rail expansion program. Scholars, activists and even Metro executives have long noted Metro's rail investments are not cost-effective,[235, 236, 237, 238] and have diverted resources from the inexpensive bus service upon which nearly all Metro riders depend.[239]

Perhaps in response to these critiques, rail's boosters have increasingly justified new investments based on their potential land-use effects, contending that rail stations can revitalize neighborhoods and catalyze new, dense development in order to increase transit ridership and reduce environmental externalities.[240, 241,242] For

[230] For a review of recent literature on the topic see, e.g. Newman, Kathe and Wyly, Elvin (2005). The right to stay put, revisited: Gentrification and resistance to displacement in New York City. *Urban Studies,* 43: 1, 23-57.
[231] Freeman, L. and Braconi, F. (2002). Gentrification and Displacement. *The Urban Prospect*, 8(1), pp. 1–4
[232] See Appendix E, Changes in Bus and Rail Transit Capacity.
[233]The Bus Riders Union. (2011).Transit civil rights and economic survival in Los Angeles. Los Angeles, Ca.
[234] Richmond, J, (2005). *Transport of delight: The mythical conception of rail transit in Los Angeles*. Akron: The University of Akron Press. Pages 32-90.
[235] Taylor, P. Deputy CEO, Los Angeles County Metro (2012, May). *The state of rapid transit in LA County*. Lewis Center Spring Transportation Lecture Series, UCLA Luskin School of Public Affairs.
[236] Richmond, J. (1998). The mythical conception of rail transit in Los Angeles. *Journal of Architectural and Planning Research*, 15(4): 294-320.
[237] Rubin, et al. (1999). Ten myths about U.S. urban rail systems. *Transport Policy*, 6: 57-73.
[238] Snyder, R. (2009). The Bus Riders Union transit model: Why a bus-centered system will best serve U.S. cities. Los Angeles: The Labor Community Strategy Center.
[239] Rubin,T., et al. (1999). Ten myths about U.S. urban rail systems. *Transport Policy*, 6: 57-73.

[240] Cervero, Robert. ( 2008.) Transit-oriented development in America: Strategies, issues, policy directions. In: *New urbanism and beyond: designing cities for the future*, Tigran H. Editor. New York: Rizzoli. Pages 124-129
[241] Dittmarr In: Cox, et al. (2000). Point/counterpoint: Questions about the future of light rail in America. *University of Texas at Austin Planning Forum*, Arosemena, Martha and Lane, Maria eds. 6: 79-90.
[242] Taylor, P. Deputy CEO, Los Angeles County Metro (2012, May). *The state of rapid transit in LA County*. Lewis Center Spring Transportation Lecture Series, UCLA Luskin School of Public Affairs.

instance, in a recent email newsletter, the rail advocacy organization Move LA, noted the 600 percent increase in Hollywood property values—which they partly attribute to the "revitalization potential" of transit investments—as justification for continued system expansion.

This study suggests that this type of argument should be read as a strong condemnation of current practice. While property value increases no doubt benefit developers and some politicians, there is strong evidence that they significantly reduce transit ridership by displacing low-income transit riders. In fact, the Hollywood and Vine station at the heart of Hollywood's trumpeted resurgence has hemorrhaged riders over the past two decades. Only two other stations lost as many transit riders during this period.

While Hollywood is an extreme example, it does illustrate a general pattern. Rail investments do often appear to stimulate new, dense development, and Model 1 indicates that density increases are in fact correlated with increased transit ridership. However, previous studies have found that station area land use changes are often accompanied by gentrification[243]—as is the case in Hollywood. Model 1 also shows that neighborhood change has a stronger effect than density on transit ridership, meaning that the land use changes associated with new rail investments may often do more harm then good. These findings suggest that policy-makers should judge rail investments based on their (weak) cost-effectiveness and the opportunity costs of retaining desperately needed bus service, rather than on their often counterproductive land-use effects.

Finally, this study raises grave concerns about Metro's joint development program. This program is predicated on the assumption that partnering with private developers to build housing above transit stations will increase transit ridership. Yet, stations where Metro has pursued this strategy have seen statistically significant *decreases* in transit ridership, even after controlling for socioeconomic change. It is not entirely clear what mechanisms may be driving this effect (see Section 7 for a more complete discussion). However, it is clear that the joint development program is not meeting its goals. Metro should therefore critically assess the effects of their real estate development program on transit use, and consider dramatically retooling this program. The results above—which suggest the importance of retaining low-income households—can provide a starting point for a reworked policy.

[243] See Literature Review.

# 9. Recommendations

The results of this study suggest that in order to stabilize and grow station area transit ridership, Los Angeles will need to:

1. **Preserve** housing affordable to households earning less than $40,000 on a mass scale
2. **Stabilize** existing households earning less than $40,000.
3. **Build** new housing affordable to households earning less than $40,000 on a mass scale
4. **Plan Ahead** and stabilize station areas before they change.
5. **Support Bus Transit**. Put the T back in the OD.
6. **Rework** Metro's joint development program to ensure it meets its goal of increased transit ridership.

The next several years provide Los Angeles a short window of opportunity to implement these recommendations. A number of planning processes are currently underway that will determine how transit stations will be developed in the future. Both the City and Metro are currently in the process of writing strategic TOD plans and formal policies, both scheduled to be unveiled in the spring of 2012. Additionally, the City has released a draft TOD district policy for station areas in South Los Angeles that will likely form the model for future districts.

Below are a number of specific tools which the City and Metro should enact in their TOD planning processes.

## Housing Preservation Strategies

### Why?

Station areas are the engines of transit use in the region, housing approximately one—third of all transit commuters (92,000). Overall, these areas have changed faster than similar neighborhoods without transit, endangering their ability to retain and attract households that use transit.

While approximately 30,000 federally-subsidized units are currently located in station areas, 82 percent of these are under affordability contracts that are scheduled to expire by 2014.[244] If these are allowed to expire without replacement, we can expect to lose two to ten thousand transit riders from station areas. Many will likely need to acquire cars to get around their new neighborhoods.

In addition to formally subsidized units, station areas are home to 370,000 households, most of which have incomes well below the county median. Policymakers should utilize the following tools to keep both subsidized and inexpensive market rate housing affordable to residents.

### STRATEGIES

- Refrain from using transit investments and station area planning as a tool to attract higher-income households to currently affordable neighborhoods.
- Require replacement of affordable housing (No Net Loss)
- Track and prioritize expiring affordable housing units.
- Target expiring affordable units for contract renewal or purchase by non-profits.
- Use Community Land Trusts and Limited Equity Housing Coops to take housing off the open market.
- Remove parking minimums,[245] institute parking maximums, and unbundle parking.[246] These strategies can have the dual effect of reducing driving, and slowing gentrification by car-dependent households.[247, 248]

[244] Harrell, R, Brooks, A Nedwick, T. (2009). Preserving affordability and access in livable communities: Subsidized housing opportunities near transit and the 50+ population. AARP.
[245] See for example: http://www.scanph.org/files/Parking%20Requirements%20Guide_forweb.pdf
[246] See for example: http://www.dukakiscenter.org/unbundled-parking/
[247] See for example: http://www.dukakiscenter.org/reduced-parking/
[248] See for example: http://urbanhabitat.org/sec/sor/2011/preventing-displacement-TOD

## Stabilization Strategies

### Why?

While preserving housing units is important, ultimately it is demographic change that appears to determine station area performance. Therefore, policymakers should implement strategies to enable low-income people to stay in their homes and neighborhoods. Many of these strategies, such as increasing or enforcing tenant protections, are extremely cost-effective and can successfully keep transit riders in their neighborhoods.

### STRATEGIES

- Use developer impact fees to fund stabilization programs.
- Enforce and expand existing tenant protections, particularly in station areas.
- Expand existing tenant protections, particularly in station areas.
- Support tenant and homeowner counseling and emergency assistance programs.
- Make targeted home improvement loans available to financially distressed homeowners.
- Create value capture programs directing 100 percent of proceeds toward affordable housing retention, production, and resident stabilization.[249]

[249]See for example: State of Texas Executive Summary of Community Development Legislation of 2007: http://www.window.state.tx.us/comptrol/cra07/execsum.html

## Housing Production Strategies

### Why?

The need for affordable housing in Los Angeles is well documented. While the City's 2010 housing plan forecasts that over 40,000 units will be needed by 2014, only 4,300 affordable units and 3,000 units affordable to very-low income households had been permitted by 2010.[250] The situation is even more abysmal at the county level, where less than one percent of needed affordable units were permitted in the plan's first year.[251] While housing production languishes, over 33,000 families are currently on the LA Housing Authority's waiting list.[252]

The results above suggest that building new stocks of very affordable housing could significantly increase station area transit ridership—both by increasing the density on which transit relies, and by attracting core transit riders. Metro's land holdings at station areas and the city's control over land use incentives can be leveraged to increase affordable housing production.

### STRATEGIES

- Institute a value capture program for affordable housing based on ridership gains.
- Prioritize affordable housing in Metro's Joint Development RFP scoring process. (currently only 22% of Metro's Joint Development program is affordable).
- Grant first right of refusal for affordable housing construction in Metro's Land Disposition Policy.
- Create a markdown, or giveaway, for affordable housing in Metro's Land Disposition Policy.
- Create an acquisition fund to purchase land near transit stations for use in affordable housing.
- Target the Housing Trust Fund to station areas.
- Institute Inclusionary Zoning.
- Create value capture programs directing 100 percent of proceeds toward affordable housing retention, production, and resident stabilization.[253]

[250]See for example: http://www.publiccounsel.org/tools/publications/files/TOD_Advocates_Guide.pdf and City of Los Angeles, *2010 Housing Element Annual Progress Report.*
[251] Ibid.
[252]See for example: http://cityplanning.lacity.org/HousingInitiatives/HousingElement/Final/HE_Final.pdf 58.
[253]See for example: State of Texas Executive Summary of Community Development Legislation of 2007: http://www.window.state.tx.us/comptrol/cra07/execsum.html

## Planning Ahead

### Why?

Transit investments can cause waves of speculation that sweep quickly through a neighborhood, potentially displacing transit riders.[254] The City and Metro should monitor potential indicators of gentrification[255]and respond before change occurs. Additionally, by putting policies to limit displacement into place ahead of time, these bodies can avoid having to make piecemeal or post-hoc interventions.

## STRATEGIES

- Monitor the potential indicators of gentrification as well as neighborhood vulnerabilities.
- Establish TOD "equity policies" to establish policies and tools to limit displacement.

[254]Pollack, S., Bluestone, B., & Billington, C. (2010). *Maintaining diversity in America's transit-rich neighborhoods: Tools for equitable neighborhood change*. Dukakis Center for Urban and Regional Policy. Boston, MA.
[255]Chapple, K. (2009). Mapping Susceptibility to Gentrification: The Early Warning Toolkit. Center for Community Innovation, Berkeley, CA.

## Put the T Back in the OD

### Why?

While policymakers tend to view TOD as a strategy to increase rail patronage, rail riders comprise only 1 percent of station area commuters, and only 6 percent of transit riders. The other 94 percent of station area transit commuters rely on bus service. Yet Metro has systematically cut bus service in these areas, or reconfigured it to serve the rail system. The high rates of bus ridership in station areas should prompt policymakers to reconsider these service reductions, and improve the transit upon which the vast majority of transit commuters depend. Metro has traditionally used bus service cuts to finance new rail construction, despite the weak cost effectiveness of these new investments. The results of this study suggest that new rail stations have contradictory land use effects, often stimulating both density increases and gentrification—which is likely to erase ridership gains due to density. In this light, policy-makers should judge rail investments based on their (weak) cost-effectiveness and the opportunity costs of retaining desperately needed bus service, rather than on their often counterproductive land-use effects.

### STRATEGIES

- Stop cuts to bus service.
- Reinstate cut service.
- Improve high patronage lines.
- Evaluate new rail expansion plans based on their (generally week) cost-effectiveness rather than on often counterproductive land use effects.
- Remove parking minimums,[256] institute parking maximums, and unbundle parking.[257] These strategies can have the dual effect of reducing driving, and slowing gentrification by car-dependent households.[258, 259]

[256]See for example: http://www.scanph.org/files/Parking%20Requirements%20Guide_forweb.pdf
[257]See for example: http://www.dukakiscenter.org/unbundled-parking/
[258] See for example: http://www.dukakiscenter.org/reduced-parking/
[259]See for example: http://urbanhabitat.org/sec/sor/2011/preventing-displacement-TOD

# 10. Conclusion

The results of this analysis are striking. Although not all Los Angeles transit stations have gentrified over the last two decades, many did. Those that did lost transit riders and gained drivers much faster than the rest of the county. These effects are quite robust—gentrification is the most powerful predictor of neighborhood transit use. Since transit riders in Los Angeles are overwhelmingly low-income people, immigrants, and people of color, it is perhaps not surprising that where these groups are displaced, transit use has declined.

These findings yield compelling implications for policymakers concerned with our environmental future. Specifically, they suggest that current TOD practice, with its emphasis on attracting wealthier residents to new, mixed-income development, is entirely counterproductive. Indeed, if TOD is to be at all successful as a green development paradigm, it will need to totally reconceived as housing for those who we know actually take transit—primarily low-income people and people of color.

As I write these words, Los Angeles is in the midst of defining its future. The actions we take over the next few years will determine whether we set ourselves on a path toward increasing transit use or continue to displace the low-income households that sustain our transit system. It is my hope that this report will encourage policymakers to think carefully about the direction that transit-oriented development should take in Los Angeles. Will we prioritize the transportation needs of low-income neighborhoods, and in doing so move toward environmental and economic sustainability, or will we build a city in which transit is underused, inefficient and inequitable?

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# 11. Appendices

## Appendix A: Metro Stations, Los Angeles County

**Metro Stations in Operation in 1995**

| | Line(s) | Station | Completed |
|---|---|---|---|
| 1 | Blue | 103RD STREET | 1990 |
| 2 | Blue | 1ST STREET | 1990 |
| 3 | Blue | 5TH STREET | 1990 |
| 4 | Blue, Red, Purple | 7TH/METRO CENTER | 1990 |
| 5 | Blue | ANAHEIM | 1990 |
| 6 | Blue | ARTESIA | 1990 |
| 7 | Blue | COMPTON | 1990 |
| 8 | Blue | DEL AMO | 1990 |
| 9 | Blue | FIRESTONE | 1990 |
| 10 | Blue | FLORENCE | 1990 |
| 11 | Blue | GRAND | 1990 |
| 12 | Blue, Green | IMPERIAL/WILMINGTON | 1990 |
| 13 | Blue | PACIFIC | 1990 |
| 14 | Blue | PACIFIC COAST HIGHWAY | 1990 |
| 15 | Blue | PICO | 1990 |
| 16 | Blue | SAN PEDRO | 1990 |
| 17 | Blue | SLAUSON | 1990 |
| 18 | Blue | TRANSIT MALL | 1990 |
| 19 | Blue | VERNON | 1990 |
| 20 | Blue | WARDLOW | 1990 |
| 21 | Blue | WASHINGTON | 1990 |
| 22 | Blue | WILLOW | 1990 |
| 23 | Red, Purple | CIVIC CENTER | 1993 |
| 24 | Red, Purple | PERSHING SQUARE | 1993 |
| 25 | Red, Purple | WESTLAKE | 1993 |
| 26 | Red, Purple, Gold | UNION STATION | 1993 |
| 27 | Green | AVALON | 1995 |
| 28 | Green | AVIATION | 1995 |

**Metro Stations in Operation in 2000**

| | Line(s) | Station | Completed |
|---|---|---|---|
| 1 | Purple | WILSHIRE/NORMANDIE | 1996 |
| 2 | Purple | WILSHIRE/WESTERN | 1996 |
| 3 | Red, Purple | WILSHIRE/VERMONT | 1996 |
| 4 | Red | HOLLYWOOD/VINE | 1999 |
| 5 | Red | HOLLYWOOD/WESTERN | 1999 |
| 6 | Red | VERMONT/BEVERLY | 1999 |
| 7 | Red | VERMONT/SANTA MONICA | 1999 |
| 8 | Red | VERMONT/SUNSET | 1999 |
| 9 | Red | HOLLYWOOD/HIGHLAND | 2000 |
| 10 | Red, Orange | NORTH HOLLYWOOD | 2000 |
| 11 | Red | UNIVERSAL CITY | 2000 |

**Metro Stations in Operation in 2005**

| | Line(s) | Station | Completed |
|---|---|---|---|
| 1 | Gold | ALLEN | 2003 |
| 2 | Gold | CHINATOWN | 2003 |
| 3 | Gold | DEL MAR | 2003 |
| 4 | Gold | FILLMORE | 2003 |
| 5 | Gold | HERITAGE SQR/ARROYO | 2003 |
| 6 | Gold | HIGHLAND PARK | 2003 |
| 7 | Gold | LAKE AVENUE | 2003 |
| 8 | Gold | LINCOLN | 2003 |
| 9 | Gold | MEMORIAL PARK | 2003 |
| 10 | Gold | MISSION | 2003 |
| 11 | Gold | SIERRA MADRE VILLA | 2003 |
| 12 | Gold | SOUTHWEST MUSEUM | 2003 |
| 13 | Orange | Laurel Canyon | 2005 |

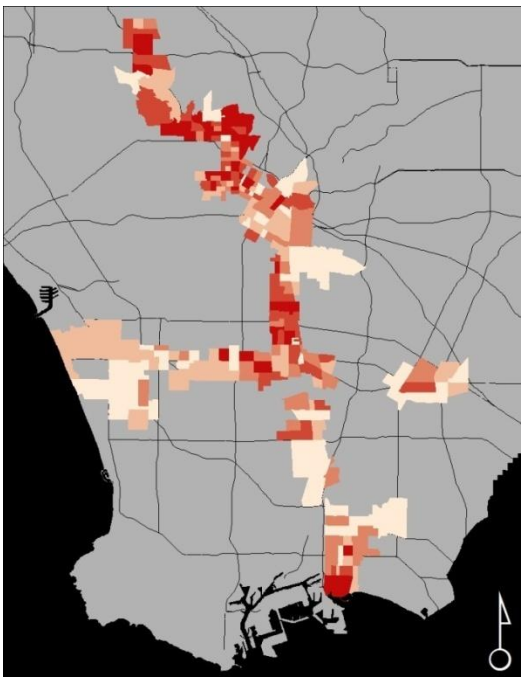
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 29 | Green | CRENSHAW | 1995 | 14 | Orange | VALLEY COLLEGE | 2005 |
| 30 | Green | DOUGLAS/ROSECRANS | 1995 | 15 | Orange | WOODMAN | 2005 |
| 31 | Green | EL SEGUNDO/NASH | 1995 | 16 | Orange | VAN NUYS | 2005 |
| 32 | Green | HARBOR FREEWAY | 1995 | 17 | Orange | SEPULVEDA | 2005 |
| 33 | Green | HAWTHORNE | 1995 | 18 | Orange | WOODLEY | 2005 |
| 34 | Green | I-605/I-105 | 1995 | 19 | Orange | BALBOA | 2005 |
| 35 | Green | LAKEWOOD | 1995 | 20 | Orange | RESEDA | 2005 |
| 36 | Green | LONG BEACH | 1995 | 21 | Orange | TAMPA | 2005 |
| 37 | Green | MARINE/REDONDO | 1995 | 22 | Orange | PIERCE COLLEGE | 2005 |
| 38 | Green | MARIPOSA/NASH | 1995 | 23 | Orange | DE SOTO | 2005 |
| 39 | Green | VERMONT | 1995 | 24 | Orange | CANOGA | 2005 |
| | | | | 25 | Orange | WARNER CTR | 2005 |

**Metro Stations in Operation in 2010**

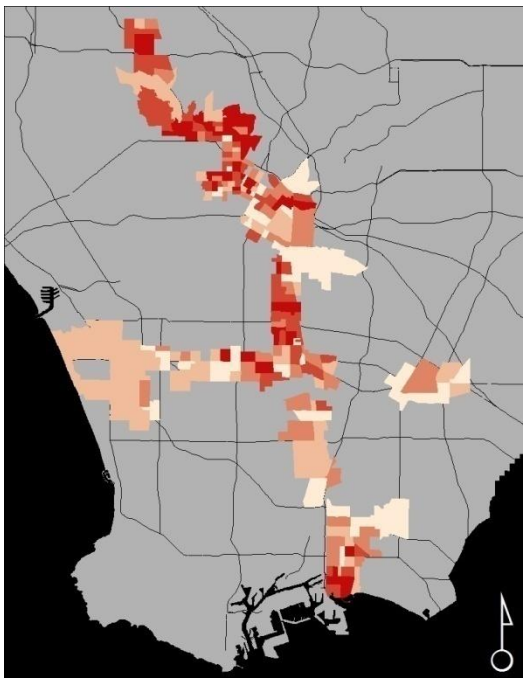
| | Line(s) | Station | Completed |
|---|---|---|---|
| 1 | Gold | EAST L A CIVIC CENTER | 2009 |
| 2 | Gold | INDIANA | 2009 |
| 3 | Gold | LITTLE TOKYO/ARTS | 2009 |
| 4 | Gold | MARAVILLA | 2009 |
| 5 | Gold | MARIACHI PLAZA | 2009 |
| 6 | Gold | PICO/ALISO | 2009 |
| 7 | Gold | SOTO | 2009 |

## Appendix B: Socioeconomic Change and Gentrification Variables

Socioeconomic Change Index, Station Areas.



Gentrification (Socioeconomic Change Index * Percent Low-Income in 1990) Station Areas.



## Appendix C: Variable Definition, Measurement and Calculation

| Independent, Dependent | Category | Variable | Measurement | Static or Change | Source |
|---|---|---|---|---|---|
| Dependent | Commute Mode | Transit Use | # of Transit Commuters | Change | Decennial Census and 2006-20010 Five Year ACS |
| Dependent | Commute Mode | Drive Alone | # of Commuters Who Drive Alone | Change | Decennial Census and 2006-20010 Five Year ACS |
| | | | | | |
| Independent | Population | Commuters | # Commuting Population | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Population | Commuters in 1990 | # Commuting Population | Static | Decennial Census and 2006-20010 Five Year ACS |
| | | | | | |
| Independent | Income | Extremely Low-Income Households | # of Households Earning <$25k (2010 $s) | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Income | Very Low-Income Households | # of Households Earning $25-40k (2010 $s) | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Income | Lower-Income Households | # of Households Earning $40-60k (2010 $s) | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Income | Moderate-Income Households | # of Households Earning $60-75k (2010 $s) | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Income | High-Income Households | # of Households Earning >$75k (2010 $s) | Change | Decennial Census and 2006-20010 Five Year ACS |
| | | | | | |
| Independent | Demographic | Non-Latino Whites | # of Non-Latino Whites | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Demographic | Bachelors or Higher | # of People With a Bachelors Degree or Higher | Change | Decennial Census and 2006-20010 |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | Five Year ACS |
| Independent | Demographic | Managers | # of People in Managerial Occupations | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Index | Socioeconomic Change | Based on the number of standard deviations (z-scores) each data point is from the county mean. Socioeconomic Change= Z (Change in High-Income HHs) + (Change in Highly Educated Adults) + Z (Change in Managers) – Z (Change in Extremely Low + Very-Low-Income HHs). | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Index | Gentrification | Based on the number of standard deviations (z-scores) each data point is from the county mean. Gentrification= (% of Very Low and Extremely Low-Income HHs) * Z (Change in High-Income HHs) + (Change in Highly Educated Adults) + Z (Change in Managers) – Z (Change in Extremely Low + Very-Low-Income HHs). | Change | Decennial Census and 2006-20010 Five Year ACS |
| | | | | | |
| Independent | Housing | Median Rent | Dollars (Not-Adjusted) | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Housing | Median Home Value | Dollars (Not-Adjusted) | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Housing | Tenure | % Owners | Change | Decennial Census and 2006-20010 Five Year ACS |
| | | | | | |
| Independent | Policy | Joint Development? | Site of Metro Joint Development Real Estate Activities (Yes or No) | Static | Metro |
| Independent | Policy | Park and Ride Lot | Park and Ride Lot at Station (Yes or No) | Static | Metro |
| Independent | Policy | Parking Spaces at Station | # of Spaces | Static | Metro |
| Independent | Spatial | Population Density | People/Mile | Change | Decennial Census and 2006-20010 Five Year ACS |
| Independent | Spatial | Distance to Central Business District | Natural Log (Ln) of Distance to Point of Highest Employment Density | Static | Decennial Census and 2006-20010 Five Year ACS |
| | | | | | |
| Independent | Transit Availability | Transit Provision | Capacity Hours of all Bus And Rail Vehicles (7:30-8:30 AM) Within .5 Mile of Station (Metro and Municipal Operators) | Change | Metro, Municipal Operators |

## Appendix D: Transit Provision

As described briefly in Section 6 above, I computed changes in transit service provision within a half mile of each rail station completed prior to 2000. This metric measures the change in the number of potential seating and standing spaces available to passengers on transit vehicles passing through their neighborhoods during Metro's peak hour of service (7:30 to 8:30 am) each day. I weighted bus, light rail and heavy rail service equally based on vehicle capacity (Seats/Vehicle*Metro's Allowed Load Factor* Vehicles/Train), a method loosely based on intermodal performance measures developed by Wachs.[260] This allows apples-to-apples capacity comparisons among different modes.

While the vast majority of transit service in Los Angeles County is run by Metro, a number of other operators (or municipal operators) also provide transit, usually in relatively small geographic areas. Thus, in order to account for all the transit in each station area, it was necessary to aggregate data from both Metro and the municipal operators. Additionally, since I was concerned with change over time, I needed to calculate transit availability for both 1990 and 2010. Essentially, this meant collecting four different data sets:

| | **1990** | **2010** |
|---|---|---|
| **Metro** | 3 | 1 |
| **Muni** | 4 | 2 |

Unfortunately, data collection varies considerably between operators and has evolved over time. Thus, each of the four datasets required its own methodology. These are explained in greater detail below.

**1) Metro Service, 2010**

This was quite straightforward. I calculated capacity/hour from current bus and rail schedules. Vehicles per train were given by current Operating Costs Factor (4-24) Reports provided by Metro. While there have been changes between 2010 and 2012, these changes have been relatively minor compared to those of the preceding two decades.

**2) Municipal Service, 2010**

As above, I simply calculated service levels from current maps and schedules.

**3) Metro Service, 1990**

I used paper maps to identify bus lines within .5 mile of rail stations. Metro rail service did not exist, so there was no need to identify rail routes. Since schedules were not available, I relied on 1990 4-24 Reports, which give Revenue Service Hours (RSH) and Revenue Service Miles (RSM) per line. Using current data, I tested the relationship between station area RSH/RSM and capacity/hour. RSM provided an extremely

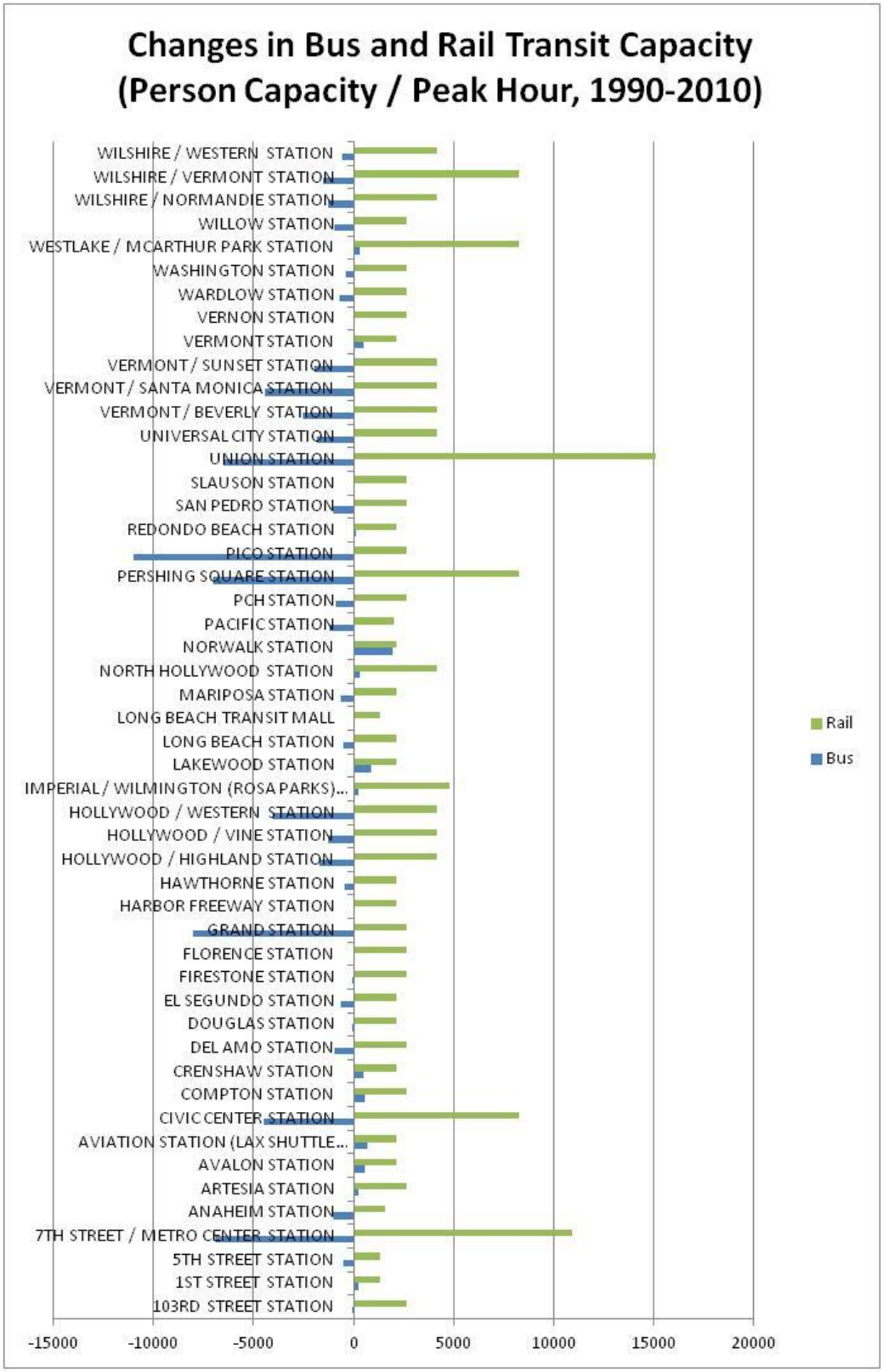
[260] Wachs, M. and Li, J. (2000). *A test of inter-modal performance measures for transit investment decisions.* University of California Transportation Center. Berkeley, CA.

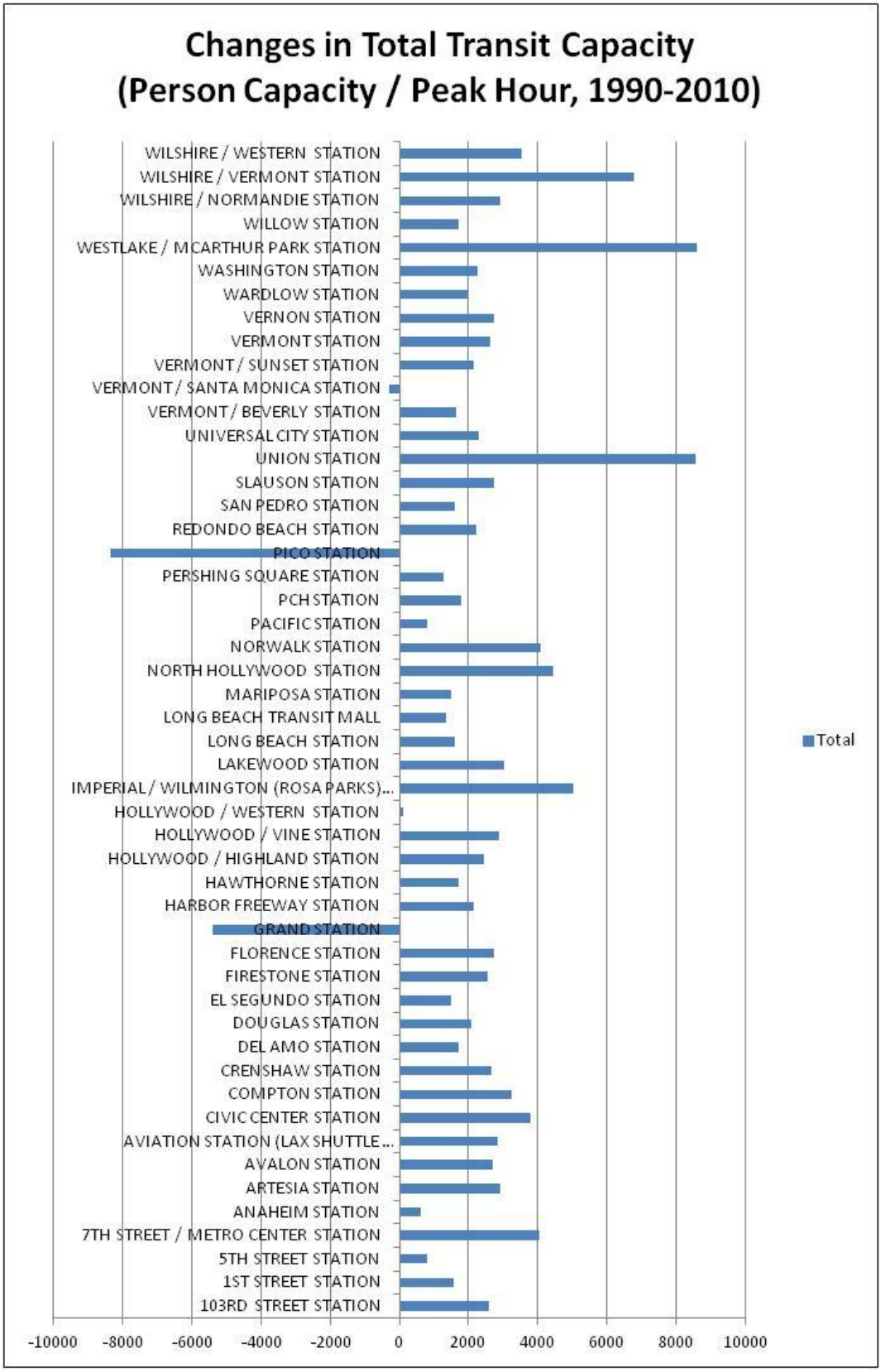
good match (with a correlation coefficient of .995). I therefore used these values to impute capacity/hour for 1990. (Capacity/Hour= 1.3+57.2* (-2.4265+0.0022 RSM). Given the extremely high correlation between RSM and capacity/hour in 2010, this method seems to be reasonably accurate.

**4) Muni Service, 1990**

This was by far the most problematic dataset. While paper maps showed each line in 1990, no document comparable to the 4-24 report was available across operators to evaluate the density of service on each line. I therefore relied on system-wide averages for each municipal operator computed from 2010 data. I applied these averages to each line within a given system. I tested this technique using 2010 data, finding that system wide averages correlate far more closely (.645) to each line's actual capacity/hour than does an average taken from all lines. Nonetheless, this method is far from precise. It could conceivably understate the capacity of high frequency corridors and overstate the capacity of relatively spare routes. If transit provision is actually biased in this direction, it could potentially lead model to understate the relationship between transit provision and transit ridership. However, given the lack of municipal operator transit service information for 1990, this technique was the most accurate available.

## Appendix E: Transit Capacity

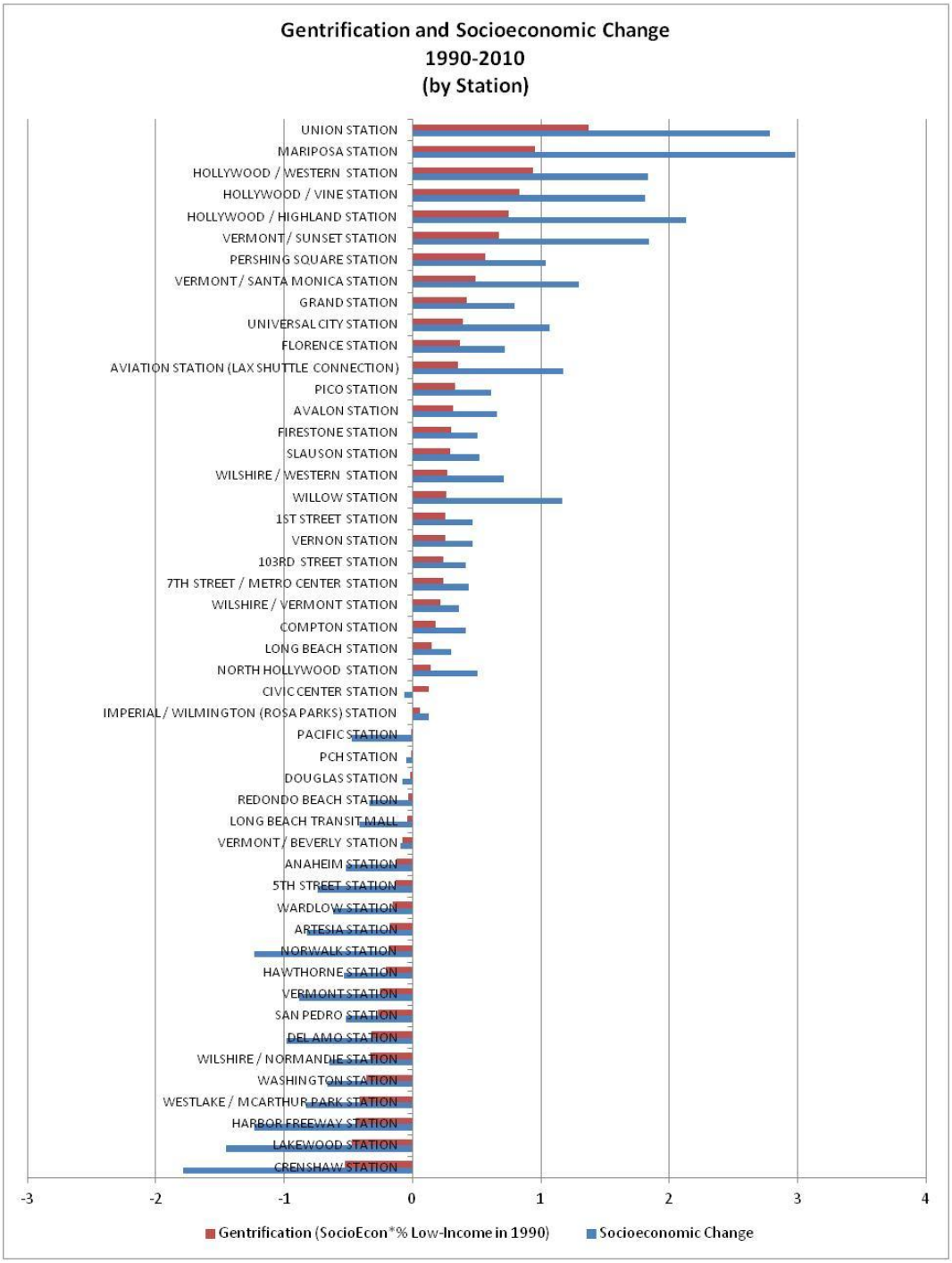



Changes in Total Transit Capacity
(Person Capacity / Peak Hour, 1990-2010)
WILSHIRE / WESTERN STATION
WILSHIRE / VERMONT STATION
WILSHIRE / NORMANDIE STATION
WILLOW STATION
WESTLAKE / MCARTHUR PARK STATION
WASHINGTON STATION
WARDLOW STATION
VERNON STATION
VERMONT STATION
VERMONT / SUNSET STATION
VERMONT / SANTA MONICA STATION
VERMONT / BEVERLY STATION
UNIVERSAL CITY STATION
UNION STATION
SLAUSON STATION
SAN PEDRO STATION
REDONDO BEACH STATION
PICO STATION
PERSHING SQUARE STATION
PCH STATION
PACIFIC STATION
NORWALK STATION
NORTH HOLLYWOOD STATION
MARIPOSA STATION
LONG BEACH TRANSIT MALL
LONG BEACH STATION
LAKEWOOD STATION
IMPERIAL / WILMINGTON (ROSA PARKS)...
HOLLYWOOD / WESTERN STATION
HOLLYWOOD / VINE STATION
HOLLYWOOD / HIGHLAND STATION
HAWTHORNE STATION
HARBOR FREEWAY STATION
GRAND STATION
FLORENCE STATION
FIRESTONE STATION
EL SEGUNDO STATION
DOUGLAS STATION
DEL AMO STATION
CRENSHAW STATION
COMPTON STATION
CIVIC CENTER STATION
AVIATION STATION (LAX SHUTTLE...
AVALON STATION
ARTESIA STATION
ANAHEIM STATION
7TH STREET / METRO CENTER STATION
5TH STREET STATION
1ST STREET STATION
103RD STREET STATION
-10000
-8000
-6000
-4000
-2000
0
2000
4000
6000
8000
10000
Total

## Appendix F: Population, Socioeconomic and Housing Indicators by Census Tract (1990-2010) Los Angeles County and Areas with Transit Station in 2000

| | County Average (1990) | County Average (2006/2010) | %Change (1990-2006/2010) | Station Area Average (1990) | Station Area Average (2006/2010) | Change (1990-2006/2010) |
|---|---|---|---|---|---|---|
| **Population** | | | | | | |
| Population | 4307 | 4780 | 11% | 4273 | 4619 | 8% |
| Commuters | 2000 | 2141 | 7% | 1776 | 2002 | 13% |
| | | | | | | |
| **Socioeconomics** | | | | | | |
| Median Income | $30,530 | $67,443 | 121% | $19,556 | $48,194 | 146% |
| Low-Income (<40k in | 31% | 37% | 17% | 44% | 51% | 18% |
| High-Income (>75k in | 33% | 37% | 11% | 17% | 22% | 31% |
| Renters | 50% | 51% | 2% | 73% | 74% | 1% |
| Non-Latino White | 41% | 29% | -29% | 22% | 17% | -23% |
| Bachelors Degree or Higher | 21% | 28% | 33% | 13% | 22% | 69% |
| Managerial Occupation | 26% | 33% | 27% | 18% | 25% | 39% |
| | | | | | | |
| **Housing** | | | | | | |
| Median Home Value | $189,576 | $535,430 | 182% | $144,606 | $519,163 | 259% |
| Median Rent | $542 | $1,297 | 139% | $431 | $1,160 | 169% |
| | | | | | | |
| **Cars** | | | | | | |
| | | | | | | |
| 0 Car Households | 11% | 5% | -57% | 25% | 12% | -52% |
| 2+ Car Households | 53% | 72% | 36% | 34% | 55% | 62% |

# Appendix G: Gentrification and Socioeconomic Change by Station



## Appendix H: Gentrification and Transit Commuters (Income and Demographics, Prediction Model)

| Variable | Static or Change Variable | B Coefficient | Standardized Error |
|---|---|---|---|
| **Population** | | | |
| Population (Commuters) | Change | 0.118*** | 0.032 |
| Commuting Population in 1990 | Static | 0.007 | 0.012 |
| **Income** | | | |
| Extremely Low-Income (<$25K) | Change | 0.072 | 0.046 |
| Very Low-Income ($25-40K) | Change | 0.323*** | 0.098 |
| Lower-Income ($40-60K) | Change | -0.265*** | 0.085 |
| Moderate Income ($60-75K) | Change | -0.453*** | 0.130 |
| High Income (>$75K) | Change | -0.301*** | 0.071 |
| **Demographics** | | | |
| Non-Latino Whites | Change | | |
| Highly Educated | Change | | |
| **Spatial Characteristics** | | | |
| Population/Square Mile | Change | 0.021*** | 0.005 |
| Ln Distance to the CBD | Change | | |
| **Transit Provision** | | | |
| Transit Capacity/Hour | Change | | |
| Notes: R Squared =.322**p<.05. **p<.01 *p<.1. | | | |

# Appendix H: Gentrification and Driving Alone (Income and Demographics, Prediction Model)

| Variable | Static or Change Variable | B Coefficient | Standardized Error |
|---|---|---|---|
| **Population** | | | |
| Population (Commuters) | Change | 0.716*** | 0.045 |
| Commuting Population in 1990 | Static | 0.029 | 0.015 |
| **Income** | | | |
| Extremely Low-Income (<$25K) | Change | -0.104 | 0.063 |
| Very Low-Income ($25-40K) | Change | -0.355*** | 0.132 |
| Lower-Income ($40-60K) | Change | 0.380*** | 0.126 |
| Moderate Income ($60-75K) | Change | 0.606*** | 0.172 |
| High Income (>$75K) | Change | 0.165*** | 0.099 |
| **Demographics** | | | |
| Non-Latino Whites | Change | | |
| Highly Educated | Change | .043** | 0.020 |
| **Spatial Characteristics** | | | |
| Population/Square Mile | Change | -0.031*** | 0.006 |
| Ln Distance to the CBD | Change | -41.296*** | 12.233 |
| **Transit Provision** | | | |
| Transit Capacity/Hour | Change | | |
| Notes: R Squared =.708 ***p<.05. **p<.01 *p<.1. | | | |