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Transit Blues in the Golden State: Analyzing Recent California Ridership Trends

June 2020

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16. Abstract

Transit patronage plunged staggeringly, from 50 to as much as 94 percent, during the first half of 2020 amidst the worst global pandemic in a century. But transit's troubles in California date much earlier. From 2014 to 2018, California lost over 165 million annual boardings, a drop of over 11 percent. This report examines public transit in California in the 2010s and the factors behind its falling ridership.

We find that ridership gains and losses have been asymmetric with respect to location, operators, modes, and transit users. Transit ridership has been on a longer-term decline in regions like Greater Los Angeles and on buses, while ridership losses in the Bay Area are more recent. While overall transit boardings across the state are down since 2014, worrisome underlying trends date back earlier as patronage failed to keep up with population growth. But reduced transit service is not responsible for ridership losses, as falling transit ridership occurred at the same time as operators instead increased their levels of transit service.

What factors help to explain losses in transit ridership? Increased access to automobiles explains much, if not most, of declining transit use. Private vehicle access has increased significantly in California and, outside of the Bay Area, is likely the biggest single cause of falling transit ridership. Additionally, new ridehail services such as Lyft and Uber allow travelers to purchase automobility one trip at a time and likely serve as a substitute for at least some transit trips. Finally, neighborhoods are changing in ways that do not bode well for public transit. Households are increasingly locating in outlying areas where they experience longer commutes and less transit access to employment. At the same time, a smaller share of high-propensity transit users now live in the state's most transit-friendly neighborhoods.

While the 2010s proved a difficult decade for public transit in California, and the opening of the current decade has been an even bigger challenge, transit remains an essential public service. Effectively managing transit recovery in California will require a clear-eyed understanding of the substantially altered environment within which these systems large and small must now operate.

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Disclaimer

The contents of this report reflect the views of the authors and not necessarily the funders of this work. The authors are solely responsible for the accuracy of the information presented herein, and the State of California assumes no liability for the contents or use thereof. This report does not constitute a standard, specification, or regulation.

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Table of Contents

Table of Contents

List of Figures

List of Tables

Executive Summary

Executive Summary: Transit Blues in the Golden State

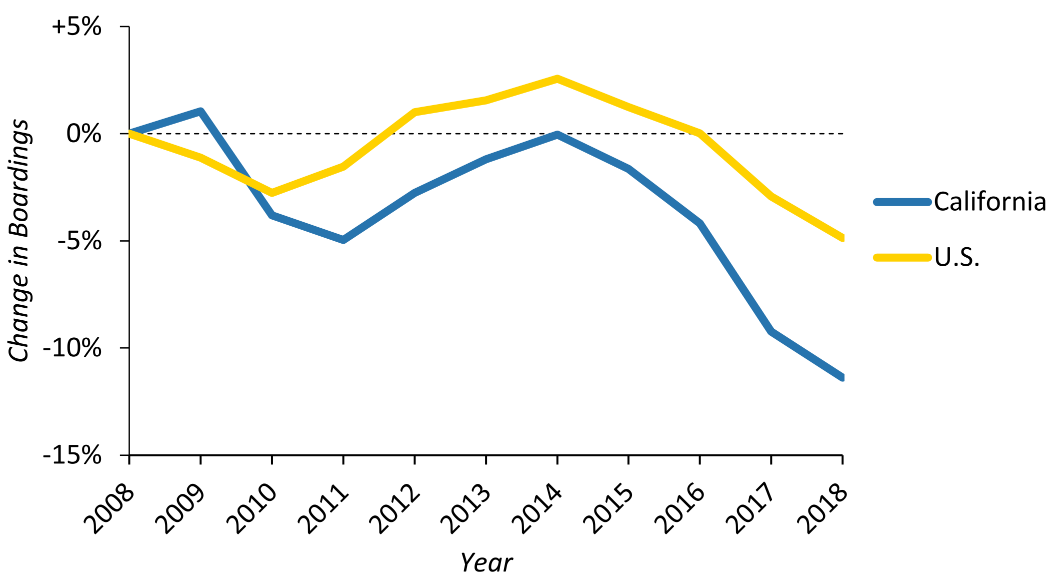
ES.1. Introduction: Transit Ridership Woes

ES.1.1. The Scale of the Ridership Decline

Transit ridership in California is on the wrong track. Patronage plunged staggeringly, from 50 to as much as 94 percent, during the first half of 2020 amidst the worst global pandemic in a century. While such ridership losses are extraordinary—and hopefully short-lived—all was not well for public transit in the 2010s either. Despite spending billions since 2000 to improve and expand public transit across the Golden State, transit use mostly lagged for six years leading up to the extraordinary events of 2020 (Levy and Goldwyn, 2020; Walker, 2020; BTS, 2020; Transit App, 2020; Moovit, 2020; and FTA, 2019). This report examines these pre-pandemic ridership doldrums and what might be behind them, as they will surely affect transit's post-pandemic recovery.

From 2014 to 2018, the state lost over 165 million annual boardings, falling over 11 percent (See **Figure ES-1**). Beneath this topline figure, though, lies significant variation across regions, modes, and operators. More broadly, transit trips in the Bay Area and on rail grew significantly over the past decade and only started declining more recently, while ridership in areas like Greater Los Angeles, on buses generally, and across the state when accounting for population growth has experienced longer-term declines that have steepened as of late. All the while, the average transit trip in the state has grown longer (FTA, 2019).

Figure ES-1. Change in Transit Boardings in California and the U.S.



Data source: FTA, 2019

ES.1.2. The Landscape of Transit Ridership Losses

Transit use in California is highly asymmetric: thirteen percent of trips in California in 2018 were carried on lines traveling on or under one block of Market Street in San Francisco's Financial District; another eight percent happened on routes running through or under one intersection near Pershing Square in Los Angeles.

Recent ridership gains and losses have been asymmetric as well. Between 2011 and 2015, just one operator, the Bay Area Rapid Transit District (BART), accounted for half of the state's net patronage gains. Just one trip type on BART, transbay trips crossing San Francisco Bay, accounted for over 31 percent of the entire state's net ridership growth from 2011 to 2015 (BART, 2019c and FTA, 2019).[i] And during the statewide patronage downturn after 2014, the Bay Area's regional heavy and commuter rail systems were still out-performing the rest of the state. From 2014 to 2018, only BART and Caltrain—another commuter-focused rail system serving large Bay Area job clusters—saw a net increase in unlinked trips (See **Table ES-1**). But even these star performers lost boardings in two of the three most recent years of data, with recent ridership losses on BART, especially on weekends and off-peak times, particularly stark (FTA, 2019 and Wasserman et al., 2020).

While the state's post-Great-Recession ridership gains were disproportionately enjoyed by a single Bay Area transit operator, the *majority* of California's ridership losses since 2014 have been suffered by a single operator in Greater Los Angeles: the Los Angeles County Metropolitan Transportation Authority (LA Metro). LA Metro is California's largest operator, carrying three in ten California transit trips, and its contributions to the state's patronage drop have been even more outsized. No other agency comes close (FTA, 2019).

LA Metro's ridership losses from 2014 to 2018 (See **Table ES-1**) accounted for 11 percent of the entire ridership decline nationwide, the second-most of any American transit agency by absolute numbers. But beyond LA Metro, eight of the top ten transit agencies in California had fewer boardings in 2018 than 2014. The Orange County Transportation Authority (OCTA) and Long Beach Transit (LBT) in the Los Angeles Area, San José's Valley Transportation Authority (VTA) in the Bay Area, and the Sacramento Regional Transit District (SacRT) in the Sacramento Area have each lost a high double-digit percentage of their ridership over this period (FTA, 2019).

LA Metro's ridership losses from 2014 to 2018 accounted for 11 percent of the entire ridership decline nationwide, the second-most of any American transit agency by absolute numbers.

i. This is an estimate because internal BART data on transbay trips count linked trips (BART, 2019c), while the NTD data from which we calculated statewide figures count unlinked trips (FTA, 2019).

The asymmetry of transit use and patronage losses applies not only to transit agencies, but to particular lines operated by those agencies as well. Indeed, just 21 routes in Greater Los Angeles—20 LA Metro lines and one OCTA line—accounted for a quarter of the entire state's ridership losses from 2014 to 2018. Over ten percent of California's patronage drop came from five LA Metro routes alone, and lines passing through a single block of downtown Los Angeles accounted for 11 percent of the state's losses (LA Metro, 2019b; OCTA, 2020; and FTA, 2019). California's transit ridership problems prior to 2020 largely ran through Greater Los Angeles' major transit corridors.

Table ES-1. Ridership Changes on the Top Ten California Transit Operators

TRANSIT OPERATOR	REGION OF OPERATOR	CHANGE IN BOARDINGS, 2014-2018		SHARE OF STATEWIDE LOSSES, 2014-2018	BOARDINGS, 2018	SHARE OF STATEWIDE BOARDINGS, 2018
LA Metro	Greater Los Angeles	-85.3 mil.	-17.8%	51.5%	394 mil.	30.5%
Muni	Bay Area	-3.7 mil.	-1.6%	2.2%	225 mil.	17.4%
BART	Bay Area	+3.3 mil.	+2.6%	-2.0%	129 mil.	10.0%
MTS	San Diego Area	-6.4 mil.	-7.0%	3.9%	85 mil.	6.6%
AC Transit	Bay Area	-4.0 mil.	-7.0%	2.4%	53 mil.	4.1%
OCTA	Greater Los Angeles	-9.6 mil.	-18.5%	5.8%	42 mil.	3.3%
VTA	Bay Area	-7.0 mil.	-15.8%	4.2%	38 mil.	2.9%
LBT	Greater Los Angeles	-4.7 mil.	-16.5%	2.8%	24 mil.	1.8%
SacRT	Sacramento Area	-5.5 mil.	-20.8%	3.3%	21 mil.	1.6%
Caltrain	Bay Area	+0.4 mil.	+2.1%	-0.2%	19 mil.	1.5%
Others (Combined)		-43.0 mil.	-14.0%	26.0%	263 mil.	20.3%
California Total		-165.5 mil.	-11.3%	100.0%	1,293 mil.	100.0%

Data source: FTA, 2019

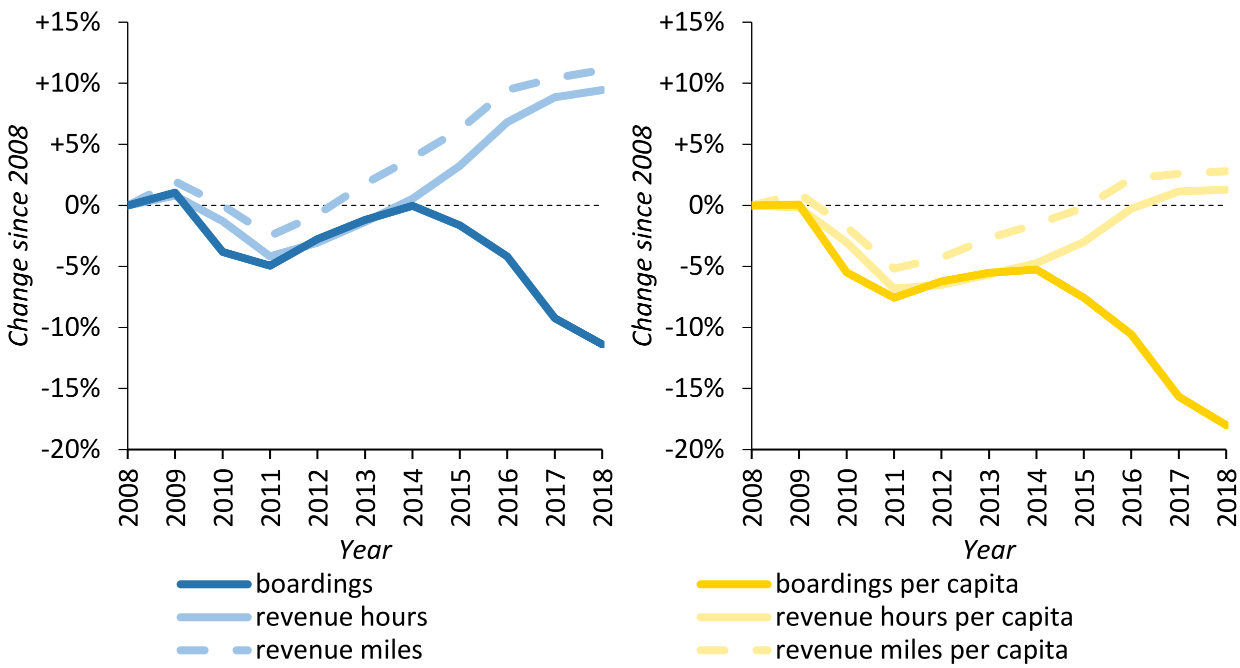
While overall transit boardings across the state are down since 2014, worrisome underlying trends date back earlier. Patronage has failed to keep pace with population growth; per capita ridership has been steadily falling in most regions of the state for more than a decade. Bus ridership, meanwhile, has been declining since 2009; while rail boardings grew substantially through 2015, they have been falling since.

ES.2. Transit Service Is Up, but Performance is Down

ES.2.1. Transit Service Has Been Increasing since 2011

If falling transit use in California were not troubling enough, these losses have manifested as the overall supply of transit service has risen. In many agencies across America, service cuts and ridership declines have created a vicious cycle. As headways rise and reliability falls, riders find other ways to travel, reducing operator farebox revenues that precipitate another round of cutbacks. But this has not been the case in California. Despite all the money and energy the state is pumping into transit service, ridership is still falling. Thus, this new service either is not having the desired effect, or other factors are overwhelming its benefits to ridership. **Figure ES-2** shows this disjuncture.

Figure ES-2. Trends in Boardings versus Trends in Service Supply in California



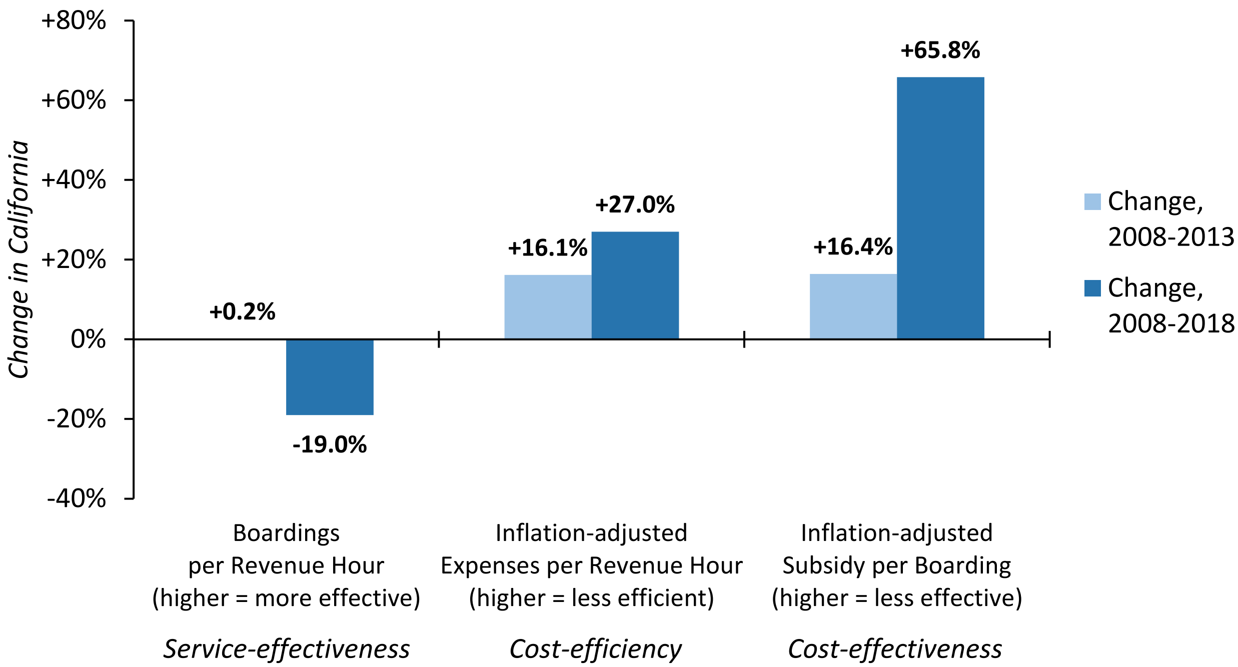
Data source: FTA, 2019 and U.S. Census Bureau, 2019

Despite all the money and energy the state is pumping into transit service, ridership is still falling.

ES.2.2. Transit Performance Has Been Sliding throughout the 2010s

Metropolitan areas in California have grown substantially, while overall transit use has not—even as the total supply of transit service has increased. As a result, aggregate transit performance fell sharply in the 2010s across a number of metrics (See **Figure ES-3**).

Figure ES-3. Change in Transit Performance Metrics in California since 2008



Data source: FTA, 2019 and BLS, 2019

California's transit systems have been operating less efficiently (inputs to outputs) over the past decade and less effectively (outputs to consumption) since just before the recent ridership slump. Rising costs, especially on rail, help explain the former, and falling ridership combined with rising service supply explain the latter. The causes of productivity and ridership declines thus do not neatly overlap. Factors related to service provision, like rising costs and slowing speeds, have hurt transit's performance but do not explain the bulk of its recent patronage losses.

ES.3. Frequent Transit Users Are Riding Less, Occasional Users Are Riding More

Not only are transit systems, service, patronage, and ridership losses asymmetric, transit travelers are asymmetric as well. A few people make a lot of transit trips, some people make some trips, and most people make no trips at all. Because a relatively small share of the population accounts for a large share of transit trips, who these groups are and how their numbers and riding habits have changed are of critical importance to understanding why transit use is falling.

From the perspective of transit users, ridership trends are the outcome of two factors: changes in the relative number of people who are more or less likely to use transit and changes in the travel behavior of those people. So if the number of people with a high propensity to ride transit rose or fell over time, we would term this a *population effect*; and if the average frequency that such people ride transit increases or decreases over time, we would term this a *usage effect*.

With respect to population effects, we find that transit ridership would likely have been higher had rates of international immigration to California not slowed and had the makeup of the state's immigration flow not notably shifted toward higher-income immigrants from Asia who are less likely to rely on public transit than prior waves of immigrants from Latin America. At the same time, transit use rates declined among Hispanics, those with low incomes, and those with limited access to automobiles—population groups that traditionally use public transit relatively frequently. Conversely, ridership rates increased among non-Hispanic whites, those with higher incomes, and people living in households with at least a one-to-one ratio between drivers and vehicles—groups that are typically not associated with high rates of transit patronage. Unfortunately, these rate increases among low-propensity transit riders were not enough to offset the rate decreases by high-propensity transit riders, so changes in usage rates had an overall negative effect on statewide ridership (FHWA, 2009, 2017).

Our analysis of the relative contribution of population and usage effects shows that between 2009 and 2017, much of the substantial ridership losses statewide were due to usage and not population effects. The biggest effects were due to declining average levels of transit use among Hispanics, adults living in households with fewer vehicles than drivers, and adults living in high-density neighborhoods. While these negative usage effects did not lead to ridership losses in the central Bay Area counties between 2009 and 2017, they did lead to steep declines in transit use in Los Angeles and Orange Counties and across California as a whole.

In combination, these effects shifted the composition of transit riders in the state. The proportion of Transit Dependents (those with low incomes who take transit for most of their personal trips) remained relatively stable between 2009 and 2017. In contrast, the share of Occasional Transit Riders declined substantially while the percentage of Choice Riders (those with a private vehicle available for most trips, but who choose to ride transit) more than doubled. People who use transit for short, occasional trips now represent a shrinking share of transit riders, while the presence of higher-income, longer-distance riders became more pronounced.

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ES.4. Alternatives to Transit Are Expanding, a Lot

When deciding whether, where, and when to make a trip, people also decide on the means—or "mode"—of travel. Should they walk, ride a bike, take a bus or train, call for Lyft or Uber, drive a car, or get a ride from a family member or acquaintance driving theirs? Because most people have access to private cars for their trips, and because much of metropolitan America has been designed to support driving, most people travel in cars for most trips. So when deciding whether to ride public transit for a given trip, most people weigh the costs and benefits of transit vis-à-vis a variety of other options, including driving. Because these other options importantly influence transit use, we consider their possible effects on ridership.

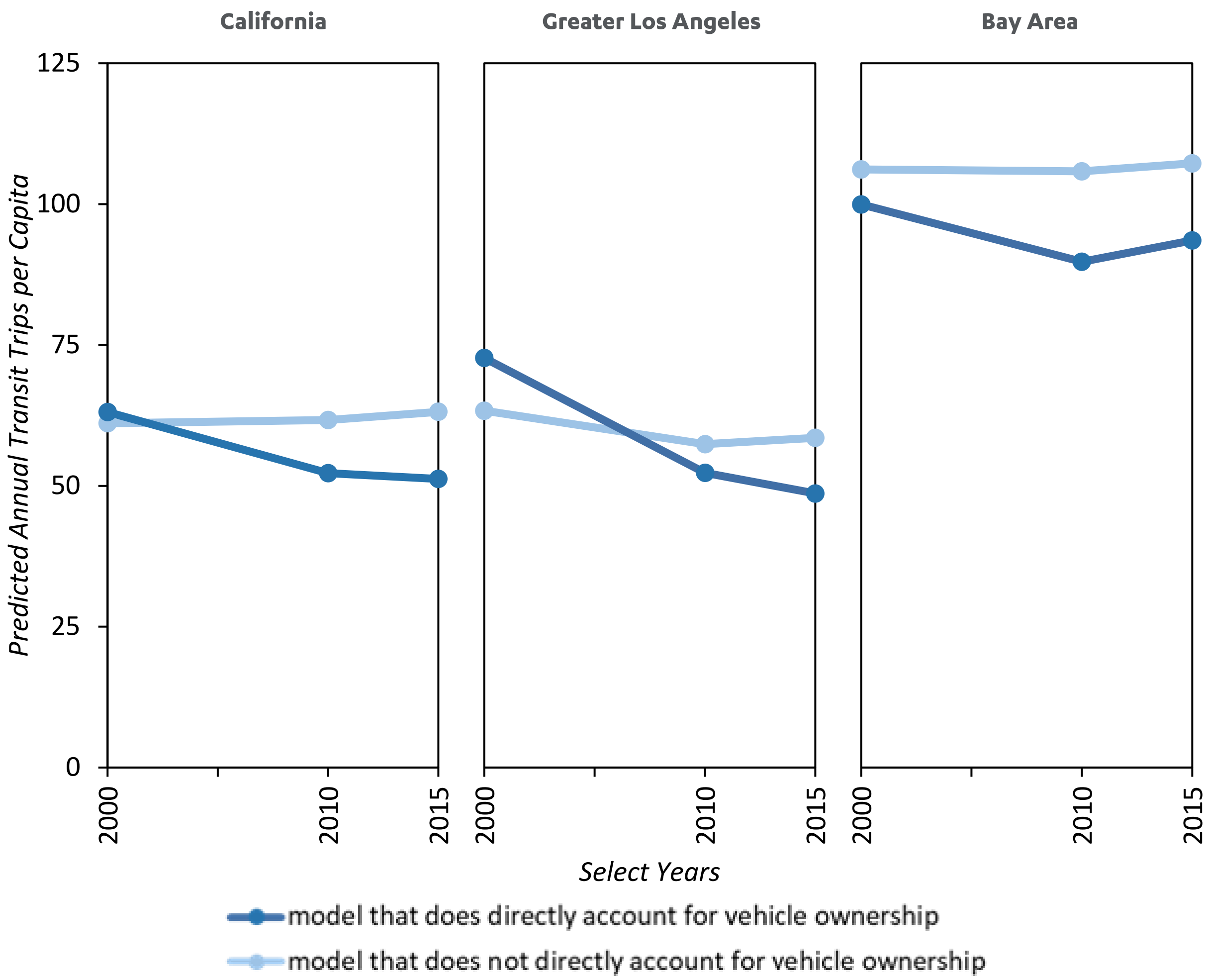
ES.4.1. Private Vehicle Access Is Way Up; This Is Likely the Biggest Single Cause of Falling Ridership

Private vehicles are transit's major competitor. From 2000 to 2018, private vehicle access in California increased substantially. The state added almost 3 million vehicles from 2000 to 2010 and another 2.6 million vehicles from 2010 to 2018. Over this same time period, the percent of California households without motor vehicles declined by 16 percent, a downward trend that took place to varying degrees in all five major urban regions in the state (Ruggles et al., 2020).

This growth in private vehicle ownership in California has likely had the largest effect on falling transit use of any of the potential causes analyzed for this report. In most areas of the state, the decline in carless households was associated with a significant decrease in the number of daily transit trips per person; **Figure ES-4** shows the dramatic difference in trends in predicted transit trips per person with and without accounting for changes in vehicle access. This relationship was particularly pronounced in the Greater Los Angeles region. Trends in the San Francisco Bay Area differed from those in the rest of the state, as car ownership levels remained relatively stable (though, as we discuss below, high levels of ridehail use in the Bay Area increased vehicle access there by another means).

Growth in private vehicle ownership in California has likely had the largest effect on falling transit use of any of the potential causes analyzed for this report.

Figure ES-4. Estimating the Independent Effect of Rising Vehicle Ownership on Transit Ridership: California and Its Two Largest Regions



Note: Both sets of statistical models control for a wide array of other factors thought to influence transit ridership in order to show the independent effect of changes in private vehicle access on transit use.

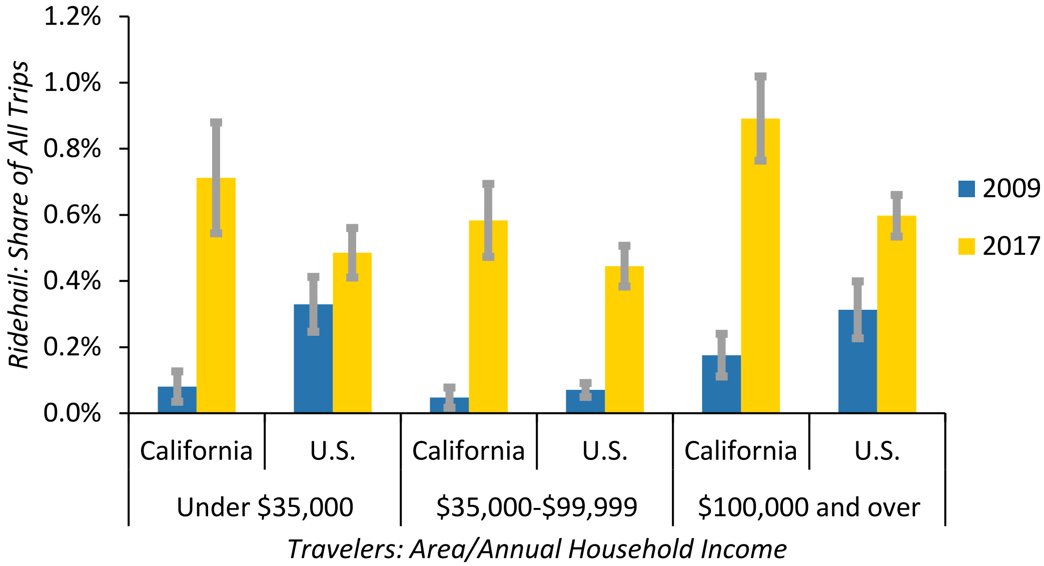
Data source: Caltrans, 2012 and Ruggles et al., 2020

ES.4.2. The Rise of Ridehail Has Likely Reduced Transit Use, But It Is Hard to Say How Much

Critics of ridehail services like Lyft and Uber have frequently held these still-relatively-new services responsible for falling transit use in California and elsewhere. The rapid rise of ridehail has clearly affected the travel landscape in California in the last decade but also represents just one more way that Californians choose automobiles for mobility—where vehicle trips are purchased individually rather than in bulk, via a car or truck purchase. Our analysis suggests that ridehail likely subtracts some transit riders in net (who substitute ridehail for transit trips)—particularly in the Bay Area, where ridehail use appears highest, but likely in the San Diego and Los Angeles Areas as well.

All told, California witnessed an estimated eight-fold increase in combined ridehail and taxi use between 2009 and 2017, which is substantially larger than for the U.S. as a whole. Ridehail/taxi use has increased substantially across all income groups (**Figure ES-5**) and among younger riders and Hispanics, two traditional core transit-riding population segments that (as discussed above) have been abandoning public transit in recent years (FHWA, 2009, 2017).

Figure ES-5. Growth in the Share of Ridehail/Taxi Trips by Income Category



Data source: FHWA, 2009, 2017

But while strongly suggestive, the case for ridehail replacing transit use is not an open-and-shut one. The timing and trip purposes of ridehail/taxi trips and transit trips differ substantially. Ridehail use is typically highest in the evening and on weekends, which are not peak times for transit. In addition, ridehail passengers systematically differ socio-economically and with respect to trip purpose from transit travelers. However, in the Bay Area, transit operators there have lost a disproportionate share of evening and weekend trips, which constitute a substantial majority (68.3%) of the growing number of ridehail/taxi trips (FHWA, 2017). Moreover, a number of studies have found that metropolitan areas with more mature and ubiquitous ridehail networks see more substitution for transit over time (Graehler, Mucci, and Erhardt, 2019 and Babar and Burtch, 2017), and Lyft and Uber have operated in the Bay Area longer than anywhere else (Hartmans and Leskin, 2019). So the Bay Area, with respect to ridehail and transit use, may present an exceptional case.

Quantifying the substitution and complementarity between public transit and ridehail is not straightforward, especially without detailed ridehail trip data—which are generally not available. But to plan effectively for these new services, and to understand how they complement and compete with public transit, governments and researchers need regular access to standardized reporting data from these service providers, while remaining sensitive to user privacy concerns.

ES.4.3. Other Possible Culprits—Driver's Licensing for Undocumented Immigrants, Private Shuttles, Micromobility, and Fuel Prices—Have Likely Played, at Best, Only Minor Roles

As vehicle ownership has increased across the state, the portion of the population allowed to drive has also expanded. California passed Assembly Bill 60 (AB 60), the Safe and Responsible Drivers Act, in 2013. The bill required the Department of Motor Vehicles to issue "an original driver license to an applicant who is unable to submit satisfactory proof of legal presence in the United States" beginning on January 2, 2015

(California DMV, 2020). A central goal of the bill was to reduce unlicensed and uninsured driving among undocumented immigrants in California.

As of spring 2018, a total of more than one million driver's licenses had been issued under this program. Most California counties issued more licenses in 2015 (the year in which AB 60 was adopted) than in 2008 (prior to the adoption of AB 60). Population growth is strongly associated with increased licensing; however, since 2011-12 the percent change in the number of driver's licenses in California exceeded population growth.

Immigrants in California remain 1.5 times more likely to use transit than native-born adults. Assuming that at least some of the new AB 60 license holders previously relied on transit, changing state driver's licensing regulations may have contributed to declining transit use. We developed statistical models of commuting before and after the implementation of AB 60 to test this relationship and conclude that AB 60 likely had a small but statistically significant negative effect on transit ridership.

Additional mobility options for Californians emerged during the 2010s, all dependent to some degree on information and communications technologies and most delivered by the private sector. Private commuter shuttles incorporate new technology and provide expanded transit options, particularly in the Bay Area, and bicycle share systems, electric scooters, and e-bikes all offer new, personalized possibilities for travel (albeit typically serving much shorter trips than those taken via private shuttles).

Despite their ubiquity in some urban areas and popularity among users, it is difficult at this point to make a convincing circumstantial case that the new services described here have had substantial negative effects on public transit use over the last decade. Transit ridership has been growing in the Caltrain commuter rail corridor between San Francisco and Silicon Valley where corporate shuttle use is highest (Bay Area Council and MTC, 2016 and Wasserman et al., 2020). And given that micro-mobility may be improving first-mile/last-mile access to transit, there is a stronger case for these new services enhancing the transit experience and use than detracting from them.

Finally, research has shown that changes in the relative costs of driving can influence transit ridership. The price of public transit is almost always lower than the average cost of driving, so high gasoline prices could motivate some travelers to switch from driving to riding in order to save money. Since 2000, fuel prices have fluctuated widely in California, in contrast to the relatively steady rise in the price of a transit trip. However, neither fluctuating fuel prices nor rising transit fares track well with rising then falling transit use in the 2010s (EIA, 2019; FTA, 2019; BLS, 2019; and U.S. Census Bureau, 2019). Thus, we see little evidence that motor fuel prices substantially affected transit use.

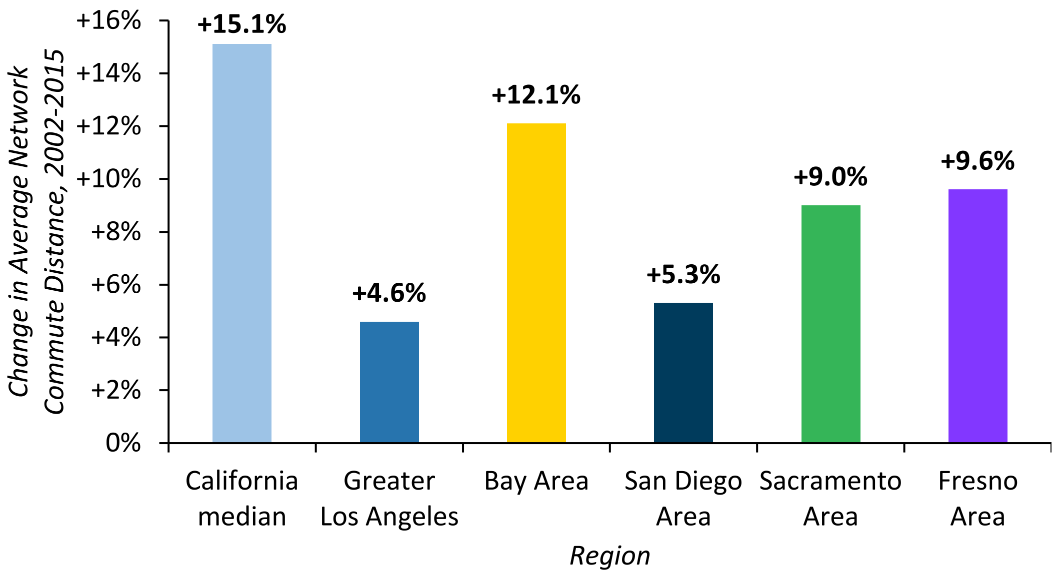
ES.5. California's Neighborhoods Are Changing

ES.5.1. Commute Distances Are Growing and Transit Access to Jobs Is Declining

We see evidence that households are increasingly locating away from expensive cities and neighborhoods and into outlying areas where housing is more affordable but transit service and use is more limited. This likely reflects the affordable housing crisis in many of California's metropolitan areas, as well as the fact that most new housing stock is being added at the edges of cities. We find that California's cities and regions have become less self-contained over time in that fewer workers live in the cities in which they work. This gap is greatest in employment-rich cities where housing costs have increased fastest. These patterns also play out with respect to the five major urban regions in the state, where the share of jobs held by workers living outside of each region, already large in 2002, increased substantially by 2015 (U.S. Census Bureau, 2002, 2015).

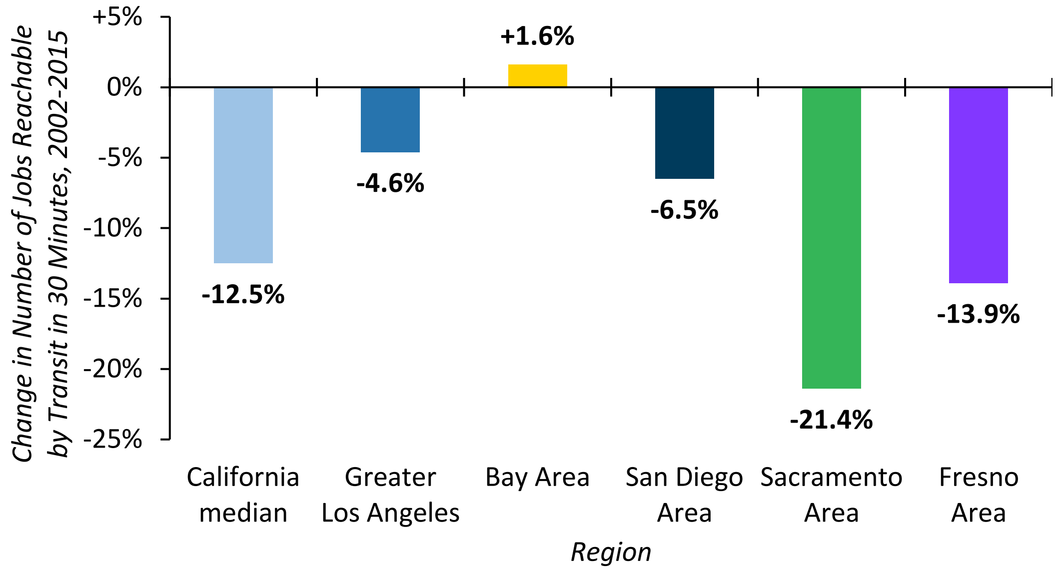
The transportation impacts of the growing jobs-housing imbalance include an increase in commute distance and a decline in the number of jobs accessible to workers by public transit within 30 minutes. Median commute distance in the state increased by 15 percent from 2002 to 2015 and commute distances grew in all five major regions of the state (See **Figure ES-6**) (U.S. Census Bureau, 2002, 2015). At the same time, workers experienced a decline in their transit access to employment in California and in four of the five regions studied (See **Figure ES-7**) (Owen, Levinson, and Murphy, 2017).

Figure ES-6. Change in Commute Distance, 2002 to 2015



Data source: U.S. Census Bureau, 2002, 2015

Figure ES-7. Change in Number of Jobs Reachable by Transit in 30 Minutes, 2002 to 2015



Data source: Owen, Levinson, and Murphy, 2017

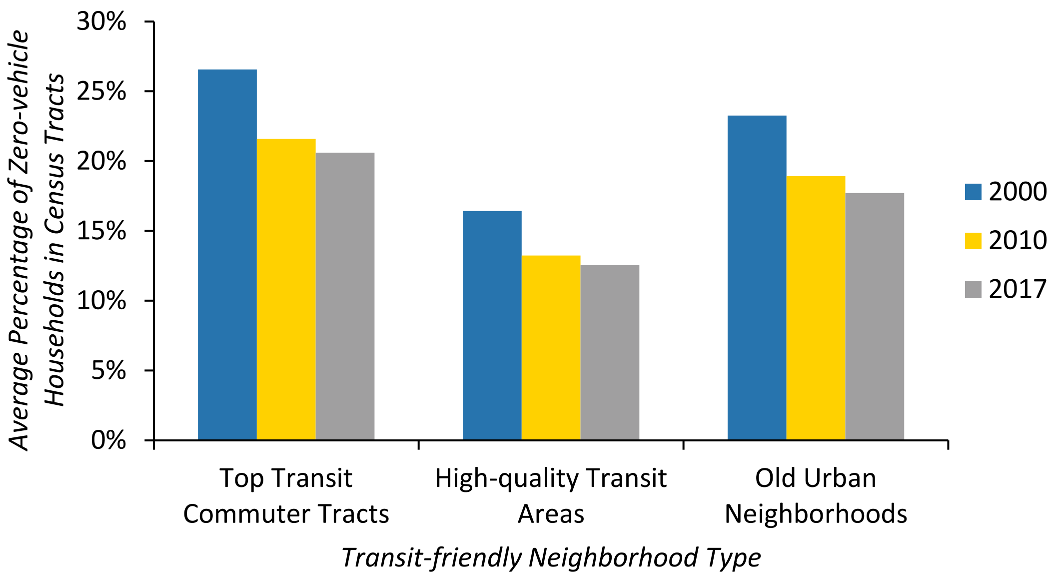
The employment data we analyzed here are not associated with commute mode, so we cannot directly quantify the effect of these changes on transit ridership. But changes in housing and employment patterns have caused commutes to grow and transit to less effectively link people to work opportunities. Indeed, for longer trips, transit is usually less competitive with driving on measures of time, comfort, and reliability, so longer commutes bode ill for transit's mode share. As the share of the population living in areas with worse transit access to employment centers (including stores and services) grows, people will likely make fewer non-work local trips on transit as well. These trends suggest trouble for transit agencies, which are having or will soon have difficulty accommodating trips in lower-density, outlying regions of the state and parts of each region.

Changes in housing and employment patterns have caused commutes to grow and transit to less effectively link people to work opportunities.

ES.5.2. There Are Relatively Fewer High-propensity Transit Users in the State's Most Transit-friendly Neighborhoods over Time

California's most transit-friendly neighborhoods are changing in ways that often mimic trends seen across the state, though in some cases the shifts have been even more pronounced than for the state as a whole. As noted elsewhere in this report, the presence or absence of a private vehicle is a powerful predictor of public transit use. Residents of zero-vehicle households in particular use public transit at much higher levels than households with at least some or substantial vehicle access. Transit-friendly neighborhoods should be the places where getting around on transit, and getting by without a car, should be easiest. But our analysis shows that zero-vehicle households are down substantially since 2000 across all three of our definitions of zero-vehicle neighborhoods (See **Figure ES-8**). However, this trend is not unique to such areas: the rate of decline of zero-vehicle households in transit-friendly neighborhoods is similar to the decline for the state as a whole.

Figure ES-8. Average Percentage of Zero-vehicle Households in California's Transit-friendly Neighborhoods



Data source: U.S. Census Bureau, 2019; SCAG, 2020; MTC, 2018; SANDAG, 2019; SACOG, 2017a, 2017b; FCOG, 2019; and Voulgaris et al., 2016

Among zero-vehicle households in transit-friendly neighborhoods, the number of neighborhoods we classified as "car-free"—having few household vehicles but low poverty rates—was both low and largely unchanged over time. Still, in some parts of California, especially in the City of San Francisco, this category of neighborhoods where at least some sizable share of residents likely *choose* to live without automobiles is growing, if still small. These "choice" riders may represent a silver lining for transit agencies seeking to recover ridership.

The number of transit-friendly neighborhoods classified as "car-less" (that is, places with a lack of auto access due to economic exigency rather than choice) declined substantially between 2000 and 2017. Foreign-born residents of transit-friendly neighborhoods also declined between 2000 and 2017, and at a faster rate than for the state as a whole. Shares of immigrants from Latin America were down substantially, while those from Asia increased slightly. Finally, the share of transit-friendly neighborhood households living in poverty also fell between 2000 and 2017, and like immigrants at an even faster rate than for the state as a whole. While declining poverty rates are unambiguously good economic news, their disproportionate drops in transit-friendly neighborhoods do not bode well for transit use.

Collectively, these findings point to changes in those living in California's most transit-friendly neighborhoods that are not very, well, transit-friendly. Our data do not, however, allow us to determine the extent to which such shifts reflect gentrification of or displacement from these neighborhoods or whether the observed changes have occurred through processes of residential turnover that did not entail displacement. But regardless of the underlying processes at work, all three of these trends—declining numbers of zero-vehicle households, Latin-American immigrants, and those in poverty—have occurred in the most transit-friendly of California's neighborhoods, boding ill for transit use.

ES.6. Conclusion

The pandemic of 2020 and the many changes in the users of and competitors with public transit leading up to it paint a challenging picture of public transit in California. Substantial increases in auto access—primarily in the ownership of cars and trucks, but also in the availability of ridehail—have increased the travel options for many former transit users. These changes have been especially dramatic among populations that have tended to ride transit most frequently.

While the 2010s proved a difficult decade for public transit in California, and the opening of the current decade has been an even bigger challenge, transit remains an essential public service. First and foremost, it provides critical mobility for those who, because of age, income, or ability, cannot travel in automobiles. Transit thus serves an essential social equity function. It also connects major centers of activity, like central business districts, universities, and airports, far more effectively than private vehicles, and thus serves a critical economic function, too. And when heavily patronized, it is a green form of travel that can contribute to state environmental objectives. However, past experience suggests that public transit use recovers slowly following epidemics (Wang, 2014). Given this research on California transit use in the 2010s, effectively managing that transit recovery will require a clear-eyed understanding of the substantially altered environment within which these systems large and small must now operate.

Part I. Transit Use Trends: An Overview

1. Introduction

1.1. Diagnosing California's Transit Troubles

Public transit in California and around the globe experienced an unprecedented ridership free fall in the first half of 2020. The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) pandemic led to stay-at-home orders, curtailed travel, and requests from public officials—and even transit operators themselves—to minimize travel by public transit. Amidst social distancing measures to combat the spread of the Coronavirus Disease of 2019 (COVID-19), ridership on transit systems around California plummeted 50 to 90 percent in just a few weeks (Levy and Goldwyn, 2020; Walker, 2020; BTS, 2020; Transit App, 2020; and Moovit, 2020).

Public transit systems excel at moving large numbers of people in the same direction at the same time, and can serve large agglomerations of economic (think central business districts) and social (think major sporting events) activity better than the individual private vehicles that continue to dominate metropolitan travel. For this reason, and because public transit systems can provide mobility for those without access to cars or unable to drive in order to reach needed destinations, public transit is an essential public service.

While the pandemic, and its extraordinary effects on transit systems and use, are still underway at the publication of this report, and the stay-at-home orders and travel restrictions that have devastated transit ridership are surely temporary, a return to regular operations and crowded buses and trains remains far from certain (Blumgart, 2020). Will transit ridership eventually rebound when we are finally past this terrible pandemic? Perhaps. Eventually.

But an equally important parallel question is this: rebound to what? This second question is crucially important because public transit ridership has been in something of a crisis for at least five years. Ridership has been declining in California and nationally since 2014. Per capita ridership (or the annual number of rides per resident) has been sloping mostly down for even longer: it is down 18 percent between 2008 and 2018 (FTA, 2019). Greater Los Angeles has seen the largest absolute drops in transit use in California—indeed, some of the largest in the entire United States—but no region of the state has been immune. Even the San Francisco Bay Area, with its white-hot, tech-driven economy, has seen drops in boardings in recent years.

Such patronage declines would be cause for concern in any case, but they are especially problematic given California's substantial commitment to investing in, improving, and increasing use of public transit. With funding from the Federal Transit Administration (FTA), California's Transportation Development Act, and the recently passed Senate Bill 1, as well as local option sales taxes for transportation and other local funding in counties around the state (Lederman et al., 2018), California is collectively investing billions of dollars into expanding and upgrading its public transit services to provide travelers with mobility options, increase transit travel, reduce driving and traffic congestion, minimize sprawl and fuel consumption, and help California meet its ambitious greenhouse gas emission reduction goals. To help achieve these goals, the California Department of Transportation (Caltrans) has adopted ambitious goals of doubling transit's mode share (Matute, Wickland, et al., 2017; Gahbauer et al., 2017; and Matute, Bains, et al., 2017).

Understanding the dimensions of falling ridership amidst rising transit investment and aspirations is the goal of this report.

1.2. Why Was Pre-pandemic Transit Struggling Amidst an Investment Boom?

There is no shortage of theories as to why California transit ridership has been falling since 2014. We can divide commonly proffered explanations into four broad categories:

1. *Changes in transit service*: transit service has been cut, has gotten slower, and/or has become less reliable.
2. *Changes among the people likely to ride*: who rides transit is evolving, and transit service needs to reflect those changes.
3. *Changes in the number of transit alternatives*: new, technology-enabled, and mostly privately provided services are attracting former riders away from transit.
4. *Changes to metropolitan areas and travel patterns in them*: high housing costs are pushing former riders away from transit rich areas, while affluent residents flocking to cities tend to ride less.

Under each of these four broad categories are more specific explanations. We examine these and other possible explanations in this report.

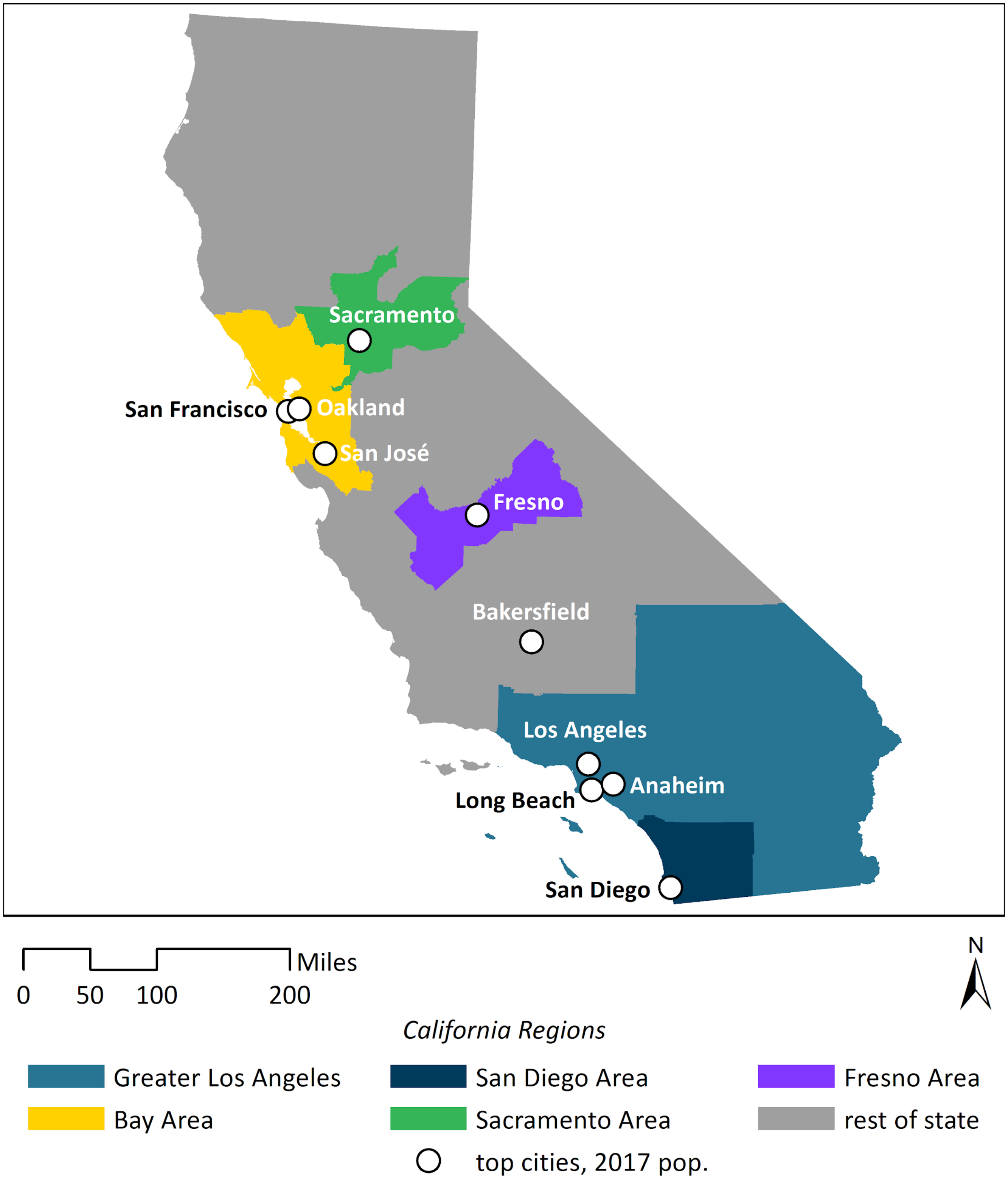
These explanations are not, of course, mutually exclusive, and may well interact with one another—and we explore this as well. As we will see, the relevance of these explanations varies across different parts of the state. We will also show that some are clearly more important than others, and we aim to highlight the most important causes for policy makers, planners, and transit operators to improve public transit when we eventually move past the current pandemic.

1.3. What We Do: A Report Roadmap

This report by the UCLA Institute of Transportation Studies is part of a series of research studies on the present and future of public transit. It follows on 1) assistance we provided to Caltrans in updating its Statewide Strategic Transit Plan (Matute, Wickland, et al., 2017; Gahbauer et al., 2017; and Matute, Bains, et al., 2017), 2) a 2018 study of falling transit ridership in greater Los Angeles for the Southern California Association of Governments (Manville, Taylor, and Blumenberg, 2018), and 3) a study of more recent declines in transit use in the San Francisco Bay Area for the Metropolitan Transportation Commission (Blumenberg et al., 2020 and Wasserman et al., 2020). This report builds on this previous work but goes well beyond it. First, it covers the entire state and its major regions; second, it updates earlier analyses with more recent data; and third, it includes several new analyses that were not conducted previously.

To the extent that our data allow, we examine transit statewide, as well as across the state's key regions: at the direction of Caltrans staff, we divide California into six regions in our analyses, based on metropolitan planning organizations (MPOs) as detailed in **Figure 1-1** and **Table 1-1** (Further geographic definitions are given in Appendix A, Section 1.).

Figure 1-1. California Regions



Data source: California Open Data, 2019; Bell, 2019; CaliDetail, n.d.; and U.S. Census Bureau, 2019

Table 1-1. California Regions

REGION	COUNTIES	MPO	POPULATION
Greater Los Angeles	Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura	Southern California Association of Governments (SCAG)	18.9 mil.
San Francisco Bay Area	Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma	Metropolitan Transportation Commission (MTC)	7.6 mil.
San Diego Area	San Diego	San Diego Association of Governments (SANDAG)	3.3 mil.
Sacramento Area	Sacramento, Sutter, Yolo, Yuba, most of El Dorado, and most of Placer[1]	Sacramento Area Council of Governments (SACOG)	2.5 mil.
Fresno Area	Fresno	Fresno Council of Governments (FCOG)	1.0 mil.
rest of the state	all others in California	all others in California	6.0 mil.

Data source: U.S. Census Bureau, 2019

Finally, this report is organized as follows:

Part I provides an overview of transit use trends:

- Chapter 1 is this introduction.
- Chapter 2 places California public transit in context by presenting a brief overview of national transit trends and a review of previous relevant research on transit ridership.
- Chapter 3 then provides a detailed review of how transit use has changed in California over the past dozen years.

Part II examines how California transit systems have changed in recent years:

- Chapter 4 examines trends in transit service provision, including by region and mode
- Chapter 5 analyzes transit performance trends in light of public expenditures, fare revenues, and congestion.

1. Small portions of El Dorado and Placer Counties in the Lake Tahoe Basin are not part of the Sacramento Area, though due to data limitations, some of the analyses in this report include all of El Dorado and Placer Counties (See Appendix A, Section 1 for further details).

Part III examines how California's transit users are changing:

- Chapter 6 examines changes in ridership patterns of transit users.
- Chapter 7 develops a typology of transit users and analyzes how they are changing over time.

Part IV examines the many and expanding alternatives to traveling by transit and their probable effects on ridership:

- Chapter 8 examines trends in motor vehicle access and use.
- Chapter 9 analyses trends in fuel prices and transit use.
- Chapter 10 considers the effect of driver's licensing for undocumented immigrants.
- Chapter 11 examines the rise of ridehail services and their effects on transit
- Chapter 12 reviews the rise of corporate shuttles and micromobility services.

Part V examines how metropolitan areas and neighborhoods in California are changing:

- Chapter 13 considers the changing location of workers to jobs, particularly in light of California's housing affordability crisis.
- Chapter 14 analyzes changes in the characteristics of residents living in transit-friendly neighborhoods over time.

And finally, in Part VI, Chapter 15 provides a summary of the principal findings of this analysis.

2. California Transit in Context: National Trends and Previous Research

2.1. Introduction

Our examination of falling transit ridership in California since 2014 and what might be causing it begins with a brief overview of public transit trends nationally. We review previous research (global, national, and California-specific) on the factors influencing transit use in order to frame and contextualize our analysis. This overall review of the literature paints a complex picture of supply-side, context, and demand-side factors affecting transit use broadly and recent ridership losses in particular. In addition to this overall summary of previous research, we revisit relevant parts of this review in several of the analytical chapters that follow.

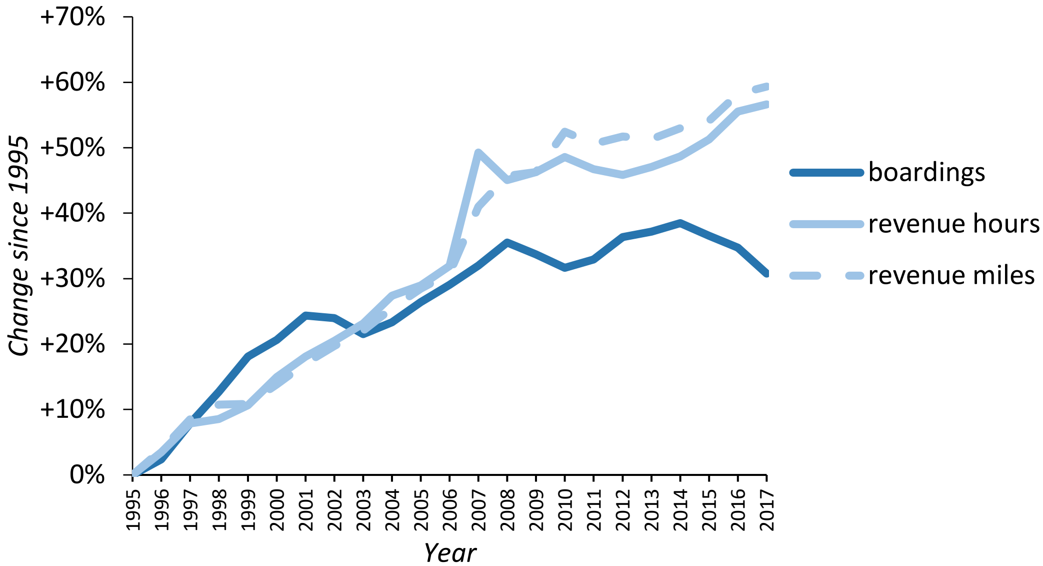
Recent scholarship has shown that transit use and performance are eroding nationally and across most American metropolitan areas, though as we will see in the following chapter, California transit systems have been especially hard hit. Similarly, our review of research on the determinants of transit use highlights key factors, such as motor vehicle access (via ownership or ridehail), income, and immigration. And as we will then see in several of the chapters that follow, many of these factors have been shifting in directions unfavorable to transit ridership in California.

2.2. Changes in Transit Service and Use

Transit use depends on a wide variety of factors, some within operators' control (so-called "internal factors") and some beyond it ("external factors"). The internal factor that transit agencies most directly control is the supply of transit: by changing the type of service offered, its geographic extent, routing, timing, quality, and price. For instance, research suggests that increasing vehicle revenue miles and hours of service offered raises ridership, as do improvements to service quality like route network design (Liu, 1993; Gómez-Ibáñez, 1996; Kain and Liu, 1996; Kohn, 2000; and Thompson, Brown, and Bhattacharya, 2012). In fact, some recent studies show that changes in vehicle revenue miles are the most important factor in explaining variations in transit ridership per capita in the United States, though many of these analyses are logically flawed in that they do not account for the degree to which supply and demand are interrelated (Alam, Nixon, and Zhang, 2015 and Boisjoly et al., 2018). Transit supply and demand are thus, in econometric parlance, endogenous.

Figure 2-1 shows national trends in two measures of service supply (hours and miles) along with transit total boardings. It shows that service supply and ridership generally rose in concert between 1995 and 2006. Between 2006 and 2010, however, transit service supply nationally began to rise faster than ridership. The two converged somewhat between 2010 and 2014 but have diverged further and faster since then, with transit service growing while ridership has declined. As we will see in the next three chapters, which focus in detail on California transit use, supply, and performance since 2008, the divergence between service supply and use in California (with some notable regional exceptions) has been even more dramatic than for the nation as a whole.

Figure 2-1. Change in U.S. Transit Boardings and Revenue Service, 1995-2017



Data source: APTA, 2019

These trends suggest that demand for transit service is to some extent independent of transit supply and, as we detail in our review of previous research below, depends on other factors such as riders' income; employment; access to other forms of transportation like private automobiles, taxis and increasingly available ridehail services; and even the weather (Taylor and Fink, 2013). Studies find that population density, percent of zero-vehicle households, and median household income explain far more than the availability of transit service (Gómez-Ibáñez, 1996; Chung, 1997; and Taylor et al., 2009), which may simply respond to changes in consumer demand.

Given that the state's ridership decline is so recent, there has been little research to date about its possible causes. One study suggests that employment growth between 2009 and 2013 can explain most of the overall growth in ridership on the Bay Area Rapid Transit District (BART) (Erhardt, 2016), but ridership losses since then on many other Bay Area transit operators have come even as employment continues to boom. A prior UCLA ITS study of Greater Los Angeles, meanwhile, finds that increased auto access—a factor explored more below and in Chapter 8—explains much of recent transit patronage losses there (Manville, Taylor, and Blumenberg, 2018).

2.3. How Transit User Characteristics Affect Use

People with low incomes, people in poverty, people living in households with few or no private automobiles, and immigrants (and especially less-educated and/or recent immigrants) are especially likely to ride public transit (Anderson, 2016). Of these, two of the most significant traveler attributes associated with transit use are income and auto access. Both are particularly relevant in California, though they are interrelated since income influences auto ownership and access to an automobile can have an important impact on personal and family income (Liu, 1993; Gómez-Ibáñez, 1996; Ong, 2002; Taylor et al., 2009; Baum, 2009; and Giuliano and Hu, 2001).

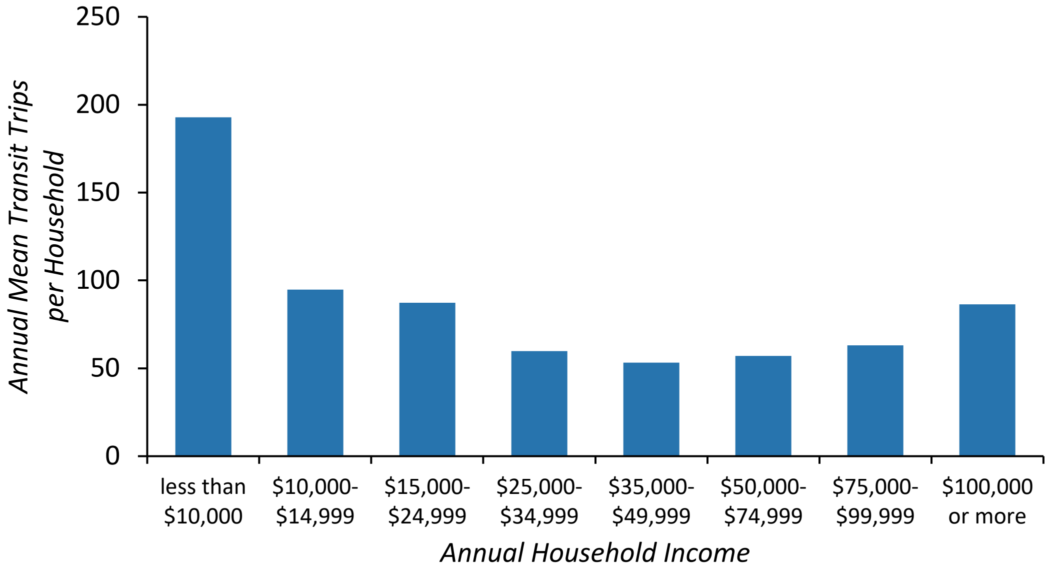
2.3.1. Income and Transit Use

With the exception of commuter rail services, most American public transit is, in economists' parlance, an "inferior good"—which is defined as something that people tend to consume less of when incomes rise. Indeed, studies of transportation behavior have consistently found a strong negative association between income and transit use in the United States (Giuliano, 2005). This is a historical development, however; prior to the explosion of motor vehicle ownership and use a century ago, public transit was regularly used by a broad cross-section of society (Jones, 2008). Yet as more middle-income people bought and drove private vehicles, transit use and investment in the mode (then mostly private) declined, and the average transit rider has grown more lower-income relative to the population as a whole as more and more people have migrated to driving. Low-income travelers' pragmatic decision-making partly drove this change—taking transit is cheaper than owning, registering, insuring, fueling, and maintaining a private vehicle (Gardner and Abraham, 2007). As a result, public transit in many places increasingly resembles a social service (Garrett and Taylor, 1999 and Taylor and Morris, 2015).

However, the relationship between transit use and poverty is not a simple one. Differences exist by mode; the average commuter rail user is higher-income compared to the average American, while the average bus user is markedly lower-income (Taylor and Morris, 2015). Meanwhile, the quality of the modes differs and reflects user constraints, as local buses often travel slowly as they crawl through congested areas while grade-separated rail and bus systems travel quickly, serve high-density commercial and employment districts, and can provide an attractive alternative to driving (Tirachini, Hensher, and Jara-Díaz, 2010). Exceptions to the poverty/transit user connection also vary substantially by region and area. For example, New York City has by far the largest share of transit users in the country—36 percent of unlinked passenger transit trips in 2018 took place on New York's Metropolitan Transportation Authority bus or rail (FTA, 2019)—and its many users have higher median incomes than those of the average American (NuStats, 2009). In New York and other older, densely populated cities of the Northeastern United States, transit commuters tend to be wealthier than transit commuters in the Sunbelt and the rest of California (Maciag, 2014).

Generally speaking, though, higher income leads to less transit use while those without access to cars tend to ride transit far more (Liu, 1993; Kain and Liu, 1996; Taylor et al., 2009; and Manville, Taylor, and Blumenberg, 2018). Nationally, the curve is actually somewhat U-shaped, with some increase in transit trip taking occurring at the highest income levels, as shown in **Figure 2-2**.

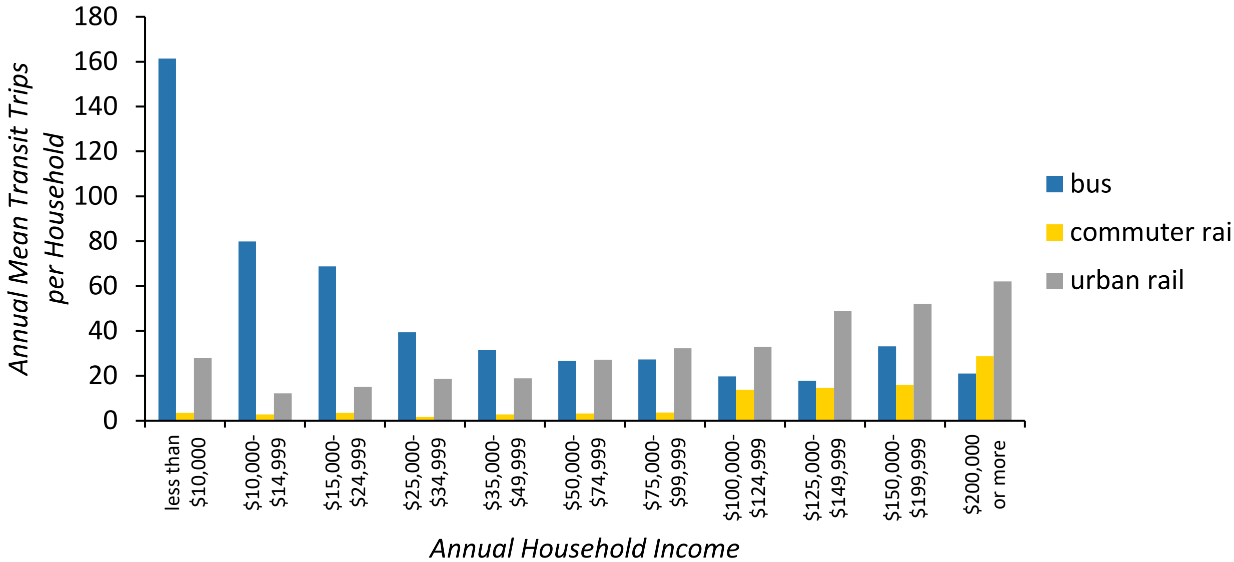
Figure 2-2. Distribution of U.S. Transit Trips by Household Income in 2017



Data source: FHWA, 2009, 2017

This pattern of transit use by income category can be partly explained by differences in the usual transit mode used by households in different income classes. As shown in **Figure 2-3**, lower-income households make far greater use of buses than rail modes, but bus use declines quickly with rising income. On the other hand, higher-income households use buses infrequently but tend to take more urban and commuter rail trips as household income goes up, particularly for journey-to-work trips. In fact, nearly 70 percent of the reported increase in transit trips between the 2009 and 2017 National Household Travel Surveys (NHTS) was commute trips. Thus, changes in income over time, as well as changes in the likelihood that certain income groups will favor certain transit modes for their travel needs, may help explain why buses have been affected more by ridership losses than have rail modes.

Figure 2-3. Annual U.S. Household Transit Trips by Income and Mode, 2017



Data source: FHWA, 2017

2.3.2. Immigrants and Transit Use

Immigrants also represent a major pool of likely transit users, and research has shown a positive association between foreign origin and transit use (Chatman and Klein, 2009). But the effect on transit use varies by changes in the size, composition, and years in the United States of foreign-born population groups. Immigrants are more likely to take transit than U.S.-born travelers—and thus regions with large foreign-born populations like the Bay Area and Greater Los Angeles have higher transit use, all else equal. In fact, immigration explained most of the increase in transit commuters in California from 1980 to 2000 (Blumenberg and Evans, 2007). Other research shows that much of the drop in transit ridership in Greater Los Angeles can be attributed to a dramatic increase in auto ownership among immigrants since 2000, especially among Hispanic immigrants (Manville, Taylor, and Blumenberg, 2018). But, as we discuss further in Chapters 6 and 8, this trend does not seem to have been the case in the Bay Area, though changes within the composition of the immigrant population in the Bay Area may be at play.

While foreign-born residents use transit at higher rates because they tend to be lower-income and own fewer vehicles than the average American, a unique "transit immigrant effect" exists beyond income and vehicle access (Blumenberg and Smart, 2010). Several studies show that, even when controlling for a variety of socio-economic factors, immigrants travel by means other than driving—walking, bicycling, carpooling, and transit—at higher rates than U.S.-born travelers (Blumenberg and Shiki, 2007). However, as the time of residence in the United States increases, this effect diminishes.

Several theories explain the immigrant effect, including that higher levels of transit use in the sending country socializes people to prefer transit to driving (Blumenberg, 2009) and that enclave effects and social networks may engender more carpooling and other types of collective behavior (Blumenberg and Smart, 2010). And as approximately 10.7 million undocumented immigrants (or 24 percent of the foreign-born population) lived in the United States in 2016, many of these immigrants lack access to drivers' licenses (Passel and Cohn, 2018).

Nationally, the sending countries of immigrants have changed over time, with Asian immigrant entries surpassing Latin American entries since 2010 (Radford, 2019). This is consequential because foreign-born residents tend to travel differently depending on their region of origin and time in the U.S.; recent immigrants from Asia are far more likely to commute by driving alone than recent immigrants from Latin America (Blumenberg, 2009). And, Latin American immigrants tend to ride transit at higher rates than do U.S.-born Hispanics; Asian immigrants also take transit more than the U.S.-born Asian Americans do, but at lower rates than Latin American immigrants (Blumenberg and Shiki, 2007).

In 2015, Assembly Bill 60 (AB 60) granted access to driver's licenses for California's undocumented immigrants. At between 2.35 and 2.6 million, California has the largest population of undocumented immigrants in the country, which comprised more than six percent of the state's total population in 2014 (Hayes and Hill, 2017), and over 1 million licenses have been issued under AB 60 to them (California DMV, 2018). While this policy has indeed substantially increased the number of licenses issued (See Chapter 10), researchers have struggled to evaluate how licensure access affects actual travel behavior. Evidence from interviews in 2006 with undocumented California residents suggests that many undocumented immigrants already drove without licenses and weighed the risks of illegal activity against the benefits of mobility and necessity of regular employment (Lovejoy and Handy, 2011).

Among both documented and undocumented immigrant populations, the distribution of the foreign-born population is not uniform across California. Of the 10.5 million immigrants living in California in 2017, 38.5 percent were born in Asia, 51.3 percent in Latin America, and 10.2 percent elsewhere (U.S. Census Bureau, 2019). However, the Bay Area has twice as many immigrants from Asia as from Latin America, which could explain some of the differences in ridership losses between there and Greater Los Angeles. We look at the changing composition of likely transit users in terms of income, automobile access, and immigrant status in Chapter 6.

2.4. How Access to Other Transportation Modes Affect Transit Use

2.4.1. Zero-vehicle Households and Transit Use

The strongest single predictor of transit use for a trip is the lack of private vehicle access for that trip, as car ownership is strongly associated with lower transit use (Taylor and Morris, 2015). As mentioned above, many low-income people take transit because they cannot afford to own and operate cars; however, most low-income people in the U.S. *do* own cars (Blumenberg and Pierce, 2012). Similarly, while low-income people take transit at higher rates than others, most low-income people do *not* regularly take transit (Anderson, 2016) and instead rely on rides in other people's vehicles or alternatives like biking or walking.

Zero-vehicle households make up less than 10 percent of all American households. Nearly half of all transit trips, however, are made by households with no motor vehicles, and another 30 percent by those with just one automobile. But zero-vehicle households make far and away more transit trips per household than those with even a single vehicle (See **Figure 2-4**).

Figure 2-4. Annual Transit Trips per Household by Motor Vehicle Access in 2017

Data source: FHWA, 2017

Additionally, while lack of vehicle ownership is typically associated with poverty, some people not in poverty make housing and employment choices that enable life without a car. Brown (2017) distinguishes between "car-less" and "car-free" households (See Appendix A, Section 2 for further definitions). Using 2012 California Household Travel Survey data, she estimates that 79 percent of zero-vehicle households in the state were car-less—without a private vehicle due to financial or personal constraints—while 21 percent were car-free—without a private vehicle due to personal lifestyle choices (Brown, 2017). We investigate this distinction further in Chapter 14. As noted above, the car-free lifestyle may appeal to a generation that values dense urban living and physical proximity to activities (Moos, Pfeiffer, and Vinodrai, 2017) and may also be able to afford alternatives to transit such as taxis, limousine services, or emerging mobility services that offer new options for purchasing auto trips one at a time.

2.4.2. Ridehail and Transit Use

The growing popularity of such ridehail services, like Lyft and Uber, has been blamed by some for the decline in transit use, though their true effects are uncertain. While ridehail *may* be replacing some trips once made on bus or rail, it could also be encouraging more transit use by bringing new riders to rail stations or bus stops (the so-called "first-mile/last-mile" problem). Conversely, it might be having little noticeable effect either way, as the two modes could be serving different travel markets.

Surveys of ridehail passengers run the gamut (Schaller, 2018 and Feigon and Murphy, 2016), with some agreement that the times of highest ridehail demand, like Friday and Saturday nights, do not coincide with times of high transit use (Rayle et al., 2016 and Castiglione et al., 2017). There is some evidence that in metro areas where ridehail service is more mature, it may be displacing some transit service (Graehler, Mucci, and Erhardt, 2019 and Babar and Burtch, 2017), though Hall, Palsson, and Price (2018) dissent. It also may be that ridehail users differ demographically from core transit riders—the former tend to be younger, more well-educated, and higher-income—and, therefore, less likely to use transit in the first place (Dias et al., 2017). Chapter 11, Section 3 includes a full review of these studies of ridehail use and its relationship to transit ridership, particularly in California.

But if ridehail services are having an effect, it would be in its first home, the San Francisco Bay Area. The region was the earliest adopter of ridehail services (Circella et al., 2018 and Hartmans and Leskin, 2019). The central Bay Area counties boasted the highest levels of ridehail use nationally in the 2017 NHTS (Conway, Salon, and King, 2018).

Other mobility options (often collectively referred to as "shared mobility") include bike-share systems, car-share systems like ZipCar, electric scooters, and electric bicycles (NACTO, 2019). The precise effect of new shared mobility options on transit use is not yet well understood; however, we note that even travelers in low-income zero-vehicle households increasingly have new travel options to consider when contemplating travel by transit. We report on the potential effects of these new services on public transit use in Chapter 12.

2.5. Changes to Regions and Neighborhoods

2.5.1. Jobs, Housing, and Transit Use

Another possible reason for the drop in transit ridership centers on the relocation of households away from expensive cities and neighborhoods to outlying areas where housing is more affordable but transit service and use is more limited. Transportation scholars have long focused on the jobs–housing balance—the spatial location of employment relative to housing within geographic areas—to predict vehicle miles of travel and traffic congestion (Salon et al., 2012). The underlying notion is that moving workers closer to jobs (or vice versa) will result in less travel and, perhaps, greater travel by modes other than the automobile. A number of scholars—using different data and approaches—find at least some evidence for job-housing balance in influencing transportation outcomes (Salon et al., 2012; Cervero, 1989; Peng, 1997; and Sultana, 2002).

Other scholars argue, however, that factors beyond proximity to employment—such as the willingness of households to trade off longer commutes for larger homes and lot sizes and improved neighborhood amenities (e.g., high-quality schools, low crime rates, availability of parks, etc.)—are more important to residential location choice and employment and travel outcomes (Giuliano, 1991 and Giuliano and Small, 1991). For low-income households, job outcomes may have less to do with proximity to jobs than with racial discrimination in hiring (Hellerstein, Neumark, and McInerney, 2008) and access to automobiles (Gautier and Zenou, 2010).

In either case, the prospects of achieving better jobs-housing balance has often been hindered by land use policies that restrict residential densities, raising housing prices and preventing some workers from living in the same city in which they find jobs (Levine, 1998 and Cervero, 1996). Additionally, as housing prices rise, low-income renters may be priced out of neighborhoods with high transit access, and be forced to commute farther (Levine, 1998; Cervero, 1996; Schuetz, 2019; Joint Center for Housing Studies, 2018; and Moos, Revington, and Wilkin, 2018). Though, at least some of those low-wage workers may search for jobs in closer proximity to their new homes, thereby increasing jobs-housing balance but potentially at the cost of lower wages (Glaeser and Gyourko, 2018).

Changes in the location of jobs and households may lead to increased vehicle use, which is likely to have several impacts on public transit supply and use. First, living in outlying areas may motivate former transit-dependents and occasional transit users to substantially reduce or even eliminate the number of transit trips they take. Second, decreased reliance on transit due to increasing vehicle use may well undermine popular support for transit service, potentially resulting in reduced subsidies to transit agencies and consequent cuts to transit service. Third, increased private vehicle use may spur long-term changes to land use patterns (e.g., decentralization) that reduce the viability and efficiency of transit as a mode of transport, except perhaps for services designed to facilitate the commutes of suburban workers to jobs located in downtown areas. Fourth, a car-free lifestyle facilitated by proximity to transit may appeal to a generation that values dense urban living and physical proximity to activities (Moos, Pfeiffer, and Vinodrai, 2017), but these residents may be less inclined to use transit than those with fewer alternatives. We consider recent changes in the geography of jobs and housing in California in Chapter 13.

2.6. Neighborhood Change

2.6.1. Transit-friendly Neighborhoods

Related to the above, transit ridership may be negatively affected by the changing composition of transit-friendly neighborhoods, neighborhoods that typically host outsized shares of transit trips (See Appendix A, Section 2 for further definitions). Such neighborhoods not only tend to be built to higher densities and have relatively high levels of transit service, but historically these areas have been disproportionately populated by the poor, immigrants, and those with little or no access to private automobiles (Glaeser, Kahn, and Rappaport, 2008). However, rising housing costs in many California cities, as well as gentrification in some of these neighborhoods, may make it increasingly difficult for poorer "car-less" households to live and ride transit in such areas.

Much of the literature on this topic centers on neighborhood change and potential displacement surrounding rail stations and the findings are mixed. Examining 14 metropolitan areas with new transit stations, Kahn (2007) finds some evidence of gentrification in certain cities, particularly around "walk and ride" stations; however, he did not find evidence of this effect in San Francisco. In his study of Portland, Dong (2017) likewise does not find evidence of rail-transit induced gentrification. Similarly, in their study of 14 urbanized areas, Baker and Lee (2019) do not find widespread evidence of gentrification around light rail stations, but (in contrast to Kahn) they do find strong effects in San Francisco. Finally, Chapple et al. (2017) find that in California, neighborhood change, though not necessarily displacement, is associated with transit oriented developments (TODs), particularly in urban cores.

Even if higher-income residents replace frequent transit users in TODs, the newly increased development densities should lead to a net increase in potential transit *users*, though perhaps not a net increase in transit *use* if new TOD residents do not ride as frequently as those replaced. For example, Dominie (2012) examined transit commuting before and after the development of new rail transit stations and station-area development in Los Angeles and found that overall transit commuting declined in most station areas, even if the overall station-area populations grew. We explore recent changes in the composition of transit-friendly areas across the state in Chapter 14.

2.7. Conclusion

All of the factors reviewed here are at work eroding public transit use in California to varying degrees, and this report examines many of them in considerable detail. Commonly cited culprits include transit service and budget cuts, plummeting transit service reliability, the rise of Lyft and Uber, and relatively cheap gas, among others (Bliss, 2017). Regional studies suggest that the causes of falling transit use may be more connected to factors unique to particular locations. As discussed above, our earlier research found that the steep decline in transit use in the Los Angeles Area appears largely due to increased auto access (Manville, Taylor, and Blumenberg, 2018), something not evident in the Bay Area. The transit systems in

New York City and Washington, D.C. have been accused of spending too little on maintenance, with eroding service reliability the result (Kabak, 2018; Colon, 2018; and Aratani, 2016), while in Los Angeles, the Los Angeles County Metropolitan Transportation Authority (LA Metro) has been accused of spending too much on building new rail lines at the expense of existing (particularly bus) service (Nelson, 2017; Nelson and Weikel, 2016; and Rubin, n.d.). In D.C., deadly train crashes and the line-closing repair work that followed led to dramatic plunges in ridership (Aratani, 2016); in other cities, gradual service cuts have been accused of causing a slower ridership erosion (Grabar, 2016). In short, factors influencing ridership may be mostly universal, but their relative importance appears to vary dramatically from region to region. Thus, the experiences elsewhere can be informative and suggestive, but they are not conclusive. To know what's behind recent ridership losses in California, we need to look specifically at changes in transit service and the changing characteristics of transit riders around the state. And it is to that task we now turn.

3. How Has Transit Use Been Changing in California?

3.1. Introduction

Even before the current health crisis, transit ridership in California was on the wrong track. From 2014 to 2018, the state lost over 165 million annual boardings, falling over 11 percent. Beneath this topline figure, though, lies significant variation across regions, modes, and operators. For instance, from 2011 to 2015, just one operator, BART, accounted for half of the state's net patronage gains, while during the current period of ridership loss (2014-2018), another operator, LA Metro accounts for over half of the state's patronage drop (FTA, 2019). More broadly, transit trips in the Bay Area and on rail grew significantly over the past decade and only started declining more recently, while ridership in areas like Greater Los Angeles, on buses generally, and across the state when accounting for population growth has experienced longer-term declines that have steepened as of late. All the while, the average transit trip in the state has grown longer. This chapter looks at these contours of California's transit use decline.

The analysis in this chapter, as well as Chapters 4 and 5, draws on the National Transit Database (NTD),[2] the FTA's repository of ridership, service, and financial statistics for transit operators nationwide (FTA, 2019). The most recent NTD data are through the end of 2018.

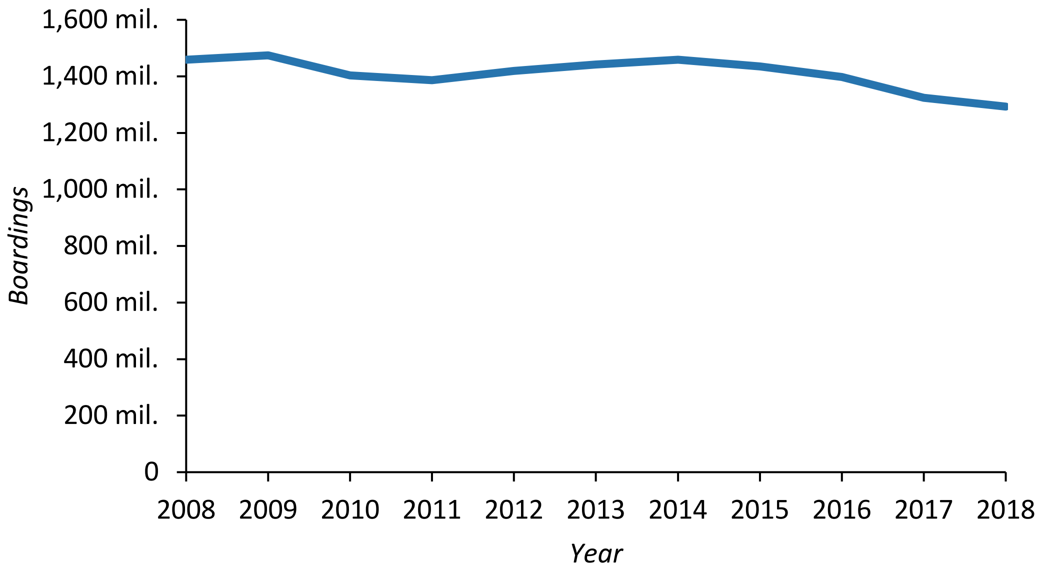
3.2. State and Regional Ridership Trends

3.2.1. Ridership across California

In the first part of the last decade, transit use in the state had been growing. After a drop at the beginning of the Great Recession, the number of boardings in California grew consistently to 2014 (See **Figure 3-1**). Ridership totals rose to just below their pre-recession peak in 2014. However, boardings began to fall in 2015 and continued to drop at an accelerating rate the next two years. In 2017 alone, California lost over five percent of its prior year's transit boardings. In 2018, the rate of decline flattened slightly, but the ridership slump continued. Over the four years of decline—a time of relative economic growth and continued increases in population—annual transit patronage fell from 1.46 billion to 1.29 billion. While the timing of California's ridership drop lines up with trends in America as a whole, U.S. ridership only dipped 7.2 percent from 2014 to 2018, compared to 11.2 percent in the Golden State. Indeed, California accounted for 22 percent of the nation's total patronage losses, while containing only 12 percent of its population (FTA, 2019 and U.S. Census Bureau, 2019).

2. The NTD reports statistics by year, which are labeled in the dataset as calendar years but are actually the aggregate of each operator's fiscal year (whose start and end dates vary between operators). Following the lead of other scholarly publications, we reference annual NTD data by calendar year in graphs and text.

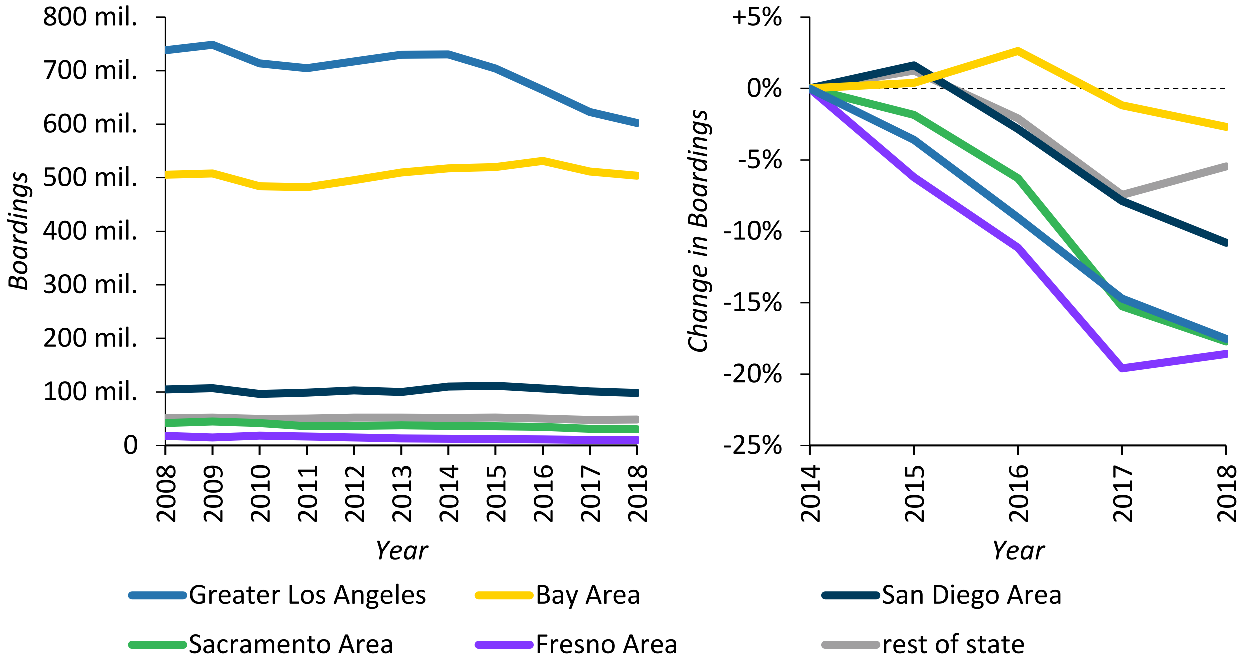
Figure 3-1. California Transit Boardings



Data source: FTA, 2019

Both before and since the ridership decline began, transit service has been consumed highly unevenly across the state. Large, densely populated areas host large numbers of boardings, while smaller, more sparsely populated areas have relatively few. The left graph of **Figure 3-2** shows just how much of California's transit trips happen in two metro areas: Greater Los Angeles and the San Francisco Bay Area, with other regions far below. Over the past decade around half of the state's transit annual boardings occurred in the former, and approximately another third—and rising—were in the latter.

Figure 3-2. Transit Boardings in California Regions

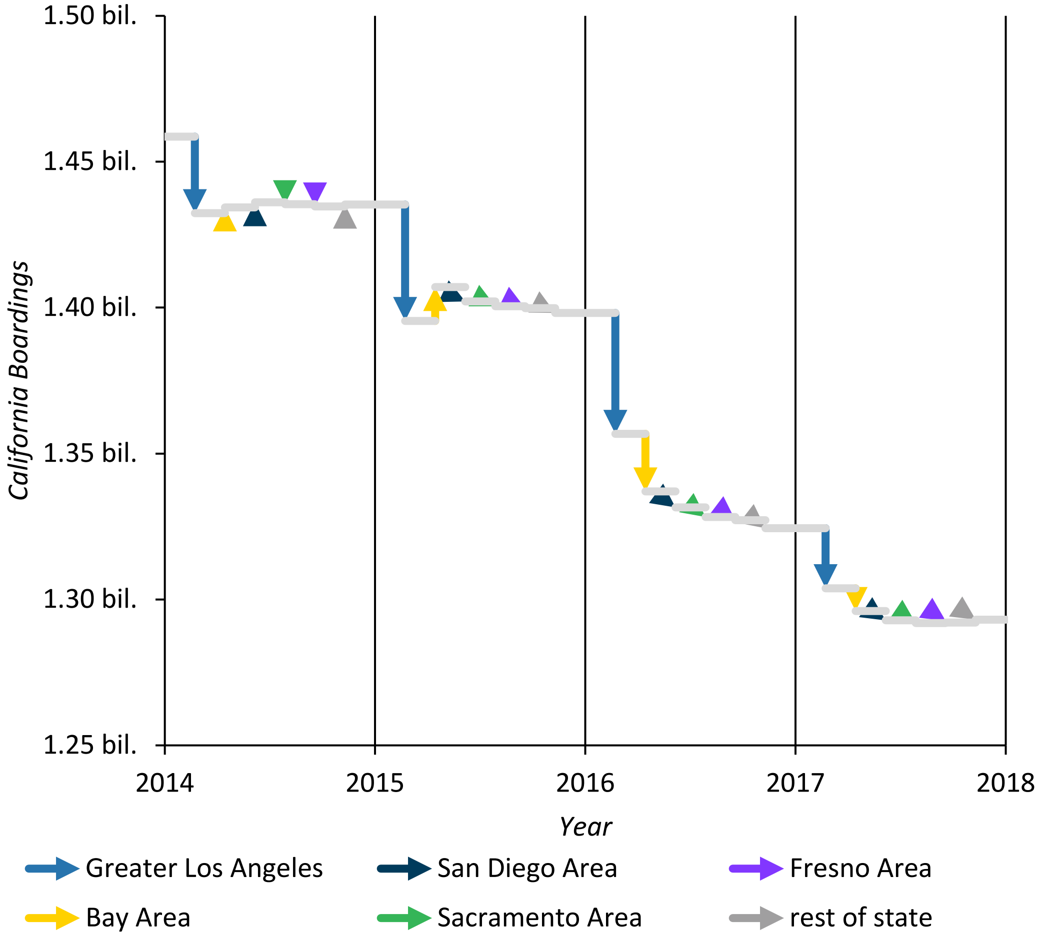


Data source: FTA, 2019

Even considering this asymmetry, within California, Greater Los Angeles transit has fared the worst. With boardings falling 18 percent from 2014 to 2018 (See **Figure 3-2**), the Los Angeles Area accounted for the lion's share—77 percent—of the state's drop in transit boardings, though it is home to less than half of the state's residents. In fact, losses in Greater LA made up almost 17 percent of the *nation's* decline for that period. To be sure, transit use and supply are not uniformly distributed, so we should expect the LA Area to have a larger effect on national transit trends than areas with as many people but less transit. Nonetheless, the disproportionate epicenter of California's transit collapse is Greater Los Angeles, both because of its population size and its particularly steep ridership decline (FTA, 2019 and U.S. Census Bureau, 2019).

The effect of Greater Los Angeles on the whole state's ridership trends stands out in **Figure 3-3**. **Figure 3-3** plots the contribution of each region to the state's change in total transit boardings every year. Each of the past five years of available data, the LA Area accounts for by far the largest share of California's ridership decline. From 2014 to 2015 and 2015 to 2016, Greater LA lost more boardings than the state overall, with net gains in all other regions making up the difference (FTA, 2019).

Figure 3-3. Contribution of Each Region to California's Annual Change in Transit Boardings



Data source: FTA, 2019

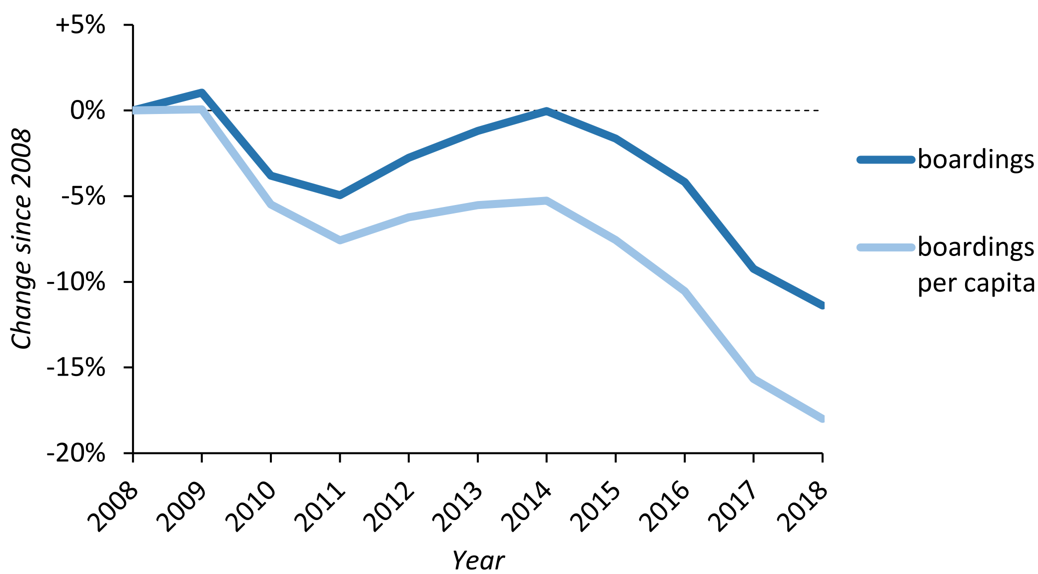
That said, *every* region of the state has lost transit ridership since 2014. The right graph in **Figure 3-2** shows that Sacramento and Fresno lost a similar share of transit trips as Greater LA: 18 percent and 19 percent, respectively. The Sacramento Area actually began losing trips a year before the state overall, while Fresno, worrisomely, has been dropping since 2011. Meanwhile, San Diego has fared slightly better than California overall, losing just under 11 percent and beginning its decline a year later, though its patronage is now on a consistent downward slope. The rest of the state actually recovered slightly in 2018 and also outpaced the whole state, falling just six percent (FTA, 2019).

The standout, however, is the Bay Area. The region gained riders in 2015 and 2016 as the other regions were losing them (See **Figures 3-2** and **3-3**). Until then, the Bay Area appeared to be an exception to both the state and the nation's ridership trends. However, in 2017 and 2018 combined, the region lost 27.5 million annual boardings, falling five percent from its peak and three percent compared to 2014 (See **Figure 3-2**) (FTA, 2019). Indeed, high ridership on the San Francisco Municipal Transportation Agency (Muni or SFMTA) and especially growth on BART, the Bay Area's two largest operators, propped up the region's ridership totals until 2017; excluding them, Bay Area ridership trends look similar to the rest of the state (Blumenberg et al., 2020). As discussed throughout this report, the Bay Area has a unique set of circumstances that propped up ridership—a booming economy and the second-densest large city in the nation at its center, for two (U.S. Census Bureau, 2019)—and the reasons for its recent decline differ at least in part from elsewhere. Still, the region only managed to delay, not stop, the transit patronage decline.

3.2.2. Ridership per Capita

In absolute terms, the statewide drop in **Figure 3-1** may not look that deep, compared to the scale of transit use in the Golden State. But California is also growing: from 2008 to 2018, California gained almost three million new residents, at a rate higher than that of the nation overall. Transit patronage has failed to keep pace with this growth. **Figure 3-4** compares change in absolute boardings and change in boardings per capita in the state over the past decade. While absolute ridership trends grab the most headlines, transit trips per capita is a better measure of the role of transit in an area, as it accounts for changes in population to measure average levels of transit use by residents. Per capita, California transit ridership never recovered from the Great Recession, only arresting its fall between 2011 and 2014 before dropping again. Put differently, population growth alone may have accounted for much of the increase in transit patronage observed between 2011 and 2014. While transit boardings per person are still higher in California than the country as a whole, per capita use fell 18 percent over the past decade and 13 percent between 2014 and 2018 alone (FTA, 2019 and U.S. Census Bureau, 2019). California's transit issues therefore date back longer than the more recent drop in absolute boardings.

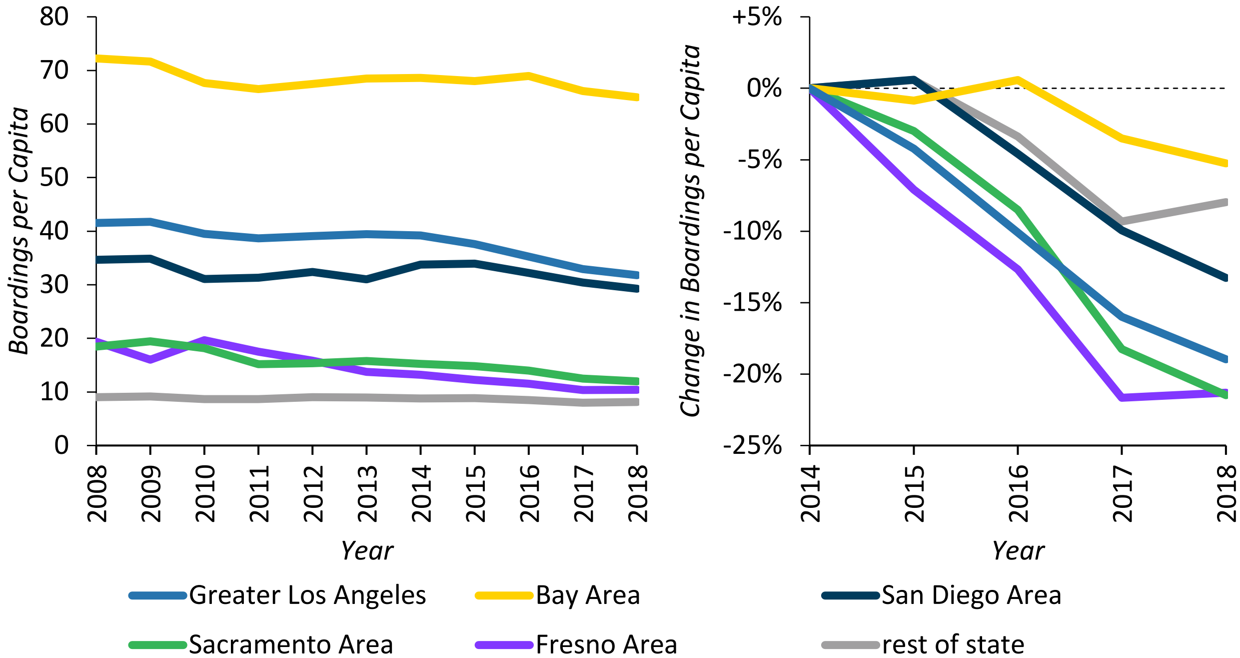
Figure 3-4. Change in California Statewide Boardings and Boardings per Capita



Data source: FTA, 2019 and U.S. Census Bureau, 2019

As with overall ridership, ridership per capita is also on the wane in every region. The baseline, though, differs across the state. As seen in the left graph of **Figure 3-5**, among the different regions, the Bay Area stands far above the others by boardings per person. Residents of the Bay Area took almost twice as many unlinked trips as residents of Greater Los Angeles, the next highest region. The Los Angeles and San Diego Areas have transit use statistics similar to California, with other regions below (FTA, 2019 and U.S. Census Bureau, 2019). The Bay Area's relatively dense urban form and high transit supply likely explain this, with Greater Los Angeles' (underappreciated) density putting the region in second (Levy, 2018).

Figure 3-5. Boardings per Capita in California Regions



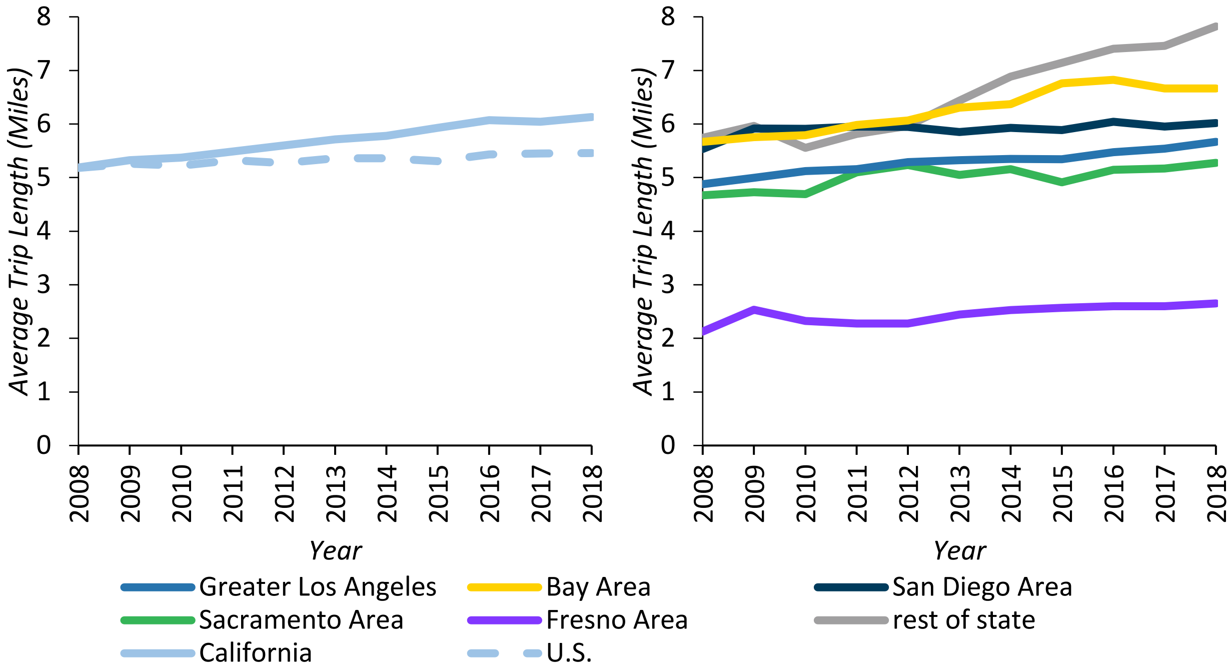
Data source: FTA, 2019 and U.S. Census Bureau, 2019

Unfortunately, ridership per capita in many regions not only has fallen more steeply than absolute ridership but also has done so for more than just the last few years (See **Figure 3-5**). In the Los Angeles, Sacramento, and Fresno Areas, boardings per person have been on the decline for the past decade, with the latter two falling further nearly every year. Residents of Greater LA took 19 percent fewer trips in 2018 than 2014. The Bay Area and the rest of the state have the flattest trend lines, albeit with recent sharp drops since 2016 and 2015. While the Bay Area, unlike other regions, did measurably gain ridership per capita in the recovery years after the Great Recession, its patterns of transit use over time track somewhat more closely to that of the state overall when viewed in per capita terms. In San Diego, transit use per person moved similarly to the Bay Area, but with more volatility and a more pronounced post-Recession recovery (that has since been erased) (FTA, 2019 and U.S. Census Bureau, 2019). The earlier declines in ridership per capita suggest that the causes of the transit woes in regions like Greater Los Angeles, Sacramento, and Fresno date back earlier as well. Still, the rate of decline in many regions has accelerated as of late, and in the Bay Area, transit use only began falling very recently.

3.2.3. Transit Trip Length

As transit boardings have fallen in California and its major metro areas, so too have passenger-miles on transit. Passenger-miles, however, have dropped less steeply—only six percent statewide between 2014 and 2018—indicating that as transit use is down, the remaining transit trips are growing longer. **Figure 3-6** plots average transit trip lengths over the past decade. While the distance covered in the average transit trip remained nearly flat in America overall, the average California trip lengthened nearly a mile. Average transit trips also grew longer in every region of the state, with particularly long trips and marked increases in the Bay Area and the rest of the state. Even in the Fresno Area, where transit trips are much shorter on average, transit trips grew by a quarter.

Figure 3-6. Transit Trip Lengths in California and California Regions



Data source: FTA, 2019

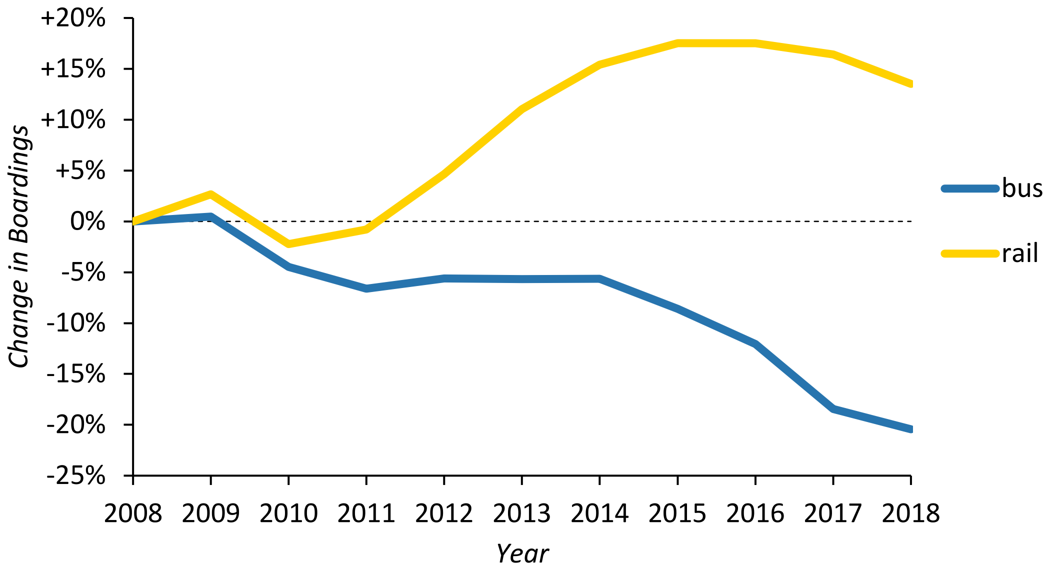
This divergence from the nation overall suggests that California's land use and housing patterns may be particularly affecting transit in the state. Lengthening trips suggests an increasing distance between home, work, and other destinations. While the data here do not separate commute trips and the data in Chapter 13 do not break travel out by mode, the lengthening of commute distances discussed in Chapter 13 are likely related. In concert, lengthening average trip lengths across regions may indicate that people throughout the state are no longer using transit for many of their short trips (more often made for purposes other than work (FHWA, 2009, 2017)). This dynamic is particularly at play in the Bay Area, where average transit trip length increased 18 percent over the past decade. This dovetails with what we found in Volume II of our recent report on Bay Area transit trends (Wasserman et al., 2020): transit use at off-peak hours, in non-commute directions, and on weekends accounts for most of that region's ridership losses (Wasserman et al., 2020 and Wasserman, 2019).

3.3. Ridership Trends by Mode, System, and Routes

3.3.1. Ridership by Mode

Though transit ridership trends do vary across California's major regions, its transit use trends diverge far more widely by mode. Together, buses and trains (of various types) carried over 97 percent of statewide transit trips in 2018, yet the modes have moved in opposite directions. Over the past decade, California has lost one in five bus boardings, with no appreciable post-Great-Recession recovery (See **Figure 3-7**). In every region, bus ridership has followed a similar course, including regions like the Bay Area with otherwise relatively robust overall ridership. Meanwhile, rail boardings increased by almost the same percentage from 2008 to 2014, with a rapid and sustained recovery after the Great Recession. Only after 2015 has rail ridership fallen, and only slightly at that. From 2014 to 2018, buses accounted for 97 percent of California's total transit ridership losses. As a consequence, the share of California transit trips made by bus in 2018 fell to its lowest percentage since reliable NTD data became available—just over two thirds (FTA, 2019). Most transit trips in the state do still take place on buses, but an even greater share of recent losses have come from buses, too. All the while, the average rail trip distance has grown longer, by six percent from 2014 to 2018, while the average bus trip distance shrunk two percent over the same years.

Figure 3-7. Change in California Statewide Boardings by Mode



Data source: FTA, 2019

Some part of this divergence is due to riders shifting from buses to trains, instead of reducing or ceasing their transit use altogether. In major metro areas like Greater Los Angeles that are expanding their rail network, loss of bus ridership along corridors parallel to new rail lines may be acceptable so long as the trains begin to carry as many or more trips and provide faster, more reliable service in the process. The data used here also count unlinked trips (See Appendix A, Section 2), so total trip counts may drop if travelers now make one rail trip for what used to require a transfer between two buses. However, shifting cannot explain much of the losses from buses. Bus ridership is down on many routes in the Bay Area and Greater Los Angeles that do not parallel rail lines (Wasserman et al., 2020 and Manville, Taylor, and Blumenberg, 2018), as explored further below. And the sheer scale of bus losses, pulling down the state's overall ridership figures, is too large for shifting alone to explain it.

Chapters 4 and 5 discuss two possible explanations for these differing modal trends: differences in service supply and investments, respectively. However, as stark as the gap is over the past decade, it is nonetheless noteworthy that both bus and rail ridership has been falling since 2016. Whatever the factors behind their past divergence, the causes of the recent ridership slump have affected both modes. The usual reasons for the bus/rail divide thus do not neatly align with the reasons for today's overall transit use decline.

3.3.2. Ridership by Operator

As with mode, ridership declines across different operators have been particularly concentrated on certain systems. Here and in later analyses of California's transit industry, we focus on the top ten California transit operators by 2018 ridership: LA Metro, Muni, BART, the San Diego Metropolitan Transit System (MTS), the Alameda-Contra Costa Transit District (AC Transit), the Orange County Transportation Authority (OCTA), the Santa Clara Valley Transportation Authority (VTA), Long Beach Transit (LBT), the Sacramento Regional Transit District (SacRT), and the Peninsula Corridor Joint Powers Board (Caltrain). Eight of these agencies operate in Greater Los Angeles or the Bay Area, again demonstrating those regions' importance for statewide transit trends.

Just one operator, LA Metro, accounted for over half of the state's ridership losses from 2014 to 2018 (See **Table 3-1**)—and 11 percent of the entire ridership decline nationwide, the second-most of any American transit agency by absolute numbers. While LA Metro is California's largest operator, carrying three in ten California transit trips, its contribution to the state's patronage drop is even more outsized. No other agency comes close. Even so, eight of the top ten agencies had fewer boardings in 2018 than 2014. OCTA and LBT in the Los Angeles Area, VTA in the Bay Area (San José), and SacRT in the Sacramento Area have each lost a high double-digit percentage of their ridership over this period (FTA, 2019). So while operators across the state have experienced patronage declines, LA Metro stands out as the major contributor.

Table 3-1. Ridership Changes on the Top Ten California Transit Operators

TRANSIT OPERATOR	REGION OF OPERATOR	CHANGE IN BOARDINGS, 2014-2018		SHARE OF STATEWIDE LOSSES, 2014-2018	BOARDINGS, 2018	SHARE OF STATEWIDE BOARDINGS, 2018
LA Metro	Greater Los Angeles	-85.3 mil.	-17.8%	51.5%	394 mil.	30.5%
Muni	Bay Area	-3.7 mil.	-1.6%	2.2%	225 mil.	17.4%
BART	Bay Area	+3.3 mil.	+2.6%	-2.0%	129 mil.	10.0%
MTS	San Diego Area	-6.4 mil.	-7.0%	3.9%	85 mil.	6.6%
AC Transit	Bay Area	-4.0 mil.	-7.0%	2.4%	53 mil.	4.1%
OCTA	Greater Los Angeles	-9.6 mil.	-18.5%	5.8%	42 mil.	3.3%
VTA	Bay Area	-7.0 mil.	-15.8%	4.2%	38 mil.	2.9%
LBT	Greater Los Angeles	-4.7 mil.	-16.5%	2.8%	24 mil.	1.8%
SacRT	Sacramento Area	-5.5 mil.	-20.8%	3.3%	21 mil.	1.6%
Caltrain	Bay Area	+0.4 mil.	+2.1%	-0.2%	19 mil.	1.5%
Others (Combined)		-43.0 mil.	-14.0%	26.0%	263 mil.	20.3%
California Total		**-165.5 mil.**	**-11.3%**	**100.0%**	**1,293 mil.**	**100.0%**

Data source: FTA, 2019

If most of the state's losses during the recent decline came from one transit agency, then much of the state's earlier gains during the post-Great-Recession recovery came from another single operator: BART. Of the state's patronage net gains from 2011 to 2015, ridership growth on BART alone accounted for almost exactly half (FTA, 2019). Just one trip type on BART, transbay trips crossing San Francisco Bay, accounted for over 31 percent of the entire state's net ridership growth from 2011 to 2015 (BART, 2019c and FTA, 2019).[3] And during the ongoing ridership crisis of today, the Bay Area's regional subway system is still overperforming. From 2014 to 2018, only BART and Caltrain—another commuter-focused rail system

3. This is an estimate because internal BART data on transbay trips count linked trips (BART, 2019c), while the NTD data from which we calculated statewide figures count unlinked trips (FTA, 2019).

serving large Bay Area job clusters—saw a net increase in unlinked trips (See **Table 3-1**). But even they lost boardings in two of the three most recent years of data (FTA, 2019). BART's recent ridership losses, especially on weekends and off-peak times, have been particularly stark (Wasserman et al., 2020). Thus, BART is far from immune from the state's ridership ills, even if it was responsible for a large share of California's prior gains.

3.3.3. Ridership by Routes

Even as transit ridership and its losses are highly concentrated on certain operators, both are even further concentrated on certain routes and in certain areas within transit systems. **Figures 3-8** and **3-9** dramatically chart these concentrations,[4] with line widths corresponding to annual ridership along each route, scaled the same on each map.[5] These maps include lines on the eight largest Bay Area operators[6] and the two largest Greater Los Angeles operators[7] (These operators were selected based on availability of ridership data by route, with more in the Bay Area because of UCLA ITS' access to more data from our prior report on Bay Area transit ridership trends (Wasserman et al., 2020).). Downtown/Central Los Angeles and downtown San Francisco stand out: much of the state's transit ridership runs through those two areas. Thirteen percent of trips in California in 2018 were carried on lines traveling on or under one block of Market Street in San Francisco's Financial District; another eight percent happened on routes running through or under one intersection near Pershing Square in Los Angeles.

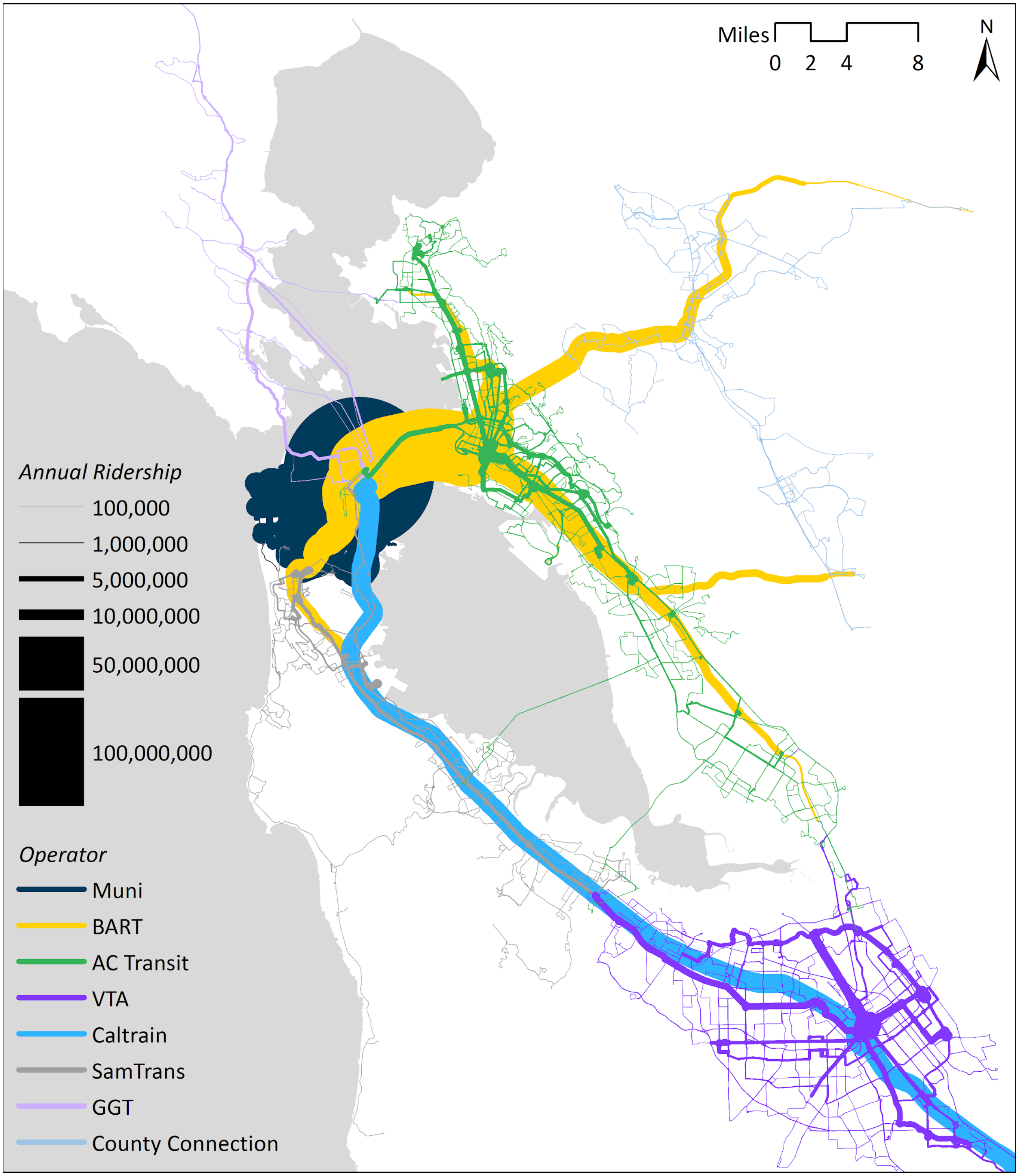
4. In **Figures 3-8**, **3-9**, **3-10**, **3-11**, **3-12**, and **3-13**, due to data availability, each individual route is depicted with the same ridership along its length—except on BART, whose origin-destination matrices allow for ridership to be shown between each pair of stations (BART, 2019c). However, where multiple routes of the same operator run on the same street, the line width for that segment reflects the sum of those routes.

5. In **Figures 3-8** and **3-9**, routes with annual ridership of under 500,000 boardings were rounded up for visibility. Ridership data reflect either calendar year 2018 or Fiscal Year 2018, depending on the operator.

6. Muni, BART, AC Transit, VTA, Caltrain, the San Mateo County Transit District (SamTrans), the Golden Gate Bridge, Highway, and Transportation District (GGT), and the Central Contra Costa Transit Authority (County Connection).

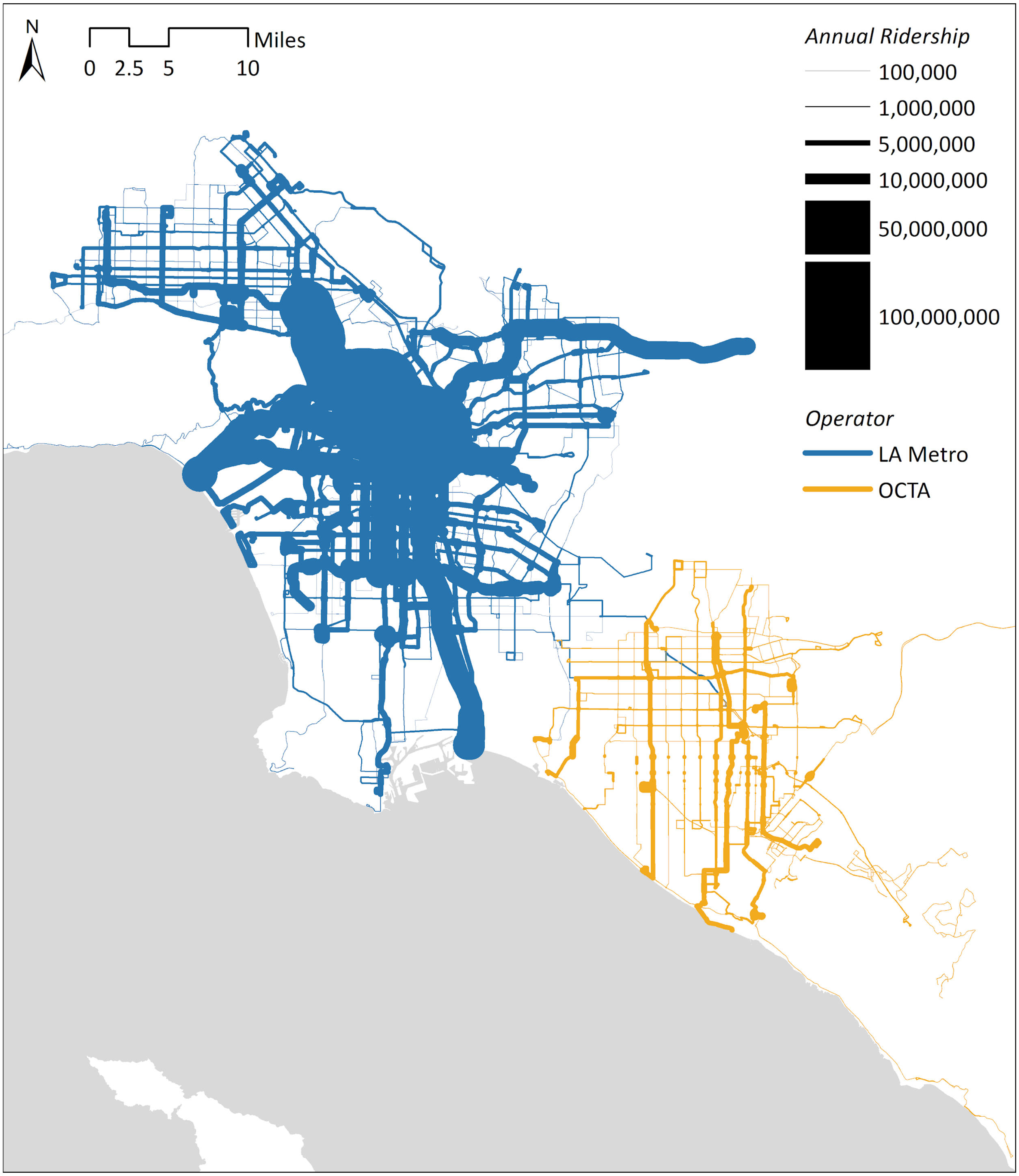
7. LA Metro and OCTA

Figure 3-8. Ridership by Line for the Eight Largest Bay Area Operators, 2018 or Fiscal Year '18



Data source: SFMTA, 2013, 2018; BART, 2019b, 2019c; AC Transit, 2019, 2018; VTA, 2019, 2018; Caltrain, 2019, 2018; SamTrans, 2019b, 2019a; GGBHTD, 2019a, 2019b; County Connection, 2019a, 2019b; U.S. Census Bureau, 2019; and CaliDetail, n.d.

Figure 3-9. Ridership by Line for the Two Largest Greater LA Operators, 2018 or Fiscal Year '18



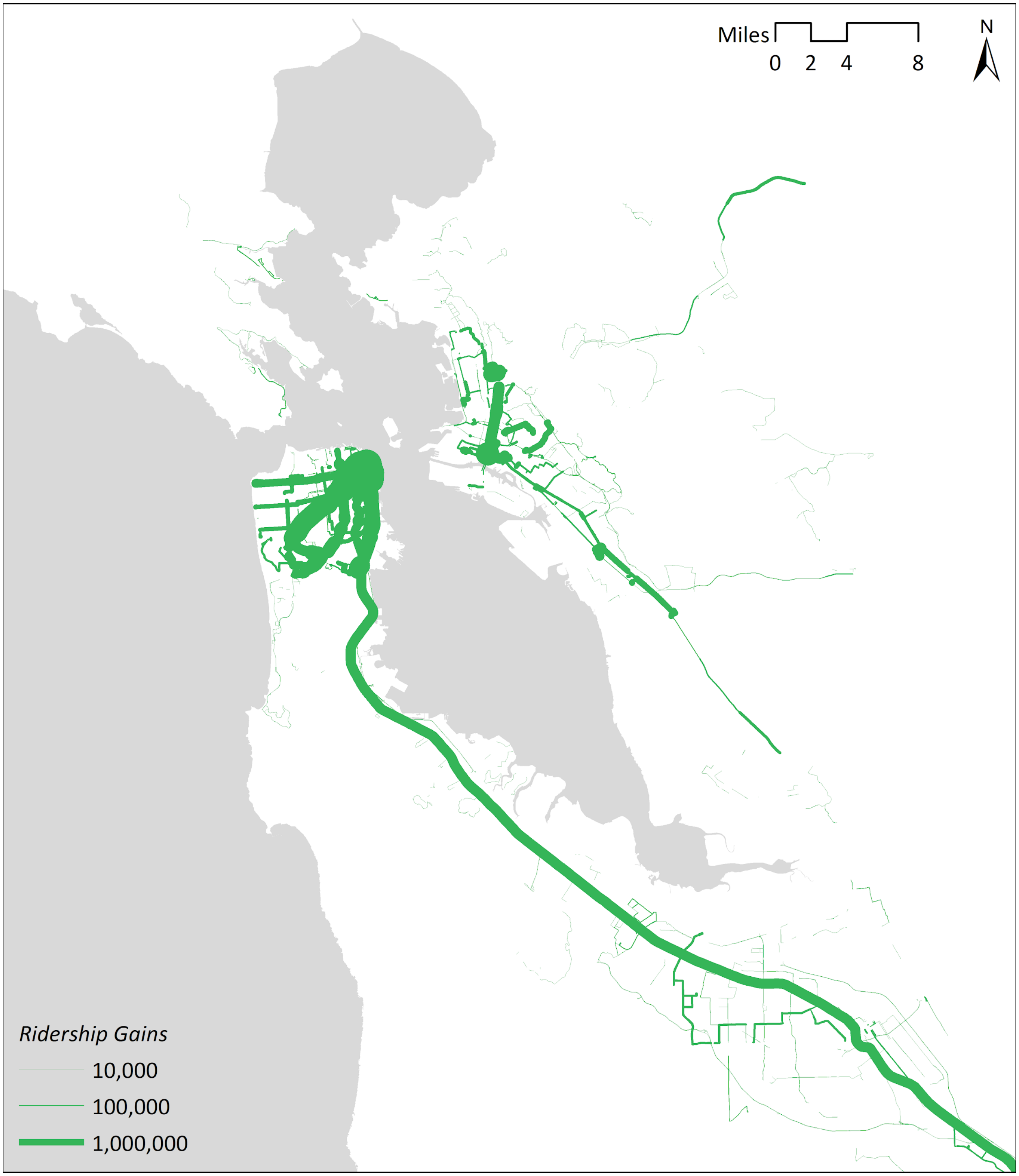
Data source: LA Metro, 2020, 2019b; OCTA, 2019, 2020; and CaliDetail, n.d.

Ridership gains, and especially losses, are even more concentrated on a few routes. **Figures 3-10** and **3-11** show lines that gained boardings between 2015 and 2018, among the operators mapped.[8] These are relatively sparse. In the Bay Area, these lines serve major job centers and include some Muni light rail and trunk bus routes, Caltrain, and a few routes in central Oakland (See **Figure 3-10**). In the Los Angeles Area, the only major gains came on light rail lines that opened extensions during the period: the L (Gold) and especially E (Expo) Lines (See **Figure 3-11**). Ridership on parallel bus routes fell, though, dampening the overall effect of these few gains.

Maps of losses by line show stark regional differences. As shown in **Figure 3-12**, Bay Area ridership losses have occurred on local buses and light rail in Silicon Valley and San José, on BART south of downtown San Francisco, and in the East Bay, with additional relative losses on smaller lines in outlying areas. Most of these losses have come at off-peak times and in non-commute directions (Wasserman et al., 2020). **Figure 3-13** tells a far different story for the Los Angeles Area. Significant losses have occurred across the region, on major trunk lines as well as more minor routes, on weekdays as well as on weekends (LA Metro, 2019a). The declines are of a much greater magnitude than even the worst performing lines in the Bay Area. Indeed, just 21 routes in Greater Los Angeles—20 LA Metro lines and one OCTA line—accounted for a quarter of the entire state's ridership losses from 2014 to 2018. Over ten percent of California's patronage drop came from five LA Metro routes alone, and lines passing through a single block of downtown Los Angeles accounted for 11 percent of the state's losses (LA Metro, 2019b; OCTA, 2020; and FTA, 2019). California's transit ridership problems prior to 2020 largely ran through Greater Los Angeles' major transit corridors.

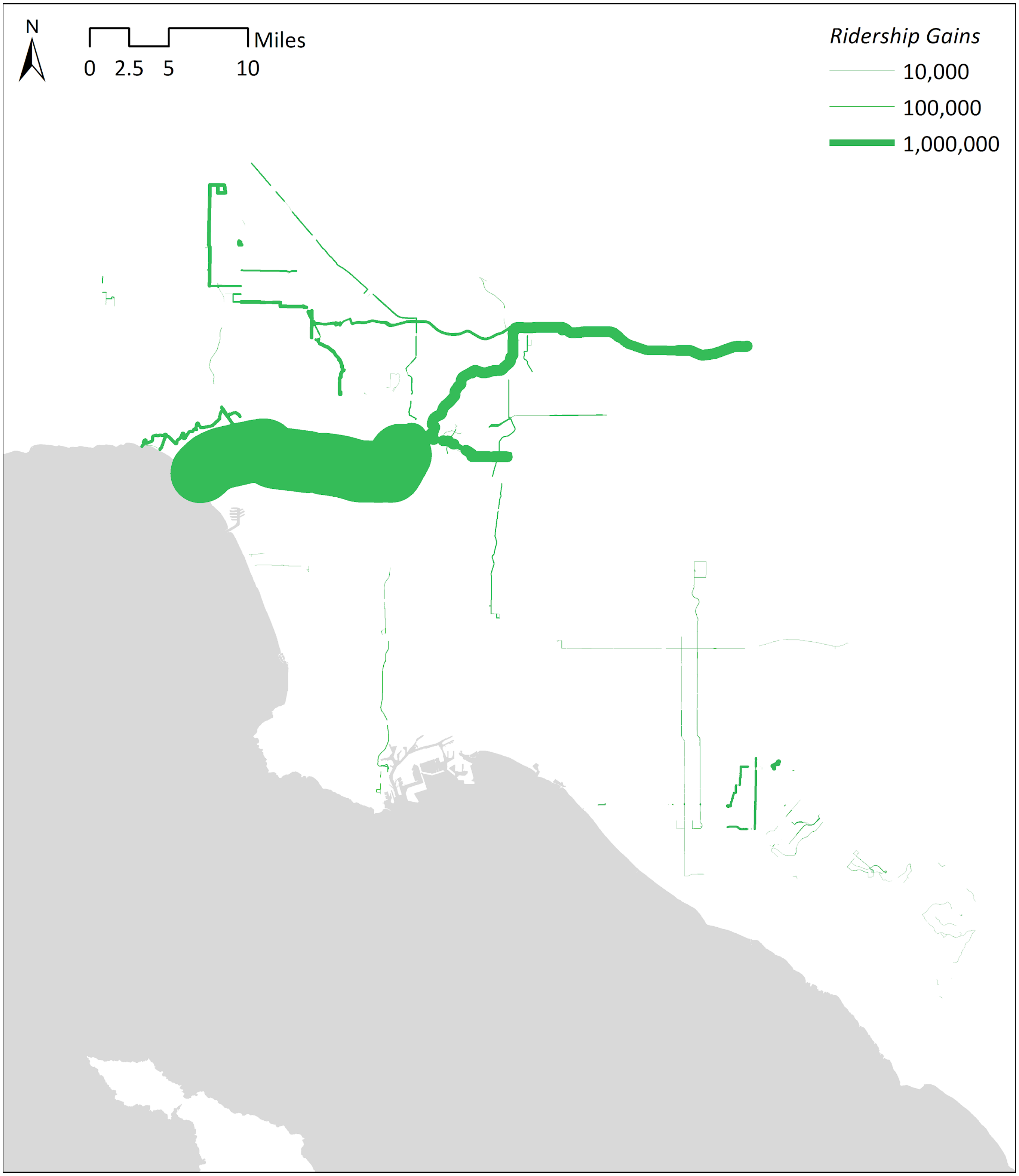
8. In **Figures 3-10**, **3-11**, **3-12**, and **3-13**, routes with a gain or loss in annual ridership of under 20,000 boardings were rounded up for visibility. Ridership data reflect either the change between calendar years 2015 and 2018 or the change between Fiscal Years 2015 and 2018, depending on the operator. These years—slightly different than other ridership change analyses in this chapter—were chosen based on having ridership data by route for those years available from UCLA ITS' prior report on Bay Area transit ridership trends (Wasserman et al., 2020).

Figure 3-10. Ridership Gains by Line for the Eight Largest Bay Area Operators, 2015-2018 or FY '15-'18



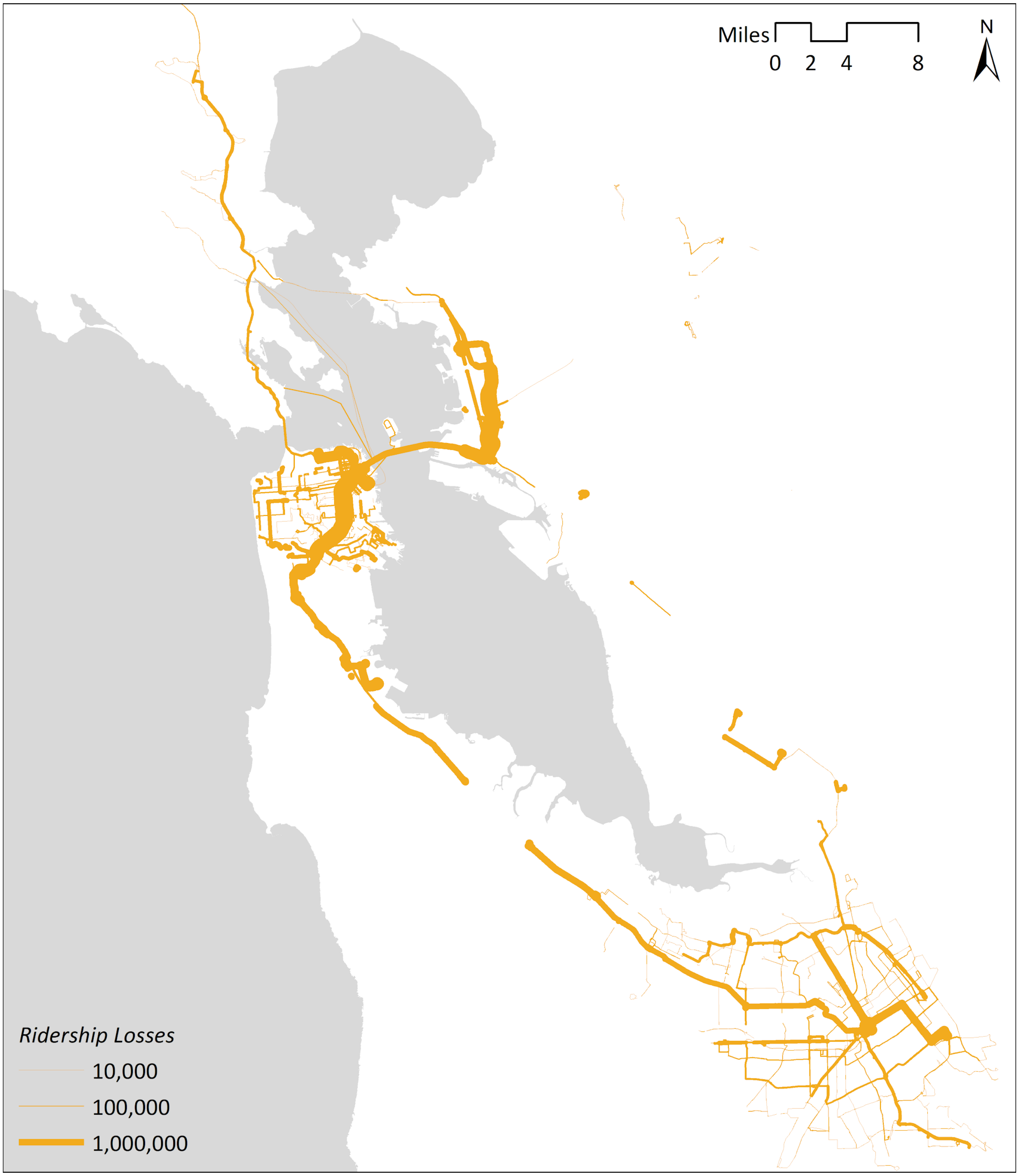
Data source: SFMTA, 2013, 2018; BART, 2019b, 2019c; AC Transit, 2019, 2018; VTA, 2019, 2018; Caltrain, 2019, 2018; SamTrans, 2019b, 2019a; GGBHTD, 2019a, 2019b; County Connection, 2019a, 2019b; U.S. Census Bureau, 2019; and CaliDetail, n.d.

Figure 3-11. Ridership Gains by Line for the Two Largest Greater LA Operators, 2015-2018 or FY '15-'18



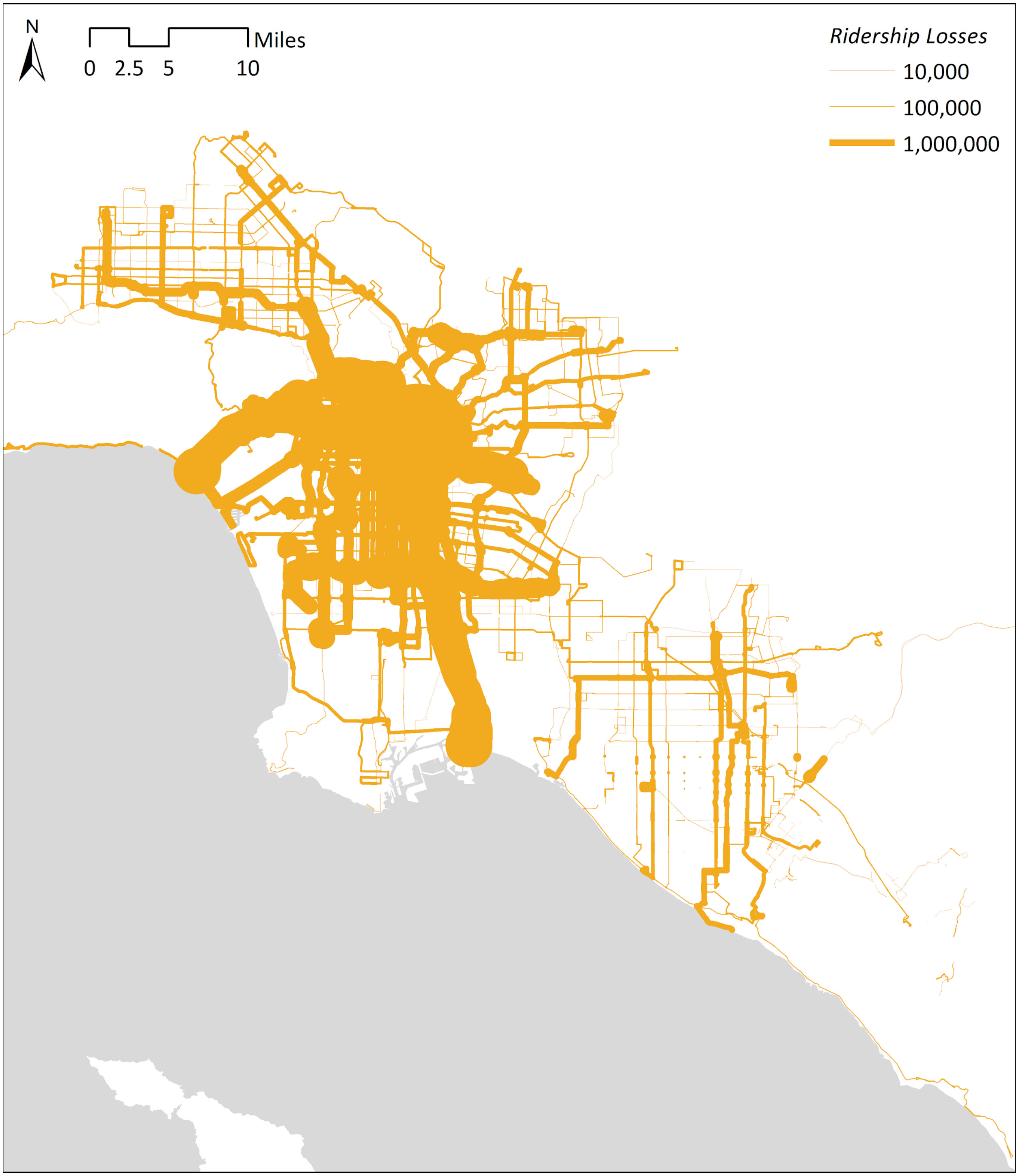
Data source: LA Metro, 2020, 2019b; OCTA, 2019, 2020; and CaliDetail, n.d.

Figure 3-12. Ridership Losses by Line for the Eight Largest Bay Area Operators, 2015-2018 or FY ’15-’18



Data source: SFMTA, 2013, 2018; BART, 2019b, 2019c; AC Transit, 2019, 2018; VTA, 2019, 2018; Caltrain, 2019, 2018; SamTrans, 2019b, 2019a; GGBHTD, 2019a, 2019b; County Connection, 2019a, 2019b; U.S. Census Bureau, 2019; and CaliDetail, n.d.

Figure 3-13. Ridership Losses by Line for the Two Largest Greater LA Operators, 2015-2018 or FY '15-'18



Data source: LA Metro, 2020, 2019b; OCTA, 2019, 2020; and CaliDetail, n.d.

3.4. Conclusion

Transit boardings across the state have been down since 2014. But this decline has not occurred evenly by region, mode, operator, nor line. By absolute numbers, Greater Los Angeles has had the largest losses, though every region has suffered declines. But the negative trends date back earlier than 2014. Per capita, ridership has been steadily falling in most regions for the past decade. Patronage has failed to keep pace with population growth. Bus ridership, meanwhile, has been declining since 2009; while rail boardings grew substantially through 2015, they have been falling since. Finally, while eight of the top ten operators by boardings lost unlinked trips between 2014 and 2018, a majority of California's patronage losses over that period were on LA Metro, with losses particularly heavy on its major lines. The remainder of this report examines the factors behind these trends and explains why ridership losses are concentrated like this.

Part II. How Are California Transit Systems Changing?

As with other modes of transportation—and other goods and services—the supply and performance of public transit determines its use in some significant part. More hours and miles of transit service, should all else equal, lead to greater transit patronage. As vehicles come more frequently, offer more space for riders, and/or serve more areas and destinations, transit becomes more competitive with other modes like driving. Indirectly, increased spending on transit should also improve the transit experience and increase ridership—again, all else equal. But changes in ridership can in turn politically and financially motivate changes in service supply and spending. Keeping this cyclicality in mind, we explore the state of California's transit provision, examine trends in service and performance, and relate them to trends in patronage, here in Part II.

Chapter 4 reviews changes in service supply across the state and by region, mode, and operator (Lacking comprehensive data on service quality, we analyze only trends in service quantity.). While there are significant differences in service supply trends across these divisions, especially between bus and rail, we find that service changes are not a causes of recent ridership losses. Instead, service is increasing as ridership is decreasing—itself a worrisome divergence.

In Chapter 5, we discuss trends in transit performance, specifically the efficiency and effectiveness with which operators are supplying transit. In California and its major regions, transit is being delivered steadily less efficiently in recent years than a decade ago, but the reasons for this trend appear independent of the ridership slump of the past half-decade. Because of worsening efficiency combined with these more recent ridership losses, transit's effectiveness has fallen more sharply as of late. However, among three service-provision-related transit expenditures—transit fares, and vehicle speeds and congestion—the first two do not appear to be causing ridership losses; evidence for the last is mixed at best.

The natural tendency of transit operators and their critics may be to pin ridership losses first on factors internal to transit systems and look for solutions within agencies' control. However, while rising costs and ineffective service are certainly concerns worth addressing, this part of the report provides evidence that the most significant drivers of transit use trends lie outside the purview of operators themselves. Parts III and IV discuss what may instead be depressing transit ridership, beyond the transit system itself.

4. Transit Service

4.1. Introduction

Like any product or service, both the supply of and demand for transit affect its use. Thus, on the surface, changes in transit supply represent a significant plausible reason behind the state's ridership decline. If fewer vehicles are operating for fewer hours or fewer miles, ridership is likely to fall. However, the state appears to be facing the opposite problem: as service has increased across the state, transit use has counterintuitively fallen. In this chapter, we explore this divergence between transit supply and transit ridership, including its variation across regions, modes, and operators, and rule out service changes as a substantive cause of the recent ridership decline.

This chapter analyzes trends in service quantity, not service quality. While ample data exist for the former, measuring the latter is less straightforward. There are routinely collected data on service quality, like late timepoint arrivals, early timepoint departures, service revenue miles between roadcalls, and so on, but these tend to be less standardized across transit operators and less centrally compiled than service quantity metrics. Further, there are many important aspects of service quality that are difficult to measure consistently, or in some cases measure at all. For example, passengers consistently indicate that friendliness among front-line transit agency personnel, particularly drivers and station agents, is important to the rider experience, but "friendliness" is a difficult metric to reliably document.

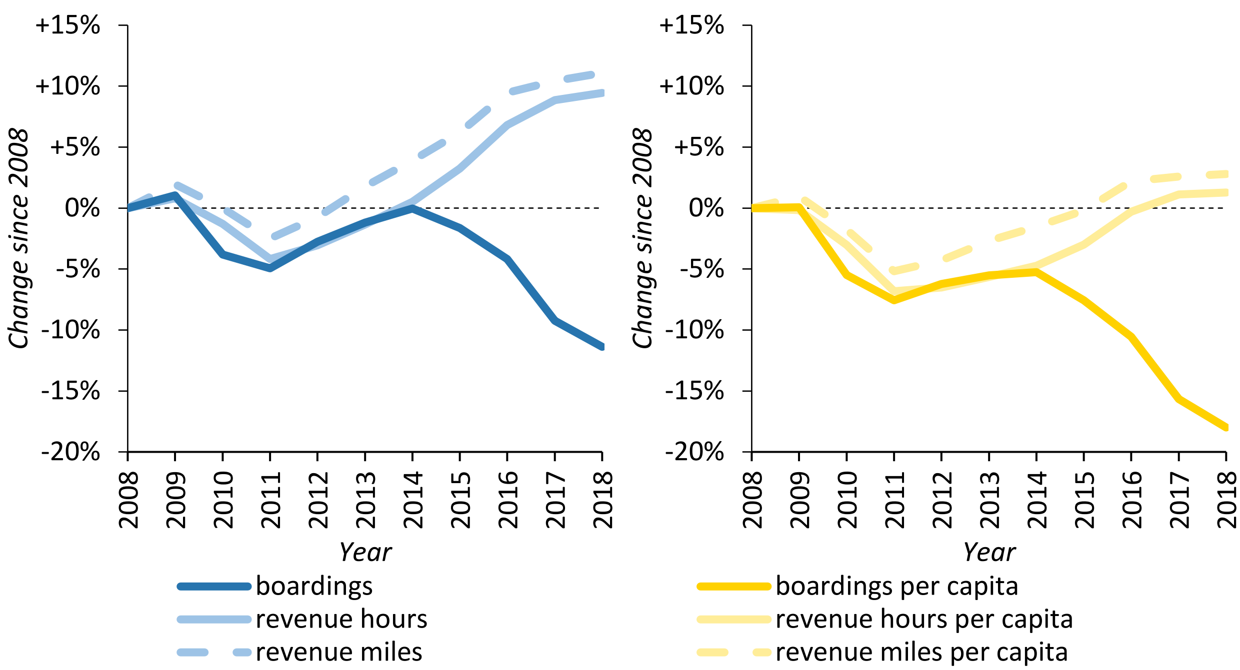
Capturing these more qualitative aspects of service quality most often entails drawing on a patchwork of passenger surveys on individual operators, conducted at different times, at different intervals, with different questions. The surveys typically gather "stated" and not "revealed" preferences; that is, they ask respondents about their "stated" transit service perceptions, preferences, and concerns but not how these relate to their "revealed" transit use behaviors. To be sure, on a smaller scale than this statewide report, analyses of service quality can provide valuable insight into the potential causes of the ridership decline—after all, perceived safety and reliability are two of the most important factors in determining whether people ride transit or make transfers (Iseki and Taylor, 2009, 2010). However, in our earlier report on Bay Area transit ridership, we found little correlation between surveyed satisfaction levels and ridership trends across operators and could not find a relationship between fare evasion and ridership trends (Blumenberg et al., 2020). Without comprehensive, apples-to-apples data on service quality statewide, though, we must limit our analysis here to service quantity.

4.2. Statewide Service Trends

As transit ridership in California has fallen, the supply of transit service has risen. In many agencies across America, service cuts and ridership declines have created a vicious cycle. As headways rise and reliability falls, riders find other ways to travel, reducing operator farebox revenues that precipitate another round of cutbacks. Evidence suggests transit in the New York (Colon, 2018 and Kabak, 2018) and Washington, D.C. (Aratani, 2016) regions, which host very high levels of transit use (FTA, 2019), have fallen into this downward spiral. But this has not been the case in California. This seemingly positive finding belies a perhaps more worrisome conclusion: ridership in California is falling in spite of more service availability. That is, despite all the money and energy the state is pumping into transit service (See Chapter 5), ridership is still falling. Thus, this new service either is not having the desired effect, or other factors are overwhelming its benefits to ridership.

Figure 4-1 shows this disjuncture. As shown in the left graph, from 2008 to 2014, changes in vehicle revenue miles, vehicle revenue hours, and boardings tracked closely. During the Great Recession, all of them fell, and in the years after, they all recovered and rose in tandem. However, after 2014, when statewide boardings peaked, patronage began falling as service continued to increase. Transit operators in the Golden State have been putting more and more service on the street and on the rails in the past few years, rising relatively constantly since 2011. But this increased service is no longer paying off with increasing boardings. Years of close parallels between ridership and service trends ended in 2014, replaced by a widening and troubling divergence (FTA, 2019 and U.S. Census Bureau, 2019).

Figure 4-1. Trends in Boardings versus Trends in Service Supply in California



Data source: FTA, 2019 and U.S. Census Bureau, 2019

To some degree, the state's increase in transit service is simply keeping up with population growth. As the right graph of **Figure 4-1** shows, only in 2015 and 2016 did statewide vehicle revenue miles per capita and hours per capita return to their pre-Great-Recession figures. Nonetheless, unlike boardings per capita, both have risen somewhat faster than population, increasing by 2018 to 1.2 hours and 17.5 miles of transit service supplied per Californian (FTA, 2019 and U.S. Census Bureau, 2019).

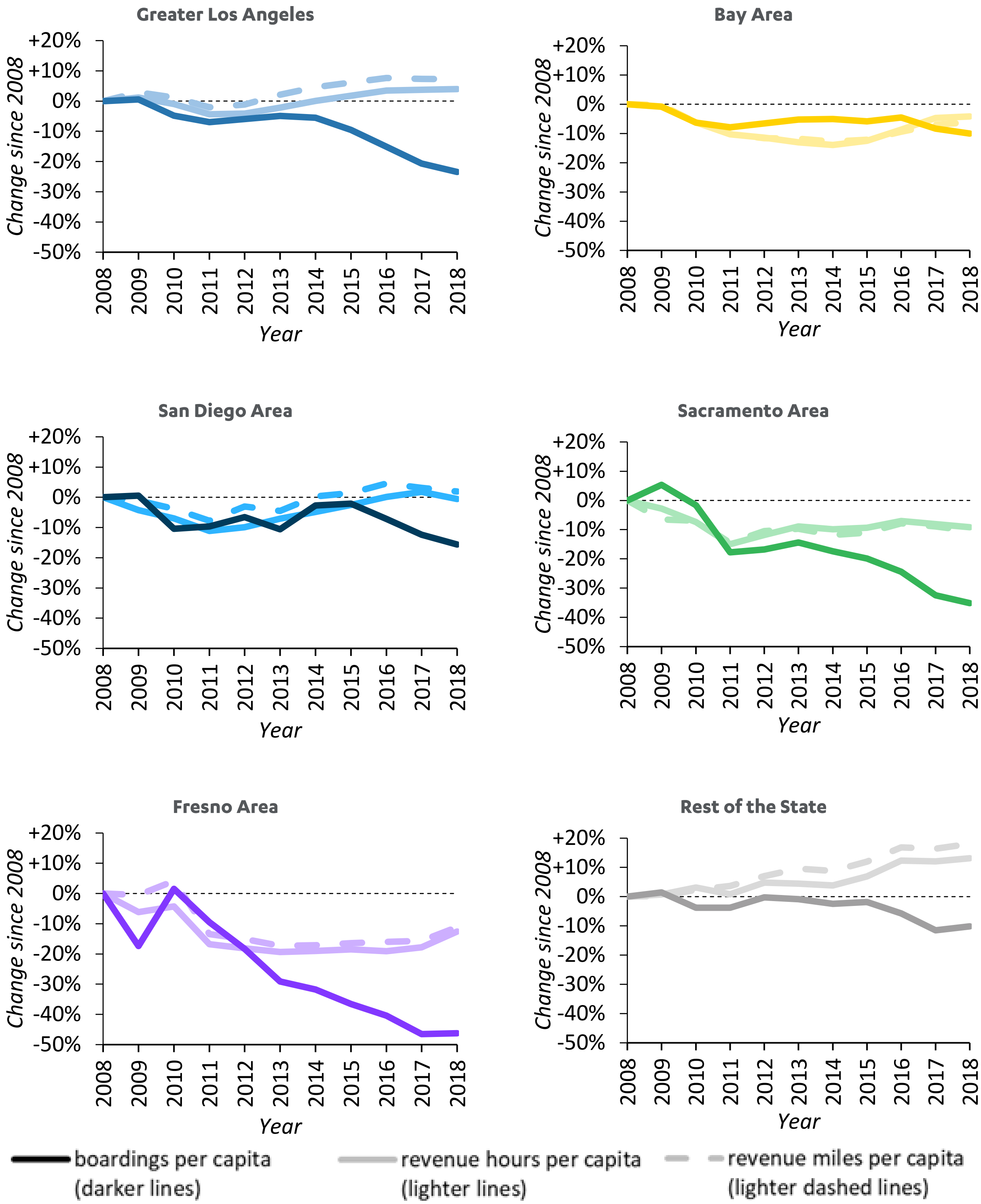
4.3. Regional, Operator, and Modal Service Trends

4.3.1. Service Trends across California Regions

Across the state's different regions, the same general story holds: after half a decade of paralleling changes in ridership, service supply in each is now mostly increasing or in some cases flat, while ridership is falling. **Figure 4-2** illustrates these growing gaps in every region, while also revealing three general categories among them. In Southern California and the rest of the state beyond the five largest regions, service hours and miles per person have increased steadily since 2011, while boardings per person have fallen nearly as steadily since around 2013. The divergence between service and ridership is clearest in these areas. In the

Bay Area and San Diego, where patronage per person started falling more recently, the divide is newer. Bay Area operators have only begun restoring service following the Great Recession fairly recently; revenue hours and miles per capita still have not recovered to pre-Great-Recession levels. In San Diego, ridership and service totals have been more variable. But in each region, service and patronage are nevertheless moving in opposite directions, albeit less dramatically. Finally, in Sacramento and Fresno, ridership per capita is down steeply and has been falling for many years, while service per capita is merely flat (FTA, 2019 and U.S. Census Bureau, 2019). Across the regions, there is some very recent flattening or slight declines in service supply, but this appears to be a lagged response to years of falling ridership, not a cause of patronage declines.

Figure 4-2. Trends in Boardings versus Trends in Service Supply in California Regions



Data source: FTA, 2019 and U.S. Census Bureau, 2019

4.3.2. Service Trends on Large Operators

The major operators across the state have followed the same pattern, though with more variation (See **Table 4-1**). The top ten operators by number of 2018 boardings all increased their revenue hours between 2014 and 2018, as did all other California transit operators combined. Vehicle revenue hours have particularly gone up in the Bay Area since 2014, with increases of around 20 percent on BART and AC Transit (FTA, 2019). BART, one of only two operators among the top ten to gain boardings over this period, does demonstrate that service and boardings can still move in tandem—though BART's additional service may be due as much to opening new extensions as service boosts on existing lines (BART, 2019a and Rudick, 2017).

Table 4-1. Service Changes on the Top Ten California Transit Operators

TRANSIT OPERATOR	REGION OF OPERATOR	CHANGE IN REVENUE HOURS, 2014-2018	CHANGE IN REVENUE MILES, 2014-2018
LA Metro	Greater Los Angeles	+1.9%	-0.4%
Muni	Bay Area	+11.8%	+6.5%
BART	Bay Area	+22.6%	+20.0%
MTS	San Diego Area	+11.2%	+13.5%
AC Transit	Bay Area	+19.5%	+7.9%
OCTA	Greater Los Angeles	+2.4%	+3.9%
VTA	Bay Area	+8.9%	+1.4%
LBT	Greater Los Angeles	+6.8%	+3.1%
SacRT	Sacramento Area	+4.9%	+7.4%
Caltrain	Bay Area	+8.9%	+5.4%
Others (Combined)		+10.0%	+7.5%
California Total		**+8.9%**	**+6.9%**

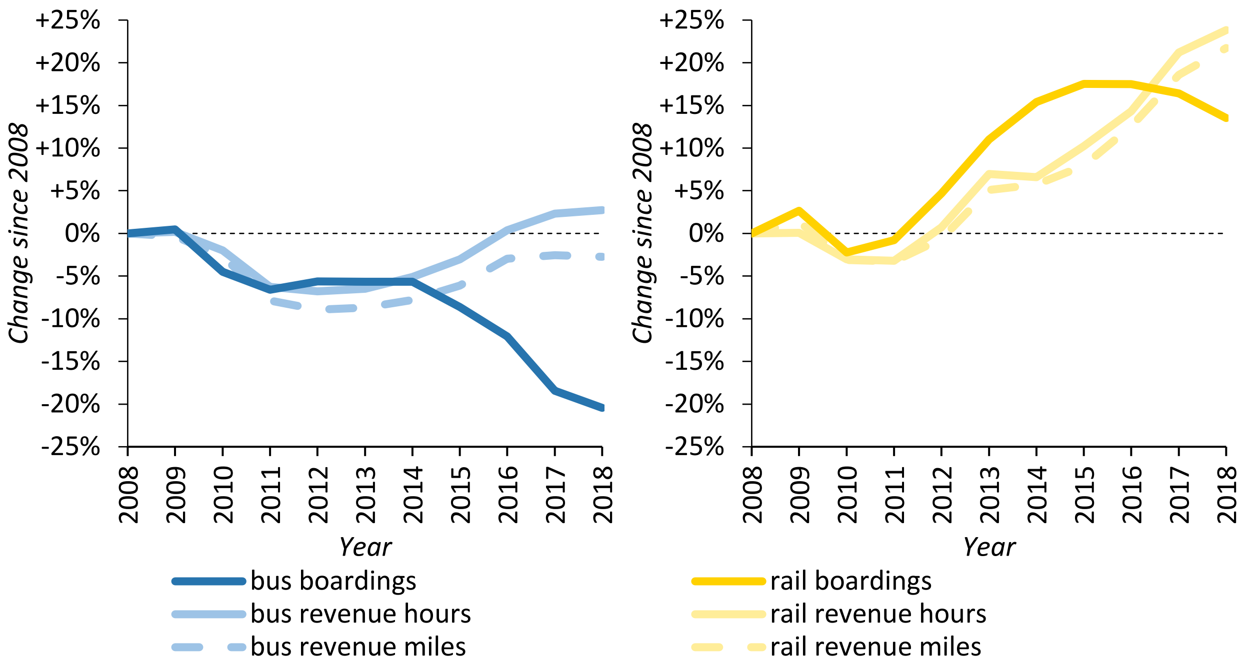
Data source: FTA, 2019

Greater Los Angeles' largest operators, LA Metro and OCTA, both stand as outliers in **Table 4.1**. Both added far less service relative to the state's other big transit agencies. LA Metro even cut revenue miles slightly over this period (FTA, 2019). As LA Metro accounts for over half of the state's ridership losses (See Chapter 3), the difference in its service trends from other California operators is significant. However, flat service alone cannot explain the scale of the agency's patronage losses over the period. While LA Metro and OCTA have not added service in the way other large operators have, we still see little evidence of a "death spiral" of service cuts and ridership losses on those agencies, at least to date.

4.3.3. Service Trends by Mode

Finally, we find the same divergence between ridership and service on both buses and trains. As with ridership, rail service has increased far more than bus service (See **Figure 4-3**). Bus service dipped during the Great Recession and recovered gradually thereafter. Rail service, meanwhile, took off after 2011, with an increase of nearly a quarter in revenue hours and miles between 2008 and 2018. As rail operators put out more hours of train service in the early 2010s, ridership responded—until 2015. Thereafter, rail ridership fell despite continued service increases. All the while, bus patronage dropped as ridership flatlined and then fell rapidly (FTA, 2019).

Figure 4-3. Trends in Boardings versus Trends in Service Supply in California by Mode



Data source: FTA, 2019

The two graphs in **Figure 4-3** obviously look quite different, with rail trends dramatically higher than those for buses. That said, for both, service and ridership tracked closely until 2014 or 2015 and now are moving in opposite directions. The large increase in rail service—which, in a world of limited resources, comes in part at buses' expense—may help explain why rail ridership has performed much better over the past decade, but it does not explain the recent drop on both modes.

4.4. Conclusion

Across California, transit operators have supplied more hours and more miles of revenue service each year since 2011. To a lesser extent, service per capita has also increased. Yet since 2014, ridership has followed a different, downward path. Either transit patronage has failed to respond to increases in service or other, new factors have overwhelmed the positive effects of service growth on ridership. This divergence between ridership and service is most clear and dates back furthest in Greater Los Angeles and the rest of the state, with the Bay Area and San Diego experiencing the same patterns more recently. With some outliers though no outright exceptions, service and patronage trends are diverging on the state's major operators and on both bus and rail.

This service/ridership dynamic has resulted in measurably diminished performance for California transit operators on a variety of metrics. Likewise, while we have thus far discussed revenue hours and revenue miles in the same breath, the differences between them indicate changes in average transit speed across the state. We discuss both consequences in the next chapter.

5. Transit Performance

5.1. Introduction

While overall ridership numbers typically garner the most popular and political attention, transit managers and analysts more often evaluate transit operations in terms of their productivity and performance. A system with very few riders could operate more productively than a system with many riders, if, for instance, the small system carries its riders at a lower cost per trip or if the smaller system attracts more trips per vehicle-hour of service. Such measures allow for more apples-to-apples comparisons across operators and can reveal the underlying drivers of transit performance that top-line ridership figures cannot.

Aggregate transit ridership per capita across the U.S. has been mostly flat for the better part of a half-century, but transit performance during that time has been mostly sliding. Metropolitan areas have grown substantially, while overall transit use has not—even as the total supply of transit service has increased. Across California, aggregate transit performance fell sharply in the 2010s across a number of metrics. In this chapter, we begin with an overview of trends in these productivity measures and then investigate possible reasons behind their erosion.

Transit productivity can be measured in a variety of ways; the two most common are in terms of efficiency and effectiveness. A system operates *efficiently* when inputs like spending translate into high levels of outputs supplied to the public, like hours of service. A system operates *effectively* when those inputs and outputs in turn lead to high consumption of transit—i.e., high ridership. Either way, productivity is key to determining whether 1) investing public money or increasing hours of service is actually translating into a better public transit, 2) increased funds and workforce are merely delivering service more expensively, or 3) added service is doing little to attract additional riders.

We find that California transit is performing worse on both efficiency and effectiveness metrics over the past decade across all regions of the state, and more so than the nation as a whole. Why might this be? We next explore three possible reasons for productivity declines directly related to the provision of transit service by operators: trends in expenditures, trends in fares, and trends in vehicle speeds and congestion. Each of these could individually or in concert contribute to falling transit ridership. As we will show, however, we find no evidence for a significant ridership effect from the former two and mixed evidence of the effects of speed and congestion.

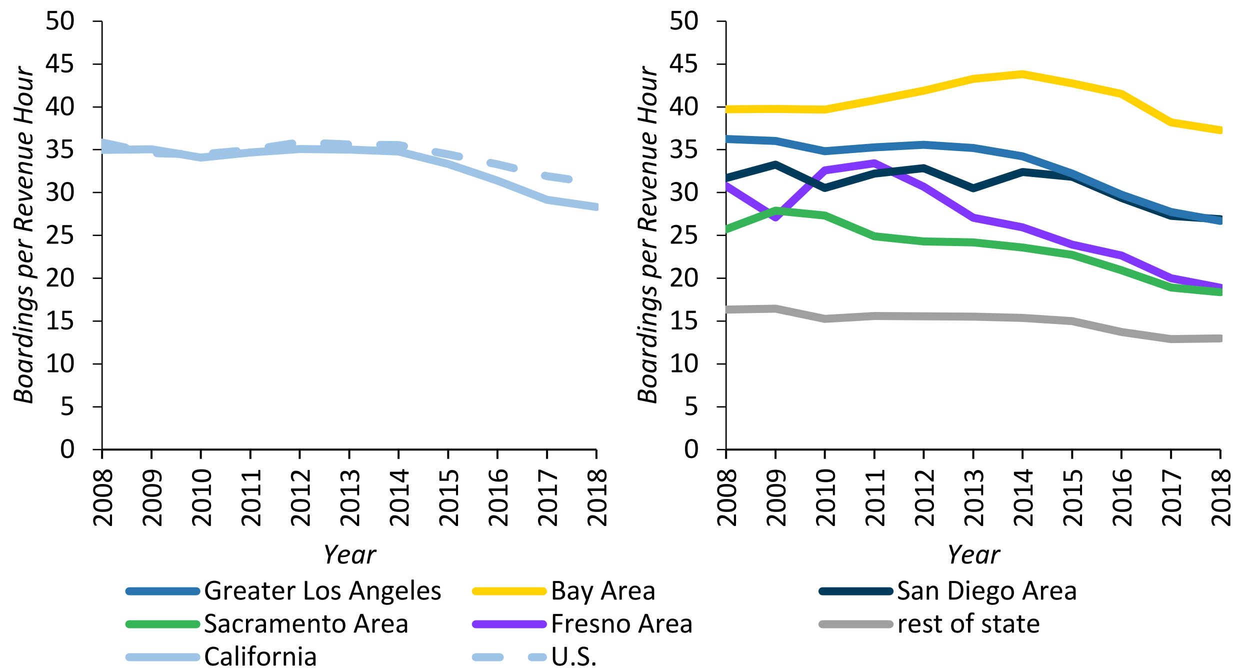
5.2. Transit Productivity

5.2.1. Service-effectiveness

As described in Chapter 4, California and its major regions face two countervailing trends: more and more service supplied as transit systems carry fewer and fewer trips. This simultaneous increase in service and decrease in boardings has depressed service-effectiveness (See **Figure 5-1**), a standard productivity measure of boardings per revenue hour of service. Like the ocean receding before a tsunami, service-effectiveness often ebbs (despite service increases) some time before ridership itself crashes down.

Statewide, service-effectiveness began to decline substantially after 2012, two years earlier than ridership itself began to fall (See **Figure 5-1**). This was perhaps a warning sign, a harbinger of the ridership decline to come. Before 2012, service-effectiveness was mostly flat: the post-Great-Recession increase in ridership did not substantively raise service-effectiveness because service supply was increasing simultaneously (See Chapter 4). But since 2012—as service supply first rose and then, after 2014, ridership fell—California transit systems carry over 19 percent fewer boardings per hour of revenue service, dropping from 35 in 2012 to 28 in 2018 and trending down more steeply than the nation overall (FTA, 2019). This drop represents the most significant change in service-effectiveness in either direction in the past decade.

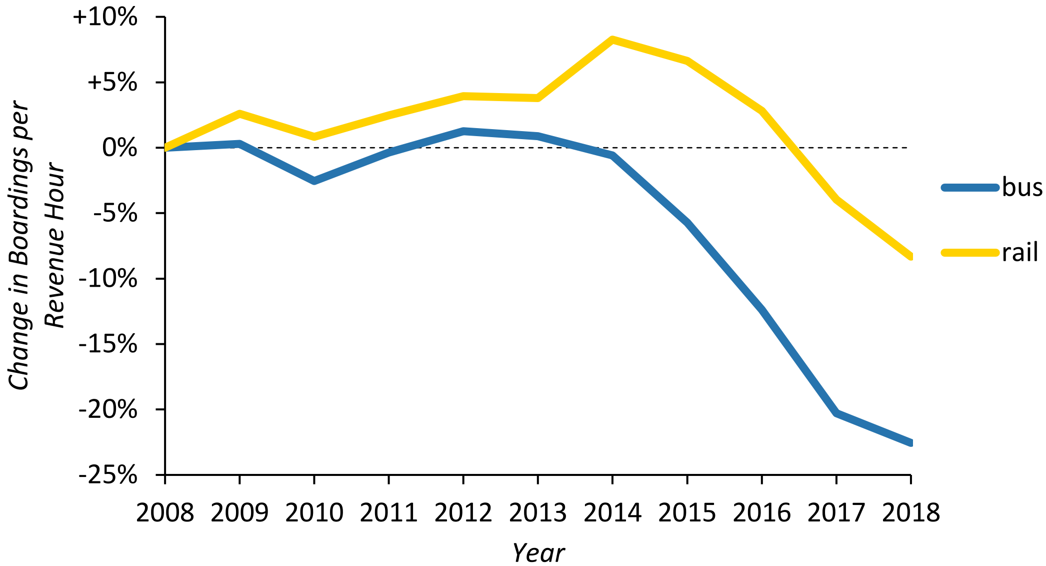
Figure 5-1. Service-effectiveness in California and California Regions



Data source: FTA, 2019

In the different regions of the state, service-effectiveness similarly began to fall before overall ridership (See **Figure 5-1**). Because of its relatively resilient ridership and recent service increases, the Bay Area—already the region with the highest average service-effectiveness in the state—saw an increase until 2014. But there too, service-effectiveness peaked and fell before ridership did. In the other regions, service-effectiveness has been on a relatively steady decline for years. The trend has worsened slightly since around 2014, depending on the region. By mode, service-effectiveness has also fallen on both buses and rail (See **Figure 5-2**). Average boardings per revenue hour on trains are much higher than on buses—in the 70s most of the past decade versus the 30s for buses—and rail service-effectiveness grew more in the recovery years after the Great Recession, but the two modes' recent downward trends are comparable (FTA, 2019). By 2019, in every region and on every mode in California, each hour of service is carrying fewer and fewer passengers.

Figure 5-2. Change in California Statewide Service-effectiveness by Mode

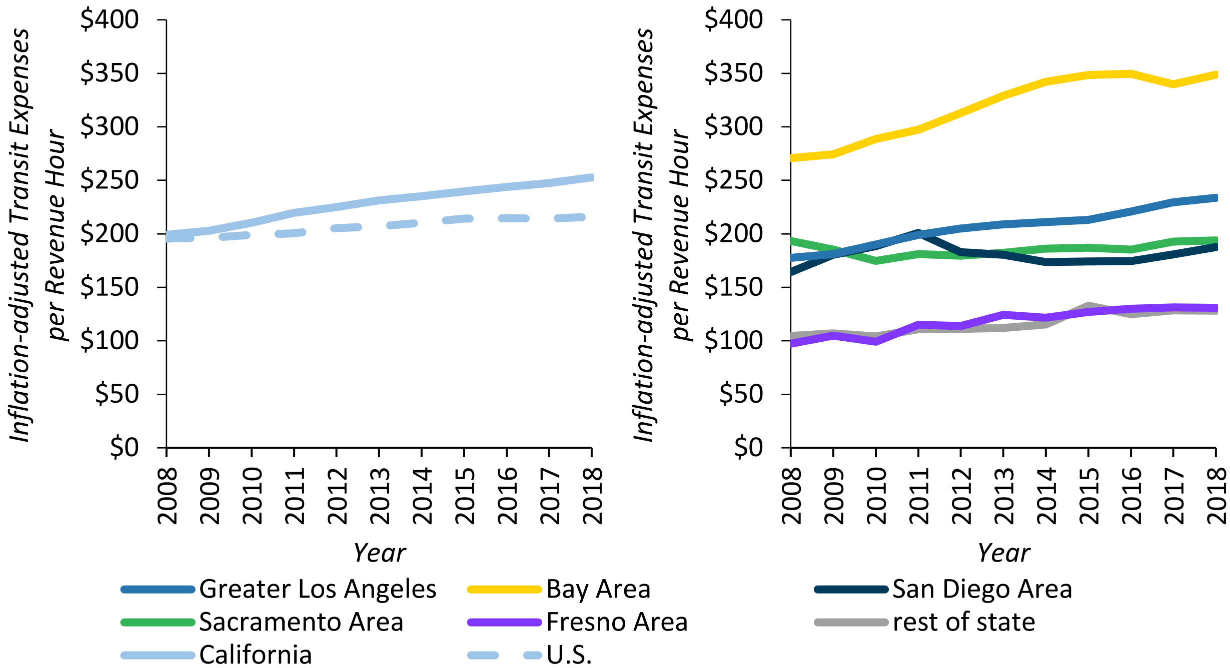


Data source: FTA, 2019

5.2.2. Cost-efficiency

At the same time, these less-patronized hours of transit service are costing operators more to deliver. Throughout this report, we calculate costs as a combination of annual operating expenses and a rolling average of annual capital expenses, adjusted for inflation (See Appendix A, Section 2 for further details). The metric of cost-efficiency divides these costs by the number of revenue hours operators supply. In California, the cost of an hour of service has risen out of pace with America overall (See **Figure 5-3**). Since 2008, when a service-hour cost just under $200 in both California and the U.S., California operators now spend over $50 more per hour, while U.S. transit agencies overall only added $20. We discuss possible reasons for this below, but the timing is worth noting here. Unlike service-effectiveness above, which fell in advance of ridership declines, cost-efficiency has worsened consistently over the past decade, with no discernable relation to rising or falling ridership (FTA, 2019 and BLS, 2019).

Figure 5-3. Cost-efficiency in California and California Regions



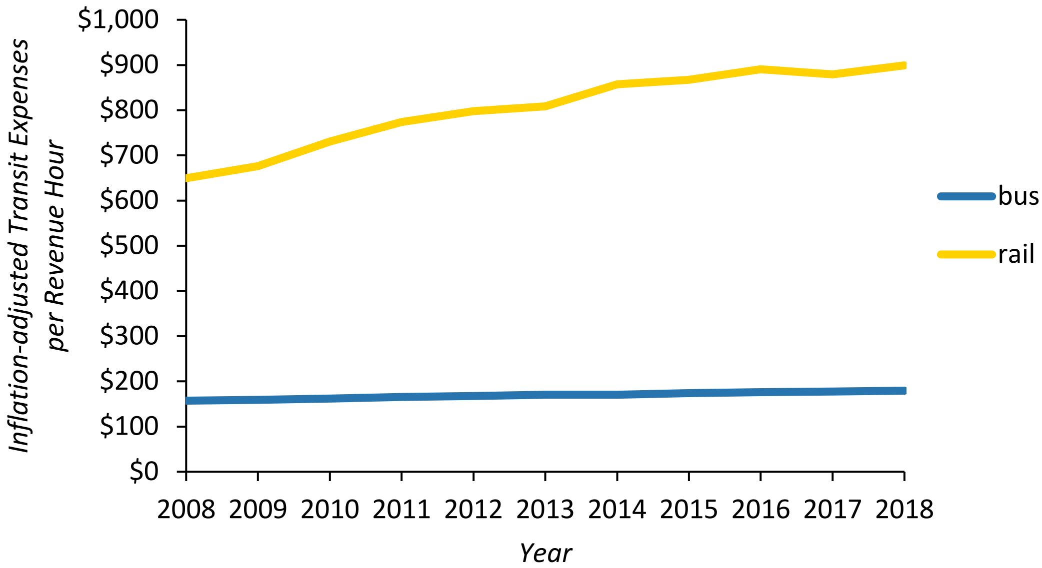
Data source: FTA, 2019 and BLS, 2019

Across California regions, the cost of an hour of transit service has also steadily risen (See **Figure 5-3**). The Bay Area spends the most per hour on transit, with increases driven more by rising total costs than by changes in service supply. But other than a slight dip in the Bay Area in 2017 and a relatively flatter curve in the San Diego Area, each region has seen costs per hour of service increase steadily on roughly similar slopes. There does not appear to be any substantive relationship between these trends and ridership changes by region (FTA, 2019 and BLS, 2019).

Much more noticeable is the gap between rail and bus expenses per hour of service (See **Figure 5-4**). Per hour of revenue service, trains cost far more than buses, especially in capital expenses.[9] But while this has long been true, the cost of a rail hour of service grew 38 percent from 2008 to 2018, again adjusting for inflation. The cost of an hour of bus service, meanwhile, remained essentially flat. Thus, an hour of rail service in California, which in 2008 cost four times more than an hour of bus service, now costs five times as much (FTA, 2019 and BLS, 2019). California's growing rail transit fleet is almost solely driving the state's worsening cost-efficiency.

9. There are several reasons for the much higher rail costs: rail transit typically supplies its own right of way (and even when operating in streets, must provide its own rails and overhead power source), while buses operate in streets paid by motorists and property owners; rail stations are typically larger and have more elaborate facilities compared to bus stops; an hour of rail service typically provides more passenger-carrying capacity than an hour of bus service, so the comparison is not apples-to-apples; and railcars typically cost more to purchase per unit of passenger capacity than buses due to the scale economies of railcar and bus production.

Figure 5-4. California Statewide Cost-efficiency by Mode



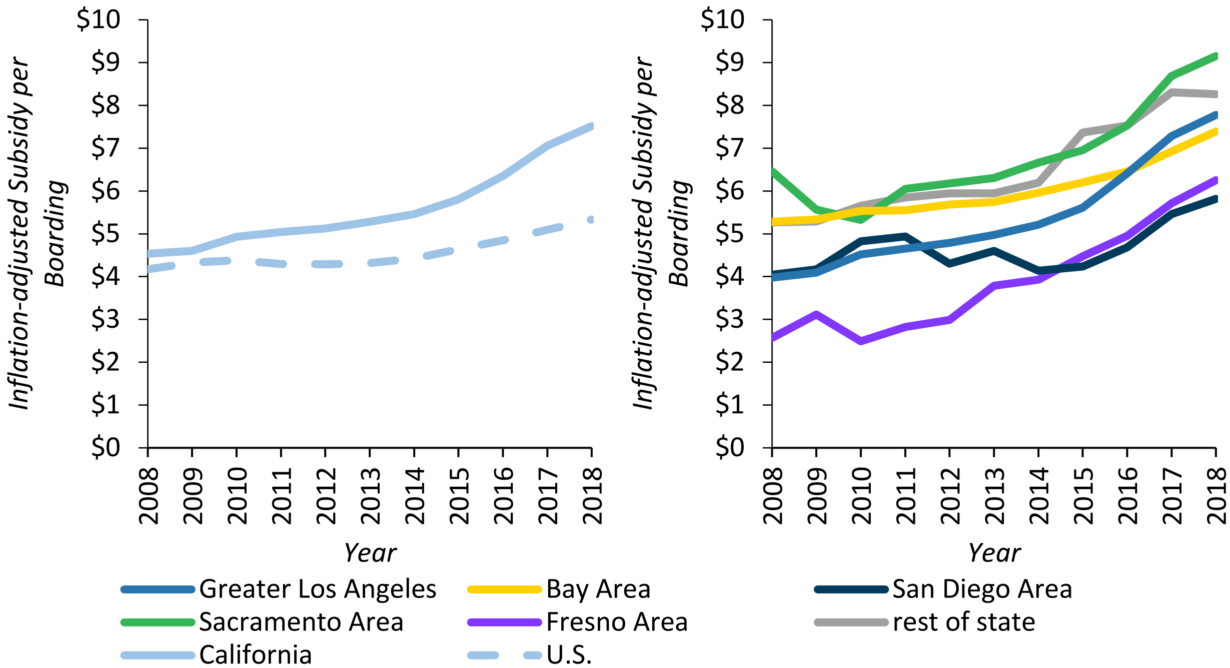
Data source: FTA, 2019 and BLS, 2019

5.2.3. Cost-effectiveness

As service-effectiveness and cost-efficiency have worsened across the state, so too has a third key productivity metric: cost-effectiveness. Essentially, cost-effectiveness combines the two measures above. Unlike cost-efficiency, cost-effectiveness measures the direct effect of spending on ridership: how much does an agency spend on each boarding? Here, we calculate cost-effectiveness as the subsidy—the net cost, subtracting out fare revenue—of each boarding (See Appendix A, Section 2 for further details).

As with cost-efficiency, California transit's cost-effectiveness has diverged from the nation overall, with each boarding in 2018 having a subsidy two-thirds larger than in 2008 (See **Figure 5-5**). Until around 2014, the subsidy per boarding rose at a relatively constant rate, similar to cost-efficiency, but in 2014, California's cost-effectiveness curve began to bend as ridership fell (FTA, 2019 and BLS, 2019). Putting together the three productivity measures, we find that as the cost of service steadily increased, so too did the subsidy for each trip—until it jumped when the number of trips borne by that service fell. Intuitively, this makes sense: the costs of running a transit system with gradually increasing levels of service gradually increase, but when ridership drops dramatically, the subsidy per boarding goes up as well.

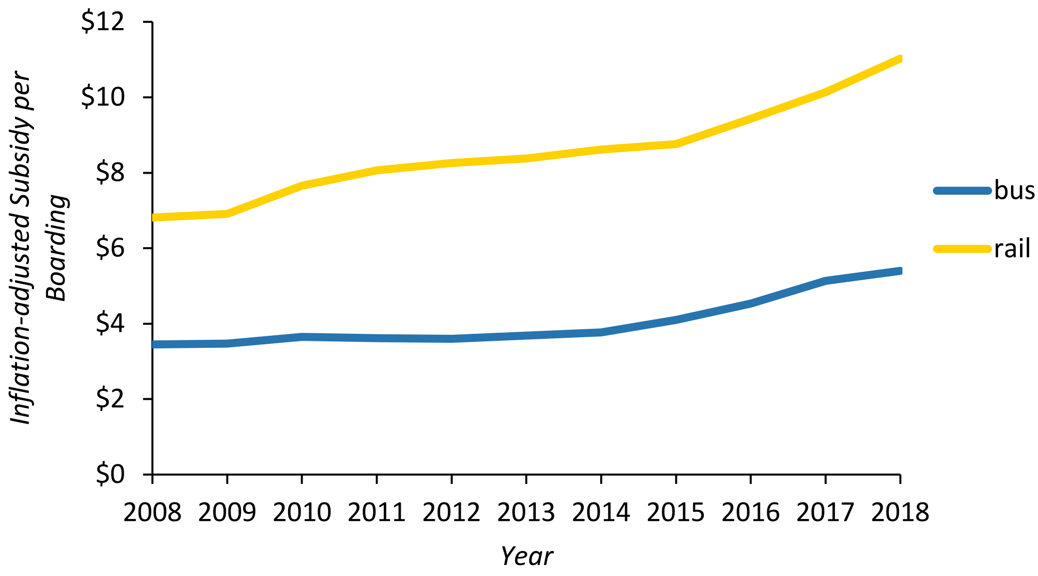
Figure 5-5. Cost-effectiveness in California and California Regions



Data source: FTA, 2019 and BLS, 2019

In all six major regions of California, subsidies per boarding have risen since 2008 and accelerated recently (See **Figure 5-5**). More robust ridership in the Bay Area and San Diego Area have flattened their cost-effectiveness trends relative to other regions, but inflation-adjusted subsidies per trip are still on the rise there too. Across modes, the story is the same (See **Figure 5-6**). Rail costs far more than bus per boarding, but both have seen higher rates of cost escalation around the time the ridership decline commenced (FTA, 2019 and BLS, 2019).

Figure 5-6. California Statewide Cost-effectiveness by Mode



Data source: FTA, 2019 and BLS, 2019

5.3. Possible Supply-side Explanations for Transit Productivity Declines

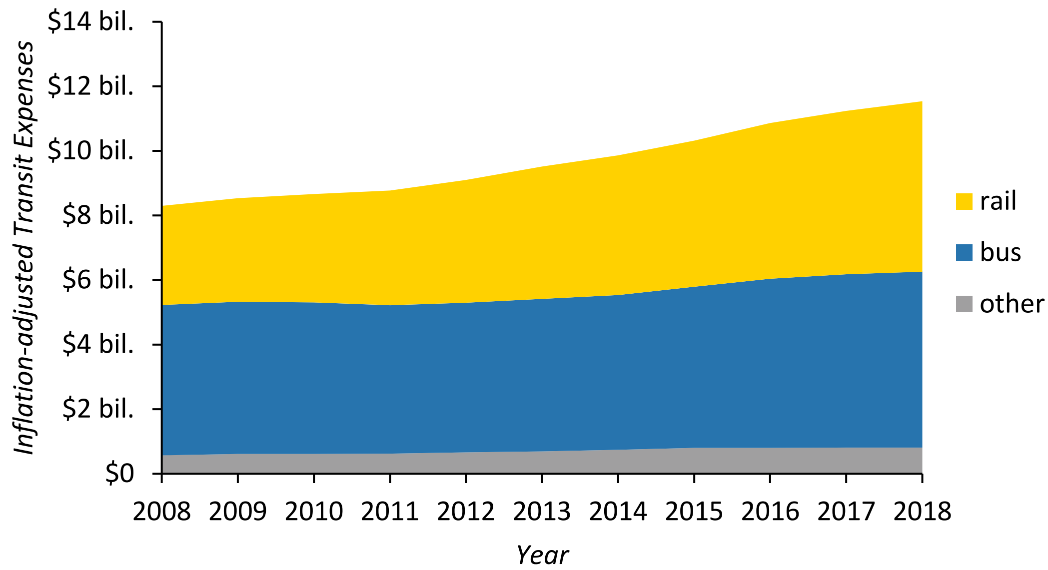
What explains why California transit has become both less efficient and less effective in the 2010s? We explore below three possible explanations for these trends and for the ridership decline overall: changes in transit expenditures, changes in transit fares, and changes in transit speed and road congestion. These factors each relate to the supply of transit service; in later chapters, we explore other possible explanations beyond the remit of operators themselves.

5.3.1. Transit Expenditures

During past economic downturns, governments have cut their spending on transit, which forces service cuts, reduces ridership, and in turn diminishes fare revenues. This dynamic is not at play, though, in California today. Not only have California operators added service in recent years (See Chapter 4), but they have also spent more on transit as well. **Figure 5-7** shows that expenditures[10] on transit have grown consistently and significantly across the state. On the surface, the fact that "spending on transit is up" may hearten advocates of greater investment in public transportation. Both subsidies and fare revenues have risen over the past decade. But as demonstrated above, this increased spending is buying less service and fewer boardings per dollar (FTA, 2019 and BLS, 2019).

10. Technically this section analyzes transit expenses. The NTD expenditure data are not broken down by mode, so we substitute NTD expense data instead to maintain consistency with the rest of the analyses in this report; expenditure and expense figures are largely similar (FTA, 2019).

Figure 5-7. California Transit Expenses



Data source: FTA, 2019 and BLS, 2019

Most of the increase in transit expenditures has been spent on rail (See **Figure 5-7**) (FTA, 2019 and BLS, 2019). This modal gap in expenditures helps explain the growth in rail service compared to buses, described in Chapter 4, and the steep losses in bus ridership compared to rail since 2008, described in Chapter 3. However, the fact that rail ridership has fallen as of late as funding has risen still suggests that the recent patronage decline is a larger issue than just funding.

Across modes, what the optimist reads as an increase in transit spending the pessimist sees as an increase in transit costs. The fact that California transit's material, equipment, land, labor, and environmental review costs are higher than the national average likely helps explain California's long-term rising costs and growing inefficiency. Because California's relative cost-inefficiency dates from long before the patronage downturn and because the state's expenditure and cost-efficiency trends do not correlate with ridership changes, the relatively recent downturn in transit patronage appears less at fault than these rising cost factors.

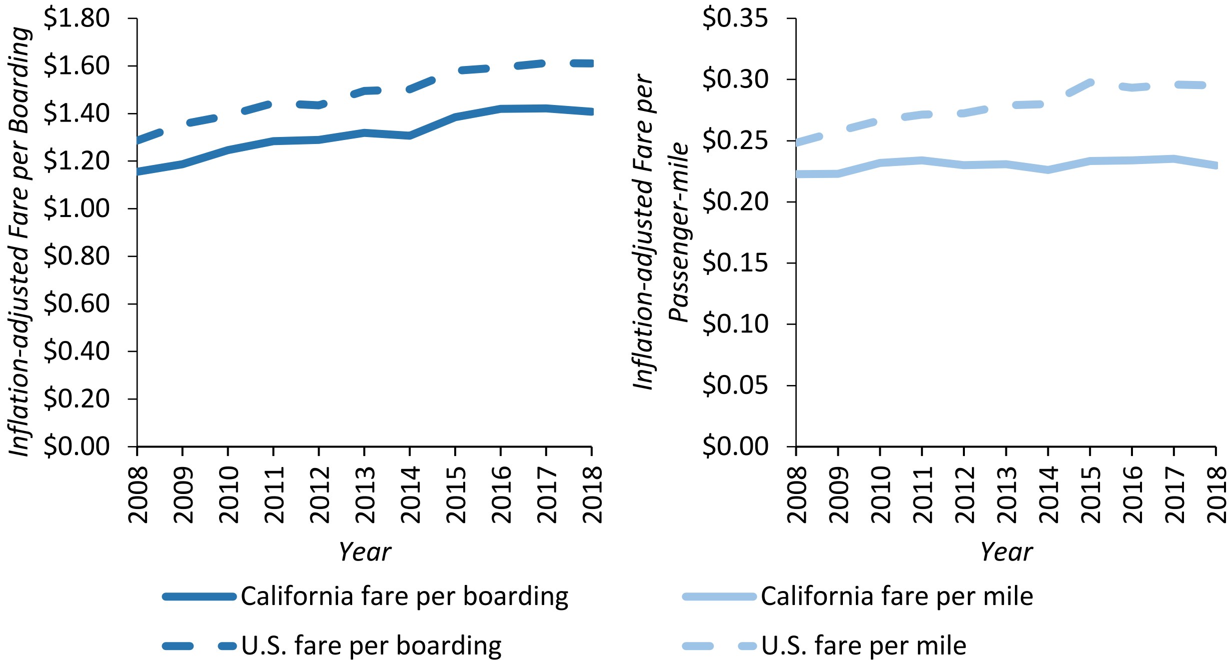
5.3.2. Transit Fares

When riders decide whether to take transit, they weigh many perceived costs, like the cost of time and the cost of discomfort. But of course, most riders pay an actual monetary cost as well: the fare. Despite fares' undoubted influence on transit use, this most visible cost of transit appears neither to be significantly influencing recent changes in California transit ridership nor productivity.

Note that the average fare paid is not the "sticker price" fare listed on fareboxes and websites. Most transit operators offer discounts for certain riders—students, seniors, youth, people with disabilities, etc.—or for purchasing trips in bulk, like daily, weekly, and monthly passes (Yoh, Taylor, and Gahbauer, 2016); thus, the fare paid per boarding and per mile traveled can vary substantially across riders and trips.

Across the state, fares are up and ridership is down, but it does not appear that higher fares are causing ridership losses. The average inflation-adjusted fare per boarding has increased steadily, albeit modestly, for the past decade (See the left graph of **Figure 5-8**) as ridership also increased (FTA, 2019 and BLS, 2019). Fares per boarding did not rise any faster before ridership recently went down, nor when patronage fell during the Great Recession. In other words, ridership trends appear largely independent of steadily rising fares.

Figure 5-8. California and U.S. Transit Fare Trends



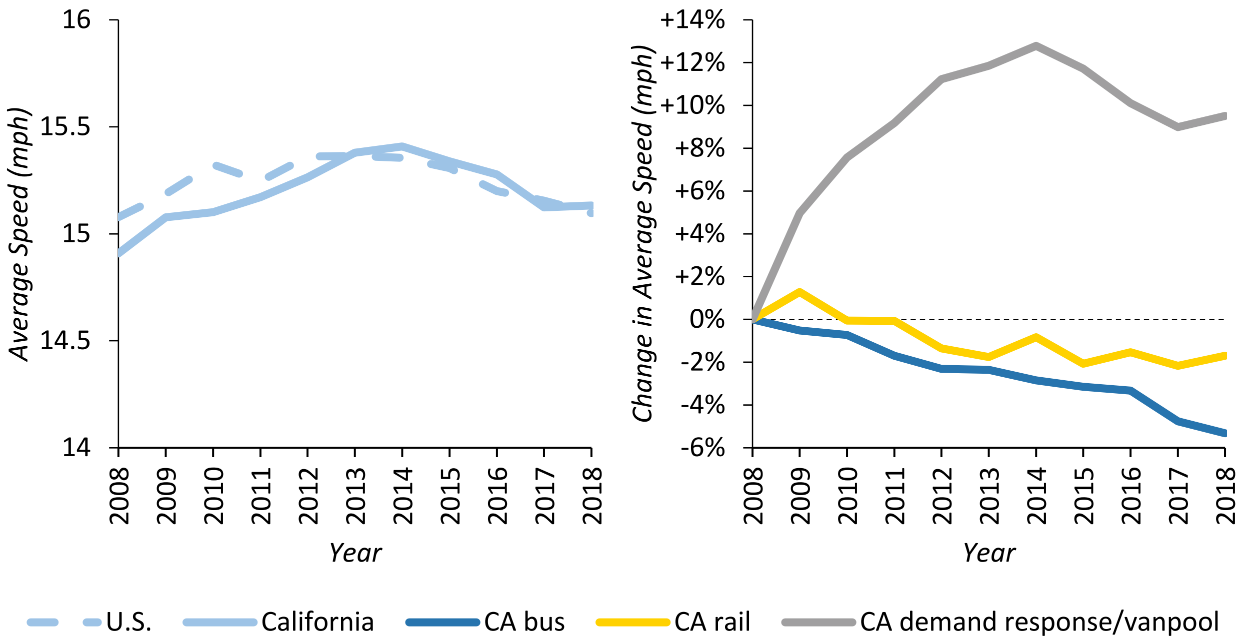
Data source: FTA, 2019 and BLS, 2019

The average length of a transit trip in California has been increasing over time (See Chapter 3), but most fares do not vary with distance. When measured per passenger-mile, the average inflation-adjusted fare has actually remained flat in California over the past decade (See the right graph of **Figure 5-8**). While inflation-adjusted fares per passenger-mile have risen nationwide, they have remained near $0.23 per passenger-mile (again in 2018 dollars) in California since 2008. By either fare metric, fares are not rising at a rate that would explain falling ridership. Additionally, because fares have not changed much, average fare trends are not a significant factor in the state's cost-efficiency and cost-effectiveness woes. Since 2016, the total fare revenue for all California operators has dropped, but because of falling ridership alone, not average fare changes (FTA, 2019 and BLS, 2019).

5.3.3. Vehicle Speeds and Congestion

Rarely outside of the movies do buses in California reach 50 miles per hour. In the state, the average speed of a transit vehicle of any type during revenue service has hovered at around 15 miles per hour for the past decade (See **Figure 5-9**) (FTA, 2019). Has this sluggish pace affected transit ridership and performance? Unlike with revenue and expenditure changes, evidence for a relationship here with ridership and productivity is, at the least, mixed.

Figure 5-9. Average Transit Speed in California



Data source: FTA, 2019

Though slow-moving public transit is nothing new, transit speeds in California have dropped since peaking in 2014 (See the left graph of **Figure 5-9**). This slowing could be dissuading people from riding transit and in turn depressing transit's service-effectiveness. However, this decline in average speed comes with a caveat: as the right graph of **Figure 5-9** shows, the rise in average speeds prior to 2014 came largely from demand response services like paratransit. Trains and buses, which carry most boardings, have slowed relatively consistently over the past decade (FTA, 2019). Thus, we see the evidence for a connection between slowing average speeds, falling ridership, and dropping service-effectiveness as relatively weak.

Average bus and train speeds are a function not only of how quickly transit vehicles navigate through traffic as they ply their routes, but also the "dwell times" at stops and in stations when passengers board and alight transit vehicles. These dwell times are thus affected by the number of passengers riding, their familiarity with boarding and alighting procedures, and their means of payment. So-called "smart cards" and "flash passes" speed boarding and reduce dwell times, while feeding cash into fareboxes typically takes longer.[11] So as passengers increasingly use quicker fare payment instruments like smart cards and as there have been fewer of them to board and alight in California since 2014, dwell times should be expected to fall. Thus, these countervailing factors—slower movement through heavier traffic and faster movement due to reduced dwell times—may explain why transit vehicle speeds have not changed all that much in recent years.

That said, the average speeds of demand-response transit has been on the decline since 2014, and in 2017, bus speeds fell more steeply than before. Among the top ten operators in the state, average speed fell ten percent on AC Transit and seven percent on VTA between 2014 and 2018, as ridership on those systems also

11. While transit vehicles frequently operate at slower than scheduled speeds, due to myriad factors, they do not as a rule operate faster than scheduled speeds, even if conditions permit. This is to prevent arriving passengers from missing a scheduled vehicle departure due to an early arrival, and to maintain relatively even spacing between vehicles.

dropped steeply (See Chapter 3) (FTA, 2019). This decrease in average speed could have come about for multiple reasons beyond changes in dwell times discussed above. Congestion could be worsening, slowing buses and on-street light rail. Alternatively, congestion could be stable, but agencies could be reallocating service from outlying routes, on which vehicles travel many miles at higher speeds, to routes in urban cores, on which vehicles travel shorter distances at lower speeds. In this case, the specific bus route that a given commuter takes to work is not getting any slower, but the whole system, on the average, is. Or, both factors could be occurring at the same time.

We lack the data on service allocation strategies on the state's many operators to test the latter hypothesis. But we can examine whether congestion is slowing transit and therefore depressing ridership and productivity. **Table 5-1** compares changes in average speeds on modes in mixed traffic—buses and demand-response transit—to changes in congestion in California's major regions. To measure congestion, we use calculations of average annual hours of delay per auto commute in each region's largest urbanized area from the Texas A&M Transportation Institute (TTI) (2019).[12] There is little correlation between the two. Bus speeds have actually risen over the past decade in the regions with the most worsening congestion, the Sacramento and Fresno Areas.

Table 5-1. Change in Bus and Demand Response Speeds versus Change in Road Congestion

REGION	CHANGE IN AVERAGE SPEED, 2008-2017		CHANGE IN CONGESTION (AVERAGE ANNUAL HOURS OF DELAY PER AUTO COMMUTER), 2008-2017
	BUS	DEMAND RESPONSE/ VANPOOL	
Greater Los Angeles	-6%	+12%	+28%
Bay Area	-7%	-3%	+20%
San Diego Area	-5%	-7%	+33%
Sacramento Area	+3%	-5%	+34%
Fresno Area	+2%	+5%	+67%

Data source: FTA, 2019 and TTI, 2019

To be sure, removing transit from the snarl of congestion onto dedicated rights-of-way would be of great benefit to transit riders, would increase average speeds, and could boost ridership (See Chapter 15). But in recent ridership losses, congestion does not appear to be a major culprit, with the possible exception of a few systems and minor modes. Indeed, as road congestion rises, there should also be a converse effect on transit ridership: slower auto speeds should also push more car commuters to ride grade-separated transit

12. Traffic delays occur on specific directional roadway links or at particular intersections, so aggregating congestion measures to higher levels of geography, which TTI does, is conceptually problematic. Even in a traffic-congested place like Greater Los Angeles, traffic delays vary dramatically across the region, though the average level of delay is meaningfully greater than in, say, metropolitan Bakersfield. But while this and other criticisms have been leveled against the TTI congestion metrics (Litman, 2019 and Cortright, 2015), the measures are likely internally consistent over time for a given metropolitan area.

that avoids congestion, like rail and bus rapid transit. But rail ridership, while better-performing, has also fallen.

5.4. Conclusion

California's transit systems are operating less efficiently over the past decade and less effectively since just before the recent ridership slump. Rising costs, especially on rail, help explain the former, and falling ridership combined with rising service supply explain the latter. The causes of productivity and ridership declines thus do not neatly overlap. Factors related to service provision, like rising costs and slowing speeds, have hurt transit's performance but do not explain the bulk of its recent patronage losses. For that, we turn next to factors beyond the control of transit operators themselves: changes in transit's user base and changes in travel, residential, and employment patterns in California's major metropolitan areas.

Part III. How Are California Transit Users Changing?

Understanding changes in transit ridership requires an understanding of the individuals that use transit systems. In Part III, we examine populations that have a high likelihood of riding transit, and investigate how changes in these populations are associated with changes in total transit ridership in California.

In Chapter 6, we take a broad overview of transit ridership—and more specifically, transit riders—during the past decade. Data from the 2009 and 2017 NHTS suggest some important shifts in transit use, particularly with regard to race and ethnicity and automobile access. Specifically, we find that the average number of daily trips declined among groups typically associated with relatively high levels of transit use (Hispanics and individuals with limited vehicle access) and increased among those that traditionally have avoided transit (non-Hispanic whites and individuals living in households with at least one car per driver) (FHWA, 2009, 2017).

Next, we examine trends in immigration. Latin American immigrants—particularly those that are relatively recent arrivals—have traditionally had high ridership rates, and have long comprised a significant proportion of ridership on systems across the state. Immigrants from Asian countries, by contrast, tend to have higher average incomes, higher levels of automobile ownership, and lower rates of transit ridership (Ruggles et al., 2020). Therefore, as the proportion of immigrants from Asia has increased and the proportion of immigrants from Latin America has decreased, transit systems statewide have lost an important customer base. These findings highlight potential associations between ridership declines, immigration trends, and immigration policy.

We then examine changes in transit ridership as a function of two factors: changes in the population size of transit riders (a "population effect") and changes in usage rates of transit riders (a "usage effect"). Data from the 2009 and 2017 NHTS show that usage effects are associated with declining ridership totals, particularly among groups that have long been relatively heavy riders of transit such as Hispanics, those with limited automobile access, and residents of densely populated neighborhoods. These declines, however, have been offset to some extent by higher usage rates among populations not typically associated with frequent transit use such as non-Hispanic whites, households with at least one car per driver, and those living in neighborhoods with low population densities (FHWA, 2009, 2017).

In Chapter 7, we use NHTS data to conduct a latent profile analysis to investigate changes in the pool of transit riders between 2009 and 2017. During this time period, we find that the proportion of "Transit Dependents"—low-income riders that use transit for the bulk of their trips—remained relatively stable, and accounted for more than half of the state's transit riders. The share of "Occasional Riders"—medium-income users who ride transit for a small proportion of their trips—shrank, dropping from 38 percent of all riders in 2009 to 30 percent in 2017. Lastly, the share of "Choice Riders"—high-income transit users that take frequent, relatively long-distance trips on transit—more than doubled in size during the study period, growing from 7 percent to 15 percent of all transit riders.

Overall, findings from Part III highlight an important shift in transit ridership in California: as ridership among population groups that are typically associated with high-levels of transit use has declined noticeably, those who have traditionally avoided transit are riding somewhat more frequently. While these changes suggest that some transit systems across the state have attracted new riders, the recent decline in total transit ridership in California indicates that these gains are limited, and have not compensated for declining ridership rates among traditional transit users.

6. Changes in Transit Use and Users

6.1. Introduction

Traditionally, transit ridership has been highest among several population groups: non-white and low-income adults and those living in households without automobiles (Giuliano, 2005; Renne and Bennett, 2014; and Taylor and Morris, 2015). Transit ridership, therefore, can be negatively affected by both declines in the population of groups likely to use transit ("population effects") and declines in the frequency of transit use by members of those groups ("usage effects"). In this chapter, we examine the relative contribution of both of these trends.

This analysis focuses on adults (18+ years) and relies on data from the 2009 and 2017 National Household Travel Surveys (FHWA, 2009, 2017). Each iteration of the NHTS collects a single-day travel diary from households and individuals across the U.S. While the NHTS is national in scope, both the 2009 and 2017 surveys include a special California add-on sample that allows us to specifically focus on statewide transit usage trends between the survey years. The 2009 California add-on contains data from just over 21,000 households and nearly 45,000 individuals; the 2017 NHTS California sample includes over 26,000 households and 56,000 people. We supplement these data with American Community Survey microdata (Ruggles et al., 2020) to summarize changes among California's immigrant population, whose composition has notably shifted in recent years toward higher-income immigrants less likely to rely on public transit.

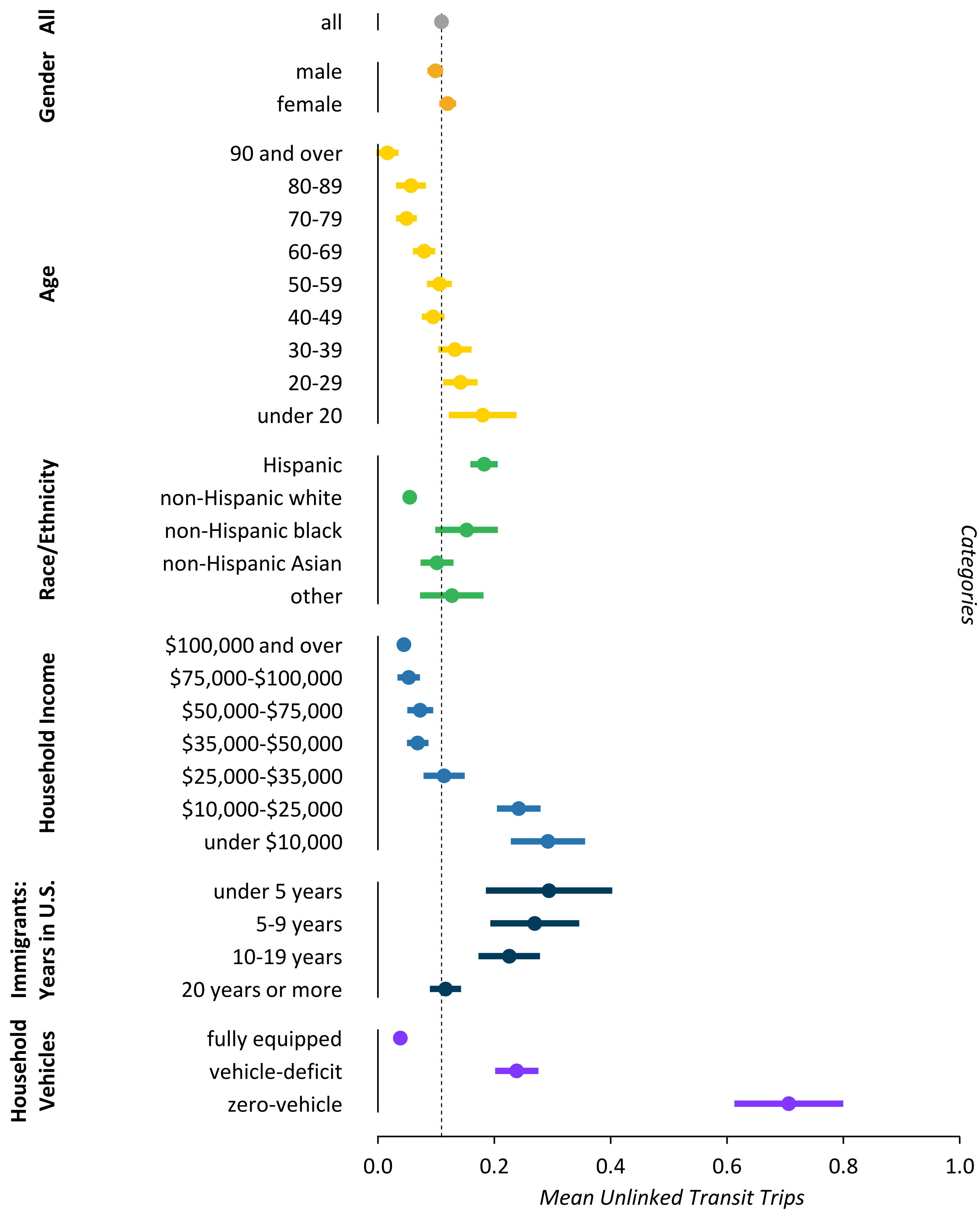
We find significant declines in transit use among Hispanic adults as well as among individuals living in low-income households and those with limited access to automobiles. In contrast, transit use is growing—albeit slowly—among higher-income households. We also note that transit ridership would have been higher had the state not experienced a shift in the composition of immigrants away from those from Latin America. Overall, waning usage rates among certain households—vehicle-deficit, Hispanic, those living in high-density neighborhoods, etc.—were responsible for a large share of the state's ridership losses.

6.2. Changes in Transit Use

Because the NHTS contains a wealth of household- and person-level characteristics in addition to travel data, we are able to use data from the 2009 and 2017 surveys to examine changes in transit use among various socio-demographic groups.[13] **Figures 6-1** and **6-2** plot mean daily transit trips in 2009 and 2017, disaggregated by several categories: sex, age, race and ethnicity, income, immigrants by length of time in the U.S., and vehicle ownership. We selected these characteristics to highlight trends among population groups that—at least historically—have had higher than average transit usage rates: women, young adults, minorities, low-income adults, recent immigrants, and individuals who live in households without automobiles (Anderson, 2016; Blumenberg and Evans, 2007; Maciag, 2014; and Rosenbloom, 1998).

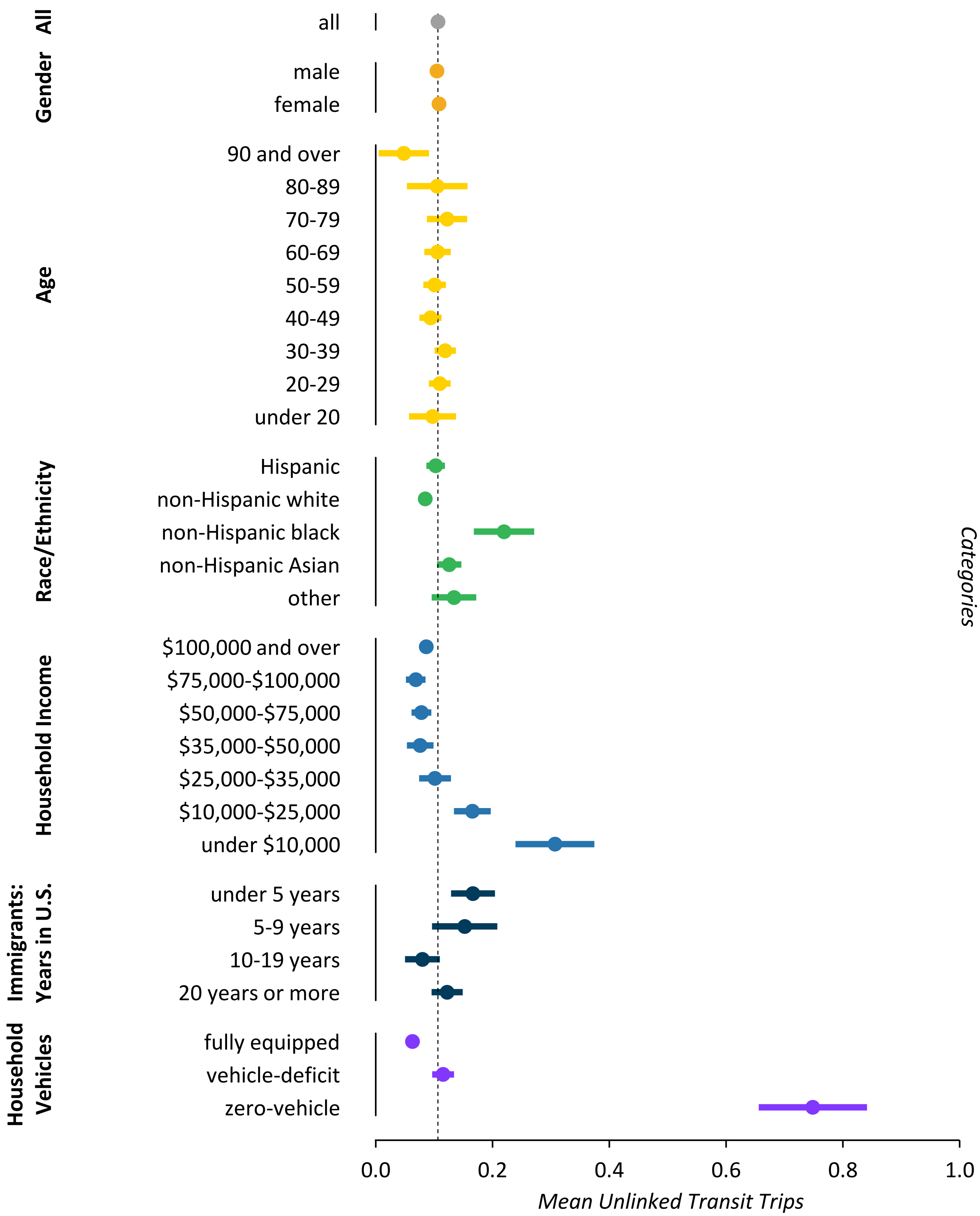
13. Because the NHTS is a survey, not a near-census of transit operators like the NTD, the overall statewide per capita transit ridership figure used in this chapter differs somewhat from that used in Chapter 3.

Figure 6-1. Daily Transit Trips in California by Socioeconomic Categories, 2009



Data source: FHWA, 2009

Figure 6-2. Daily Transit Trips in California by Socioeconomic Categories, 2017



Data source: FHWA, 2017

Among the many group-level changes in transit patronage between 2009 and 2017, a few stand out as particularly noteworthy. In terms of race and ethnicity, the biggest shift in mean daily trips occurred among Hispanics, whose ridership dropped from an average of 0.18 trips per day in 2009 to 0.10 trips per day in 2017. Non-Hispanic whites, by contrast, increased their ridership rates, taking 0.09 trips in 2017 compared to just 0.05 daily trips in 2009. There were also important shifts in transit ridership related to household income. Residents of high-income households—those making over $100,000 in yearly income—rode more in 2017 than in 2009, more than doubling their mean number of daily transit trips from 0.04 to 0.09. At the other end of the income distribution, the trend was the opposite. While individuals in households earning between $10,000 and $25,000 made 0.24 transit trips per day in 2009, in 2017 they made only 0.17 daily trips (FHWA, 2009, 2017).

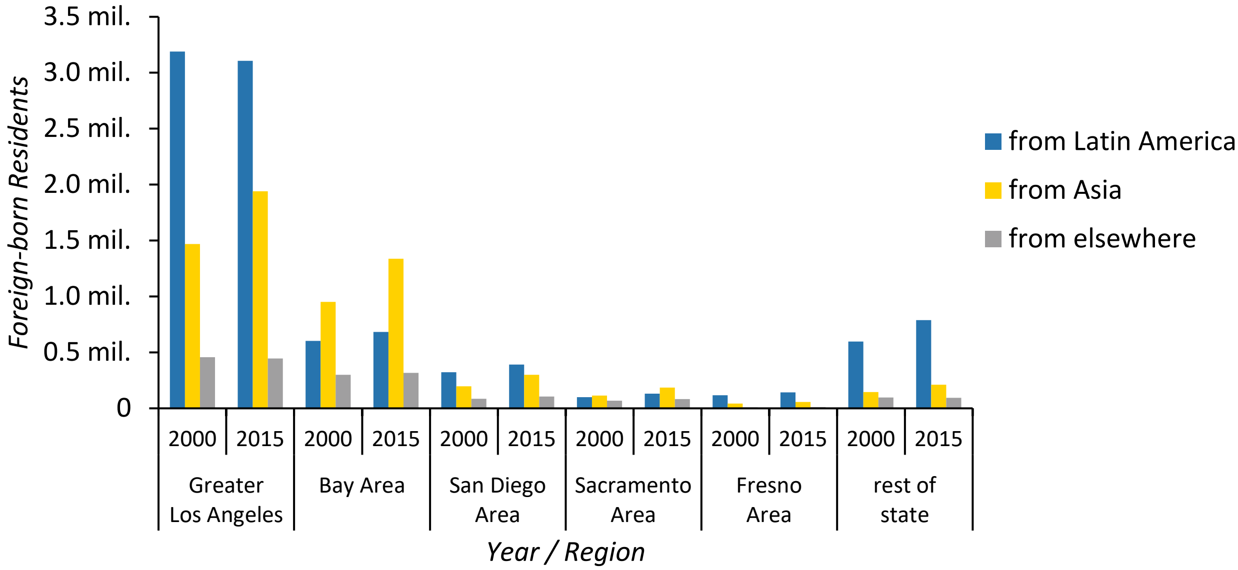
Finally, there were also fluctuations in ridership with regard to vehicle ownership. Ridership decreased dramatically among residents of vehicle-deficit households (i.e., those with less than one vehicle per driver; see Appendix A, Section 2 for definitions), dropping from an average of 0.24 daily person-trips in 2009 to 0.11 in 2017. Conversely, for those living in "fully equipped" households (households with at least one vehicle for each driver), the trend was positive; in 2009, residents of fully equipped households made just 0.04 trips per day on transit; by 2017, this number had risen to 0.06 (FHWA, 2009, 2017). While this increase is rather small in magnitude, it is important to remember that over 75 percent of households in California own at least one vehicle per driver (FHWA, 2017). Therefore, in the aggregate, even a small upturn in transit use within this demographic group can translate into a fairly substantial increase in overall ridership.

6.3. Changes in the Immigrant Population

Immigrants to the U.S. ride transit at higher rates than people born in the U.S. But in recent years, international immigration to California has slowed, especially among those from Latin America. The population of Asian immigrants, meanwhile, has grown. From 2010 to 2018, these two regions accounted for 78% of immigrants to the U.S. between them (U.S. DHS, 2020). But Asian immigrants have higher incomes on average than those from Latin America and are, therefore, less likely to ride transit (U.S. Census Bureau, 2019). This changing composition of immigrants may indicate that immigrants in California are less frequent transit users today than in the past.

Microdata from the Census and the American Community Survey show that between 2000 and 2015, every part of the state saw an increase in the proportion of immigrants from Asia and a decrease in the proportion of immigrants from Latin America. As seen in **Figure 6-3**, immigrants from Latin America still make up the majority of immigrants in the state, but their share is declining (Ruggles et al., 2020 and U.S. Census Bureau, 2019).

Figure 6-3. Immigrants by Birthplace in California Regions

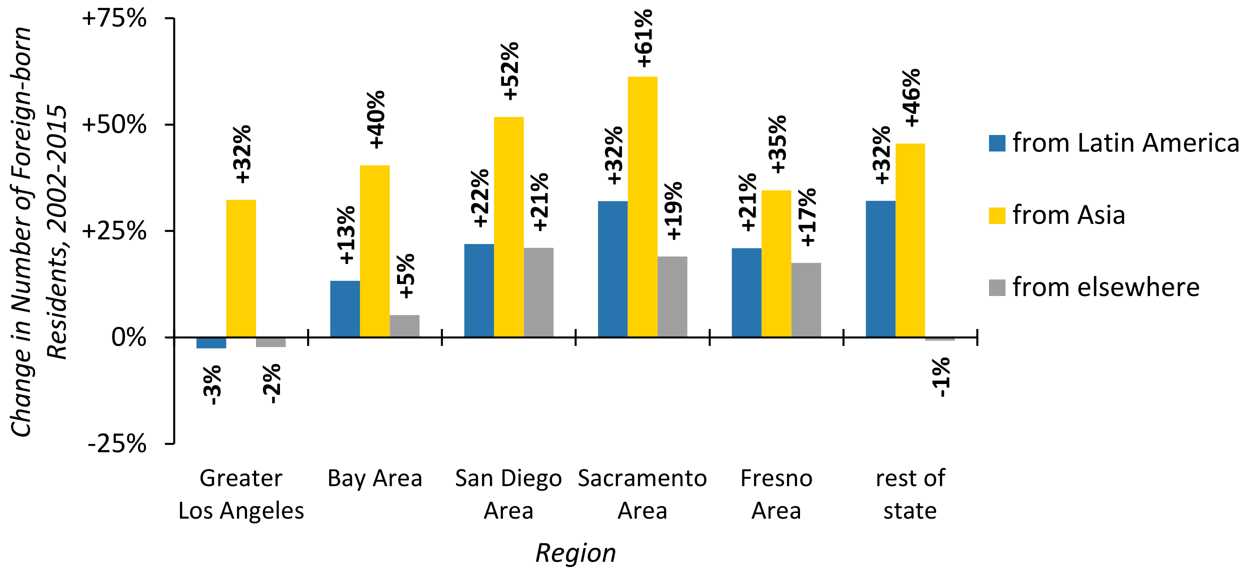


Data source: Ruggles et al., 2020 and U.S. Census Bureau, 2019

Of the state's regions, Greater Los Angeles has the highest total share of immigrants. There, 62 percent of immigrants were from Latin America in 2000, a share that dropped five percentage points, to 57 percent, by 2015. The share of Latin American immigrants also notably declined in the San Diego Area, from 53 to 49 percent, and the Bay Area, from 32 to 29 percent. Meanwhile, the share of immigrants from Asia increased during this time period, growing 6 percentage points in Greater Los Angeles, the Bay Area, and the Sacramento Area. The San Diego Area also saw a sizable increase of Asian immigrants, with the share increasing from 33 to 38 percent (Ruggles et al., 2020 and U.S. Census Bureau, 2019).

Though immigration *rates* have slowed, the absolute number of foreign-born residents still rose in most areas between 2000 and 2015. As seen in **Figure 6-4**, the number of Asia-born residents grew in every region of the state, with a 61 percent increase in the Sacramento Area and a 52 percent increase in the San Diego Area. While the number of residents born in Latin America also rose in most regions, their relative increases were smaller. Greater Los Angeles actually lost immigrants from Latin America during this time period (Ruggles et al., 2020 and U.S. Census Bureau, 2019).

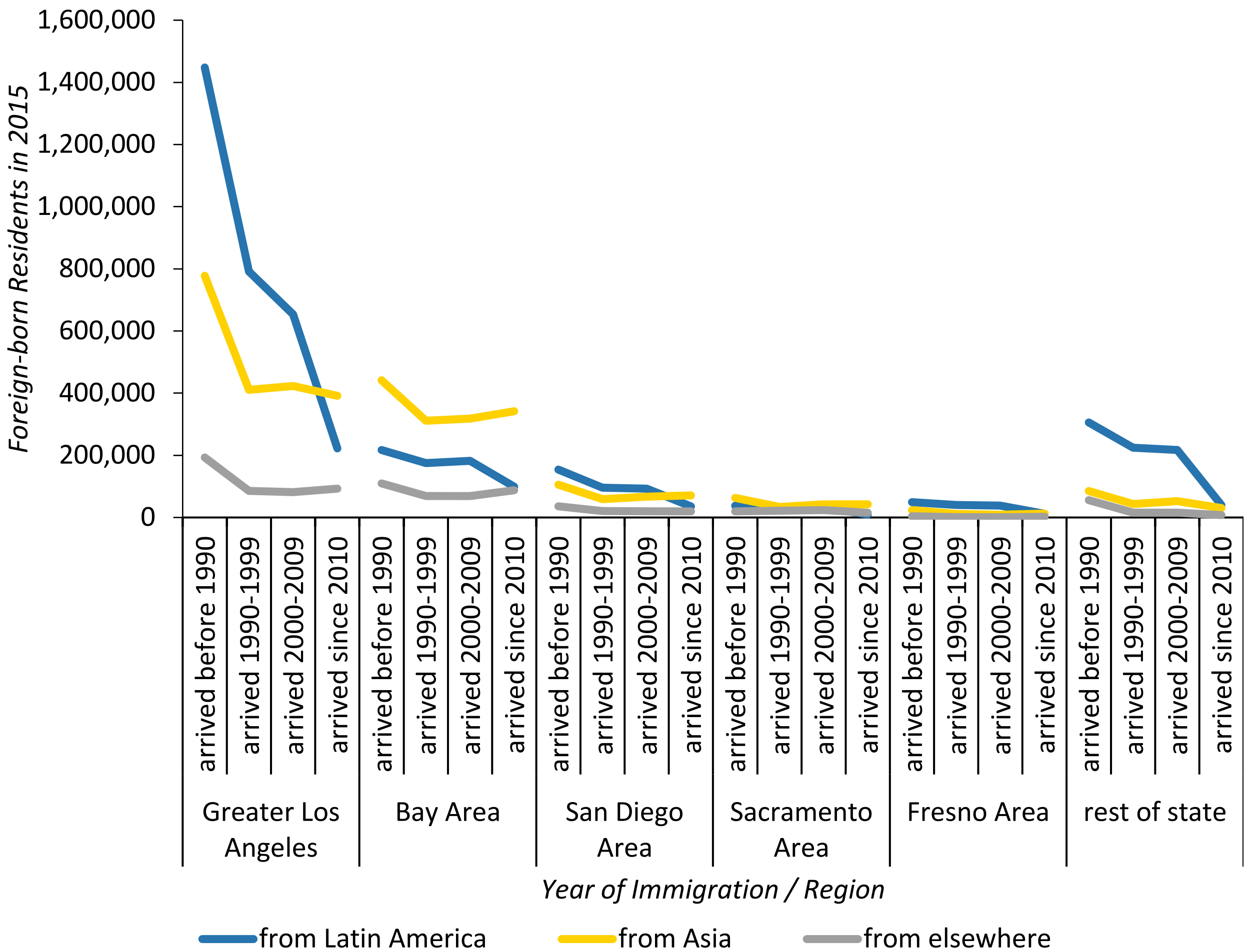
Figure 6-4. Change in the Number of California Immigrants by Birthplace, 2000-2015



Data source: Ruggles et al., 2020 and U.S. Census Bureau, 2019

Recent immigrants are even more likely to be from Asian countries than the overall immigrant population. Of the immigrants who have come to the United States since 2010, the plurality in the five largest regions of California are from Asia, a significant change from past trends (See **Figure 6-5**) (Ruggles et al., 2020 and U.S. Census Bureau, 2019).

Figure 6-5. California Immigrants by Birthplace, Year of Immigration, and Region



Data source: Ruggles et al., 2020 and U.S. Census Bureau, 2019

For many decades, the vast majority of immigrants to California came from Latin America. Other than the Bay Area and the Sacramento Area, which has always had more immigrants from Asian countries than from Latin America, this was true across California regions. Since 2010, however, the state has seen a fairly dramatic shift. More and more immigrants are arriving from Asian countries, and fewer are coming from Latin America.

Overall, these trends (in combination with zero-vehicle household data discussed in Chapter 8) point to lower transit ridership among immigrants. Because Asian immigrants tend to come to the United States with more resources than their Latin American peers, their propensity to use transit is lower. While immigrants are still among the most likely transit users, these changing demographics suggest that newer immigrants may be less likely to ride transit than earlier cohorts.

6.4. Changes in Use and Composition

Along with immigrant status, several demographics characteristics are strongly associated with transit ridership, as discussed above (See **Figures 6-1** and **6-2**). The effects that these demographic characteristics can have on total statewide ridership are a combination of "population effects"—changes in the number of persons in each category (for example, the number of car owners versus non-owners in the state)—and "usage effects"—changes in the travel behavior of persons within each of those groups (say, how likely car owners as a group are to ride transit, compared to non-owners).

Using data from the 2009 and 2017 NHTS (FHWA, 2009, 2017), we first examine the "population effect." As certain socio-demographic groups ride transit far more than others, increases or decreases in the total population of these groups may lead to large changes in aggregate ridership, even if the frequency of use among individuals remains the same. Here, we focus on changes in the number of those with access to automobiles, changes in the number of those in different racial and ethnic groups, changes in the number of those living in densely-populated areas, and changes in the number of those in different household income groups. Assuming each of these population groups were just as likely to ride transit in 2017 as they were in 2009, we calculated the number of trips that would have been taken on transit in 2017 based solely on changes in the population within each group and compare that number to the actual number of observed trips in 2017. The percentage difference between these two numbers represents the population effect—in other words, the proportion of the actual change in ridership that is due solely to population growth or decline, as opposed to changes in ridership habits.

Second, we assess the "usage effect." Here, we again used the same four key determinants of transit use to investigate how changes in ridership frequency have affected total transit patronage. We assumed a constant population size based on 2017 levels, and then calculated the difference in total ridership between 2009 and 2017 due only to changes in ridership frequency among these groups. Thus, the usage effect represents how much of the change in ridership is due to changing ridership habits as opposed to population change.

We find that between 2009 and 2017, declines in the size of the population of some groups that are traditionally heavy transit users contributed to moderate losses in transit ridership throughout the state. More importantly, however, decreasing transit usage rates among certain groups have led to substantial ridership losses statewide. We also find notable differences in the relationship between population effects, usage effects, and transit ridership at the regional level. Negative trends in Los Angeles and Orange Counties generally mirrored downward shifts in the state, though in most cases, the magnitude of these effects was more pronounced in these areas than in California as a whole. In the central Bay Area, by contrast, growth in the population of key demographic groups and increased ridership frequency among these groups during the period largely had moderate positive effects on transit ridership.

6.4.1. Population and Usage Effects in California

Table 6-1 shows the results of our breakdown of these population and usage effects for California. The "Population Effect" column represents the change in regional transit trips that would have occurred if every group was just as likely to ride transit in 2009 as 2017, but the groups grew as observed in the NHTS data. The "Usage Effect" column represents the change in regional transit trips that would have occurred if the population of every group had stayed the same between 2009 and 2017, but the group's transit use habits changed as observed. These percentages are not additive; they cannot be used to examine two different groups cumulatively.

Table 6-1. Changes in Transit Ridership Due to Changes in Population and Usage Effects in California

CHARACTERISTIC		2009		2017		POPULATION EFFECT	USAGE EFFECT
		SHARE OF THE POPULATION	TRANSIT TRIPS PER YEAR	SHARE OF THE POPULATION	TRANSIT TRIPS PER YEAR		
Car Ownership	Zero-vehicle	5.8%	257.8	5.2%	273.3	-1.2%	+2.1%
	Vehicle-deficit	16.0%	87.1	15.5%	42.1	+0.9%	-17.9%
	Fully Equipped	78.2%	14.0	79.4%	23.0	+4.7%	+18.4%
Race/ Ethnicity	Hispanic	32.5%	66.6	35.6%	37.5	+5.6%	-26.7%
Population Density	High Population Density	31.5%	86.5	32.4%	72.6	+6.8%	-11.6%
	Low Population Density	68.5%	18.5	67.6%	22.7	+2.9%	+7.2%
Income[14]	Low-income	22.5%	93.3	18.0%	76.3	-5.1%	-7.9%
	Not Low-income	73.0%	23.6	79.7%	30.1	+10.0%	+13.2%
All		100%	39.9	100%	38.9	+8.6	-2.7

Data source: FHWA, 2009, 2017

The top panel of **Table 6-1** illustrates how the changing size and the changing ridership rates of individuals living in zero-vehicle, vehicle-deficit, and fully equipped households affected transit patronage statewide from 2009 to 2017. Perhaps most notably, the frequency of transit use among individuals living in vehicle-deficit households dropped dramatically between the two survey periods. Whereas Californians with a vehicle deficit rode transit roughly 87 times per year in 2009, they averaged just over 42 transit trips per year in 2017. As the "Usage Effect" column shows, this resulted in nearly an 18 percent drop in total transit use statewide. By comparison, the influence of the population effect is far more modest. Although the proportion of individuals living in vehicle-deficit households declined slightly, the total vehicle-deficit population actually rose (by about 255,000 people) due to population growth, resulting in a small increase in aggregate transit ridership (0.9%) (FHWA, 2009, 2017).

In contrast to the substantial loss in ridership due to declining transit use among those living in vehicle-

14. Population and usage effects for households that did not report income are not shown. Therefore, column totals for this category do not add up to 100%.

deficit households, individuals living in fully equipped households actually rode transit more frequently in 2017 than in 2009. Not surprisingly, ridership among this demographic was quite low in 2009, with a per capita observed rate of only 14 transit trips per year—equivalent to one round trip on public transit every 52 days. By 2017, however, the frequency of use among those in the fully equipped category increased by 64 percent to 23 trips per person per year—or one round trip every 31 days. While an increase of nine per capita trips per year is undoubtedly modest, the fact that this group comprises an extremely large proportion of the population—79.4 percent in 2017—means that even small increases in usage rates translate into a substantial growth in aggregate ridership. In fact, although the per person increase in transit use among fully equipped individuals was far smaller than the decrease among those in vehicle-deficit households, fully equipped riders actually had a slightly greater impact on overall statewide transit ridership (FHWA, 2009, 2017).

With regard to race and ethnicity, we focus primarily on trends among Hispanics. To be sure, the ridership rates of other racial and ethnic groups shifted in important ways during the study period. However, the large size of California's Hispanic population combined with Hispanic travelers' high average transit use means that even small changes in ridership among this group can have outsized effects on aggregate patronage. As **Table 6-1** shows, transit use among Hispanics dropped substantially between 2009 and 2017. On average, Hispanics took 29 fewer transit trips per capita per year in 2017 than in 2009. This negative usage effect resulted in a loss of nearly 27 percent of total ridership statewide. In contrast to this large drop in transit use due to usage effects, the population effect for Hispanics was positive. This is because the overall Hispanic population grew between the two survey years, meaning that, had ridership rates held constant, total transit use by Hispanic residents would have grown by 5.6 percent relative to 2009[15] (FHWA, 2009, 2017).

We also evaluate shifts in transit use due to usage and population changes of households living in neighborhoods with different population densities. Not surprisingly, individuals living in areas of high population density[16] take transit quite frequently, making an average of 86.5 transit trips per year in 2009. By 2017, however, this rate dropped by almost 14 yearly person-trips—roughly a 16 percent decrease. In total, this declining trip rate led to an 11.6 percent drop in total transit trips. Nevertheless, during this same period, the total population living in high-density neighborhoods grew by over one million people. This population growth led to a population effect that, when holding trip-making rates constant at 2017 levels, was associated with a total ridership increase of 6.8 percent (FHWA, 2009, 2017). In other words, while more people are living in high-density neighborhoods over time, the average number of transit trips taken by those high-density neighborhood residents is falling (See Chapter 14 for specific analysis of changes in transit-friendly neighborhoods).

In contrast to lower trip-taking by those in high-density neighborhoods, transit use among those living in areas of low population density[17] rose between 2009 and 2017, going from 18.5 person-trips per year to 22.7 person-trips per year. Holding population counts constant, this represents a 7.2 percent increase in total statewide ridership. Furthermore, the population in low-density areas increased by roughly 1.8 million individuals—enough to produce a 2.9 percent increase in transit ridership, holding usage rates constant at 2017 levels (FHWA, 2009, 2017).

15. Transit ridership might have been even higher had California not experienced a shift in the composition of immigrants toward those from Asia.

16. In this chapter, defined as census tracts with greater than 10,000 inhabitants per square mile

17. In this chapter, defined as census tracts with 10,000 inhabitants or fewer per square mile

Finally, we also examine the usage and population effects for individuals living in low-income[18] and non-low-income[19] households. Ridership rates for low-income household residents, traditionally heavy transit users, dropped considerably between 2009 and 2017. On average, they took 17 fewer trips per year, which was associated with a 7.9 percent decrease in overall transit ridership in California. During the same period, the proportion of those living in low-income households also declined from 22.5 percent of the population in 2009 to only 18 percent in 2017. This drop—likely the result of both a recovery from the Great Recession and a generally vibrant economy during the 2010s—was associated with an estimated 5.1 percent fewer trips in 2017 (assuming 2017 ridership levels) (FHWA, 2009, 2017).

Transit use among non-low-income household travelers sharply contrasts with their low-income counterparts. A relatively small 6.5 trip per year increase in transit use among these middle- and higher-income individuals between 2009 and 2017 translated into a large 13.2 percent overall rise in ridership due to the relatively large size of this group. In addition, population growth in these higher income groups led to a ten percent increase in total ridership (FHWA, 2009, 2017).

In summary, the most significant changes in transit ridership statewide were due to the lower transit use by those living in households with a vehicle deficit and somewhat higher transit use by those with better automobile access (We explore the effects of changes in vehicle access further in Chapter 8.). This change coincided with the decline in transit use in higher-density areas and higher transit use in lower-density areas. In addition, transit ridership has been affected by the fall-off in transit use by the shrinking proportion of low-income households and the dramatic drop in ridership among Hispanics (despite some growth in their population statewide).

6.4.2. Population and Usage Effects in the Central Bay Area and Los Angeles and Orange Counties

In addition to our statewide analysis, we also investigate changes in aggregate transit use at the regional level. Sample-size limitations and the way NHTS data are geographically classified mean that we can only separately analyze the two largest metropolitan statistical areas in the state: the central Bay Area counties (at the heart of the San Francisco Bay Area) and Los Angeles and Orange Counties (at the heart of Greater Los Angeles) (See Appendix A, Section 1). Given their unique contexts, one might expect substantial differences in ridership trends between these areas. We therefore performed an analysis of transit use in each area using the same population and usage effect methodology described above. The results are presented in **Table 6-2**.

18. In this chapter, defined as households earning less than $25,000 per year

19. In this chapter, defined as households earning $25,000 or more per year

Table 6-2. Changes in Population and Usage Effects in Major California Metropolitan Areas

Characteristic		Central Bay Area Counties		Los Angeles and Orange Counties	
		Population Effect	Usage Effect	Population Effect	Usage Effect
Car Ownership	Zero-vehicle	+5.4%	-1.7%	-14.5%	+0.7%
	Vehicle-deficit	+3.6%	-3.5%	-2.6%	-27.1%
	Fully Equipped	+9.0%	+20.7%	+6.7%	+8.5%
Race/ Ethnicity	Hispanic	+1.1%	-3.9%	-0.1%	-48.2%
Population Density	High Population Density	+15.5%	+2.0%	+0.3%	-32.4%
	Low Population Density	+4.5%	+10.5%	+2.8%	-7.5%
Income	Low-income	-3.0%	-4.5%	+18.7%	-11.7%
	Not Low-income	+21.7%	+23.8%	+9.0%	-5.8%
All		+18.6%	+14.6%	+5.7%	-44.2%

Data source: FHWA, 2009, 2017

Table 6-2 highlights enormous regional differences in transit ridership trends. Broadly speaking, transit use in the central Bay Area grew substantially between 2009 and 2017. In terms of absolute value, the largest population and usage effects were all positive. Perhaps most surprisingly, some of the biggest increases occurred among socio-demographic groups that tend to use transit rather infrequently. For example, increasing ridership rates of those living in fully equipped households resulted in a 20.7 percent increase in transit patronage when holding population size constant at 2017 levels. Similarly, non-low-income households also rode public transportation more frequently, leading to 23.8 percent more transit use than in 2009. Importantly, while transit use among fully equipped and non-low-income individuals increased, the population size of these two groups also expanded. As a result, even when holding usage rates constant, increases in fully equipped individuals led to a nine percent rise in transit ridership in the central Bay Area counties, while the growth in the non-low-income population led to 21.7 percent more transit use there (FHWA, 2009, 2017).

In contrast to the central Bay Area's overall positive ridership trends, transit use in Los Angeles and Orange Counties declined sharply between 2009 and 2017. Some of the biggest drops in aggregate ridership occurred among socio-demographic groups that are traditionally frequent transit users. The usage rates of individuals living in vehicle-deficit households, for example, fell dramatically. Holding their population constant at 2017 levels, decreased transit-use rates by vehicle-deficit residents led to a 27.1 percent drop in the counties' ridership. Similarly, those living in high-density census tracts used transit far less in 2017 than in 2009, resulting in a 32.4 percent decline in public transportation patronage there. Most noticeably, transit use by Hispanics in Los Angeles and Orange Counties plummeted between 2009 and 2017. Holding population constant at 2017 levels, lower ridership rates among Hispanics resulted in nearly 200 million fewer trips being taken in 2017 than in 2009, driving down total transit ridership by 48.2 percent (FHWA, 2009, 2017).

Just as declining ridership rates among heavy transit users have led to a decline in aggregate patronage, so too have population decreases in some of these groups. Los Angeles and Orange Counties' shrinking low-income population, for example, resulted in 18.7 percent fewer riders in 2017 relative to 2009 population levels. Likewise, drops in the zero-vehicle population—typically the most transit-dependent demographic group—also depressed ridership there. Specifically, the loss of about 180,000 individuals in zero-vehicle households led to almost 60 million fewer transit trips in 2017, a 14.5 percent drop in overall transit use (FHWA, 2009, 2017).

6.5. Conclusion

Changing demographics and changing ridership rates have had important impacts on transit ridership in California over the past several years. Broadly speaking, demographic groups that have traditionally used transit relatively frequently are using it less, including those with limited automobile access, Hispanics, and those that live in densely-populated neighborhoods. By contrast, groups that typically have very low levels of transit use are now riding more frequently, particularly those with ample vehicle access, non-Hispanic whites, and individuals living in relatively low-density neighborhoods. While changes in the *population size* of certain demographic groups have contributed to some ridership losses, the aforementioned changes in *ridership rates* among those groups are the most prominent contributor to overall ridership declines. Finally, trends differed dramatically by region between 2009 and 2017. While population and usage effects were generally negative in Los Angeles and Orange Counties (for the most part mirroring trends statewide), changes in population and usage in the central Bay Area had moderately positive effects on transit ridership—dovetailing with the regional differences in ridership trends discussed in Chapter 3.

7. Changes in the Types of Transit Users

7.1. Introduction

In Chapter 6, we examined how changes in transit use and population size among specific demographic groups have affected total transit ridership in California. In this chapter, we focus not on the relationship between demographic trends and aggregate transit use, but instead on how the demographics of transit users have changed over time. To do so, we use a statistical technique called latent profile analysis to identify "classes" of transit riders in the state. We then track the relative size of these classes between 2009 and 2017 to better understand how the characteristics of transit users in California have changed over time.

We find three distinct classes of transit riders in the state: "Occasional Transit Riders," who tend to have moderate incomes and use transit for only a small portion of their daily travel; "Transit Dependents," who generally have low incomes and take transit for most of their personal trips; and "Choice Riders," who have high average incomes and are heavy transit users. While the proportion of Transit Dependents was relatively stable between 2009 and 2017, the share of Occasional Transit Riders declined substantially and the percentage of Choice Riders more than doubled. People who use transit for short, occasional trips now represent a shrinking share of transit riders, while the presence of higher-income, longer-distance riders has become more pronounced.

7.2. Transit User Types

Latent profile analysis provides a convenient way to develop a "broad brush" picture of travel behavior in the state. Performing a latent profile analysis first requires identifying travel-behavior characteristics that differentiate one group of transit users from another. For example, a wealthy suburbanite who uses rail transit to commute into a central business district represents a very different type of transit user from a poorer urban resident who relies on bus transit to carry out his or her daily errands. To identify the underlying groups to which these types of travelers belong and to track their size and behavior over time, we specify four types of variables that distinguish various "classes" of transit users: 1) the extent to which an individual rides transit; 2) an individual's relative dependence on public transportation; 3) the availability of alternative modes of travel; and 4) the type of transit an individual uses. **Table 7-1** provides a description of the specific data included in the latent profile analysis to measure these characteristics.

Table 7-1. Independent Variables for Latent Profile Analysis

VARIABLE		RANGE
Extent of Transit Use	Number of Transit Trips on the Survey Day	1-7
	Person-miles Traveled on Transit on the Survey Day	0.1-150
	Number of Transit Trips over the Past Month	1-150
Relative Transit Dependence	Percent of Total Trips Made on Transit on the Survey Day	7-100
	Percent of Total Person-miles Traveled Made on Transit on the Survey Day	0.2-100
Availability of Alternatives	Driver's License	yes; no
	Household Vehicle Ownership	zero-vehicle; vehicle-deficit; fully equipped
Transit Type	Mode of Transit Used on the Survey Day	bus only; rail only; mix

Data source: FHWA, 2009, 2017

Latent profile analysis models do not specify an optimal number of latent classes; instead, analysts generally estimate models for a range of class solutions, and use one or more fit statistics to determine the ideal number of classes. Following prior research on models of this type (Nylund, Asparouhov, and Muthén, 2007 and Lanza et al., 2007), we chose a three-class solution. **Table 7-2** shows the characteristics of each class, with names suggested by us.

Table 7-2. Latent Classes of Transit Users in California, 2009 and 2017 (Pooled)

CHARACTERISTIC		OCCASIONAL TRANSIT RIDERS	TRANSIT DEPENDENTS	CHOICE RIDERS
Transportation/ Travel Characteristics	Percent Zero-vehicle	22.5%	40.2%	7.7%
	Percent Vehicle-deficit	30.8%	25.5%	18.9%
	Percent Fully Equipped	46.8%	34.3%	73.3%
	Daily Person-miles Traveled on Transit	8.1	16.2	68.9
	Daily Person-miles Traveled Total	24.3	17.3	76.8

CHARACTERISTIC		OCCASIONAL TRANSIT RIDERS	TRANSIT DEPENDENTS	CHOICE RIDERS
Transportation/ Travel Characteristics	Number of Daily Transit Trips	1.4	2.4	2.1
	Total Daily Person Trips	5.0	3.6	3.9
	Number of Transit Trips in Past Month	18.7	22.5	17.9
	Number of Daily Bus Trips	1.06	1.89	0.84
	Number of Daily Rail Trips	0.34	0.48	1.28
	Number of Daily Transit Work Trips	0.40	0.71	1.12
	Percent who Commute on Transit (among Employed Individuals Only)	61.0%	83.3%	73.6%
Socio-economic Characteristics	Percent Non-Hispanic White	33.7%	28.7%	36.5%
	Percent Hispanic	38.0%	41.2%	21.1%
	Percent Non-Hispanic Black	7.0%	10.8%	12.1%
	Percent Non-Hispanic Asian	15.9%	12.6%	20.0%
	Percent Non-Hispanic Other	5.4%	6.6%	10.4%
	Percent Immigrant	40.5%	37.3%	36.3%
	Percent Employed	64.8%	53.2%	81.6%
	Percent Income under $10,000	13.3%	18.7%	4.9%
	Percent Income $10,000-$25,000	20.0%	27.7%	8.5%
	Percent Income over $100,000	25.6%	17.5%	50.6%
Residential Location	Percent Living in Very High Density Areas	23.9%	24.0%	8.6%
Percent of Sample		32.7%	55.1%	12.2%

Data source: FHWA, 2009, 2017

An examination of **Table 7-2** reveals clear inter-group distinctions on a number of socioeconomic, demographic, and travel behavior factors. The first class, "Occasional Transit Riders," is a group of individuals who appear to use transit to supplement travel by other modes. This class uses transit to cover 30 percent of their daily person-miles traveled and on 28 percent of their daily trips, and they represent about one-third of transit users in California. These Occasional Transit Riders have a moderate level of vehicle access: just under half of the individuals in this group live in fully-equipped households (with at least one vehicle per driver), while just over half live in a household where vehicle availability is limited. The income distribution of Occasional Transit Riders is quite diffuse, with one-third of these transit users residing in a household earning less than $25,000 per year, while over a quarter earn over $100,000.

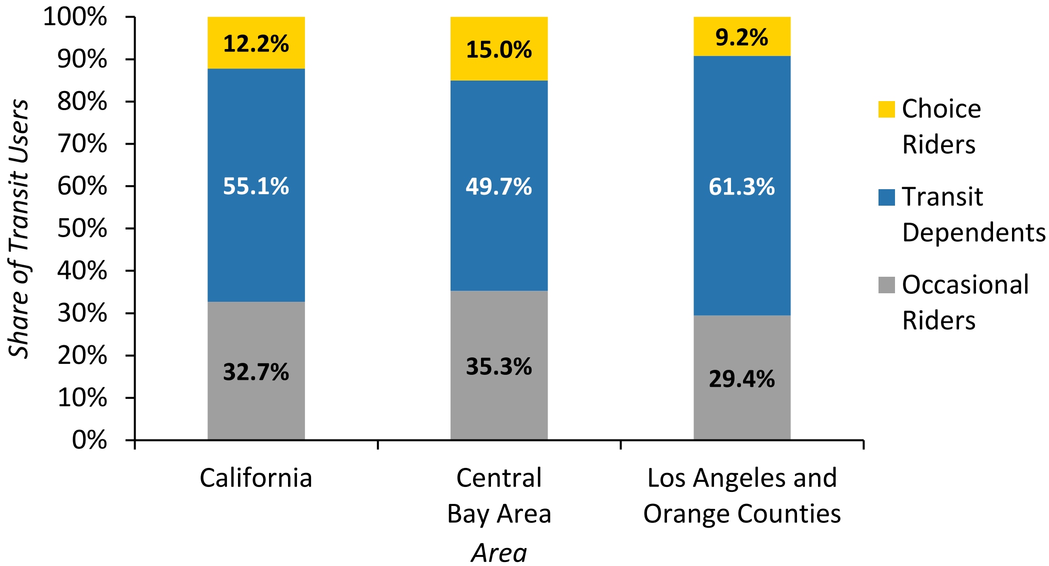
In contrast to Occasional Transit Riders, those grouped into the second class are classic "Transit Dependents." These individuals have limited car access, with almost two-thirds living in zero-vehicle or vehicle-deficit (e.g., less than one vehicle per driver) households. They also have relatively low levels of income, with 46.4 percent of Transit Dependents residing in households earning less than $25,000 per year. Given their combination of relatively poor automobile access and lack of financial resources, Transit Dependents likely have little choice but to rely on public transportation for most of their travel needs. Perhaps not surprisingly then, the trip-making and personal mobility of Transit Dependents are quite limited: these individuals make the fewest number of average daily trips (3.6), have the lowest average daily person-miles traveled (17.3) of all transit users, and rely on transit for almost all of their daily miles traveled (94%). Also of note is the fact that Transit Dependents make up a majority of transit users in California, comprising 55 percent of all riders during the period from 2009 to 2017.

Finally, the third class, like the second, includes individuals who use transit for a very high proportion of their overall travel, with members of the third class traveling roughly 90 percent of their total miles on public transportation. However, individuals in this last class appear to be "Choice Riders" rather than truly transit-dependent: these riders have good automobile access (Over 73 percent live in fully-equipped households.), high incomes (More than half earn more than $100,000 in yearly household income.), and live in relatively low-density communities (Only 8.6% reside in a census tract with more than 25,000 inhabitants per square mile.). While these characteristics traditionally predict a very low level of transit use, Choice Riders have by far the highest transit person-miles traveled of the three classes: they travel more than four times farther on public transportation than Transit Dependents, and over 8.5 times farther than Occasional Transit Riders. Choice Riders are also more likely than other transit users to ride rail, with well over half of their transit trips being made by train. Finally, for Choice Riders, there is a clear connection between work-related activity and transit ridership. Over 81 percent of Choice Riders are employed, and nearly three-quarters of these workers commute to their place of employment via transit. Not surprisingly then, Choice Riders take a considerable amount of work-related transit trips, averaging 1.12 trips to or from work per day, more than that of the other two classes combined. Choice riders were the smallest group of riders during the study period, making up roughly 12 percent of transit riders in the state.

Figure 7-1 presents the relative distribution of transit users in the Central Bay Area and Los Angeles and Orange Counties that fall into each of the three identified latent classes.[20]

20. As a robustness check, we also performed region-level latent profile analyses in which we reclassified transit riders using one model that included only individuals from the central Bay Area and another model that included only individuals from Los Angeles and Orange Counties. Class distributions are very similar to those from the statewide model. Given the similarity of these results and given the much larger sample sizes available for the state-level model, we present our results from the all-California model throughout this analysis.

Figure 7-1. Latent Classes of Transit Users, 2009 and 2017 (Pooled)



Data source: FHWA, 2009, 2017

Transit users in the central Bay Area are somewhat more evenly distributed across the three groups relative to those in the Los Angeles and Orange Counties (and relative to those in the state as a whole). Less than half of transit riders in the central Bay Area are Transit Dependents, while 35.3 percent are Occasional Transit Riders and 15.0 percent are Choice Riders. Los Angeles and Orange Counties, by contrast, have a high proportion of Transit Dependent riders (61.3%), with only 29.4 percent Occasional Transit Riders and 9.2 percent Choice Riders.

7.3. Changes in Transit User Types

We also examined changes in the travel behavior, socioeconomic features, and population distribution of our three latent classes of transit users over the two survey periods. The results, shown in **Table 7-3**, highlight several important trends. First, trip-making on transit declined among all three groups during the study period. The number of transit trips made by Occasional Transit Riders dropped from 1.5 in 2009 to 1.3 in 2017; for Transit Dependents, daily trips declined from 2.5 to 2.3; for Choice Riders, trip making decreased from 2.5 to 2.0. Clearly, transit users rode transit less on average as time passed, regardless of their ridership class. In addition to this decrease in trip-making, there were also major shifts in the type of transit used by riders. While the number of bus trips dropped dramatically for all three categories during the study period, rail trips increased in each class. This trend was especially pronounced among Choice Riders, whose bus-trip-making decreased by over one daily ride from 1.62 to 0.59 while their average number of rail trips increased 0.59 rides per person per day.

Also of note is the shift in the overall distribution of individuals in the three classes: while the percentage of riders in the Transit Dependent class stayed relatively stable, the proportion of Occasional Transit Riders dropped from 37.9 percent to 29.6 percent and the share of Choice Riders more than doubled, rising from 7.1 percent to 15.3 percent of California's transit users. This trend suggests that as the share of riders taking occasional, short transit trips is decreasing, the proportion of individuals making relatively long-distance trips, often by rail and often to or from work, is growing. In addition to changes in their travel behavior, the residential location of Choice Riders has shifted. In 2009, 17.2 percent of Choice Riders lived in very high-density neighborhoods.[21] While this was the lowest proportion of very high-density residents among the three types of riders, gaps in the residential location of members of the three classes were relatively small. By 2017, however, the share of Choice Riders living in very high-density neighborhoods dropped dramatically—to 5.8 percent—while the proportion of very high-density residents in the other classes remained relatively stable.

Table 7-3. Changes in Characteristics of Latent Classes in California, 2009 and 2017

CHARACTERISTIC		2009			2017		
		OCCASIONAL TRANSIT RIDERS	TRANSIT DEPENDENTS	CHOICE RIDERS	OCCASIONAL TRANSIT RIDERS	TRANSIT DEPENDENTS	CHOICE RIDERS
Transportation/Travel Characteristics	Percent Zero-vehicle	19.9%	38.2%	10.1%	24.9%	41.5%	7.0%
	Percent Vehicle-deficit	39.7%	38.9%	22.1%	22.5%	16.7%	17.9%
	Percent Fully Equipped	40.4%	22.9%	67.8%	52.6%	41.8%	75.2%
	Daily Person-miles Traveled on Transit	7.2	13.9	74.7	8.9	17.7	67.0
	Daily Person-miles Traveled Total	23.8	15.0	82.0	24.8	18.8	75.1
	Number of Daily Transit Trips	1.5	2.5	2.5	1.3	2.3	2.0
	Total Daily Person Trips	5.2	3.6	3.9	4.7	3.6	3.9
	Number of Transit Trips in Past Month	21.3	28.3	23.7	16.2	18.7	16.1

21. Census tracts with greater than 25,000 inhabitants per square mile

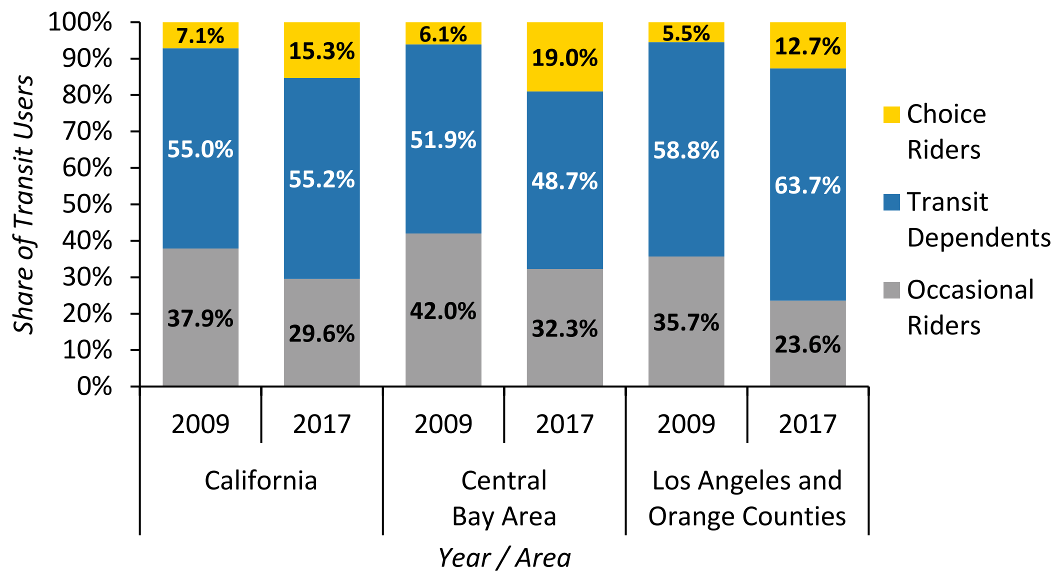
CHARACTERISTIC		2009			2017		
		OCCASIONAL TRANSIT RIDERS	TRANSIT DEPENDENTS	CHOICE RIDERS	OCCASIONAL TRANSIT RIDERS	TRANSIT DEPENDENTS	CHOICE RIDERS
Transportation/Travel Characteristics	Number of Daily Bus Trips	1.22	2.20	1.62	0.92	1.68	0.59
	Number of Daily Rail Trips	0.24	0.28	0.84	0.42	0.60	1.43
	Number of Daily Transit Work Trips	0.40	0.75	1.11	0.40	0.67	1.12
	Percent who Commute on Transit (among Employed Individuals Only)	56.6%	81.4%	77.0%	65.3%	84.7%	72.7%
Socio-economic Characteristics	Percent Non-Hispanic White	45.2%	41.9%	50.1%	36.2%	34.3%	31.8%
	Percent Hispanic	30.8%	28.7%	39.3%	36.5%	28.7%	35.6%
	Percent Non-Hispanic Black	41.5%	46.9%	27.2%	34.8%	37.5%	19.1%
	Percent Non-Hispanic Asian	5.8%	9.9%	20.7%	8.1%	11.5%	9.2%
	Percent Non-Hispanic Other	14.2%	7.7%	11.3%	17.4%	15.9%	22.8%
	Percent Immigrant	7.7%	6.9%	1.5%	3.2%	6.4%	13.3%
	Percent Employed	63.3%	56.2%	74.2%	66.1%	51.2%	84.0%
	Percent Income under $10,000	16.3%	16.7%	7.5%	10.6%	20.1%	4.0%
	Percent Income $10,000-$25,000	24.5%	38.7%	13.7%	15.8%	20.5%	6.8%
	Percent Income over $100,000	17.3%	9.6%	33.8%	33.3%	22.6%	56.0%

CHARACTERISTIC		2009			2017		
		OCCASIONAL TRANSIT RIDERS	TRANSIT DEPENDENTS	CHOICE RIDERS	OCCASIONAL TRANSIT RIDERS	TRANSIT DEPENDENTS	CHOICE RIDERS
Residential Location	Percent Living in Very High Density Areas	22.9%	25.5%	17.2%	24.8%	23.0%	5.8%
Percent of Sample		37.9%	55.0%	7.1%	29.6%	55.2%	15.3%

Data source: FHWA, 2009, 2017

Regional-level changes are also noteworthy (See **Figure 7-2**). The proportion of Choice Riders grew substantially in both regions, with the share of these riders more than tripling in the central Bay Area and more than doubling in Los Angeles and Orange Counties. By contrast, the percentage of Occasional Transit Riders in both regions shrank, dropping 23 percent in the central Bay Area counties and 34 percent in Los Angeles and Orange Counties. Finally, the proportion of Transit Dependents in the central Bay Area decreased from 51.9 percent of users to 48.7 percent, while in Los Angeles and Orange Counties, the share of Transit Dependents increased, from 58.8 percent in 2009 to 63.7 percent in 2017.

Figure 7-2. Changes in Latent Classes of Transit Users in Major California Metropolitan Areas



Data source: FHWA, 2009, 2017

7.4. Conclusion

The results of our latent profile analysis highlight a shift in the pool of transit riders in California between 2009 and 2017. As the proportion of Occasional Riders—moderate-income individuals who tend to take short, irregular trips on transit—has declined, the share of Choice Riders—higher-income riders that take longer, often work-related trips—has increased. To some extent, these findings echo those from Chapter 6, where we note an increase in transit use by individuals in high-income households and those that live in relatively low-density neighborhoods. Because our analysis here focuses only on changes in the proportion of each of the latent classes (and not the total number of individuals in them), it is not possible to draw conclusions regarding how these changes have affected overall ridership in the state. However, this chapter's results, interpreted in combination with the findings from Chapter 6, suggest that between 2009 and 2017 the market for transit use in California has shifted somewhat: over time, systems are attracting riders not typically associated with transit ridership, while losing those that have traditionally comprised their core customer base.

Part IV. How Are Alternatives to Public Transit Changing?

When deciding whether, where, and when to make a trip, people also decide on the means—or "mode"—of travel. Should they walk, ride a bike, take a bus or train, call for Lyft or Uber, drive a car, or get a ride from a family member or acquaintance driving theirs? Because most people have access to private cars for their trips, and because much of metropolitan America has been designed to support driving, most people travel in cars for most trips. So when deciding whether to ride public transit for a given trip, most people weigh the costs and benefits of transit vis-à-vis a variety of other options, including driving. In the following chapters, we evaluate how the transportation context outside of public transit has changed in California. While we emphasize trends in increased motor vehicles access, we also address the growing presence of other options like ridehail, private commuter shuttles, and micromobility services (See Appendix A, Section 2 for definitions).

In Chapters 8, 9, and 10, we examine changes in dynamics related to private vehicles. These include rates of motor vehicle ownership, fluctuations in fuel prices, and the influence of AB 60—the extension of drivers licenses to undocumented immigrants—on rates of public transit use. Echoing our previous study of transit ridership declines in Greater Los Angeles (Manville, Taylor, and Blumenberg, 2018), our analysis in Chapter 8 suggests that increases in car ownership have had an important effect—indeed, likely the largest effect of any other factor—on statewide transit use. Most of the areas of the state have seen a decline in the share of zero-vehicle households; our models suggest that this trend is associated with a significant drop in the number of transit trips taken per person. While this relationship is especially strong in Greater Los Angeles, it differs in the Bay Area, where changes in car access are small and have done little to affect transit use.

In Chapter 9, we find that changes in fuel prices have had no substantive effect on transit ridership in recent years. In terms of driver's licensing, we find in Chapter 10 that AB 60 has had a small but statistically significant effect on transit use among Latino/a undocumented immigrants.

In Chapter 11, we examine possible effects of the emergence of ridehail services like Uber and Lyft. We analyze data from the California oversample of the National Household Travel Survey and Census data on taxi and ridehail establishments, which both indicate a rapid growth in ridehail services throughout most of the state. We also draw upon previous studies and surveys addressing the relationship between ridehail and public transit, both in California and in other American metropolitan regions. This evidence suggests that ridehail in California has likely depressed statewide ridership, but to what extent we cannot determine for certain. While ridehail's transit substitution rates are likely highest in the Bay Area, it probably substitutes for transit to a lesser but still substantive degree in the San Diego Area and Greater Los Angeles as well.

Finally, in Chapter 12, we explore other emerging transportation alternatives, which include services like micromobility and private shuttles. Micromobility services include an array of fairly recent additions to the transportation landscape, including motorized scooters and electric bicycle share systems. We find little evidence that these services have seriously depressed transit ridership, both due to their very recent timing and the fact that they are not competitive for most transit trips. Instead, micromobility services mostly comprise very short trips and likely replace trips made by active modes like walking. Private shuttles have mostly concentrated in the Bay Area and serve many commuters traveling between Silicon Valley, San Francisco, and the East Bay. Analyzing data from private operators, we find little evidence that shuttle services have directly replaced many public transit trips. However, the new urban patterns enabled by shuttle services could have indirect effects on transit ridership.

Altogether, Part IV suggests that increased rates of automobile access and use of ridehail have likely reduced public transit ridership in much of California. In both cases, then, many residents have turned to automobiles—both their own personal ones, and those of ridehail drivers—for their travel needs. This has occurred in spite of rising fuel prices. However, the effects of these trends are not uniform across the state; a notable outlier, the Bay Area, has seen lower rates of increased automobile ownership but higher concentrations of ridehail drivers. With respect to newer technologies, including scooters and electric bicycles, we do not see strong evidence that such services have driven the bulk of California's transit ridership decline. However, these systems are relatively new, so their long-term influences on public transit ridership, both positive and negative, remain unclear.

8. Trends in Motor Vehicle Access and Use

8.1. Introduction

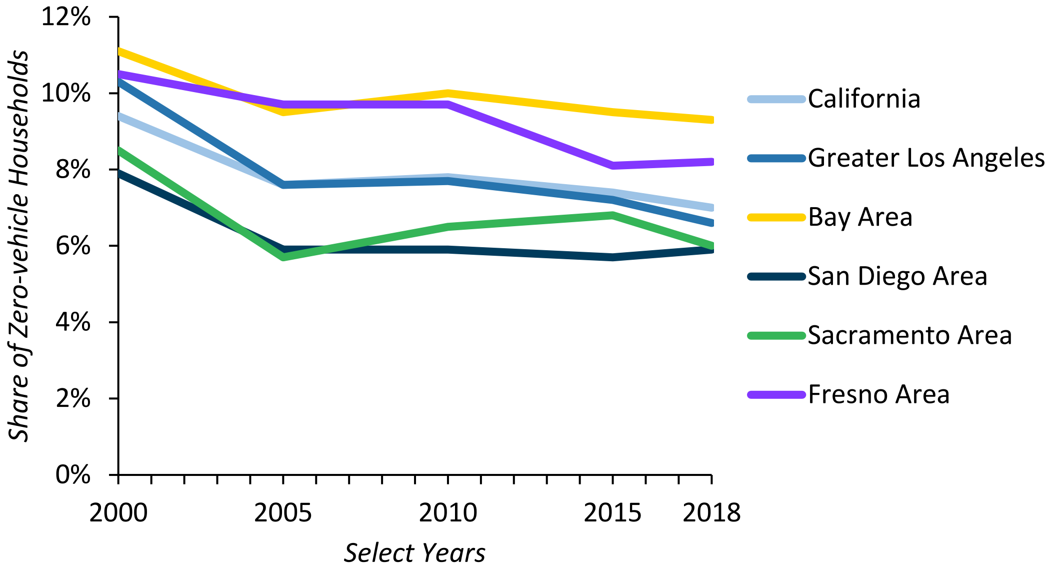
Automobile ownership is perhaps the strongest determinant of travel behavior. Individuals living in households with automobiles tend to use them for much if not all of their travel. Travelers in households without automobiles are more likely to travel by non-automobile modes including public transit. Among households with cars, 85 percent of all trips are in a private vehicle, compared to only 21 percent among individuals in households without automobiles (FHWA, 2017). Consequently, zero-vehicle households are overrepresented among transit users, comprising approximately 44 percent of all transit trips in the United States (FHWA, 2017). Therefore, we would expect increasing automobile ownership rates also to be associated with increased driving and, relatedly, waning use of public transit. We find this to be the case in California. Increased access to automobiles is strongly associated with declining transit ridership in all regions of the state with one exception—the Bay Area.

In this chapter, we review changes in auto ownership across the state's regions and population groups. Then, we see how these changes have played out in commute patterns. Finally, we model how rising auto access has affected transit use for all trip purposes, finding strong negative effects statewide and in Greater Los Angeles but not in the Bay Area.

8.2. Private Vehicle Access

From 2000 to 2018, vehicle access in California increased substantially. In the first decade of that period, between 2000 and 2010, the state added almost three million vehicles: roughly 0.89 additional cars for each additional resident. Relative to population growth, California's total car ownership increased even faster from 2010 to 2018: the number of household vehicles grew by almost 2.6 million, meaning that the state added 1.11 automobiles for every new resident. Over this same time period, the percent of households with zero vehicles declined by 16 percent (See **Figure 8-1**) (Ruggles et al., 2020).

Figure 8-1. Share of Zero-vehicle Households in California and California Regions



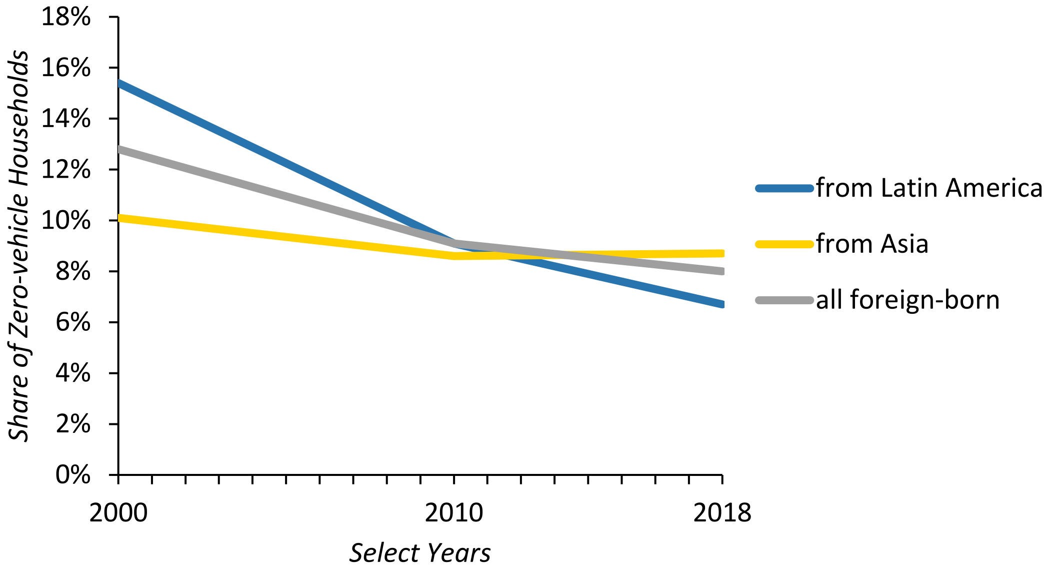
Data source: Ruggles et al., 2020

Figure 8-1 also includes information on automobile ownership for households in the state's five largest regions (See Appendix A, Section 1). Notably, the steeply declining proportion of high-transit use zero-vehicle households in Greater Los Angeles—where transit use has fallen sharply—closely matches the state as a whole. In contrast, the percentage of zero-vehicle households in the Bay Area—the region where transit ridership has proven most robust (See Chapter 3)—declined the least over this period (Ruggles et al., 2020).

Across these regions, changes in automobile ownership vary by population group. Immigrants are more likely to live in zero-vehicle households and to take transit than native-born adults. But car ownership among immigrant households increased significantly between 2000 and 2018, with the share of zero-vehicle immigrant households in California declining by 38 percent. Automobile ownership among immigrants also increased substantially in all five California regions, with the largest increase in Greater Los Angeles (Ruggles et al., 2020).

As **Figure 8-2** shows, this decrease is most dramatic among foreign-born households from Latin America. In 2000, 15.4 percent of California immigrant households from Latin America lacked a vehicle, but by 2018 this percentage had dropped to 6.7 percent (Ruggles et al., 2020). Additionally, as we note in Chapter 6, the composition of the immigrant population has shifted over time toward immigrants from Asia who tend to have higher incomes and therefore were more likely than immigrants from Latin America to own automobiles (at least until recently) and therefore less likely to take transit.

Figure 8-2. Share of Zero-vehicle Immigrant Households in California

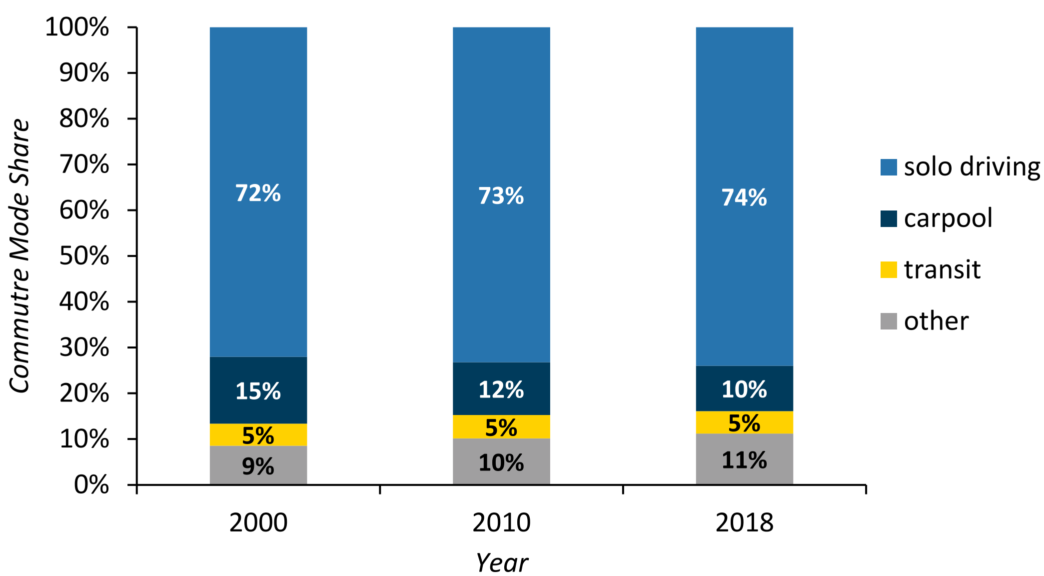


Data source: Ruggles et al., 2020

8.3. Commute Patterns

As auto ownership increases, though, commute patterns are changing more slowly. The American Community Survey, from which this analysis draws data, only includes information on travel mode to work, not travel mode for other trips. Among commute trips only, then, the share of California workers who drive alone changed very little (+2%) from 2000 to 2018, although carpooling declined significantly (See **Figure 8-3**). Transit use held steady over this period, with five percent of all workers commuting by transit (Ruggles et al., 2020). These statewide trends suggest that falling use of transit *for the commute* is not contributing as much to the decline in overall transit ridership in California as other trip types.

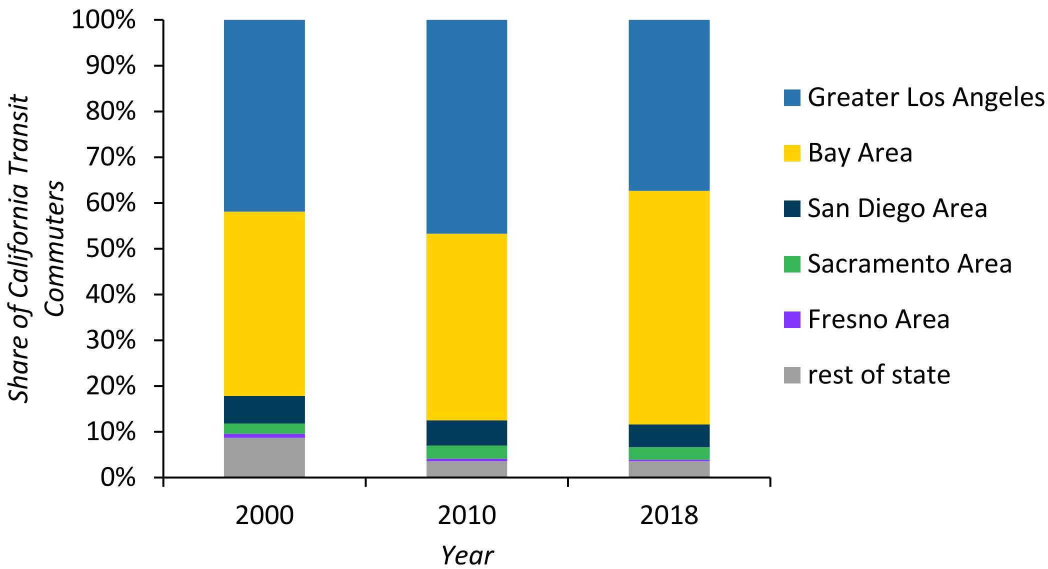
Figure 8-3. Commute Mode Share in California



Data source: Ruggles et al., 2020

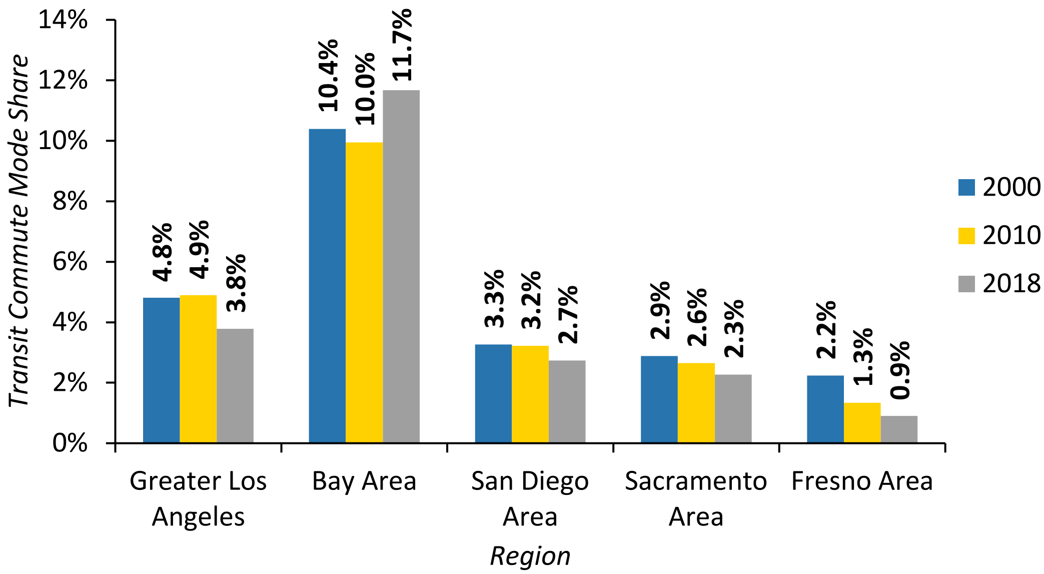
As auto access waxes and commute patterns shift in California, so too does the geography of the state's transit commuters. As **Figure 8-4** shows, more than 90 percent of all transit commuters in California live in the state's five largest regions. This percentage has increased over time, from 91 percent in 2000 to 96.5 percent in 2018. But over that period, the share of California's transit commuters from the Bay Area grew substantially as the share in Greater Los Angeles shrunk. This is because transit's commute mode share in the Bay Area increased over a percentage point between 2000 and 2018 (See **Figure 8-5**), while it declined significantly in Greater Los Angeles and noticeably in the other three major regions of the state. The gap between the Bay Area and the remainder of the state in transit commuting has widened since 2000, in concert with its overall more robust transit ridership trends (See Chapter 3) and its more stable rate of private vehicle ownership, described above.

Figure 8-4. Share of California Transit Commuters by Region



Data source: Ruggles et al., 2020

Figure 8-5. Transit Commute Mode Share by Region and Year



Data source: Ruggles et al., 2020

8.4. Predicting the Relationship between Private Vehicle Ownership and Transit Use

8.4.1. Modeling Transit Use

Taking these trends together, auto ownership has increased, but transit's commute mode share is relatively stable. How might these be squared? To model the effects of vehicle ownership on *all* transit trips, we drew on a different dataset, the California Household Travel Survey (CHTS), which includes all trip purposes and demographic information on trip-makers. While the data used above are limited to commute trips only (where transit's mode share is highest), 67 percent of all transit trips in California are for non-work purposes (FHWA, 2017). Therefore, to overcome this weakness, we used the 2012 CHTS to develop multivariate models to identify the relationship between vehicle ownership and transit patronage for all transit trips and travelers statewide (Caltrans, 2012).

We assess change in transit patronage over time by merging CHTS model estimations with earlier and later data from the U.S. Census and American Community Surveys. In short, we use the CHTS to estimate the relationship between transit use and different social and economic characteristics in 2012 and then apply these estimates to Census data to track how these characteristics have changed before and since.[22]

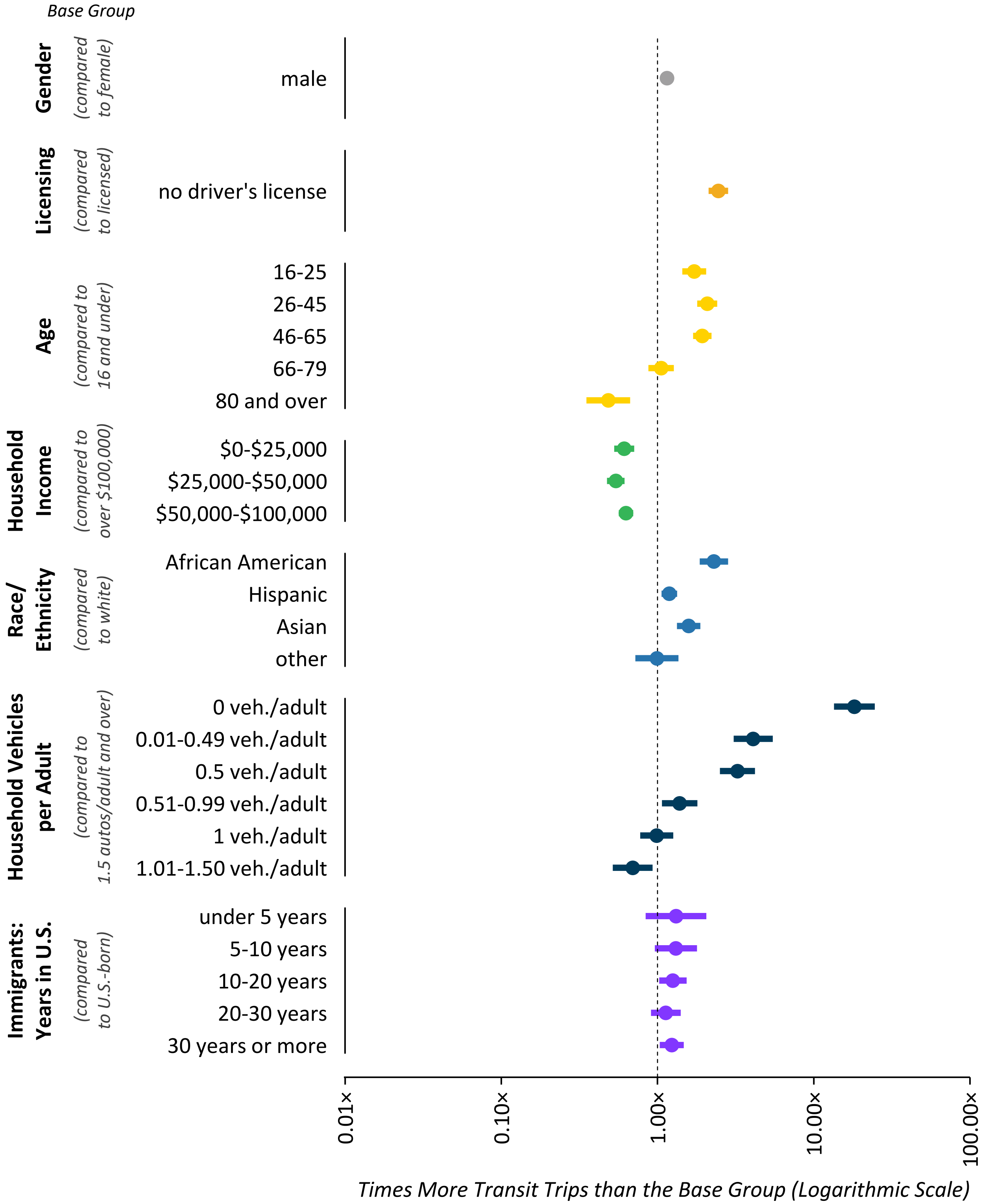
We constructed separate models for 1) California, 2) Greater Los Angeles, 3) Los Angeles and Orange Counties, 4) the San Francisco Bay Area, and 5) the central Bay Area counties (See Appendix A, Section 1).

22. A key assumption of this approach is that the relationships between transit use and the socioeconomic and demographic attributes, for which we only have data from 2012, are relatively constant across time. As our results in Chapter 6 show, this is not, in fact, the case: our analysis of usage and population effects demonstrates how the association between transit patronage and a number of socio-demographic characteristics changed during our study period. Nevertheless, this approach provides valuable insight into ridership trends in California: it allows us to examine trends over a much longer period of time than our analysis in Chapter 6, and it avoids the bias that might result from the NHTS, used in Chapter 6, being taken during the depths of a recession in 2009 versus the heights of an economic recovery in 2017.

Before estimating the effect of vehicle ownership changes on transit use over time, we first determined the major predictors of transit trips in each of these geographies at the time the CHTS was taken. **Figures 8-6** through **8-10** show the results: how transit use changes, all else equal, between travelers with a given socioeconomic or demographic characteristic. As **Figures 8-6**, **8-7**, and **8-8** illustrate, statewide, in Greater Los Angeles, and in Los Angeles and Orange Counties, lack of automobile ownership and access generally results in taking fewer transit trips, even accounting for other potential determinants of transit use. Beyond automobile access, transit use is lower for those who lack a driver's license, are non-white, and foreign-born—especially new arrivals.

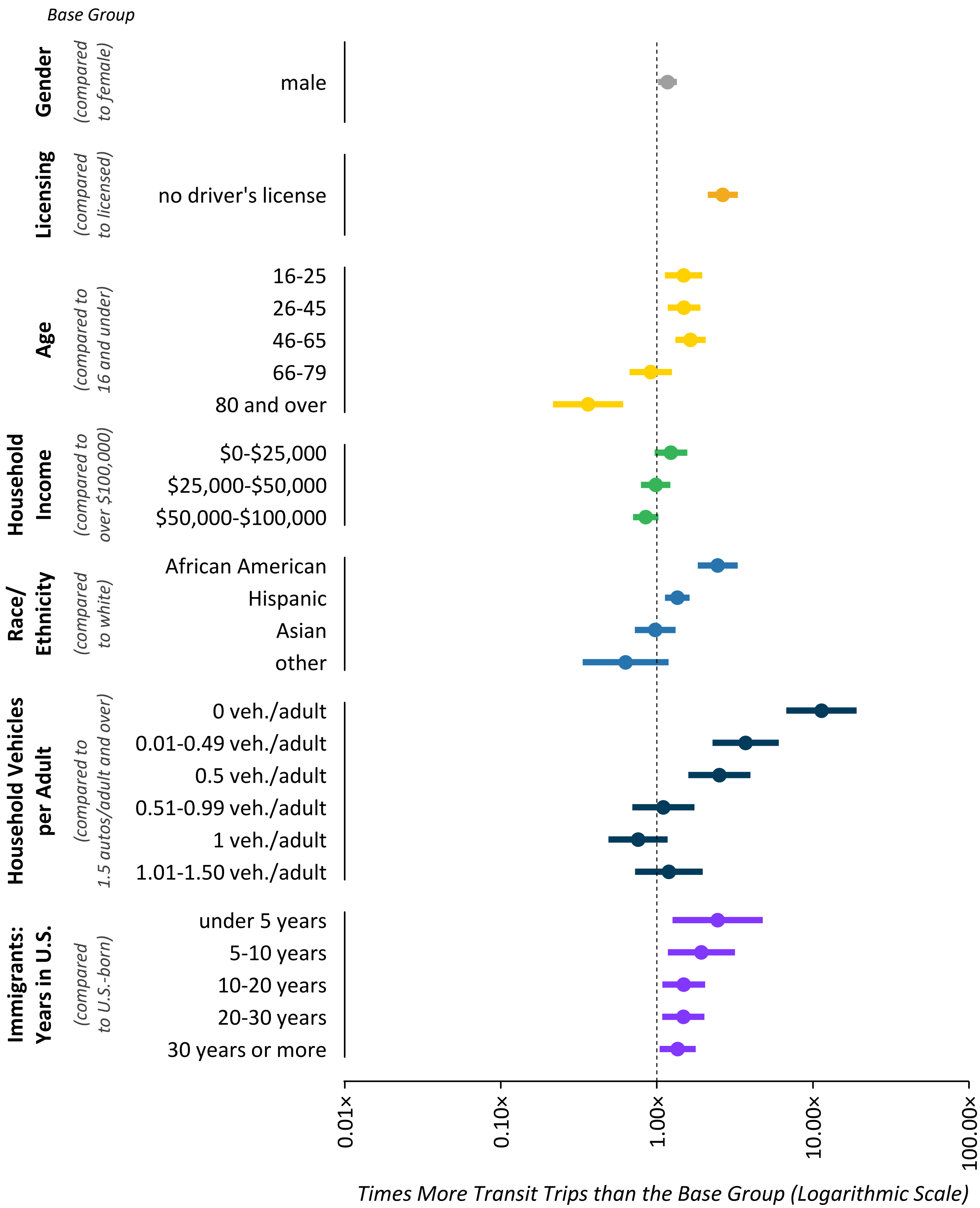
Figures 8-9 and **8-10** show that in the Bay Area and its central counties, auto access and lack of a driver's license are also strong predictors of transit use. However, several of the variables that were powerful predictors of transit use in California and in Greater Los Angeles—race, ethnicity, and immigrant status—are weaker predictors of transit ridership in the Bay Area. Furthermore, unlike residents of Los Angeles and Orange Counties, individuals in the Bay Area from high-income households actually ride transit slightly more than their lower-income counterparts, all else equal. Despite these differences, the overall relationship between vehicle ownership and transit use is consistent across geographies. Like residents statewide and in Southern California, individuals living in the Bay Area whose access to automobiles is limited—specifically those without a household vehicle and those with less than one vehicle per household driver—take transit far more frequently than those with higher levels of automobile access.

Figure 8-6. Predicted Transit Use by Group in California, 2012



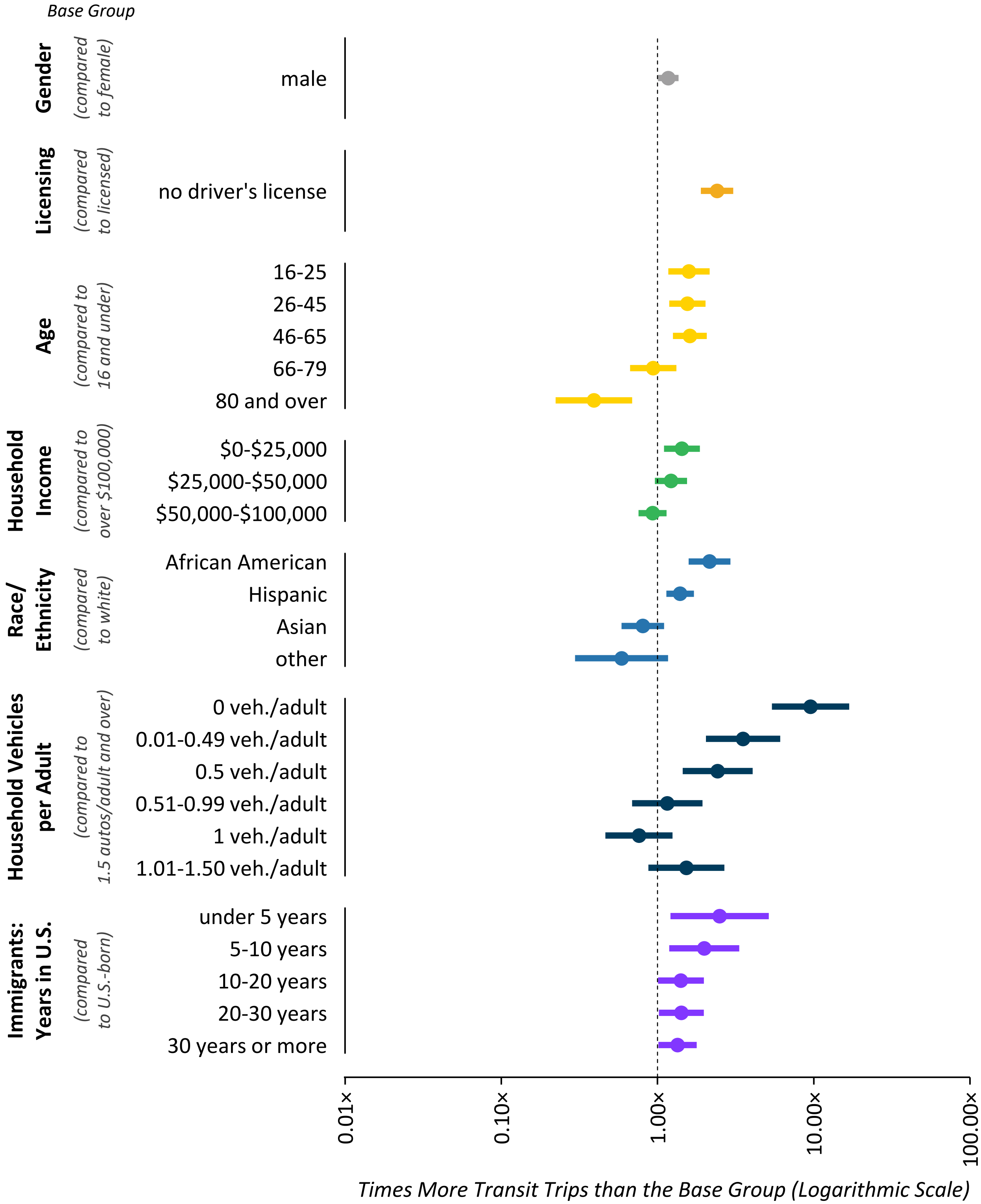
Data source: Caltrans, 2012

Figure 8-7. Predicted Transit Use by Group in Greater Los Angeles, 2012



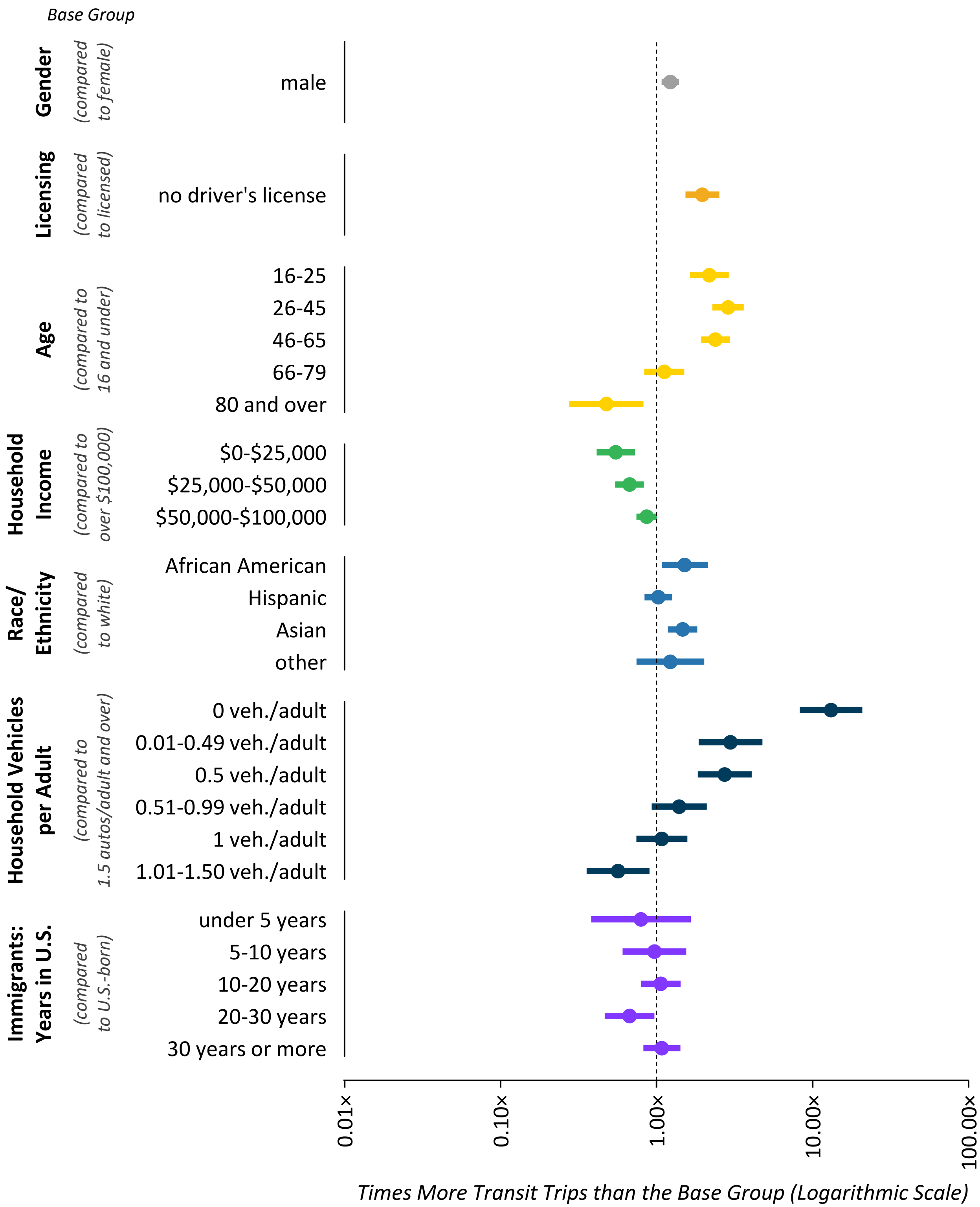
Data source: Caltrans, 2012

Figure 8-8. Predicted Transit Use by Group in Los Angeles and Orange Counties, 2012



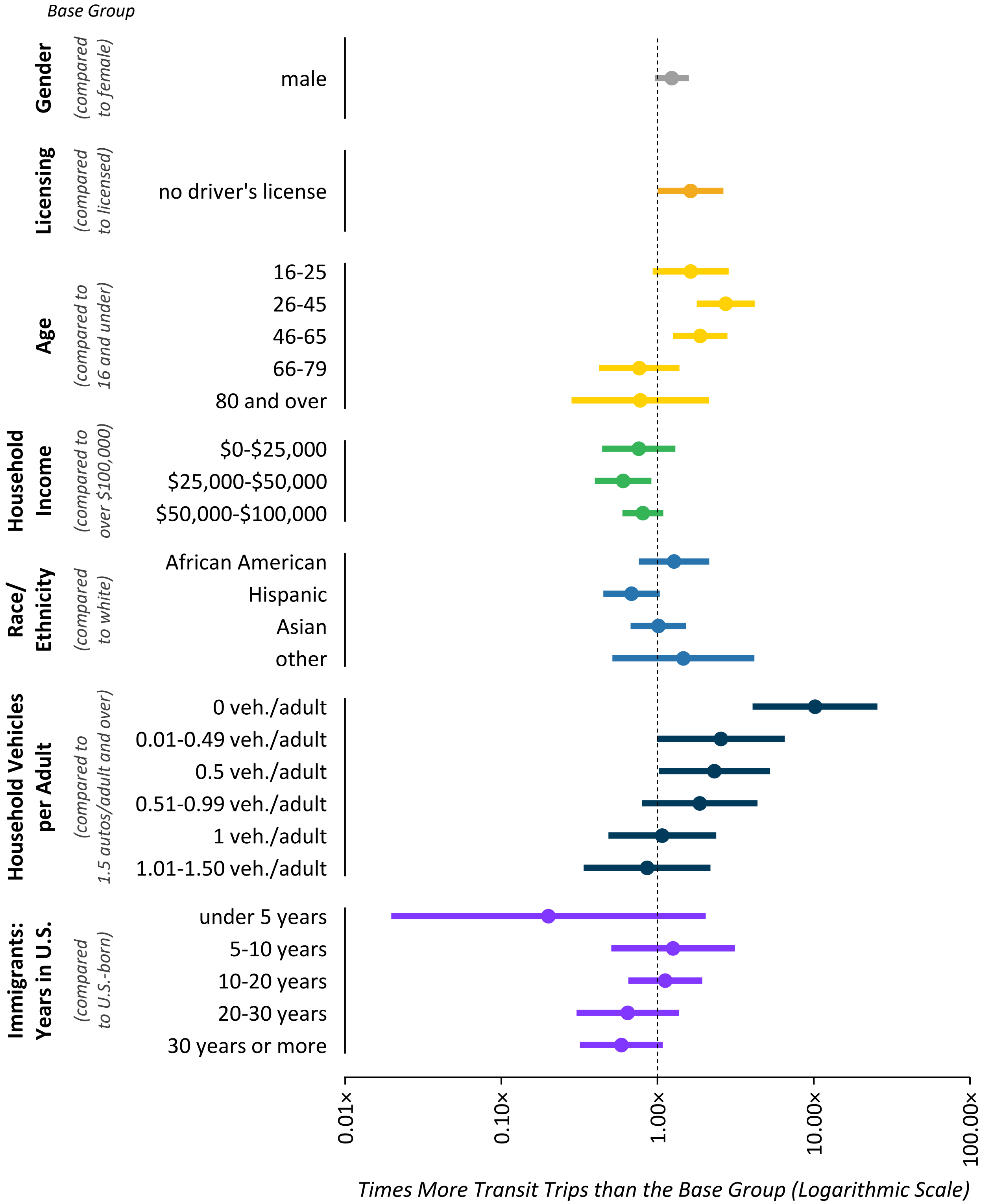
Data source: Caltrans, 2012

Figure 8-9. Predicted Transit Use by Group in the Bay Area, 2012



Data source: Caltrans, 2012

Figure 8-10. Predicted Transit Use by Group in Central Bay Area Counties, 2012



Data source: Caltrans, 2012

8.4.2. How Vehicle Ownership Affects Transit Use

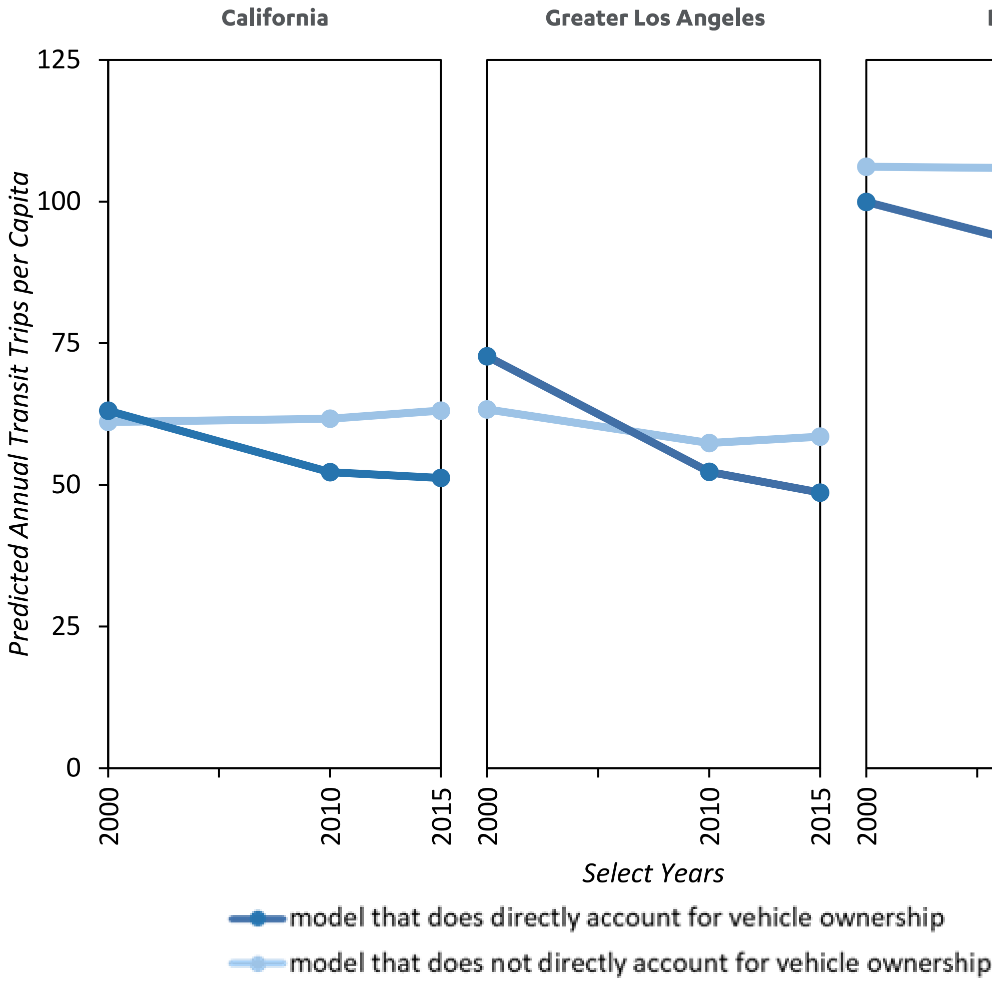
When we apply our base model above to Census data from 2000, 2010, and 2015, we see strong geographic differences in the influence of household vehicle access on transit trip-making over time. Statewide, and in Greater Los Angeles in particular, results suggest a powerful association between rising household vehicle access and falling transit trips.

Figures 8-11 and **8-12** graph the results of the models. In each graph, the first model, represented by the light blue line, predicts the change in transit trips per capita based on all factors *except* vehicle access. Throughout the state as a whole, the line has a very modest upward slope between 2000 and 2015, suggesting that changes in other demographic, economic, and geographic factors would have resulted in a small increase in transit use since 2000. In Greater LA, the line has a mild negative slope from 2000 to 2010 and then a small positive slope from 2010 to 2015, pointing to a small decline in transit use since 2000, albeit with a modest uptick between 2010 and 2015.

The second model, represented by the dark blue line, is identical to the first model but includes changes in automobile access. The difference in results between the first and second models is striking. In the statewide, Greater Los Angeles, and Los Angeles and Orange County models, the dark blue line starts at a higher point and falls sharply to a lower point, both of which suggest lack of access to automobiles increases the likelihood of taking transit and that increasing access to automobiles over time has reduced transit use. Indeed, the line also suggests that many socioeconomic attributes like income, nativity, age, and location play an essentially intermediary role primarily by predicting people's access to private vehicles.

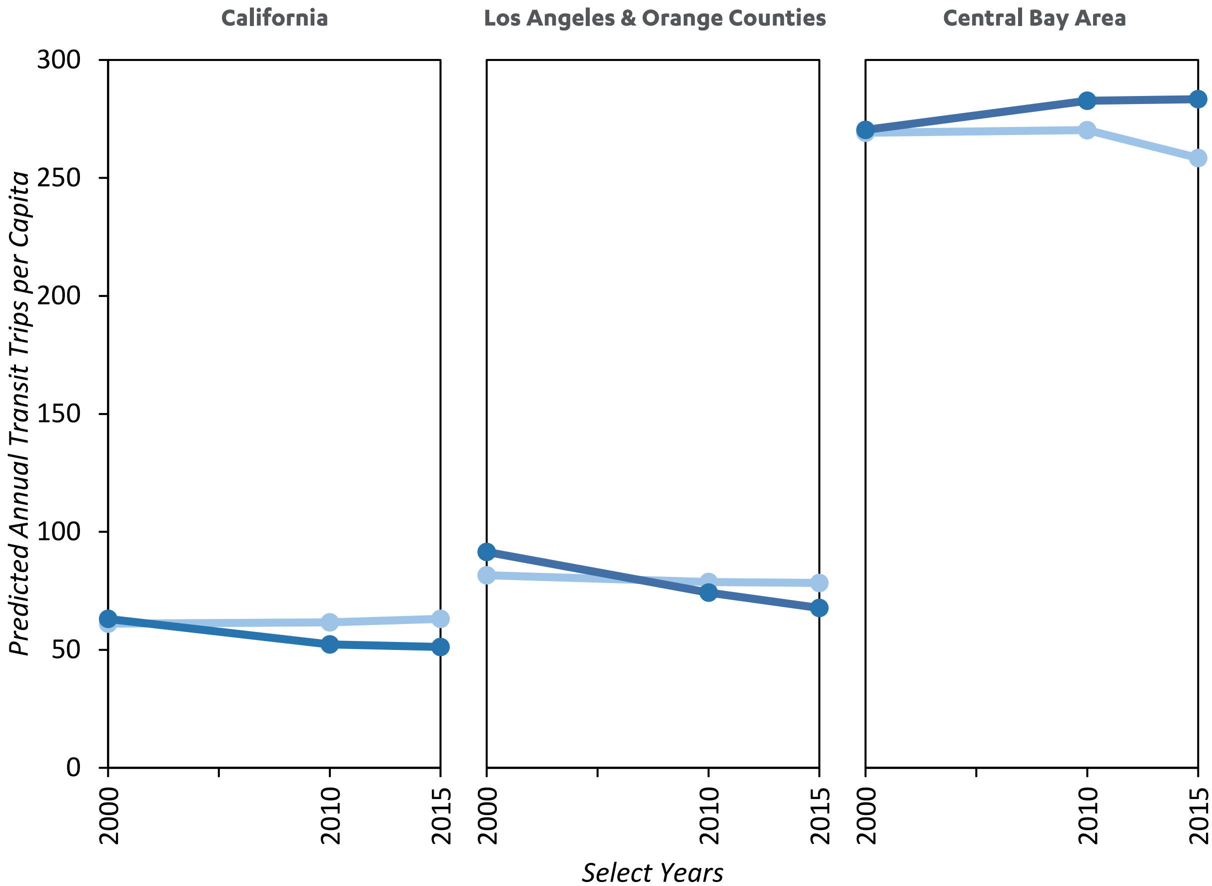
In contrast to the dramatic association between increasing vehicle ownership and declining transit use in the state and in Greater Los Angeles, the relationship between automobile access and trends in transit use in the Bay Area is much more muted. While there is a notable decline in transit trips per person between 2000 and 2010 in the vehicle ownership model, there is actually a small increase in the number of predicted transit trips between 2010 and 2015. This finding suggests that unlike the state as a whole and Greater Los Angeles, growth in vehicle ownership in the Bay Area is not associated with declining transit use after 2010. Interestingly, this trend is particularly pronounced in the central Bay Area, where between 2000 and 2015, higher rates of vehicle ownership are correlated with an *increase* in transit use. In other words, while growth in vehicle access appears to have led to a decrease in per person transit ridership in most areas throughout the state, the relationship appears to be the opposite in the central Bay Area.

Figure 8-11. Estimating the Independent Effect of Vehicle Ownership on Transit Ridership



Data source: Caltrans, 2012 and Ruggles et al., 2020

Figure 8-12. Estimating the Independent Effect of Vehicle Ownership on Transit Ridership



Data source: Caltrans, 2012 and Ruggles et al., 2020

8.5. Conclusion

All told, our analysis suggests that increases in car ownership have had an important impact on statewide transit use. In most areas of the state, the share of zero-vehicle households has declined, a trend that our models suggest is associated with a significant decrease in the number of daily transit trips per person. This relationship was particularly pronounced in Greater Los Angeles, where increased access to automobiles was associated with a more than 30 percent decline in the number of daily person-trips by transit between 2000 and 2015. Trends in the San Francisco Bay Area, however, were distinct from those in the rest of the state. Car ownership levels remained relatively stable in the Bay Area, and the relative level of automobile access in the Bay Area was actually associated with a small increase in daily person-trips by transit between 2000 and 2015. Rising personal vehicle access can explains much of the state's transit ridership woes, but other factors, like changing residential and employment patterns (See Chapter 13) and an increased use of ridehail (See Chapter 11)—a different type of vehicle access—may be at play in the Bay Area.

9. Trends in Fuel Prices

9.1. Introduction

In this section, we analyze the relationship between fluctuating fuel prices and falling transit use. When the price of fuel increases, so does the cost of driving; while the price of public transit is almost always lower than the average cost of driving, very high gasoline prices could motivate some people to switch from driving to public transit in order to save on travel costs. Conversely, lower fuel costs could encourage people to eschew transit in favor of driving. To investigate this issue, we examine the relationship between the ratio of transit fares to fuel costs on one hand and the number of transit trips taken by California residents on the other. In short, we find no such relationship. While other aspects of auto use, like increased vehicle access (See Chapter 8), the growth of ridehail (See Chapter 11), and driver's licensing for undocumented immigrants (See Chapter 10), likely have contributed to declining transit ridership, lower fuel prices do not appear to be a culprit.

9.2. Context

Many costs of owning and operating motor vehicles do not relate directly to the marginal costs of driving. Cars and trucks are expensive to purchase before an owner ever drives a mile in them. Insurance and maintenance costs can be substantial as well, and have a relationship to miles driven, but an indirect one. Auto insurance companies typically present their rates annually, while repair costs can seemingly strike at random. By contrast, filling up one's fuel tank every few days or weeks presents a more visible cost of driving. Further, no other commodity has its daily price fluctuations posted on large signs at major urban and rural intersections.

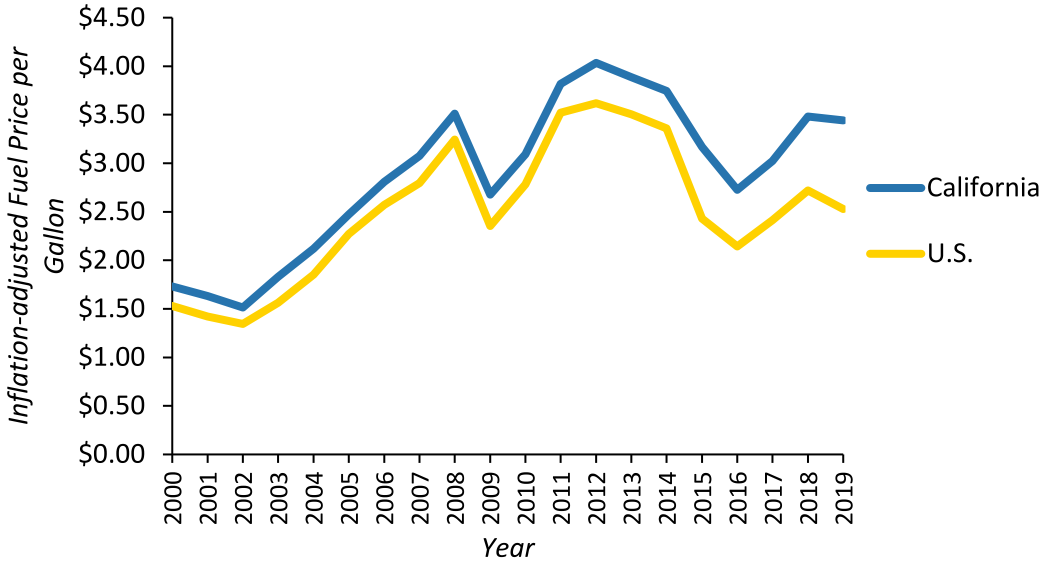
As a result, fuel prices may influence transit ridership because they visibly affect driving costs. When gasoline prices increase, driving becomes more expensive, and transit may become more attractive by comparison. Of course, most people do not use private vehicles and public transit interchangeably; not only do many car owners never take transit, but many regular transit users do not own cars (Pucher and Renne, 2003). However, fuel prices could influence rates of car ownership, if a prospective car owner decides that high fuel prices make auto ownership and use impractical.

The volatility of fuel prices affects the larger economy in ways indirectly related to transportation behavior (Sawhill, 2012). Fuel prices may also affect individual transit modes differently. For instance, light rail ridership appears more sensitive to fuel price changes than heavy rail and buses, presumably because more "choice" riders take it (Currie and Phung, 2007).

9.3. Fuel Prices, Transit Fares, and Transit Ridership

Over the past two decades, fuel prices have fluctuated significantly. **Figure 9-1** shows the average inflation-adjusted price for a gallon of gasoline from 2000 to 2019 for the United States and California (EIA, 2019). The graph shows that inflation-adjusted gasoline prices have gradually increased since 2000, with notable price downturns between 2008 and 2010 (during the Great Recession) and between 2014 and 2016. Significantly, California gasoline prices have always stood higher than national prices, but usually by less than $0.50 per gallon.

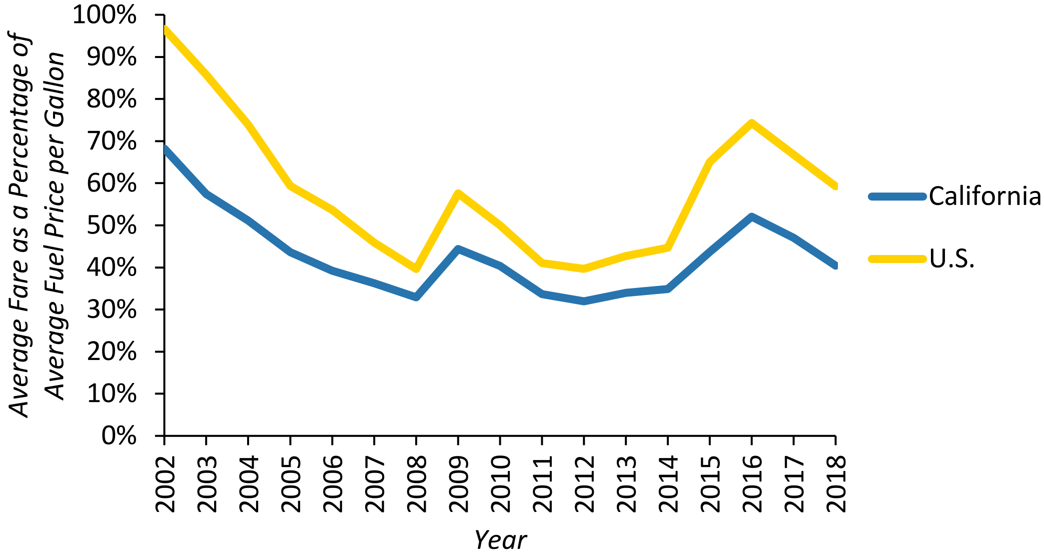
Figure 9-1. Average Price of Gasoline per Gallon, in 2018 Dollars



Data source: EIA, 2019 and BLS, 2019

Does this match up with trends in transit prices? **Figure 9-2** compares the average fare paid per transit trip to the price per gallon of gasoline over time, for California and nationally, from 2002 to 2018. While not entirely comparable, the average transit fare paid has consistently been less than the price per gallon of gasoline (See Chapter 5, Section 3, Subsection 2 for more on transit fares). Between 2002 and 2018, the average transit fare paid as a percentage of the cost of a gallon of gas fell from 68 to 40 percent in California. If travelers are highly price-sensitive (to both fuel and fares), we would expect an increase in California transit ridership per capita over the period; however, as noted in Chapter 3, it has not happened (EIA, 2019; FTA, 2019; and BLS, 2019). Instead, the relationship between transit trips per person in California and the fare-to-gas ratio is not statistically significant.

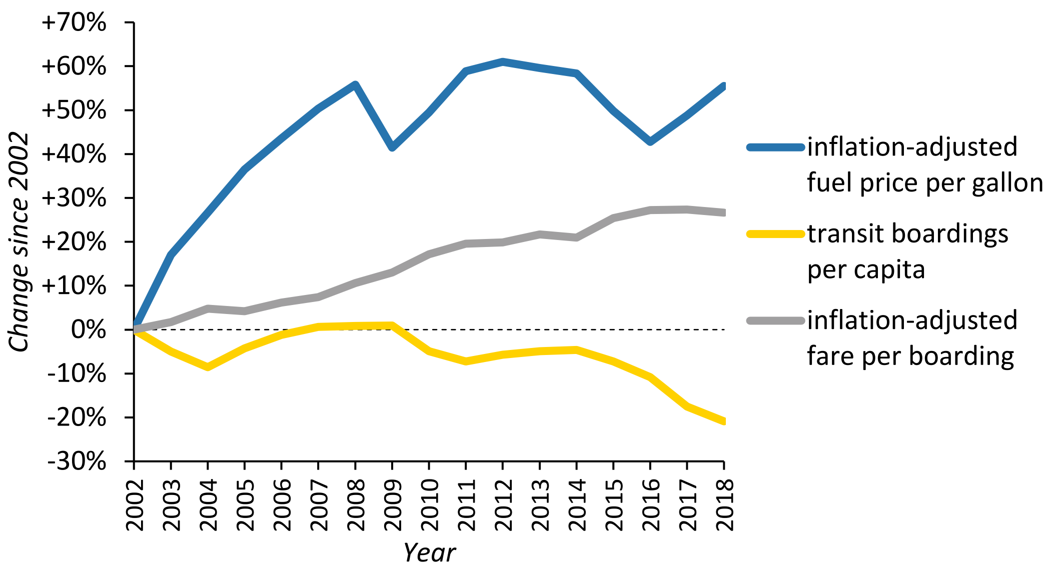
Figure 9-2. Average Fare as a Percent of Average Gas Price per Gallon



Data source: EIA, 2019; FTA, 2019; and BLS, 2019

Figure 9-3 shows the percentage changes in fuel price, transit fares, and transit ridership per capita from 2002 to 2018. Fuel prices increased significantly from 2002 to 2008; meanwhile, transit fares also increased, but with less volatility and less steeply. Per capita transit ridership began dropping in 2008 despite the relative affordability of fares, and began falling seriously in 2014. From 2016, fuel prices rose faster than transit fares, as per capita ridership continued to drop (EIA, 2019; FTA, 2019; BLS, 2019; and U.S. Census Bureau, 2019). Indeed, the relationship between transit trips per person in California and the price of fuel is not statistically significant. All told, these trends do not line up.

Figure 9-3. Change in California Fuel Prices, Ridership per Capita, and Average Fare per Boarding



Data source: EIA, 2019; FTA, 2019; BLS, 2019; and U.S. Census Bureau, 2019

9.4. Conclusion

Since 2000, motor vehicle fuel prices have fluctuated widely, in contrast to relatively steady rise in the price of a transit trip (See Chapter 5, Section 3, Subsection 2) and out of step with changes in transit ridership (EIA, 2019; FTA, 2019; BLS, 2019; and U.S. Census Bureau, 2019). Thus, falling fuel prices did not substantively encourage cost-sensitive Californians to switch from transit to private vehicle use over the past half-decade. While past research has shown that fuel prices influence travel behavior, the relationship between gas costs and transit use is confounded by a number of other external factors (Iseki and Ali, 2015). At the time of writing, for example, the coronavirus pandemic has depressed both fuel prices and transit patronage dramatically, but no one would cite cheap gas as the cause of current empty buses and trains. Broader changes in auto access and use have significantly affected transit ridership (See Chapter 8), but gas prices alone have not.

10. Effect of Driver's Licensing for Undocumented Immigrants on Transit Use

10.1. Introduction

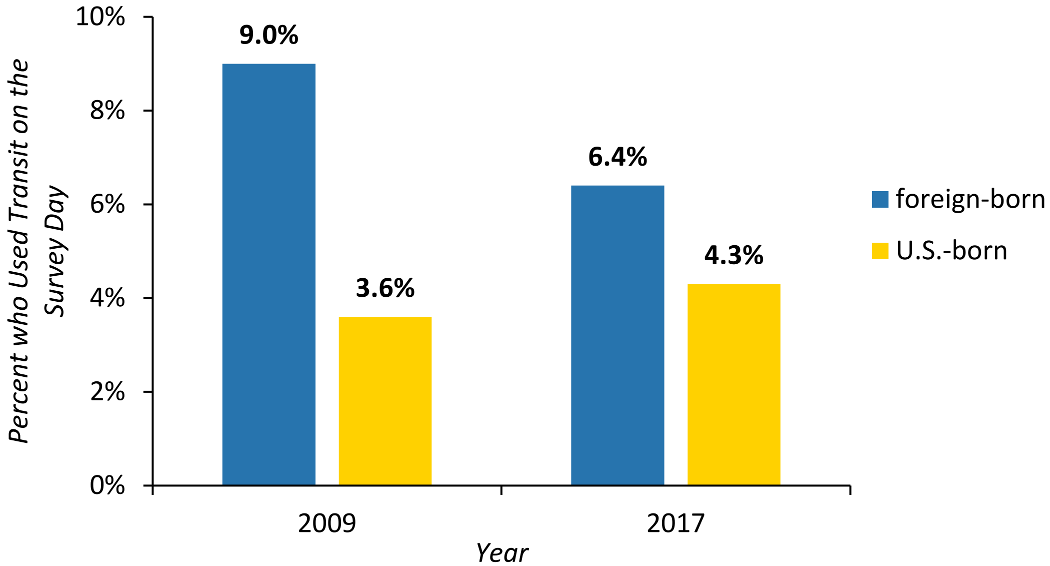
In this chapter, we look at whether the recent change in California policy to provide driver's licenses to undocumented immigrants may have resulted in declining transit use among those who obtained them. In recent years some states, including California, have made it easier for undocumented immigrants to acquire driver licenses and, therefore, to drive legally.[23] California passed Assembly Bill 60, the Safe and Responsible Drivers Act, in 2013. AB 60 required the Department of Motor Vehicles (DMV) to issue "an original driver license to an applicant who is unable to submit satisfactory proof of legal presence in the United States" (California DMV, 2020). Implemented on January 2, 2015, AB 60 was responsible for the issuance of 605,000 driver licenses in its first year (California DMV, 2016). As of spring 2018, the DMV had issued an additional 400,000 driver licenses, for a total of more than one million licenses issued under this program (California DMV, 2018).

10.2. Immigrants, Commute Patterns, and AB 60

Immigrants, particularly recent immigrants, are more likely to use transit than native-born travelers (Blumenberg and Evans, 2007; Chatman and Klein, 2009; Kim, 2009; and Manville, Taylor, and Blumenberg, 2018). Analysis of data from the National Household Travel Survey show that, although the gap in transit use between native- and foreign-born adults has narrowed over time, immigrants in California remain 1.5 times more likely to use transit than native-born adults (See **Figure 10-1**) (FHWA, 2009, 2017). However, like native-born adults, most immigrants travel by automobile. Further, studies in California show that prior to AB 60, many undocumented immigrants traveled by car (Lovejoy and Handy, 2008), underscoring the important role of automobiles in accessing opportunities. Assuming that at least some of the new AB 60 license holders previously relied on transit, changing state driver's licensing regulations may have contributed to declining transit use.

23. In addition to California, the following states have enacted similar legislation: Colorado (2013), Connecticut (2013), Delaware (2015), Hawaii (2015), Illinois (2013), Maryland (2013), Nevada (2013), New Jersey (2020), New Mexico (2016), New York (2019), Puerto Rico (2013), Oregon (2019), Utah (2005), Vermont (2013), Washington (2017), Washington, D.C. (2013) (National Conference of State Legislatures, 2020).

Figure 10-1. Transit Use on Survey Day in California

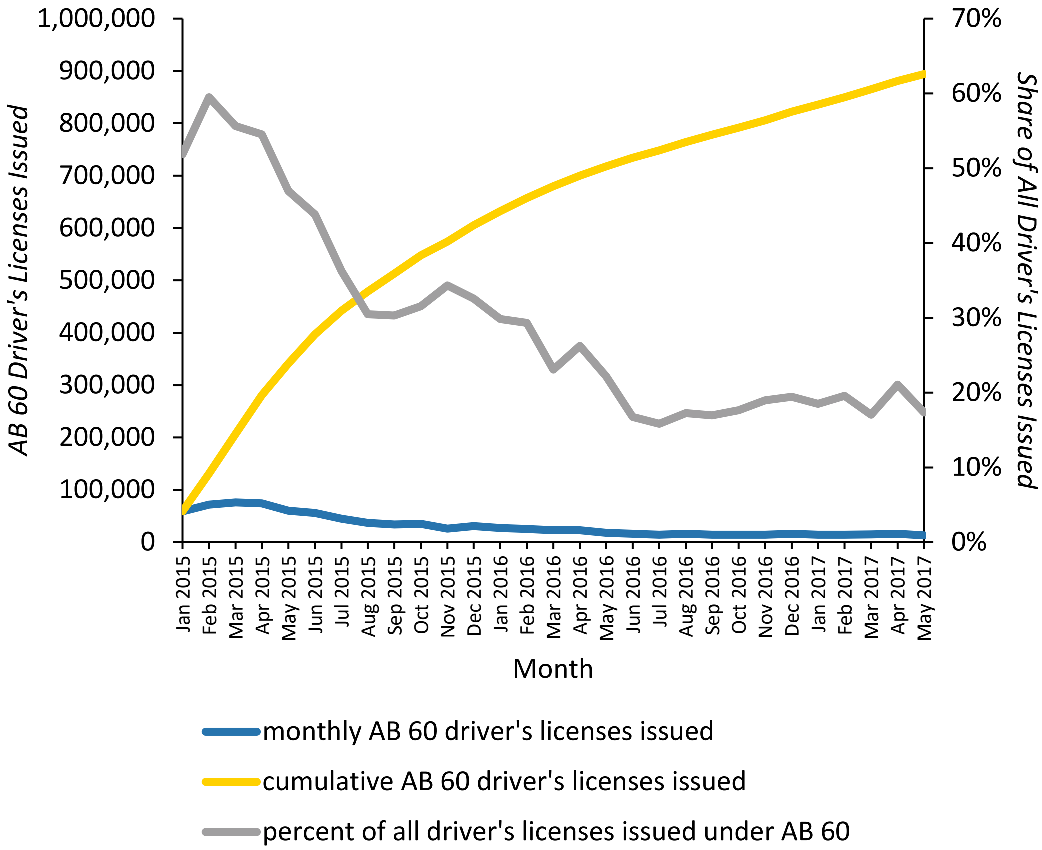


Data source: FHWA, 2009, 2017

Unfortunately, we know of no available data source to analyze this question directly, because the California DMV does not make available disaggregate data on this program and because, moving forward, there is no longer a requirement to provide proof of citizenship in order to secure a license. As such, we are limited to investigating this issue indirectly.

First, drawing on data from Tang (2018), **Figure 10-2** graphs the changes in AB 60 driver's licensing from January 2015 through May 2017 in California. Like we note above, the data show an increase in the number of licenses under this program. However, the percent change in new AB 60 licenses declines over time, as we might expect.

Figure 10-2. AB 60 Licenses in California



Data source: Tang, 2018

Data on state and county driver's licensing over time show that most counties issued more licenses in 2015 (the year in which AB 60 was adopted) than in 2008 (prior to the adoption of AB 60). **Table 10-1** provides these figures, together with estimates of the percentage of undocumented immigrants (methodology for which is described below). To match the data on licensing with data on undocumented immigrants, we aggregated the data for some of the smaller counties.

Table 10-1. Driver's Licenses and Undocumented Immigrants by California County

COUNTIES	ANNUAL DRIVER LICENSES ISSUED			ESTIMATED UNDOCUMENTED IMMIGRANTS AS A PERCENT OF COUNTY POPULATION (2008)
	2008	2015	PERCENT CHANGE: 2008 TO 2015	
Alameda	986,845	1,094,481	+10.9%	8.4%
Amador, Calaveras, Tuolumne, Mariposa, Alpine, Mono, and Inyo	148,029	147415	-0.4%	1.4%
Butte	153,567	160,335	+4.4%	1.8%
Colusa, Glenn, Tehama, and Trinity	83,165	86,005	+3.4%	8.3%
Contra Costa	706,183	782,851	+10.9%	7.7%
Del Norte, Siskiyou, Modoc, and Lassen	80,992	77,651	-4.1%	1.0%
El Dorado	141,185	146,980	+4.1%	2.2%
Fresno	509,604	561,764	+10.2%	5.3%
Humboldt	97,780	96,686	-1.1%	1.6%
Imperial	102,125	114,054	+11.7%	12.8%
Kern	456,265	505,458	+10.8%	5.7%
Kings	69,622	75,281	+8.1%	5.8%
Los Angeles	5,978,101	6,450,325	+7.9%	9.3%
Madera	78,277	85,687	+9.5%	7.7%
Marin	186,684	195,838	+4.9%	5.6%
Mendocino and Lake	111,213	112,934	+1.5%	5.0%
Merced	136,226	150,029	+10.1%	9.1%
Monterey and San Benito	269,842	298,078	+10.5%	13.5%

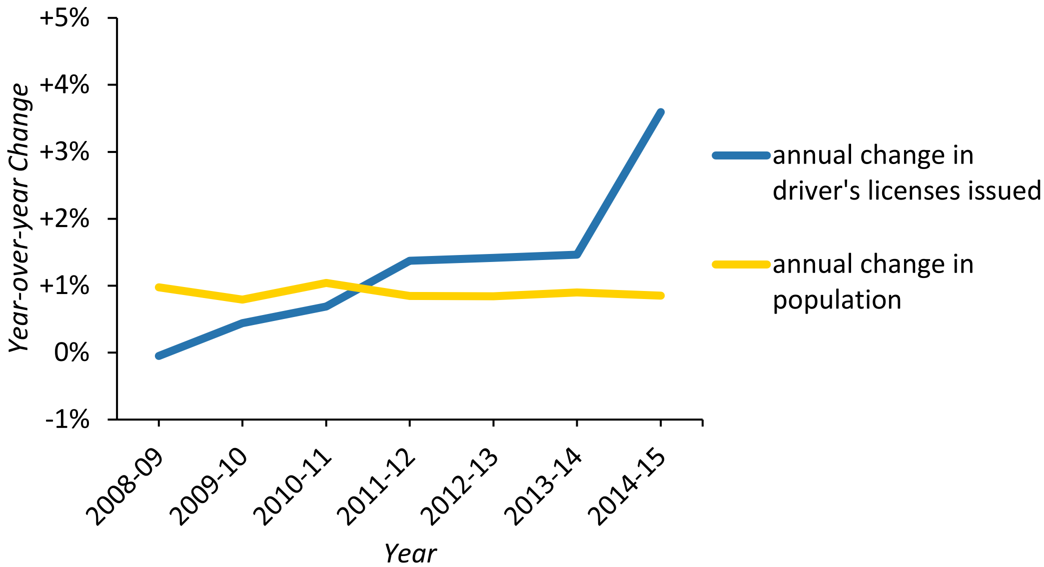
COUNTIES	ANNUAL DRIVER LICENSES ISSUED			ESTIMATED UNDOCUMENTED IMMIGRANTS AS A PERCENT OF COUNTY POPULATION (2008)
	2008	2015	PERCENT CHANGE: 2008 TO 2015	
Napa	90,709	99,625	+9.8%	12.0%
Orange	2,025,409	2,223,795	+9.8%	9.6%
Placer	252,467	283,952	+12.5%	2.3%
Plumas, Sierra, and Nevada	100,875	100,749	-0.1%	1.5%
Riverside	1,268,558	1,474,494	+16.2%	7.0%
Sacramento	912,987	989,415	+8.4%	4.6%
San Bernardino	1,210,296	1,336,506	+10.4%	7.5%
San Diego	2,099,661	2,294,808	+9.3%	6.6%
San Francisco	534,829	579,941	+8.4%	3.7%
San Joaquin	398,199	447,042	+12.3%	8.0%
San Luis Obispo	190,740	203,518	+6.7%	3.5%
San Mateo	498,361	541,792	+8.7%	7.8%
Santa Barbara	268,401	288,552	+7.5%	9.0%
Santa Clara	1,209,035	1,348,359	+11.5%	10.2%
Santa Cruz	177,680	189,167	+6.5%	8.2%
Shasta	136,736	137,603	+0.6%	0.6%
Solano	272,163	295,385	+8.5%	6.0%
Sonoma	330,909	358,809	+8.4%	8.8%
Stanislaus	313,324	339,629	+8.4%	7.6%
Sutter and Yuba	105,296	111,314	+5.7%	5.6%

COUNTIES	ANNUAL DRIVER LICENSES ISSUED			ESTIMATED UNDOCUMENTED IMMIGRANTS AS A PERCENT OF COUNTY POPULATION (2008)
	2008	2015	PERCENT CHANGE: 2008 TO 2015	
Tulare	224,376	251,679	+12.2%	6.8%
Ventura	552,882	597,748	+8.1%	9.3%
Yolo	122,808	134,046	+9.2%	6.2%

Data source: California DMV, 2019 and Hill and Johnson, 2011

As expected, the increase in the number of driver's licenses issued is strongly associated with the increase in population. Across California counties, the correlation between the percent change in the population and the percent change in driver's licenses is 0.88. However, as **Figure 10-3** shows, the percent change in the number of driver's licenses in California has exceeded population growth since 2011-12. Further, there was a substantial increase in driver's licensing from 2014 to 2015, the timing of which is associated with the implementation of AB 60. Finally, across California counties, the correlation between the percent of undocumented immigrants and the change in driver's licenses issued is also high—0.64. Since the number of undocumented immigrants in California actually declined over this period (Hayes and Hill, 2017), this strong positive relationship could be due to their increased propensity to obtain a driver's license, again suggesting that the change in licensing policy may have played a measurable role.

Figure 10-3. Change in Driver's Licenses Issued and Population in California



Data source: California DMV, 2019 and U.S. Census Bureau, 2019

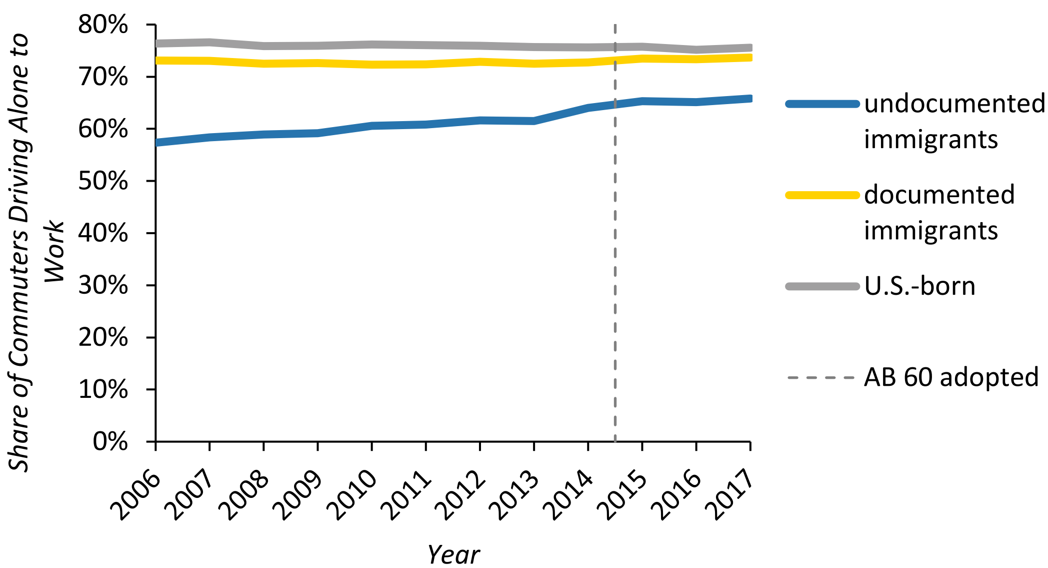
10.3. AB 60's Effects on Transit and Auto Commuting

As we note above, licensing trends are not necessarily associated with changes in travel behavior. Therefore, we examine changes in the use of automobiles for commute travel, focusing specifically on changes in the year in which AB 60 was implemented. Preliminary analyses of the effects of AB 60 suggest that it reduced the number of undocumented immigrants in California without a car by 21 percent and potentially contributed to a decline in their use of public transit, though this latter finding is less robust (Lueders, 2019).

Like Lueders, we used data from the microdata survey of the U.S. Census and the five-Year American Community Survey to examine trends in the percentage of immigrants (documented and undocumented) that travel to work by car (Ruggles et al., 2020). In our analysis we estimated undocumented immigrants by adopting the methodology used by Borjas (2017) to categorize foreign-born respondents as documented if they arrived before 1982 (Immigration Reform and Control Act of 1986, which provided legal status to most undocumented immigrants who arrived pre-1982), were citizens, had Social Security income, were veterans, were currently in the armed forces, worked in the public sector, were born in Cuba, and/or were employed in occupations that required licensing.

As **Figure 10-4** shows, across California, native-born residents have the highest rates of solo driving for the commute, followed by documented immigrants, and then undocumented immigrants. Over time, solo driving among undocumented immigrants has increased. Surprisingly, most of the growth occurred prior to the implementation of AB 60. Between 2006 and 2014, solo driving among undocumented immigrants in California increased by 12 percent, while only increasing one percent between 2015 and 2017. This finding suggests that increased licensing may not have had much effect on commuting by driving alone.

Figure 10-4. Solo Driving to Work by Nativity Status in California



Data source: Ruggles et al., 2020

To better interpret these somewhat inconclusive and possibly contradictory descriptive statistics, we developed a set of regression discontinuity models to assess the relationship between the implementation of AB 60 and the travel behavior of immigrants in California. This type of model allows us to control for the effects of numerous characteristics that are not related to AB 60 but that may affect commute mode (such as income, age, marital status, number of years in the United States, and county of residence), while also isolating the impact of an immigrant's documentation status on his or her travel behavior. Eighty-one percent of undocumented immigrants in California are from Mexico and Central America (Migration Policy Institute, 2020). Therefore, since Latino/a immigrants are both the largest undocumented immigrant group in the state as well as traditionally relatively heavy users of transit, we focus our analysis on this group.

Results of the regression discontinuity models show small but consistent associations between the commute mode share of undocumented workers and the availability of AB 60 licenses. For example, our findings suggest that for undocumented Latino/a immigrants, the predicted percentage of car commuters (driving alone plus carpooling) increased by two percentage points following the enactment of AB 60. In other words, having access to a driver's license means that undocumented Latino/a workers were slightly more likely to commute to their jobs via automobile.

Like car commuting more broadly, AB 60 also appears to have had a moderate effect on the proportion of undocumented workers that drive alone to their place of employment. All else equal, the predicted proportion of undocumented Latino/a immigrant solo-drive commuters increased by 3.5 percentage points in the first year after AB 60 licenses became available. Apparently access to driver's licenses has made it easier for undocumented immigrants to drive alone to work.

Finally, like the automobile commute models, our transit commute model suggests a small but significant association between the implementation of AB 60 and changes in travel behavior. Specifically, the predicted proportion of undocumented Latino/a workers that commuted by transit dropped by 1.5 percentage points—from 10 percent to 8.5 percent—following AB 60's implementation. While this decline is somewhat modest, it does highlight a potential relationship between the availability of licenses and declines in transit use among undocumented immigrants.

10.4. Conclusion

Despite the associations discussed above, our ability to draw strong conclusions about the relationship between the availability of AB 60 licenses and overall transit use in California is somewhat limited. Due to our reliance on census data, we are only able to examine commute trips (Ruggles et al., 2020), which represent a relatively small proportion of daily travel (FHWA, 2017). Consequently, the way in which the implementation of AB 60 has affected the non-work travel of undocumented immigrants remains unclear, and the impact that AB 60 has had on total transit patronage in California is difficult to quantify. Nonetheless, in the limited realm of commute trips, we do find a small, statistically significant effect of AB 60 on transit mode share among Latino/a undocumented immigrants. While this effect is not of the scale to explain most of California's transit ridership decline, it does complement other changes in auto access and use in the state that are.

11. Trends in Ridehail

11.1. Introduction

The global rise of ridehail during the 2010s is among the most significant innovations in the way people get around—or at least the business model behind it—of the past half-century. These services match passengers with drivers via mobile device-based apps to overcome the information problems that have plagued for-hire transportation services since the emergence of the taxi industry. They have proven immensely popular and allow riders to be ferried door-to-door in real time either as an individual passenger, or as a shared ride where passengers trade off slightly lower fares for route deviations to pick up or drop off other passengers.

Invented in the San Francisco Bay Area (Hartmans and Leskin, 2019), ridehail firms like Lyft and Uber are now global enterprises. Uber was founded in 2009 and began service in San Francisco in 2010. The largest of the firms operating in the United States today, Uber delivered its 10 billionth ride in 2018. Uber's main U.S. competitor, Lyft, was also founded in the Bay Area and carried its one billionth ride that same year (Dickey, 2018). Uber and Lyft dominate the nation's ridehail market, together capturing 98 percent of trips: Uber provides a little over two-thirds (69%) of rides and Lyft a little under a third (29%) (Zaveri, 2018). By early 2019, Uber and Lyft operated in nearly every major American city; Uber now provides service in more than 60 countries and 600 cities (Uber, 2019 and Lyft, 2019).

In this chapter, we consider the effect of ridehail services—provided by companies like Lyft and Uber—on transit ridership in California. We 1) review the research literature on the relationships between ridehail and public transit use, 2) analyze the California oversample of the 2009 and 2017 National Household Travel Surveys to understand how taxi and ridehail use is growing and changing vis-à-vis public transit, and 3) analyze data regarding taxi and ridehail driver establishments over time across California regions.

We find from our review of prior research that, if ridehail indeed replaces more transit trips than it complements, it likely does so in regions that 1) boast already high levels of transit use, 2) adopted these new services early, and 3) report high current rates of ridehail use. Some regions of California, and in particular the San Francisco Bay Area, meet all three of these conditions. However, ridehail can complement public transit for some trips, such as by providing first/last-mile connections to commuter rail stations. Several studies, national in scope, find evidence of this as well.

Our analysis of NHTS data shows that ridehail use grew rapidly between 2009 and 2017 throughout the nation and especially in California, but its relationship with public transit service remains uncertain. The NHTS data offer a detailed personal travel snapshot at two points in time: 2009, one year into the Great Recession, and 2017, three years after the post-Great-Recession peak in transit ridership in 2014, but before the recent patronage trough. These data cannot account for fluctuations in transit and ridehail use between these two time periods, the first during a deep recession and the second at the height of an economic boom, nor since. So while these data offer us detailed insights into who uses ridehail (discussed in this chapter) and public transit (discussed in previous chapters), when, and for what kinds of trips, the data are not well-suited to directly examining relationships between ridehail and transit use.

The NHTS data analyzed below show a sharp increase in ridehail and taxi use in California among Hispanics between 2009 and 2017, a group whose use of public transit also dropped sharply over the same time period (See Chapter 6). The NHTS also indicates a sharply increasing average age of public transit users in

California, accompanied by a declining average age of taxi and ridehail users, which could indicate a shift among younger travelers from transit to ridehail. Together, these two trends offer at least circumstantial evidence that public transit has lost some portion of two important transit-riding demographics—Hispanics and young people—to ridehail and taxi services.

Finally, our analysis of driver establishment data shows a spike in ridehail/taxi/limousine nonemployer establishments (i.e., individual drivers classified as independent contractors) throughout the state, with especially rapid year-over-year growth in the Bay Area, San Diego Area, and Greater Los Angeles during the 2010s.

Collectively, the information presented in this chapter shows that ridehail use grew dramatically in California during the 2010s, particularly in the largest, most transit-friendly regions. We also present suggestive evidence the growing number of ridehail trips have likely subtracted more public transit trips than they have added. Our analysis of vehicle ownership in Chapter 8 showed that private vehicle ownership has affected California's regions differently, and that the Bay Area (with already high levels of vehicle ownership) saw less growth in private vehicle ownership than most other parts of the state. But it may be that the Bay Area also saw increased motor vehicle trips in the 2010s from high and increasing levels of ridehail use, rather than increased private vehicle ownership.

11.2. How Might Ridehail Affect Transit?

Provided by transportation network companies (TNCs) (See Appendix A, Section 2 for further definitions), ridehail services (like Lyft and Uber) have risen in popularity quickly and received considerable attention from the media, elected officials, as well as transportation planners and policymakers. TNCs provide a platform (an application interface) that connects potential users with drivers. TNCs offer similar services to those of taxis, but with greater technological integration, faster average response times, no exchange of cash, lower average fares, and opportunities to reduce costs further by sharing rides with other users traveling to similar destinations. Drivers typically ferry passengers in their personal vehicles, or those that they lease.[24]

While these private firms occasionally release data on cities, drivers, and rides, they seldom release detailed data on ridehail trips, such as the number, time, origin, and destination of trips in an anonymized form. The lack of such data on ridehail use greatly limits the public sector's ability to understand and plan for these new services. But the growth of these services has clearly been substantial; the limited data available suggest that, by the end of 2018, the total number of annual ridehail trips had surpassed the total number of bus trips in the United States (Schaller, 2018).

The effect of ridehail use on transit ridership is theoretically ambiguous (Hall, Palsson, and Price, 2018). Ridehail use could:

1. replace transit trips, if travelers use ridehail services instead of taking transit, thereby decreasing

24. The relationship between the TNCs and their drivers is frequently contested, with the TNCs holding that they do not employ drivers, but instead are for-profit ride-matching platforms that link paying travelers with willing drivers. As services like Didi, Uber, and Lyft have grown into large multinational corporations that exert considerable influence over drivers, such claims have fallen under increasing scrutiny. Many drivers and their advocates argue drivers are employees of TNCs and not independent contractors given the control that TNCs exercise over the terms of drivers' work and pay. This latter view was affirmed in September 2019 when California passed a law (AB 5), which reclassifies most TNC drivers as employees (Myers, Bhuiyan, and Roosevelt, 2019).

transit use; and/or

2. complement transit travel, if travelers use ridehail to extend the reach of traditional transit, either by using it to travel from trip origins to transit stops and stations, and/or from transit stops and stations to their final destinations; or

3. have no relationship with transit use, if travelers use ridehail services instead of a non-transit mode (like driving or walking) or to make a trip they would have foregone without TNC service.

These scenarios, however, represent only the direct effects of ridehail services on public transit use. Ridehail may also indirectly affect transit ridership as well. For example, if ridehail contributes to worsening traffic congestion and, consequently, to reduced bus speeds, a transit user may decide to drive, walk, or bicycle instead. Because ridehail trips comprise only a small percentage (0.89%) of all motor vehicle trips (FHWA, 2017), the notion that ridehail could appreciably worsen congestion may seem far-fetched. But in busy commercial and entertainment districts where ridehail use is common and relatively little curb space is dedicated to passenger loading and unloading, ridehail vehicles frequently hold in bus stops and traffic lanes to pick up and drop off passengers. This can significantly impede bus and traffic flows, to an outsized degree beyond ridehail vehicles' relative modest share of autos in traffic flows.

Another possible indirect effect could increase transit use. Reliable, affordable ridehail services could motivate some households to downsize their personal vehicle fleets. For example, a family with two licensed drivers might be motivated to sell one of their two vehicles because of the mobility options ridehail provides, but as a result, they may also make more trips via carpooling and transit. Thus, the lower levels of private vehicle access could not only encourage frequent ridehail use but also more transit use as well. While researchers have found some evidence that carshare systems like ZipCar and Car2Go may enable some users to forego vehicle ownership (Martin and Shaheen, 2011), researchers have not yet established a similar, robust relationship between frequent ridehail use and car ownership.

11.3. Previous Studies of Ridehail and Transit Use

As the extent and use of ridehail grew rapidly in the 2010s, so too have studies of the new service. Among these, multiple researchers have attempted to examine the relationship between ridehail use and transit use, though, like us, have typically lacked access to quality data. They have responded by using a variety of creative methods to estimate and analyze ridehail use and its impact on transportation and transit. First, the studies summarized in **Table 11-1** document two dimensions of the extraordinary rise of ridehail beyond its relationship to public transit alone: the contours of its use across geography and demographic groups and its effects on congestion. According to this research, ridehail use is high not only in more affluent communities but also in lower-income communities, where riders are more likely to share rides. Meanwhile, analysis finds that in cities with very high levels of ridehail use, like downtown San Francisco, TNCs can increase traffic and traffic delays significantly.

Table 11-1. Summary of Findings from Studies of Ridehail and Travel Behavior

STUDY	GEOGRAPHY	SAMPLE SIZE	METHODOLOGY
Brown, 2018	Los Angeles County	6.3 million Lyft trips	geographic analysis of Lyft data
Data suggest wide geographic availability of ridehail service in Los Angeles County and price sensitivity in low-income neighborhoods.			
Castiglione et al., 2017	San Francisco	62 million trips	estimate of Uber/Lyft trips via API
San Francisco County Transportation Authority study finds half of increased congestion from 2010 to 2016 due to TNCs; suggests replacement of transit/active transportation mode use by TNCs			

The studies summarized in **Table 11-2** focus on the relationship between ridehail and transit use. Across the studies, estimates of the substitution of ridehail for transit use range very widely, from three to 50 percent. The studies vary by geography, year, sampling frame, methodology, sample size, phrasing of questions, and basis of comparison, which likely account for many of the discrepancies in findings. While virtually all of these studies focus on urban travelers, the findings from Boston and New York City suggest that dense metropolitan areas with well-patronized transit systems may be especially vulnerable to patronage losses to ridehail. Bus service also appears more subject to replacement than rail, and several studies indicate that regional effects may increase over time as more users adopt ridehail travel. Taken together, these studies suggest that, though the rate of substitution is uncertain and varies by trip type, metropolitan areas with more mature and ubiquitous ridehail networks see more TNC substitution for transit over time.

Table 11-2. Summary of Findings from Studies of Ridehail and Transit Use

STUDY	GEOGRAPHY	SAMPLE SIZE	PROPORTION OF ESTIMATED TRANSIT TRIPS REPLACED BY RIDEHAIL	METHODOLOGY
Circella et al., 2018	California	482 respondents	24%	survey
Using latent class analysis, researchers divided users into three groups, with almost 69% of those in the "Urban Travelers" group reporting using transit less since the advent of ridehail.				
Clewlow and Mishra, 2017	Boston, Chicago, Los Angeles, New York City, San Francisco / Bay Area, Seattle, Washington D.C.	4,094 total respondents (not exclusively ridehail users)	15%	survey
15% of respondents, which include urban and suburban residents from metropolitan areas of noted cities, reported previously unled transit for the trips made using Uber or Lyft; the speed of service is the primary reason cited for choosing TNCs over transit.				
Feigon and Murphy, 2016	Austin, Boston, Chicago, Los Angeles, San Francisco, Seattle, and Washington, D.C.	4,500 respondents	14%	survey
American Public Transportation Association (APTA)-sponsored survey; respondents reported relatively low proportions of shared mode trips replacing transit trips, which suggests that new modes (including shared modes such as bikeshare and carshare in addition to ridehail) often complement public transit.				
Gehrke, Felix, and Reardon, 2018	Boston	933 respondents	42%	intercept survey administered during ridehail trip
Study by the Metropolitan Area Planning Council estimates that for every ridehail trip taken, the Massachusetts Bay Transportation Authority loses 35 cents in fare revenue.				

STUDY	GEOGRAPHY	SAMPLE SIZE	PROPORTION OF ESTIMATED TRANSIT TRIPS REPLACED BY RIDEHAIL	METHODOLOGY
Graehler, Mucci, and Erhardt, 2019	22 large metropolitan statistical areas (MSAs) in the U.S.	51 entities (cities and/or agencies)	variable (depending on Uber's entry into market and transit mode type)	models relationship between TNC presence in metropolitan area and change in public transit ridership
For each year of Uber operation in a region, heavy rail ridership decreases by 1.3%, commuter rail increases by 1.9%, light rail decreases by 0.4%, and bus decreases by 1.7%.				
Hall, Palsson, and Price, 2018	196 MSAs in the U.S.	296 transit agencies	variable, depending on mode, MSA size, and agency size	statistical analysis of transit agency ridership and estimated Uber market entrance/ penetration
Uber's entrance varies from 5.9% decrease in ridership (for small cities) to 6.0% *increase* in ridership (for small transit agencies).				
Hampshire et al., 2017	Austin	1,840 respondents	3% of disrupted riders	survey
Non-random survey distributed to ridehail users during service disruption finds that only three percent reported switching to transit after ridehail's temporary departure.				
Henao, 2017	Denver	311 respondents	22%	intercept survey administered during ridehail trip
Only one percent of ridehail riders surveyed in urban Denver were connecting to transit.				

STUDY	GEOGRAPHY	SAMPLE SIZE	PROPORTION OF ESTIMATED TRANSIT TRIPS REPLACED BY RIDEHAIL	METHODOLOGY
New York City Department of Transportation, 2018	New York City	616 respondents	50%	travel diary
50% of respondents reported that the ridehail trip had replaced a transit trip.				
Rayle et al., 2016	San Francisco	321 respondents	33%	intercept survey
Ridehail trips are highest for social trips on weekends and in the evenings.				

11.4. Analysis of Available Data for California

11.4.1. National Household Travel Survey Data

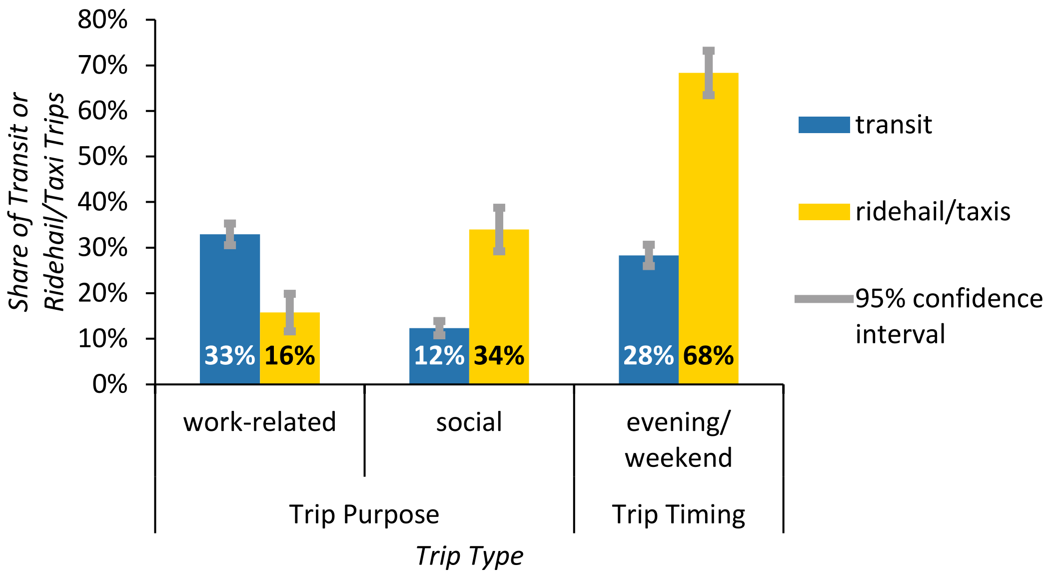
Data from the 2009 and 2017 National Household Travel Surveys allow us to compare taxi use in 2009 (immediately prior to ridehail's arrival on the transportation scene) with combined taxi and TNC use in 2017 (when Lyft and Uber operated widely in California cities). We can also compare the national data with the California oversamples of the NHTS (FHWA, 2009, 2017). These data do not differentiate taxi and TNC use, but since research has shown that taxi service and use has declined with the rise of ridehail (Berger, Chen, and Frey, 2018), we presume that ridehail is responsible for all of the net growth in TNC/taxi trips (if not more).

As noted at the outset, the NHTS data do not allow us to measure mode shifting between ridehail and transit, nor can we examine ridehail use regionally within the state. But these data *do* allow us to analyze the growth and change in taxi and ridehail use over time, to compare its scale to other forms of travel, and to compare the purposes and timing of transit versus TNC/taxi trips in California. Many of the sample sizes from the NHTS and California oversample are quite small, so readers must interpret these findings with caution (FHWA, 2009, 2017).

From 2009 to 2017, the total number of TNC/taxi trips grew rapidly among California travelers. While TNC/taxi trips still comprise less than one percent of all person trips in California, their mode share increased eight-fold, from 0.09 percent in 2009 to 0.73 percent in 2017. The nation as a whole saw a smaller increase: TNC/taxi trips rose by 2.5 times, from 0.20 percent of trips in 2009 to 0.50 percent of trips in 2017 (FHWA, 2009, 2017).

Figure 11-1 compares the share of trips in California on public transit and TNC/taxis by trip purpose and time of day in 2017, which suggest stark differences in trip purpose and timing between the modes. A third of all California transit trips are work-related (traveling to work, from work, or in the course of work), a share over twice as large as that of TNCs/taxis. Meanwhile, the share of trips for social purposes on TNCs/taxis is estimated to be almost three times greater (34.0% versus 12.3%) than on public transit. The timing of TNC/taxi and transit trips varies substantially as well: more than two-thirds (68.3%) of all TNC/taxi trips occur in the evening or on weekends—a rate almost 2.5 times that of transit trips (28.3%) (FHWA, 2017).

Figure 11-1. Share of California Transit and Ridehail/TNC Trip Types by Trip Type in 2017



Data source: FHWA, 2017

Racial/ethnic patterns of TNC/taxi and public transit use in California appear to vary substantially as well (though again, some of these differences are not statistically significant, likely—though not certainly—due to the small sample size). While the proportion of TNC/taxi trips taken by Non-Hispanic white Californians remained relatively stable at roughly 50 percent from 2009 to 2017, this group composed a growing share of transit trips (increasing from 24% to 32% of all transit trips). During the same period, the share of TNC/taxi trips by non-Hispanic African Americans declined (from 13% to 4%) and their share of transit trips increased (from 8% to 11%). Trends for Hispanics were the inverse of African Americans: between 2009 and 2017, TNC/taxi use among Hispanics waxed, while transit use waned. In California, the share of all TNC/taxi trips taken by Hispanics increased from 15.2 percent in 2009 to 27.6 percent in 2017. Moreover, Hispanics took 54.3 percent of California's total public transit trips in 2009 but only 34.3 percent in 2017. These changes in travel behavior among demographics with historically higher transit usage provide additional circumstantial evidence of a substitution effect between public transit and ridehail (FHWA, 2009, 2017).[25]

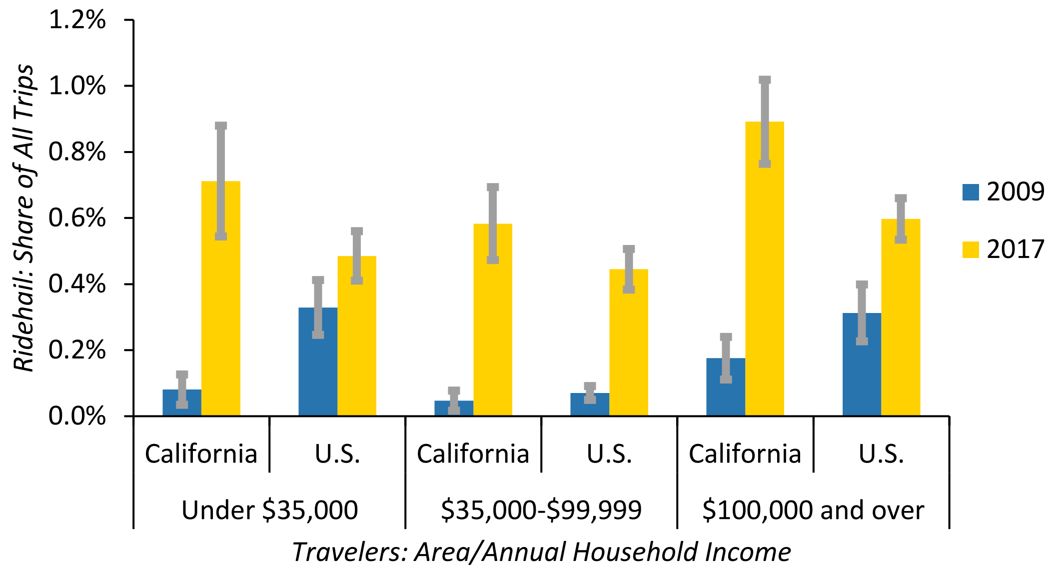
With respect to age, the average California transit user in 2017 is estimated to have been substantially older (45.8 years) than TNC/taxi users (38.1 years). Further, the average California transit user is estimated to have gotten older between 2009 and 2017 (by 5.5 years), while the average TNC/taxi user is estimated to have gotten younger (by 2.3 years, although the observed age differences for TNC/taxi users is not statistically significant) (FHWA, 2009, 2017). These shifts in age may suggest a generational shift in shared mobility use that, if true, may not bode well for public transit in the years ahead.

Differences in average traveler income between the modes are also of note. Taxis have historically been

25. The share of transit trips made by Hispanics declined nationally as well, but by far less than in California: from 26.2% of all transit trips in 2009 to 20.1% in 2017 (FHWA, 2009, 2017).

used more by high- *and* low-income travelers and comparatively less by middle-income travelers: nationally, only 17.6 percent of 2009 taxi trips were taken by travelers with incomes from $35,000 to $100,000. However, in 2017, when TNC trips were included in the taxi category, the share of middle-class riders using these services doubled, from 17.6 to 36.8 percent. California is estimated to have similarly experienced an increase in middle-class TNC/taxi use, though a less dramatic one than for the nation as a whole: from 22.0 to 30.1 percent of the mode's trips (These observed differences are statistically significant for the U.S. data but not for California.). While this substantial increase among middle-class travelers breaks a long-established income pattern of taxi use, this does not mean that TNC/taxi use is declining among lower- or higher-income travelers. Instead, as **Figure 11-2** shows, TNC/taxi use increased substantially across all income categories between 2009 and 2017, likely owing to the rapid growth of ridehail. Still, the growth rates were highest among middle-income travelers, who previously tended to use taxis less than higher- and lower-income travelers (FHWA, 2009, 2017).

Figure 11-2. Growth in the Share of Ridehail/Taxi Trips by Income Category



Data source: FHWA, 2009, 2017

11.4.2. Taxi and Ridehail Establishments Data

While the NHTS data described above tell us about who is using ridehail in California, they cannot tell us where they are riding. To examine that question, we turned to U.S. Census Bureau data on the number of residents who register as taxi or limousine drivers (i.e., set up a "taxi and limousine establishment") (U.S. Census Bureau, 2019)—a category that also includes people who drive for TNCs (Sandusky, 2018). These data thus provide an approximation of TNC activity in California and its major regions. However, such estimates should be viewed with caution for a few reasons:

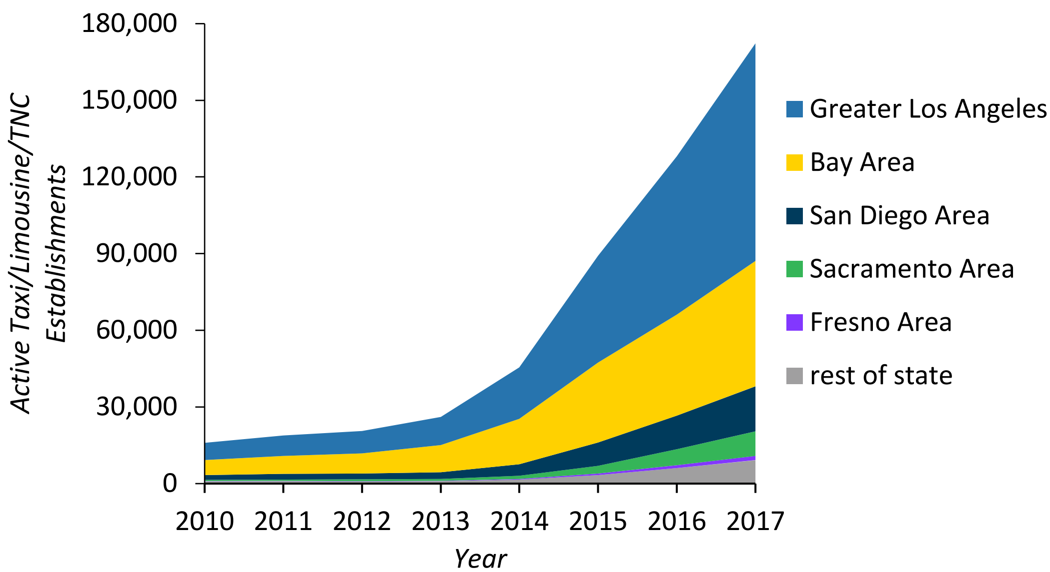
- The number of establishments may overstate the level of ridehail service provided. Establishments are not linearly related to levels of service, as some Uber and Lyft drivers work the equivalent of full time or more, while others drive only occasionally. Further, research shows that only four percent of Uber drivers were driving a year later (Efrati, 2017). The number of establishments recorded for tax purposes in a given year therefore likely overstates the number of drivers working at a single point in time.

- Relatedly, counts of driver measures of "establishments" do not directly capture the numbers of trips completed (and thus potential transit trips displaced or complemented). For example, the establishment count data would not provide any differentiation if, say, the average registered taxi and limousine driver in the San Diego Area completes 240 trips per month, while those in the Los Angeles Area typically complete 160 trips per month.

- Where drivers *live* does not necessarily reflect where they *drive*. For example, although drivers who live in Iowa are unlikely to travel to San Francisco in order to drive for Lyft, journalists have interviewed TNC drivers who live in cities like Modesto (located 90 miles east of San Francisco in the San Joaquin Valley) and travel two or more hours each way to drive in San Francisco ((Paul, 2019). Such anecdotes suggest that the Census data may understate the number of TNC drivers working in the Bay Area, and overcount those working in the Central Valley.

Figure 11-3 shows the total number of driver establishments registered each year by California region. The enormous jump after 2012 almost certainly reflects increased registrations to drive for Lyft, Uber, or another (now defunct) ridehail service. By 2016, California's two largest regions, Greater Los Angeles and the Bay Area, unsurprisingly had the most establishments. Greater Los Angeles, with nearly half of the state's population, had more than 60,000 establishments—over half of the state total (U.S. Census Bureau, 2019).

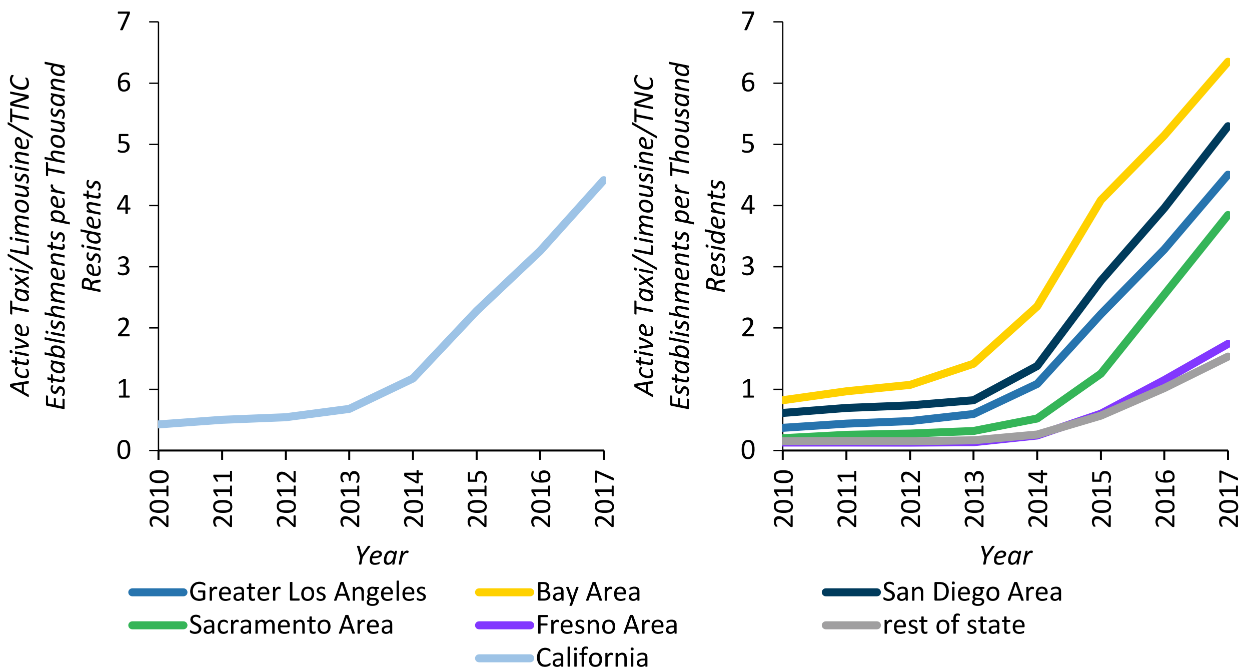
Figure 11-3. Active Taxi and Limousine (Including TNC) Establishments in California



Data source: U.S. Census Bureau, 2019

The aggregate numbers in **Figure 11-3** mask the density of establishments and thus ridehail service available across regions. **Figure 11-4** reveals the variation of drivers across regions by controlling for population and showing the change over time in per capita establishments by area.

Figure 11-4. Active Taxi and Limousine (Including TNC) Establishments per Capita in California



Data source: U.S. Census Bureau, 2019

Across the state, the number of establishments per capita increased dramatically after 2012, with year-over-year increases growing up through 2017. There is also substantial variation in the density of driver establishments across California regions. The San Francisco Bay Area, where both Uber and then Lyft were born, has by far the highest density of ridehail establishments in the state. The San Diego Area has the second highest density of ridehail establishments, followed by Greater Los Angeles and the Sacramento Area. The Fresno Area, as well as the rest of California, have about one quarter as many establishments per capita as does the Bay Area (U.S. Census Bureau, 2019).

Together, these business establishment data suggest a large and rapid increase in the number of taxi/limousine/TNC workers throughout California, almost certainly due to growth in TNC drivers. These patterns also suggest substantial increases in ridehail use in Greater Los Angeles, the San Diego Area, and, in particular, the San Francisco Bay Area.

11.5. Conclusion

The evidence presented in this chapter, drawing from previous research on ridehail and transit use, an analysis of the California oversample of the National Household Travel Survey, and Census data on taxi and ridehail establishments, shows that ridehail use in California grew dramatically during the 2010s. Combined, this evidence suggests that ridehail likely subtracts more transit riders (who substitute ridehail for transit trips) than it adds (who add transit trips due to better first-/last-mile connections to transit stops and stations)—particularly in the San Francisco Bay Area, where ridehail use appears highest, but likely in the San Diego and Los Angeles Areas as well.

All told, California witnessed an eight-fold increase in TNC/taxi use between 2009 and 2017, which is substantially larger than for the United States as a whole. The timing and trip purposes of TNC/taxi trips and transit trips differ substantially. However, in the Bay Area at least, transit operators have lost a disproportionate share of evening and weekend trips (See Chapter 3), which constitute a substantial majority (68.3%) of the growing number of TNC/taxi trips (FHWA, 2017). We see stark racial/ethnic differences in TNC/taxi use compared with transit, with whites much more likely to use TNC/taxis and African Americans much more likely to ride transit. Further, TNC/taxi use among California Hispanics increased substantially between 2009 and 2017, while transit use decreased even more dramatically (See Chapter 6). The average age of TNC/taxi users decreased between 2009 and 2017, while it increased among transit users. Finally, while TNC/taxi use increased substantially across all income groups between 2009 and 2017, it increased most significantly among riders from middle-class households (FHWA, 2009, 2017).

As noted in Chapter 3 and our previous study of transit decline in Greater Los Angeles (Manville, Taylor, and Blumenberg, 2018), the major declines in per capita transit ridership in much of the state began prior to the widespread availability of ridehail. Thus, we do not lay the blame for public transit ridership's decline throughout California squarely at the feet of Lyft and Uber. However, the Bay Area presents a different story. While ridehail does not fit the timeline for statewide decline, the rise of ridehail and fall of transit use align—in terms of timing, location, and trip purpose—relatively well in the Bay Area. There, off-peak trips, TNC's core market, account for much of transit's patronage decline, which began later than in the rest of the state, at a time when ridehail establishment numbers were growing rapidly (See Chapter 3). Further, the concentration of ridehail drivers in the Bay Area outstrips rates in other California regions.

While strongly suggestive, the case here for ridehail replacing transit use is not an open-and-shut one. Several studies find, and the NHTS data analyzed here show, that public transit and ridehail tend to serve two very different travel markets. Ridehail use is typically highest in the evening and on weekends, which are not peak times for transit (although they have been peak times for ridership losses). In addition, ridehail passengers systematically differ socio-economically and with respect to trip purpose from transit travelers (Rayle et al., 2016 and Feigon and Murphy, 2016). Further, only in limited situations can Lyft and Uber fares compete with transit fares, and since the companies' public offerings in 2019, fares have risen even higher (Sainato, 2019).

The rapid rise of ridehail has clearly affected the travel landscape in California in the last decade, but also represents just one more way that Californians choose private automobiles for mobility. TNC/taxi use has increased substantially among younger riders and Hispanics, two traditional core transit-riding population segments that have been abandoning public transit in recent years. These national and state travel survey data provide circumstantial evidence that ridehail has likely lured at least some riders away from public transit, particularly for social trips and in evenings and on weekends. Quantifying this substitution, however, is not straightforward, especially without TNC trip data. As a state of early adopters, California may offer clues to unpacking the relationship between ridehail and public transit for the rest of the country. But to move beyond clues, the local, regional, and state government agencies that regulate and plan for mobility in the Golden State need regular access to standardized data from these new service providers, while remaining sensitive to user privacy concerns.

12. Shuttles and Micromobility

12.1. Introduction

Over the past decade, the private sector has launched new transportation services in a variety of modes. While far smaller in scale than private auto use (discussed in the prior chapters), these travel options may influence transit use as well. In this chapter, we review the potential effects of major emerging mobility services available in California, like private commuter shuttles and "micromobility services" (See Appendix A, Section 2 for definitions). We find little evidence, however, that they have substantively depressed transit ridership in the state.

12.2. Private Commuter Shuttles

Private shuttle services (often called "Google buses" after their most prominent corporate operator) grew substantially in the 2010s, particularly in the San Francisco Bay Area. Yet their impact on public transit ridership in California is not well known. Google's shuttle program began in 2004 with fewer than 200 users (O. Thomas, 2012); by 2007, 1,200 Google employees regularly used the shuttles, representing almost a quarter of the company's then-workforce (Helft, 2007). Other major companies such as Apple, Cisco, Genentech, Facebook, and Yahoo also offer long-distance private transportation services to employees (Bay Area Council and MTC, 2016). Beyond the Bay Area, other large companies have developed similar services for their suburban campuses that employ urban residents. For example, since 2007, Microsoft has offered a shuttle service—the Microsoft Connector—to employees traveling from urban Seattle to their campus in suburban Redmond (Long, 2009).

The potential effects of employee shuttles are mixed. Some of the benefits identified by researchers and the press include increased mobility and choice, comfort, shorter trip times relative to traditional public transit, and the enhanced ability to work while traveling due to wi-fi access and laptop tables (Helft, 2007). Positive external effects also include decreased single-occupancy vehicle use, lower greenhouse gas emissions, and reduced congestion (Brooks, 2014). However, shuttles have potential downsides. They may exacerbate issues of housing affordability and neighborhood change by making it easy for comparatively well-paid employees to live in dense, urban areas previously occupied by lower-paid residents (Crucchiola, 2016). Moreover, as private operators, shuttle services only offer services to their employees and contractors, and not to the general public; the expansion of these services consumes street and curb space (the latter for boarding and alighting) and raises equity concerns regarding mobility and access for travelers excluded from the private shuttle services (O'Brien and Guyn, 2014). Finally, shuttle services have generated operational concerns in places like San Francisco where they are plentiful. The lack of dedicated drop-off and pick-up zones raises safety issues for pedestrians and bicyclists when the buses stop in traffic or bike lanes to board or discharge passengers, conflicts with public buses at bus stops when they pull to the curb, and increases congestion, particularly on narrow streets (San Francisco Board of Supervisors, 2014).

In California, we have access to comprehensive regional data on private shuttle services only for the San Francisco Bay Area. There, private shuttle services concentrate in San Francisco and Silicon Valley 40 miles to the south. The direct effect of these services on transit ridership, however, likely is small—with a very rough estimate of around 11,000 daily deferred trips throughout the Bay Area (Bay Area Council and MTC, 2016). These express services are most heavily concentrated between San Francisco and Silicon Valley, which is also served by the Caltrain commuter rail service. Caltrain is one of the few ridership success stories in California in the 2010s, having enjoyed over a dozen years of nearly uninterrupted patronage growth (Wasserman et al., 2020). So while it is possible that Caltrain's ridership expansion would have been even greater in the absence of the private shuttle services, it is hard to argue that they are behind declining public transit ridership—at least in the corridor where they operate the most.

These shuttle services may have other, less direct effects on public transit. They can encourage suburban tech workers to live in more urban, transit-friendly places that make it easier to get around with fewer cars. If employee shuttles are associated with reduced car ownership, shuttle users may use transit at higher rates for non-commute trips, thereby boosting public transit use. But if these new urban residents replace others with lower incomes and even higher propensities to get around using public transit, then the net effect of private shuttles on public transit use may be negative. Finally, not all of these shuttle services are between San Francisco and Silicon Valley; some connect suburban job centers to far-flung suburbs where nearly every trip, other than the private shuttle commute, is by private car and not public transit.

However, given the apparently concentrated supply of private commuter shuttles in the Bay Area, and that the greatest drops in ridership have occurred outside of the Bay Area, as shown in Chapter 3, these services have likely had relatively modest effects on statewide public transit ridership. The bulk of California's transit ridership declines, then, do not arise from private shuttles.

12.3. Micromobility

Micromobility is a term that captures a wide array of travel services, but commonly refers to small mobility systems (weighing less than 1,000 pounds) that offer what is termed "first-mile, last-mile" connectivity (Bruce and Dediu, 2018). These services attract users because of their flexibility, speeds (faster than walking), and ease of use. In contrast to longer trips via transit, the average micromobility trip is less than 2.5 miles (NACTO, 2019), often considerably less. Such short trips and relatively slow travel speeds suggest that scooters and other forms of micromobility are more likely to replace walking than transit trips, and in fact may complement more than substitute for transit by making it easier for travelers to access transit stops and stations more easily than by foot. Indeed, in a UCLA study of micromobility survey data from San Francisco, Barnes (2019) found that around 3 in 10 scooter trips enabled a complementary transit trip that otherwise would not have been made by transit and that scooters induced five times more transit trips than they replaced.

Whatever their effect on transit, micromobility has been growing meteorically in popularity. One study found that travelers took over 84 million trips on shared micromobility services in 2018, over twice as many as the previous year (NACTO, 2019). Because bicycle share systems have been around for much longer, it is likely that much of this growth is attributable to the introduction of scooter share. But as many of these systems—especially electric scooters—have been in operation for less than three years, and relatively widespread only very recently in certain areas, if micromobility trips are replacing transit trips in California, the effects would only be just as recent. As documented in Chapter 3, though, the state's transit ridership decline dates back around five years, with per capita declines occurring earlier in many regions. Overall, and in the absence of conclusive data, the case for micromobility's complementarity with public transit appears stronger than the case for substitution.

12.3.1. Bicycle Share Systems

Bicycle share systems have operated for many years in cities internationally and in North America, although recent technology changes like electric bikes ("e-bikes") have broadened user appeal. These systems provide wide-spread, usually public, bicycle access, and appeal to both visitors and local residents who either do not own bicycles, or who do not have their bikes with them. Amsterdam established the first bicycle share system (albeit temporarily) in the 1960s, but the idea would not begin to take off for another three decades. In the 1990s, bikeshare systems began operating in cities with extensive bicycle infrastructure, like Copenhagen (Goodyear, 2018). While the earliest systems almost entirely mimicked a regular bicycle, a "second generation" of bicycle share systems has integrated electric batteries and other forms of motorization to increase speeds.

Most observers distinguish between two kinds of bikeshare systems: station-based and dockless (NACTO, 2019). Station-based systems center bicycles in areas with high densities of potential users, such as adjacent to major transit hubs like subway stations (NACTO, 2016). In contrast, dockless systems do not have "docks" to which the bicycles must be returned; users can locate them with GPS-enabled mobile devices and leave them most anywhere within predefined zones (McKenzie, 2018). While docked systems have proven easier to manage, dockless systems have rapidly gained popularity with users who enjoy not being tied to just a few docking locations (which may themselves be empty when seeking a bike or full when attempting to return one) and easier access to bikes as GPS technology has improved (Sun, 2018).

The effects of bicycle share systems on transit ridership remain uncertain. As noted at the outset of this section, they can provide first-mile/last-mile access to transit stops and stations, and indeed many cities choose to install the systems adjacent to major transit hubs (NACTO, 2019, 2016). However, because bikeshare is most common in areas well-served by transit, it may also replace short transit trips. Preliminary evidence suggests that bicycle share systems may replace trips formerly taken by bus but complement trips taken by rail (Graehler, Mucci, and Erhardt, 2019). Additionally, in Washington D.C. and Minneapolis, bicycle share trips appear to replace transit trips more for people who live on the urban periphery, as opposed to those who live in the urban core (Martin and Shaheen, 2014).

As of 2019, California had at least 51 bicycle share systems in operation (including both public, private, and university systems) (CycleHop, 2019). They range from large systems in cities like San Francisco to small systems in resort communities like Truckee, so their effects on transit likely differ substantially across cities and systems. However they may influence transit ridership, bicycle share systems have become a part of the transportation landscape in many California cities.

12.3.2. Electric Scooters and E-bikes

Two recently introduced motorized shared services—electric scooters and e-bikes—provide shared mobility for users in predominantly urban locations. Most of these shared motorized systems have only been present in American cities for a few years; Bird and Lime, the two of the most prominent electric scooter companies, began operation in 2017 (Yakowicz, 2018). While the private companies operating these services have frequently clashed with local governments internationally—especially in terms of safety and use of public space—their ubiquity and widespread popularity suggest rapidly evolving user preferences in the urban transportation market.

Few studies have specifically evaluated the effects of e-scooter and e-bike trips on transit, though some have measured their general traits. In 2018, over 40 percent of e-scooter trips nationwide took place in three regions: Greater Los Angeles, the San Diego Area, and Austin, Texas (NACTO, 2019). In Washington, D.C., 70 percent of e-scooter and dockless bicycle share trips were less than one mile, and across several different cities, 98 percent of e-scooter trips were less than 5 miles long. In contrast, only 35 percent of e-bike trips covered less than one mile. Unlike other shared modes used primarily during the rush-hour peaks on weekdays, e-scooters see their highest daily use on weekends. E-bikes, by contrast, are more likely to be used during weekday peak periods (Chang et al., 2019).

The types of trips riders take using e-scooters and e-bikes vary greatly from city to city. In Portland, Oregon, 20 percent of respondents reported using e-scooters and e-bikes primarily for commuting to and from school or work, while 55 percent of San Francisco respondents reported the same. Further, respondents in many cities report frequently replacing walking and bicycling trips, but not transit trips, with e-scooters: in Denver, Colorado, 57 percent reported that e-scooter trips replaced trips that otherwise would have been made by foot or bicycle, and 46 percent of Portland respondents reported the same (Chang et al., 2019 and Portland Bureau of Transportation, 2019).

Due to the frequently unsanctioned roll-outs of these dockless micromobility services and the fact that are often haphazardly parked on public sidewalks, many local governments have resisted their introduction (Birnbaum, 2019). Bird's first scooters appeared on the sidewalks of Santa Monica in 2017, whereupon the city immediately banned them (Etehad, 2018). Following a legal battle, Santa Monica subsequently permitted some companies to operate within specific guidelines, and has fined others for operating without licenses (Pauker, 2019). The deployment of these services is uneven, and regulatory questions remain far from settled. Just prior to the global pandemic in early 2020, the two largest e-scooter companies were operating in half of California's ten largest cities, and continued expansion was in the works (Bird, 2019 and Lime, 2019).

The fragmentary information we have on these fast-evolving services—in particular that e-scooter trips are typically very short, and are used mostly for trip purposes other than commuting—suggests that micromobility options have not played a central role in transit ridership declines. These services do, however, pose other difficulties and concerns for transit operators, including potentially substantial questions of safety, as well as those concerning the equity implications of private companies using public sidewalks and other rights-of-way for the parking and operation of their vehicles.

12.4. Conclusion

A new array of mobility options for Californians emerged during the 2010s, all dependent to some degree on information and communications technologies and most delivered by the private sector. All are some form of shared mobility, but the sharing is typically serial (that is, one customer per vehicle at a time) rather than parallel (when many transit riders travel together). As the global center of the tech industry, California cities in particular have been early hosts of these new services—sometimes willingly, others unwillingly. While private commuter shuttles are not a new technology, they incorporate new technology (travelers can track vehicle arrivals on their mobile devices and work using wi-fi while on board). They expand transit options—now private in addition to public—for some travelers, particularly in the Bay Area. Meanwhile, bicycle share systems, electric scooters, and e-bikes all offer new, personalized possibilities for travel (albeit typically serving much shorter trips than those taken via private shuttles). Despite their ubiquity in some areas and popularity among users, it is difficult at this point to make a convincing circumstantial case that the new services described here are having substantial negative effects on public transit use over the last decade. Given that micromobility may be improving first-mile/last-mile access to transit, we see a stronger case for these new services enhancing the transit experience and transit use than detracting from them.

Part V. How Are California Neighborhoods Changing?

In recent years, two related issues have prominently emerged in policymaking and political discourse in California: changes in the cost housing and changes in the location of jobs. The state's shortage of housing stock and boom in employment have had wide-ranging effects, including on areas like homelessness, tax revenue, urban design, and, of course, transportation. In Part V, we analyze the relationships between housing patterns, employment patterns, and mobility patterns, with an emphasis on possible effects on transit use in California.

In Chapter 13, we examine changes in the location of California workers and jobs from 2002 to 2015. Using employment and commuting data from the Census Bureau, we track changes in "self-containment"—that is, changes in the number of workers who both live and work in a jurisdiction relative to the number of workers who travel into or out of the jurisdiction for work (See Appendix A, Section 2 for further definitions). Jurisdictions that are more self-contained provide increased opportunities for workers to live near their place of residence, which may reduce commute lengths and make transit use more attractive. High levels of self-containment require jurisdictions to provide their workforce with a sufficient quantity of nearby affordable housing. We thus explore the role of housing affordability in self-containment and complement this analysis by exploring changes in commute distances and access to jobs by public transit.

We find that California cities and regions are, indeed, becoming less self-contained over time. In other words, we find growing imbalances between jobs and available housing in California cities in recent years. These imbalances have become most acute in cities with significant (and growing) numbers of jobs and where housing costs have risen quickly. More generally, we find that cities with more expensive housing are increasingly less self-contained. As a consequence, average commute distances are increasing, and the number of workers who live in neighborhoods with high access to jobs by transit is falling. In short, the location of jobs and workers in California is changing in ways that are likely to make transit commuting less attractive.

In Chapter 14, we build on these findings to examine changes in the socioeconomic characteristics of residents of transit-friendly areas since 2000. As low-income people, immigrants, and residents of zero-vehicle households take transit at disproportionately high rates, we examine changes in these groups in areas with high transit access, to evaluate how these trends have affected transit use.

Overall, we find that poverty in the areas with the best transit service has declined. While over the last two decades, Latin-America-born immigrants live in transit-friendly neighborhoods at lower rates, their departure has been counterbalanced by a growing population of Asia-born residents. We also find that the share of households with no vehicles has declined significantly in transit-friendly neighborhoods since 2000; however, this drop is neither confined to nor disproportionate in transit-friendly neighborhoods. Further, we differentiate between the neighborhoods likely dominated by "car-less" households—those who likely cannot afford to own a vehicle—and neighborhoods likely dominated by "car-free" households—those that *choose* to forego car ownership. We find small but steady increases in neighborhoods dominated by car-free households. Most of these are located in the San Francisco Bay Area, which has maintained stronger levels of transit ridership than other areas of the state in recent years.

These findings suggest two things. First, the demographics of the foreign-born and low-income populations are changing transit-friendly neighborhoods, and these changes may have negative consequences for transit systems serving them. Second, with respect to increasing vehicle access, California's transit-friendly neighborhoods have changed much like the rest of California—with major implications for the state's transportation system, as explored in Chapter 15.

13. Changing Location of Workers Relative to Jobs

13.1. Introduction

Across the state's metropolitan areas, changes in the numbers and locations of jobs and homes have changed the way residents travel. Considering these shifts, one explanation for declining transit ridership centers on the relocation of households away from expensive cities and neighborhoods to outlying areas where housing is more affordable but transit service and use is more limited. In this chapter, we examine this theory, focusing on changes in the spatial location of workers relative to jobs in California cities and its major regions from 2002 to 2015. In light of these trends, we then analyze changes in commute distance and access to jobs by transit.

Our data include all California cities for which administrative and demographic data are available for 2002 and 2015 (the earliest and latest years of full data at time of analysis), constituting approximately 83 percent of California jobs and cities. We first examine whether California cities are less "independent" or self-contained over time, defined as a decline in the number of workers who both live and work within a jurisdiction relative to the number of workers who either travel into or out of a city (See Appendix A, Section 2 for further definitions). We then present data on the associated changes in commute distance and access to jobs by public transit. The analysis draws on data from the Longitudinal Employer-Household Dynamics Origin-Destination Employment Statistics (LODES) (U.S. Census Bureau, 2002, 2015), assembled by the U.S. Census Bureau from state administrative data. Data on the number of jobs available by public transit are from the Accessibility Observatory at the University of Minnesota (Owen, Levinson, and Murphy, 2017).

Despite the "back to the city" movement that commentators once hypothesized would recentralize housing and jobs in urban centers, we find that California cities and regions have become less self-contained over time, with a waning percentage of workers both living and working in the same city. Although these patterns are widespread, the downward trend is greatest in employment-rich cities where housing costs are rising fastest. At the same time, a growing percentage of workers commute into urban regions from elsewhere. These trends have contributed to growing commute distances and an increasing percentage of workers who live in less transit-accessible neighborhoods. Together, they also suggest that California cities are changing in ways that make them difficult to serve effectively with traditional fixed-route, fixed-schedule transit.

13.2. The Spatial Location of Jobs and Workers in California Cities and Regions

Across California cities, the location of employment and workers has changed from 2002 to 2015 (See **Table 13-1**). Over that period, cities experienced an increase in both the number of jobs and the number of employed residents. However, on average, the number of jobs grew faster than the rate of employed residents—22 percent compared to 10.5 percent. Consequently, the ratio of jobs to employed residents, a measure of jobs-housing balance, increased by approximately two percent (U.S. Census Bureau, 2002, 2015) (See Appendix C for statistics on jobs and housing in California's 50 most populous cities).

Table 13-1. Jobs-Housing Measures in California Cities, 2002 and 2015

MEDIAN JOBS-HOUSING MEASURES	2002	2015	CHANGE, 2002-2015
Total Jobs	10,701	13,053	+22.0%
Employed Residents	13,861	15,310	+10.5%
Ratio of Jobs to Employed Residents	0.82	0.84	+1.8%
Share of Locally Working Residents	12.88%	11.30%	-12.3%
Share of Locally Residing Workers	14.92%	13.18%	-11.6%
Independence Index	0.075	0.063	-15.5%

Data source: U.S. Census Bureau, 2002, 2015

However, the percentage of locally working residents—residents who worked in the same city in which they lived—declined between 2002 and 2015, decreasing from 12.9 to 11.3 percent. This possibly reflects increased housing prices near employment centers, higher job growth in outlying areas, and/or dispersal of higher-paying jobs. The trend is similar for locally residing workers (the percentage of workers who live in the same city as they work)—a decline from 14.9 to 13.2 percent (U.S. Census Bureau, 2002, 2015).

Consequently, cities have become less self-contained. To measure self-containment, we calculate an "independence index" (R. Thomas, 1969 and Cervero, 1996): the ratio of internal work trips (working and living inside a given city) to external work trips (the sum of employed residents of a city who work outside it and workers in a city who live outside it) (See Appendix A, Section 2). This independence index, which was low in 2002 (0.075), declined further by 2015 (0.063). As research suggests, low-wage workers and their jobs are more "self-contained" than higher-wage workers and their respective jobs, likely reflecting the benefits of city living to lower-income households (e.g., better access to public transit, affordable housing, and other services) (Glaeser, Kahn, and Rappaport, 2008) (See Appendix C for the independence index for California's 50 most populous cities).

As cities' jobs and housing patterns have changed, so too have patterns in the state's major regions. **Table 13-2** reports the number of employed residents and jobs in California's five regions and the rest of the state in 2002 and 2015. The number of jobs and employed residents increased across all regions and in California as a whole. Absolute growth of both workers and jobs was highest in Greater Los Angeles, followed by the Bay Area—the two regions with the highest total number of workers and jobs. However, percentage growth was highest in the Sacramento Area, followed by the Fresno Area. The Sacramento and San Diego Areas added more employed workers than jobs, while the other three regions added more jobs than employed workers (U.S. Census Bureau, 2002, 2015).

Table 13-2. Number of Employed Residents and Jobs in California Regions, 2002 and 2015

REGION	EMPLOYED RESIDENTS				JOBS			
	2002	2015	CHANGE, 2002-2015		2002	2015	CHANGE, 2002-2015	
Greater Los Angeles	6.59 mil.	7.58 mil.	+0.99 mil.	+15.0%	6.59 mil.	7.60 mil.	+1.01 mil.	+15.3%
Bay Area	3.04 mil.	3.50 mil.	+0.46 mil.	+15.2%	3.19 mil.	3.71 mil.	+0.52 mil.	+16.2%
San Diego Area	1.17 mil.	1.35 mil.	+0.19 mil.	+16.0%	1.17 mil.	1.33 mil.	+0.16 mil.	+13.7%
Sacramento Area	0.76 mil.	0.96 mil.	+0.20 mil.	+26.6%	0.76 mil.	0.94 mil.	+0.18 mil.	+23.1%
Fresno Area	0.29 mil.	0.35 mil.	+0.06 mil.	+20.0%	0.29 mil.	0.35 mil.	+0.06 mil.	+20.7%
rest of state	1.88 mil.	2.16 mil.	+0.28 mil.	+15.1%	1.73 mil.	1.99 mil.	+0.26 mil.	+15.0%
California	13.73 mil.	15.91 mil.	+2.18 mil.	+15.9%	13.73 mil.	15.91 mil.	+2.18 mil.	+15.9%

Data source: U.S. Census Bureau, 2002, 2015

Like cities, California regions have also become less self-contained. **Table 13-3** displays changes in the percent of jobs located in each region held by workers who live outside that region and commute into the region for work. This percentage increased across all regions from 2002 to 2015. This percentage was highest in both years in the Sacramento and Fresno Areas, although the rank order of the two regions switched from 2002 to 2015. The Fresno Area in particular saw a large increase in its share of in-commuters (U.S. Census Bureau, 2002, 2015).

Table 13-3. Share of Jobs Held by Workers Living Outside Each Region and Commuting In

REGION	SHARE OF IN-COMMUTERS		CHANGE IN SHARE OF IN-COMMUTERS	
	2002	2015	PERCENTAGE POINTS	PERCENT
Greater Los Angeles	4.3%	6.3%	+2.0	+44.6%
Bay Area	11.5%	14.5%	+3.0	+25.6%
San Diego Area	14.6%	16.7%	+2.1	+14.1%
Sacramento Area	20.4%	22.2%	+1.8	+8.9%
Fresno Area	18.7%	26.5%	+7.8	+41.8%

Data source: U.S. Census Bureau, 2002, 2015

13.3. Affordable Housing and the Jobs-Housing Balance

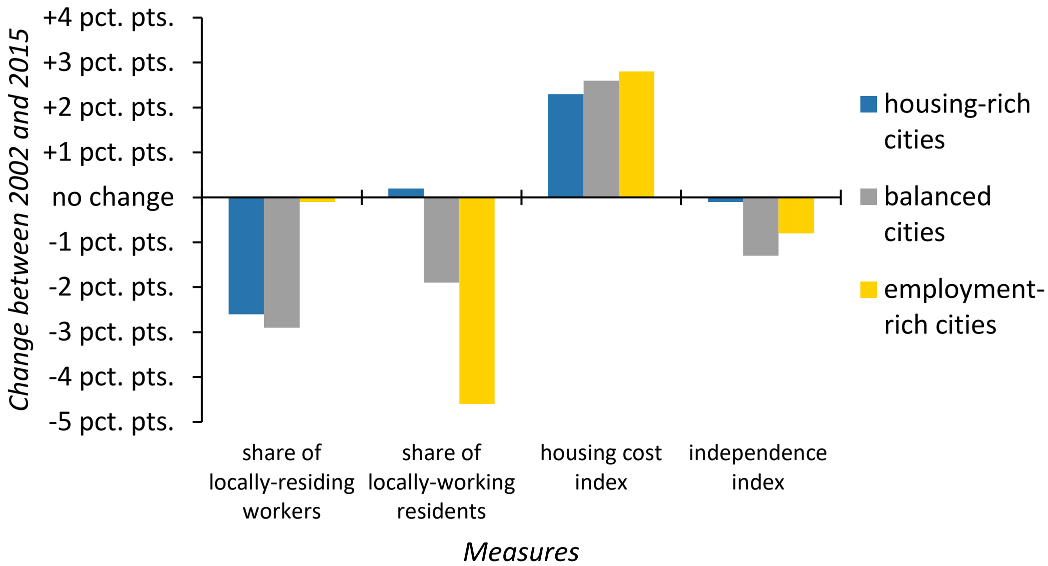
To further explore the relationship between jobs and housing, we next categorize California cities into three types: "housing-rich,"[26] "employment-rich,"[27] and "balanced."[28] **Figure 13-1** shows the changes in our measures over time by city type. From 2002 to 2015, the percent of locally residing workers declined across all city types, with the smallest decline evident in employment-rich cities. Employment-rich cities experienced the largest decrease in the percentage of locally employed residents (-4.6 percentage points); the decline was half that rate (-1.9 percentage points) for balanced cities. Housing-rich cities, however, experienced a small increase in the percentage of residents who are employed locally. These findings highlight the dependence of commuting behavior on housing policy and land use more generally.

26. Cities in which the logarithm of the ratio of jobs to employed residents is less than one-half of the standard deviation below the mean (Cervero, 1996)

27. Cities in which the logarithm of the ratio of jobs to employed residents is greater than one-half of the standard deviation above the mean (Cervero, 1996)

28. Cities in which the logarithm of the ratio of the jobs to employed residents falls within one standard deviation of the mean (i.e., falling between one-half standard deviation below the mean and one-half standard deviation above the mean) (Cervero, 1996)

Figure 13-1. Change in Housing and Jobs Measures in California Cities, 2002 to 2015



Data source: U.S. Census Bureau, 2002, 2015

Housing costs—as measured by our housing cost index[29]—rose across all city types, an indication of the widespread nature of the housing crisis in California (See Appendix C for the housing cost index for California's 50 most populous cities). The largest increase occurred in employment-rich cities and the lowest in housing-rich cities. Similarly, the independence index declined least in housing-rich cities. Combined, these trends indicate that workers are locating farther from their places of work and that housing costs, while increasing across all city types, are mitigated in cities with greater excess of housing units over employed residents. In housing-rich cities, workers may be better able to find housing as a function of the greater supply of available housing units. It is also theoretically possible that housing-rich cities disproportionately attract workers who otherwise would choose to locate elsewhere. These cities (e.g., Brentwood, Calabasas, and Alameda) are likely to be suburban areas with fewer social and cultural attractions for workers beyond particular employment opportunities, whereas balanced (e.g., Los Angeles, San Diego, and San José) and employment-rich (e.g., San Francisco and Sacramento) cities may be more likely to possess social, cultural, and physical amenities that compensate workers for a relatively longer commute.

All of these changes come in the context of California's affordable housing crisis. Do rising housing costs predict cities becoming less self-contained (i.e., having more in-commuting and out-commuting)? To test the role of housing affordability in predicting the independence index (our measure of city self-containment), we constructed statistical models for 2002 and 2015 that control for the median number of low-wage workers (a proxy for city size), job density, housing costs, and median household vehicle ownership, each of which are statistically significant.

From the models, we find that larger cities tend to be more self-contained, all else equal, since they offer numerous opportunities to live and work in the same municipality. However, cities with dense employment (i.e., more workers per unit of land area) are less self-contained, a finding that suggests that large

29. We construct our housing cost index by dividing the median single family home value by median household income in each city. Conceptually, higher index scores indicate higher housing costs relative to household incomes.

employment concentrations in a given city attract workers from around the region. Cities with higher rates of vehicle ownership are also less self-contained, again all else equal, as 1) vehicle access is associated with income, and income is positively related to travel distance and 2) cars enable workers to travel longer distances.

Controlling for the variables above, cities with higher housing costs are less self-contained. This suggests that an insufficient stock of affordable housing near their place of work has forced some workers to locate farther from their places of employment. Reflecting this, in our base model for the whole state, this inverse relationship between cities' housing costs and independence index has grown over time, in tandem with the substantial rise in housing costs in the state.

We next added controls for the five major California regions into the models above. In both 2002 and 2015, controlling for other factors, cities in the Bay Area, Greater Los Angeles, and the San Diego Area are less self-contained than cities in other areas of the state. If rising housing costs contribute to cities becoming less self-contained, then it makes sense that housing costs would have a larger negative effect in these large urban housing markets where costs have risen most significantly. This interpretation is consistent with findings by Glaeser and Gyourko (2018), who argue that housing costs in some coastal areas are exacerbated by restrictions on development. Unfortunately, our data do not allow us to directly explore whether there is a housing cost premium associated with coastal cities in growing urban areas. However, our regression results are consistent with the idea that the effects of housing costs on commuter residential location/travel behavior are strongest in large coastal economies with growing housing demand yet limited housing supply.

13.4. Commute Distance and Access to Jobs by Transit

All of these changes have significant implications for commute patterns and transit use. For one, as lower shares of the population both live and work in the same city and as housing prices have risen, commute distances have grown. **Table 13-4** shows that, on average, commute distances increased across California from 2002 to 2015. In 2002, average commute distances across California were approximately 11 miles and by 2015 increased by around 15 percent, or two miles. Average commute distances increased across all regions, but remained lowest in both years in Fresno (U.S. Census Bureau, 2002, 2015).

Table 13-4. Network Commute Distance in California, 2002 and 2015

AREA		COMMUTE DISTANCE		CHANGE IN COMMUTE DISTANCE	
		2002	2015		
California Regions	Greater Los Angeles	11.2 mi.	11.7 mi.	+0.5 mi.	+4.6%
	Bay Area	10.1 mi.	11.4 mi.	+1.2 mi.	+12.1%
	San Diego Area	10.8 mi.	11.4 mi.	+0.6 mi.	+5.3%
	Sacramento Area	11.1 mi.	12.1 mi.	+1.0 mi.	+9.0%
	Fresno Area	8.5 mi.	9.3 mi.	+0.8 mi.	+9.6%
California	Mean	11.5 mi.	13.2 mi.	+1.7 mi.	+14.8%
	Median	10.6 mi.	12.2 mi.	+1.6 mi.	+15.1%

Data source: U.S. Census Bureau, 2002, 2015

In addition to increasing average commute distance, commutes across all cities are becoming less amenable to being taken on transit. The number of jobs reachable in 30 minutes on transit from the neighborhoods in which workers reside decreased approximately 10 percent across California from 2002 to 2015 (See **Table 13-5**). It also decreased across most regions, with the exception of the Bay Area (Owen, Levinson, and Murphy, 2017). This difference between the Bay Area and other regions of the state may be part of the reason why transit ridership has held up proportionately more in the Bay Area than in other regions. The utility of any particular mode of travel comes down to how easily it makes getting to certain locations. Although individual workers are primarily interested in reaching their current job conveniently and quickly, the likelihood of a given transit system serving any given job location increases with the number of total jobs reachable by that transit system. For workers as a group, transit systems that provide easy travel to many jobs will be more useful than those that reach fewer jobs. Therefore, if transit systems over time provide access to fewer potential jobs, an increasing number of workers will be inclined to switch to other means of travel.

Table 13-5. Jobs Reachable by Transit in 30 Minutes in California, 2002 and 2015

AREA		AVERAGE NUMBER OF JOBS REACHABLE BY TRANSIT IN 30 MINUTES		CHANGE IN NUMBER OF JOBS REACHABLE BY TRANSIT IN 30 MINUTES	
		2002	2015		
California Regions	Greater Los Angeles	14,306	13,655	-651	-4.6%
	Bay Area	10,546	10,716	+170	+1.6%
	San Diego Area	6,091	5,693	-398	-6.5%
	Sacramento Area	4,114	3,232	-882	-21.4%
	Fresno Area	3,299	2,841	-458	-13.9%
California	Mean	**8,290**	**7,666**	**-624**	**-7.5%**
	Median	**6,358**	**5,565**	**-793**	**-12.5%**

Data source: Owen, Levinson, and Murphy, 2017

Thus, the utility of commuting via transit is generally decreasing across California, likely due to changing job and worker residential locations. Workers who are able to commute via other modes (so-called "choice riders") may increasingly do so, most likely by private automobile. Even if workers continue to use transit for the commute (for example, using commuter rail to access jobs in central cities), they may start making other trips by car. For example, a worker who relocates from a very transit-accessible neighborhood to a neighborhood with little or no transit access may be less likely (or able) to use transit for other trips outside their commute, such as those to the grocery store or to visit friends. Overall, these trends suggest that, in aggregate, transit ridership is likely to decrease as a result. These changes in the locations of workers and jobs are likely to interact with demographic changes in shaping travel behavior. We examine the role of demographic change in declining transit use in the next chapter.

13.5. Conclusion

California workers are becoming less likely to both live and work in the same city over time. Even in the state's largest regions, an increasing share of workers are commuting in from afar. At the same time, commutes have lengthened, and fewer jobs are in reach by transit.

At first glance, the implications of this chapter are more in the realm of housing policy than transportation policy. Indeed, our analysis suggests that limited housing supplies, exacerbated by local resistance to new housing development in built-up areas and growing demand for housing, inflate housing prices and incentivize workers to locate farther from their places of work in search of more affordable housing. But these issues also have strong effects on travel patterns and transit use. Changes in housing and employment patterns have caused commutes to grow and transit to less effectively link people to work opportunities. For longer trips, transit is usually less competitive with driving on measures of time, comfort, and reliability, so longer commutes bode ill for transit's mode share. As the share of the population living in areas with worse transit access to employment centers (including stores and services) grows, people will likely make fewer non-work local trips on transit as well. These trends suggest trouble for transit agencies, which are having or will soon have difficulty accommodating trips in lower-density, outlying regions of the state and parts of each region. In particular, the finding above also help explain why the Bay Area, an increasingly imbalanced region with respect to jobs and housing, is losing transit ridership (albeit more recently and less steeply than elsewhere), despite avoiding the large increases auto access that are driving down transit ridership elsewhere in the state (See Chapter 8).

The costs of these trends on California workers and residents are significant. Indeed, the transportation impacts of jobs-housing imbalance differ across space and population groups. Workers in booming coastal economies face intense competition for housing and, the data suggest, are more likely to live in outlying parts of their regions where housing is more affordable. Lower-wage workers face financial and transportation barriers to locating farther from their places of work. Some lower-wage workers may exchange reduced housing costs for increased commuting costs (Alonso, 1971); however, it is possible that their combined housing and transportation expenditure burdens may grow over time, potentially resulting in additional hardship.

14. Changes in the Characteristics of Residents Living in Transit-friendly Neighborhoods

14.1. Introduction

14.1.1. Overview

In this chapter, we examine social and economic trends taking place in transit-friendly neighborhoods since 2000. As housing costs have increased in California and neighborhoods change, many reasonably worry that lower-income residents who tend to ride transit frequently may be replaced in these neighborhoods by higher-income, less-frequent transit riders. This process may entail gentrification of formerly low-income and ethnically or racially diverse neighborhoods but can occur in middle-class or wealthy transit-friendly neighborhoods that experience rising housing prices and demographic change. While a plausible and widely touted theory, we find ambiguous evidence to support it in California.

We focus here on three socio-economic aspects of those living in transit-friendly neighborhoods in California, all of which relate to the propensity to ride transit. First, we find that poverty rates in transit-friendly neighborhoods have declined. Second, with respect to foreign-born residents, we find that the share of Latin-America-born immigrants living in transit-friendly neighborhoods has declined, but the share of Asia-born immigrants has increased somewhat. Finally, and perhaps most importantly for public transit, California has seen steep declines in the share of zero-vehicle households in its transit-friendly neighborhoods (Manville, Taylor, and Blumenberg, 2018). However, this drop in zero-vehicle households is not confined to these neighborhoods, but affects the state as a whole.

With respect to households without cars, whose members tend to ride transit much more than those with cars (see Chapters 6 and 8), we differentiate between “car-less” and “car-free” neighborhoods, the former where zero-vehicle households lack a car mostly by circumstance and the latter where many get by without one by choice. We find small but steady increases in car-free neighborhoods—places with many zero-vehicle households but low levels of poverty—in a handful of areas; these are mostly in the San Francisco Bay Area.

14.1.2. Context

Building on the findings of the previous chapter examining the location of workers and jobs and the job-housing balance, we examine in this chapter changes in the characteristics of residents in transit-friendly areas and their possible effects on transit ridership. Recently, housing costs have soared in most metropolitan neighborhoods in California, and in some of these areas, increasingly expensive housing has raised the specter of more affluent, less transit-riding newcomers displacing incumbent lower-income, more transit-riding residents. Even if newcomers to transit-friendly neighborhoods ride more than they did before their move, they may ride considerably less than those they replace. Further, if those who move out of transit-friendly neighborhoods relocate—because of economic exigency or preference—to more auto-oriented neighborhoods, they may ride transit less as well.

The research literature on gentrification and residential displacement are vast, messy, and, in full, beyond the scope of this chapter. Scholars have raised issues of resident turnover in existing transit-friendly neighborhoods with respect to efforts to concentrate housing and commercial development around major transit stops and stations—known as transit-oriented development (Hess and Lombardi, 2004). While generally popular with transit and environmental advocates, some affordable housing scholars and activists have criticized these efforts for their unintended consequences: the higher housing prices in TODs may displace lower-income, transit-riding households to less transit-friendly areas (Rayle, 2015).

Researchers have consistently found that TODs are associated with somewhat higher levels of transit ridership, even controlling for other factors known to influence transit use, including self-selection into transit-oriented developments (Ewing and Cervero, 2010). A recent study in the Bay Area and Los Angeles found that neighborhood change (although not necessarily displacement) is associated with TODs, especially in core urban areas (Chapple et al., 2017). The authors concluded that, even if new wealthy residents replace intensive transit users in TODs, the higher densities associated with development should offset these losses and increase the number of potential transit *users*. Of course, while transit *users* may increase, transit *trips* may not. As discussed in Chapter 2, Dominie (2012) found that transit commuting fell in areas around new rail stations in Los Angeles after their development, though the total population of these areas rose.

Aside from neighborhood residential turnover and the related issue of gentrification, housing costs in California have risen dramatically, particularly in coastal metropolitan areas. As population has grown faster than housing supply in many parts of the state, residents at all income strata have geographically broadened their housing searches into relatively more affordable areas, which can result in cascading waves of displacement. This process may ultimately push higher-propensity (and often lower-income) transit users into more affordable housing in outlying, more auto-oriented places where most new housing is being built (Kimberlin, 2019).

With these prior findings in mind, we examine changes in the characteristics of residents in the most transit-friendly neighborhoods in California, focusing in particular on those segments of the population that are far more likely to use transit than others. As a result, these groups account for a relatively large share of transit trips. Thus, we examine changes in three household characteristics—income, vehicle access, and immigrant status—all of which have been shown in the literature to significantly influence transit use. We also focus on the metropolitan areas and neighborhoods within them that host a very large share of transit trips. Consequently, even small shifts in the composition of people living in certain neighborhoods could have outsized effects on transit systems that depend on regular users for patronage (Manville, Taylor, and Blumenberg, 2018).

14.2. Types of Transit-friendly Neighborhoods

What qualifies an area as “transit-friendly”—having many transit users, having much frequent transit, and/or having a transit-supportive built environment? For robustness, we use three different methods to categorize census tracts as “transit-friendly,” each of which measures one of these different dimensions (See **Figure 14-1** and **Table 14-1**), and compare the results, holding geographies as constant as possible over time:

1. “Top Transit Commuter Tracts,” are census tracts with the highest percentage of commuters that, combined, are home to half of all total transit commuters in California. These commuters live in just 10 percent of California’s tracts; 96 percent of these neighborhoods are located in the Bay Area or Greater Los Angeles (U.S. Census Bureau, 2019).
2. “High-quality Transit Areas,” a definition established by California law to encompass areas near

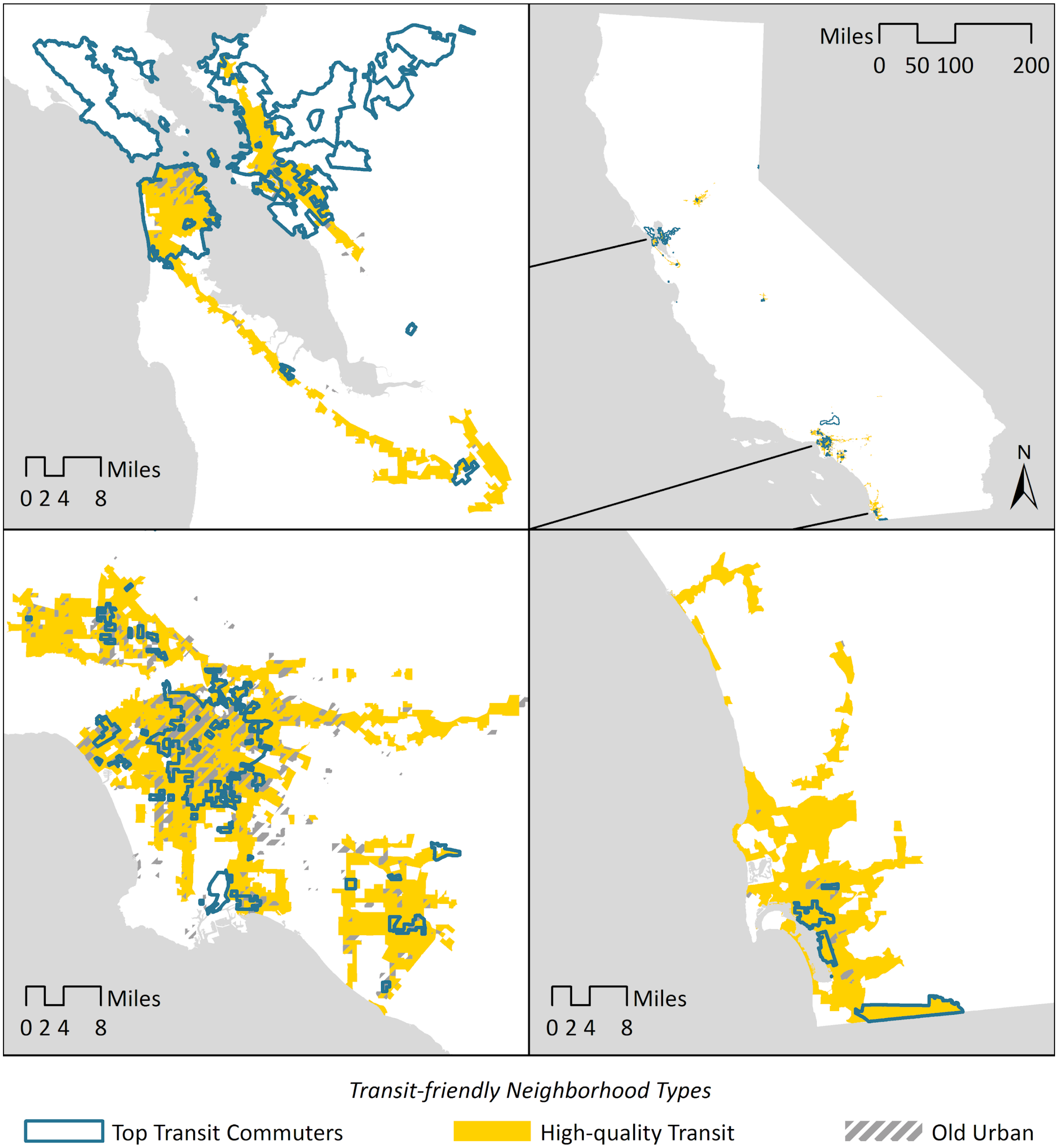
high-frequency transit stops and corridors (Implementation of the Sustainable Communities Strategy, 2008).[30] In other words, these census tracts host high levels of transit *supply*, regardless of the degree to which nearby residents use it. This is the most generous of our three definitions of transit-friendly neighborhoods.[31]

3. "Old Urban" neighborhoods are one of seven land use/transportation neighborhood types developed by Voulgaris et al. (2017) for the U.S. Federal Highway Administration. Among the seven neighborhood types, Old Urban have by far the highest average residential densities, job access, and transit service supply. Accordingly, residents of these neighborhoods typically walk and ride public transit frequently and drive less. While they account for just five percent of tracts nationally and are home to only four percent of the U.S. population, residents of Old Urban Census tracts make nearly a third of all transit trips nationwide. Greater Los Angeles contains 84 percent of all Old Urban tracts in California; together, Greater Los Angeles and the Bay Area account for 97 percent of the state's Old Urban tracts (Voulgaris et al., 2017).

30. Specifically, the term "high-quality transit area" comes from California Senate Bill 375, which allows for streamlined environmental review processes for designated projects in high-priority growth areas (Barbour and Deakin, 2012). SB 375 allows MPOs to develop eligible projects that include tracts "within one-half mile of a major transit stop or high-quality transit corridor included in a regional transportation plan. A high-quality transit corridor means "a corridor with fixed route bus service with service intervals no longer than 15 minutes during peak commute hours" (Implementation of the Sustainable Communities Strategy, 2008).

31. Due to data limitations, our High-quality Transit classification only accounts for counties in the five largest regions of the state (See Appendix A, Section 1). This overlooks neighborhoods in a few dense communities outside of these counties: for example in the central areas of Santa Barbara and Santa Cruz Counties.

Figure 14-1. Distribution of Transit-friendly Neighborhoods in California



Insets: Bay Area, Greater Los Angeles, and San Diego Area

Data source: U.S. Census Bureau, 2018, 2019; SCAG, 2020; MTC, 2018; SANDAG, 2019; SACOG, 2017a, 2017b; FCOG, 2019; and Voulgaris et al., 2016

Table 14-1. Comparison of Transit-friendly Neighborhood Types across California Regions

REGION	TOP TRANSIT COMMUTERS		HIGH-QUALITY TRANSIT		OLD URBAN	
	TRACTS	SHARE OF STATE TRACTS	TRACTS	SHARE OF STATE TRACTS	TRACTS	SHARE OF STATE TRACTS
Greater Los Angeles	393	49%	1,559	60%	719	84%
Bay Area	375	47%	526	20%	112	13%
San Diego Area	24	3%	304	12%	25	3%
Sacramento Area	8	1%	177	7%	3	0%
Fresno Area	3	0%	35	1%	0	0%
rest of state	2	0%	N/A	N/A	0	0%
California	805	100%	2,601	100%	859	100%

Data source: U.S. Census Bureau, 2019; SCAG, 2020; MTC, 2018; SANDAG, 2019; SACOG, 2017a, 2017b; FCOG, 2019; and Voulgaris et al., 2016

Across all three types, most lie in central parts of Los Angeles, Orange, and San Diego Counties and the Bay Area, with a small number in Sacramento and Fresno and almost none elsewhere in the state (See **Figure 14-1** and **Table 14-1**) (Note that these transit-friendly neighborhoods are distinct from the jurisdictions whose jobs/housing balances are analyzed in Appendix C, which are simply California's 50 most populous cities.).

Among the three transit-friendly neighborhood types, rates of transit commuting increased among High-quality transit and Old Urban neighborhoods from 2000 to 2017. In contrast, rates of transit commuting decreased among Top Transit Commuter neighborhoods over the same time period (U.S. Census Bureau, 2019). Commutes, however, comprise only a minority of transit trips in California (FHWA, 2017).

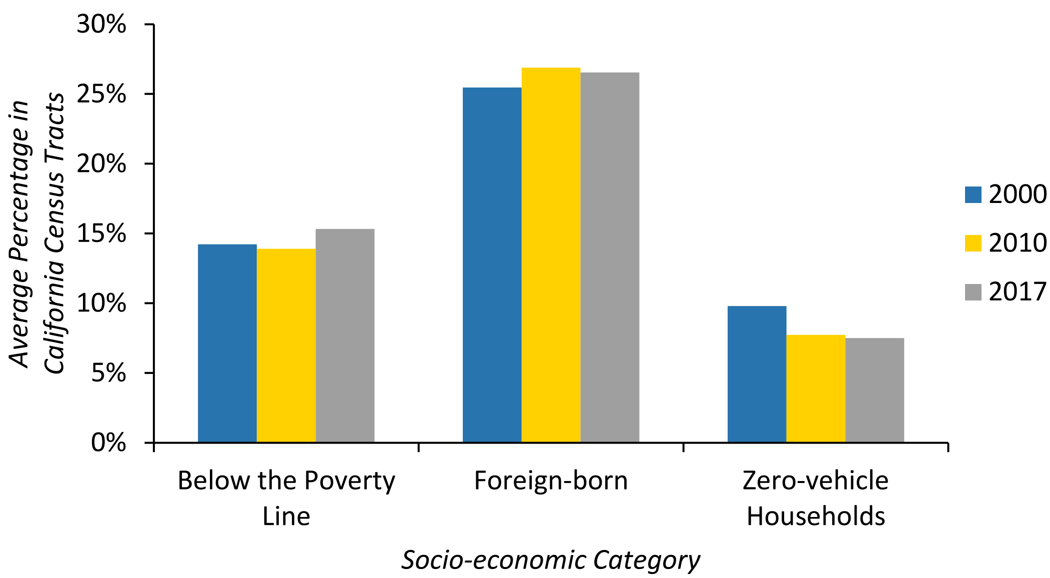
14.3. Change in Transit-friendly Neighborhoods

14.3.1. Baseline: All California Neighborhoods

As a baseline, we first explore California in terms of our three key socio-economic categories and then focus on changes in these characteristics in our transit-friendly neighborhood types. As we discuss in Chapter 6, low-income households ride transit at much higher rates; still, most low-income Californians get around in cars. Residents of low-income households are also more likely to live in transit-friendly neighborhoods and are less likely to own vehicles, also conducive to higher transit use. Finally, poorer neighborhoods usually have more immigrants, who tend to take transit at even higher rates. In general, we should expect high rates of poverty, zero-vehicle households, and immigrant households to be associated with greater transit use.

Figure 14-2 shows our three variables of interest across the entire state and how they have changed from 2000 to 2017. First, poverty rates edged up slightly between 2010 and 2017. Second, the average neighborhood share of foreign-born residents in California is relatively high compared to the nation as a whole, at almost a quarter of the population, but has remained steady over time. Finally, the most notable change is the substantial decline of zero-vehicle households since 2000. From 2000 to 2017, the share of zero-vehicle households in California dropped by almost a quarter, from 9.8 to 7.5 percent (See Chapter 8).

Figure 14-2. Change in California: Three Socio-economic Categories of High-propensity Transit Users



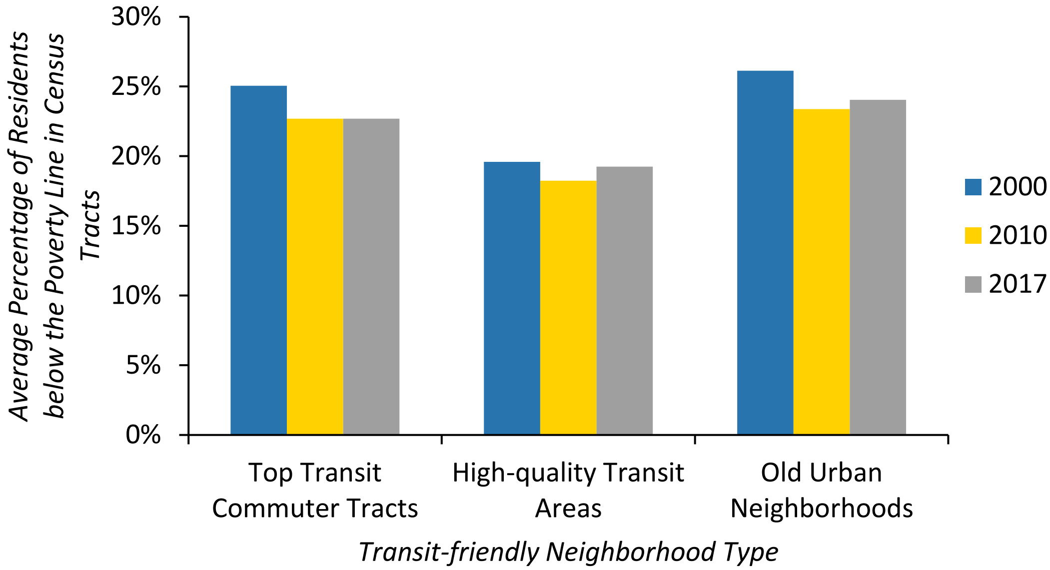
Data source: U.S. Census Bureau, 2019

14.3.2. Socio-economic Change in Transit-friendly Neighborhoods

Compared to the state overall, transit-friendly neighborhoods (however defined) have larger shares of poor and foreign-born residents, as well as households without vehicles. From 2010 to 2017, transit-friendly neighborhoods experienced small declines in their shares of poor and foreign-born residents (more so for Latin-American-origin immigrants) but dramatic losses in the share of zero-vehicle households.

Figure 14-3 shows the share of residents living below the poverty line in each of the transit-friendly neighborhood types. In 2017, the average California transit-friendly neighborhood was poorer (ranging from 19% to 24%) than the state average (15%) in 2017. Across all three definitions of transit-friendly neighborhoods, poverty rates fell between 2000 and 2017, and then stayed roughly the same or ticked up slightly between 2010 and 2017.

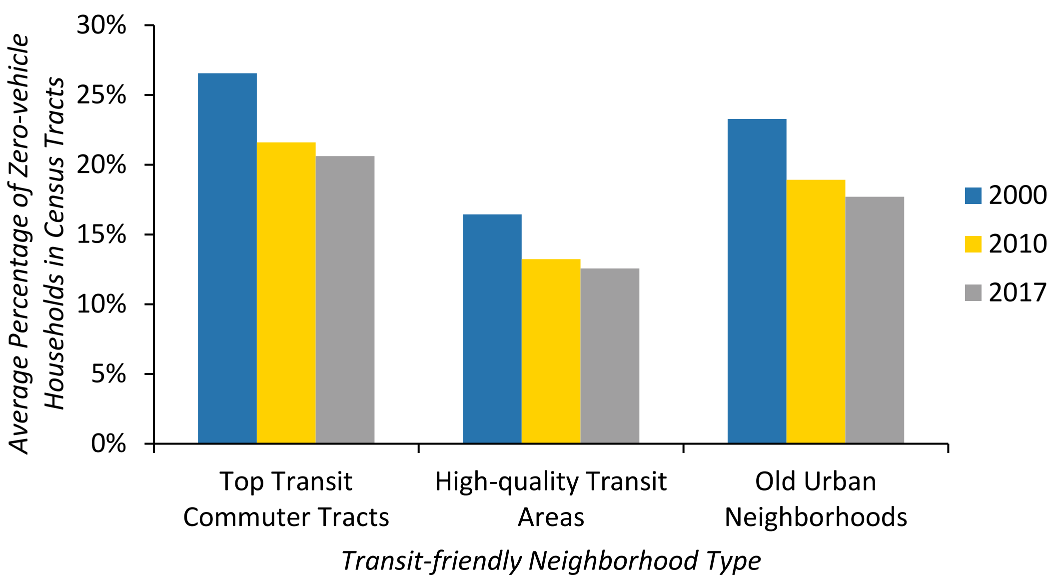
Figure 14-3. Average Share: Residents in Poverty in California's Transit-friendly Neighborhoods



Data source: U.S. Census Bureau, 2019; SCAG, 2020; MTC, 2018; SANDAG, 2019; SACOG, 2017a, 2017b; FCOG, 2019; and Voulgaris et al., 2016

More so than poverty rates, the share of zero-vehicle households in California's transit-friendly neighborhoods has fallen over time (See **Figure 14-4**). Drops in Top Transit Commuter neighborhoods are especially stark: from 2000 to 2017 the share of zero-vehicle neighborhoods in these tracts fell from 23.3 percent to 17.7 percent, a decline of almost 22 percent.

Figure 14-4. Average Share: Zero-vehicle Households in California's Transit-friendly Neighborhoods

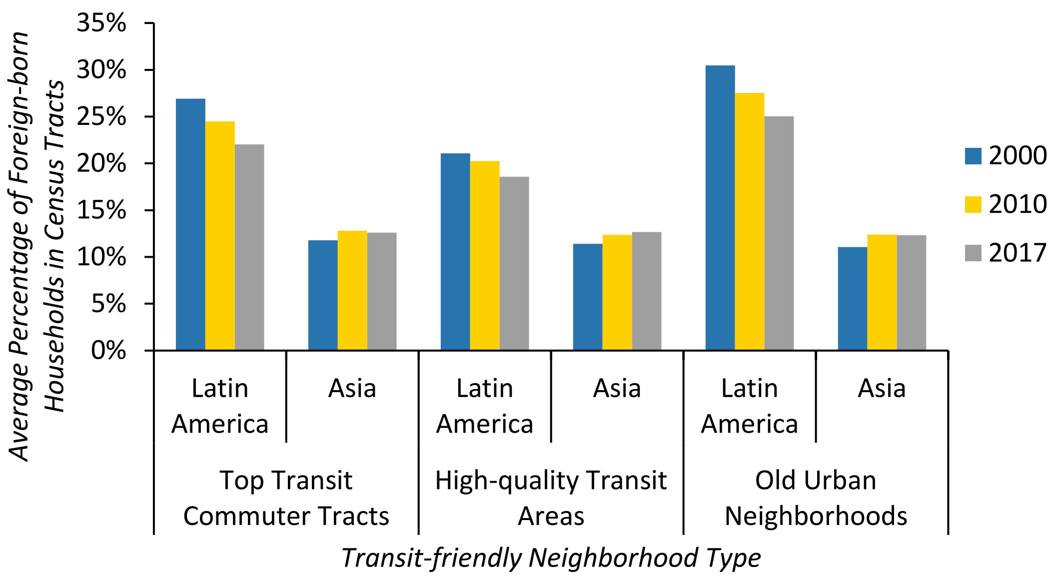


Data source: U.S. Census Bureau, 2019; SCAG, 2020; MTC, 2018; SANDAG, 2019; SACOG, 2017a, 2017b; FCOG, 2019; and Voulgaris et al., 2016

Notably, the rate of decline in zero-vehicle households in transit-friendly neighborhoods is similar to in the state as a whole. For example, Old Urban neighborhoods had about 2.4 times the percentage of zero-vehicle households as the entire state in 2000 and again in 2010 and 2017. Thus, while transit-friendly neighborhoods in California experienced a substantial reduction in zero-vehicle households, this trend is not unique to these neighborhoods. Residents in most California neighborhoods added vehicles since 2000 (See Chapter 8), and transit-friendly neighborhoods are no exception.

Figure 14-5 presents data on changes in the share of foreign-born residents by region of origin among the three transit-friendly neighborhood types. All transit-friendly neighborhoods held a smaller share of Latin-American immigrants (who in the past have been heavy transit users) in 2017 than in 2000, while their total share of the population remained relatively flat (dropping from 14.5% in 2000 to 13.6% in 2017) (U.S. Census Bureau, 2019). This perhaps represents the most significant socio-economic change in areas near transit. In contrast, immigrants from Asia increased slightly across all three definitions of transit-friendly neighborhoods since 2000.

Figure 14-5. Average Share: Foreign-born Residents in California's Transit-friendly Neighborhoods



Data source: U.S. Census Bureau, 2019; SCAG, 2020; MTC, 2018; SANDAG, 2019; SACOG, 2017a, 2017b; FCOG, 2019; and Voulgaris et al., 2016

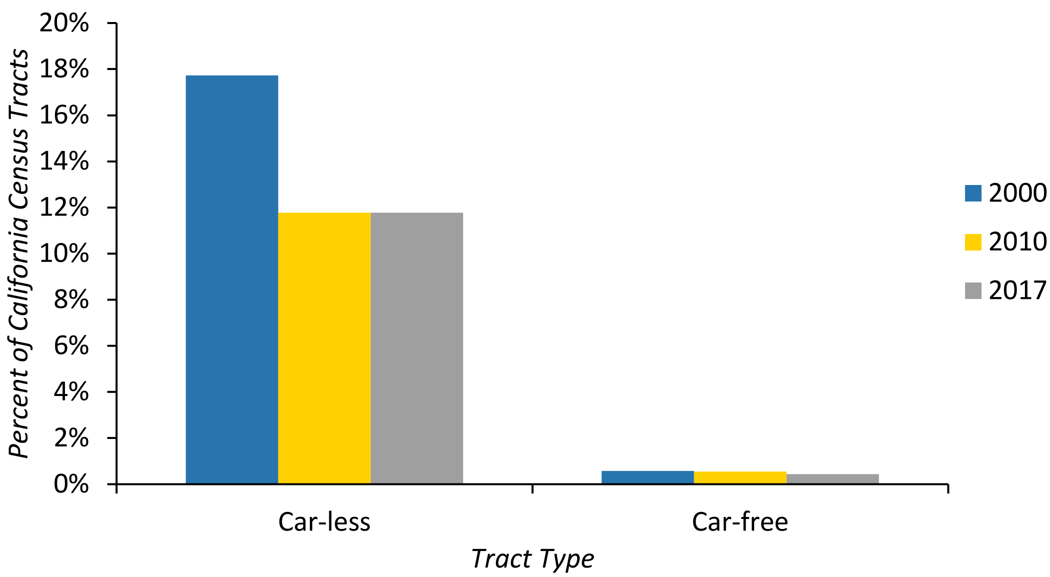
14.3.3. Car-less versus Car-free

Given the powerful relationship between zero-vehicle households and transit use, we would expect the substantial decline in the share of zero-vehicle households in transit-friendly neighborhoods to depress transit ridership. However, reasons why some households lack automobiles differ, and the aggregate auto access trends described above mask considerable heterogeneity across neighborhoods. Therefore, we distinguish between zero-vehicle households whose members have chosen to go without cars and households who must forego vehicle ownership due to financial or physical constraints. Given the widely varying circumstances, resources, travel patterns, and propensity for transit use between these two types of zero-vehicle households, any shifts in their relative share in transit-friendly neighborhoods could affect transit ridership.

To examine these two types of zero-vehicle households, we draw on a study by Brown (2017) to create a simple (and admittedly imperfect) typology of neighborhoods: "car-less" census tracts, "car-free" tracts, and other tracts (See Appendix A, Section 2). Car-less neighborhoods host many people in poverty and many households with no vehicles.[32] Together, this definition implies that many, though far from all, of residents of such areas likely do not own cars due to financial constraints, and many of those are transit-dependent. Car-free neighborhoods, in contrast, are home to few people in poverty but also many households with no vehicles[33]—that is, households whose members are more likely to have chosen to forgo a car for reasons besides financial necessity. These households may have more non-transit options at their disposal or may simply tend to not ride transit or not as often (for example, if they are retired).

Figure 14-6 shows the share of California neighborhoods that fall into these categories. Car-less neighborhoods far outnumbered car-free ones in all years. Further, the share of car-less neighborhoods dropped significantly from 2000 to 2017 (from 17.7% to 11.8%), while the very small number of car-free neighborhoods (about 0.5% across all years) was largely unchanged.

Figure 14-6. Share of California Census Tracts that Are Car-less and Car-free



Data source: U.S. Census Bureau, 2019; SCAG, 2020; MTC, 2018; SANDAG, 2019; SACOG, 2017a, 2017b; FCOG, 2019; and Voulgaris et al., 2016

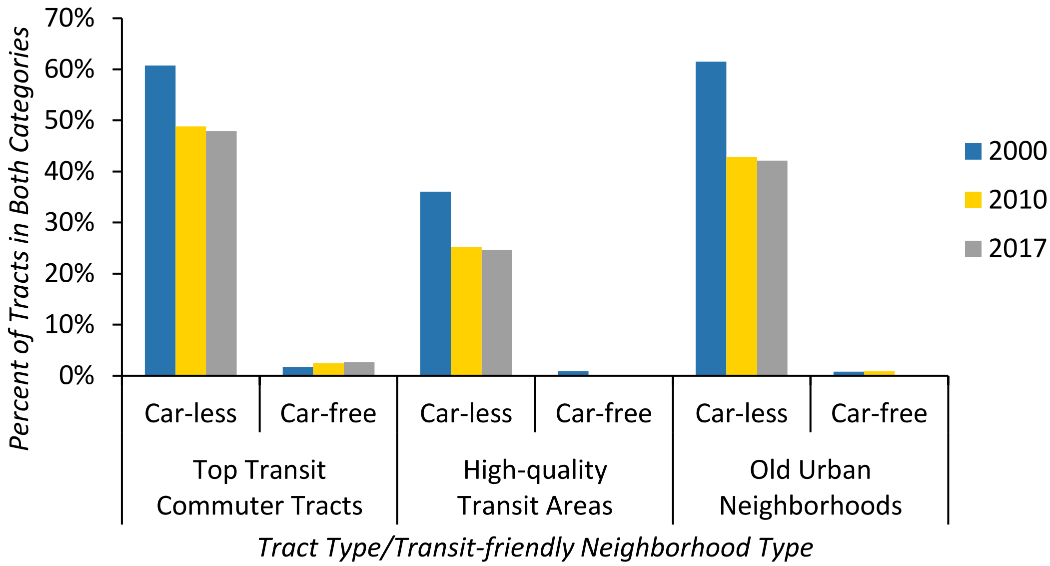
To determine if transit-friendly neighborhoods (and their residents) have become more car-free or car-less over time, we analyze changes in how car-free and car-less tracts overlap with the transit-friendly neighborhood categories established above (See **Figure 14-7**). In California, the share of car-less tracts in every type of transit-friendly neighborhood dropped from 2000 to 2010, while the overlap between car-free tracts and one definition of transit-friendly neighborhood increased slightly from 2000 to 2017. Yet car-less tracts continued to dominate transit-friendly areas. That is, transit-friendly neighborhoods tend

32. We define car-less neighborhoods as any tract whose share of zero-vehicle households is above the 75th percentile of the share of zero-vehicle households among all tracts and whose share of people living below the poverty line is above the 75th percentile of individuals below the poverty line among all tracts.

33. We define car-less neighborhoods as any tract whose share of zero-vehicle households is above the 75th percentile of the share of zero-vehicle households among all tracts and whose share of people living below the poverty line is below the 25th percentile of individuals below the poverty line among all tracts.

to lack cars by necessity, not by choice.

Figure 14-7. Percent of California Transit-friendly Neighborhoods that Are Also Car-less or Car-free



Data source: U.S. Census Bureau, 2019; SCAG, 2020; MTC, 2018; SANDAG, 2019; SACOG, 2017a, 2017b; FCOG, 2019; and Voulgaris et al., 2016

Indeed, since California has seen a major drop in zero-vehicle households, car-less neighborhoods have also declined. Californians in these neighborhoods, more of whom have car access, now have a wider array of travel options. However, this may also challenge transit agencies whose ridership relies on "constrained" users as their primary customer base.

The very small increase in car-free tracts in some transit-friendly areas is strongly biased toward neighborhoods in the Bay Area. In fact, almost two-thirds of all car-free tracts in 2017 were located in San Francisco; these tracts together account for only 2.2 percent of the entire state's population. San Francisco stands out among California cities as being extremely dense and offering extensive transit coverage. Thus, most car-free neighborhoods exist in the areas which have the greatest accessibility by non-automobile modes. However, few Californians live in places that resemble San Francisco.

14.4. Conclusion

California's most transit-friendly neighborhoods are changing. Private vehicle access, immigrant residents, and low-incomes are all associated with higher levels of transit use, and all are declining in transit-friendly neighborhoods. As noted elsewhere in this report, the presence or absence of a private vehicle is a powerful predictor of public transit use. Residents of zero-vehicle households in particular use public transit at much higher levels than households with at least some or substantial vehicle access. Transit-friendly neighborhoods should be the places where getting around on transit, and getting by without a car, should be easiest. But our analysis shows that zero-vehicle households are down substantially since 2000 across all three of our definitions of transit-friendly neighborhoods.

The decline of zero-vehicle households is not unique to California's transit-friendly neighborhoods; it is with only a few exceptions a statewide phenomenon. Among zero-vehicle households in transit-friendly neighborhoods, the number of neighborhoods we classified as “car-free” was both small and largely unchanged over time. Still, in some parts of California, especially in the City of San Francisco, this latter category of neighborhoods where at least some sizable share of residents *choose* to live without automobiles is growing, if still small. These “choice” riders may represent a silver lining for transit agencies seeking to recover ridership. Meanwhile, transit-friendly neighborhoods classified as “car-less” declined substantially between 2000 and 2017. Increases in the share of households with access to at least one automobile may well be viewed as a positive trend, particularly for car-less households whose lack of auto access was due to economic circumstance and not choice. However, this trend does not bode well for public transit use, particularly in the neighborhoods where transit service is presumably best and use highest.

With respect to immigration, foreign-born residents from Latin America in all three types of transit-friendly neighborhoods declined substantially, while those from Asia increased slightly. Again, this trend does not bode well for transit, as Latin American immigrants typically ride transit at higher rates than Asian immigrants. Finally, the share of households in poverty declined slightly in all three transit-friendly neighborhood types, between 2000 and 2017. While declines in poverty are of course good news from an economic standpoint, it is likely to have negatively affected ridership, given the general inverse relationship between income and transit use.

Collectively, these trends point to changes among residents of California’s most transit-friendly neighborhoods that are not, well, very transit-friendly. This is likely compounded in many areas of the state by increasing dispersion of jobs and residents discussed in the previous chapter. Our data do not, however, allow us to determine the extent to which such shifts reflect gentrification of and displacement from these neighborhoods or processes of residential turnover that did not entail displacement. Displacement may well have occurred in these neighborhoods, and we aim to investigate this issue in subsequent research. But regardless of the underlying processes at work, all three of these trends—declining numbers of zero-vehicle households, immigrants, and those in poverty—are not positive omens for transit.

Part VI. Conclusion

15. Conclusion

Transit patronage plunged staggeringly, from 50 to as much as 94 percent, during the first half of 2020 amidst the worst global pandemic in a century (Levy and Goldwyn, 2020; Walker, 2020; BTS, 2020; Transit App, 2020; Moovit, 2020; and FTA, 2019). But transit's troubles in California date much earlier. From 2014 to 2018, California lost over 165 million annual boardings, a drop of over 11 percent (FTA, 2019).

We find that these topline patronage figures, while troubling in their own right, obscure significant variation across regions, modes, and operators. Transit trips in the Bay Area and on rail grew significantly over the past decade and only started declining more recently, while ridership in most other places and most other modes have fallen for a longer time.

California transit use is spatially asymmetric: lines serving a single block of San Francisco's Financial District bore 13 percent of the state's trips in 2018; routes through a single intersection in downtown Los Angeles carried another eight percent.

Ridership gains and losses have been asymmetric as well, across locations, operators, and modes. With respect to operators, between 2011 and 2015, Bay Area Rapid Transit accounted for half of the state's net patronage gains, while the majority of California's ridership losses since 2014 have been suffered by a single operator: Los Angeles Metro. Just five of its lines account for over 10 percent of the state's ridership drop (FTA, 2019 and LA Metro, 2019b).

Falling transit ridership has occurred over a time period in which transit service has increased. Waning ridership and increasing service suggests that new service either is not performing as desired, or other factors are overcoming its ridership benefits. These trends have also resulted in a decline in transit performance across multiple metrics.

Transit use is also demographically asymmetric as well. A few people make a lot of transit trips, some people make some trips, and most people make no trips at all. Because a relatively small share of the population accounts for a large share of transit trips, who these groups are and how their numbers and riding habits have changed help to explain why transit use is falling. Transit ridership was negatively affected by a shift in the composition of immigrants toward higher-income immigrants from Asia who tend to rely less on transit than other immigrant groups. Even more significant was the decline in transit use among population groups traditionally reliant on transit—Hispanics, low-income adults, and those with limited access to automobiles.

Increased access to modes other than public transit—particularly automobiles—explains much, if not most, of declining transit use. Private vehicle access has increased significantly and, outside of the Bay Area, is likely the biggest single cause of falling transit ridership. At the same time, travelers can now purchase automobility one trip at a time through new ridehail services such as Lyft and Uber. These services have grown substantially across all urban areas in the state, especially the Bay Area, as well as among diverse population groups. Although the data available to study the effects of ridehail on transit are limited, the evidence suggests that these new services likely subtract some transit riders who substitute ridehail for transit trips—particularly in the San Francisco Bay Area, where ridehail use appears highest.

Finally, neighborhoods are changing in ways that do not bode well for public transit. Households are increasingly locating away from expensive cities and neighborhoods and living in outlying areas where housing is more affordable. This shift has contributed to growing commute distances in the state as well as declining access to employment by public transit. At the same time, the share of high-propensity transit users living in California's transit-friendly neighborhoods has declined. Collectively, these trends suggest trouble for transit, since transit works best in high-density urban environments.

The pandemic of 2020 and the many changes in the users of and competitors with public transit before it paint a challenging picture of transit in California. Substantial increases in auto access—primarily in the ownership of cars and trucks but also in the availability of ridehail—have increased the travel options for many former transit users. These changes have been especially dramatic among populations that have tended to ride transit most frequently.

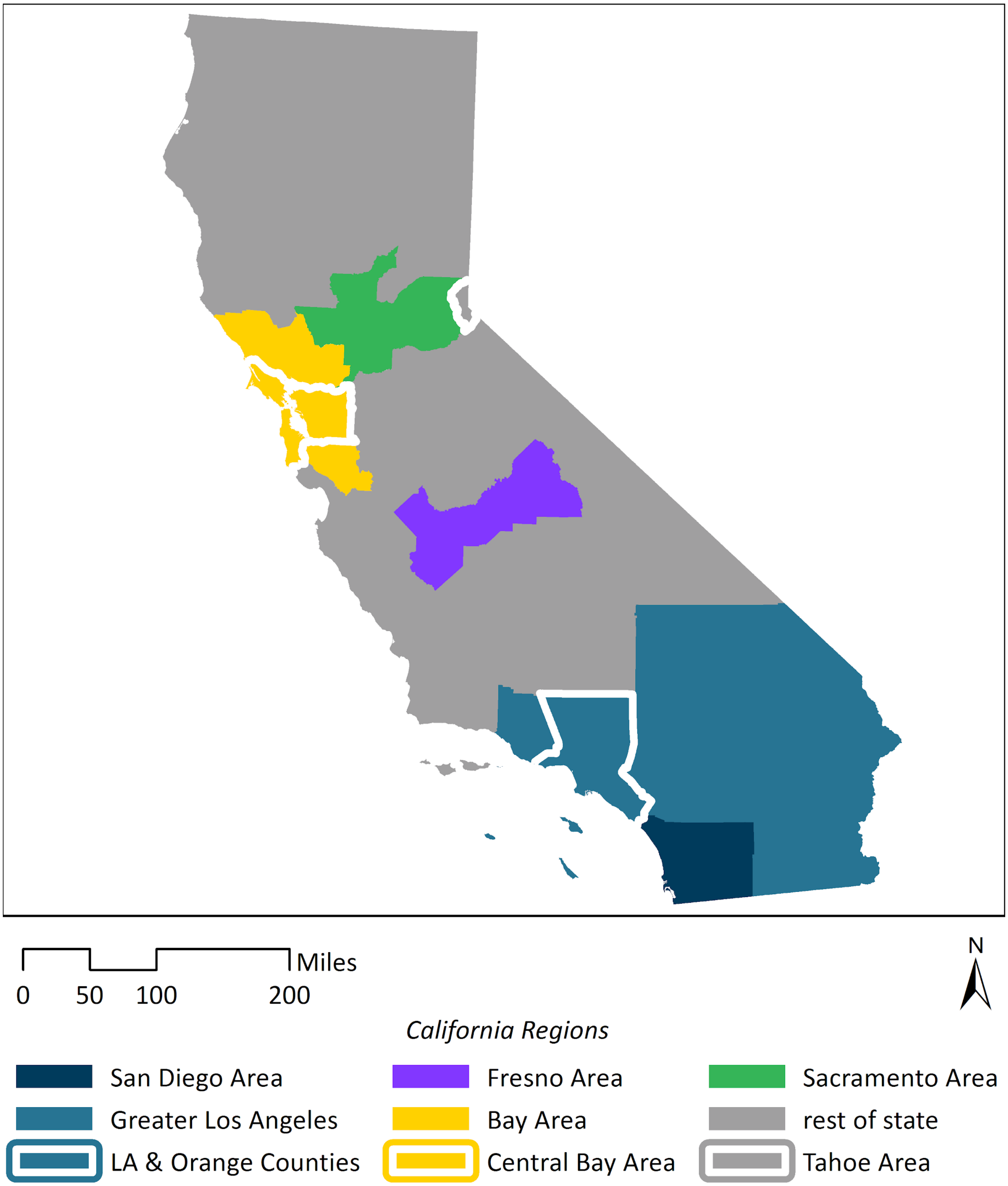
While the 2010s proved a difficult decade for public transit in California and the opening of the current decade has been an even bigger challenge, transit remains an essential public service. First and foremost, it provides critical mobility for those who, because of age, income, or ability, cannot travel in automobiles and thus serves an essential social equity function. It also serves major centers of activity, like central business districts, universities, and airports, far more effectively than private vehicles, and thus serves a critical economic function, too. And when heavily patronized, it is a green form of travel that can contribute to state environmental objectives. However, past experience suggests that public transit use recovers slowly following epidemics (Wang, 2014). Given this research on California transit use in the 2010s, effectively managing that transit recovery will require a clear-eyed understanding of the substantially altered environment within which these systems large and small must now operate.

Appendices

Appendix A. Key Terms

A.1. Geography

Figure A-1. California Regions



Data source: California Open Data, 2019; Bell, 2019; CaliDetail, n.d.; and U.S. Census Bureau, 2019

Greater Los Angeles (Greater LA) or *the Los Angeles Area (LA Area)*

The six counties covered by the Southern California Association of Governments MPO: Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura (See ***Figure A-1****)*

Los Angeles and Orange Counties

The Los Angeles-Long Beach-Anaheim Metropolitan Statistical Area, defined by the U.S. Census Bureau, including Los Angeles and Orange Counties (See ***Figure A-1****)*

For a few data sources in which we lack available data to conduct an analysis at the level of the full Greater Los Angeles region, we consider only the Los Angeles-Long Beach-Anaheim Metropolitan Statistical Area.

San Francisco Bay Area or *the Bay Area*

The nine counties covered by the Metropolitan Transportation Commission: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma (See ***Figure A-1****)*

Central Bay Area Counties or *Central Bay Area*

The San Francisco-Oakland-Berkeley Metropolitan Statistical Area, defined by the U.S. Census Bureau, including Alameda, Contra Costa, Marin, San Francisco, and San Mateo Counties (See ***Figure A-1****)*

For a few data sources in which we lack available data to conduct an analysis at the level of the full Bay Area region, we consider only the San Francisco-Oakland-Berkeley Metropolitan Statistical Area, formerly known as the San Francisco-Oakland-Fremont Metropolitan Statistical Area and the San Francisco-Oakland-Hayward Metropolitan Statistical Area.

San Diego Area

The area covered by the San Diego Association of Governments MPO: San Diego County (See ***Figure A-1****)*

Sacramento Area

The six counties covered by the Sacramento Area Council of Governments: El Dorado, Placer, Sacramento, Sutter, Yolo, and Yuba, except for the portions of the first two in the Tahoe Area (the Lake Tahoe Basin, which is in the Tahoe Metropolitan Planning Organization instead)[34] *(See* ***Figure A-1****)*

Fresno Area

The area covered by the Fresno Council of Governments MPO: Fresno County (See ***Figure A-1****)*

34. Due to data limitations, some of the analyses in this report include all of El Dorado and Placer Counties in the Sacramento Area. The portion of these counties in the Tahoe Area (the Lake Tahoe Basin) only constitute 1.5 percent of the total population when included (U.S. Census Bureau, 2019).

Rest of the state

The remainder of California not included in the five major regions above (See **Figure A-1***)*

A.2. Definitions

Boardings

Unlinked passenger trips—i.e., a single transit trip from one location to another without changing mode or vehicle.

Because the NTD (FTA, 2019) and most operator datasets do not track intra-operator transfers—let alone inter-operator transfers—a transfer therefore counts as two boardings. BART's origin-destination matrices are an exception (BART, 2019c).

Bus

The combination of the commuter bus, local bus (called simply "bus" in the NTD), bus rapid transit, and trolleybus modes in the NTD (FTA, 2019)

Car-free neighborhood

Census tracts with many zero-vehicle households but low levels of poverty; areas with many zero-vehicle households by choice (See Chapter 14, Section 3, Subsection 3 for classification methodology)

Car-less neighborhood

Census tracts with many zero-vehicle households but high levels of poverty; areas with many zero-vehicle households due to financial constraints (See Chapter 14, Section 3, Subsection 3 for classification methodology)

Costs or expenses

Sum of annual operating expenses and a ten-year rolling average of capital expenses (five years prior to four years after, as available)

Since capital costs often rise and fall dramatically as agencies incur one-time expenses for large projects every few years, a rolling average smooths out costs for fairer comparisons. In our analyses and figures, we converted all monetary values to 2018 dollars, except where noted (BLS, 2019).

Demand response/vanpool

The combination of the demand response, demand response taxi, jitney, publico, and vanpool modes in the NTD, which include most paratransit services (FTA, 2019)

Fully equipped household

A household that owns at least one vehicle per household driver

Micromobility or micromobility services

Individually-operated single-passenger shared vehicles and mobility devices, including bicycle share, shared electric bikes ("e-bikes"), and shared electric scooters

Rail

The combination of the Alaska railroad, cable car, commuter rail, heavy rail, funicular (called "inclined plane" in the NTD), light rail, monorail/automated guideway, streetcar, hybrid rail, and other rail modes in the NTD (FTA, 2019)

Self-containment

The share of an area's internal work trips (work and live inside a city) relative to external work trips (work outside the city or live outside the city); extent to which workers find housing and employment in the same spatial area

We term this calculation of self-containment the "independence index" (R. Thomas, 1969 and Cervero, 1996).

Subsidies

Costs less fare revenues; the net public funds spent on transit

In other circumstances, we would also subtract other revenue sources like advertising from costs in calculating subsidies, but the NTD does not break down other revenues by mode (FTA, 2019). Since much of our examination of subsidy trends compares between modes, we therefore left out these (relatively small) miscellaneous revenue sources from all analyses, for consistency.

Transit-friendly neighborhood

A census tract that either has many transit users, has much frequent transit, and/or has a transit-supportive built environment, according to the three respective definitions laid out in Chapter 14, Section 2.

Transportation Network Companies (TNCs), ridehail, or *ridehailing*

Transportation Network Companies (TNCs) include major companies like Uber and Lyft, which provide ridehail services. Similar to taxi companies, Uber and Lyft offer transportation with greater technological integration. The companies operate smartphone applications, in which a user selects a starting and end point. After summoning the ride, a driver (also using the application) picks up and then delivers the rider to the destination. The fare is paid entirely through the computer application, and the TNCs take some portion of the fare as a fee.

In the exchange, the TNCs set prices, often through dynamic pricing systems based on passenger demand. More recently, Uber and Lyft have offered services that allow for riders with different destinations, who usually do not know each other, to travel in the same vehicle. These services—called UberPool and Lyft Line—charge lower fares.

Vehicle-deficit household

A car-owning household that owns less than one vehicle per household driver

Zero-vehicle household

A household that owns no vehicles, for whatever reason

Appendix B. Data Sources

Table B-1. Major Data Sources

DATA SOURCE	YEARS	CHARACTERISTICS	CITATION
National Household Travel Survey (with California oversample)	2009, 2017	Characteristics of transit users and their transit travel (income, poverty, nativity, mode, race/ethnicity, vehicle availability, commute mode, miles travelled per day, share of daily trips by transit)	FHWA, 2009, 2017
National Transit Database	2000-2018	Annual absolute and per capita boardings, passenger miles traveled, vehicle revenue hours, vehicle revenue miles, operating expenses, capital expenses, and fare revenues by operator, urbanized area, MPO, mode, and whether the service was directly operated or contracted out under a purchased transportation agreement	FTA, 2019
Public Use Microdata Sample (PUMS)	2000-2017	Age, race, ethnicity, disability status, educational attainment, income, nativity, year of entry for foreign born, poverty status, income, vehicle availability, commute mode, central city/suburban status	Ruggles et al., 2020
American Community Survey, Five-year Estimates	2000-2017	Transit commuters, race, ethnicity, income, housing costs, housing tenure	U.S. Census Bureau, 2019
Longitudinal Employer-Household Dynamics Origin-Destination Employment Statistics (LODES)	2002, 2015	Counts of workers by commute, wage, and spatial location	U.S. Census Bureau, 2002, 2015
Access across America: Transit	2015	Transit access to jobs by census block	Owen and Murphy, 2018

DATA SOURCE	YEARS	CHARACTERISTICS	CITATION
U.S. Energy Information Administration (EIA) Weekly Retail Gasoline Price Estimates	2000-2019	Gasoline prices by state and major metropolitan statistical areas	EIA, 2019
Nonemployer Statistics	2010-2016	Number of taxi and limousine (Including TNC) establishments	U.S. Census Bureau, 2019

Appendix C. Jobs and Housing in California

Table C-1. Jobs and Housing in California Cities

CITY	POPULATION RANK, 2018	EMPLOYED RESIDENTS		JOBS		JOB-TO-RESIDENTS RATIO	
		2002	2015	2002	2015	2002	2015
Los Angeles	1	1,366,180	1,597,260	1,469,600	1,743,808	1.08	1.09
San Diego	2	538,550	585,392	662,021	741,000	1.23	1.27
San José	3	379,730	449,026	379,030	445,642	1.00	0.99
San Francisco	4	367,188	446,298	515,790	689,271	1.40	1.54
Fresno	5	148,105	174,130	162,130	195,300	1.09	1.12
Sacramento	6	149,313	185,261	231,937	290,133	1.55	1.57
Long Beach	7	180,762	198,116	146,128	168,469	0.81	0.85
Oakland	8	167,619	185,435	173,427	196,905	1.03	1.06
Bakersfield	9	95,295	127,917	96,328	117,510	1.01	0.92
Anaheim	10	132,247	165,571	161,942	172,479	1.22	1.04
Santa Ana	11	126,837	123,986	152,564	149,389	1.20	1.20
Riverside	12	109,538	117,850	125,122	137,566	1.14	1.17
Stockton	13	99,088	97,842	92,195	94,074	0.93	0.96
Irvine	14	68,590	83,355	95,184	136,972	1.39	1.64
Chula Vista	15	74,281	101,679	47,044	60,777	0.63	0.60
Fremont	16	94,004	106,347	36,540	43,449	0.39	0.41
San Bernardino	17	68,144	73,032	86,600	100,025	1.27	1.37
Modesto	18	63,972	69,630	57,526	70,209	0.90	1.01
Fontana	19	55,729	74,171	31,692	38,463	0.57	0.52
Santa Clarita	20	76,225	93,766	56,278	68,753	0.74	0.73
Oxnard	21	57,904	71,251	50,808	54,656	0.88	0.77

CITY	POPULATION RANK, 2018	EMPLOYED RESIDENTS		JOBS		JOB-TO-RESIDENTS RATIO	
		2002	2015	2002	2015	2002	2015
Moreno Valley	22	50,318	61,170	19,170	33,876	0.38	0.55
Glendale	23	80,686	93,400	84,897	100,891	1.05	1.08
Huntington Beach	24	93,247	88,108	66,012	69,652	0.71	0.79
Ontario	25	62,395	69,996	82,255	111,704	1.32	1.60
Rancho Cucamonga	26	61,519	72,331	56,642	77,231	0.92	1.07
Santa Rosa	27	53,324	54,004	61,730	57,331	1.16	1.06
Oceanside	28	62,879	69,240	37,611	39,737	0.60	0.57
Elk Grove	29	33,273	62,464	17,739	27,490	0.53	0.44
Garden Grove	30	74,897	82,351	48,887	51,837	0.65	0.63
Corona	31	57,428	63,405	50,806	62,111	0.88	0.98
Hayward	32	66,956	70,378	72,645	68,774	1.08	0.98
Lancaster	33	36,910	52,161	28,775	37,703	0.78	0.72
Palmdale	34	41,772	55,924	15,155	27,341	0.36	0.49
Salinas	35	56,336	57,361	51,214	51,431	0.91	0.90
Sunnyvale	36	65,356	76,147	71,053	66,065	1.09	0.87
Pomona	37	53,332	56,550	45,320	48,453	0.85	0.86
Escondido	38	43,725	53,862	27,928	26,981	0.64	0.50
Torrance	39	62,729	65,148	107,056	102,825	1.71	1.58
Pasadena	40	54,583	59,625	101,505	110,599	1.86	1.85
Fullerton	41	63,502	68,603	68,685	68,399	1.08	1.00
Orange	42	50,923	55,335	100,867	119,733	1.98	2.16
Roseville	43	32,701	45,402	48,880	67,227	1.49	1.48
Visalia	44	33,858	42,620	42,927	48,660	1.27	1.14

CITY	POPULATION RANK, 2018	EMPLOYED RESIDENTS		JOBS		JOB-TO-RESIDENTS RATIO	
		2002	2015	2002	2015	2002	2015
Concord	45	51,839	54,627	30,433	27,655	0.59	0.51
Santa Clara	46	45,384	59,853	104,591	104,190	2.30	1.74
Thousand Oaks	47	54,056	53,270	55,709	62,047	1.03	1.16
Simi Valley	48	48,402	49,582	27,739	27,933	0.57	0.56
Victorville	49	19,423	33,497	20,257	25,670	1.04	0.77
Vallejo	50	47,936	49,897	27,584	27,670	0.58	0.55

Data source: U.S. Census Bureau, 2002, 2015, 2019

Table C-2. Self-containment and Housing Costs in California Cities

CITY	POPULATION RANK, 2018	SHARE OF LOCALLY WORKING RESIDENTS		SHARE OF LOCALLY RESIDING WORKERS		INDEPENDENCE INDEX		HOUSING COST INDEX	
		2002	2015	2002	2015	2002	2015	2002	2015
Los Angeles	1	52.6%	51.8%	48.9%	47.5%	0.51	0.49	5.41	9.78
San Diego	2	66.0%	63.3%	53.7%	50.0%	0.72	0.63	4.63	7.37
San José	3	43.1%	41.0%	43.2%	41.3%	0.38	0.35	5.20	7.65
San Francisco	4	62.1%	62.1%	44.2%	40.2%	0.53	0.48	7.22	11.51
Fresno	5	58.7%	53.9%	53.6%	48.0%	0.64	0.52	2.93	5.00
Sacramento	6	43.7%	40.8%	28.1%	26.1%	0.26	0.23	3.35	5.41
Long Beach	7	22.9%	23.0%	28.3%	27.0%	0.17	0.17	4.60	7.46
Oakland	8	29.8%	27.2%	28.8%	25.6%	0.21	0.18	5.04	9.09
Bakersfield	9	53.0%	43.8%	52.4%	47.7%	0.56	0.42	2.43	3.45
Anaheim	10	20.0%	15.3%	16.3%	14.7%	0.11	0.09	4.42	7.98
Santa Ana	11	20.2%	18.5%	16.8%	15.3%	0.11	0.10	3.89	7.81

CITY	POPULATION RANK, 2018	SHARE OF LOCALLY WORKING RESIDENTS		SHARE OF LOCALLY RESIDING WORKERS		INDEPENDENCE INDEX		HOUSING COST INDEX	
		2002	2015	2002	2015	2002	2015	2002	2015
Riverside	12	33.3%	26.7%	29.2%	22.9%	0.23	0.16	3.23	5.46
Stockton	13	43.0%	36.5%	46.2%	37.9%	0.40	0.30	3.15	4.46
Irvine	14	16.6%	19.2%	11.9%	11.7%	0.08	0.08	4.01	7.69
Chula Vista	15	19.5%	17.7%	30.8%	29.7%	0.16	0.14	3.97	6.47
Fremont	16	12.2%	10.3%	31.3%	25.2%	0.11	0.09	4.61	6.81
San Bernardino	17	27.0%	23.8%	21.3%	17.4%	0.16	0.13	3.19	4.92
Modesto	18	32.0%	32.8%	35.6%	32.6%	0.25	0.24	3.13	4.48
Fontana	19	8.5%	7.8%	14.9%	15.0%	0.06	0.06	2.89	4.91
Santa Clarita	20	26.3%	23.6%	35.6%	32.2%	0.22	0.19	3.37	5.06
Oxnard	21	30.6%	27.4%	34.9%	35.8%	0.24	0.23	3.84	6.31
Moreno Valley	22	11.0%	12.8%	28.8%	23.1%	0.09	0.10	2.23	4.80
Glendale	23	20.0%	24.2%	19.0%	22.4%	0.12	0.15	6.17	11.62
Huntington Beach	24	15.6%	14.6%	22.0%	18.5%	0.11	0.10	4.51	8.04
Ontario	25	16.3%	15.1%	12.4%	9.5%	0.08	0.07	3.32	5.87
Rancho Cucamonga	26	16.7%	14.4%	18.1%	13.5%	0.11	0.08	2.82	5.73
Santa Rosa	27	39.4%	32.2%	34.1%	30.3%	0.29	0.23	4.91	7.73
Oceanside	28	20.4%	17.2%	34.1%	30.0%	0.17	0.14	4.09	7.19
Elk Grove	29	13.4%	11.1%	25.1%	25.2%	0.11	0.09	2.46	4.57
Garden Grove	30	9.4%	9.5%	14.4%	15.2%	0.06	0.07	4.18	8.34
Corona	31	17.8%	14.6%	20.1%	14.9%	0.12	0.09	2.95	5.56
Hayward	32	18.2%	14.7%	16.8%	15.1%	0.11	0.09	4.17	6.96
Lancaster	33	29.0%	26.6%	37.2%	36.9%	0.24	0.22	2.30	4.45

CITY	POPULATION RANK, 2018	SHARE OF LOCALLY WORKING RESIDENTS		SHARE OF LOCALLY RESIDING WORKERS		INDEPENDENCE INDEX		HOUSING COST INDEX	
		2002	2015	2002	2015	2002	2015	2002	2015
Palmdale	34	11.5%	13.8%	31.8%	28.2%	0.10	0.11	2.23	3.93
Salinas	35	46.9%	38.1%	51.5%	42.5%	0.48	0.34	4.23	5.99
Sunnyvale	36	14.8%	10.3%	13.6%	11.8%	0.08	0.06	6.24	8.83
Pomona	37	14.3%	11.5%	16.8%	13.4%	0.09	0.07	3.28	6.47
Escondido	38	15.8%	12.6%	24.8%	25.2%	0.12	0.10	4.03	7.53
Torrance	39	24.2%	20.6%	14.2%	13.0%	0.11	0.10	5.42	8.24
Pasadena	40	28.3%	23.7%	15.2%	12.8%	0.12	0.10	5.96	8.93
Fullerton	41	14.3%	11.7%	13.2%	11.8%	0.08	0.07	4.88	7.72
Orange	42	17.2%	14.9%	8.7%	6.9%	0.07	0.05	4.45	8.16
Roseville	43	26.4%	22.6%	17.6%	15.2%	0.13	0.11	3.38	5.70
Visalia	44	54.2%	42.2%	42.7%	37.0%	0.46	0.33	2.76	3.91
Concord	45	11.5%	10.0%	19.5%	19.7%	0.08	0.08	3.94	5.91
Santa Clara	46	19.5%	15.5%	8.5%	8.9%	0.07	0.06	5.43	8.28
Thousand Oaks	47	29.3%	27.6%	28.4%	23.7%	0.20	0.17	3.75	6.07
Simi Valley	48	18.3%	16.2%	32.0%	28.7%	0.15	0.13	3.33	5.96
Victorville	49	22.5%	18.3%	21.6%	23.9%	0.14	0.13	2.91	4.08
Vallejo	50	19.8%	15.0%	34.4%	27.0%	0.17	0.12	3.33	5.01

Data source: U.S. Census Bureau, 2002, 2015, 2019

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