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Connecting the Dots... Ridership Changes, Underlying Causes, and Strategies for Pasadena Transit

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Connecting the Dots...
Ridership Changes, Underlying Causes, and Strategies for Pasadena Transit

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16. Abstract
Over the past decade, public transit operators in the Los Angeles region started experiencing steep declines in ridership, while Pasadena Transit was adding riders. More recently, however, Pasadena Transit's ridership plateaued and then started to decrease. The Transit Division of the City of Pasadena Department of Transportation ("the Client") is therefore interested in understanding what may be causing transit ridership to decline in its jurisdiction, what are the circumstances driving these changes, and what these causes and circumstances suggest for ways to make the system more attractive to riders. This project aims to answer these questions by contrasting ridership trends with possible causal factors: vehicle access, commuting patterns, demographic changes (e.g., age), economic indicators (e.g., income), homelessness, and housing-market conditions. Increased vehicle ownership and use were discarded from the onset, since Pasadena residents, contrary to their L.A. County and California counterparts, are collectively disposing of private vehicles. The escalation of telecommuting is a likely contributor, given that the less that people physically travel to work, the less likely they are to ride transit. The aging of Pasadena's population could be an influential factor as well, since younger populations (especially people in their early 20s and younger) are, by far, more likely to ride transit than seniors and much more likely than middle-aged people. Rising homelessness in Pasadena, which went up 28 percent from 2016 to 2018, might be incentivizing riders to seek other, more private, travel modes that spare them the discomfort of sharing space with homeless people. Yet, none of these longstanding trends explain, in a satisfactory manner, why Pasadena Transit's healthy patronage base experienced mild declines in recent years. The homelessness upsurge did coincide with Pasadena's faltering ridership, but it appears unlikely that this alone would significantly impact transit patronage. Moving or displacement of frequent transit users out of transit-rich areas appears to be the main culprit. Half of Pasadena's households pay more than a third of their income in rent. A rent-burdened person who used to frequently ride on Pasadena Transit will need to take their "travel business" elsewhere when they get pushed out by a heavy influx of wealthy people, who are — at best — sporadic transit riders. This report recommends targeted marketing and awareness campaigns, informed by extensive surveying. This would help identify the population of unlikely riders, of travelers deterred from transit by the presence of homeless individuals, and of rent-burdened residents who have changed their travel patterns due to increased housing costs. All of these recommendations center on adapting to the needs of specific riders, which embodies the cornerstone of other cities' recent successes in improving service and attracting riders, and is also mentioned throughout the literature as a "best practice" in the provision of public transit in the era of modern ridership decay.

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Disclaimer

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UCLA Luskin School of Public Affairs

PASADENA TRANSIT

Connecting the Dots…

Ridership Changes, Underlying Causes, and Strategies for Pasadena Transit

Executive Summary

Over the past decade, public transit operators in the Los Angeles region started experiencing steep declines in ridership, while Pasadena Transit was adding riders. More recently, however, Pasadena Transit's ridership plateaued and then started to decrease. The Transit Division of the City of Pasadena Department of Transportation ("the Client") is therefore interested in understanding what may be causing transit ridership to decline in its jurisdiction, what are the circumstances driving these changes, and what these causes and circumstances suggest for ways to make the system more attractive to riders. This project aims to find the factors driving said fluctuations and to consider the implications they may have on Pasadena's market for transit.

Healthy ridership levels make transit service sustainable, which allows for enhancement and expansion of service provision. The importance of transit pivots on the idea of providing an array of travel choices to serve different needs. As of now, many transit agencies seek to attract drivers out of their cars, in an attempt to reduce vehicle-miles travelled, carbon emissions, and traffic congestion (Taylor & Morris, 2015). However, transit cannot achieve such ambitious goals if it cannot compete with the advantages furnished by private vehicles. To overcome the many advantages of driving, public transit systems require both substantial investments (to expand service coverage and reduce wait times) and more aggressive management of driving.[1] Unfortunately, falling transit ridership is more likely to prompt budget cuts than enhancements, and managing driving is both politically unpopular and outside of the scope of most transit operators.

Also important to keep in mind is that public transit in its present form functions first and foremost as a lifeline service to low-income people and other groups who rely heavily on it because they are not able, physically or financially, to drive. However, transit agencies are under pressure to appeal to non-riders, given their traffic reduction and environmental goals, which may cause them to overlook the needs and characteristics of frequent transit users (Taylor & Morris, 2015).

[1] With regulations and practices such as congestion pricing, gas taxes, parking pricing, traffic calming, etc.

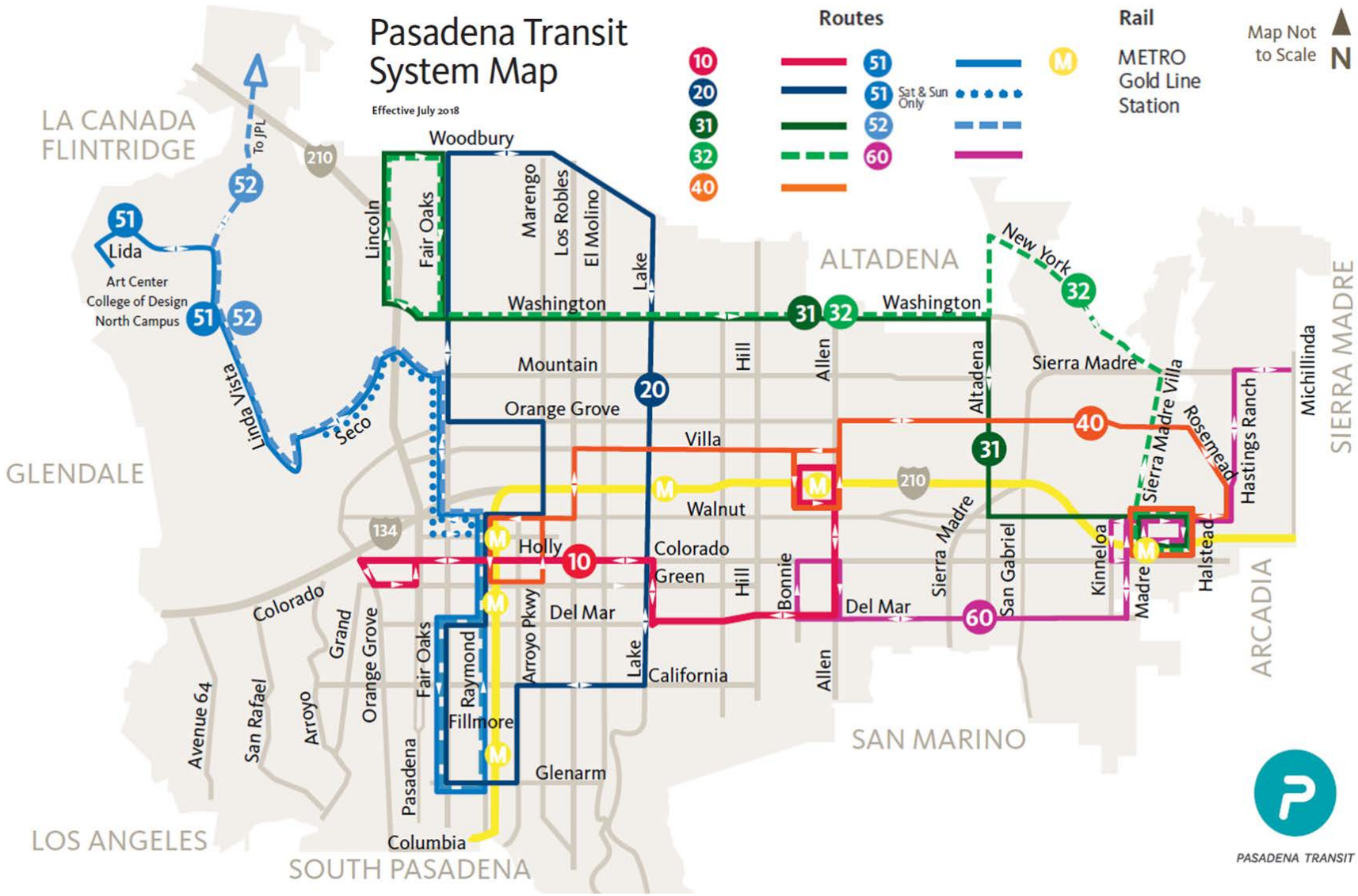

Figure ES-1. System map of Pasadena Transit's fixed-route bus network.
Base image source: City of Pasadena (2018).

The latter does not appear to be the case for Pasadena Transit, but it remains pertinent to remember the importance of public transportation and its position as a valuable travel option and social asset.

1. City of Pasadena in context

With nearly 150,000 inhabitants, Pasadena is among the ten most populous cities in Los Angeles County (L.A. County, 2018). Also, according to the U.S. Census, Pasadena hosts over 112,000 jobs (2.6% of countywide total).

In 1994, Pasadena launched its transit service with one route: a shopping-oriented downtown circulator that took people for free around the business core. Throughout the years, and accelerated by the opening of the Gold Line in 2003, this circulator gradually evolved until becoming a system with several fixed routes and a uniform fare structure, known as Pasadena Area Rapid Transit System (Pasadena ARTS) (City of Pasadena Transit Division, 2018).

Today, the system, rebranded as Pasadena Transit with **Connecting the Dots** as a slogan, consists of six main routes: three feeder lines, which take customers between major activity centers and Gold Line stations, and three local routes, which run throughout town connecting also to the Gold Line (see Figure ES-1).

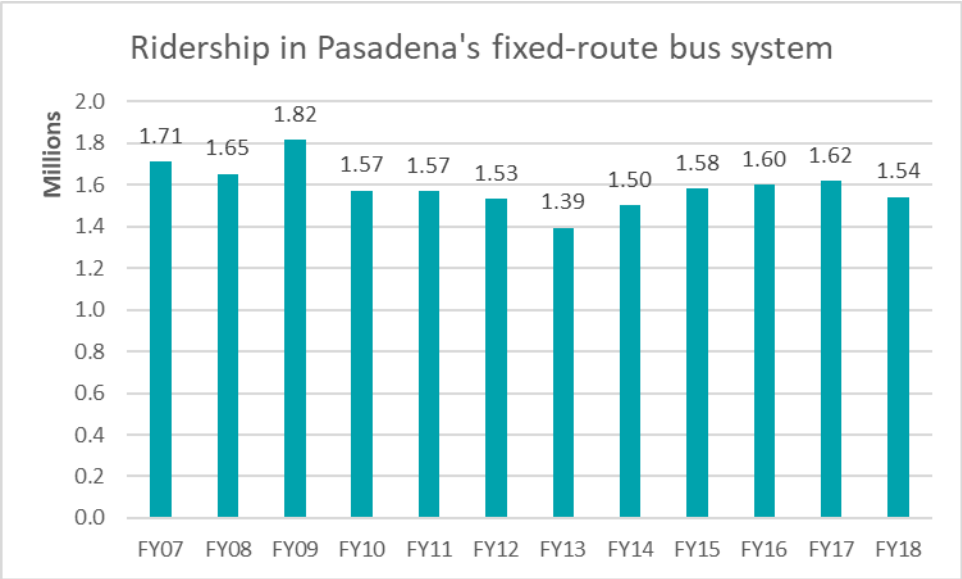

Figure ES-2. System-wide ridership trend
Data source: Pasadena Transit.

Local routes (20, 31/32, and 40), generally, carry much more ridership than feeder lines (10, 51/52, 60).[2] Overall, there are important asymmetries in the system.

System-wide Pasadena Transit ridership trends over the past 12 years show that patronage peaked at 1.82 million rides in the 2008-09 fiscal year, and experienced a low figure at 1.39 million rides during the 2012-13 fiscal year (see Figure ES-2 above); between the most recent 2016-17 and 2017-18 fiscal years, ridership declined by 5 percent to 1.54 million riders. This most recent patronage dip largely motivated the present study.

2. Background information

2.1. Determinants of ridership changes

Factors affecting transit ridership group in two main categories: those under transit agencies' control, and those that are not (Taylor & Fink, 2013).

Transit agencies control service quantity, quality, and price (Taylor & Fink, 2013). Quantity includes things such as time between arrival of two consecutive buses (known as frequency or headway), areas and corridors covered, and size of transit vehicles. Quality comprises reliability, punctuality (on-time performance), and customer service levels. The latter includes responsiveness from the agency's staff and bus operator's friendliness, which are important but hard to measure. The price (or fare) is a major determinant on people's choice to take a bus, especially for those with low incomes or who already own a car. However, system improvements, in terms of quantity or quality, diminish the negative effect of increased fares (Taylor & Fink, 2013).

Transit authorities typically have little or no control over things such as the price of driving, the availability of other alternatives to transit, land uses, development densities, parking, and demographic and economic changes in the population of likely riders (Taylor & Fink, 2013). The price of driving is mainly determined by fuel prices, barriers to vehicle ownership, and the fact that access to virtually all roads and most parking is free. Things such as access to auto loans and the ease or difficulty of obtaining a driver's license can also be barriers to car access. Alternatives to driving, such as transportation network companies (TNCs or ride-hailing companies, such as Uber and Lyft), are still relatively new and can provide auto access without vehicle ownership: customers pay by the trip, eliminating the upfront cost of purchasing a car and potentially reducing travel expenses to the marginal cost of each trip. Some research concludes that TNCs are taking customers away from transit (Graehler *et al*, 2019), while others find that TNCs are complementing transit by serving as a solution to the first/last mile problem (Boisjoly *et al*, 2018; TransitCenter, 2016).

[2] In some parts, this report refers to the 31/32 duplet as "Route 30" and the 51/52 duplet as "Route 50," for simplicity purposes, and aggregates data accordingly.

2.2. Lessons learned

The experiences of other metropolitan areas teach several lessons that transit agencies across the U.S. could apply. For example, Houston Metro redesigned its bus system by establishing a frequent network, increasing the span of service (more all-day service), and matching the system to the urban form (which had changed significantly in recent years) (Pritchard, 2015). Houston Metro experienced a three-percent increase in ridership in the first year since the redesign went live, which appears bland but is indeed a win among losses all across the country (Brazeal, 2016).

Similarly, Seattle has seen ridership increases in recent years (Fink, 2018a). King County Metro, the regional transit authority, has invested millions in transit, focusing on high-frequency bus service, seven days a week, as well as extended span of service in *certain* areas and improved weekend frequency on *main* routes (Rojc, 2015). Not only has Seattle invested heavily in bus service, but it has also been updating service according to demand and system performance (Brasuell, 2016).

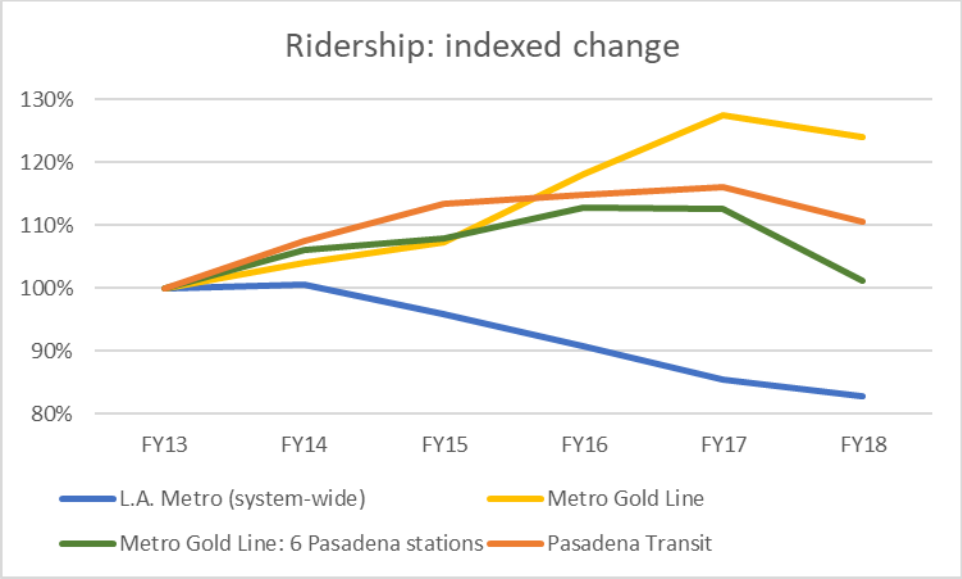

Figure ES-3. Unlinked passenger-trips indexed to fiscal year 2013.
Data sources: L.A. Metro and Pasadena Transit.

3. Methodology

The present study aims to explain the sources of recent shifts in ridership in Pasadena. The first step involved choosing the comparison years, since understanding trends in ridership requires a longitudinal study. Generally, 2009 to 2018 stood out as a good time frame, since the Census has readily available data for this period. This report makes special emphasis on 2013 to 2018 when pertinent because, during that period, Pasadena Transit experienced continued growth before peaking in 2017 (see Figure ES-2).

Then, this study contrasted ridership trends with possible causal factors, using the material presented in Section 2 (***Background information***) as a guide. Some of the variables analyzed include comparable ridership at other transit agencies, Pasadena-area vehicle ownership rates, demographic characteristics (income, race, age, etc.), homelessness, and housing-market features (rents, rent burden, etc.). This report also evaluated ridership patterns in light of the agency's performance, mainly looking at service supply (hours and miles of service provided).

4. Analysis and findings

4.1. Metro Gold Line

The Gold Line was one of the few components of the L.A. Metro system that kept adding riders even after L.A. Metro ridership as a whole started falling in 2015. L.A. Metro (or, more formally, the Los Angeles County Metropolitan Transportation Authority) is the regional transportation authority for L.A. County. The Gold Line was likely helped by the opening of the Azusa extension to the east of Pasadena in July 2015. The analysis suggests that said extension had mixed effects on the city's transit ridership. First, this examination allows to surmise that people from the eastern San Gabriel Valley (SGV) who would previously make their way to Pasadena to board the Gold Line in order to ride it to Downtown Los Angeles, are now boarding the Gold Line at one of the new stations farther to the east. Thus, these riders do not set foot in Pasadena anymore and, instead, ride through it on the train. Ridership for the Gold Line as a whole increased with the Azusa extension, but it gradually plateaued for the Pasadena stations as well as for Pasadena Transit (see Figure ES-3). However, Pasadena Transit's feeder lines experienced increased ridership right after the opening of the Azusa extension. This suggests that travelers from the eastern SGV who used to get to work (in Pasadena) by some other means are now taking the Gold Line and transferring to Pasadena Transit.

No matter how much the Gold Line apparently influences Pasadena Transit's patronage, it appears that other regional and local phenomena affect ridership on both systems. The ridership decline on Pasadena Transit in fiscal year 2018, the first one in five years, was accompanied by a fall in ridership across the board; even the Gold Line as a whole, with its brand new Azusa extension, experienced drops in ridership for the first time since 2013 (see Figure ES-3).

4.2. Pasadena Transit service performance

The trend over the past five years indicates that, generally, increases in service are followed by increases in ridership. A relevant exception occurred from fiscal year 2017 to 2018, where a very slight 0.1 percent increase in service was associated with a 4.7 percent decrease in ridership. The main increase in service took place on weekends whereas the major decline in ridership occurred on weekdays, which partly explains why added service did not lift ridership this time around.

The opening of the Gold Line Azusa extension in FY16 might have influenced the increase in ridership on the feeder lines (10, 50, and 60), including the rebound of Route 50's patronage, which had fallen since FY12. However, a ridership increase only on less patronized routes is not likely to have a significant positive effect on overall system ridership. The Azusa extension also provided a short-lived boost to ridership on Route 30, while it did not help Routes 20 and 40, which experienced a decline that year.

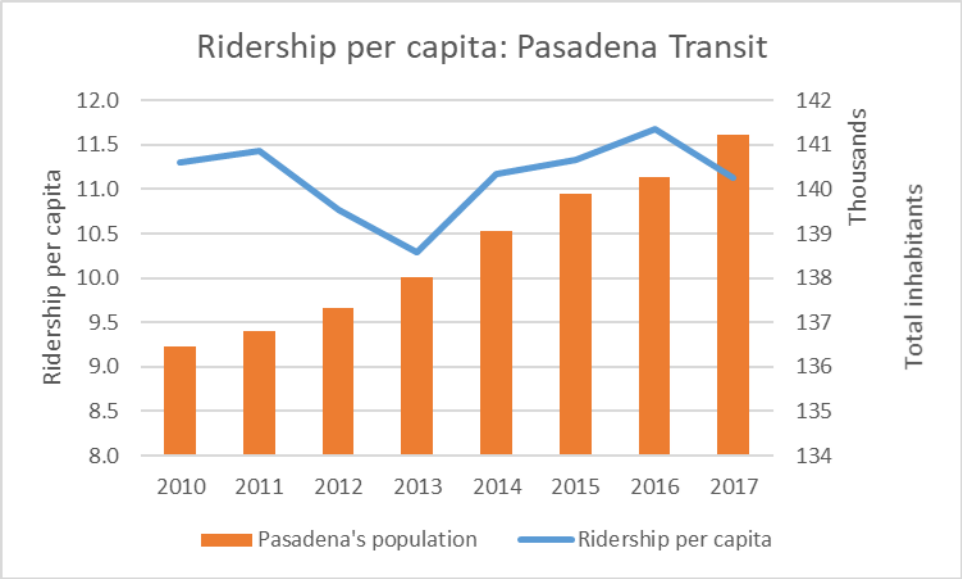

Figure ES-4. Ridership per capita[3] and Pasadena's population.[4]
Data sources: Pasadena Transit and U.S. Census Bureau.

4.3. Population growth

Analyzing population growth helps put ridership changes into context. Since 2011, Pasadena has been steadily growing, at a pace similar to that of the county, according to data from the U.S. Census Bureau.

Ridership per capita is a ratio that allows for a better understanding of how ridership grows or decreases relative to population. For example, if ridership per capita stays constant, then ridership and customer base are growing (or falling) at the same speed. The customer base, in this context, refers to the population living in the service area. Figure ES-4 puts in evidence how local bus ridership grew faster than population (ridership per capita rose even amidst

[3] Ridership per capita is a measure of **passenger-trips per inhabitant** of the service area. The service area, in this case, is the City of Pasadena. Section 4.3 of this executive summary better explains the dynamics behind this metric.
[4] Population data from 2009 did not appear to be reliable; thus, this figure displays data starting in 2010. Also, note that the Y-axes do not start on zero; this is because the changes are so slight that it is hard to visualize otherwise.

marked population growth) between 2013 and 2016, which makes the recent drop more concerning.

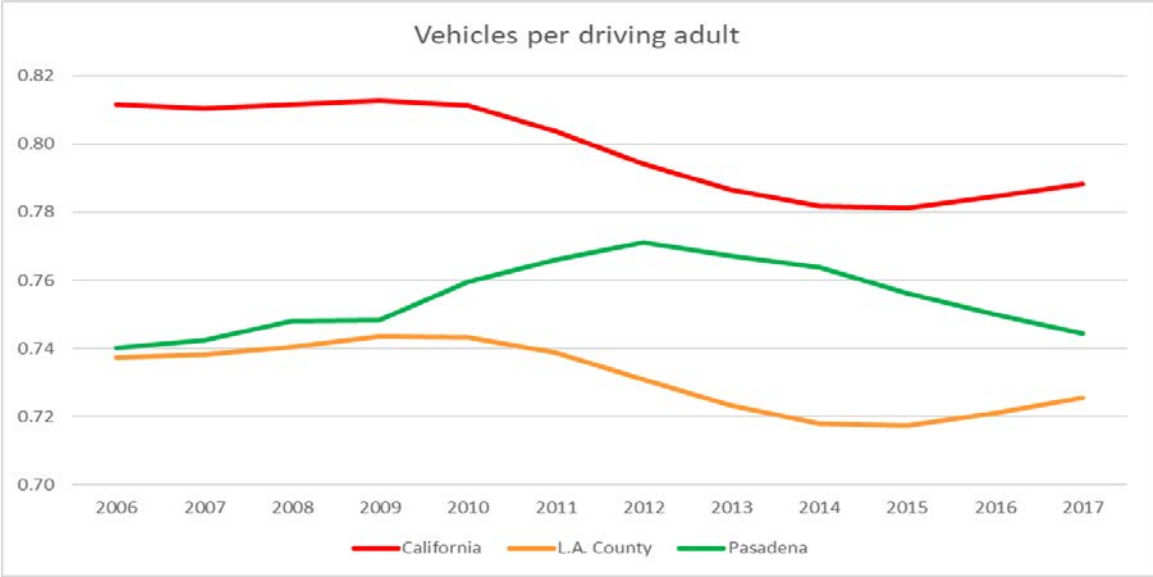

Figure ES-5. Vehicles per driving-age adult (moving average).
Data source: U.S. Census Bureau.

4.4. Vehicle access

Vehicle access is an important predictor of transit use; people with less access to cars tend to ride transit more. Notably, the share of households in Pasadena with one or more vehicles per person has shrunk in the past few years, whereas zero-vehicle and vehicle-deficient[5] households are gaining ground. Nonetheless, still more than half of Pasadena's population lives in households with at least one vehicle per person. The overall number of vehicles available per driving adult paints an even starker picture. The number of vehicles per adult in Pasadena has steadily fallen since 2012 (see Figure ES-5), while auto ownership has been increasing in Los Angeles County and statewide since 2015, as described by Manville and coauthors (2018).

Decreasing vehicle ownership should bode well for public transit ridership, but that is not the case, which suggests other factors might be playing a greater role.

4.5. The rise of telework

Changes in vehicle ownership might be linked to changes in commuting travel behaviors.[6] Driving alone to work has been on the rise in California and L.A. County since 2013, the same year the share of solo driving to work started shrinking in Pasadena. However, solo driving

[5] Vehicle-deficient households is a shorthand for homes with more people than cars, implying that two or more people need to share a car.
[6] Commute or commuting are a shorthand for the journey *to work* or travelling *to work*.

still represents over two-thirds of commuters in Pasadena. Commuting via taxicab, motorcycle, or other means (including ride-hail) represents less than two percent of all journeys to work, but has seen important increases in recent years. This is most likely due to the widespread adoption of TNCs.

Most surprisingly, working at home has risen rapidly in Pasadena; an astounding 70 percent increase in eight years. This has implications for public transit because commuting is an important market for this mode of transportation, and the less that people physically travel to work, the smaller this important pool of potential transit riders gets.

4.6. Shifts in race and ethnicity

The shares of non-Hispanic White and African American people in Pasadena have consistently shrunk since 2013. The Hispanic, or Latinx,[7] population remains relatively stable, increasing a meager 2.5 percent between 2009 and 2017. The share of non-Hispanic Asians has grown the most, going from 12 to 16 percent of the total population in this eight-year period. This demographic shift has consequences for transit ridership. Out of 572 respondents[8] to a survey conducted in 2017 among Pasadena Transit riders, 11 percent self-identified as African American and 27 percent self-identified as White, whereas only nine percent reported being Asian. This means that the two demographics that represent a third of Pasadena Transit's patronage have been shrinking in the city, and a pool that is less than a tenth of Pasadena's local bus ridership has expanded considerably.

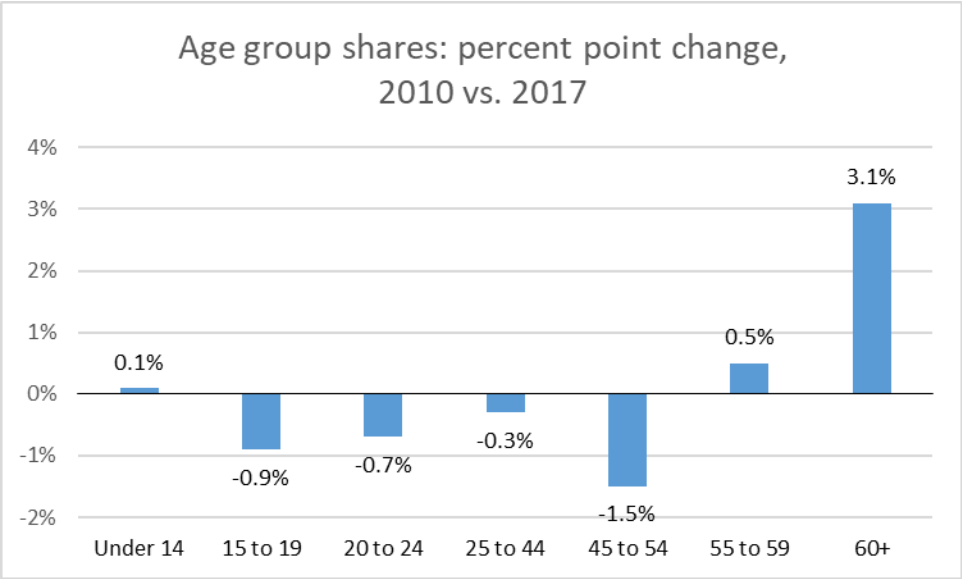

Figure ES-6. Shifts among age groups in Pasadena.
Data source: U.S. Census Bureau.

[7] Latinx is a gender-inclusive way of referring to Latin American people, as opposed to the binary construct comprised of Latino (cisgender male) and Latina (cisgender female).
[8] A total of over 600 people completed the survey, but not everybody answered every question. For example, only 572 people responded to the question about their race/ethnicity.

4.7. Aging population

In the rider survey mentioned above, more than 13 percent of respondents reported being aged 18 or younger. Also, 18 percent indicated their age as 60 years or more. Furthermore, per Census data, minors and young adults (aged 25 or less) in Pasadena are more likely to commute by transit, followed by seniors and, lastly, by middle-aged people. Pasadena has aged, which leaves a loyal group of transit riders (those aged 15 to 25) shrinking. The group of those who commute via transit the least (those aged 45 to 54) has shrunk too. However, these two reductions are made up by growth on a group that rides transit modestly often, for work and non-work trips: those aged 55 and above (see Figure ES-6).

4.8. Poverty and unemployment

Data suggest that poverty has grown in Pasadena, which would likely lead people to get rid of household cars and take transit more often, and unemployment has fallen, which would allow people to travel more often (more resources, more reasons to travel) but possibly less via transit since they now have an income and people tend to use transit less as their incomes rise.[9]

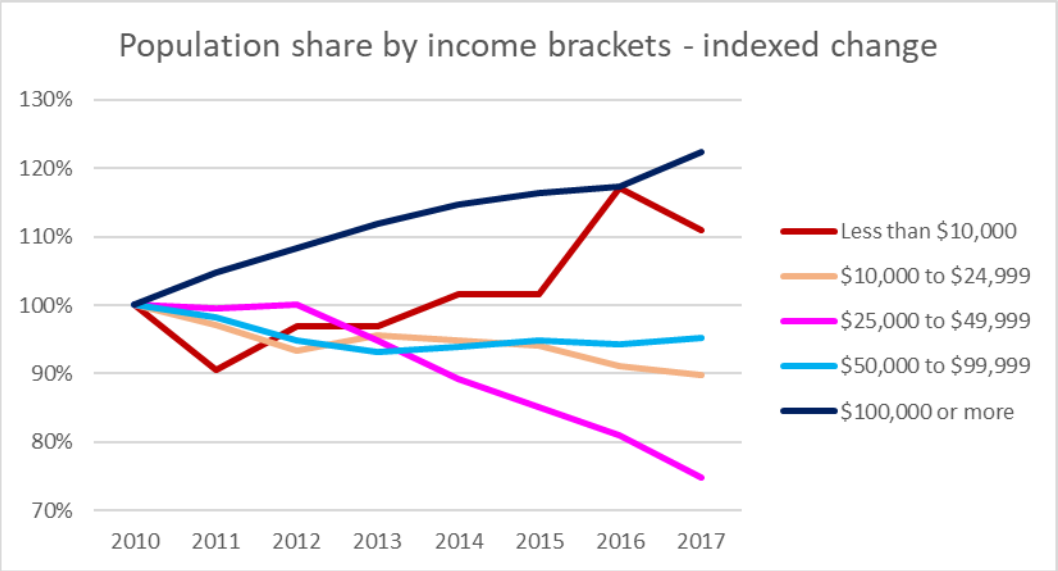

Figure ES-7. Income bracket shares in Pasadena (indexed to 2010).[10]
Data source: U.S. Census Bureau.

[9] Public transit in the U.S. is what economists define as an "inferior good," whereby people consume less of it as their incomes rise, which is the opposite for most goods (i.e., people with more money, buy more of them).
[10] Please note that the brackets are in nominal dollars (i.e., not inflation-adjusted) due to the complication of adjusting these data. This implies that inflation, pushing salaries up from one income bracket into the next as time passes by, is not accounted for. However, this period experienced relatively low inflation (annual average of 1.7%), so the analysis is not greatly affected by this limitation.

How do these opposing forces interact? Low-income people in Pasadena get jobs and start traveling more often — both to and from work, and because they now have more disposable income to spend at destinations. The inferior-good concept suggests these now-employed travelers are more likely to gain private vehicle access and start driving rather than riding transit. But big purchases like cars do not happen overnight, and the cars that lower-income travelers own tend to be older and less reliable models. So for newly-employed travelers who do not buy cars, they are likely to make more trips by transit, at least in the near term.

4.9. Homelessness

Pasadena's homeless count indicated a decline in the number of people living on the streets between 2011 and 2016. However, in 2016, this positive trend reversed, and homelessness rose 28 percent over the next two years (2016-2018). Since many homeless people find shelter in transit vehicles and stops, riders usually come in contact with homelessness and not everybody feels comfortable with that (Manville *et al*, 2018). Thus, homelessness might be a factor contributing to the fall of local transit ridership.

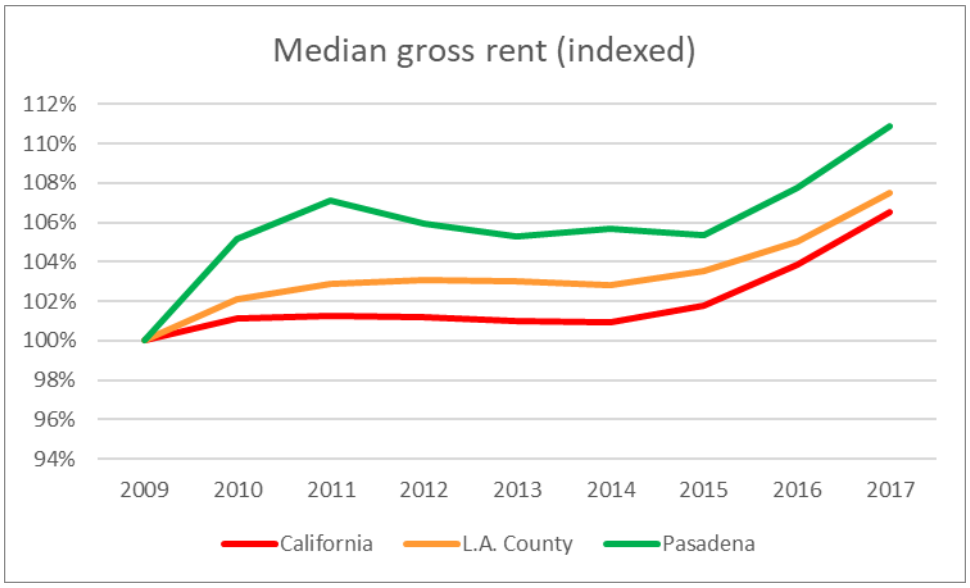

Figure ES-8. Median gross rent (inflation-adjusted to 2017), indexed to 2009.
Data source: U.S. Census Bureau

4.10. Income inequality

While it appears that the emergence of telecommuting, an aging population, shifts in racial/ethnic composition, and homelessness are likely relevant factors, none could be characterized as a primary reason.

Median household incomes in Pasadena fared well during the Great Recession and have increased since. Looking at population distribution by income brackets (see Figure ES-7), middle-income brackets have shrunk at a sizeable rate, especially those earning $10,000 to

$24,999 and $25,000 to $49,999. In contrast, the lowest and highest income brackets have rapidly grown. Those earning under $10,000 were six percent of the population in 2010 and seven percent in 2017, whereas, most notably, the share of those earning six-figure salaries went from 31 to 38 percent.

The two income extremes expanding while the middle brackets shrank lead this analysis to look deeper into income inequality, especially since most of the shift was towards the highest income bracket. This information is confirmed when looking at the Gini index for income disparity, which rose in the city between 2014 and 2016.

The main takeaway here is the fact that middle-income households are either becoming impoverished or moving away, and this is concerning, especially when this "flight" is replenished with higher-income people. This is because persons with more money tend to ride public transit less, since transit is considered an "inferior good" to private vehicles, as mentioned earlier.

4.11. Housing market and displacement

To exacerbate concerns around the widening wealth gap, Figure ES-8 shows rents have grown quickly in Pasadena (11% in eight years), a city where more than half of the housing stock is rented.

More inequality and higher housing costs yield a scenario where rent heavily burdens very-low-income residents. This low-income, high-rent-burden situation can significantly limit resources available for travel in many Pasadena households, which can both limit private vehicle access and increase dependence on public transit. Ultimately, this could also force people out of their homes, due to the inability to afford rent, displacing frequent riders who are replaced by wealthier people who are, at best, sporadic riders. Using a main transit corridor and the abutting areas as an example, this report shows that a trend of displacement appears more pervasive than increased dependence on public transit induced by high housing costs.

The problem with displacement, in the context of transit demand, is that frequent riders (generally low-income) are replaced by wealthier people who, at best, ride transit occasionally, as discussed in Section 4.10. ***Income inequality***.

5. Conclusions and recommendations

At the beginning of this research project, the assumption was that Pasadena Transit is heavily dependent on the regional transit network, particularly on L.A. Metro's Gold Line, and that faltering transit use regionally might contribute to local ridership losses in Pasadena. However, the data and analyses presented here point towards more structural issues inducing wavering ridership: an aging population, changes in demographics and travel behavior, increased homelessness, and rising rents placing undue financial burden on already-financially-strapped households.

Increased vehicle ownership and use were discarded from the onset, since Pasadena residents, contrary to their L.A. County and California counterparts, are collectively disposing of private vehicles. Perhaps, higher rent burdens have encouraged low-income residents to reduce costs and give away their surplus vehicles.

However, less vehicle access *should* foster increased transit use. Looking into other variables typically thought to cause fluctuations in transit ridership, a few stood out as additional potential disruptions.

- The escalation of telecommuting, or working from home, is a likely contributor, since commuting is a significant market for transit and the less that people commute (by physically traveling), the smaller this pool of potential riders gets.
- The aging of Pasadena's population could be an influential factor. Previous research looking into U.S. cities' transit decline (Driscoll *et al*, 2018), as well as U.S. Census data for Pasadena, point towards the weight younger populations (especially people in their early 20s and younger) have on transit patronage. When this population shrinks (young people age, and birth rates do not keep up), public transit tends to lose loyal and frequent users.
- An increasingly Asian population, which injects the market with individuals who are less likely to use transit (when compared with, for example, African Americans or Hispanics).
- Rising homelessness in Pasadena, which went up 28 percent from 2016 to 2018, tarnishes people's perception of public transit and incentivizes riders to seek other, more private, travel modes that spare them the disturbance or discomfort of sharing space with homeless people.

Yet, none of these longstanding trends explain, in a satisfactory manner, why Pasadena Transit's healthy patronage base has begun experiencing mild declines in the past couple of years. The homelessness upsurge did coincide with Pasadena's faltering ridership, but it appears unlikely that this alone would significantly impact transit patronage.

Moving or displacement of frequent transit users out of transit-rich areas and into more auto-oriented places often comes up as a plausible driver of ridership declines (Driscoll *et al*, 2018; Manville *et al*, 2018, also looked into this). Pasadena displays some symptoms of displacement: income inequality, rising housing costs, and a more high-end job market. The mapping of these phenomena to spatially visualize these changes and overlay them with the bus stops that experienced important changes in ridership helped further understand the extent of this problem.

Incomes have risen 4.6 percent since 2013 and, more significantly, the share of Pasadena residents in the top income bracket ($100,000 or above) went from 35 to 38 percent in only four years (2013-2017). Such an increase might appear modest, but this is by far the group that grew most. Furthermore, median rent burden has escalated since 2013, going from 30 to nearly 33 percent. This means half of Pasadena's households pay *more than a third* of

their income in rent. In addition, 75 percent of very-low-income households in Pasadena pay *more than half* of their income in rent.

This brings financially-strapped households to a crossroads: let go of their car and ride transit to save money and make rent, *or* move out (or get evicted) due to the inability to afford rent. Some preliminary mapping identifies the latter as a much more likely candidate. A rent-burdened person who used to frequently ride on Pasadena Transit will need to take their "travel business" elsewhere when they get pushed out by a heavy influx of wealthy people. Thus, they will either take transit in another city or, much more likely, will need to get a car (now that their rent is more affordable, they can) to move around in an area with less transit service. In contrast, those who move into Pasadena are an increasingly affluent population who, given their high incomes, are much less likely to consume an inferior good such as public transit.

These findings allow to provide some recommendations that are grouped in three broad categories:

Targeted marketing. Many of the findings point towards specific groups that, for different reasons, do not ride transit very often (or not at all): people who work from home, Asian residents, senior citizens, recently-employed people, and wealthy newcomers. Thus, this report suggests conducting targeted surveys to better understand the travel needs of these different groups and, thereby, frame transit service in a way that appeals to them. This might involve aggressive marketing, eye-catching wayfinding, and tailored transportation demand management programs in partnership with employers, property managers, and other relevant stakeholders.

Homelessness-awareness campaign. Since homelessness itself is beyond Pasadena Transit's purview, the Client could leverage awareness to make the public cognizant of the struggles of the homeless. The first step, though, would imply surveying riders extensively on the specific topic of homelessness and fear on the bus. This study would inform the campaign itself. Humanizing homelessness might aid in dispelling the perception of homeless people as a threat and allow transit riders to feel more comfortable and less intimidated around them. This will not solve homelessness, but it is a first step towards destigmatizing it and making transit friendlier for all.

Housing stability. Evidence points towards growing rent burdens as the single biggest factor weakening local bus ridership. Once again, this is something Pasadena Transit has no control over; therefore, this issue requires additional research. A good start might involve extensive surveying to build a database of rent-burdened households and know where in the city they live. Most likely, this would require collaborating with Pasadena's Department of Housing. Once these households are mapped out, the next step would consist of evaluating their access to the existing local bus network and assessing what solutions Pasadena Transit could implement to better serve this group's needs.

All of these recommendations center on ***adapting to specific riders' needs***. This report emphasizes this idea because it embodies the cornerstone of Houston's and Seattle's recent

successes in improving service and attracting riders, and it is also mentioned throughout the academic and professional literature as a "best practice" in the provision of public transit in the era of modern ridership decay.

For Pasadena Transit, which encountered mild declines in ridership despite its positive performance metrics and high levels of customer satisfaction, this report suggests further understanding the needs of existing and new participants of the city's transit market. The economic and demographic phenomena driving ridership fluctuations in Pasadena are beyond the Client's control, but still the Client can implement some measures to make the local ridership trend shift upward. Clever and focused marketing strategies, while collaborating with other city agencies, could strengthen an already robust transit system and take its performance metrics and user-oriented service to the next stop.

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UCLA Luskin School of Public Affairs

PASADENA TRANSIT

Connecting the Dots…

Ridership Changes, Underlying Causes, and Strategies for Pasadena Transit

1. Introduction

Over the past decade, public transit operators in the Los Angeles region started experiencing steep declines in ridership, while Pasadena Transit was adding riders. More recently, however, Pasadena Transit's ridership plateaued and then started to decrease. The Transit Division of the City of Pasadena Department of Transportation ("the Client") is therefore interested in understanding what may be causing fixed-route transit ridership to decline in its jurisdiction, what are the circumstances driving these changes, and what these causes and circumstances suggest for ways to make the system more attractive to riders. This project aims to find the factors driving said fluctuations and to consider the implications they may have on Pasadena's market for transit.

Ridership is a measure of demand for transit and state and federal agencies usually refer to transit usage levels as a determining metric to assign intergovernmental fund transfers, allocate other funding, and evaluate grant applications. Welch and coauthors (2018) frame the issue rather concisely: "under the current regime of historically shrinking public transportation funding, every rider makes a difference" (p. 2). Sustained ridership levels are key to secure funding sources, which allow for a more accessible and frequent service. Faltering funding leads to deteriorating service which, ultimately, chases away whatever patronage remains.

Healthy ridership levels make transit service sustainable, which allows for enhancement and expansion of service provision. The importance of transit pivots on the idea of providing an array of travel choices to serve different needs. As of now, many transit agencies seek to attract drivers out of their cars, in an attempt to reduce vehicle-miles travelled, carbon emissions, and traffic congestion (Taylor & Morris, 2015). However, transit cannot achieve such ambitious goals if it cannot compete with the advantages furnished by private vehicles. To overcome the many advantages of driving, public transit systems require both substantial investments (to expand service coverage and reduce wait times) and more aggressive management of driving.[11] Unfortunately, falling transit ridership is more likely to prompt

[11] With regulations and practices such as congestion pricing, gas taxes, parking pricing, traffic calming, etc.

budget cuts than enhancements, and managing driving is both politically unpopular and outside of the scope of most transit operators.

Also important to keep in mind is that public transit in its present form functions first and foremost as a lifeline service to low-income people and other groups who rely heavily on it because they are not able, physically or financially, to drive. However, transit agencies are under pressure to appeal to non-riders, given their traffic reduction and environmental goals as well as due to political and financial constraints (Manville & Cummins, 2015). As a consequence, sometimes transit providers overlook the needs and characteristics of frequent transit users (Taylor & Morris, 2015). The latter does not appear to be the case for Pasadena Transit, but it remains pertinent to remember the importance of public transportation and its position as a valuable travel option and social asset.

The Los Angeles metropolitan region has been moving towards a greener future, and aims to place transit at the core of this future to incentivize modal shift away from private vehicles. The Los Angeles County Metropolitan Transportation Authority (L.A. Metro), which is the regional transportation authority, has put forward several major transit projects that are slated to open by 2028; they have dubbed this "28 by 28": twenty-eight projects by 2028 (L.A. Metro, 2017). All this investment becomes possible thanks to several sales-tax increments that L.A. County voters have approved, taxing themselves to raise funds for better transit and promote less car use.

However, those regional plans are ambitious (Manville *et al*, 2018). Aside from lifting the heavy subsidy on driving, modal shift requires more than allocating funds to transit projects that take several years to complete. Some shorter-term measures include making service more frequent, among others (Meaney, 2018). Pasadena Transit is one of the municipal transit providers striving to implement higher frequencies, and it has made important progress on this front in recent years. However, ridership levels started to falter recently, which has raised concerns about the effectiveness of investments placed on enhancing service.

As a result, the present research project aims to answer the following questions:

- What is driving the fluctuations in ridership on Pasadena Transit?
- How do these ridership–altering factors relate to Pasadena Transit's popularity among users, its positive performance metrics, and its recent efforts to increase frequencies and optimize service?
- Are added service and other measures under Pasadena Transit's purview yielding results and meeting increased ridership expectations? If not, what could be done differently? What other incentives or marketing strategies could be implemented to attract more riders?

The first question is at the center of this research. The latter two questions aim to, respectively, contextualize the causes identified and propose strategies to address said causes.

The findings indicate vehicle ownership might have affected the region, but probably has not stolen ridership from transit in Pasadena. The ratio of vehicles per driving-age adult in the city has indeed decreased since 2012. The aging of the population and the growth of work-from-home stand out as potential drivers of ridership changes. Increased homelessness appears to be even more influential on recent ridership changes. However, what this report identifies as, potentially, the principal cause include income inequality and displacement of populations that use transit very frequently. The influx of wealthier people into Pasadena and rising rents might have pushed lower-income residents, who most likely were frequent transit users, out of the city. Additionally, wealthy individuals who move in are less likely to ride transit very often due to their high incomes (people with more money tend to ride public transit less).

The remainder of the report contains five sections. First, Section 2 (***City of Pasadena in context***) provides some basic facts about Pasadena and its transit environment. Section 3 (***Background information***) presents fundamental discussions around the roots of ridership changes, along with elemental considerations of "best practices" in the transit industry and lessons learned from other cities that successfully added riders. Section 4 (***Methodology***) explains how the data were obtained and analyzed. Section 5 (***Analysis and findings***) lays out what the data show and studies them in detail. Finally, Section 6 (***Conclusions and recommendations***) offers ideas to address the issue being analyzed.

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2. City of Pasadena in context

With nearly 150,000 inhabitants, Pasadena is among the ten most populous cities in Los Angeles County (L.A. County, 2018). Also, according to the U.S. Census, Pasadena hosts over 112,000 jobs (2.6% of countywide total), which places it fourth behind Los Angeles (40%), Burbank (4.6%), and Long Beach (3.9%).[12]

Figure 1. Pasadena (teal) in the San Gabriel Valley (yellow) and, more broadly, in the Los Angeles region.
Base image source: Google Maps.

[12] Data extracted from the U.S. Census Bureau's *OnTheMap* employment database (2015).

Figure 1 offers a reference map placing Pasadena in the context of the L.A. region.

To situate Pasadena within the regional transit network, Figure 2 below serves as a helpful reference. In 2003, when the Gold Line was inaugurated, Pasadena became one of the few destinations to be directly linked to Downtown Los Angeles via a rail line. Later, this same line extended southeast into East Los Angeles in 2010, and east into the San Gabriel Valley in 2016.

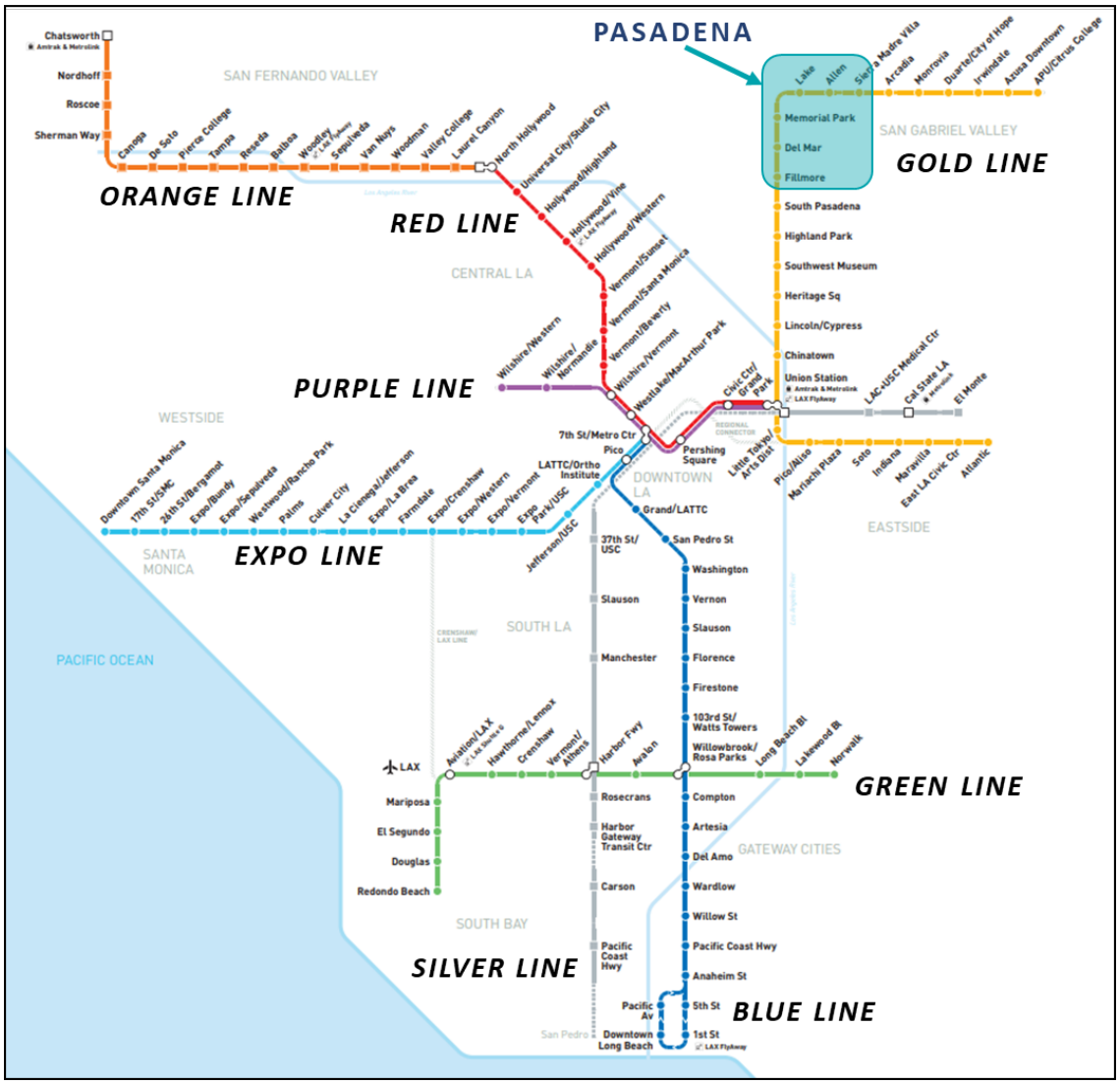

Figure 2. Pasadena and its location relative to the regional transit network.
Base image source: L.A. Metro's website (metro.net).

Figure 3. Reference map of Pasadena including its Gold Line stations and a few of its major neighborhoods and points of interest.

Base image source: Google Maps.

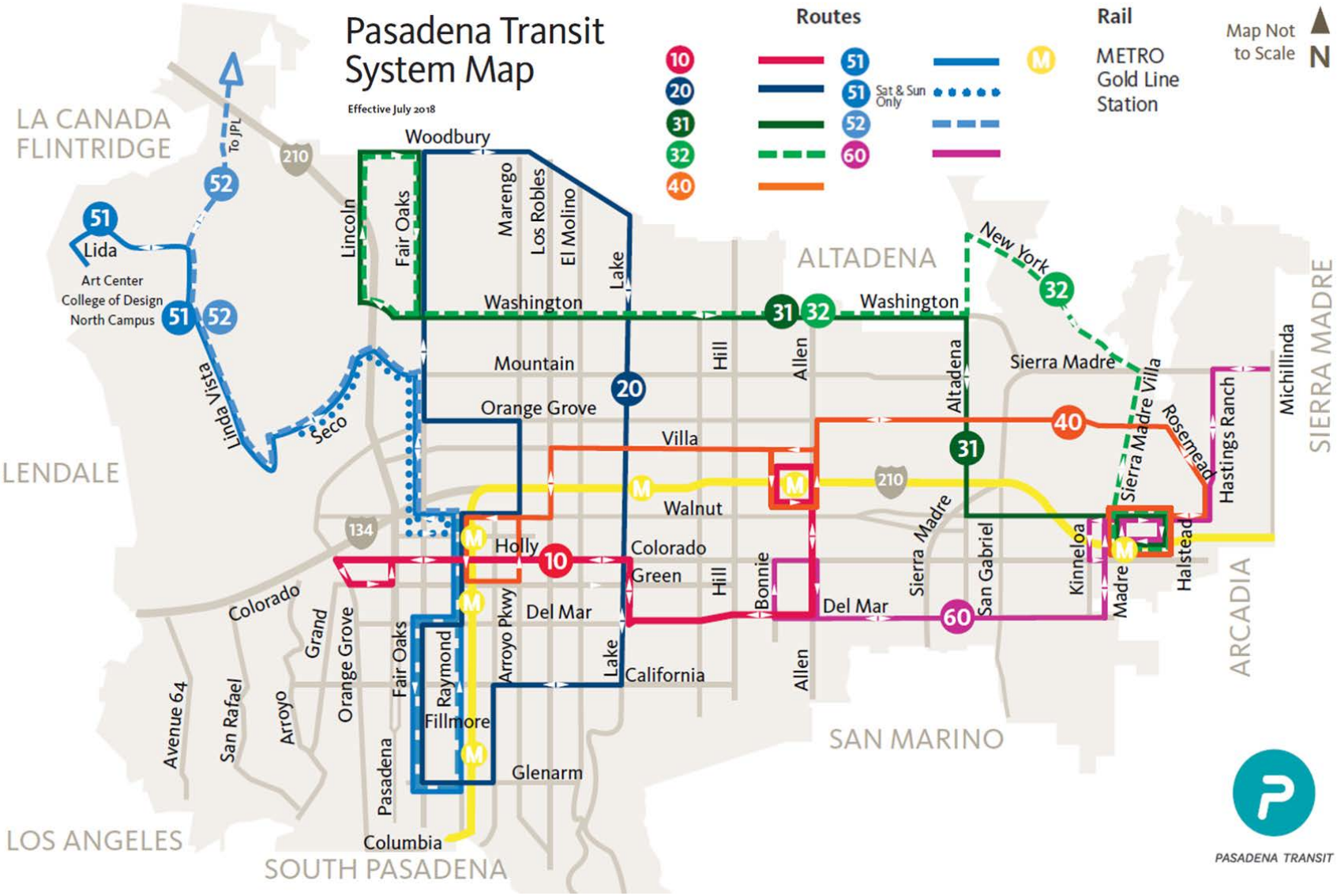

Figure 4. System map of Pasadena Transit's fixed-route bus network.
Base image source: City of Pasadena (2018).

In 1994, Pasadena launched its transit service with one route: a shopping-oriented downtown circulator that took people for free around the business core (labeled Old Pasadena in Figure 3).[13] Throughout the years, and accelerated by the opening of the Gold Line in 2003, this circulator gradually evolved until becoming a system with several fixed routes and a uniform fare structure, known as Pasadena Area Rapid Transit System (Pasadena ARTS) (City of Pasadena Transit Division, 2018).

Today, the system, rebranded as Pasadena Transit with **Connecting the Dots** as a slogan, consists of six main routes: three feeder lines, which take customers between major activity centers and Gold Line stations, and three local routes, which run throughout town connecting also to the Gold Line (see Figure 4).

Table 1. Brief description of Pasadena Transit's six bus routes.[14]

Route #	Type of Route	Main corridor(s) served	Description
Route 10	Feeder	Colorado	Old Pasadena to Allen station via PCC
Route 20	Local	Fair Oaks and Lake	Loop connecting Northwest Pasadena, Old Pasadena and areas south of Del Mar Blvd
Route 31	Local	Washington	Northwest Pasadena to SMV station via New York Dr
Route 32			Northwest Pasadena to SMV station via Altadena Dr, Foothill Blvd
Route 40	Local	Orange Grove and Villa	Old Pasadena to SMV station
Route 51	Feeder	Raymond, Fair Oaks and Linda Vista	Old Pasadena to the ArtCenter's North Campus
Route 52			Old Pasadena to the ArtCenter's North Campus via JPL
Route 51s			Memorial Park station to the Rose Bowl
Route 60	Feeder	Del Mar and Hastings Ranch	PCC to Hastings Ranch via SMV station

[13] In Figure 3: the teal line is the Pasadena city limit, labels in white indicate neighborhoods and points of interest, and the white dots with yellow labels identify the Gold Line stations.
[14] In some parts, this report refers to the 31/32 duplet as "Route 30" and the 51/52 duplet as "Route 50," for simplicity purposes, and aggregates data accordingly.

Table 1 provides a synthesized description of the different routes, their branches, and how they serve Pasadena and connect to (or feed into) the Gold Line.[15] Local routes, generally, carry much more ridership than feeder lines. Overall, there are important asymmetries in the system, which are discussed below.

Table 2. Service provided by Pasadena Transit routes[16] and their latest ridership statistics.

Route #	Span of service	Average frequency	FY2018 ridership	As percent of total
Route 10	Weekday 6:00am to 8:00pm Saturday 11:00am to 8:00pm Sunday 8:30am to 5:00pm	18 mins.	171,500	*11.2%*
Route 20	Weekday 6:00am to 8:00pm Saturday 10:30am to 8:00pm Sunday 7:00am to 5:30pm	20 mins. (weekday) 31 mins. (weekend)	794,000	*51.7%*
Route 31	Weekday 6:00am to 8:00pm Saturday 10:30am to 8:30pm Sunday 8:00am to 5:00pm	40 mins. (weekday) 60 mins. (weekend)	293,800	*19.1%*
Route 32		70 mins. (weekday) 60 mins. (weekend)		
Route 40	Weekday 6:00am to 7:30pm Saturday 11:00am to 8:00pm Sunday 8:00am to 5:00pm	15-24 mins. (rush hr.) 28 mins. (weekday) 32 mins. (weekend)	189,900	*12.4%*
Route 51	Weekday 5:30am to 7:30pm	*Route 51/52 combined frequency:* 33 mins. (AM rush hr.) 60 mins. (midday) 36 mins. (PM rush hr.)	66,200	*4.3%*
Route 52	Commuter service (weekday only): 2 morning trips and 2 afternoon trips			
Route 51s	Saturday 7:30am to 8:00pm Sunday 7:30am to 5:00pm	22 mins.		
Route 60	Weekday Rush Hour: 6:00am to 10:30am and 2:45pm to 7:30pm	45-50 mins.	19,900	*1.3%*
		TOTAL:	**1,535,300**	*100%*

Data source: Pasadena Transit.

As Table 2 shows, Route 20 carries over half of the trips served by Pasadena Transit every year, whereas the three feeder routes together serve only about 17 percent of all rides. These

[15] PCC stands for Pasadena City College, a local community college, and SMV is short for Sierra Madre Villa. Also, JPL is the Jet Propulsion Lab, a federally-funded research facility.
[16] Please note Routes 31 and 32 share corridors for most of their length (see Figure 4), which means they run on a combined frequency of 20 to 30 minutes for the most part. The frequencies indicated on this table for Routes 31 and 32 are for each individual route, not combined.

numbers are for the most recent year, but the overall share of ridership among routes has not changed much throughout time (see Figures C-1 and C-17 for more details).

Finally, to provide a high-level picture, Figure 5 below displays the trend for system-wide ridership over the past twelve years.

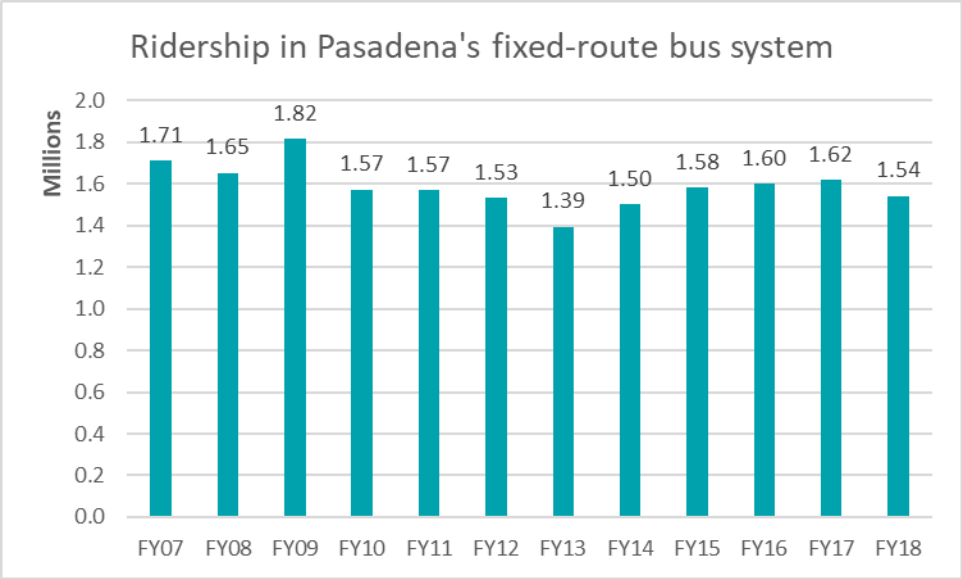

Figure 5. System-wide ridership trend.
Data source: Pasadena Transit.

The local bus system experienced a decline in patronage between fiscal years 2009 and 2013 due to a combination of factors including an aging vehicle fleet, a fare increase, and service reductions. The Client had to implement service reductions in 2010 due to severe budget constraints present during the Great Recession. Also, old buses broke down often, which made the system unreliable and service often late. In 2013, with the help of other city departments and the Pasadena City Council, Pasadena Transit renewed its bus fleet and implemented several improvements to service (City of Pasadena Transit Division, 2018). Since then, system ridership recovered until peaking again in fiscal year 2017, followed by a five-percent drop. This most recent patronage decline largely motivated the present study.

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3. Background information

3.1. Factors affecting ridership

One of the objectives of this review is to fully understand the factors that determine transit use or, more specifically, that trigger *changes* in ridership. Please note that transit use, patronage, and ridership are equivalent terms that are used interchangeably throughout this report.

Factors affecting transit ridership group in two main categories: those under transit agencies' control (internal), and those that are not (external) (Taylor & Fink, 2013).

3.1.1. What counts as internal?

Transit agencies control service quantity, quality, and price (Taylor & Fink, 2013). Quantity includes things such as time between arrival of two consecutive buses (known as frequency or headway), areas and corridors covered, and size of transit vehicles. Quality comprises reliability, punctuality (on-time performance), and customer service levels. The latter includes responsiveness from the agency's staff and bus operator's friendliness, which are important but hard to measure. The price, known as transit fare, is a major determinant on people's choice to take a bus, especially for those with low incomes or who already own a car. However, system improvements, in terms of quantity or quality, diminish the negative effect of increased fares (Taylor & Fink, 2013).

3.1.2. What counts as external?

Transit authorities typically have little or no control over things such as the price of driving, the availability of other alternatives to transit, land uses, development densities, parking, and demographic and economic changes in the population of likely riders (Taylor & Fink, 2013). The price of driving is mainly determined by fuel prices, barriers to vehicle ownership, and the fact that access to virtually all roads and most parking is free. Things such as access to auto loans and the ease or difficulty of obtaining a driver's license are examples of barriers to vehicle ownership. Alternatives to driving, such as transportation network companies (TNCs or ride-hailing companies, such as Uber and Lyft), are still relatively new and can provide auto access without vehicle ownership: customers pay by the trip, eliminating the upfront cost of purchasing a car and potentially reducing travel expenses to the marginal cost of each trip. Some research concludes that TNCs are taking customers away from transit (Graehler *et al*, 2019), while others find that TNCs are complementing transit by serving as a solution to the first/last mile problem (Boisjoly *et al*, 2018; TransitCenter, 2016). First/last-mile TNC trips take people to and from transit stops/stations, bridging what can be the most uncomfortable part of transit trips: getting to/from transit stops (Iseki *et al*, 2012).

3.1.3. How do these two interact?

Scholars have debated the relative importance of these external and internal factors. For example, Alam *et al* (2018) conducted a cross-sectional study of 358 U.S. metropolitan areas and conclude that internal factors, specifically miles and hours of service provided, are much more important in determining transit use. However, Taylor *et al* (2009) make a case for the intertwined relationship between transit supply (service provided) and transit demand (ridership), something Alam and coauthors did not control for. Transit systems do not exist where there is no demand for them, but it is also true that no demand appears where there is no transit. In other words, a lack of potential riders implies no incentive for transit provision, but the lack of transit services suppresses the incentive to ride transit, even if potential riders are present. Taylor and coauthors account for this endogenous relationship and find that external factors are indeed more important, but emphasize that elements under transit agencies' control are not negligible either (Taylor *et al*, 2009).

Boisjoly and coauthors (2018), in their longitudinal analysis of several North American cities, conclude that the withdrawal of bus service (measured as loss in vehicle revenue kilometers) prompted ridership decline in the latest years. On the other hand, a study cited in a Transportation Research Board report (Transit Cooperative Research Program, 2007, p. 13) found that ridership in Boston's main transit network was heavily influenced by downtown employment levels and per capita income. More employment in places where driving is difficult and parking expensive means more people would likely travel to work by means other than driving, which brings more riders. On the other hand, the wealthier a community is, the less likely its members will be to take transit, which speaks to the position of transit as an "inferior good" (as economists would say) relative to private vehicles (Taylor & Fink, 2013). This means that people tend to consume *less* of transit as their incomes rise, which is the opposite of most goods and services (including cars and driving). The Boston results are supported by another study cited in the same report (Transit Cooperative Research Program, 2007, p. 11), undertaken by the Mineta Transportation Institute, which found that external factors carry more weight; yet, internal factors are still relevant. The same study surveyed 12 U.S. transit agencies that succeeded in adding riders in the late 1990s. Half of the agencies cited fare structure changes (an internal aspect) as an influential factor. Another frequently cited factor was population and employment growth (an external factor). However, survey respondents also often mentioned marketing campaigns and coordination with major employers as factors (internal) that triggered their increased ridership. This research thus confirms that transit ridership results from a combination of internal and external factors, and that external factors tend to have a heavier influence.

A study of shared-mobility options in Washington, DC, reveals that higher transit fares and shorter trip distances make travelers more prone to choosing ride-hailing and bike-share services over public transit (Welch *et al*, 2018). This research points also towards the potential of catering to non-commute, non-peak trips; a market disproportionately served by other shared-mobility modes such as taxis, TNCs, and bike share.

Another research project indicates that population and employment densities are the strongest determinants of rail ridership in the regional network of Washington, DC (Iseki *et al*, 2018). This speaks to the importance of land use parameters for transit systems. However, Iseki and coauthors (2018) also point to the fact that transit fares, service levels, and the cost of competing modes (e.g., parking availability, travel time by car or bus) are important factors, too.

Land use elements can be circumvented. Broward County, Florida, a built environment unlikely to promote transit use (i.e., low-density suburbia), shows that a multi-destination network that connects scattered employment centers can succeed (Thompson *et al*, 2012). Broward County Transit stood out among its peers, with high per-capita ridership and cost effectiveness. This paper also illustrates how place-specific these metrics are: Broward County Transit operates a bus system in an area with a high number of transit-dependent people. This study indicates that directness of transit lines could be decisive in the job search of people who rely heavily on public transport, pointing towards the importance of a network cognizant of the needs of its patronage base.

These studies show how travel patterns are constantly evolving and, therefore, people's travel behavior is difficult to pin down. Accounting for this is key to incentivize travelers to switch some car trips for transit trips (Manville *et al*, 2018).

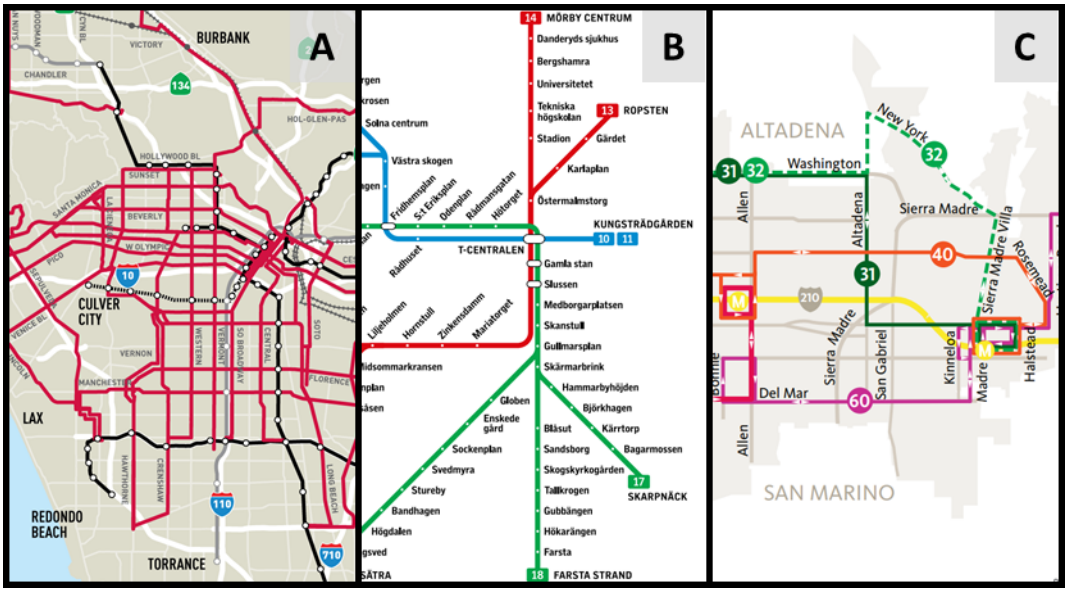

Figure 6. Examples of a transit network's array types: (A) rectangular grid, (B) hub-and-spoke centered on a downtown, and (C) local bus system with multiple destinations.[17]

[17] *Sources:* (A) Los Angeles Metro's bus rapid system (Hoffman, 2008); (B) Stockholm's subway system (Storstockholms Lokaltrafik, 2019); (C) Pasadena Transit's bus system (City of Pasadena, 2018).

3.1.4. Know your context

The transit industry is characterized by asymmetries, particularly in Southern California. Most transit trips are made by a small group of people; these people travel in small geographic areas, and they also ride on a limited set of transit routes (Manville *et al*, 2018). An apparently insignificant change on any of these specific demographic groups, neighborhoods, or transit routes could disrupt overall transit patronage.

Manville *et al* (2018) conclude that, in Southern California, increased vehicle ownership might have triggered the recent decline of transit patronage. However, different factors could be at play in different contexts, and travelers might move away from transit for a variety of reasons. Thus the interest in looking closer into Pasadena's case, especially given its divergence from the region's ridership trends.

The studies analyzed here consider a wide array of factors influencing transit ridership. However, they also reveal that transit patronage is highly context-specific and the explicit factors that might be stimulating ridership changes on one system could be different from those on another network. These differences depend on the type of system (see Figure 6), as well as on regional and local conditions. For example, for Boston in the late 20th century, the main factors behind ridership decline were downtown employment and per capita income (Transit Cooperative Research Program, 2007, p. 13), whereas for Washington, DC, in recent months, the principal reasons driving the decline have been reliability and aging facilities (Iseki *et al*, 2018). A few years ago, the main weaknesses of Houston's system included its limited span and frequency of service, as well as network legibility[18] and inconvenient transfers (Pritchard, 2015).

Lately, for Southern California as a region, the decline is attributed to increased vehicle ownership (Manville *et al*, 2018). Also, as noted above, the transit industry is much asymmetric. Thus, while by-far-the-largest Southern California transit operator (i.e., L.A. Metro) has been losing riders to private vehicles, when zooming into Pasadena and looking at what the situation is there, this study might find different results. "The situation" means elements such as: the changes in use of the local L.A. Metro stops and stations, the changes in demographics and local economic indicators, etc.

The present study contributes to this body of research by explaining the main factors at play in the context of the City of Pasadena, a part of the Southern California region but with a local bus system that serves particular markets with different needs.

3.2. Human components of transit

It is very important to have a user-friendly, people-oriented approach when conceiving a public service meant to help individuals achieve their full potential and move freely across the spaces they inhabit. However, many compromises need to be made.

[18] Legibility refers to how easy it is to understand system maps and navigate the network.

3.2.1. Of compromises and trade-offs

Public transit expert Jarrett Walker refers to these dilemmas as the "plumber questions," which are hard decisions that transit agencies must make in a limited-resources environment; there is always a trade-off. For example, should transit agencies focus their resources on very dense, high-demand corridors or should they treat equally all corners of their service area? The latter forces agencies to split resources among many places. The system needs to meet demand, but it also must be easy to understand and use so that patrons can easily digest the information and understand how to ride (also known as legibility). This allows for a smooth, amenable experience that makes riders feel comfortable and welcomed. One final example is the case of connectivity versus one-seat rides. Connectivity refers to having convenient transfer nodes in the network, which is the appeal of rectangular grid systems (see Figure 6). People like to get directly to their destination; transfers are considered tedious and burdensome (Iseki *et al*, 2012). However, a direct-trips network dilutes resources whereas a network with major transfer stations allows for a more efficient allocation of service and reduced travel times (Walker, 2012).

3.2.2. Transit's appeal

Some research points to how the image of public transit influences its appeal (or lack thereof) to private-vehicle users. Redman and coauthors (2013) indicate that reliability and frequency are important for ridership and customer satisfaction, but do not suffice to attract car users onto public transit. They argue that car users need a "habit-interrupting" incentive to even consider public transit as a travel choice. For example, deep discounts or ride-for-free days would lure drivers into transit. Once they take the bait, basic standards of service do not suffice and agencies need to go "over and above" for car users to transition to transit more permanently (Redman *et al*, 2013, p. 119). That is, frequency would need to improve, or buses would need to become even cleaner and less bumpy. Ultimately, this article implies that financially-strapped transit agencies need to pair substantial subsidies (the habit-interrupting program) with more investment (superior service); quite the opposite of a financially-sustainable operation.

However, this article is questionable, because it calls for making public transit "at least equally appealing as travel by car" (Redman *et al*, 2013, p. 125). This would imply making transit something it is not: non-fixed routes, non-fixed schedules, demand-responsive, door-to-door. Also, this article disregards the fact that driving is artificially cheap (Manville *et al*, 2018). On the plus side, Redman and coauthors speak to how car users *feel* about public transit, which brings to mind a Margaret Thatcher quote cited by Jarrett Walker: "A man who, beyond the age of 26, finds himself on a bus can count himself as a failure" (Walker, 2012, p. 42). People see public transit as something inferior, used only by the poor and by those who have not achieved the so-called American dream. This information suggests that aggressive marketing campaigns are necessary to positively influence people's perceptions of public transportation. These campaigns could introduce a common understanding of transit as a worthwhile travel choice.

3.3. Lessons learned

Other places' experiences help illustrate the dos and don'ts of public transit and how to provide a service that represents a viable alternative for some trips on each person's daily routine. This report draws from the experiences in Houston, Texas, and Seattle, Washington.

3.3.1. Houston, TX

Houston Metro's case illustrates very well the don'ts of good transit and how the community can be engaged to transform a poorly performing system into a transportation network convenient for all its riders. System legibility and up-to-date origin-destination matrices represent key lessons learned from their fruitful experience.

In Houston, the compromises or "plumber questions" were strongly considered throughout the system redesign process. For example, Houston stakeholders decided that ridership's importance[19] was four times that of coverage (Pritchard, 2015), meaning the redesign would strive to focus 80 percent on serving high-demand areas, and just 20 percent on providing service region-wide. With these goals in mind, Houston established a frequent network, increased the span of service (more all-day service), and matched the system to the urban form (which had changed significantly in recent years) (Pritchard, 2015). The system map (among other materials created to communicate to patrons how the service works) distinguishes frequent from not-so-frequent routes. These materials accompanied the implementation of a frequent network, in the spirit of making the system more legible and useful. Houston Metro experienced a three-percent increase in ridership in the first year since the redesign went live, which appears bland but is indeed a win among losses all across the country (Brazeal, 2016).

3.3.2. Seattle, WA

Similarly, Seattle has seen ridership increases in recent years (Fink, 2018a). King County Metro, the regional transit authority, has invested millions in transit, focusing on high-frequency bus service, seven days a week, as well as extended span of service in *certain* areas and improved weekend frequency on *main* routes (Rojc, 2015). Not only has Seattle invested heavily in bus service, but it has also been updating service according to demand and system performance (Brasuell, 2016).

3.3.3. What was learned?

This report draws four main takeaways from these two success stories. First, **frequency!** As Jarrett Walker says: frequency is freedom. Increased frequency allows riders to go on unplanned trips, which do not require checking a schedule but rather just showing up at the stop and expect to be picked up "soon." Riders in Seattle expressed their content with these new sizeable improvements in service (Rojc, 2015). Second, **expanded span of service**. Both

[19] In this literature, ridership versus coverage is the dilemma of allocating resources to serve more heavily those **areas where *more demand* is present**, or to serve ***all areas* equally**.

Houston and Seattle extended service hours into the night, facilitating non nine-to-five work shifts, late-night entertainment, and other after-hours (or before-hours) trips. Third, **demand trumps coverage**. Yes, all neighborhoods deserve to get some transit service, but neighborhoods who need it and use it the most merit more of it, not just in the spirit of fairness but also of efficiency. Last but not least, **active customer engagement**: asking customers what they want. Houston and Seattle asked this question of their customer base, and the customers replied back with insightful feedback and requests.

Overall, these success stories demonstrate that, even in auto-oriented America, transit can thrive.

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4. Methodology

The present study aims to explain the sources of recent shifts in ridership in Pasadena. For this, a longitudinal quantitative analysis was conducted, examining factors both within and outside the control of Pasadena's transit agency ("the Client"). The following sections outline how this report has attempted to answer the research questions laid out in Section 1 (***Introduction***), as well as the data collection methods that were undertaken.

4.1. Plan of analysis

The first step involved choosing the comparison years, since understanding trends in ridership requires a longitudinal study. Consulting with the Client and faculty advisor eased the selection of a time period relevant to the question and for which appropriate data were available. Generally, 2009 to 2018 stood out as a good time frame. Census data, for example, spans 2009 to 2017 with its 5-year estimates collected through the American Community Survey, whereas patronage data for different transit agencies was generally available between fiscal years 2009 and 2018. Some sources went as far back as 2005 but, given that the more significant fluctuations in Pasadena Transit happened within the past couple of years, this study deemed more pertinent focusing on the past 5 to 10 years. In some sections, this report makes special emphasis on the period between 2013 and 2018 because, during that period, Pasadena Transit experienced continued growth before peaking in 2017.

Then, this study contrasted ridership trends with possible causal factors, such as variations in other transit agencies' patronage, vehicle ownership rates, means of travel to work, demographic characteristics (income, race, age, socio-economic status), homelessness, and housing-market features (rents and rent burden — or rent as a percent of income). Responses to recently-conducted rider surveys allowed to contextualize the meaning of Pasadena's demographic composition and other population characteristics. Also, this report evaluated ridership patterns in light of the agency's performance, mainly looking at service supply (hours and miles of service provided).

4.2. Data sources and collection procedures

The first step was to analyze changes in ridership (measured as unlinked passenger-trips, also known as boardings) in the local bus system and other transit networks serving the City of Pasadena (particularly L.A. Metro and Foothill Transit). These variations in ridership were then compared with demographic and housing-market changes in the city, as well as some economic indicators.

4.2.1. Pasadena Transit

The Client provided Pasadena Transit's ridership data by route and fare category, as well as rider surveys and service supply data (revenue hours, revenue miles, headways, etc.). Some caveats to the ridership information include (1) bus operators juggle many tasks while

driving, including counting riders, and (2) the automated passenger counters that provide data by bus stop and by time of day lack accuracy. Noteworthy, driver counts account for over 60 percent of riders, who pay cash; the rest pay through the regional transit card program (TAP), and those counts are digitized, thus improving data precision.

4.2.2. Peer transit agencies

L.A. Metro staff provided, through a public records request, stop-level ridership data for the Metro Gold Line (light rail) and Metro Bus lines serving Pasadena (Request #19-232). On a side note, the Freedom of Information Act request was the most expedited way of getting access to these data; a key factor to consider given the limited time frame available for this study. These data were, generally, from fiscal year 2004 to 2018. Also, their open-source, online data portal provided this analysis with Metro's system-wide patronage for the years between 2009 and 2018. Metro Bus stop-level data became available as daily averages for one month of each year, rather than year totals that account for month-to-month variations. Another drawback included station-level data for Metro Rail being aggregated by fiscal year totals, which impeded converting it to calendar year. Due to the latter, this report displays transit agencies' data by fiscal year, whereas Census data are presented by calendar year. Also, a transit planner at Foothill Transit kindly provided stop-level data. This agency serves most of the San Gabriel Valley and has one bus line connecting Pasadena with communities to the east.

Additionally, L.A. Metro data on Gold Line service disruptions (e.g., maintenance schedules) were requested. However, the staffer who kindly attended to this request stated they do not systematically record such information.

4.2.3. Census data

The U.S. Census Bureau website provides multiple data describing Pasadena's population. The American Community Survey contains data as varied as total population, income, race, vehicle ownership, poverty rates, and many more.

The population indicators downloaded from the Census database include: college enrollment (B14004), worker characteristics by mode of travel to work (S0802), journey-to-work mode shares (S0801), Gini index of income inequality (B19083), household vehicle ownership (B08201), median gross rent (B25064), median household income and percent of population by income bracket (S1901), median rent as percent of income (B25071), rent burden by household income (B25074), national origin (S0502), number of housing units (B25001), number of occupied units and percent renter-occupied (S2503), number of vehicles available (B25046), population by age groups (S0101), population with a disability (B18101), poverty rate (S1701), total population and racial/ethnic composition (B03002), and unemployment rate (S2301). The code in parentheses allows the reader to more easily locate these data on the Census database.

4.2.4. Other data

This study attempted to obtain information on land use patterns (e.g., development densities and existing off-street parking stock) from Pasadena's Department of Planning & Community Development, but unfortunately these data are not recorded systematically.

On the other hand, the Parking Division provided many data on city-owned parking (curb parking and public garages). This represents a minor share of the city's entire parking stock, but certainly appeared interesting to study. The last significant changes in supply or pricing of public parking happened in 2008, which goes much beyond the time frame of interest and probably did not affect the more recent shifts in ridership. For future research, it would still be interesting to look into ridership fluctuations on bus stops located near metered parking districts to understand how their performance might vary from those located near free parking.

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5. Analysis and findings

To study more closely the phenomena that might have affected Pasadena Transit's ridership, this analysis starts by contrasting demand on Pasadena's local bus system with that of peer transit agencies. Then, this section analyzes trends in service provision, measured as hours and miles of service. To put ridership changes in context, population growth in the city is examined. In terms of travel behavior, this analysis explores access to motor vehicles and mode of travel to work. For a better picture of how demographics have changed, this report studies racial and ethnic composition, age breakdown, and transit-dependent groups (people with disabilities, college students, etc.). Additionally, this section examines homelessness in Pasadena.

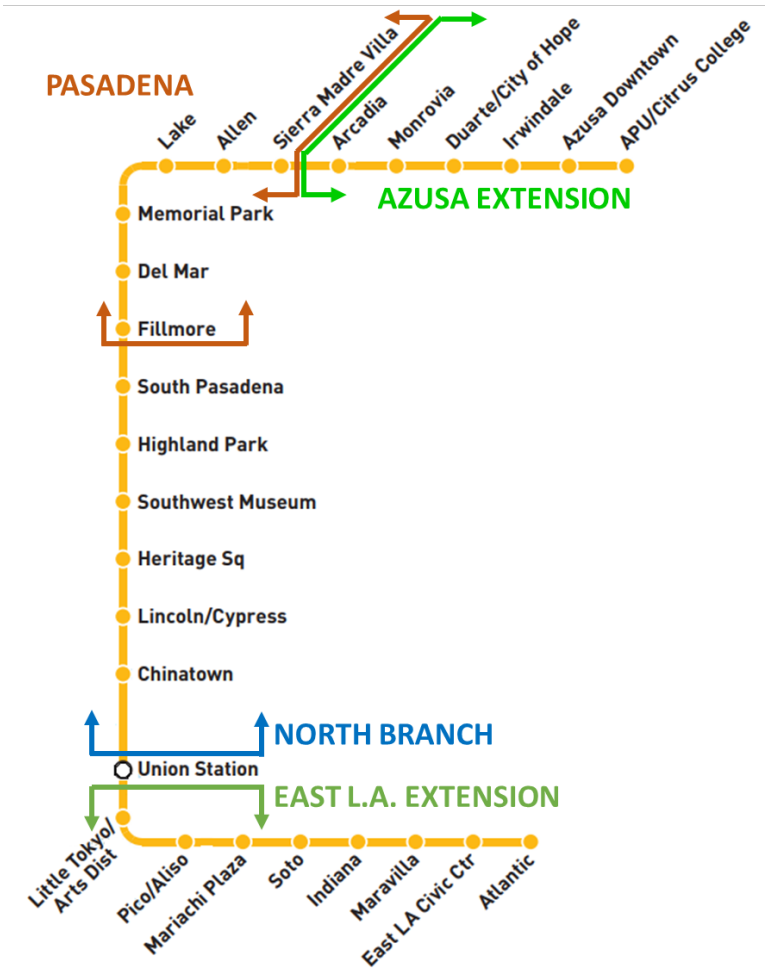

Figure 7. Metro Gold Line and its stations.
Source: Base map retrieved from metro.net (L.A. Metro's website).

Lastly, this section analyzes some economic indicators such as household income and housing market conditions, including changes in rent and rent burden (how much of their income households use to pay rent).

5.1. Ridership trends

Firstly, this section references the Metro Gold Line many times. Thus, in order to have a cue to visualize the terms used, please refer to Figure 7.

This section analyzes ridership in recent years. The synergies between Pasadena Transit and its peer agencies, particularly L.A. Metro, become apparent but do not appear to have significantly impacted local bus ridership, since mixed effects took place. In 2016, new rail stations demoted Pasadena from its position as a major rail transit hub, but brought more riders that now transfer into Pasadena's feeder lines.

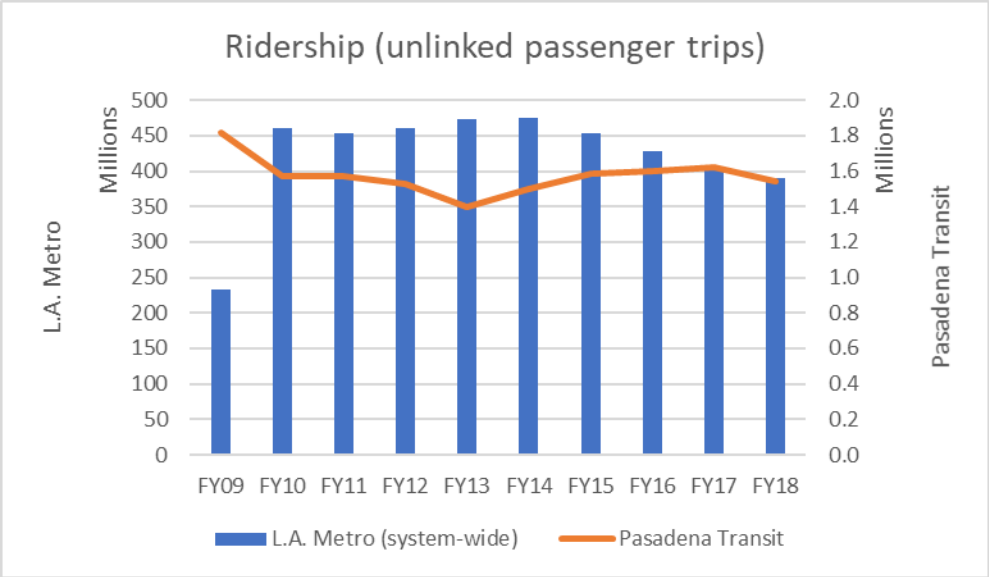

Figure 8. System-wide ridership trend for Pasadena Transit and Los Angeles Metro. Note each data series is on its own scale, due to the difference in magnitude.
Data source: Pasadena Transit and L.A. Metro online ridership statistics.

5.1.1. Overview

In the late 2000s, Pasadena Transit's ridership experienced a significant decrease due to severe reliability issues, as well as a fare increase and service cuts caused by the Great Recession (City of Pasadena Transit Division, 2018, p. 12). However, after a fleet overhaul and other service enhancements, patronage started recovering and consistently grew between 2013 and 2017. It was not until 2018 that ridership started heading downward (see Figure 8).

Pasadena Transit works as a local system (recall Figure 4) and, at the same time, feeds into the Metro Gold Line, which has a total of six stations within Pasadena's city limits and is

operated by L.A. Metro. Thus, analyzing L.A. Metro's ridership is key to understanding the fluctuations in the local bus system's patronage.

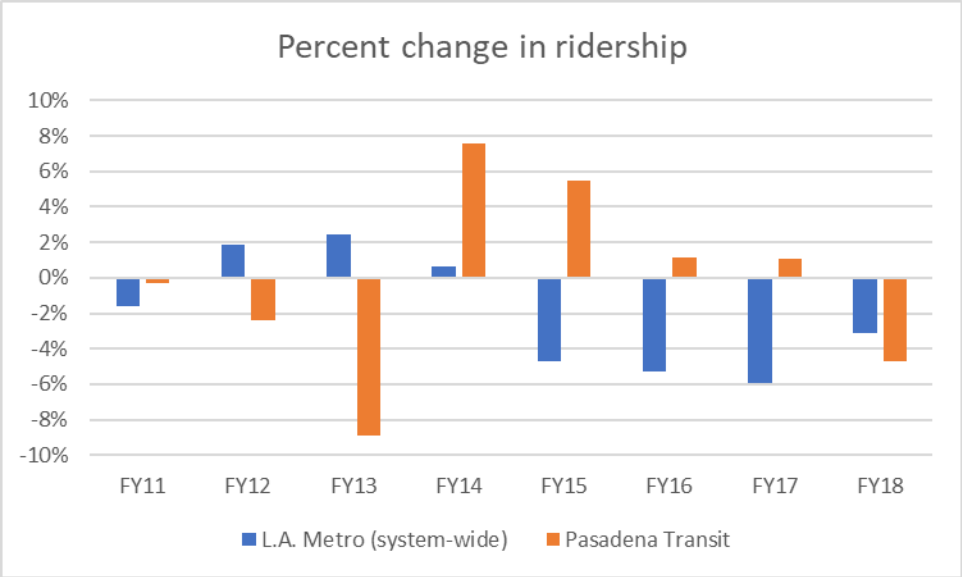

Figure 9. Year-to-year percent change in ridership for L.A. Metro and Pasadena Transit.
Data source: Pasadena Transit and L.A. Metro's online ridership statistics.

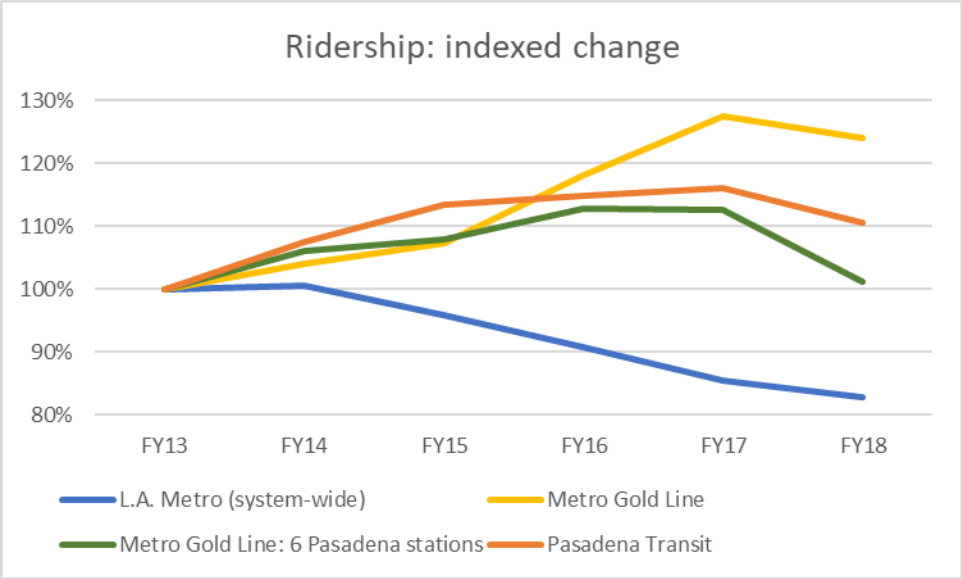

Figure 10. Unlinked passenger-trips indexed to fiscal year 2013.
Data source: L.A. Metro and Pasadena Transit.

5.1.2. Metro Gold Line

L.A. Metro's overall ridership in the 2000s peaked in fiscal year 2014 and has constantly fallen since (see Figure 8). On the other hand, that same year Pasadena Transit's ridership rebounded and kept increasing for the following four years, albeit at a slower rate every year, but still growing (see Figure 9). Fiscal year 2018 was when Pasadena Transit first experienced a decline, even bigger than that for L.A. Metro, in relative terms (see Figure 9).

The Gold Line was one of the components of the L.A. Metro system that kept adding riders even after 2014, partly helped by the opening of the Azusa extension in July 2015. Further analysis suggests that said extension had mixed effects on the city's transit ridership. First, this examination allows to surmise that people from the eastern San Gabriel Valley (SGV) who would previously make their way to Pasadena to board the Gold Line in order to ride it to Downtown Los Angeles, are now boarding the Gold Line at one of the new stations farther to the east. Thus, these riders do not set foot in Pasadena anymore and, instead, ride through it on the train. Ridership for the Gold Line as a whole increased with the Azusa extension, but it gradually plateaued for the Pasadena stations (Fillmore through Sierra Madre Villa) as well as for Pasadena Transit (see Figure 10).

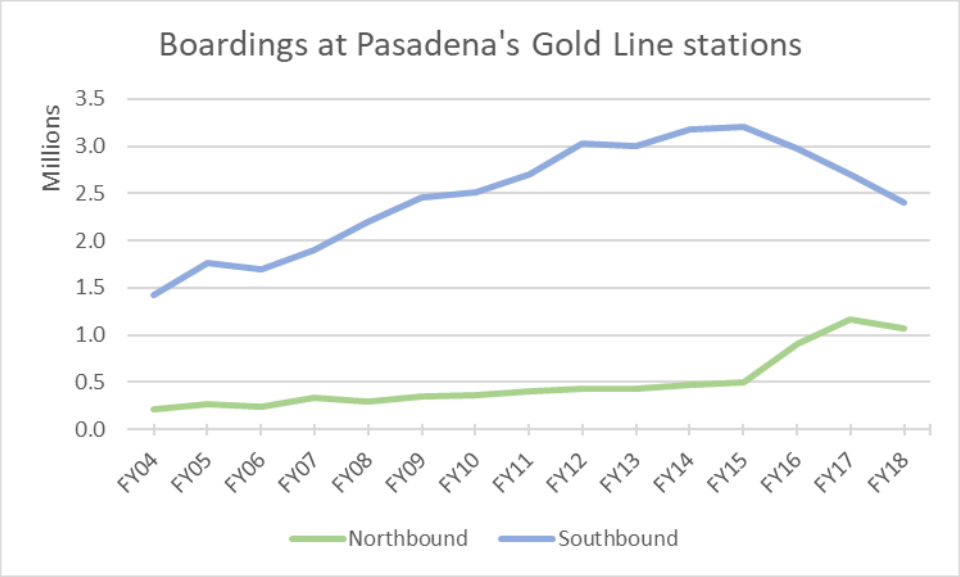

Figure 11. Gold Line ridership within Pasadena, by direction.
Data source: L.A. Metro.

However, Pasadena Transit's feeder lines experienced increased ridership right after the opening of the Azusa extension (for a detailed by-route analysis, see Section 5.2.2. ***Routes***). This suggests that travelers from the eastern SGV who used to get to work (in Pasadena) by some other means are now taking the Gold Line and transferring to Pasadena Transit. For example, a news article describes city employees who use the Gold Line and then transfer

to Route 50 to reach the Public Works Yards in Northwest Pasadena (Colorado Boulevard .net, 2016).

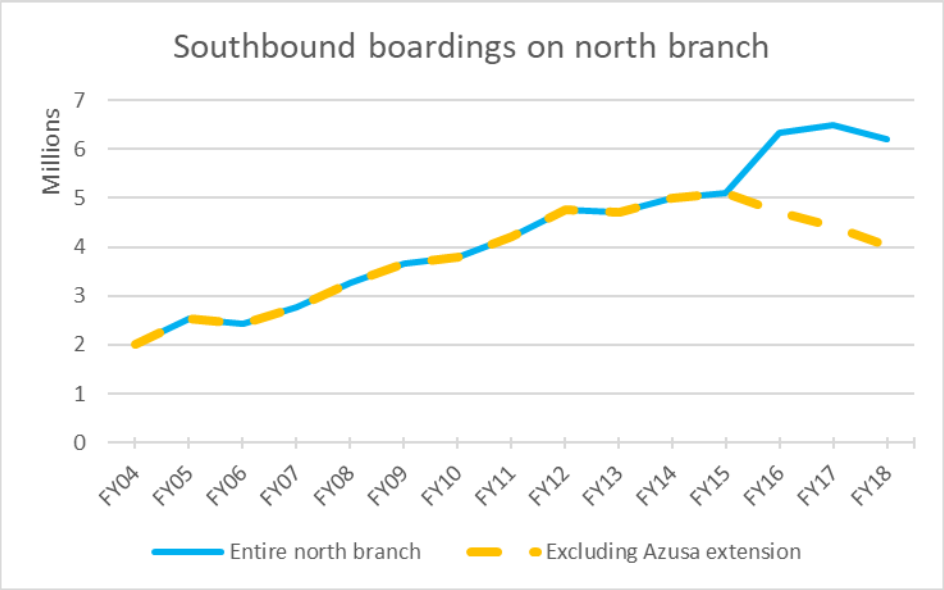

Figure 12. Travel to Downtown Los Angeles on the Metro Gold Line's north branch. ***Data source: L.A. Metro.***

Looking at patronage on the Gold Line by direction further illustrates its effects on transit use in Pasadena. This evidence suggests that travel from Pasadena to Downtown L.A. was declining since the Azusa extension opened (see Figure 11). This indicates not only that many of Pasadena's former southbound travelers were from the eastern SGV, but also that Pasadena residents are not using the Gold Line to travel to Downtown L.A. as much as they used to. Indeed, all the added trips to Downtown L.A. come from the Azusa extension (see Figure 12).

Northbound boardings along the Gold Line stations in Pasadena also tell a story. Local ridership levels towards East Pasadena (the former northern terminus of the Gold Line; see Figure 7) grew steadily from the line's opening in 2003 until 2015 when the Azusa extension was inaugurated (see Figure 11). This indicates that many people in Pasadena used the Gold Line to travel *locally*. The higher frequencies and more direct service between core employment centers along the Gold Line might have enabled this trend, despite Metro's fare ($1.75) being more than double that for Pasadena Transit (75 cents). More direct service means not only faster travel due to the exclusive right-of-way, but also physically more direct service, given that the Pasadena Transit network is conceived as a local service and as a feeder service to the Gold Line, making any express bus line mirroring the Gold Line redundant. For example, getting from Central Park to Hastings Ranch (see Figure 3) on Pasadena Transit would entail at least one transfer and likely much more time than just taking the rail line from Del Mar station to Sierra Madre Villa station.

After 2015, northbound boardings on the city's Gold Line stations grew abruptly, suggesting that people from Pasadena work in the eastern SGV (or vice versa) and the opening of the extension eased travel between these two areas. However, this trend appears to not strongly influence Pasadena Transit's patronage base, at least not on its own.

The scatterplots in Appendix A further corroborate the information above, showing that the more that riders used the Gold Line stations in the city, the less they used Pasadena Transit (see Figure A-5). Such a strong correlation (Gold Line as a substitute to Pasadena Transit) remains true, if weaker, even after the Azusa extension opened (see Figure A-6).

However, as evidenced in Figure 10, the abrupt increase in northbound Gold Line boardings did not compensate for the loss in southbound trips that the new San Gabriel Valley stations took away from those in Pasadena. Gold Line ridership within Pasadena plateaued and this ultimately might have contributed to the flattening of upward patronage trends in Pasadena Transit.

The Gold Line replacing Pasadena Transit trips is not necessarily problematic; if riders prefer the Gold Line option, and they have a choice among two competing services, they are better off (and likely more satisfied) overall, which is a good thing. However, no matter how much the Gold Line apparently influences Pasadena Transit's patronage, it appears that other regional and local phenomena affect ridership on both systems. The ridership decline on Pasadena Transit in fiscal year 2018, the first one in five years, was accompanied by a fall in ridership across the board: even the Gold Line as a whole, with its brand new Azusa extension, experienced drops in ridership for the first time since 2013 (see Figure 10).

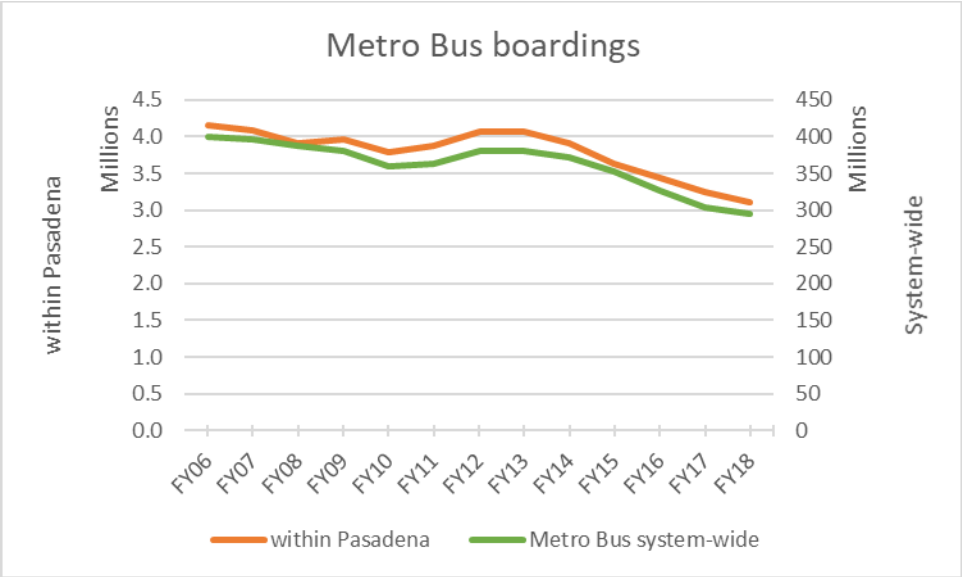

Figure 13. Metro Bus ridership across the county and within Pasadena. Note each line is on its own scale, due to the difference in magnitude.
Data source: L.A. Metro.

5.1.3. Metro Bus

The Metro Bus network complements, but generally does not duplicate, that of Pasadena Transit. Also, Metro Bus goes beyond Pasadena city limits, serving geographies as varied as Altadena, El Monte Station, East Los Angeles, the San Fernando Valley, and as far as the Artesia Blue Line station in Compton (for a reference map, see Figure 1).

Metro Bus' ridership has fallen since 2014, which deems unlikely that Metro Bus took Pasadena Transit down with it, since Pasadena's drop occurred 3 to 4 years after that. At the very least, Metro Bus' ridership decline was not the main factor behind Pasadena Transit's.

Unlike the Gold Line, Metro Bus ridership fell along with L.A. Metro's system-wide patronage (rail and bus), starting in fiscal year 2013 (recall Figure 8). As evidenced by Figure 13, falling ridership in Metro Bus is not a phenomenon exclusive to the stops within Pasadena, but rather pervasive throughout this regional bus service. Furthermore, Metro Bus patronage decreased equally on both weekdays and weekends (see Figure A-7).

However, a scatterplot of Pasadena Transit's total yearly ridership versus Metro Bus' total yearly ridership *within Pasadena* (from FY07 to FY18) revealed no correlation whatsoever (R^2 of 0.001).

This speaks to the fact that the two networks do not overlap as much; they complement one another by covering more heavily corridors the other one does not cover (see Figure 14 on the next page).[20] For more details on the correlation analysis, see Figure A-8.

[20] Please note that in Figure 13 colors identify each transit agency (per the legend) and line thickness identifies the number of lines from the corresponding agency serving that corridor.

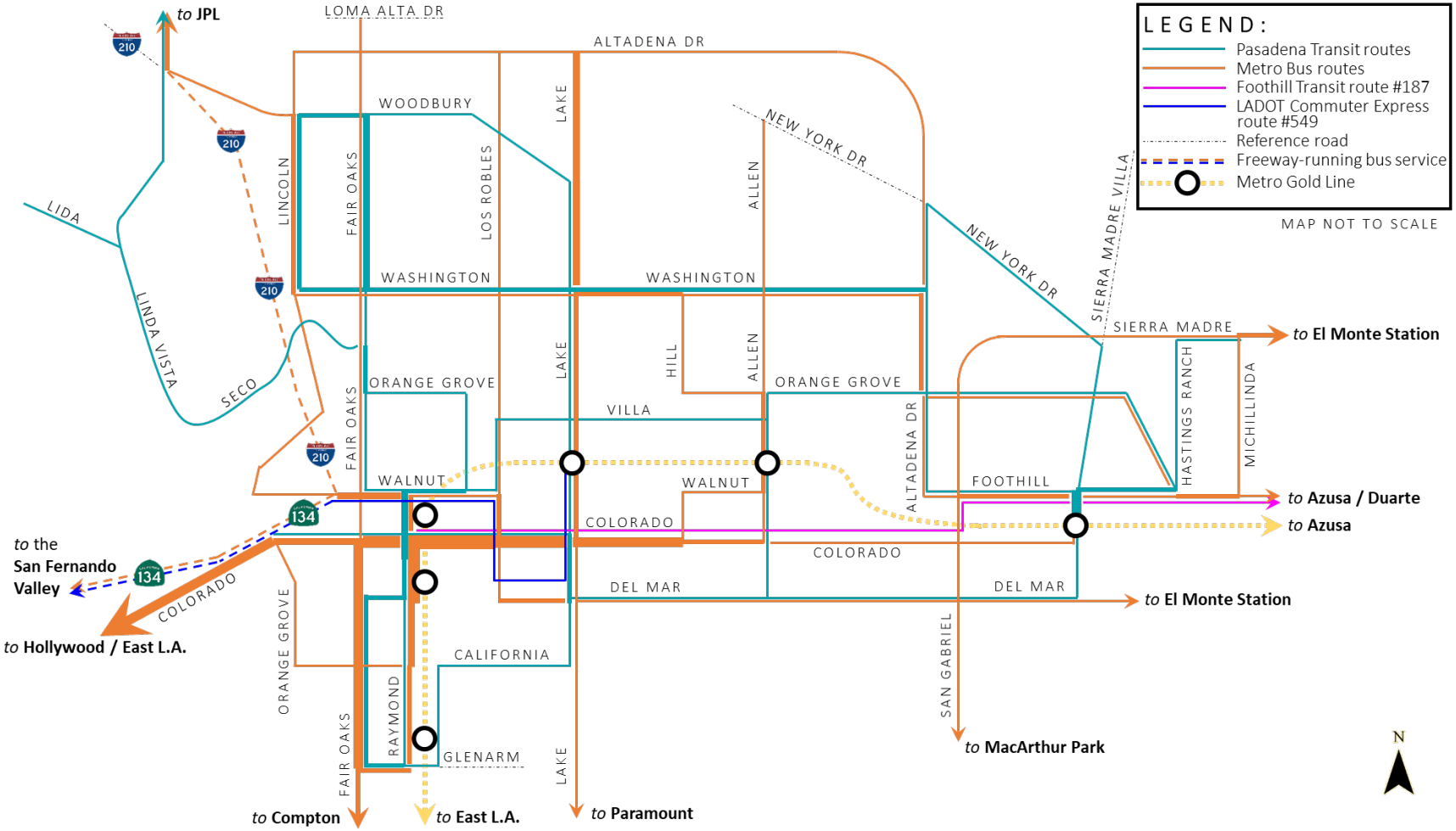

Figure 14. Schematic map of bus routes serving Pasadena.
See footnote on next page for more details.

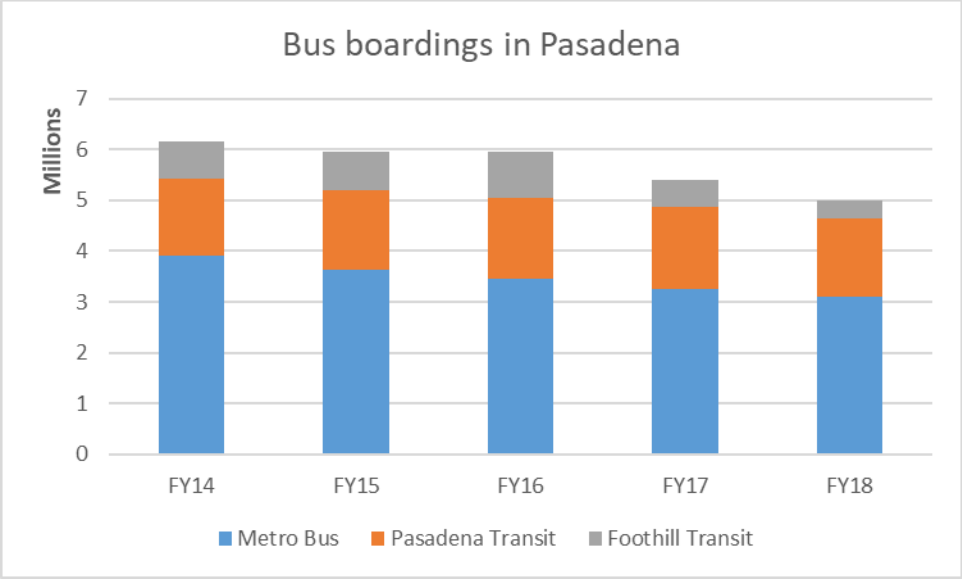

Figure 15. Local bus ridership: bus boardings taking place on stops within Pasadena.[21]
Data sources: Pasadena Transit, L.A. Metro, and Foothill Transit.

5.1.4. Foothill Transit

Foothill Transit also complements Pasadena Transit service along Colorado Boulevard (see Figure 13), one of the city's main transit corridors, with its route 187, the only one serving Pasadena. This route, as well as the extinguished commuter route that Foothill Transit used to run into Pasadena, have seen their ridership fall after the opening of the Azusa extension of the Metro Gold Line. This is because that former commuter route and the existing route 187 mirror the Gold Line extension. It appears that Foothill Transit's ridership retreated due to the Azusa extension, and perhaps other factors, but this did not drag Pasadena Transit with it, since Foothill's decline, just as that of Metro Bus, began years before Pasadena's.

Foothill Transit implemented several service changes to adapt to the new rail extension, rolling back some of the service hours allocated to route 187: re-routing, updating schedules, and splitting the route into west and east parts (Pasadena is served by the west part, which kept the same number: 187). This information explains why the drop in Foothill Transit's ridership within Pasadena appears so dramatic. This, along with riders captured by the Gold Line and probably other external factors, likely contributed to Foothill's market share in Pasadena shrinking considerably. Figure 15 shows how the amount of bus ridership in Pasadena served by Metro Bus and Foothill has contracted over the past five years, whereas it has remained rather constant for Pasadena Transit.

[21] These data do not include the one LADOT Commuter Express route that serves the city; however, per a conversation with the Client, this route's ridership in Pasadena is negligible compared to that of the other three agencies.

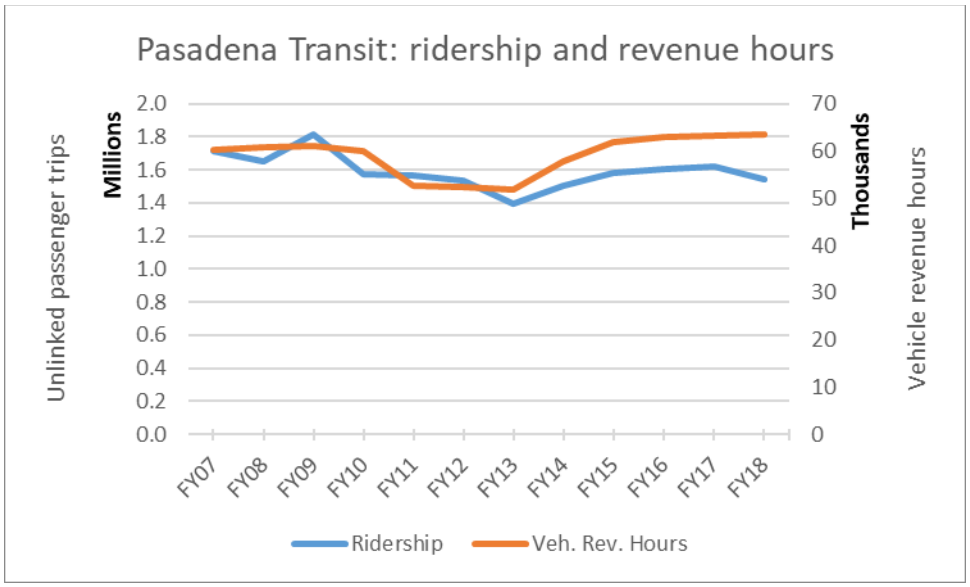

Figure 16. Hours of service provided for the Pasadena Transit network.
Note there are two different scales. Data source: Pasadena Transit.

5.2. Pasadena Transit service characteristics

Until the recent drop, Pasadena Transit had stable, positive performance metrics. Also, its different routes and their ridership varied in several ways, with ups and downs but the ups concentrated mainly in low-ridership routes and downs on high-demand ones.

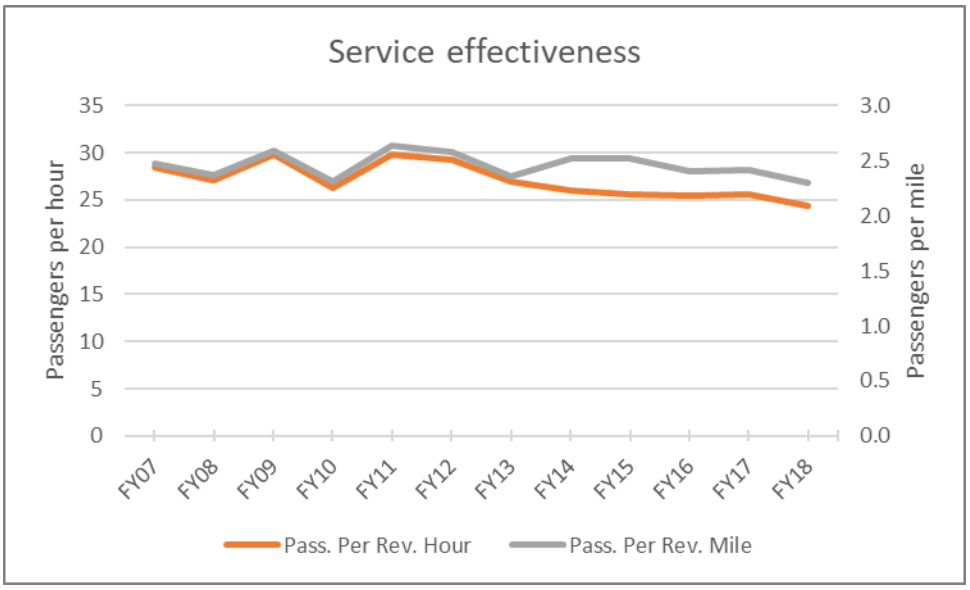

Figure 17. Service effectiveness for Pasadena Transit.
Note there are two different scales. Data source: Pasadena Transit.

5.2.1. Service performance

Figure 16 displays the trend in service hours and patronage over the past few years and shows that, through 2017, increases in service were generally followed by increases in ridership. This general trend of cause and effect, however, ended in fiscal year 2018, when a 0.1 percent increase in service was associated with a 4.7 percent decrease in ridership.

Table 3. Change in Pasadena Transit's ridership, by route, since the Azusa extension opened on the first day of FY16.

	Ridership (thousands)				Change from previous year			Percent change		
	FY15	FY16	FY17	FY18	FY16	FY17	FY18	FY16	FY17	FY18
	A	B	C	D	E = B - A	F = C - B	G = D - C	H = E / A	J = F / B	K = G / C
Route 10	147.4	167.0	175.4	171.5	19.6	8.4	(3.9)	13.3%	5.1%	-2.2%
Route 20	854.0	833.9	852.7	794.0	(20.0)	18.8	(58.7)	-2.3%	2.3%	-6.9%
Route 30	285.2	306.3	301.9	293.8	21.0	(4.4)	(8.1)	7.4%	-1.4%	-2.7%
Route 40	221.3	213.9	202.6	189.9	(7.4)	(11.2)	(12.8)	-3.3%	-5.3%	-6.3%
Route 50	58.5	63.3	66.3	66.2	4.8	3.0	(0.1)	8.3%	4.8%	-0.2%
Route 60	16.9	17.0	19.8	19.9	0.1	2.8	0.1	0.5%	16.4%	0.4%
Route 88	N/A	N/A	N/A	7.5	N/A	N/A	7.5	N/A	N/A	N/A
TOTAL	**1,583.2**	**1,601.4**	**1,618.9**	**1,542.9**	18.2	17.5	(76.0)	1.1%	1.1%	-4.7%

Increases are in green font, decreases in red, and relatively flat trends in dark yellow. Data source: Pasadena Transit.

Turning to service and patronage trends by day of week over the past year, the main increase in service took place on weekends whereas the major decline in ridership occurred on weekdays, which partly explains why added service did not lift ridership this time around. Weekday service contracted a mere 0.9 percent, while weekday ridership shrank 5.4 percent. This contrasted with an increase in service on the weekends, due to the addition of a pilot project: Route 88, which took riders through a major corridor to a trailhead north of the city. The increase in Saturday service was 6.5 percent, and was accompanied by a 1.4 percent increase in Saturday ridership. Given that Saturday service grew considerably more than ridership, performance — in terms of passengers per hour and mile — declined.[22] For graphics detailing these trends by day of week, see Appendix B.

Service effectiveness (passenger-trips both per revenue hour and per revenue mile) fell across the board from FY17 to FY18: weekdays (-4.5%), Saturdays (-4.8%), and overall (-4.8%); see Figure 17 for *overall* numbers. In the years prior to the last, service effectiveness

[22] The Great Recession forced Pasadena Transit to discontinue Sunday service, but it made a comeback in 2018, first in April with Route 88, which offered service on Saturdays and Sundays only, and officially with all regular routes on July 1st. However, since this analysis only goes up to fiscal year 2018 (ending June 30th, 2018), Sunday service is not studied in detail.

was generally flat overall and on weekdays, and was on the rise on Saturdays (see Figure 17 as well as Figures B-5 and B-9).

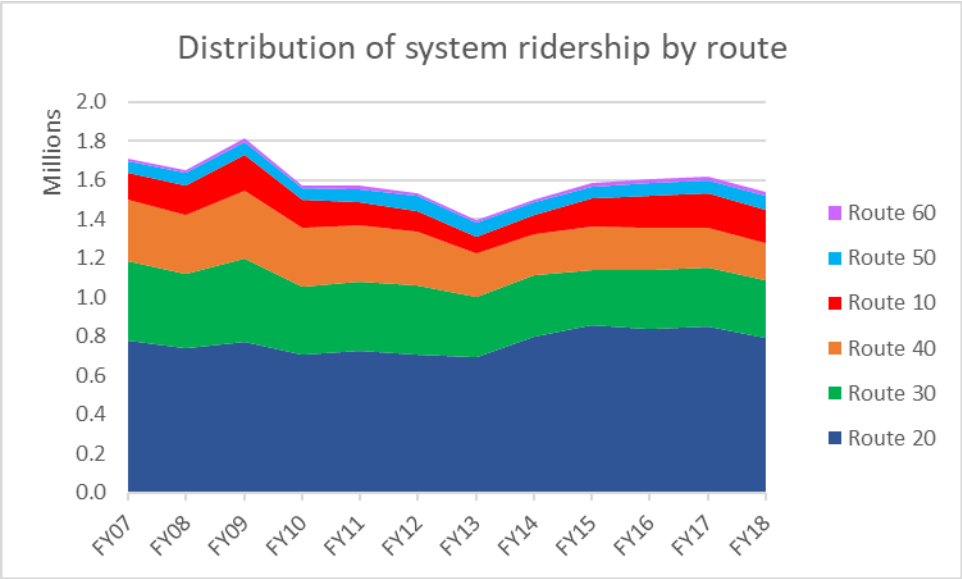

Figure 18. Pasadena Transit: system ridership broken down by route.[23]
For a zoom into the three routes with the least patronage, refer to Figure C-16. Data source: Pasadena Transit.

5.2.2. Routes

When dissecting the system by route, its asymmetries reveal several interesting facts. Since 2003, six routes have made up the core of the system (a seventh route was discontinued due to very low demand). Route 20 carries about half of the system's ridership, followed by Routes 30 and 40. Three feeder lines carry considerably fewer riders: Routes 10, 50, and 60 in declining order of patronage.

Interestingly, since the system ridership rebounded in FY13, Routes 10 and 60 (two of the less patronized routes) have been the only ones to steadily add riders every year (see Figure 18 or Table 3). Route 20, the patronage star of the system, rebounded along with the system in FY13, but just mildly, and plateaued in FY15, sustaining a flat or somewhat downward trend since then. Route 30 was relatively flat after FY13, with a faint downward trend. Route 40 has had the most troubling behavior: it continued to slowly but steadily lose riders every year since FY09. Route 50 kept losing riders — even after the FY13 system recovery — until FY15, when it rebounded and added riders along with Routes 10 and 60 (see Table 3). Refer to Figures C-2 through C-7 for a more comprehensive progression of ridership changes on each route.

[23] To understand change in a graph like this, think of it in terms of the "band width" growing or narrowing.

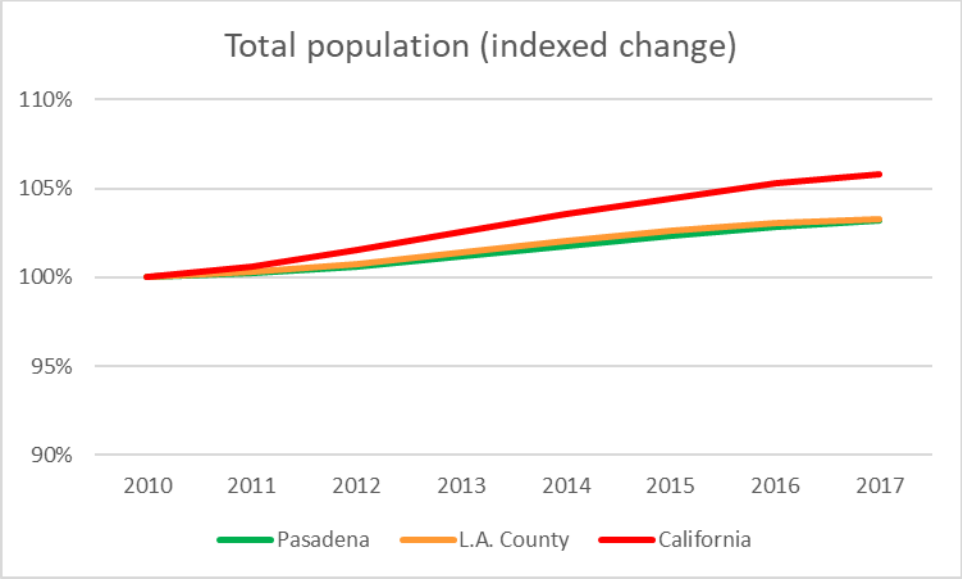

Figure 19. Population in state, county, and city.
Moving average indexed to 2010. Data source: U.S. Census Bureau.

When the drop in overall ridership happened from FY17 to FY18, Routes 50 and 60 were the only ones to remain flat (see Table 3 and, for more details, Appendix C). This fact, along with the launching of Route 88, were the only ridership gains (or non-losses) the system experienced. However, Routes 50 and 60, the most lightly patronized routes in the system, along with Route 88, a nascent pilot, saw their positive trends (see Column G of Table 3) outweighed by the losses in the four biggest routes this past year. The asymmetries present in the network create a situation where relatively modest changes in the most heavily patronized routes ripple through the entire system. See Figures C-8 through C-15 for more detailed graphs on the year-to-year change for each route and the system overall.

As Table 3 suggests, the opening of the Gold Line's Azusa extension in FY16 might have influenced the overall increase in ridership on the feeder lines (10, 50, and 60; see Figure 4) between FY13 and FY17, including the FY15 rebound of Route 50, which was losing riders since FY12. This confirms the analysis referenced earlier, done by a local news outlet (Colorado Boulevard .net, 2016). Columns E, F, and G of Table 3 attest to how the Azusa extension also provided a short-lived boost to ridership on Route 30, while it did not help Routes 20 and 40, which experienced a decline that year. Route 30 is a local route but also feeds into the Gold Line (see Figure 4), which might explain the boost, and Routes 20 and 40 are predominantly local routes, which puts them at odds with the Gold Line (recall the discussion in Section 5.1.2. ***Metro Gold Line***). However, the analysis in Section 5.1.2 points towards how Pasadena Transit (system-wide) competes with the Gold Line, and says nothing about specific effects of the rail line on each of Pasadena's local bus routes. Therefore, other factors might have caused the drop in Routes 20 and 40 between FY15 and FY16 (as well as the increases in the other four routes).

To sum up, a ridership increase only on less patronized routes, even if large in percentage terms, is not likely to have a significant positive effect on overall system ridership. Per Table 3 (Columns H, J, and K), in FY16 and FY17, this asymmetric relationship kept the system-wide gains low (+1.1%), whereas it cancelled out the gains in FY18 (-4.7%).

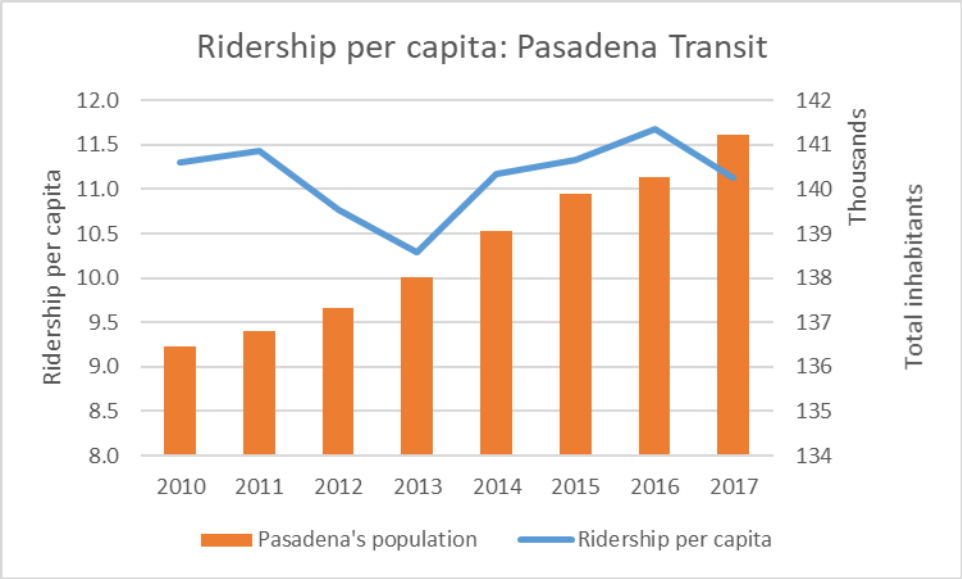

Figure 20. Ridership per capita[24] and Pasadena's population.
Note that the Y-axes do not start on zero; this is because the changes are so slight that it is hard to visualize otherwise. Data sources: Pasadena Transit and U.S. Census Bureau.

5.3. Population growth

Analyzing population growth helps put ridership changes into context. Since 2011, Pasadena has been steadily growing, at a pace similar to that of the county (see Figure 19).[25]

Ridership per capita is a ratio that allows for a better understanding of how ridership grows or decreases relative to population. For example, if ridership per capita stays constant, then ridership and customer base are growing (or falling) at the same speed. The customer base, in this context, refers to the population living in the service area. Figure 20 puts in evidence how local bus ridership grew faster than population (ridership per capita rose even amidst marked population growth) between 2013 and 2016, which makes the recent drop more concerning.

Further, Figure 20 shows a considerable drop in relative ridership, from 11.5 to 10 passenger-trips per capita, between 2010 and 2013. The numerator and the denominator go in opposite

[24] Ridership per capita is a measure of **passenger-trips per inhabitant** of the service area. The service area, in this case, is the City of Pasadena. Section 5.3 of this report better explains the dynamics behind this metric.
[25] Population data from 2009 did not appear to be reliable; thus, this figure displays data starting in 2010.

directions provoking a drop in the ratio: not only did ridership fall (Figure 5) but population constantly grew. From 2013 to 2016, population kept rising at a more accelerated pace and ridership per capita went up as well (back to 11.5). This indicates that absolute ridership rebounded (Figure 5) at a speed that allowed it to catch up with population and even surpass its growth rate (numerator and denominator both grow and numerator keeps the pace). The drop of ridership per capita in 2017 suggests transit use in Pasadena Transit was already faltering in that year, which somewhat coincides with the absolute decline observed between fiscal years 2017 and 2018 (see Figure 5).

5.4. Vehicle access

After looking at the relative growth in ridership for a clearer picture, the next logical step is to look into the variable identified as the main factor dragging ridership down in Southern California: vehicle ownership (Manville *et al*, 2018). Data suggest Pasadena's households are disposing of excess private vehicles and turning to car-sharing/pooling or other means of travel, which should encourage transit ridership but, since that is not the case, other factors may have played a stronger role.

5.4.1. Household vehicle ownership

Notably, the shares of households in Pasadena with one or more vehicles per person or with no vehicles at all are higher than those for the county and for California. This means that the share of so-called "vehicle-deficit" households is smaller in Pasadena[26] (for more details, see graphs on Appendix D).

Vehicle-deficit households are classified in two sub-categories. Households with half a car or less per person are those in which more than two persons share one car. Those with at least one car for every two people are considered households with more than 0.5 but less than one car per adult.

Access to vehicles relates to mobility opportunities. Households with more people than cars need to navigate the inconvenience of sharing cars, which puts constraints on the (spatial and temporal) span in which each person can use the car. People in zero-vehicle households need to find other means to travel, either carpooling with friends, borrowing a car, walking, biking, or using public transit. Indeed, people with no vehicle available are much more likely to ride transit. For example, according to the 2017 American Community Survey (U.S. Census Bureau), only four percent of households in Pasadena lack a vehicle but over 18 percent of Pasadena's transit commuters live in households with no car. Also, in a 2017 rider survey, 79 percent of Pasadena Transit users reported being car-less (City of Pasadena Transit Division,

[26] Vehicle-deficit households are defined as those with more driving adults than cars. However, Census data available for this indicator (see dataset #B08201 on their website) provides information on vehicles per *person* in the household, with no distinction between those who are driving-age and those who are not. The data used here present this limitation.

2018, p. 60). Households with one or more vehicles per person, usually referred to as "vehicle-surplus," are those with the highest access to a car.

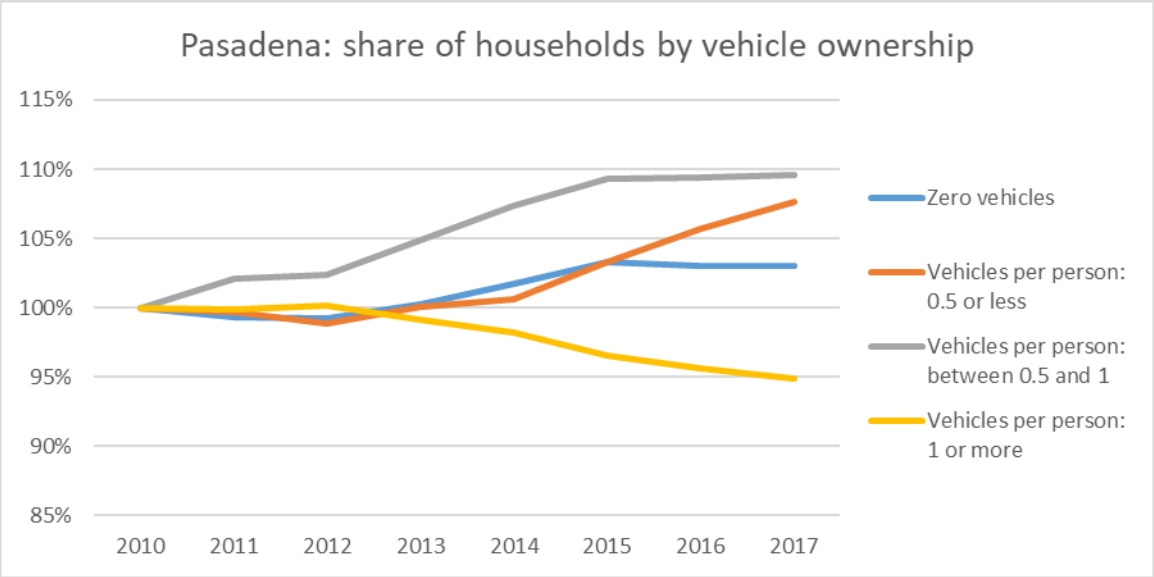

Figure 21. Change in time of the shares of Pasadena households by vehicle ownership. ***Moving average indexed to 2010. Data source: U.S. Census Bureau.***

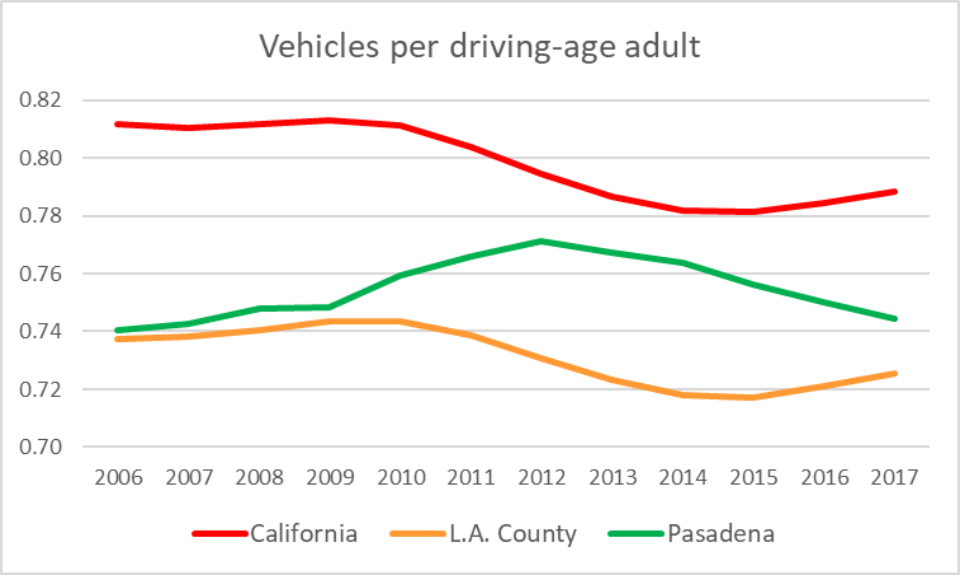

Figure 22. Vehicles per driving-age adult. ***Moving average. Note that the Y-axis does not start on zero; this is because the differences are so slight that it is hard to visualize otherwise. Data source: U.S. Census Bureau.***

A majority of Pasadena residents live in vehicle-surplus households. However, this has shifted in the past decade. Contrary to what Manville and coauthors (2018) find about

Southern California more generally, people from Pasadena have discarded cars. The share of vehicle-surplus households shrank five percent between 2010 and 2017. In contrast, vehicle-deficit and zero-vehicle households have grown between three and ten percent in the same period (see Figure 21). Reduced vehicle ownership would, in theory, foster transit use in Pasadena, since people need alternative means of travel. However, some other phenomena likely balanced out this positive effect.

5.4.2. Vehicles-to-adults ratio

A different dataset allowed to corroborate this finding about dwindling car ownership: the overall number of vehicles available per driving adult (people 16 years of age or older).

Table 4. Change in number of driving-age adults and number of vehicles available in state, county, and city for three different years.

	Total driving-age people (16+) (thousands)						Number of vehicles available (thousands)					
	2010	2014	2017	Pct. Chge. 10-14	Pct. Chge. 14-17	Pct. Chge. 10-17	2010	2014	2017	Pct. Chge. 10-14	Pct. Chge. 14-17	Pct. Chge. 10-17
Pasadena	113.5	115.7	118.0	1.9%	2.0%	**4.0%**	85.8	88.1	87.5	2.7%	-0.7%	**2.0%**
L.A. County	7,602	7,910	8,102	4.0%	2.4%	**6.6%**	5,680	5,665	5,893	-0.3%	4.0%	**3.7%**
California	28,431	29,921	30,910	5.2%	3.3%	**8.7%**	23,166	23,352	24,431	0.80%	4.6%	**5.5%**

Data source: U.S. Census Bureau.

The number of vehicles per adult in Pasadena has steadily fallen since 2012, almost reaching its 2006 levels in 2017 (see Figure 22). On the other hand, this metric for California and Los Angeles County displays a growth trend since 2015, as identified by a previous study (Manville *et al*, 2018).

A declining ratio in Pasadena could be due to more driving adults, fewer vehicles available, or some combination of these. The story in Pasadena appears to be this combination.

Overall, both the driving-adult population and the vehicle stock expanded between 2010 and 2017 for all three geographies. However, as evidenced in Table 4, growth trends for both variables were much bigger for L.A. County and California than for Pasadena, especially that of the vehicle stock. Indeed, between 2014 and 2017, when California's and the county's vehicle stocks bloomed, Pasadena's contracted (see Figures D-5 and D-6 for more details).

To conclude, Pasadena Transit has not been subject to the problem of rising auto access in its service area, in contrast to trends others have observed in L.A. County more broadly (Manville *et al*, 2018), so any recent declines in Pasadena Transit's patronage likely share little in common with perhaps the principal cause of countywide patronage trends.

Table 5. Mode of travel to work in city, county, and state for 2010 and 2017.

		Pasadena			L.A. County			California		
		2010	2017	Pct. Chge.	2010	2017	Pct. Chge.	2010	2017	Pct. Chge.
Total workers (16+) (thousands)		65.5	72.6	11%	4,399	4,685	6.5%	16,272	17,590	8.1%
Journey-to-work Mode Share	Solo driving	71%	70%	-1.7%	72%	74%	2.2%	73%	74%	0.82%
	Carpooling	8.7%	7.1%	-18%	11%	9.6%	-15%	12%	10%	-13%
	Public transit	6.6%	6.3%	-4.5%	7.1%	6.3%	-11%	5.1%	5.2%	2.0%
	Walking	5.7%	5.7%	0%	2.9%	2.7%	-6.9%	2.8%	2.7%	-3.6%
	Biking	2.2%	1.7%	-23%	0.70%	0.90%	29%	0.90%	1.1%	22%
	Work at home	4.3%	7.3%	70%	4.6%	5.3%	15%	5.0%	5.6%	12%
	Taxicab, motorcycle, or other means	1.5%	2.2%	47%	1.3%	1.5%	15%	1.3%	1.5%	15%

Data source: U.S. Census Bureau.

5.5. Journey to work

Changes in vehicle ownership might be linked to changes in how people travel to work, also known as commuting patterns. Data indicate that, to get to work, people are, more often than they used to, paying by the trip (patronizing taxis or TNCs) or are not taking the trip at all (working from home) (see Figure E-15).

Table 5 displays a before-and-after picture of the means of travel to work for Pasadena (see also Figure E-16), the county, and the state. Driving alone, not surprisingly, represents a supermajority in all three areas, and has not changed much since 2010. Remarkably, Pasadena's share of solo drivers has decreased slightly while that of the county and state expanded.

5.5.1. Did TNCs affect transit in Pasadena? Perhaps

On the opposite end of the spectrum, travel via taxicab, motorcycle, or other means[27] represents a small share of commutes; however, this category, which includes TNCs like Uber and Lyft, has changed importantly in recent years. This mode increased its share in all three geographies, but much more so in Pasadena (see Figures E-7 and E-14). This is most likely due to the widespread adoption of TNCs in the region. Uber started operations in 2009 and Lyft did so in 2012, so this explanation for the sudden increase in taxicab commuters appears plausible.

[27] This is how the Census labels the category for "all other modes."

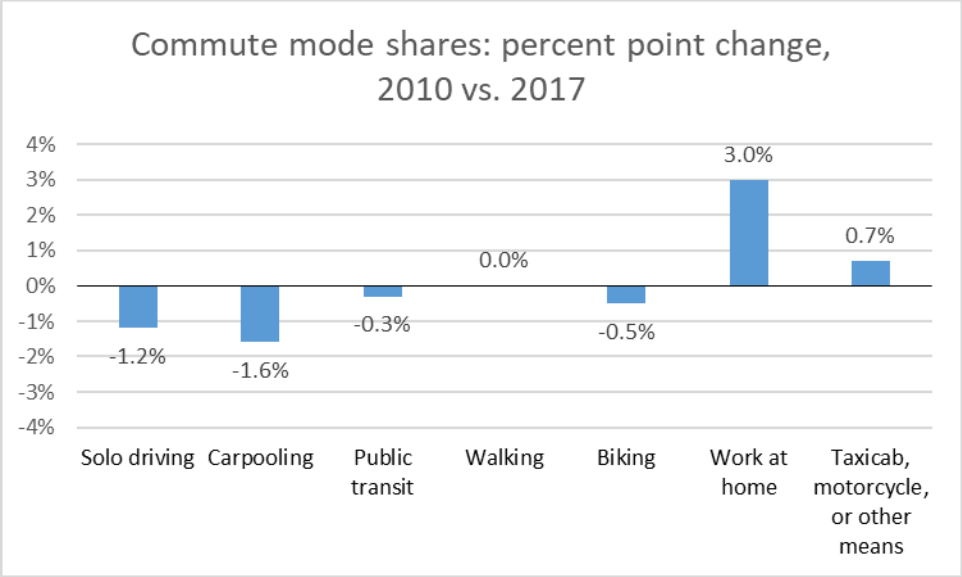

Figure 23. Commute modal shift in Pasadena
Most of the gains in telecommuting (+3.0%) are made up by a decrease in driving modes (-2.8%). Data source: U.S. Census Bureau.

5.5.2. Did telecommuting affect transit in Pasadena? Most likely

The increase in the share of people who work from home is perhaps the most surprising of all commuting travel mode trends (see Figure 23). It has risen in all three geographies, but more rapidly in Pasadena. For detailed time progressions of all these mode shares for Pasadena, Los Angeles County, and California, please refer to Appendix E.

Table 6. Shares of population by racial/ethnic group in city, county, and state for 2010 and 2017.

			Pasadena			L.A. County			California		
			2010	2017	Pct. Chge.	2010	2017	Pct. Chge.	2010	2017	Pct. Chge.
Total population (thousands)			136.4	141.2	3.5%	9,758	10,106	3.6%	36,637	38,983	6.4%
SHARES	Race / ethnicity	White, non-Hispanic	40%	37%	-7.6%	28%	26%	-6.8%	41%	38%	-8.1%
		Black, non-Hispanic	11%	9.7%	-7.9%	8.5%	7.9%	-6.6%	5.9%	5.5%	-6.1%
		Asian, non-Hispanic	13%	16%	26%	14%	14%	5.2%	13%	14%	8.9%
		Hispanic or Latinx	34%	34%	0.44%	47%	48%	2.7%	37%	39%	5.5%
		Other	3.0%	3.3%	12%	2.4%	2.9%	20%	3.3%	3.9%	16%

Data source: U.S. Census Bureau.

These results coincide with what other literature has suggested regarding recent ridership drops in public transit agencies across the United States. For example, Washington, DC,

experienced an 11 percent decline in ridership towards the end of 2016 and Iseki and coauthors (2018) mention increased telecommuting as one of the main culprits. The general manager of DC's principal transit agency also cites work from home as an important factor (Fink, 2018b).

More people working from home could partly explain the recent decline in public transportation ridership in Pasadena, since more people telecommuting means less people physically traveling to work, and the journey to work is a key market for transit. However, this growth in telecommuting has been going on for more than five years (see Figures E-6 and E-13), whereas patronage on Pasadena Transit started faltering just two years ago. Thus, there is probably more to this story.

5.6. Shifts in race and ethnicity

Different ethnic groups have different customs and different ways of thinking of and approaching public transit. Data for Pasadena suggest groups generally less likely to ride transit are growing and groups comprised of people who tend to be regular transit patrons are decreasing.

As evidenced by Table 6, in general, the two largest ethnic groups in Pasadena have been non-Hispanic White and Hispanic/Latinx.[28] However, the share of the White population in Pasadena shrank throughout the period between 2010 and 2017, along with the share of non-Hispanic African Americans. The Hispanic/Latinx proportion of the Pasadena population remained flat during this period (for a detailed progression see Figure F-9). For context, see detailed graphs comparing the city with L.A. County and California on Appendix F (especially Figures F-5 through F-8).

Table 7. Population by racial/ethnic group in city, county, and state for 2010 and 2017.

			Pasadena			L.A. County			California		
			2010	2017	Pct. Chge.	2010	2017	Pct. Chge.	2010	2017	Pct. Chge.
Total population (thousands)			136.4	141.2	3.5%	9,758	10,106	3.6%	36,637	38,983	6.4%
POP. (1000s)	Race / ethnicity	White, non-Hispanic	53.9	51.6	-4.4%	2,773	2,677	-3.5%	15,107	14,778	-2.2%
		Black, non-Hispanic	14.4	13.7	-4.7%	826	800	-3.3%	2,164	2,161	-0.12%
		Asian, non-Hispanic	17.3	22.6	31%	1,324	1,443	8.9%	4,684	5,428	16%
		Hispanic or Latinx	46.8	48.6	4.0%	4,599	4,894	6.4%	13,456	15,106	12%
		Other	4.0	4.7	16%	236	293	24%	1,226	1,510	23%

Data source: U.S. Census Bureau.

[28] Latinx is a gender-inclusive way of referring to Latin American people, as opposed to the binary construct comprised of Latino (cisgender male) and Latina (cisgender female).

On the other hand, the non-Hispanic Asian share rose over 25 percent in this period, which was a much faster growth rate than in California or L.A. County (see Table 6). Overall, Asians and Hispanics shifted from representing 47 to 50 percent of Pasadena's population, while the White and Black share of the population shifted from 51 to 47 percent.

Table 8. Race/ethnicity of Pasadena Transit riders, per a 2017 survey.[29]

	White, non-Hispanic	Black, non-Hispanic	Asian, non-Hispanic	Hispanic or Latinx	Other	TOTAL
# of responses	156	63	49	259	45	**572**
percent	27%	11%	9%	45%	8%	

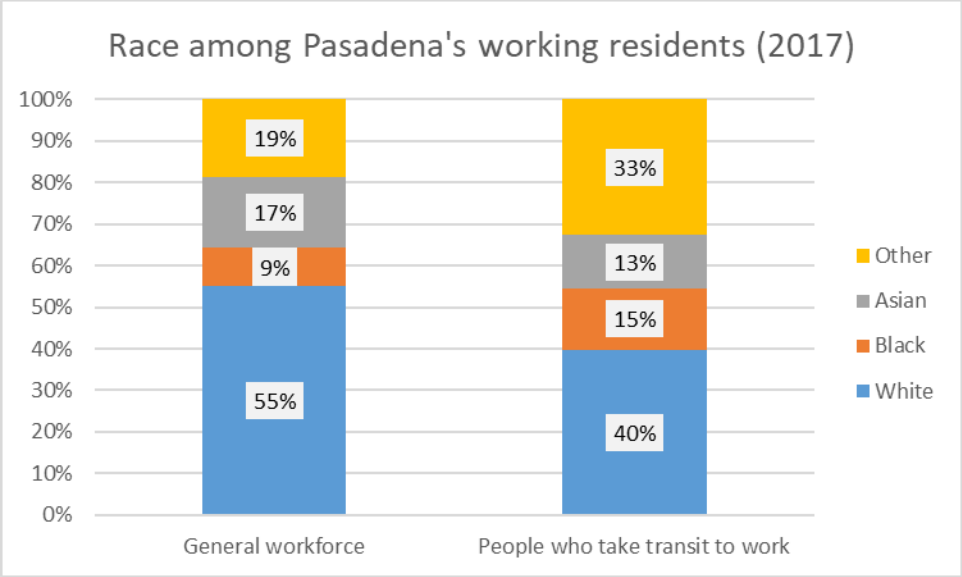

Figure 24. Race[30] of Pasadena's workforce in general and its transit commuters in particular (2017 data).
Data source: U.S. Census Bureau.

[29] A total of over 600 people completed the survey, but not everybody answered every question. For example, as Table 8 shows, only 572 people responded to the question about their race/ethnicity.
[30] This is race *regardless of ethnicity*. This dataset does not disaggregate each race by ethnicity (or each ethnicity by race). Elsewhere in this report usually four racial/ethnic groups are discussed: Hispanics (any race) and non-Hispanic Whites, Blacks, and Asians. However, the data in Figure 24 are available in the Census database *by race only*; i.e., Hispanic Blacks and non-Hispanic Blacks are under the same label: Black; the same applies for Whites, Asians, and others. In case the reader is wondering, Hispanics (any race) are more likely to commute by transit.

Table 7 displays the same data as Table 6 but in absolute terms — actual number of people as opposed to share of the total — which allows to better understand how racial/ethnic groups shifted around from 2010 to 2017. The decline in the White and Black populations is not just relative to the total but also, in general, there are less people from those ethnic groups in Pasadena.

5.6.1. Why does this matter for transit?

This demographic shift may have consequences for transit ridership. Table 8 (below) shows some results from a 2017 survey conducted by the transit agency's staff among Pasadena Transit riders.

The shares of the White and Black populations, who represent a third of Pasadena Transit's patronage (Table 8), have been shrinking in the city, whereas the group that accounts for less than a tenth of Pasadena's local bus ridership (non-Hispanic Asian) has expanded significantly. The large majority of respondents are Hispanic but, as Table 6 and Table 7 show, this group grew very mildly in Pasadena — in absolute and relative terms.

The 2017 American Community Survey enables this study to examine these demographic trends in more detail (see Figure 24). Among Pasadena transit commuters, Asian and White workers are proportionally underrepresented. Thus, the shrinking of the White population is not as concerning for transit ridership as the rapid increase in the city's Asian population is, assuming that average levels of transit usage among racial/ethnic groups remain similar to what they are now. On the other hand, African Americans are overrepresented among transit commuters. Thus, the relative decline of the Black population in Pasadena could be contributing to recent ridership declines as well.

5.7. Aging population

The evidence here presented suggests that the aging of the local citizenry (shrinkage of younger population to expansion of seniors' share) might be a factor affecting ridership, but likely not one with much weight, since seniors also ride transit fairly often.

Table 9. Age composition of Pasadena Transit riders, per a 2017 survey.

	18 or less	19 to 29	30 to 39	40 to 49	50 to 59	60 or more	TOTAL
# of responses	78	80	113	105	100	106	**582**
percent	13%	14%	19%	18%	17%	18%	

Table 9 above presents results from the 2017 rider survey regarding age brackets. People under 30 make up over a quarter of Pasadena Transit's customer base, and seniors (60 or older) represent nearly a fifth.

Table 10. Age composition of Pasadena, in absolute and relative terms, for 2010 and 2017.

		Population by age (1000s)			Share of population by age		
		2010	2017	Percent Change	2010	2017	Percent Change
Total population		136.4	141.2	3.5%	100%	100%	-
PASADENA	19 or less	29.2	28.9	-0.90%	21%	20%	-4.3%
	20 to 29	22.2	22.5	1.1%	16%	16%	-2.3%
	30 to 39	23.2	23.4	1.1%	17%	17%	-2.3%
	40 to 49	19.5	19.0	-2.5%	14%	13%	-5.8%
	50 to 59	17.7	17.7	-0.24%	13%	13%	-3.6%
	60 or more	24.6	29.7	21%	18%	21%	17%

Data source: U.S. Census Bureau.

5.7.1. Senior citizens

In absolute terms (left section of Table 10), the oldest age group shows the most significant change; whereas all other groups remained fairly flat. In relative terms (i.e., as a percent of total), the picture becomes clearer. All groups have shrunk in favor of the senior bracket (right section of Table 10). People who, in 2010, were in their 50s have aged and now are sexagenarians. However, the disproportionate increase in the senior population points towards an influx of older persons into Pasadena.

Seniors make up about a fifth of Pasadena Transit's patronage (Table 9) and the share of seniors in the city increased 17 percent between 2010 and 2017 (Table 10). This would, in theory, suggest a strengthening of Pasadena Transit's ridership, but the reality is another. Many other factors could play a role here and counteract this positive effect. For example, Pasadena's paratransit program (Dial-A-Ride), a specialized share-ride service exclusively for seniors and people with disabilities, has experienced record ridership in recent years. Another possibility includes that senior newcomers are well-off and drive (or are driven) instead of taking transit. Controlling for these and other variables would help shed some light on these intricacies. Due to time constraints, this study refrained from conducting a regression analysis, but it would definitely be worthwhile for future research to explore this further.

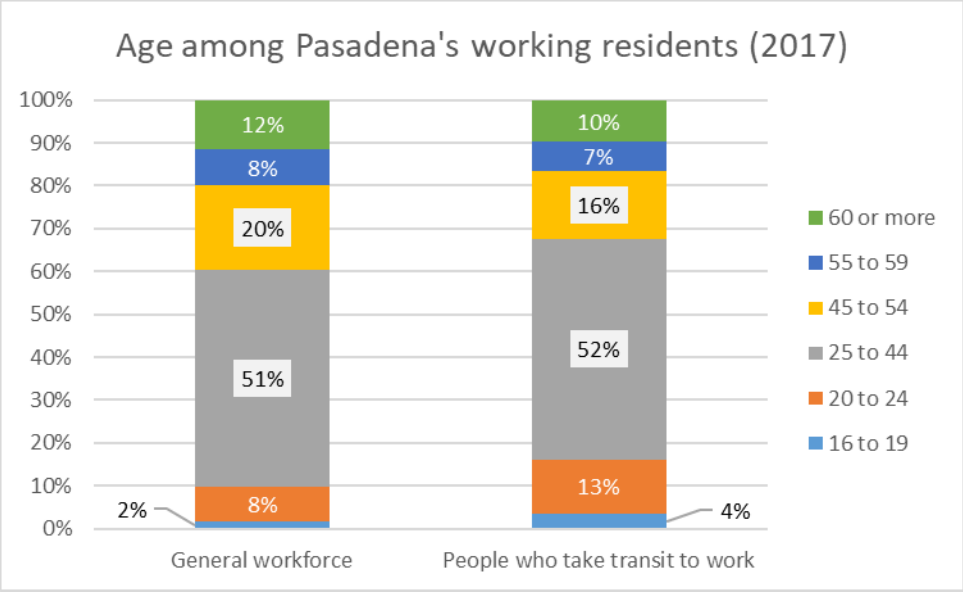

Figure 25. Age of Pasadena's workforce in general and its transit commuters in particular (2017 data).
Data source: U.S. Census Bureau.

5.7.2. Where did the kids go?

Lastly, Pasadena's population under 20 has decreased, in absolute numbers *and* as a share of the total (see Table 10). This is important, not only because 13 percent of Pasadena Transit's clientele is made up of individuals under 18 (Table 9), but also because a significant portion of ridership is comprised of students (K-12). This information was gathered from conversations with transit planners at the agency, whom attested to (1) the fact that they tailor the schedule for some trips specifically to public schools, as well as (2) the high load factors experienced by certain routes during schools' bell schedules. While working with the Client during the summer of 2018, the author personally witnessed how, when school was back in session, ridership experienced a boost, adding an average of 750 passenger-trips per weekday. To complement this qualitative information, almost 19 percent of the respondents to the 2017 rider survey declared being students (City of Pasadena Transit Division, 2018). Also, internal ridership reports from the last semester of 2018 show an average of 16.6 percent of riders fall under the Student/Youth fare category, which includes only K-12 students who pay a discounted rate of 50 cents.

This drastic decline in the proportion of minors in the city is accompanied by the steady drop of school enrollment across the Pasadena Unified School District, which went from 23,500 students, in the 1999-2000 school year, to 18,200 this past academic year (23% decrease), falling an average of 1.4 percent every year (see Figure F-10).

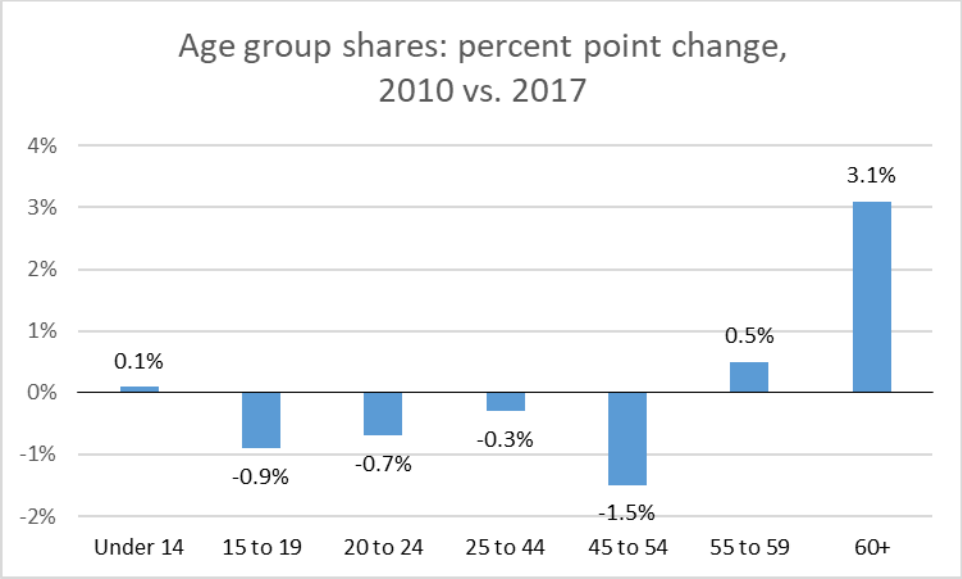

Figure 26. Shifts among age groups in Pasadena.
Data source: U.S. Census Bureau.

According to the 2017 American Community Survey (see Figure 25), Pasadena residents under 25 are the most likely to travel to work via transit. Second more inclined are seniors, who are less likely to take transit to work, but more so than people in their late 40s or early 50s. Thus, the growth of the senior population and the decline in 50-year olds could promote added transit ridership, but the decline in youth — as well as many other factors — could offset this effect. These data only apply to trips to work, which limits the utility of this information since commuting comprises only a minority of overall travel. For example, most transit trips by seniors are likely non-commute trips (e.g., retirees).

5.7.3. Main takeaways

Remarkably, half of the increase in the share of seniors (a group modestly likely to commute via transit and a major share of Pasadena Transit's riders) compensates a decrease in the demographic that is overrepresented among transit commuters (people between 16 and 44; see Figure 26). That represents a downside, but the silver lining is that the other half of said increase compensates a decrease in the group that is the least reliant on transit: the 45- to 54-year olds (see Figure 25 and Figure 26). Therefore, the group somewhat likely to ride transit (seniors) is growing and replacing those who are the most likely to ride (younger people) and those who are the least likely to do so (middle-aged people). Ultimately, this might result in reduced transit ridership.

These results match what other research have identified as driving factors of ridership decline in the U.S.: "the population is aging and there is a lower share of the population in the young age cohorts that have a higher propensity for transit use" (Driscoll *et al*, 2018, p. 1).

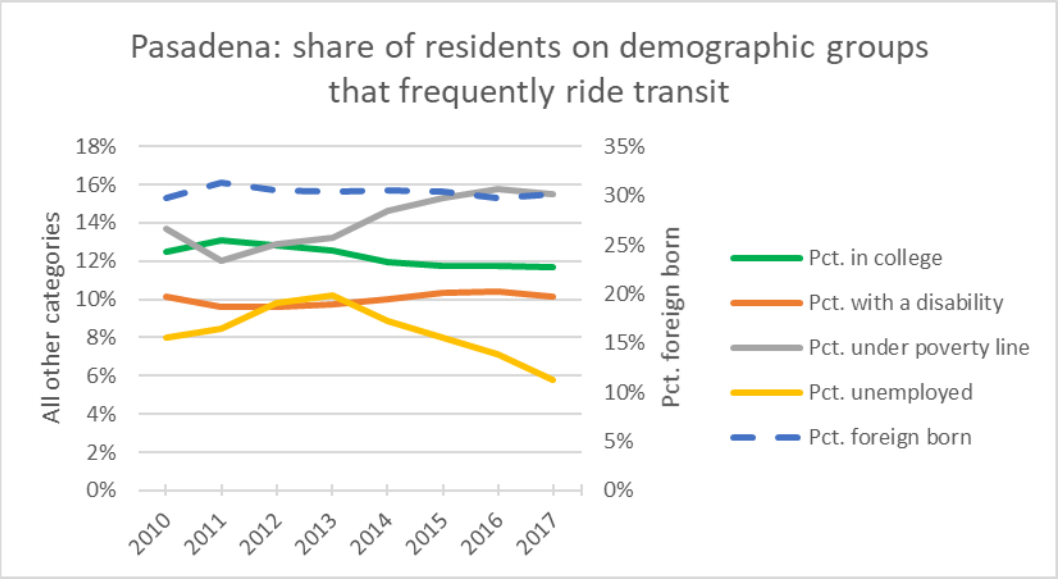

Figure 27. Transit-dependent populations in Pasadena.
Note that the line for "Pct. foreign born" is on a different scale. For indexed change, refer to Figure F-11. Data source: U.S. Census Bureau.

5.8. Transit-dependent groups

According to previous studies, demographic groups such as college students, people with disabilities, low-income individuals, the unemployed, and immigrants rely disproportionately on public transit (Taylor *et al*, 2009; Boisjoly *et al*, 2018; Taylor & Fink, 2013). Data suggest poverty has grown in Pasadena, which would likely lead people to get rid of household cars and take transit more often, and unemployment has fallen, which would allow people to travel more often (more resources, more reasons to travel) but possibly less via transit since they now have an income and people tend to use transit (an "inferior good") less as their incomes rise.

Figure 27 shows that most of the transit-dependent groups remained flat as a share of Pasadena's population. Poverty and unemployment stand out as notable exceptions.

5.8.1. Unemployment

The unemployment rate in Pasadena declined steeply between 2013 and 2017, going from ten to six percent (see Figure 27). Unemployed people usually ride transit heavily (Boisjoly *et al*, 2018) — perhaps due to their restricted options to afford car use — but travel less overall since they do not go to work every day and have limited income, which suggests limited opportunities to engage in activities and, hence, less need to travel (Taylor *et al*, 2009).

The 2017 Pasadena rider survey confirms that the unemployed ride transit but not excessively: only 6.7 percent of Pasadena Transit's patrons reported being unemployed.

Thus, this steep decline in unemployment might have a positive effect on ridership, since the unemployed are not a big share of Pasadena Transit's patronage and higher employment implies more travel overall. However, less unemployment could also drag ridership down because newly-employed people now have an income that could potentially afford them a car, thus reducing their likelihood to ride transit (recall transit is an "inferior good").

Previous research (Taylor *et al*, 2009; Boisjoly *et al*, 2018) validates the inconclusive relationship between unemployment and transit ridership implied by this discussion: these authors point towards a weak negative relationship (both found it to be not statistically significant): less unemployment induces more ridership (negative relationship), but the opposite could be true as well (since the correlation is statistically insignificant).

5.8.2. Poverty

Poverty levels rose from 13 to 16 percent between 2013 and 2016 (see Figure 27). People falling below the poverty line might ride transit more frequently, since they might lose or give up access to private vehicles in order to save money.

How do these opposing forces interact? Low-income people in Pasadena get jobs and start traveling more often — both to and from work, and because they now have more disposable income to spend at destinations. The inferior-good concept suggests these now-employed travelers are more likely to gain private vehicle access and start driving rather than riding transit. But big purchases like cars do not happen overnight, and the cars that lower-income travelers own tend to be older and less reliable models. So for newly-employed travelers who do not buy cars, they are likely to make more trips by transit, at least in the near term. In the longer term, higher poverty and less unemployment might have mixed effects on transit ridership.

Table 11. Pasadena homeless counts, 2011-2018.[31]

	2011	2012	2013	2014	2015	2016	2017	2018
Count	1,216	904	772	666	632	530	575	677
Difference with prior year	-	(312)	(132)	(106)	(34)	(102)	45	102
Percent difference	-	-26%	-15%	-14%	-5%	-16%	8%	18%

Data source: Pasadena Partnership, 2018.

5.9. Homelessness

Some literature indicates that increased numbers of people experiencing homelessness could affect transit use (Manville *et al*, 2018). This line of research suggests riders feel intimidated or uncomfortable by the presence of homeless persons in transit buses and

[31] The City of Pasadena implemented new service approaches in 2011 (Pasadena Partnership, 2018), which is why the number of people without homes reversed its upward trend that year. Pre-2011 increases are excluded because they are not relevant to this research.

trains, especially the "chronically homeless" who experience some sort of problem such as substance abuse or mental illness. For some people, this makes transit feel less safe and, thus, higher levels of homelessness deter ridership. In Pasadena, this could have had some effect on local bus transit patronage.

Between 2011 and 2016, homeless counts registered 15 percent reductions (yearly, on average) in the homeless population of Pasadena (Table 11). However, Table 11 also shows that, since 2016, the homeless population has grown every year. In fact, the homeless population in Los Angeles County decreased four percent between 2017 and 2018 (from 55,000 to 52,700) (LAHSA, 2018), the same year Pasadena's grew 18 percent.

Given that people experiencing homelessness tend to seek refuge in transit stops and vehicles (Manville *et al*, 2018), it is likely the presence of homeless persons in Pasadena Transit buses and stops has discouraged some frequent riders from taking the bus as often as they used to, or from taking it at all.

5.10. Income inequality

Thus far, nothing appears to convincingly point towards a single or principal driving factor behind weakening ridership on Pasadena Transit. The emergence of telecommuting, an aging population, shifts in racial/ethnic composition, and rising homelessness may be contributing factors, but none stands out as the major reason.

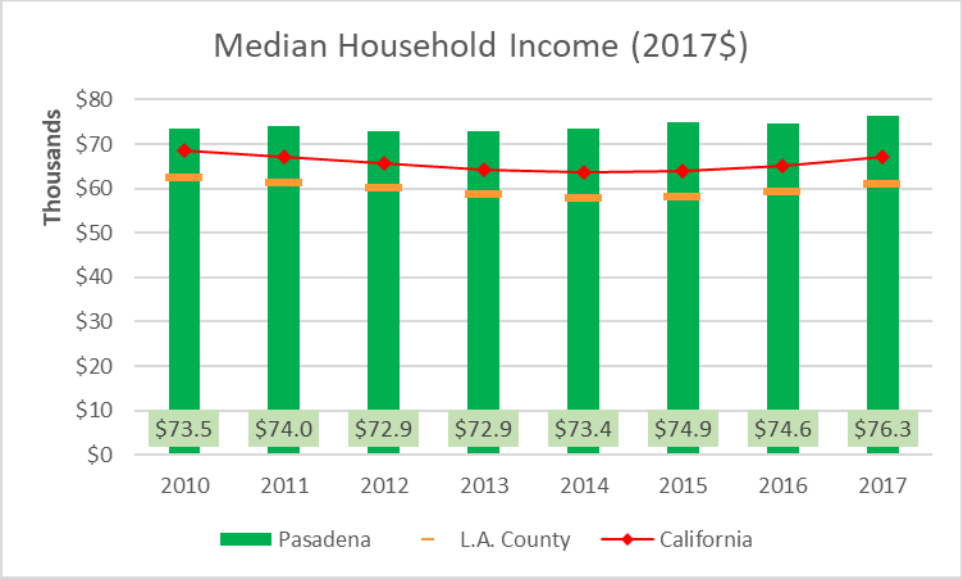

Figure 28. Median household income (inflation-adjusted to 2017).
Data source: U.S. Census Bureau.

Income was a variable to examine because of the inferior-good character of transit, which has been referenced before. Data indicate that Pasadena residents have become notably wealthier, which might lead to less transit use.

5.10.1. Median household income

As Figure 28 shows, median household income for Pasadena has been above the state and county medians since at least 2010. Interestingly, Pasadena fared better throughout the Great Recession, experiencing only minor slowdowns in an otherwise steady growth. On the other hand, California and L.A. County did experience a dip in median household income during the economic downturn, and started recovering in 2014. Overall, Pasadena experienced a four-percent income growth in the 2010 to 2017 period, whereas incomes decreased two percent in California and L.A. County in the same period (for indexed changes, see Figure F-12).

5.10.2. Income brackets

Table 12. Income composition of Pasadena, in absolute and relative terms, for 2010 and 2017 (not adjusted for inflation).[32]

		Population by income (1000s)			Share of population by income		
		2010	2017	Percent Change	2010	2017	Percent Change
Total population		136.4	141.2	3.5%	100%	100%	-
PASADENA	Less than $10,000	8.7	10.0	15%	6%	7%	11%
	$10,000 to $24,999	18.6	17.2	-7.2%	14%	12%	-10%
	$25,000 to $49,999	26.5	20.5	-23%	19%	15%	-25%
	$50,000 to $99,999	40.3	39.7	-1.4%	30%	28%	-4.7%
	$100,000 or more	42.6	54.0	27%	31%	38%	22%

Data source: U.S. Census Bureau.

Table 13. Pasadena Transit riders by yearly earnings, per a 2017 survey.

	Less than $12,000	$12,000 to $19,999	$20,000 to $39,999	$40,000 to $49,999	$50,000 or more	TOTAL
# of responses	177	89	51	33	168	518
percent	34%	17%	10%	6%	32%	

[32] Please note that the brackets are in nominal dollars (i.e., not inflation-adjusted) due to the complication of adjusting these data. This implies that inflation, pushing salaries up from one income bracket into the next as time passes by, is not accounted for. However, this period experienced relatively low inflation (annual average of 1.7%), so the analysis is not greatly affected by this limitation.

Looking at population distribution by income brackets (see Table 12), the population in middle-income brackets has shrunk considerably — in both absolute and relative terms. In contrast, the lowest and highest income brackets have rapidly grown, especially the group earning six figures. For a graphic representation of the before-and-after distribution of income, see Figure F-13.

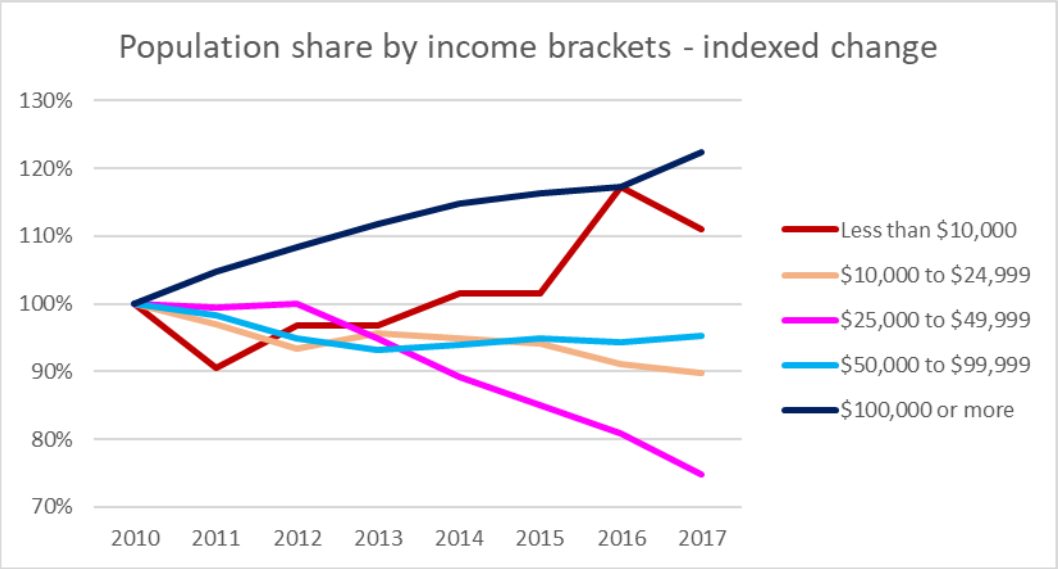

Figure 29. Income bracket shares in Pasadena.
Indexed to 2010; not adjusted for inflation. Data source: U.S. Census Bureau.

Figure 29 shows that these changes in all brackets have, in general, occurred progressively throughout this period.

5.10.3. Wealth and transit

The lowest income bracket remaining relatively stable or increasing slightly means an important share of Pasadena Transit riders (Table 13) stayed fairly consistent.

Over a third of Pasadena Transit riders belonging to the lowest income group led to aggregating the Census brackets as shown in Figure 29: less than $10,000 to account for the poorest people and over $100,000 because a six-figure salary likely provides much stability. Then, the middle-income brackets were split in three. However, for a more fine-grained understanding of the variation among income groups, please refer to Figure F-15. Section 5.10.5. ***Implications*** discusses in detail what this means for transit (the inferior-good concept).

5.10.4. Inequality: the two Pasadenas

The two income extremes expanding while the middle brackets shrank led this analysis to look deeper into income inequality, especially since most of the shift was towards the highest income brackets (see Figures F-14 and F-15). The Gini index is a standard measure of

disparity that looks at the statistical dispersion of income. If zero, then income is perfectly equal throughout; if one, then a single person gets all the income (perfect inequality) (U.S. Census Bureau, 2016).

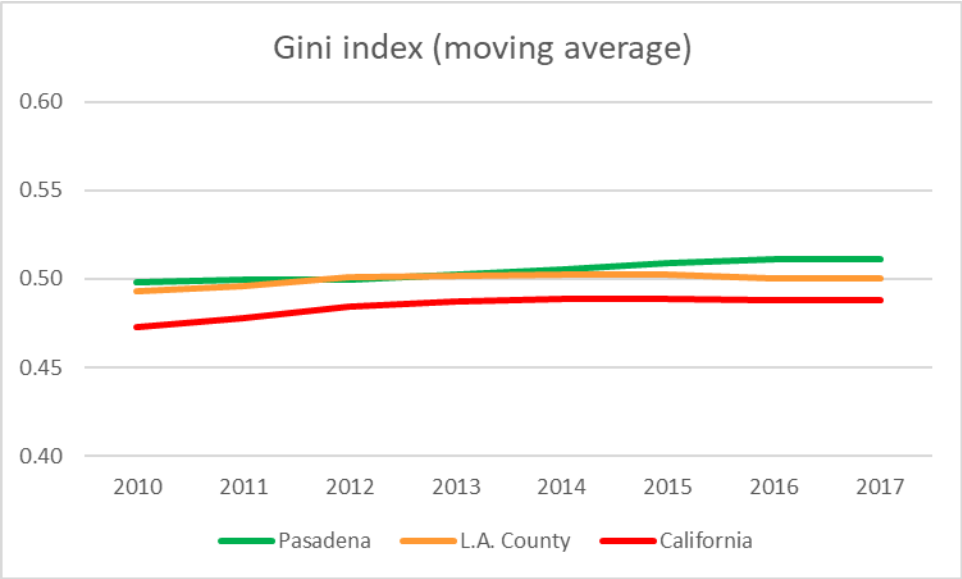

Figure 30. Gini index.
Note that the Y-axis does not start on zero; this is because the changes are so slight that it is hard to visualize otherwise. Data source: U.S. Census Bureau.

Figure 30 shows Pasadena is more unequal than the county and much more unequal than California, in terms of income. Also, Pasadena has become more unequal since 2014, a trend that flattened in 2016. Remarkably, California and L.A. County's growth in the income disparity index flattened when Pasadena's started to grow faster.

5.10.5. Implications

The infusion of wealthier people into Pasadena means that an average resident becomes less likely to ride transit, since people with high incomes use transit very little (once again, transit is an inferior good). In addition, more lower-income riders — even just a bit more — would tip the scale in the other direction. However, in Pasadena, the growth in the top income bracket dwarfs that of the bottom bracket (Table 12). Then, what about income inequality? It does not affect transit directly; yet, in an unbalanced housing market, inequality nurtures gentrification. In such a scenario, wealthy people displace low-income residents away from areas rich in transit service. Would-be riders moving away from transit-rich areas and, likely, into transit-poor areas drives, in the aggregate, transit ridership down (Driscoll *et al*, 2018). Consequently, this report turns now to examine the housing situation in Pasadena.

5.11.Housing market and displacement

Building on the previous section, the current conditions of the local housing market shed further light on the matter. Data indicate some Pasadena households pay sizeable portions of their income in rent alone, generating financial burdens that potentially drive low-income people out of their homes and perhaps even away from Pasadena.

5.11.1. Overview

The housing stock in the city expanded 5.4 percent between 2010 and 2017 (averaging 0.8% annual growth). Compared to the state and county's housing stock growth in the same period of 3.3 and 2.4 percent, respectively, Pasadena has stayed ahead on this matter. Adding to this point, the percent of units that are vacant in Pasadena grew from 7 to 9 percent in the same period, which would imply a sufficiency in housing supply.

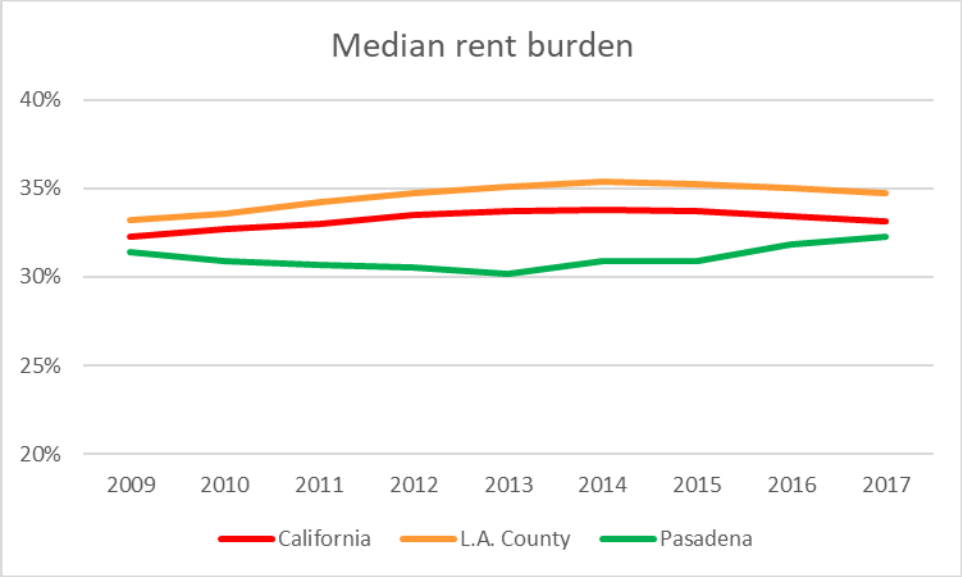

Figure 31. Median rent burden (rent as a percent of monthly household income). ***Note that the Y-axis does not start on zero; this is because the changes are so slight that it is hard to visualize otherwise. Data source: U.S. Census Bureau.***

5.11.2. Of rents and burdens

Housing costs make the picture grayer, especially considering that over half of city residents are renters — a share that has slowly but gradually grown between 2010 and 2017. Table 14 (below) shows rents in Pasadena have outgrown those for California and L.A. County since at least 2009 and have risen at a much faster pace (see Figure F-16 for indexed change).

Table 14. Median rent in city, county, and state for 2009 and 2017.

Median gross rent (2017$)	2009	2017	Percent Change
Pasadena	$1,347	$1,494	10.9%
L.A. County	$1,229	$1,322	7.5%
California	$1,275	$1,358	6.5%

Data source: U.S. Census Bureau.

Table 15. Share of renter-occupied units in Pasadena by rent-burden bracket and household income.

Household ▶ Income	Less than $10,000			$10,000 to $49,999			$50,000 to $74,999		
	2014	2017	Pct. Chge.	2014	2017	Pct. Chge.	2014	2017	Pct. Chge.
Total Number of Renter-Occupied Housing Units ▶	2,788	3,030	8.7%	12,171	10,997	-9.6%	5,432	5,763	6.1%
Rent burden ▼									
Under 20%	0%	0%	-	2.9%	1.9%	-34%	16%	9.8%	-38%
20 to 24.9%	0.65%	0%	-100%	2.3%	1.3%	-43%	24%	18%	-22%
25 to 29.9%	1.3%	0.36%	-71%	8.3%	6.2%	-25%	23%	19%	-16%
30 to 34.9%	0.54%	1.7%	225%	11%	9.6%	-13%	13%	17%	29%
35 to 39.9%	0.65%	0.26%	-59%	8.3%	9.0%	9.1%	8.6%	14%	61%
40 to 49.9%	3.0%	0.26%	-91%	19%	16%	-14%	11%	15%	35%
50% or more	60%	72%	20%	46%	53%	15%	4.4%	6.0%	37%
Not computed	34%	26%	-25%	2.3%	3.0%	31%	0.90%	1.4%	58%

Household ▶ Income	$75,000 to $99,999			$100,000 or more			TOTAL		
	2014	2017	Pct. Chge.	2014	2017	Pct. Chge.	2014	2017	Pct. Chge.
Total Number of Renter-Occupied Housing Units ▶	3,627	3,801	4.8%	6,303	7,271	15%	30,321	30,862	1.8%
Rent burden ▼									
Under 20%	31%	24%	-23%	70%	66%	-5.8%	22%	21%	-5.7%
20 to 24.9%	30%	32%	7.9%	19%	22%	20%	13%	13%	3.8%
25 to 29.9%	16%	19%	22%	7.9%	6.0%	-23%	11%	10%	-13%
30 to 34.9%	13%	12%	-3.3%	1.9%	2.6%	33%	8.7%	8.9%	1.3%
35 to 39.9%	3.8%	4.5%	20%	1.1%	1.4%	36%	5.6%	6.7%	20%
40 to 49.9%	1.6%	4.2%	165%	0%	0.85%	-	10%	9.4%	-7.3%
50% or more	0.91%	0.63%	-31%	0%	0%	-	25%	27%	8.8%
Not computed	3.7%	2.4%	-35%	0.54%	0.81%	50%	4.8%	4.3%	-9.1%

Data source: U.S. Census Bureau.

Figure 31 displays how Pasadena renters have historically been less burdened by their rent payments than state or county residents, likely due to the city being generally wealthier (recall Figure 28). However, Figure 28 also shows how household incomes for California and L.A. County started to recover in 2014 from the recession, around the same time rents began rising in those two geographies (Figure F-16); but incomes kept the pace with rent, to the point rent burden started to decrease (Figure 31). However, Pasadena's slight increase in household incomes between 2015 and 2017 (Figure 28) did not make up for the accelerated growth in rents (Figure F-16), which is why median rent burden climbed dramatically in the city since 2015. Thus, the city is still less rent burdened than the county or state because it is *generally* wealthier, but the income inequality described above makes high rents a substantial burden to the very poor in Pasadena.

5.11.3. Who carries the largest burden?

Higher rent burdens raise concerns of displacement of frequent transit riders (generally low-income), out of areas where transit service abounds (transit-rich), by wealthier people who usually ride transit much less frequently (Manville *et al*, 2018).

Table 16. Earning brackets in Pasadena, for the workforce in general and transit commuters in particular, for 2014 and 2017.

People who take transit to work		Population by earnings			Share of pop. by earnings		
		2014	2017	Pct. Chge.	2014	2017	Pct. Chge.
Total number of transit commuters		4,050	4,600	13%	100%	100%	-
PASADENA	Less than $10,000	760	870	14%	19%	19%	0.53%
PASADENA	$10,000 to $49,999	2,350	2,250	-4.0%	58%	49%	-15%
PASADENA	$50,000 to $74,999	430	630	45%	11%	14%	28%
PASADENA	$75,000 or more	510	840	66%	13%	18%	46%

General workforce		Population by earnings			Share of pop. by earnings		
		2014	2017	Pct. Chge.	2014	2017	Pct. Chge.
Total number of full-time workers (16+) with earnings		48,560	51,990	7.0%	100%	100%	-
PASADENA	Less than $10,000	730	770	5.3%	2%	1%	-1.6%
PASADENA	$10,000 to $49,999	20,930	21,340	2.0%	43%	41%	-4.8%
PASADENA	$50,000 to $74,999	9,080	9,840	8.4%	19%	19%	1.2%
PASADENA	$75,000 or more	17,820	20,040	12%	37%	39%	5.0%

Data source: U.S. Census Bureau.

Another consequence of higher rent burdens involves poorer residents being forced to drive less and take transit more often to make up for the increased rent burden. Since they need to allocate more money for housing, owning a car becomes an unessential expense that transit can replace, which might partly explain why vehicle ownership has fallen in Pasadena. This means there could be two forces at play: more transit use as a means to mitigate increased rent burden or less transit use because sporadic users (wealthier people) displace regular users (lower-income residents).

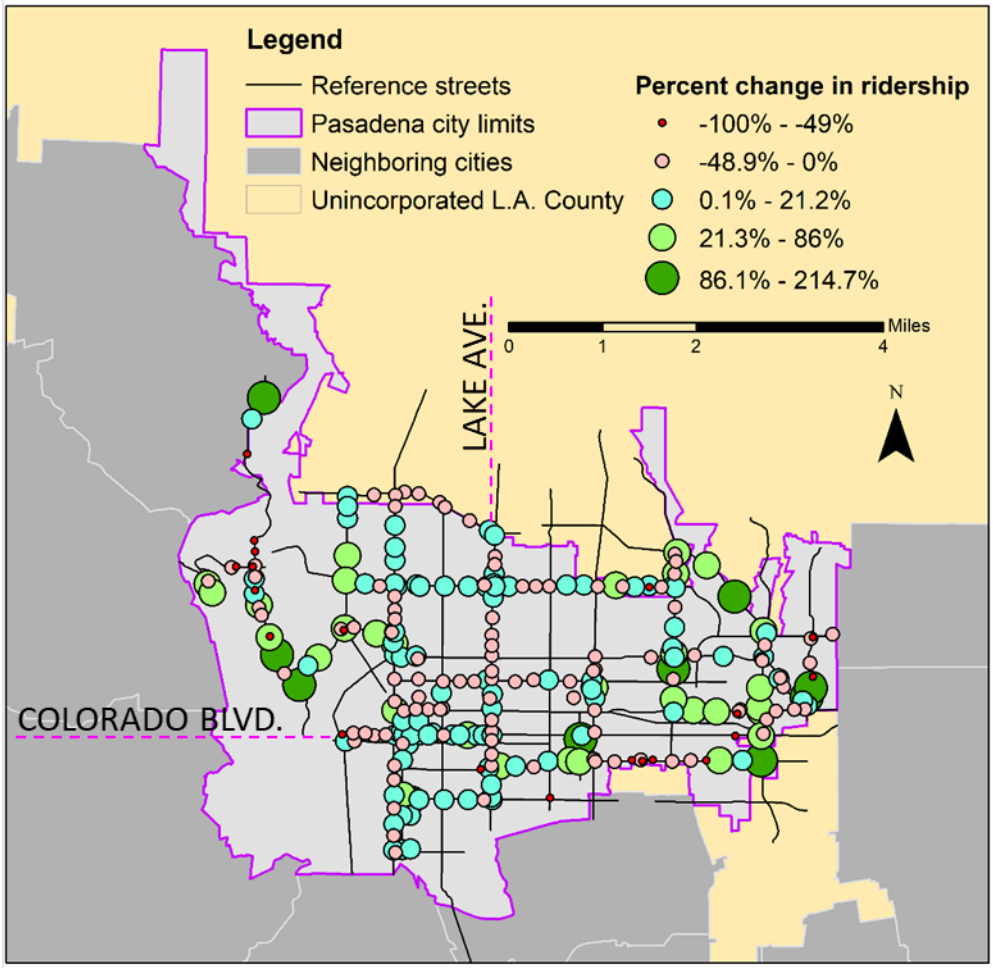

Figure 32. Pasadena Transit stops and their FY17-FY18 change in ridership.[33]
Colorado and Lake are roads displayed for reference only. Data source: Pasadena Transit. GIS shapefiles source: U.S. Census TIGER lines.

[33] Please note: a major limitation of these data is they are collected via automated passenger counters located in the buses, which are not very precise instruments. Sometimes people come in and out of buses without actually taking a ride; e.g., bus operators or confused riders.

Table 15 shows data for rent burden by household income.[34] In 2017, nearly three in every four Pasadena households in the lowest income bracket paid at least half of their income in rent, up from less than two-thirds of these households in 2014 (Table 15). As mentioned above, increased rent burden might incentivize a reaction from this group of households: cut costs (e.g., get rid of a vehicle) or move out (to a unit with more affordable rent).

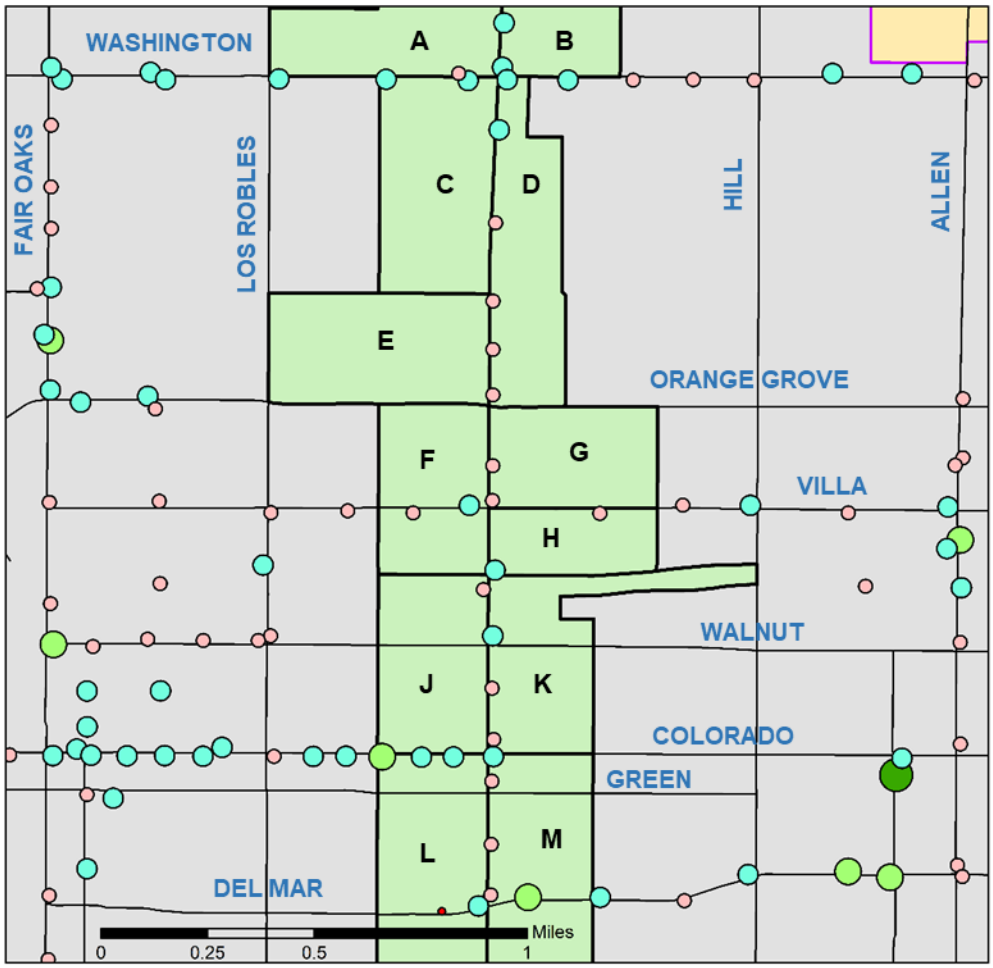

Figure 33. Zoom into the census block groups abutting Lake Avenue (between Washington and Del Mar).[35]
Block groups are painted in green and labeled with capitalized letters.

[34] Please note this table displays these changes between 2014 and 2017 because 2014 is the first year the U.S. Census started reporting more disaggregated rent-burden brackets (previous data stopped at "35% or more"). Also, this dataset did not allow to break income brackets in the same fashion as in Figure 29, so there was a need to adapt and aggregate data differently.
[35] For detailed information identifying each stop along Lake Avenue (displayed in this figure) and their corresponding change in ridership, see Figure G-1 and the associated Table G-1.

Table 16 helps further clarify which of the two forces at play has more weight. Not only do more Pasadena residents now have higher-wage jobs (lower part of Table 16), but also these high-wage workers are taking transit to work much more often than they used to do in 2014. In contrast, low-wage jobs have not grown much and their workers are not taking transit to work significantly more often.

More high-income residents riding transit to work might indicate an influx of wealthier people into areas with abundant transit service. Low-income people not riding transit more frequently to work could indicate they have been displaced to transit-poor areas. Also, this could lead to the conclusion that low-wage workers in rent-burdened households are preserving their vehicle to more easily access their job, which not only might be hard to reach via public transit but also could be at late hours (when transit service is usually scarce).

5.12. Mapping these changes

In an attempt to understand the relative importance of the two forces (financially-strapped households versus displaced households), this study looked at the data spatially using geographic information systems (GIS). This analysis shows both forces remain important, but displacement had a stronger influence overall.

Table 17. Some statistics for the census block groups highlighted in Figure 33.

TRACT	Median Household Income (2017$) (thousands)		Median Gross Rent (2017$)		Pct. with household income of: less than $10,000		Pct. with household income of: $100,000 or more		Pct. with rent burden of: less than 20%		Pct. with rent burden of: 35 to 49.9%		Pct. with rent burden of: 50% or more	
	2013	2017	2013	2017	2013	2017	2013	2017	2014	2017	2014	2017	2014	2017
A	$61.8	$43.3	$1,260	$1,280	16%	1%	24%	23%	12%	19%	13%	13%	35%	41%
B	$105.8	$64.2	$1,180	$1,220	1%	8%	55%	28%	23%	31%	9%	20%	6%	15%
C	$52.4	$53.8	$1,390	$1,070	13%	5%	26%	19%	15%	11%	4%	9%	21%	13%
D	$35.9	$57.7	$1,030	$1,050	12%	10%	30%	34%	18%	6%	24%	33%	17%	35%
E	$47.3	$46.3	$1,160	$1,180	1%	3%	13%	13%	11%	9%	24%	22%	25%	33%
F	$52.5	$55.0	$1,260	$1,210	13%	7%	15%	19%	33%	31%	15%	21%	30%	35%
G	$38.6	$48.5	$1,430	$1,230	7%	5%	10%	11%	21%	26%	30%	16%	31%	45%
H	$33.8	$51.5	$1,370	$1,410	8%	20%	4%	12%	13%	19%	32%	9%	40%	34%
J	$53.0	$71.1	$1,880	$2,230	13%	3%	30%	33%	27%	21%	9%	19%	23%	32%
K	$69.1	$79.1	$1,370	$1,980	7%	12%	23%	39%	21%	25%	14%	5%	25%	28%
L	$73.9	$84.0	$1,460	$1,640	8%	11%	29%	43%	31%	34%	14%	11%	8%	20%
M	$57.8	$68.8	$1,520	$1,660	4%	4%	24%	39%	32%	29%	13%	24%	18%	23%

Data source: U.S. Census Bureau.

Census block groups A and B got significantly poorer, and many households started paying over half of their income in rent (Table 17). Then, note how the stops located at Lake and Washington, by these block groups, experienced modest gains in ridership (Figure 33). This

speaks to households taking transit more and driving less in order to save money. Limitations of this statement include Lake and Washington's status as a highly-patronized bus stop, since two of the main system routes intersect there. Thus, the increase in ridership could be due to changes in transit demand as well.

On the other hand, block groups D, F, and J not only saw rent burden go up for many households, but also saw a sizeable outflow of poor residents (income < $10,000) and inflow of wealthy people (income > $100,000). These three census block groups abut sections of Lake Avenue that, overall, experienced losses in ridership (Figure 33). This alludes to the other force at play: displacement.

Remember that Census data are not yet available for 2018, which is why this analysis uses changes from 2013/2014 through 2017 as proxy (and predecessor) of what triggered the fall in ridership between FY17 and FY18.

This analysis denotes a case study of Lake Avenue as representative of a broader issue. Since, overall, Pasadena Transit's system lost riders between fiscal years 2017 and 2018, it appears safe to assume that displacement was much more pervasive in areas adjacent to major transit corridors.

6. Conclusions and recommendations

At the beginning of this research project, the assumption was that Pasadena Transit is heavily dependent on the regional transit network, particularly on L.A. Metro's Gold Line, and that faltering transit use regionally might contribute to local ridership losses in Pasadena. However, the data and analyses presented here point towards more structural issues inducing wavering ridership: an aging population, changes in demographics and travel behavior, increased homelessness, and rising rents placing undue financial burden on already-financially-strapped households.

For L.A. Metro's system and its components, the reasons for ridership falling since 2014 abound: increased vehicle ownership and underinvested bus service come out as main causes (Manville *et al*, 2018; Meaney, 2018). In contrast, the decline in Pasadena Transit's patronage over the past two years followed four years of steady patronage growth, which coincided with the implementation of several service improvements, particularly additional frequency on major routes.

Increased vehicle ownership and use were discarded from the onset, since Pasadena residents, contrary to their L.A. County and California counterparts, are collectively disposing of private vehicles. Perhaps, higher rent burdens have encouraged low-income residents to reduce costs and give away their surplus vehicles.

However, less vehicle access *should* foster increased transit use. Looking into other variables typically thought to cause fluctuations in transit ridership, a few stood out as additional potential disruptions. The escalation of telecommuting, or working from home, is a likely contributor, since commuting is a significant market for transit and the less that people commute (by physically traveling), the smaller this pool of potential riders gets. In 2009, only 4.2 percent of Pasadena's commuters worked from home. Such share grew steadily until reaching 7.3 percent in 2017, more than a percent point above that for state and county.

Secondly, the aging of Pasadena's population could be an influential factor. Previous research looking into U.S. cities' transit decline (Driscoll *et al*, 2018), as well as U.S. Census data for Pasadena, point towards the weight younger populations (especially people in their early 20s and younger) have on transit patronage. When this population shrinks (young people age, and birth rates do not keep up), public transit tends to lose loyal and frequent users. Younger travelers lean towards using transit more because they are not legally allowed to drive or because their circumstances lead them to opt for other modes over driving (Blumenberg *et al*, 2016).

These two trends go along with an increasingly Asian population and rising homelessness. The former injects the market with individuals who are less likely to use transit (when compared with, for example, African Americans or Hispanics). Homelessness in Pasadena, on the other hand, which went up 28 percent from 2016 to 2018, tarnishes people's

perception of public transit and incentivizes riders to seek other, more private, travel modes that spare them the disturbance or discomfort of sharing space with homeless people.

Yet, none of these longstanding trends explain, in a satisfactory manner, why Pasadena Transit's healthy patronage base has begun experiencing mild declines in the past couple of years. The homelessness upsurge did coincide with Pasadena's faltering ridership, but it appears unlikely that this alone would significantly impact transit patronage.

Moving or displacement of frequent transit users out of transit-rich areas and into more auto-oriented places often comes up as a plausible driver of ridership declines (Driscoll *et al*, 2018; Manville *et al*, 2018, also looked into this). Pasadena displays some symptoms of displacement: income inequality, rising housing costs, and a more high-end job market. The mapping of these phenomena to spatially visualize these changes and overlay them with the bus stops that experienced important changes in ridership helped further understand the extent of this problem.

Incomes have risen 4.6 percent since 2013 and, more significantly, the share of Pasadena residents in the top income bracket ($100,000 or above) went from 35 to 38 percent in only four years (2013-2017). Such an increase might appear modest, but this is by far the group that grew most. Furthermore, median rent burden has escalated since 2013, going from 30 to nearly 33 percent. This means half of Pasadena's households pay *more than a third* of their income in rent. In addition, 75 percent of very-low-income households in Pasadena pay *more than half* of their income in rent.

This brings financially-strapped households to a crossroads: let go of their car and ride transit to save money, *or* move out (or get evicted) due to the inability to afford rent. Some preliminary mapping identifies the latter as a much more likely candidate. A rent-burdened person who used to frequently ride on Pasadena Transit will need to take their "travel business" elsewhere when they get pushed out by a heavy influx of wealthy people. Thus, they will either take transit in another city or, much more likely, will need to get a car (now that their rent is more affordable, they can) to move around in an area with less transit service. In contrast, those who move into Pasadena are an increasingly affluent population who, given their high incomes, are much less likely to consume an inferior good such as public transit.

These findings allow to provide some recommendations that are grouped in three broad categories:

Targeted marketing. Many of the findings point towards specific groups that, for different reasons, do not ride transit very often (or not at all): people who work from home, Asian residents, senior citizens, recently-employed people, and wealthy newcomers. Thus, this report suggests conducting targeted surveys to better understand the travel needs of these different groups and, thereby, frame transit service in a way that appeals to them. This might

involve aggressive marketing, eye-catching wayfinding, and tailored transportation demand management programs in partnership with employers, property managers, and other relevant stakeholders.

Homelessness-awareness campaign. Since homelessness itself is beyond Pasadena Transit's purview, the Client could leverage awareness to make the public cognizant of the struggles of the homeless. The first step, though, would imply surveying riders extensively on the specific topic of homelessness and fear on the bus. This study would inform the campaign itself. The idea consists of something along the lines of *homeless is not hopeless*[39] that educates Pasadena Transit's clientele, and the public at large, on the issue of homelessness and creates a common understanding that homeless individuals are fellow citizens experiencing a rough time. Humanizing homelessness might aid in dispelling the perception of homeless people as a threat and allow transit riders to feel more comfortable and less intimidated around them. This will not solve homelessness, but it is a first step towards destigmatizing it and making transit friendlier for all. The campaign should also further enhance the existing training of bus operators on how to respectfully address homeless individuals and how to de-escalate conflict were one to emerge between passengers.

Housing stability. Evidence points towards growing rent burdens as the single biggest factor weakening local bus ridership. Once again, this is something Pasadena Transit has no control over; therefore, this issue requires additional research. A good start might involve extensive surveying to build a database of rent-burdened and extremely rent-burdened households (two or three tiers) and know where in the city they live. Most likely, this would require collaborating with Pasadena's Department of Housing. Once these households are mapped out, the next step would consist of evaluating their access to the existing local bus network and assessing what solutions Pasadena Transit could implement to better serve this group's needs.

There are other minor suggestions that this study finds relevant but that do not derive directly from its findings. Nonetheless, these are steps the transit agency could implement in the short term:

- Where have loyal riders been displaced to? They might have moved to areas within Pasadena currently underserved by transit, opening up potential for the restructuring of routes. This is unlikely (displaced residents probably wound up somewhere farther away from employment centers), but merits consideration and further analysis.

[39] Phrase taken from the title of a book by R. Fritz published in 2016. This is also the name of a campaign pushed forward by the City of West Hollywood, California (see weho.org).

- Analyzing in depth Routes 30 and 40, including onboard surveys and more in-detail data studies. The 2019 Short Range Transit Plan did some research on this front, but now this report suggests drilling down on Routes 30 and 40 specifically. These are two of the three most patronized routes, but have steadily lost riders *almost every year* since fiscal year 2009 (see Figures C-10 and C-11). To illustrate their critical state: last fiscal year (FY18) had these as the only two routes below their 2007 ridership levels (20-40% less). Service enhancements very specific to the context of each route might adapt service to the present needs of patrons living in the corridors served and ergo boost ridership.

All of these recommendations center on ***adapting to specific riders' needs***. This report emphasizes this idea because it embodies the cornerstone of Houston's and Seattle's recent successes in improving service and attracting riders, and it is also mentioned throughout the academic and professional literature as a "best practice" in the provision of public transit in the era of modern ridership decay.

For Pasadena Transit, which encountered mild declines in ridership despite its positive performance metrics and high levels of customer satisfaction, this report suggests further understanding the needs of existing and new participants of the city's transit market. The economic and demographic phenomena driving ridership fluctuations in Pasadena are beyond the Client's control, but still the Client can implement some measures to make the local ridership trend shift upward. Clever and focused marketing strategies, while collaborating with other city agencies, could strengthen an already robust transit system and take its performance metrics and user-oriented service to the next stop.

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Appendices

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Appendix A: Metro v. Pasadena

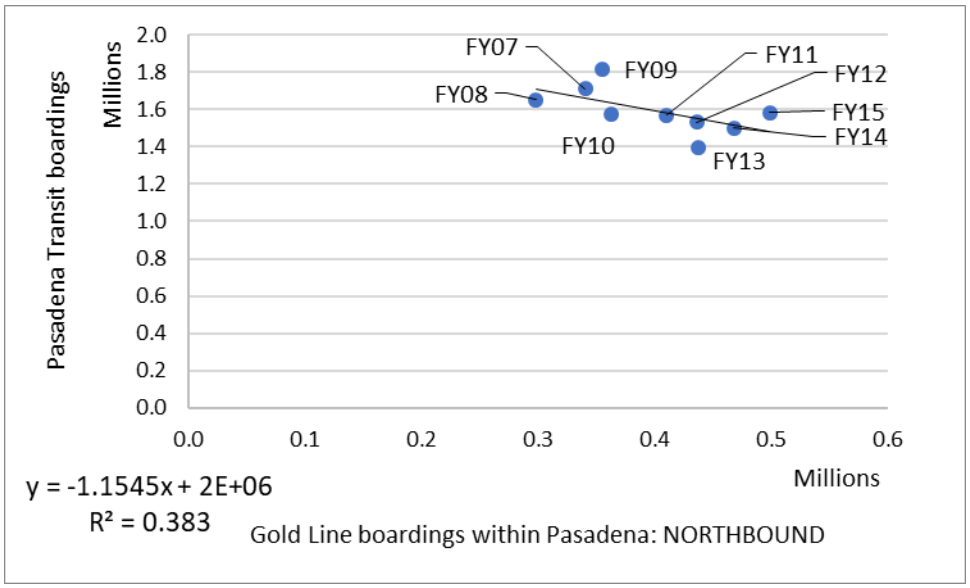

Figure A-1. Pasadena Transit vs. **Northbound** Gold Line; before Azusa extension: FY07 – FY15.

Data source: Pasadena Transit and L.A. Metro.

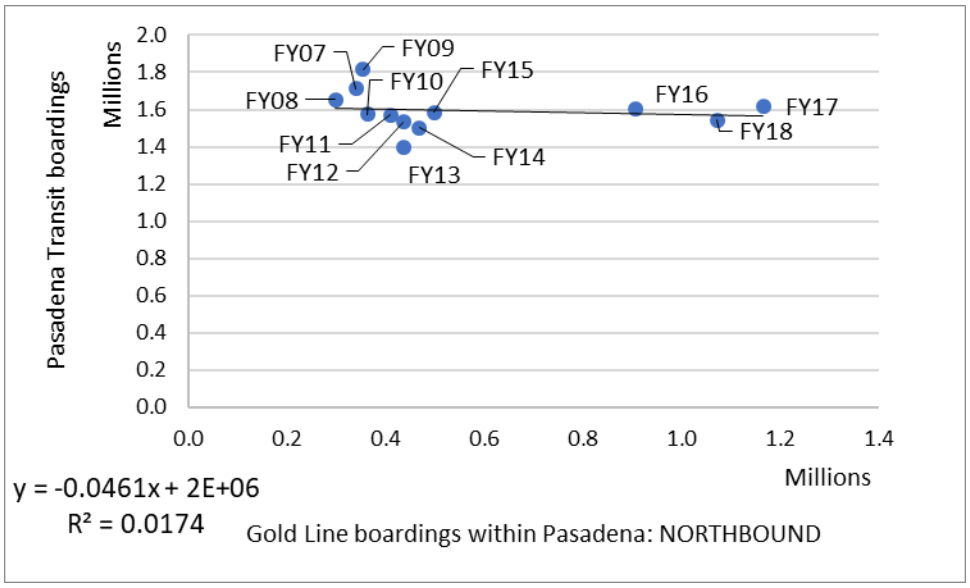

Figure A-2. Pasadena Transit vs. **Northbound** Gold Line; with Azusa extension: FY07 – FY18.

Data source: Pasadena Transit and L.A. Metro.

Note how the negative correlation with northbound Gold Line boardings (pure local travel before the Azusa extension opened) displayed in Figure A-1 fades away after the extension opens (see Figure A-2: R^2 under 0.02 and coefficient below 0.05). This is because the added

Gold Line ridership brought by the extension was accompanied with added ridership in Pasadena Transit, due in part to the extension, hence counteracting the negative effect caused by the Gold Line replacing Pasadena Transit trips.

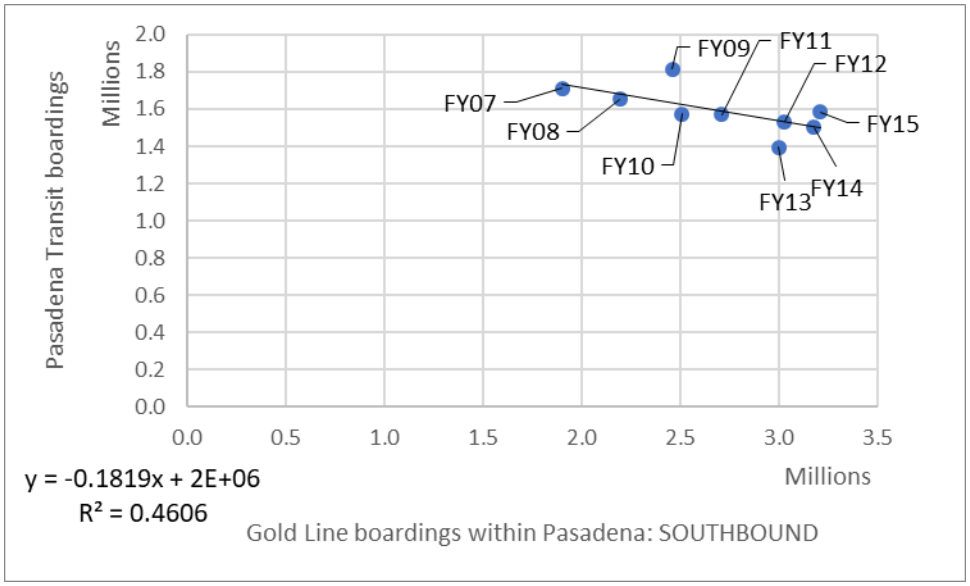

Figure A-3. Pasadena Transit vs. **Southbound** Gold Line; before Azusa extension: FY07 – FY15.

Data source: Pasadena Transit and L.A. Metro.

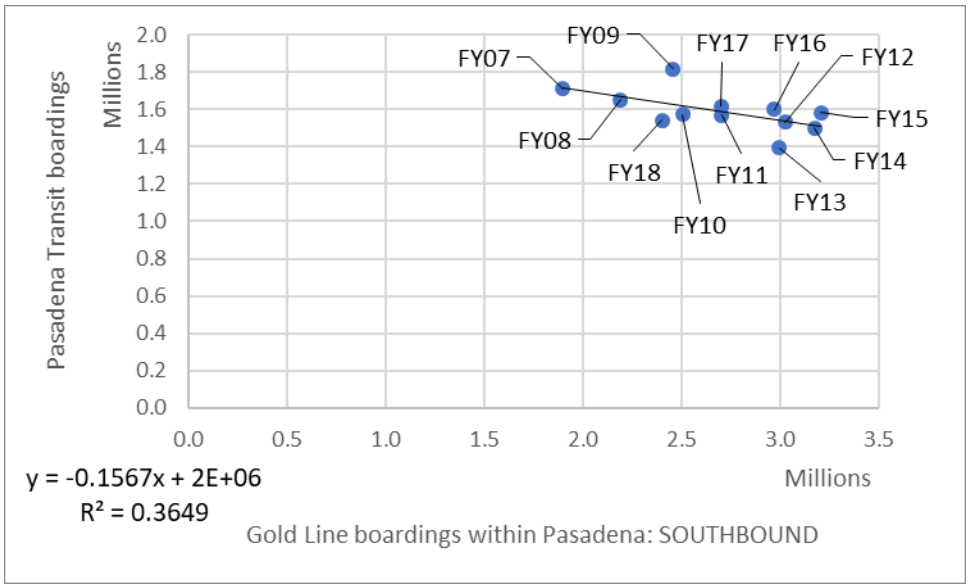

Figure A-4. Pasadena Transit vs. **Southbound** Gold Line; with Azusa extension: FY07 – FY18.

Data source: Pasadena Transit and L.A. Metro.

A similar but less disruptive behavior is observed with southbound Gold Line trips (see Figures A-3 and A-4).

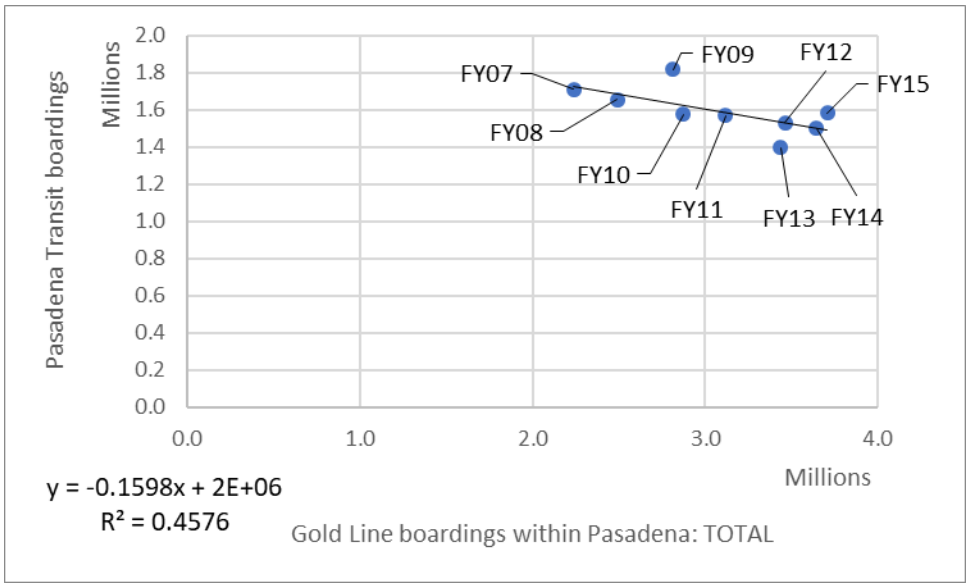

Figure A-5. Pasadena Transit vs. **Total** Gold Line (north- and southbound); before Azusa extension: FY07 – FY15.
Data source: Pasadena Transit and L.A. Metro.

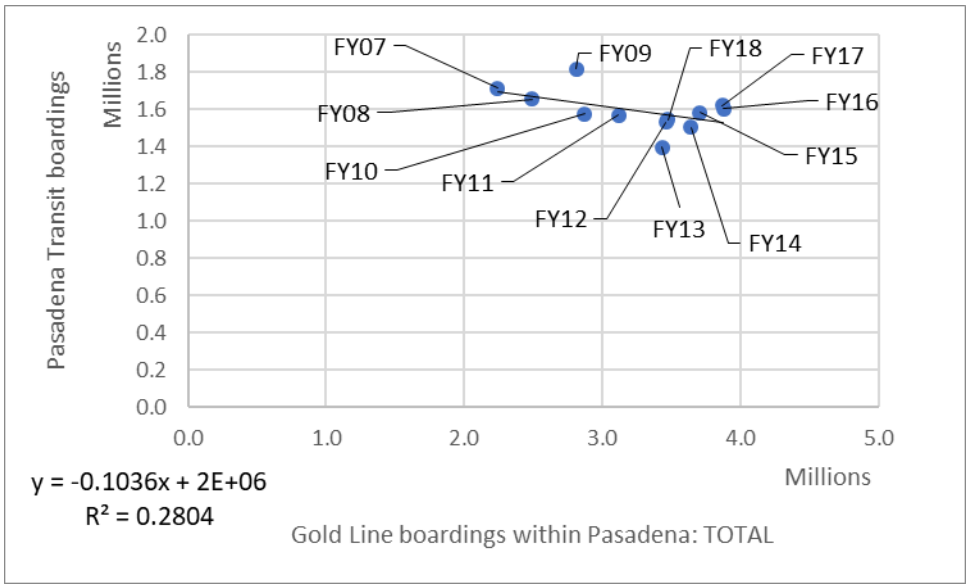

Figure A-6. Pasadena Transit vs. **Total** Gold Line (north- and southbound); with Azusa extension: FY07 – FY18.
Data source: Pasadena Transit and L.A. Metro.

Overall, the Gold Line remains a plausible substitute to Pasadena Transit, but less so after the extension opened (see Figures A-5 and A-6), likely because the Gold Line started serving

a wider market that includes trips other than just intra-Pasadena trips and Pasadena-to-Downtown trips, and those are trips that Pasadena Transit does not offer, hence reducing competition.

A.1. Metro Bus

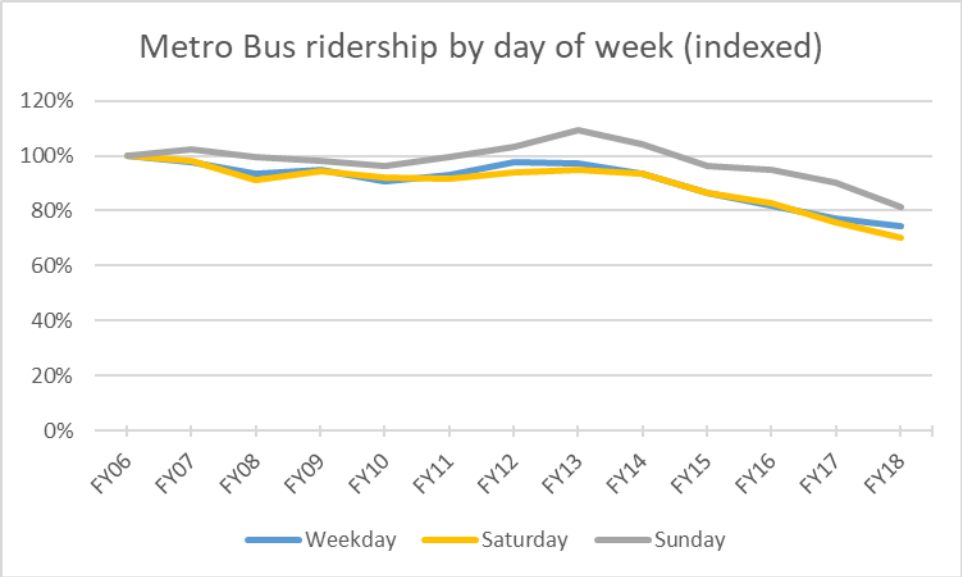

Figure A-7. Metro Bus ridership within Pasadena, by day of week.
Data source: L.A. Metro.

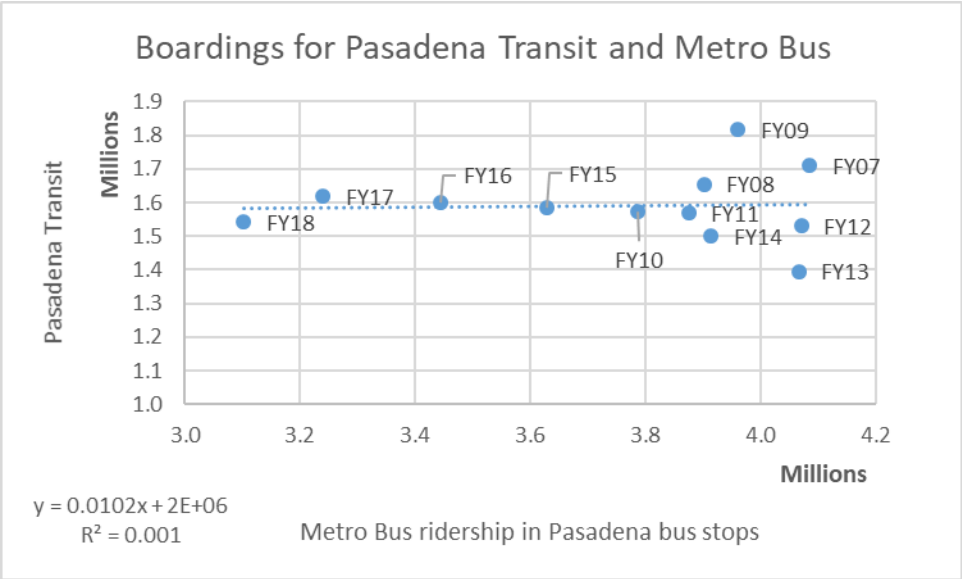

Figure A-8. Correlation between Pasadena Transit's ridership and Metro Bus' Pasadena ridership.
Data sources: Pasadena Transit and L.A. Metro.

Remarkably, per Figure A-7, Sunday service rose between FY10 and FY13, whereas weekday and Saturday service flattened in the same period. All service started falling considerably on FY13, and the trend appears to still remain.

Figure A-8 shows that Metro Bus has a weak correlation with Pasadena Transit, in terms of ridership, to the point that Metro Bus experienced dramatic drops in patronage when Pasadena Transit had slight increases (notice how the points go left from FY15 onward).

Metro Bus boardings within Pasadena were obtained by associating each stop on a Metro Bus GIS shapefile with its corresponding ridership and selecting only those stops located within Pasadena city limits.

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Appendix B: Pasadena v. Pasadena

Note that, throughout Appendix B, most graphs display two data series on ***two different scales*** due to the difference in magnitude.

B.1. Total service

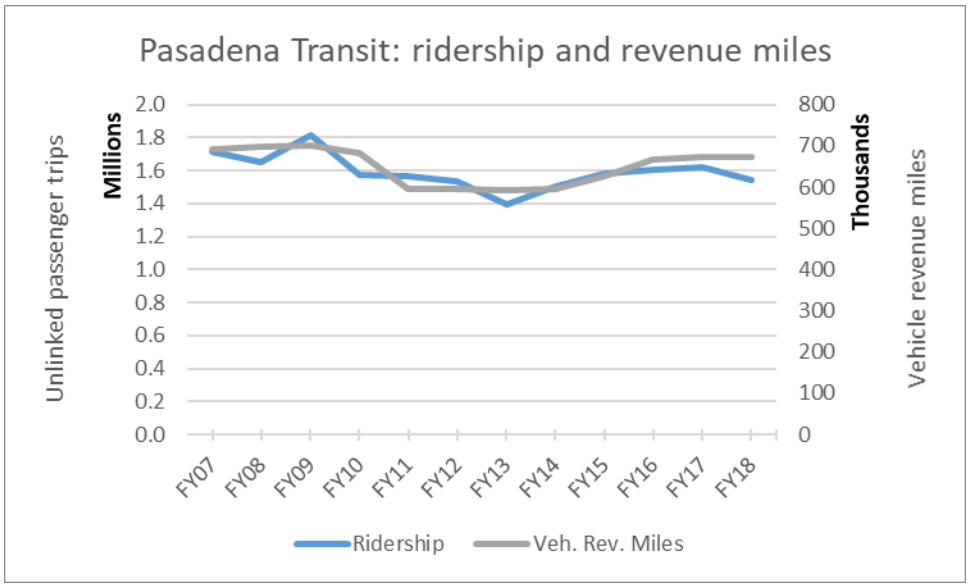

Figure B-1. Pasadena Transit's **total** ridership and vehicle revenue miles.
Data source: Pasadena Transit.

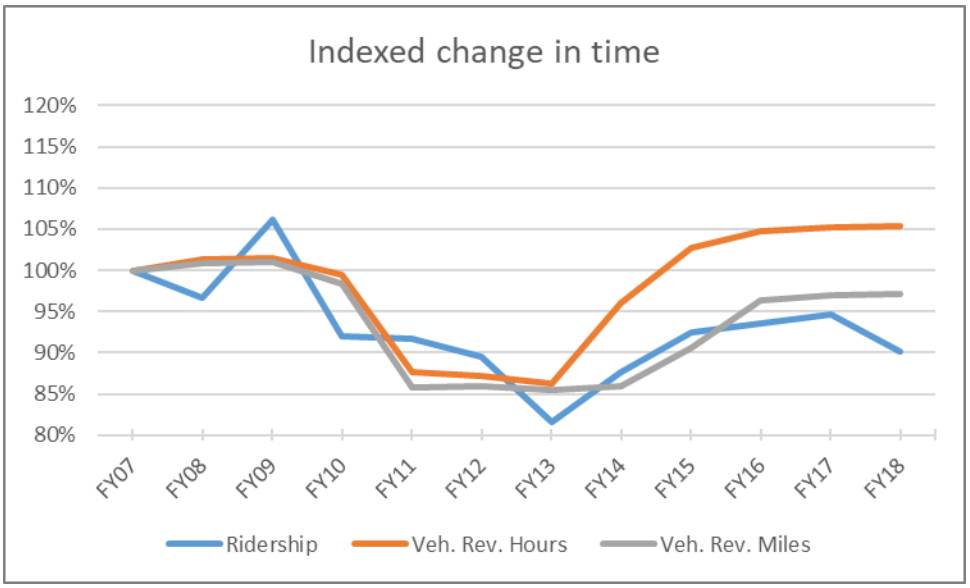

Figure B-2. Pasadena Transit's **total** ridership and vehicle revenue miles and hours, indexed to FY07.
Data source: Pasadena Transit.

Generally, changes in service follow changes in ridership (or vice versa); e.g., more service would usually result in more ridership. However, 2018 diverged from this trend (see Figures B-1 and B-2).

B.2. Weekday service

Similar trends as those for the system overall are observed.

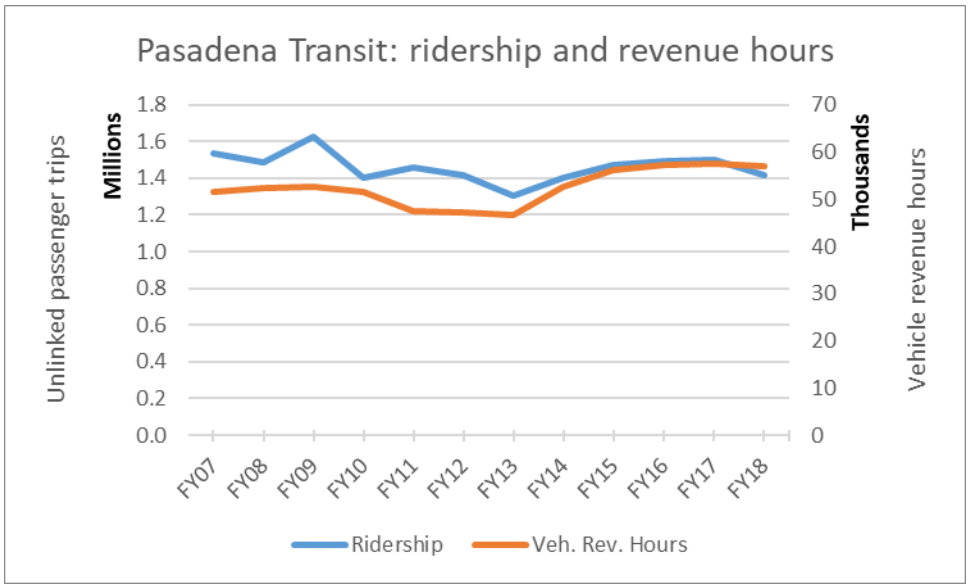

Figure B-3. Pasadena Transit's **weekday** ridership and vehicle revenue hours.
Data source: Pasadena Transit.

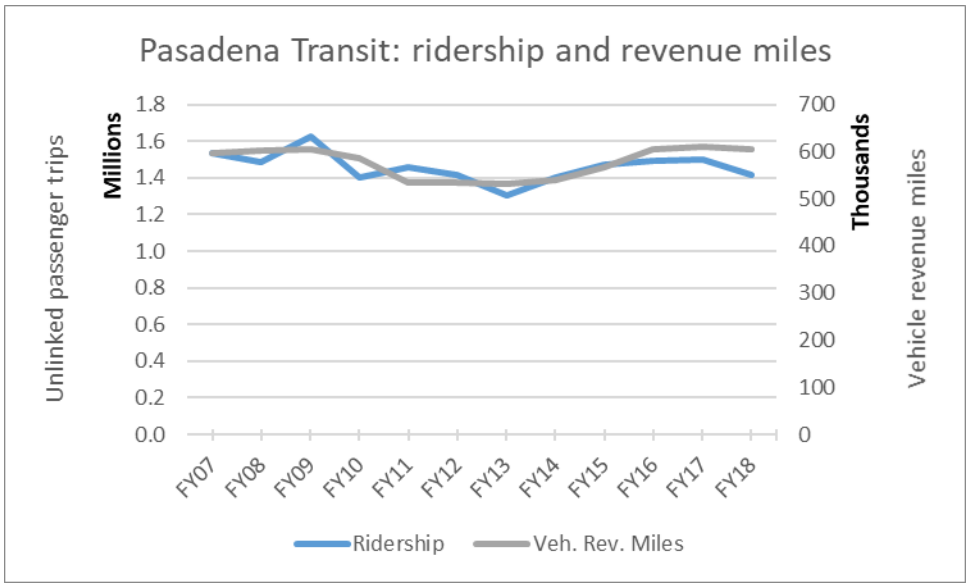

Figure B-4. Pasadena Transit's **weekday** ridership and vehicle revenue miles.
Data source: Pasadena Transit.

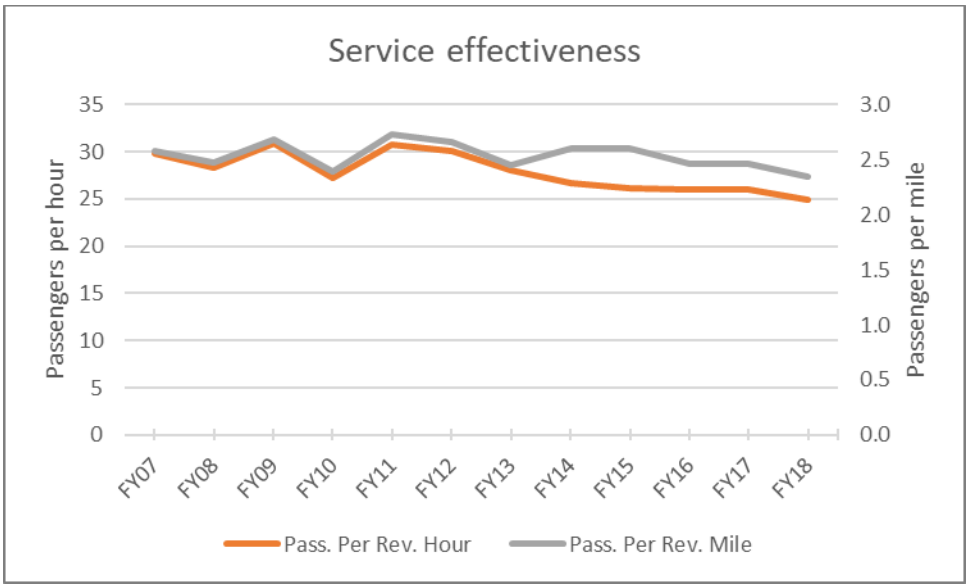

Figure B-5. Pasadena Transit's **weekday** service effectiveness.
Data source: Pasadena Transit.

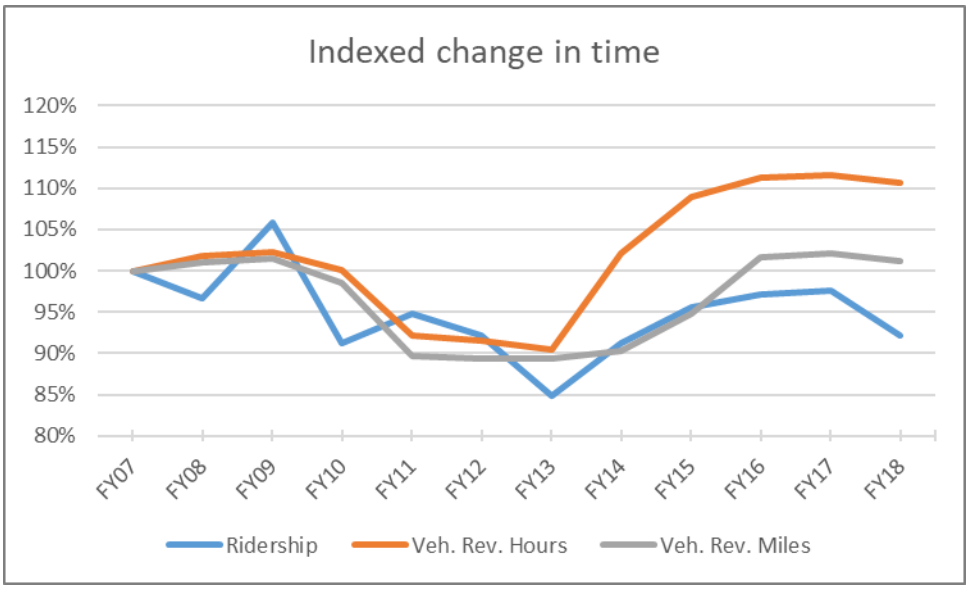

Figure B-6. Pasadena Transit's **weekday** ridership and vehicle revenue miles and hours, indexed to FY07.
Data source: Pasadena Transit.

B.3. Saturday service

Saturday ridership appears less sensitive to changes in service quantity, perhaps because it is more susceptible to macro changes (weekend travel is more expendable than weekday travel). Also notable, Saturday service effectiveness generally rose between FY13 and FY17; FY18 saw a drop.

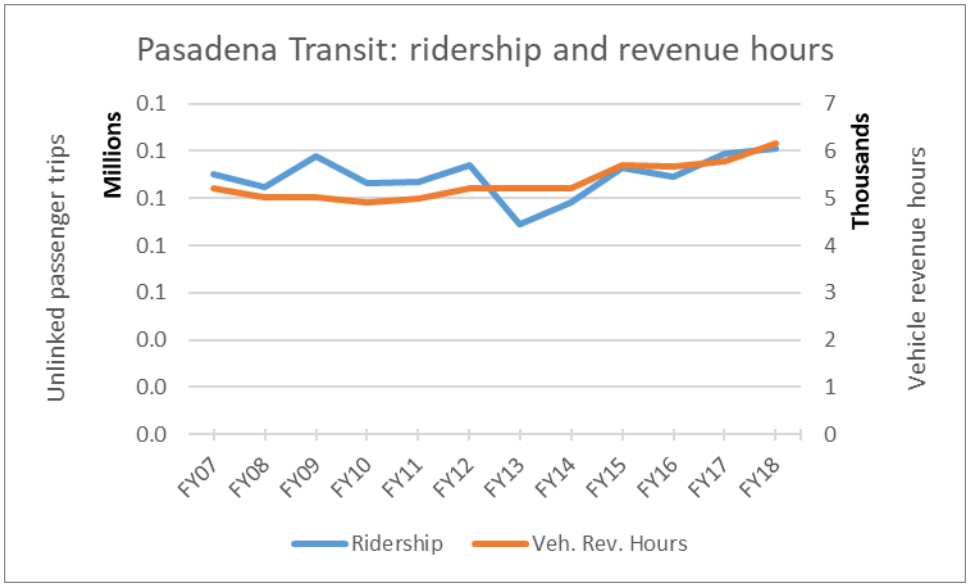

Figure B-7. Pasadena Transit's **Saturday** ridership and vehicle revenue hours.
Data source: Pasadena Transit.

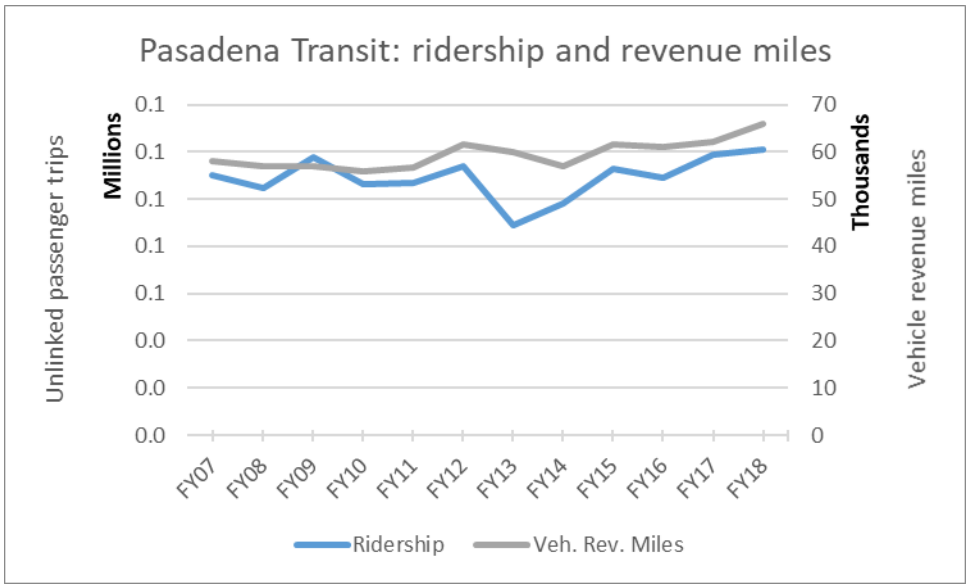

Figure B-8. Pasadena Transit's **Saturday** ridership and vehicle revenue miles.
Data source: Pasadena Transit.

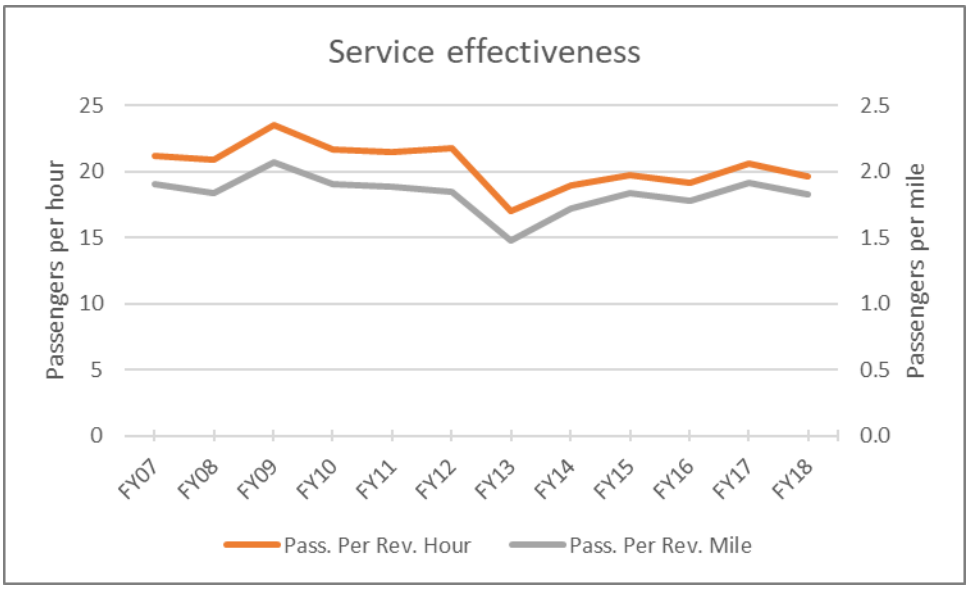

Figure B-9. Pasadena Transit's **Saturday** service effectiveness.
Data source: Pasadena Transit.

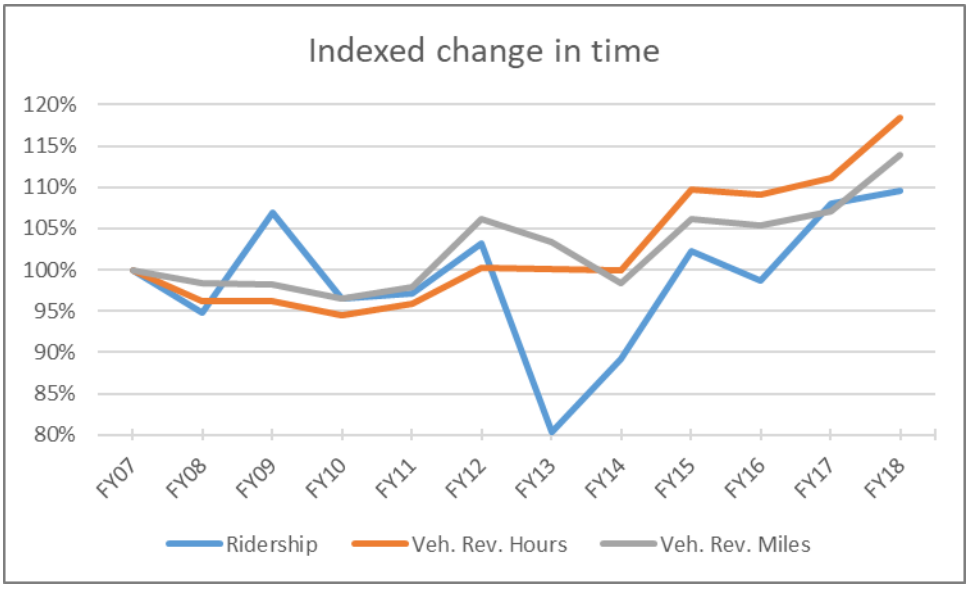

Figure B-10. Pasadena Transit's **Saturday** ridership and vehicle revenue miles and hours, indexed to FY07.
Data source: Pasadena Transit.

B.4. Other performance metrics

Service "speed" (the ratio of vehicle revenue miles to vehicle revenue hours) has remained relatively constant, around an average of 11 mph (see Figure B-11 below).

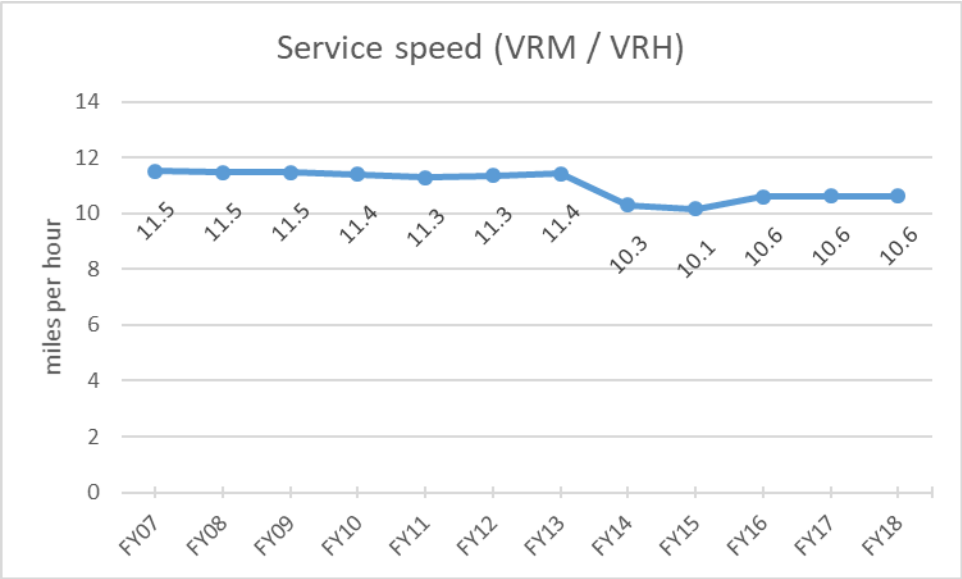

Figure B-11. Pasadena Transit's **average** service speed.
The overall, 12-year average equals 11 mph. Data source: Pasadena Transit.

Figures B-12 and B-13 (below) show that, as expected, added service brings more ridership. However, ***this alone does not suffice***. For example, an extra revenue hour (without controlling for anything else) adds only 13 trips. The Client's standard is 10 passengers per hour for feeder lines and 26 for local lines; thus, 13 passenger-trips per added hour is not good enough.

Also noteworthy, revenue miles have a stronger influence on ridership (R^2 of 0.58) than do revenue hours (R^2 of 0.28). Furthermore, if the average speed (11 mph) is applied, equivalent revenue miles increase ridership more. To illustrate this, Figure B-12 suggests that an extra 10 revenue hours adds **128 trips**. Ten hours, at 11 mph, is equivalent to **110 miles**. However, Figure B-13 suggests that an extra **100 revenue miles** adds **180 trips** (less equivalent miles needed to attract more trips). One hundred revenue miles is equivalent to 9 hours (at 11 mph), thus yielding an effectiveness of 180 trips per 9 hours, or 20 passenger-trips per revenue hour. Thus, these data suggest that expanding coverage rather than frequency might have greater positive effects on ridership. However, please note this charts are not controlling for any other variable.

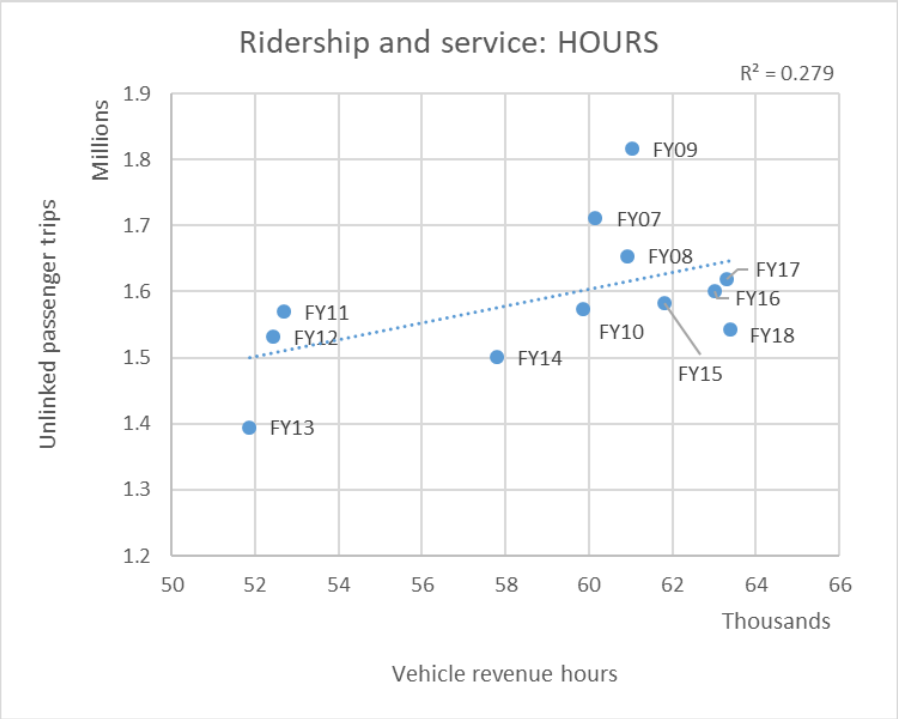

Figure B-12. Correlation between ridership and service hours (+12.8 trips per added hour).

Data source: Pasadena Transit.

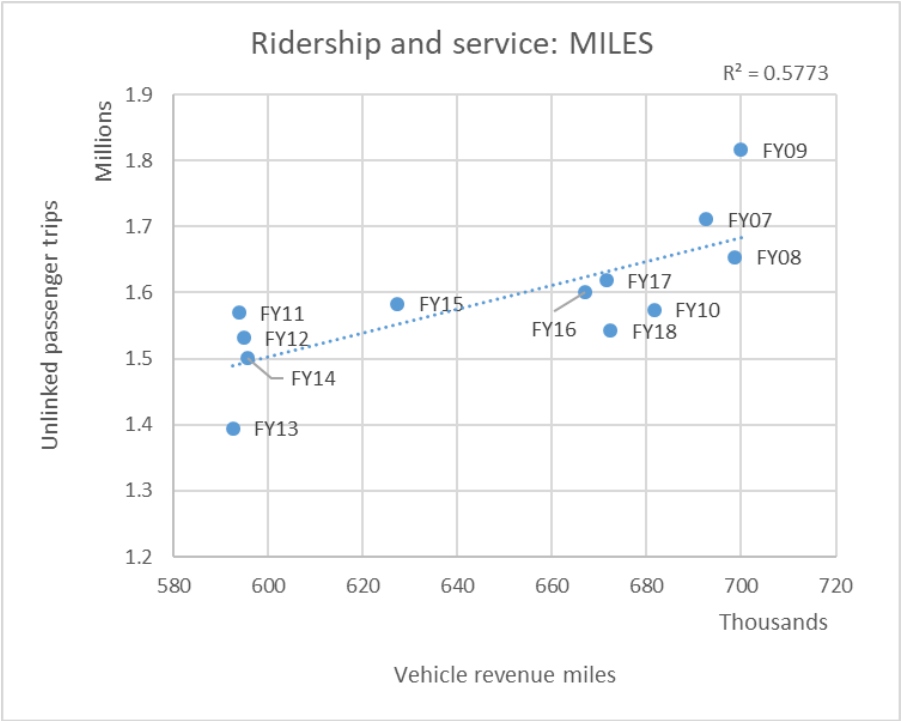

Figure B-13. Correlation between ridership and service miles (+1.8 trips per added mile).

Data source: Pasadena Transit.

Appendix C: Pasadena Transit routes

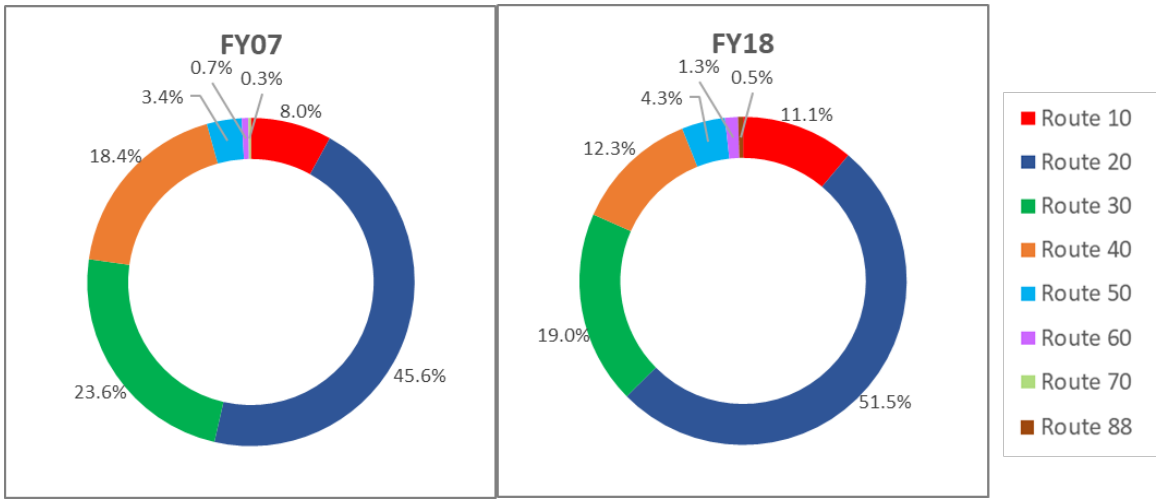

Figure C-1. Ridership distribution by route: two snapshots.
This figure shows how Routes 30 and 40 lost ground to the three smallest routes and to the biggest one. Complement this with Figure C-17. Data source: Pasadena Transit.

Figures C-2 through C-7 illustrate more closely how ridership has changed in the different routes. Other graphs on this matter (here and in the body of the report) do not zoom in close enough. Notice the different orders of magnitude among these graphs.

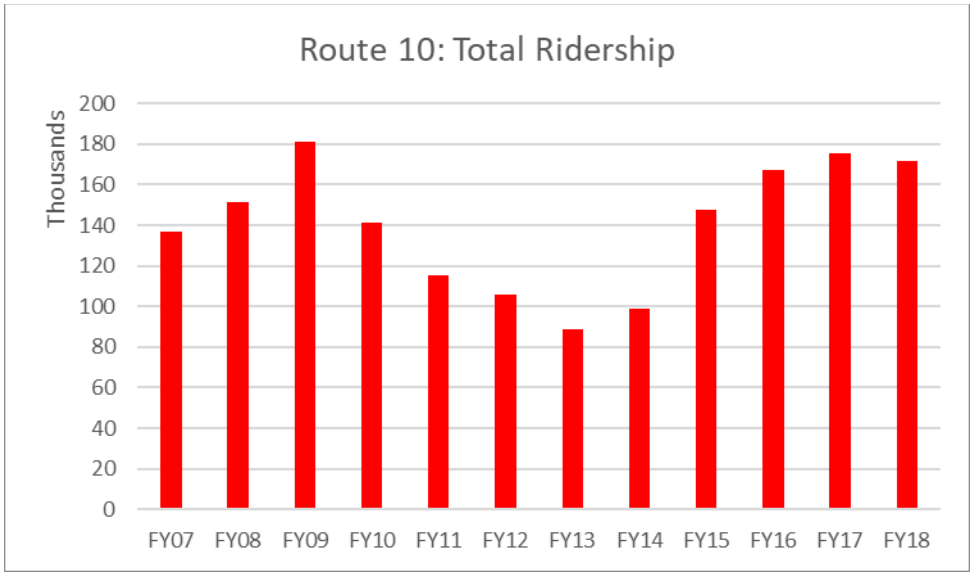

Figure C-2. Total ridership on Route 10.
Data source: Pasadena Transit.

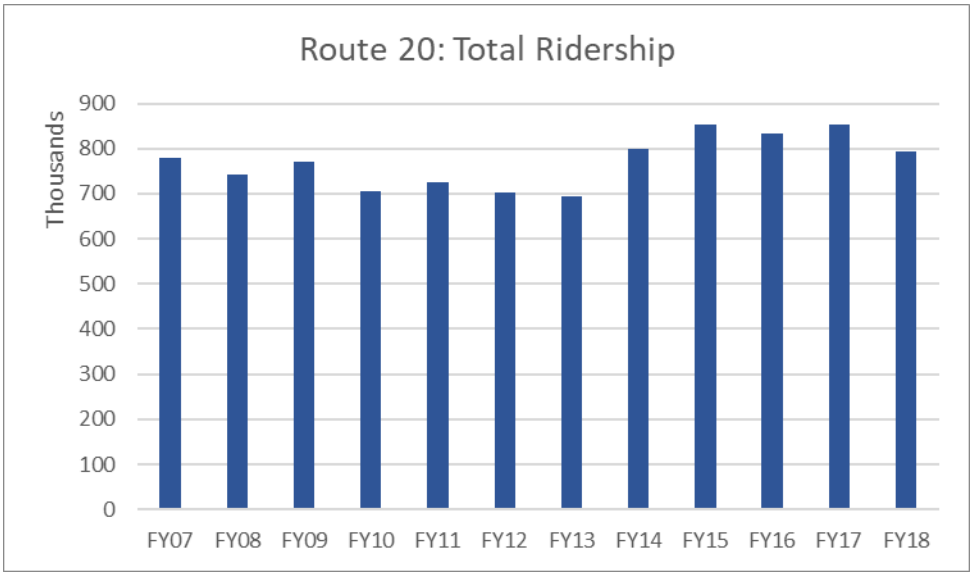

Figure C-3. Total ridership on Route 20.
Data source: Pasadena Transit.

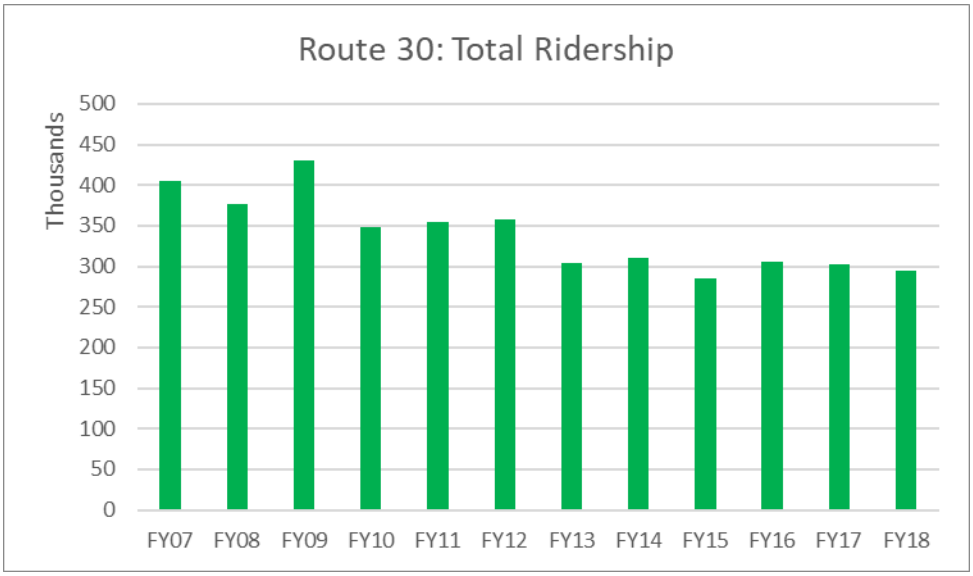

Figure C-4. Total ridership on Route 30.
Data source: Pasadena Transit.

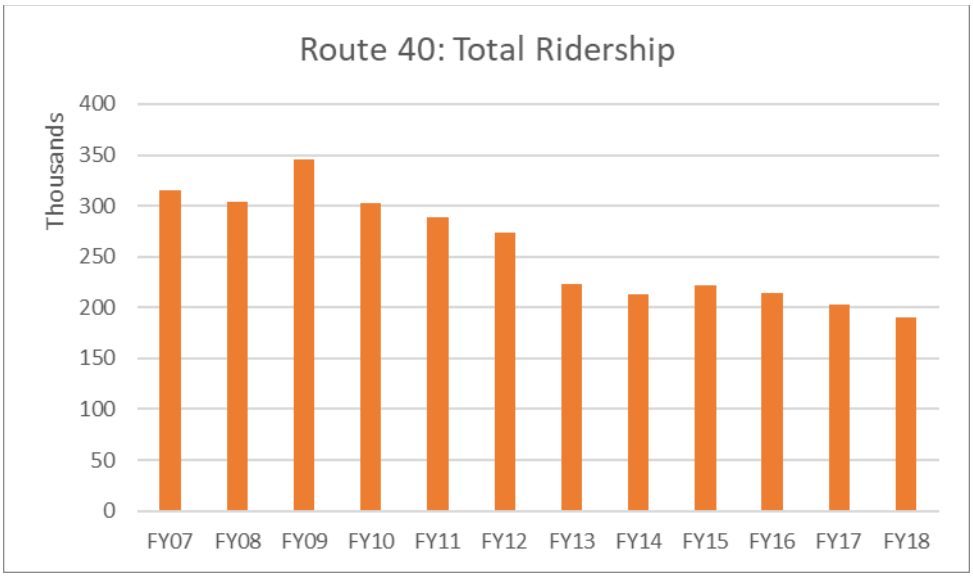

Figure C-5. Total ridership on Route 40.
Data source: Pasadena Transit.

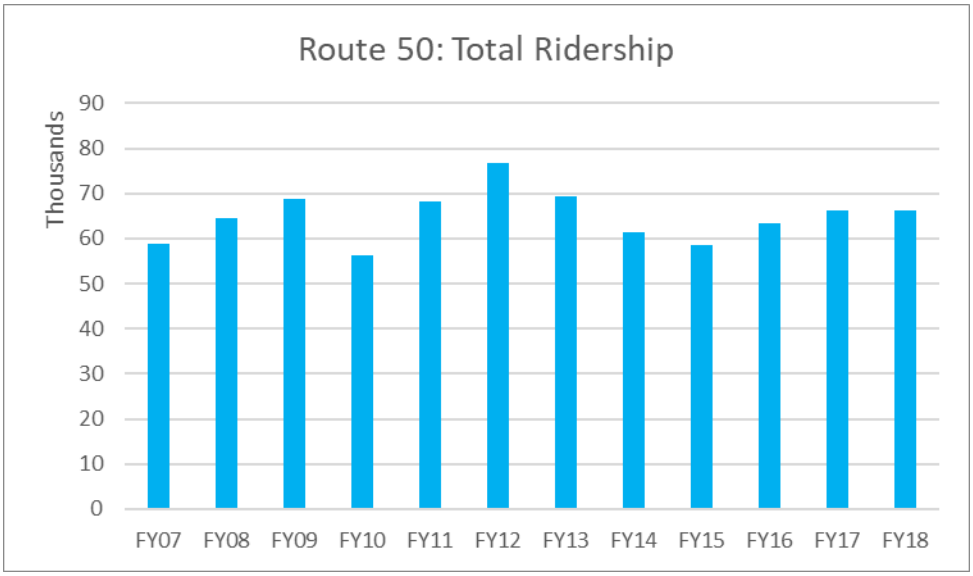

Figure C-6. Total ridership on Route 50.
Data source: Pasadena Transit.

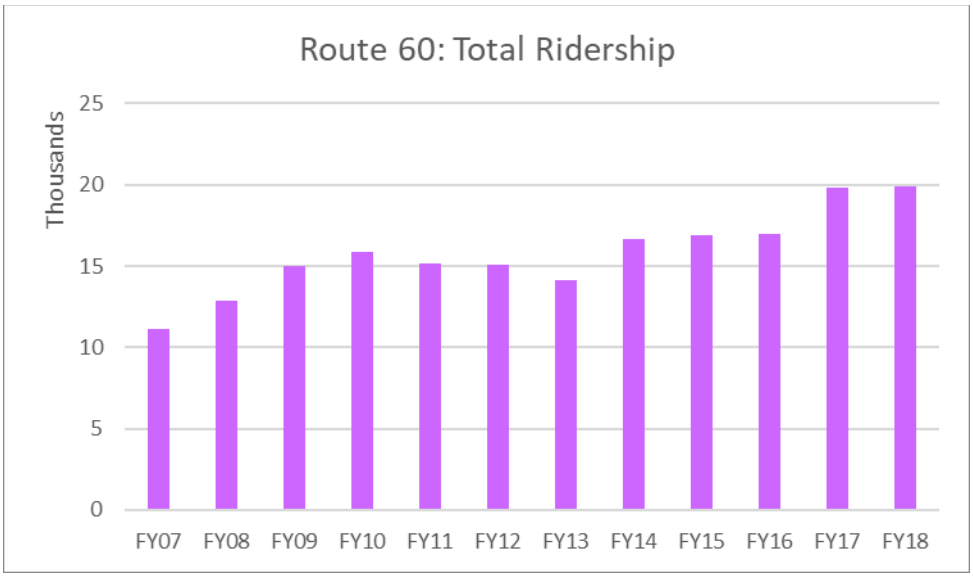

Figure C-7. Total ridership on Route 60.
Data source: Pasadena Transit.

Figures C-8 through C-14 show the change in absolute ridership: each year's bar shows *its* ridership *minus* that of the previous year. See discussion in Section 5.2.2. ***Routes*** for more details. Notice the different orders of magnitude among these graphs as well.

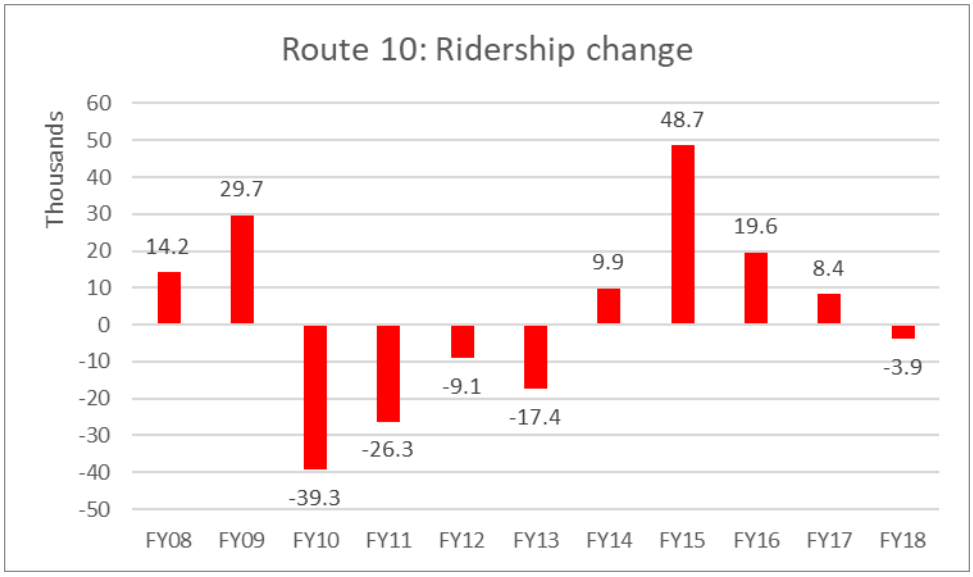

Figure C-8. Ridership change on Route 10 relative to the previous year.
Data source: Pasadena Transit.

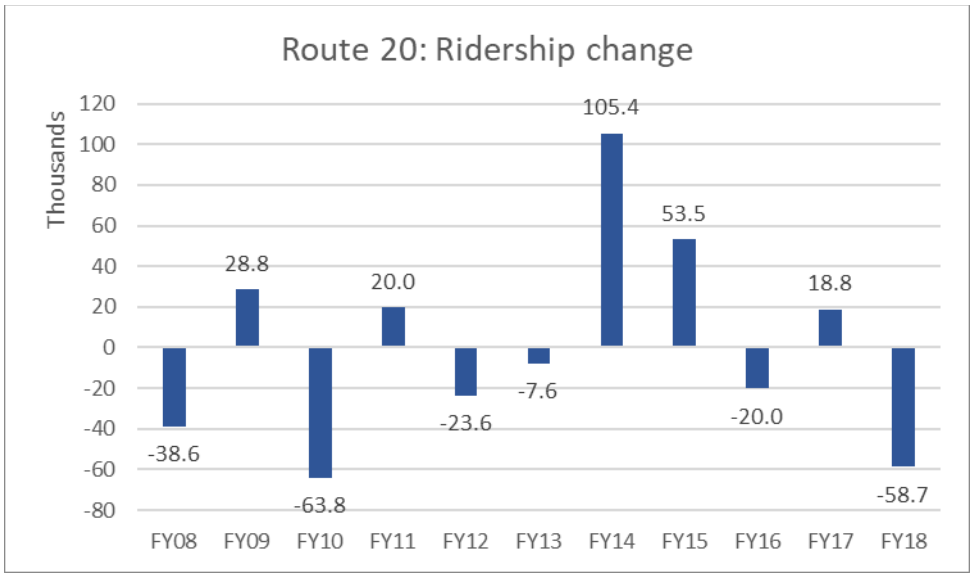

Figure C-9. Ridership change on Route 20 relative to the previous year.
Data source: Pasadena Transit.

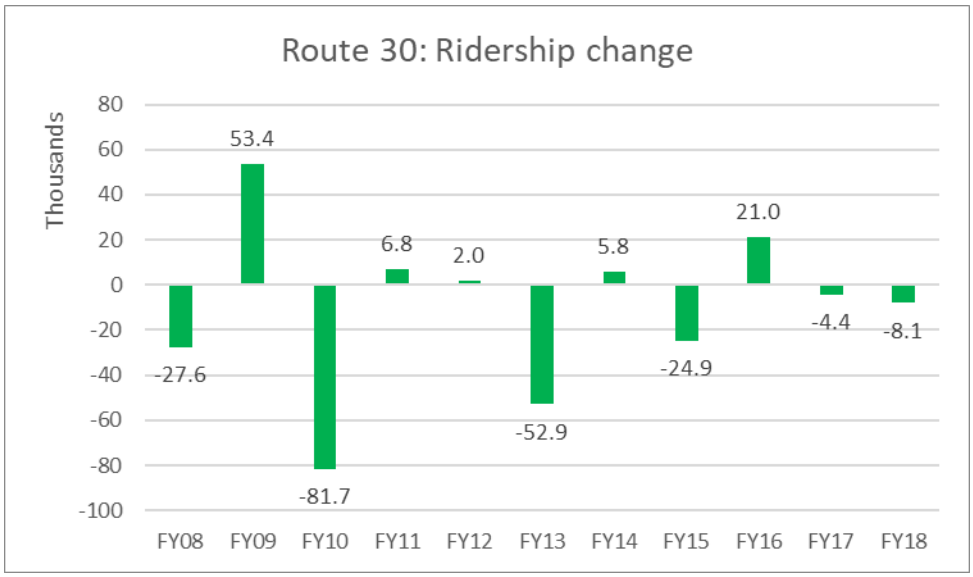

Figure C-10. Ridership change on Route 30 relative to the previous year.
Data source: Pasadena Transit.

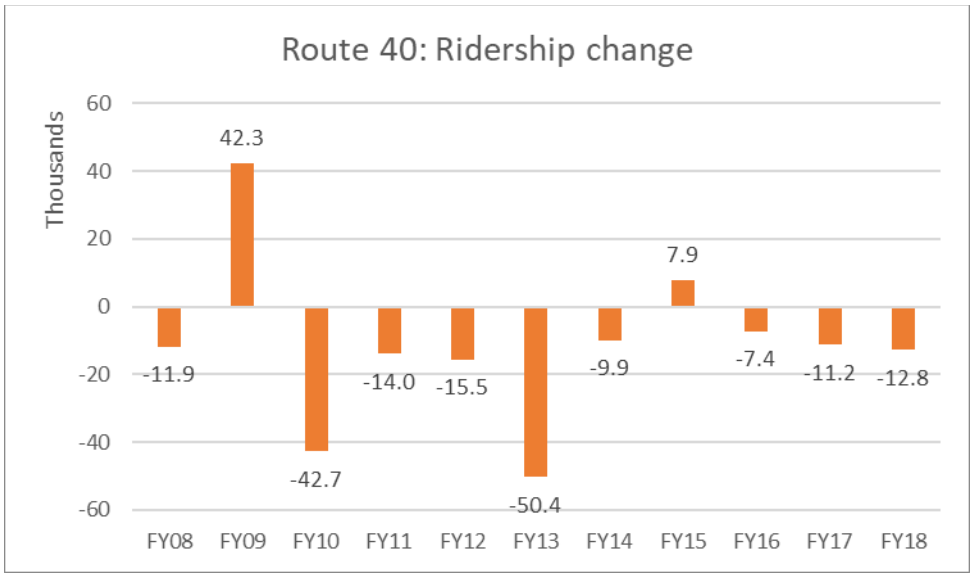

Figure C-11. Ridership change on Route 40 relative to the previous year.
Data source: Pasadena Transit.

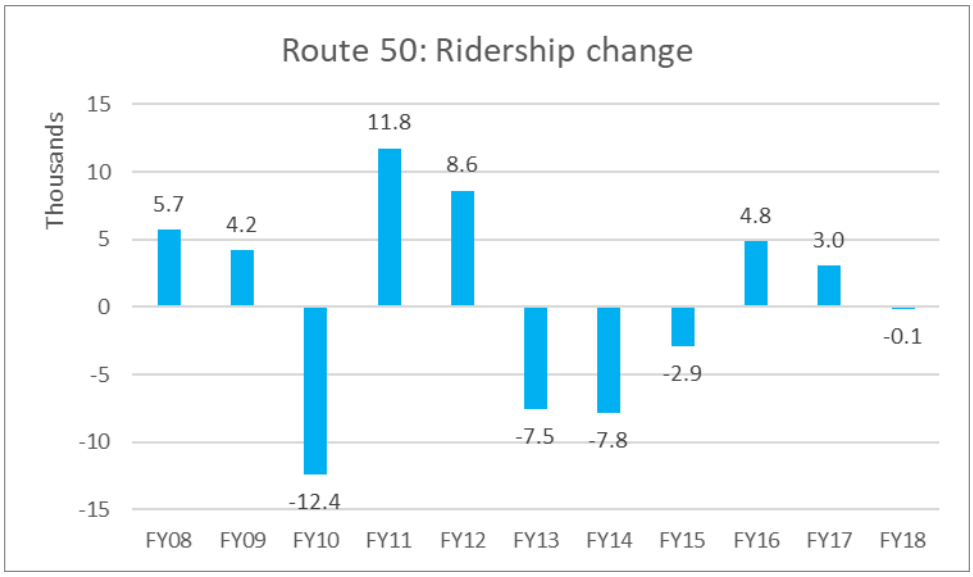

Figure C-12. Ridership change on Route 50 relative to the previous year.
Data source: Pasadena Transit.

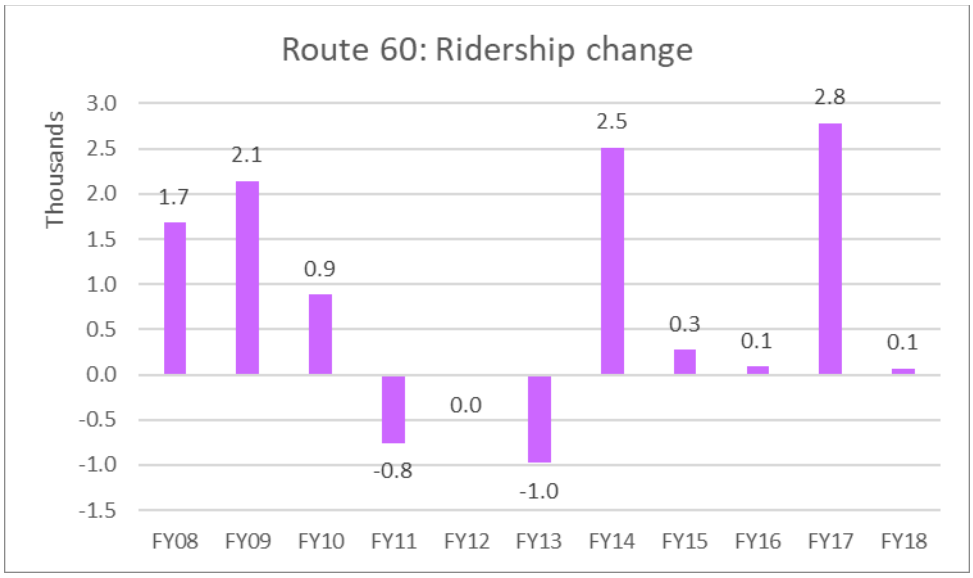

Figure C-13. Ridership change on Route 60 relative to the previous year.
Data source: Pasadena Transit.

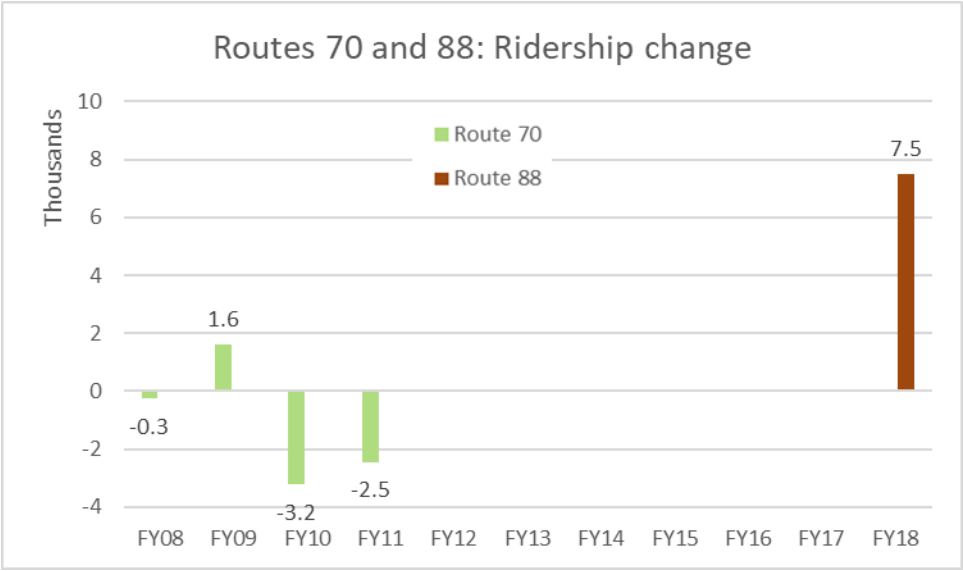

Figure C-14. Ridership change on Routes 70 and 88 (currently discontinued) relative to the previous year.
Data source: Pasadena Transit.

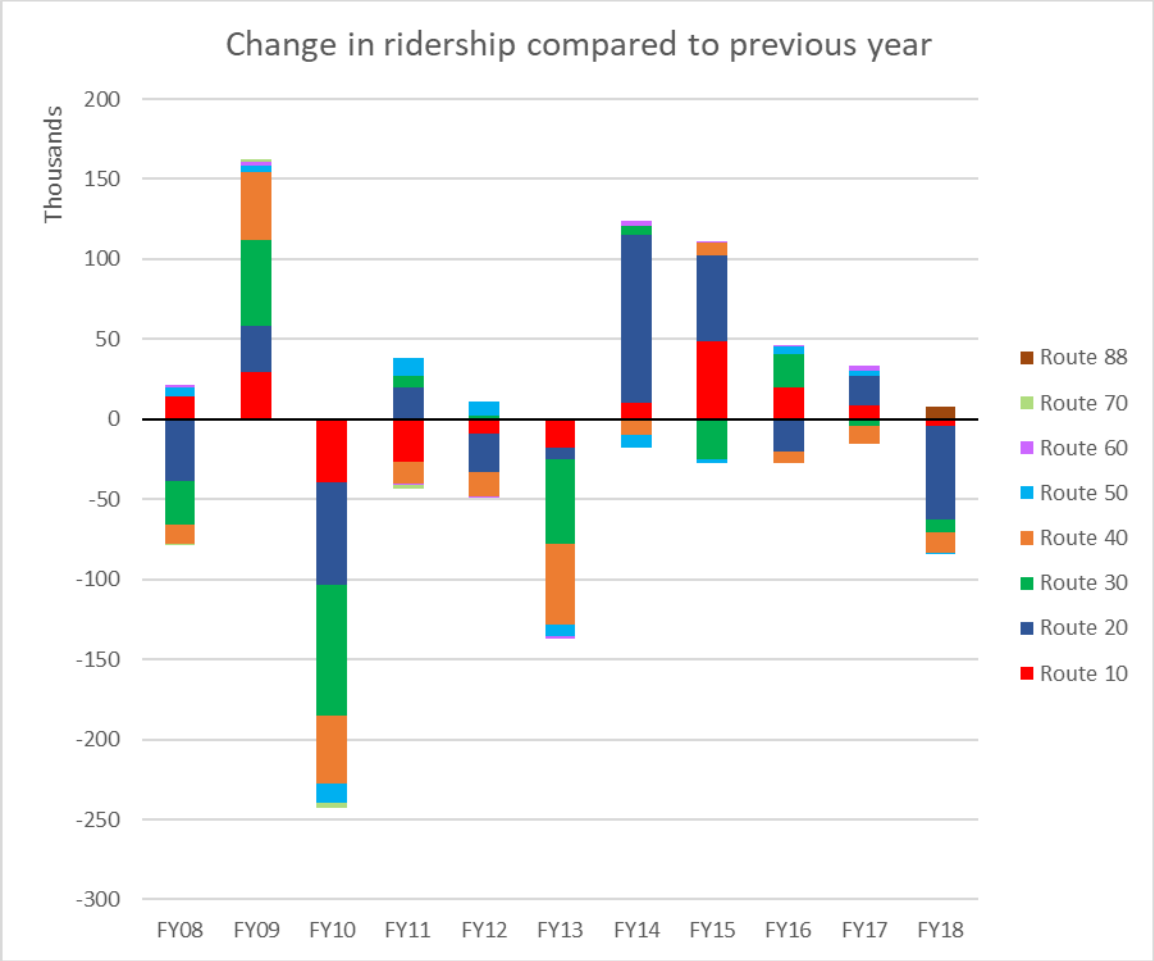

Figure C-15. Breakdown by route of ridership change in the system, relative to the previous year.
Data source: Pasadena Transit.

The concept here on Figure C-15 is the same as Figures C-8 through C-14, but for the system; with the added perk that the "delta" shows how much of the gain (or loss) was generated by each route. The smaller routes are hard to visualize here so, for those, refer to Figures C-8 through C-14.

Notice how, for each fiscal year, part of the bar is above the X-axis and another part is below it. These are the routes that gained ridership (above X-axis) and the routes that lost ridership (below). When the above part of the bar is longer than the one below, then the system *gained* riders overall (and vice versa). For example, look at FY14: most of the gain (in absolute ridership) came from Route 20 and the losses were on Routes 40 and 50. The other three routes contributed with minor gains as well. That year, Route 20 alone outweighed the minor ridership losses experienced by Routes 40 and 50, yielding an overall ridership increase in the system. Pair this with Figures C-8 through C-14 for a zoom into each bar's route components.

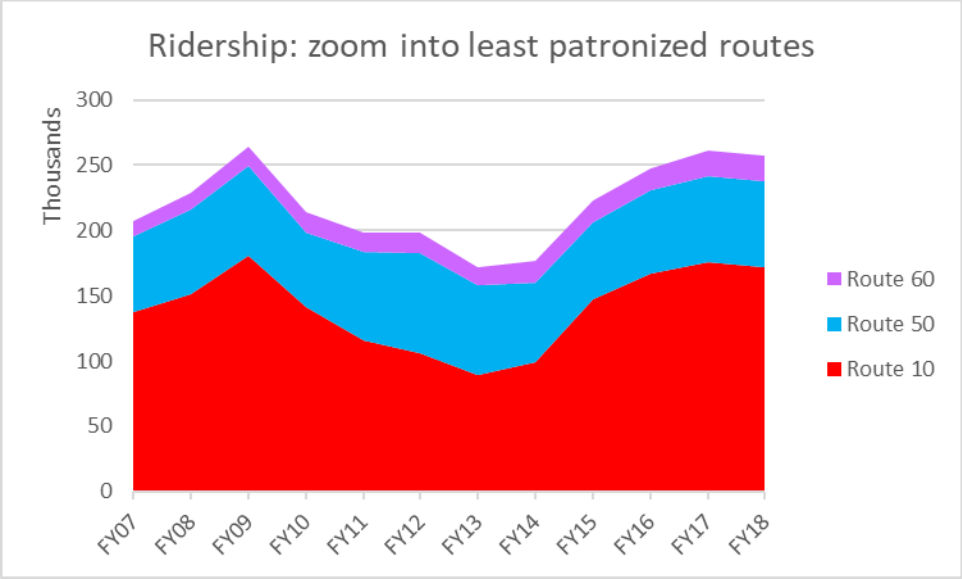

Figure C-16. Distribution of ridership between the three smallest routes.
Data source: Pasadena Transit.

The graph on the report body (Figure 18) blurs out these routes because their ridership is very small compared to the top three routes. Thus, in Figure C-16 it is easier to appreciate how all three "band widths" expanded since, at least, FY15.

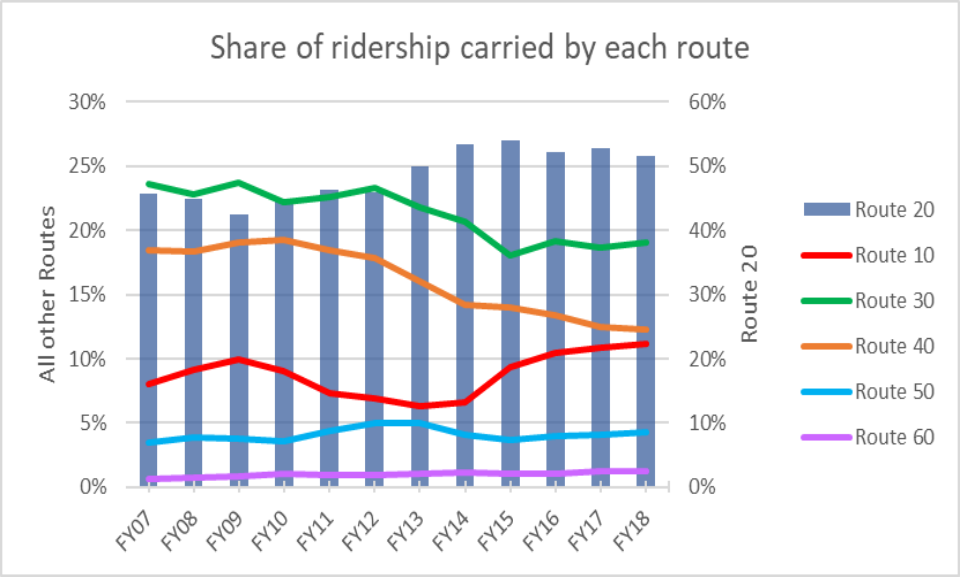

Figure C-17. Timeline of each route's share of ridership.
Note there are two scales. Complement this graph with Figure C-1. Data source: Pasadena Transit.

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Appendix D: Vehicle access

Figures D-1 through D-4 complement the discussion on Section 5.4 of the report body (***Vehicle access***) by showing the absolute value of the share of each "ownership bracket" as opposed to percent/indexed changes. Please refer to the body for a discussion of these.

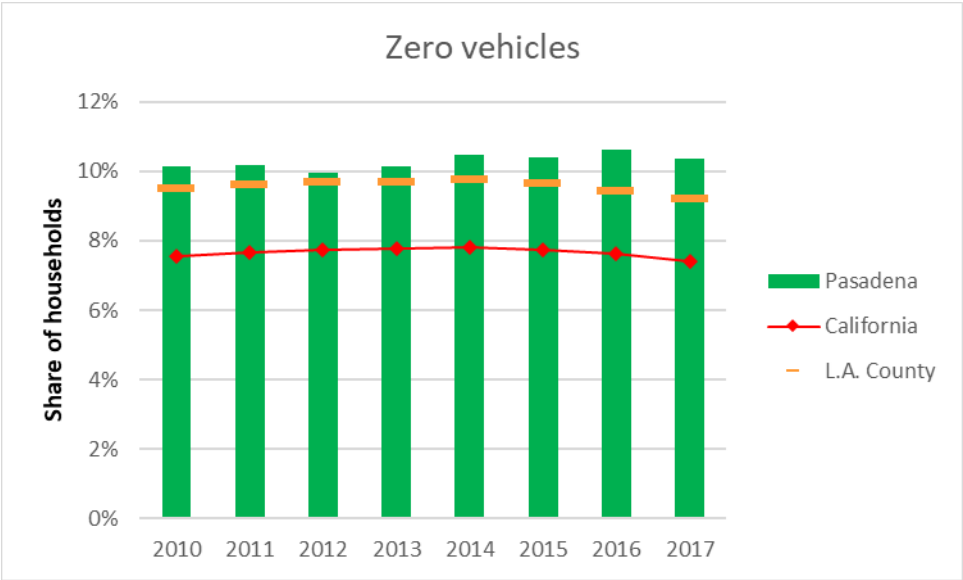

Figure D-1. Share of zero-vehicle households.
Data source: U.S. Census Bureau.

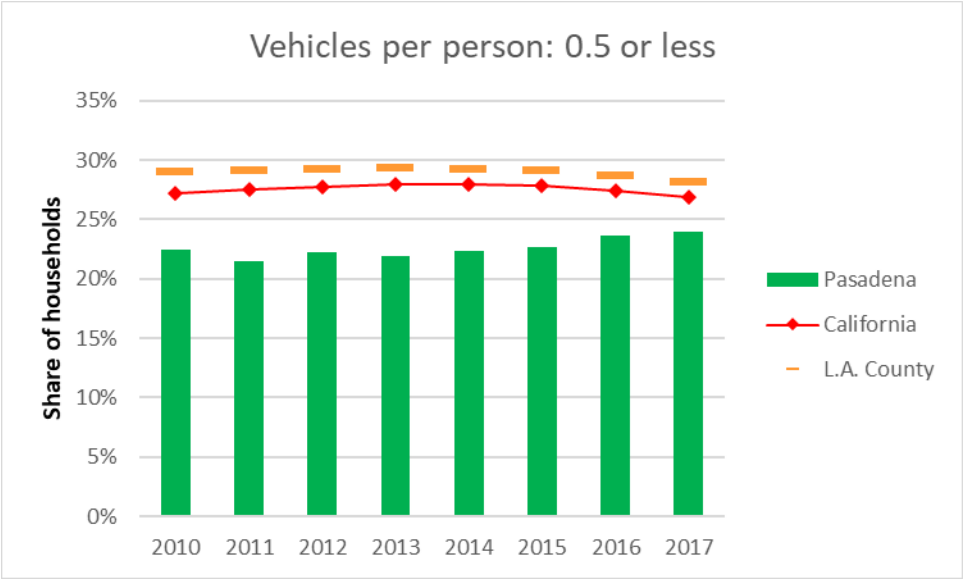

Figure D-2. Share of vehicle-deficient households (0.5 or less).
Data source: U.S. Census Bureau.

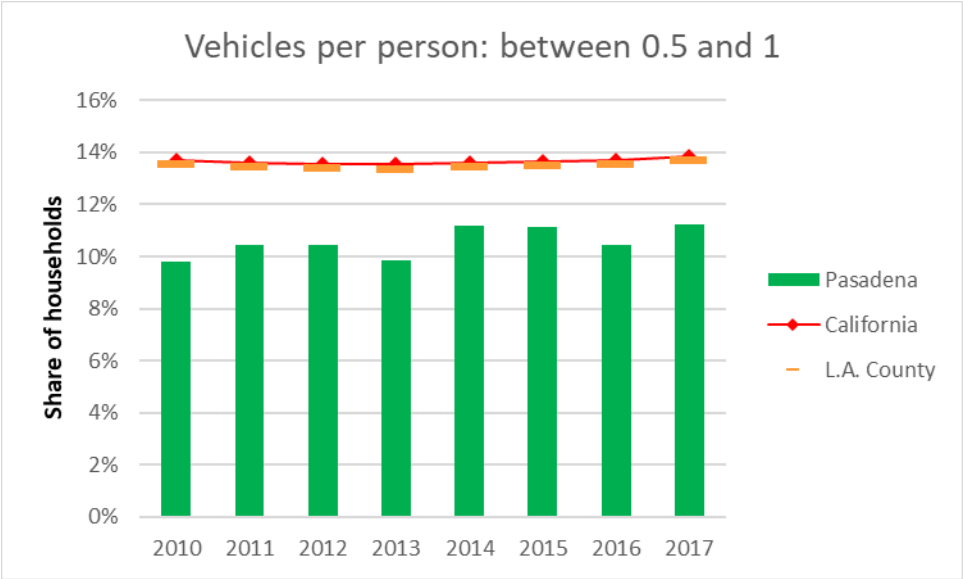

Figure D-3. Share of vehicle-deficient households (0.5 to 1).
Data source: U.S. Census Bureau.

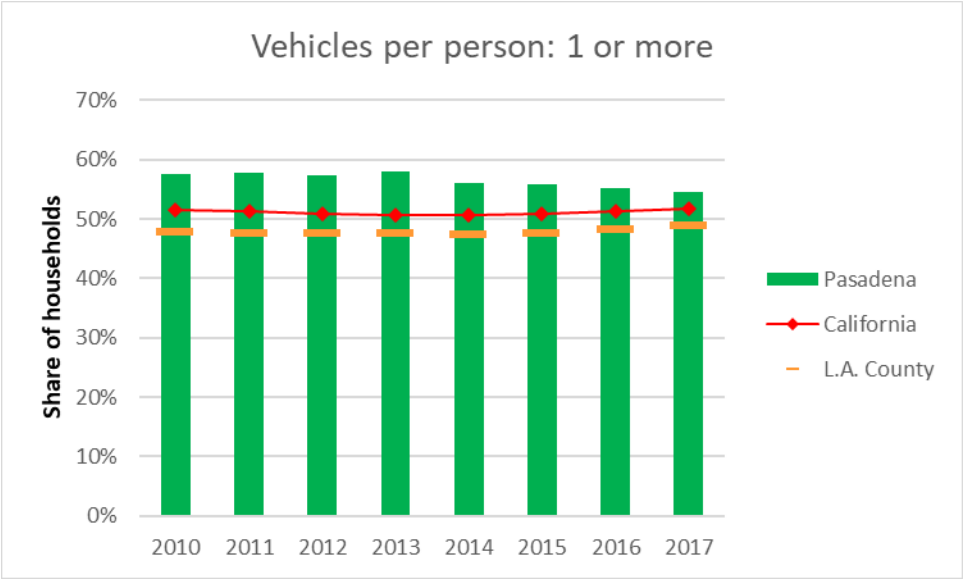

Figure D-4. Share of households with one or more vehicles per person.
Data source: U.S. Census Bureau.

Figures D-5 and D-6 (below) show how the two components of the vehicles-to-adults ratio changed with time in California, L.A. County, and Pasadena. Pasadena lags behind in growth of driving-age population and is actually shrinking its absolute vehicle stock. Meanwhile, California and L.A. County are competing for who emits the most carbon dioxide by means of vehicle-miles travelled, with California ahead in the competition.

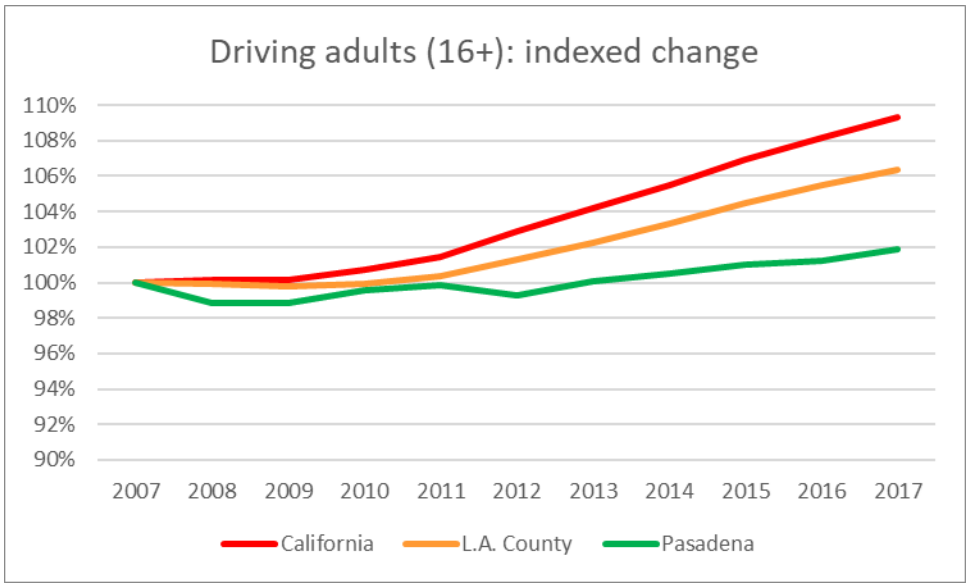

Figure D-5. Population 16 years of age or older, indexed to 2007.
Data source: U.S. Census Bureau.

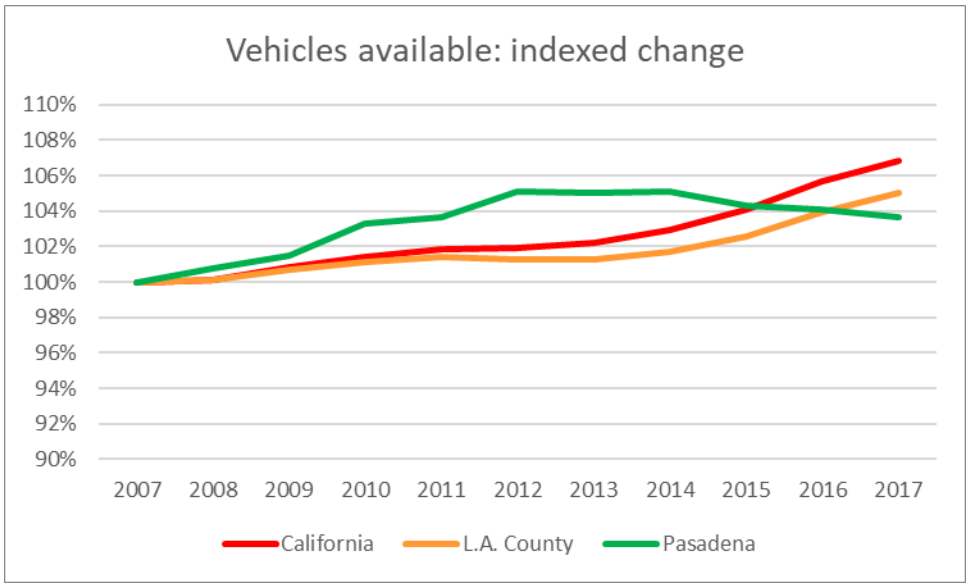

Figure D-6. Number of vehicles available, indexed to 2007.
Data source: U.S. Census Bureau.

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Appendix E: Journey to work

Figures E-1 through E-7 show the absolute value of the shares of commuters that travel to work by each mode. Complement the observations on the caption of these figures with what Figures E-8 through E-14 display.

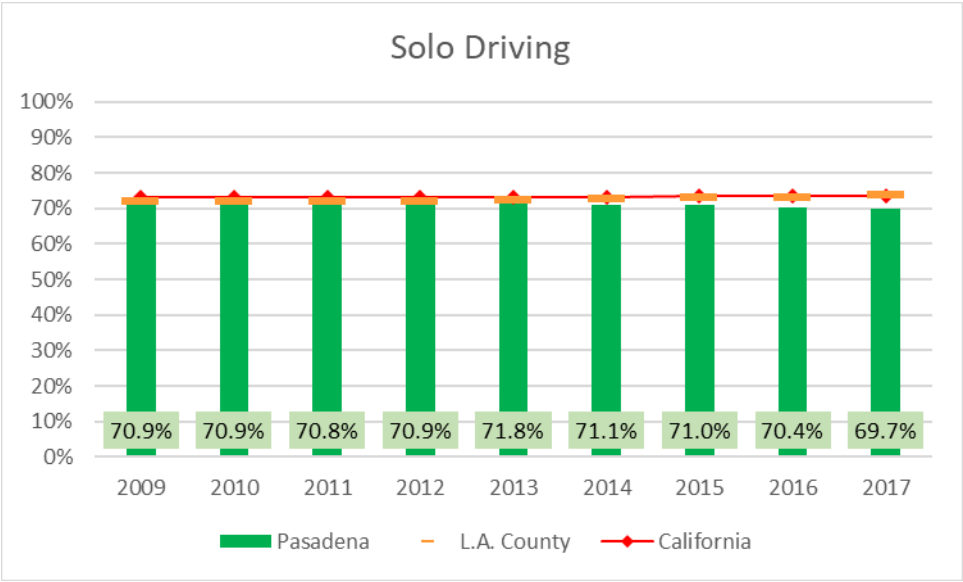

Figure E-1. Share of commuters who drive alone.
It went slightly up for state and county and slightly down for Pasadena. Data source: U.S. Census Bureau.

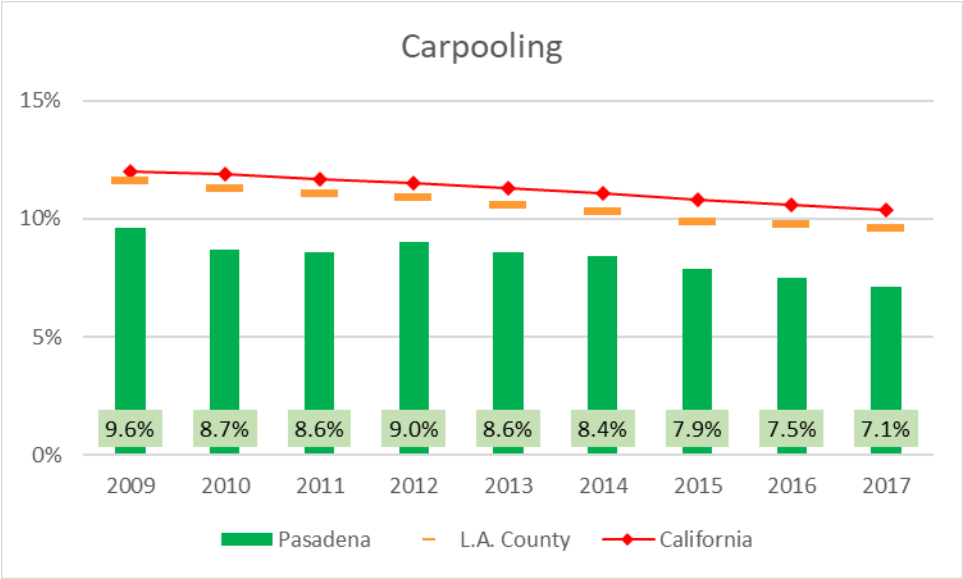

Figure E-2. Share of commuters who carpool.
Reduction across the board. Data source: U.S. Census Bureau.

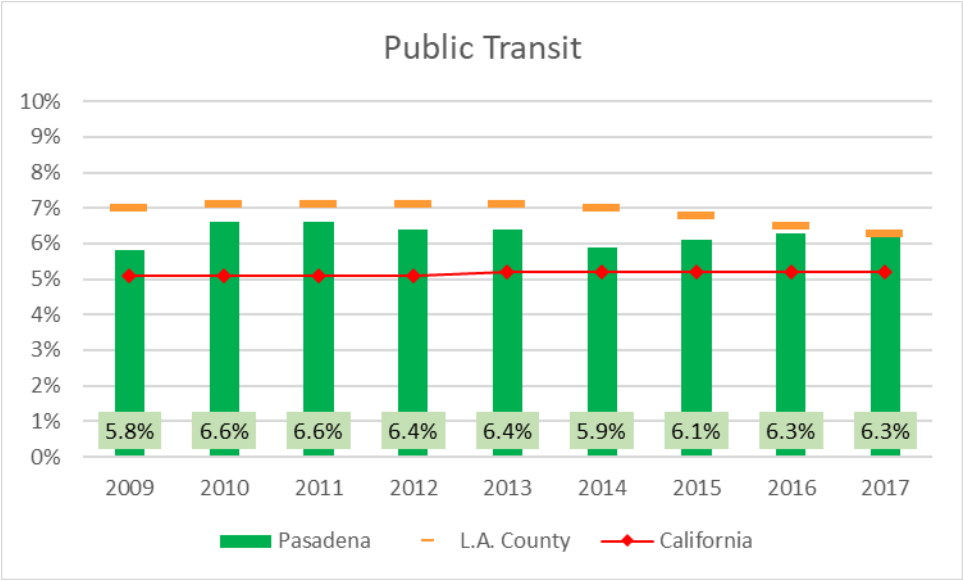

Figure E-3. Share of commuters who take transit.
Somewhat steady overall; declining in L.A. County. Data source: U.S. Census Bureau.

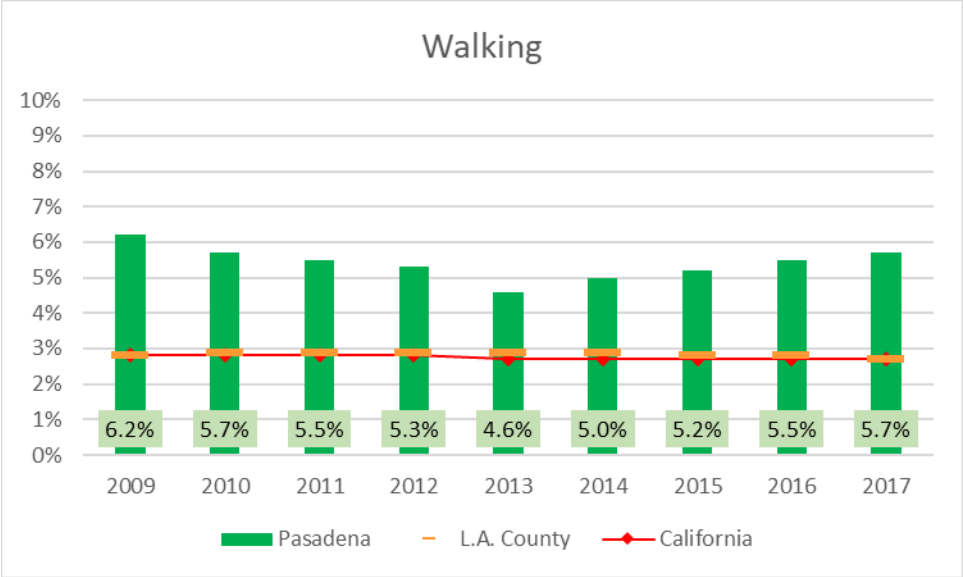

Figure E-4. Share of commuters who walk.
Steady in state and county; oscillating in Pasadena but, most recently, growing. Data source: U.S. Census Bureau.

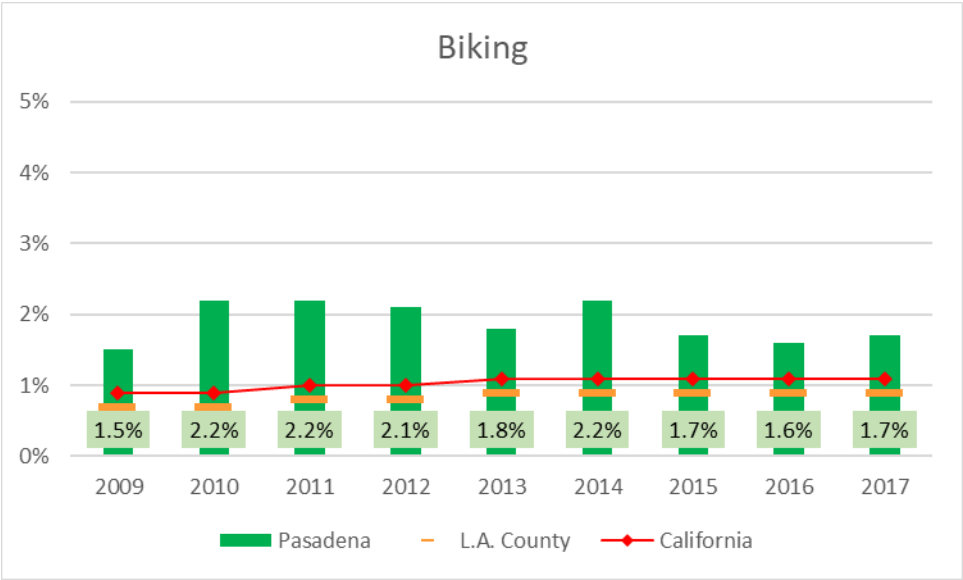

Figure E-5. Share of commuters who bike.
Slight increase in state and county; oscillating in Pasadena but, most recently, flattening. Data source: U.S. Census Bureau.

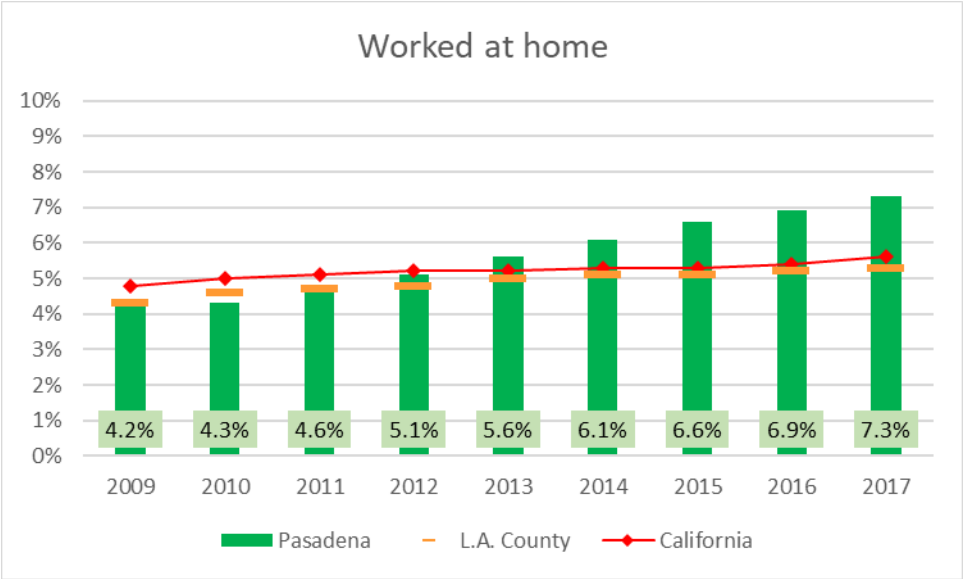

Figure E-6. Share of commuters who work from home.
Up across the board, but more rapidly so in Pasadena. Data source: U.S. Census Bureau.

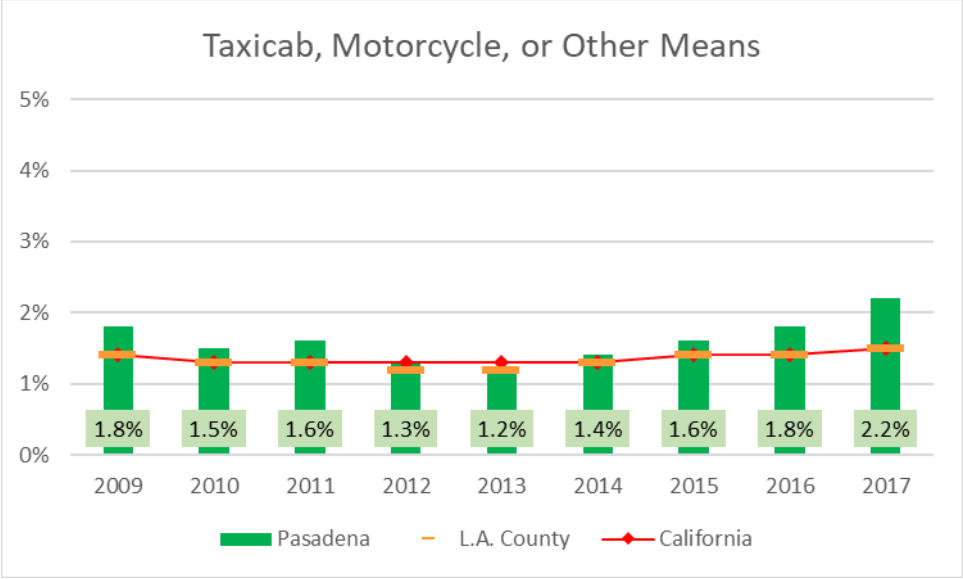

Figure E-7. Share of commuters who take other means.
Up across the board since 2013, but more rapidly so in Pasadena. Data source: U.S. Census Bureau.

Figures E-8 through E-14 show the same information as E-1 through E-7 do, but *indexed* to 2009. These graphs make it easier to appreciate the percent changes and the relative paces between the different geographies.

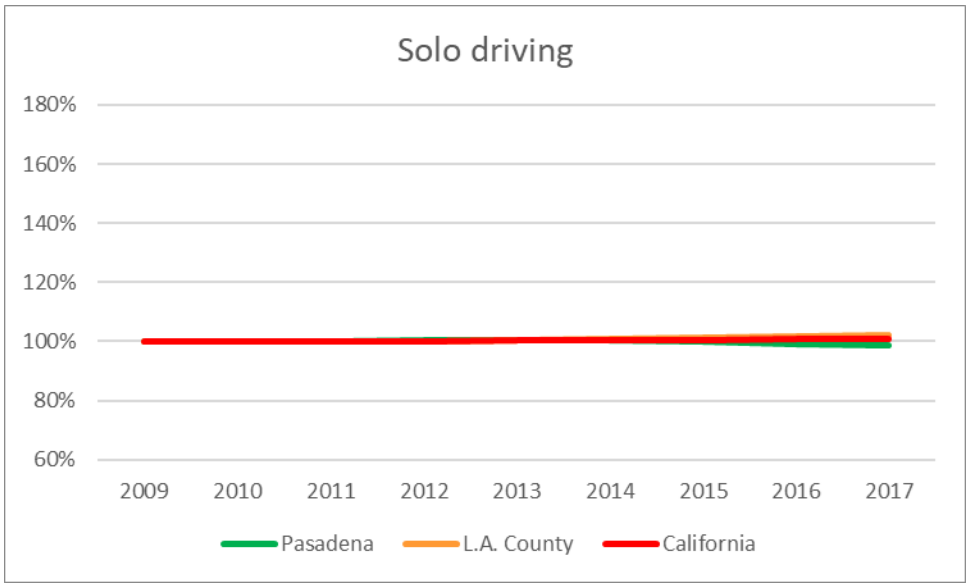

Figure E-8. Change in time of share of solo driving.
Moving average indexed to 2009. Data source: U.S. Census Bureau.

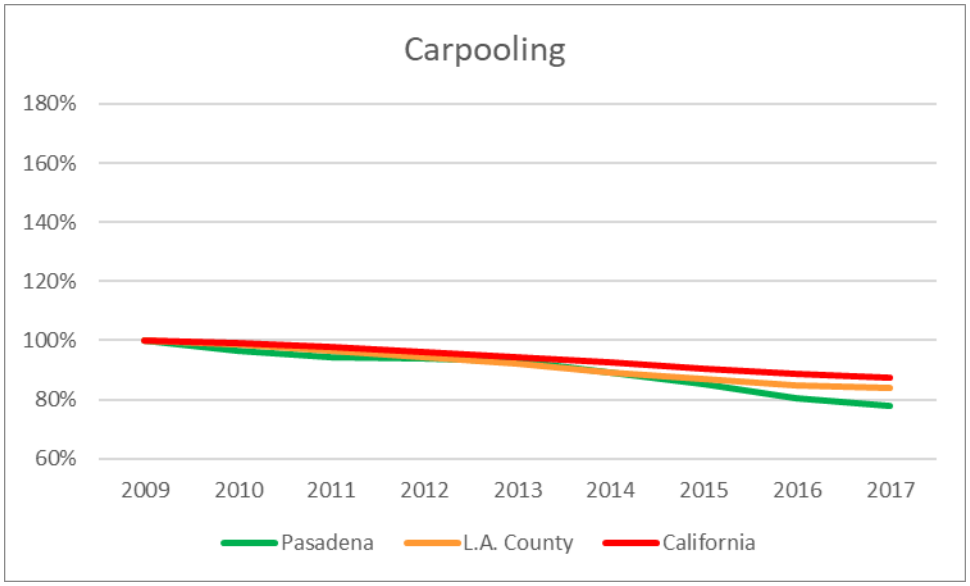

Figure E-9. Change in time of share of carpooling.
Moving average indexed to 2009. Data source: U.S. Census Bureau.

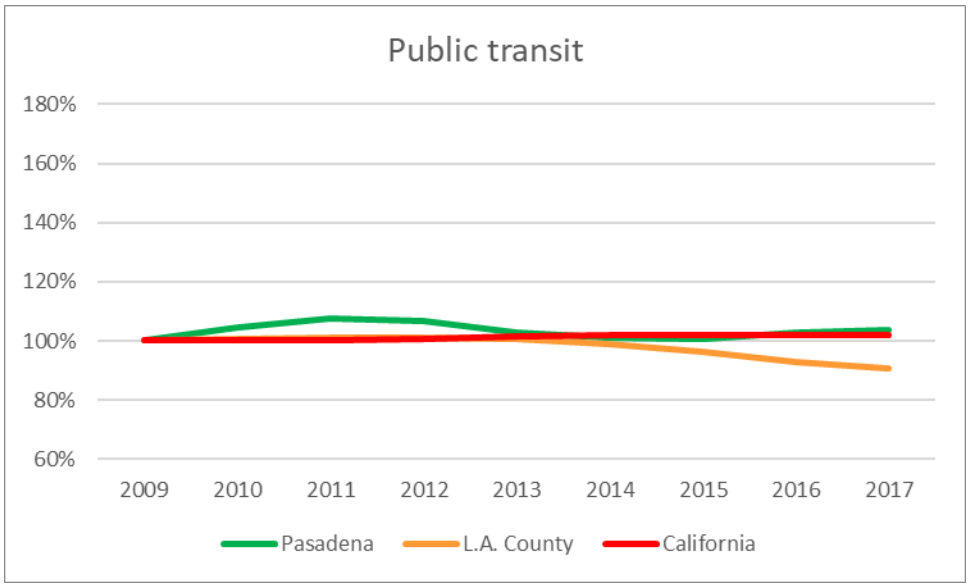

Figure E-10. Change in time of share of commuting by transit.
Moving average indexed to 2009. Data source: U.S. Census Bureau.

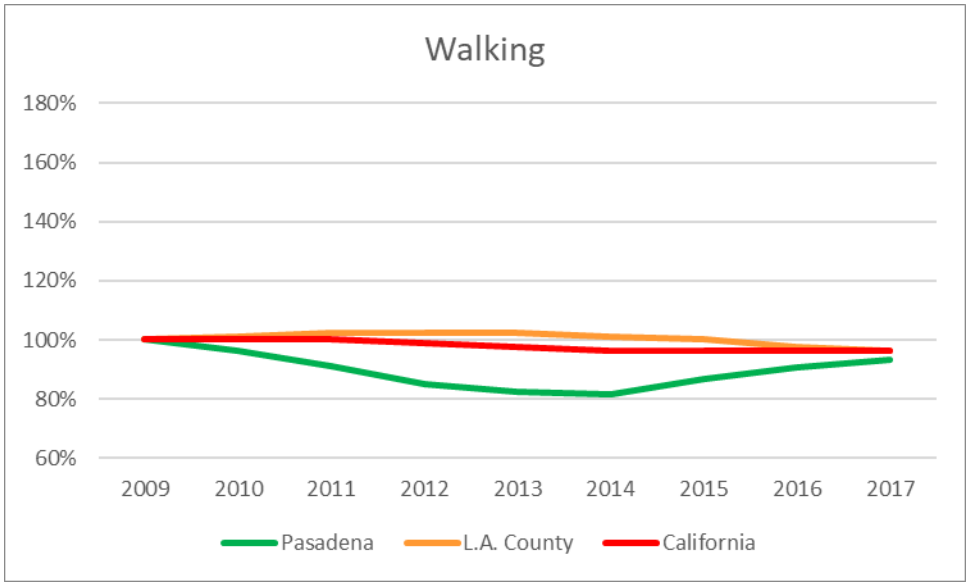

Figure E-11. Change in time of share of walking.
Moving average indexed to 2009. Data source: U.S. Census Bureau.

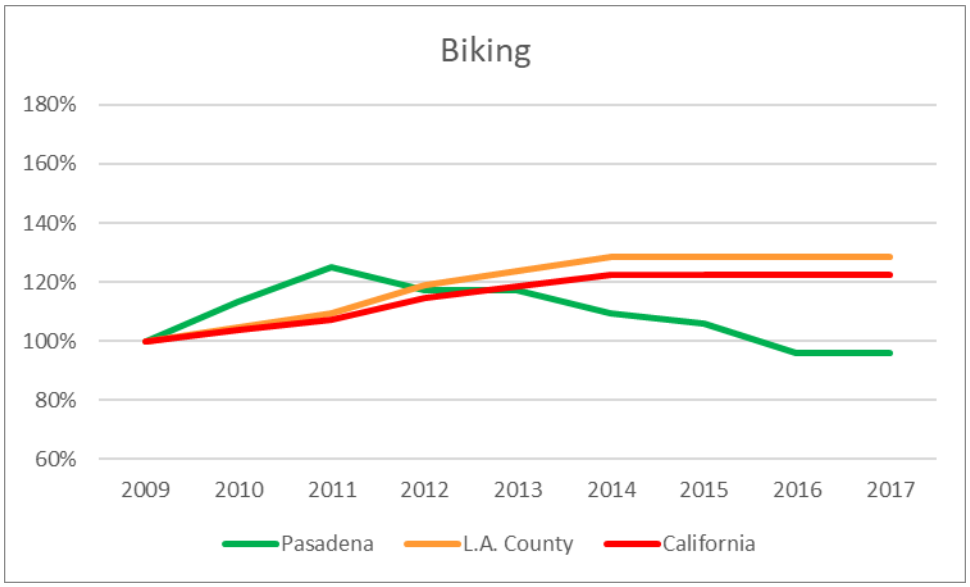

Figure E-12. Change in time of share of biking.
Moving average indexed to 2009. Data source: U.S. Census Bureau.

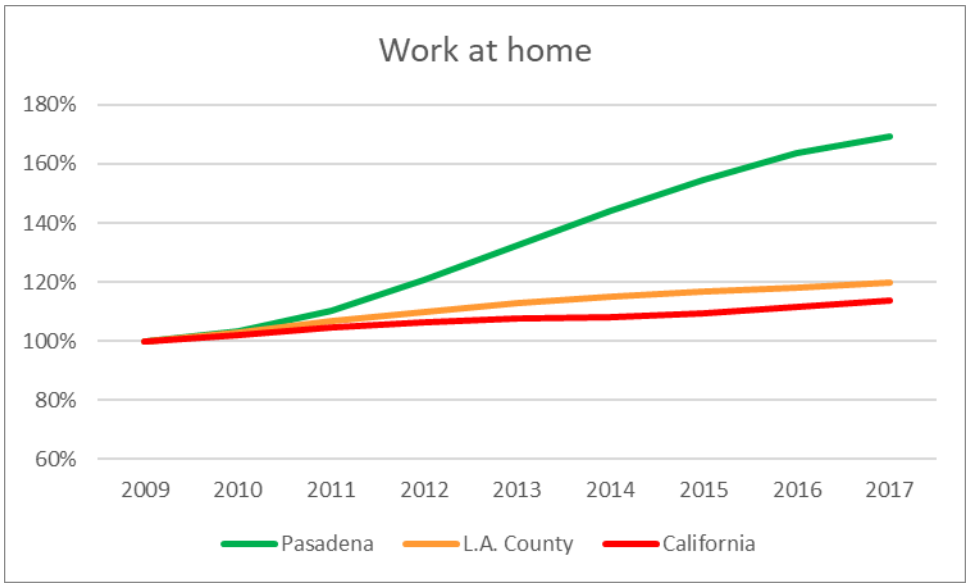

Figure E-13. Change in time of share of telecommuting.
Moving average indexed to 2009. Data source: U.S. Census Bureau.

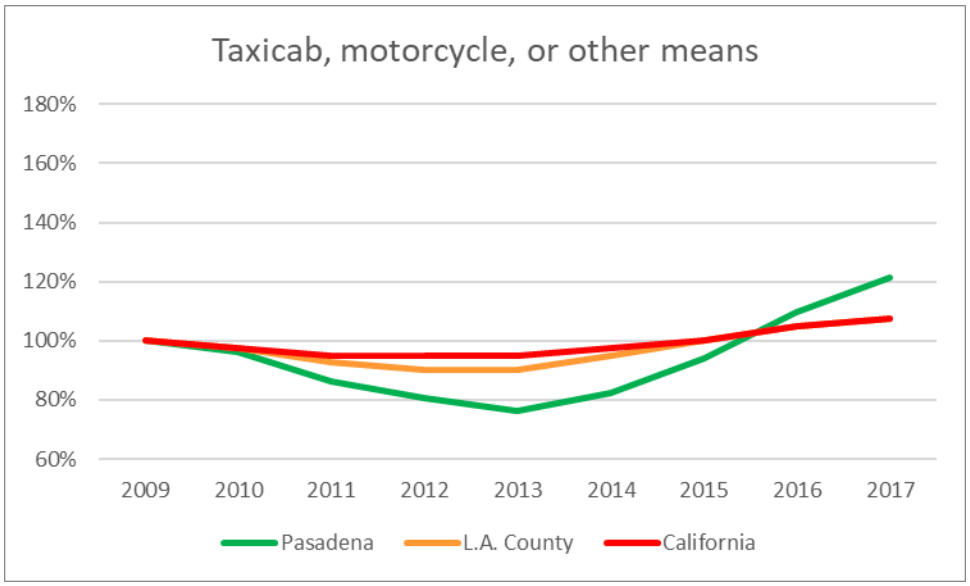

Figure E-14. Change in time of share of commuting by other means.
Moving average indexed to 2009. Data source: U.S. Census Bureau.

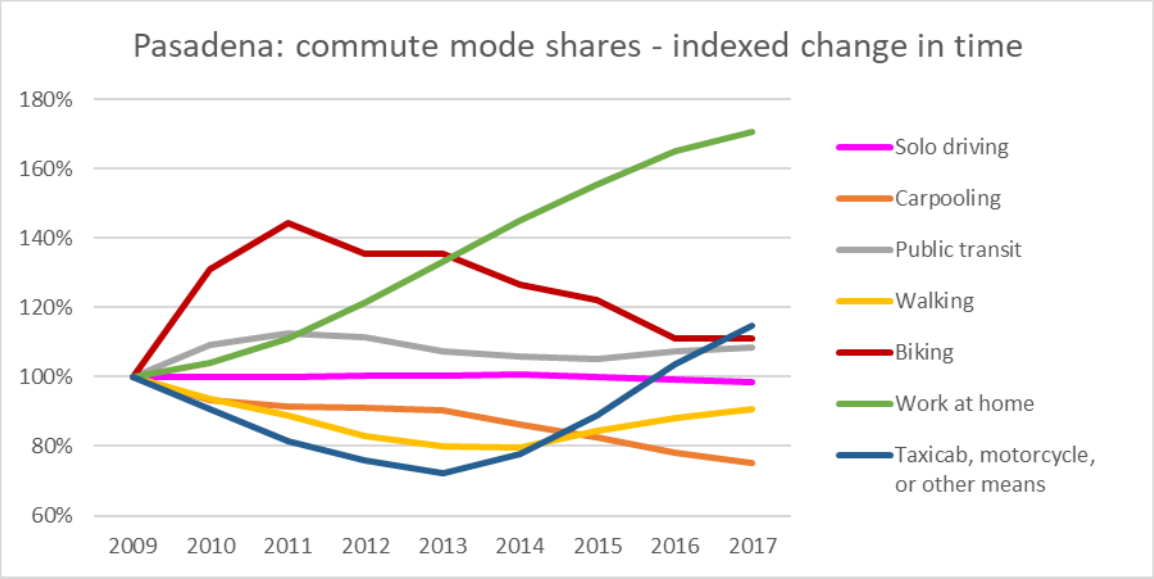

Figure E-15. Change in time of all commuter shares in Pasadena .
Moving average indexed to 2009. This graph combines Pasadena's data displayed in Figures E-8 through E-14. Data source: U.S. Census Bureau.

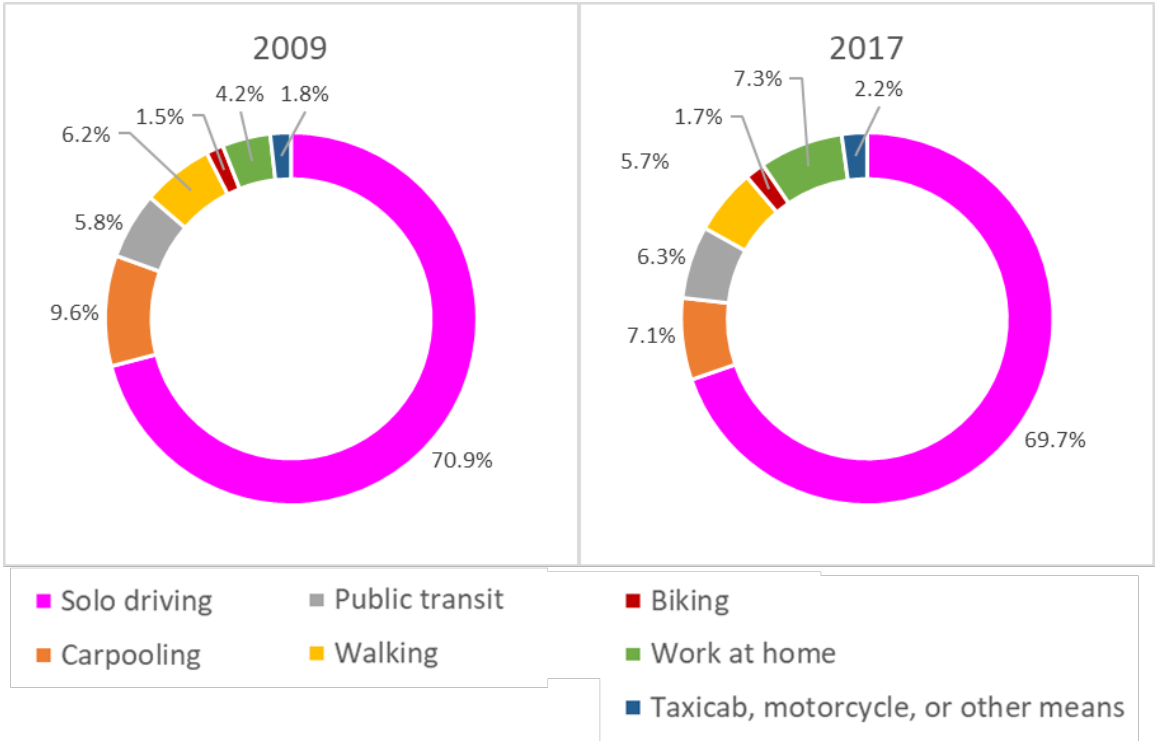

Figure E-16. Commuting in Pasadena: before-and-after snapshots.
Data source: U.S. Census Bureau.

Appendix F: Race, income, and rent

Figures F-1 to F-4 show the portion of Pasadena's population that belong to each racial/ethnic group and its change over time.

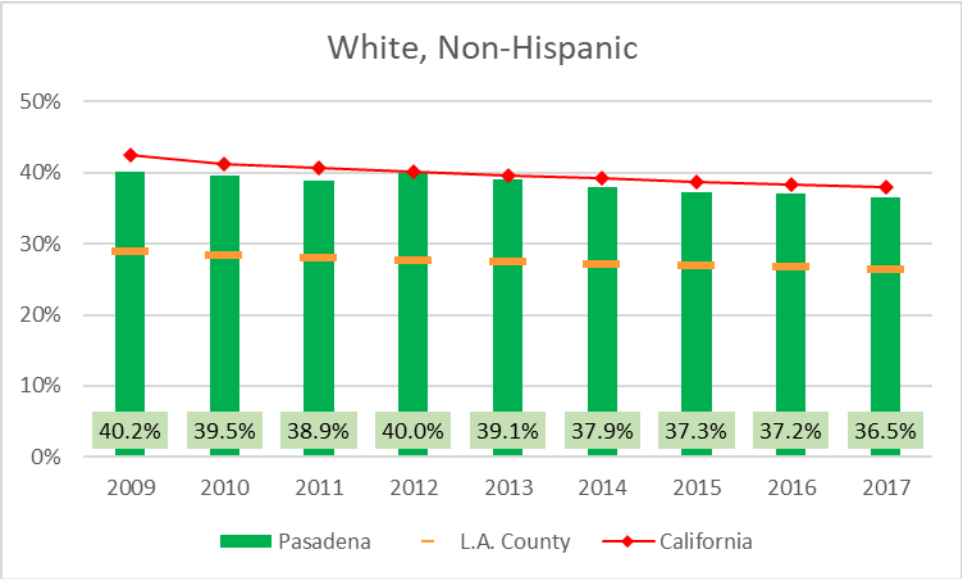

Figure F-1. Share of the population that identifies as non-Hispanic White.
Data source: U.S. Census Bureau.

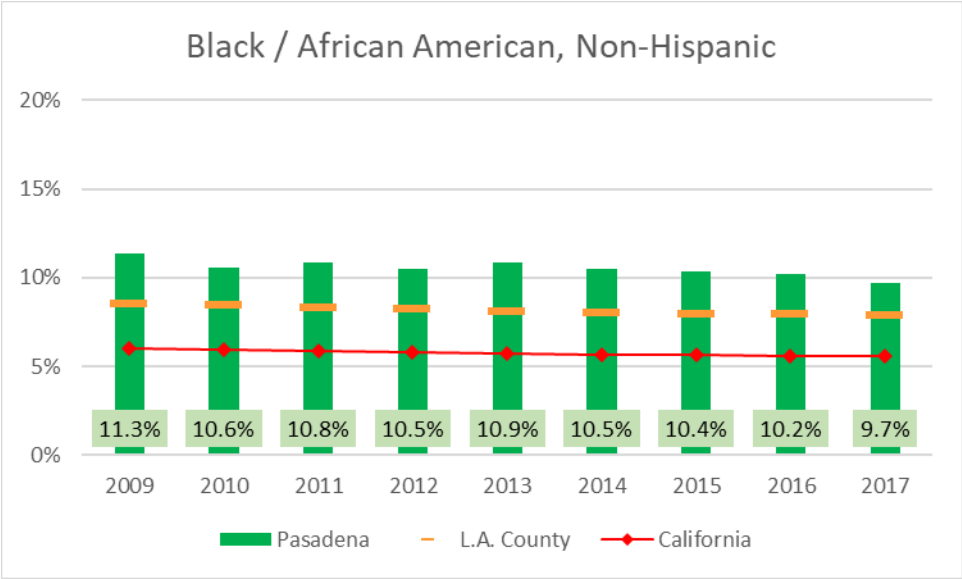

Figure F-2. Share of the population that identifies as non-Hispanic Black.
Data source: U.S. Census Bureau.

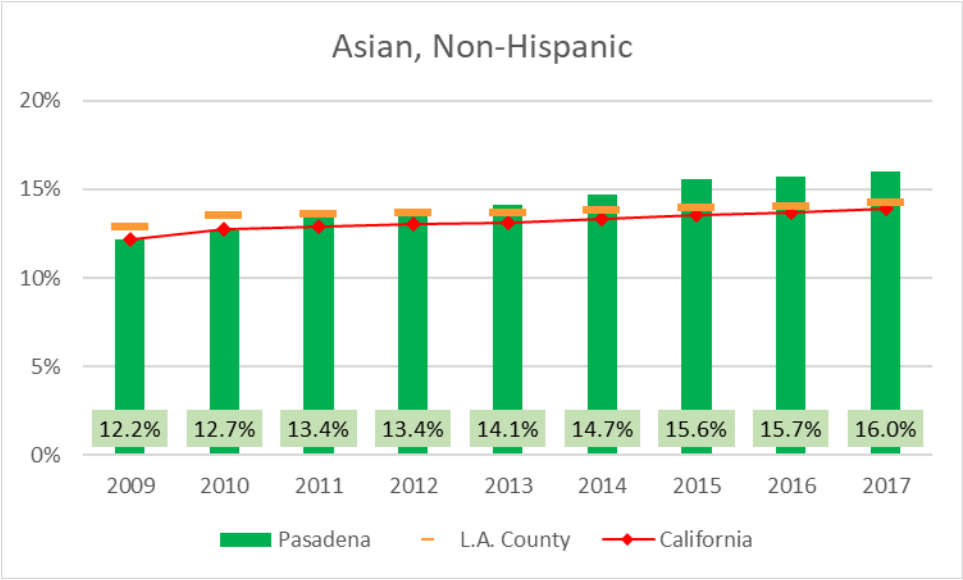

Figure F-3. Share of the population that identifies as non-Hispanic Asian.
Data source: U.S. Census Bureau.

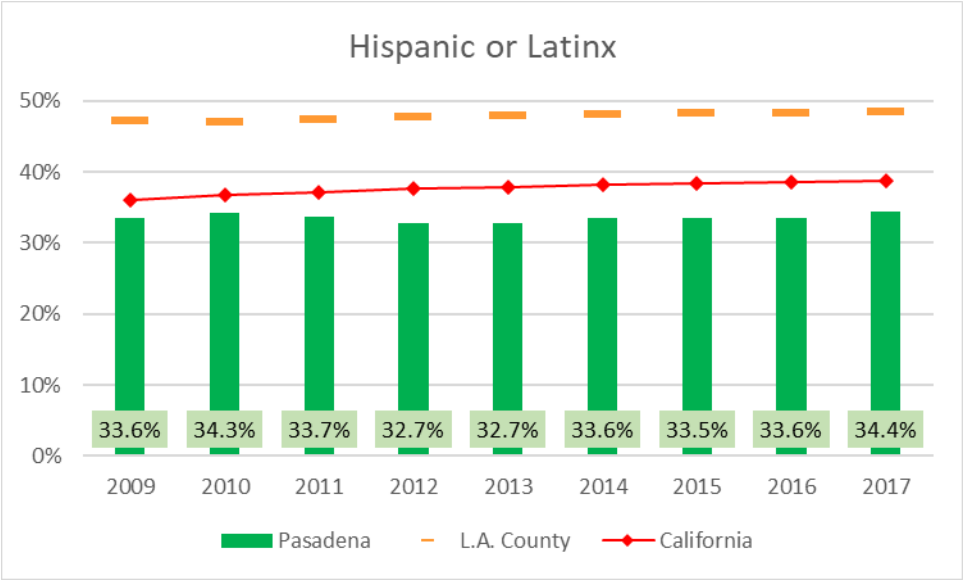

Figure F-4. Share of the population that identifies as Hispanic or Latinx.
Data source: U.S. Census Bureau.

Figures F-5 through F-8 show the same information, but indexed to 2009 (percent change).

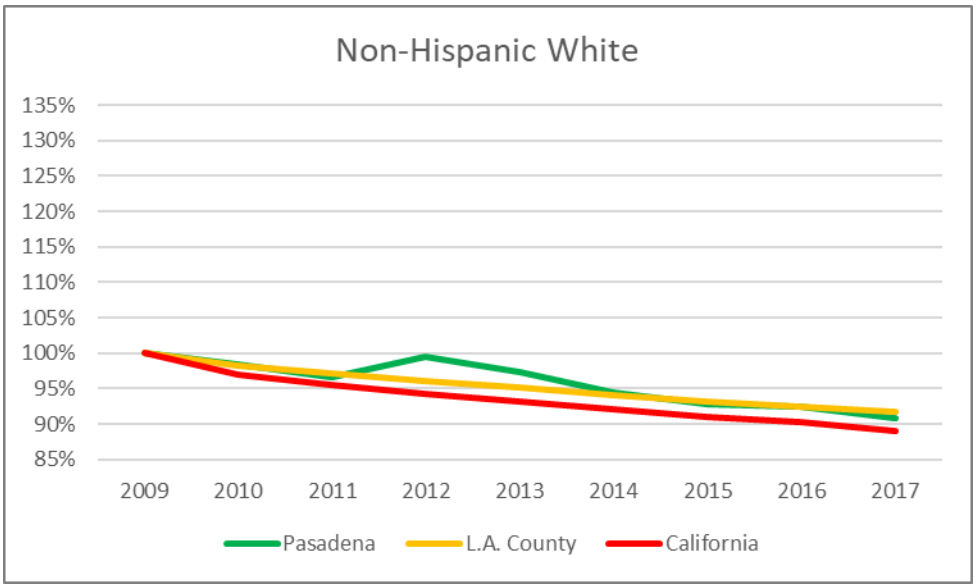

Figure F-5. Change in time of the proportion of White people in the population (indexed to 2009).
Data source: U.S. Census Bureau.

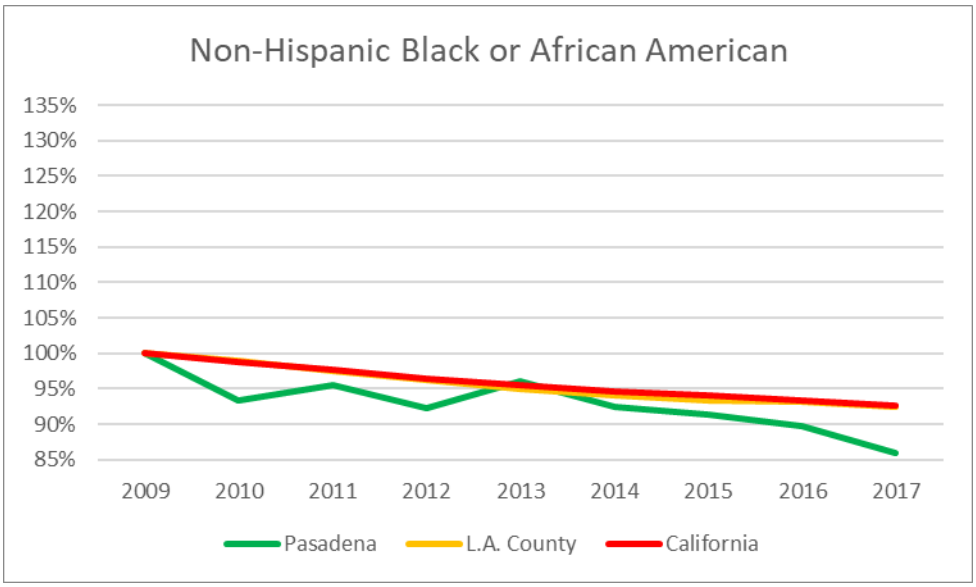

Figure F-6. Change in time of the proportion of African American people in the population (indexed to 2009).
Data source: U.S. Census Bureau.

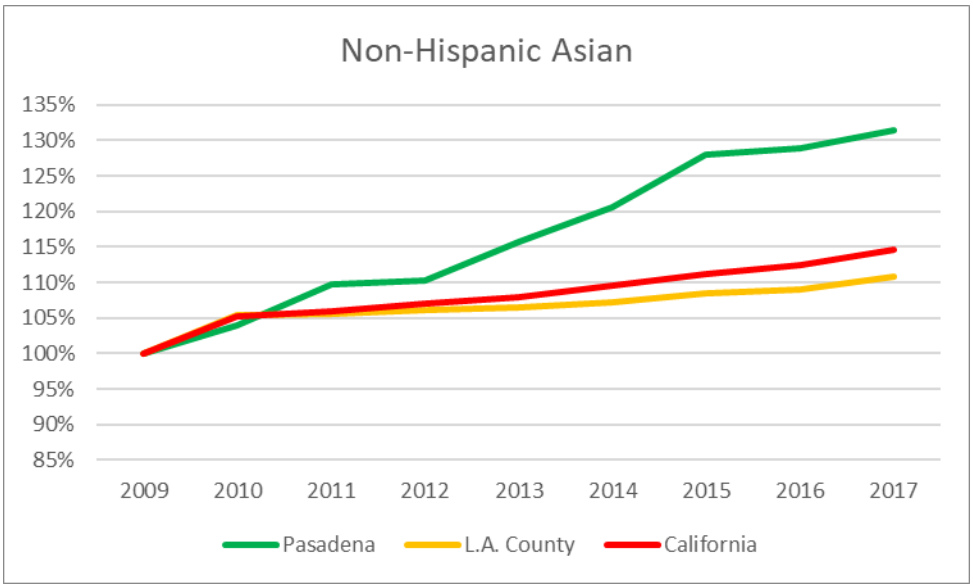

Figure F-7. Change in time of the proportion of Asian people in the population (indexed to 2009).
Data source: U.S. Census Bureau.

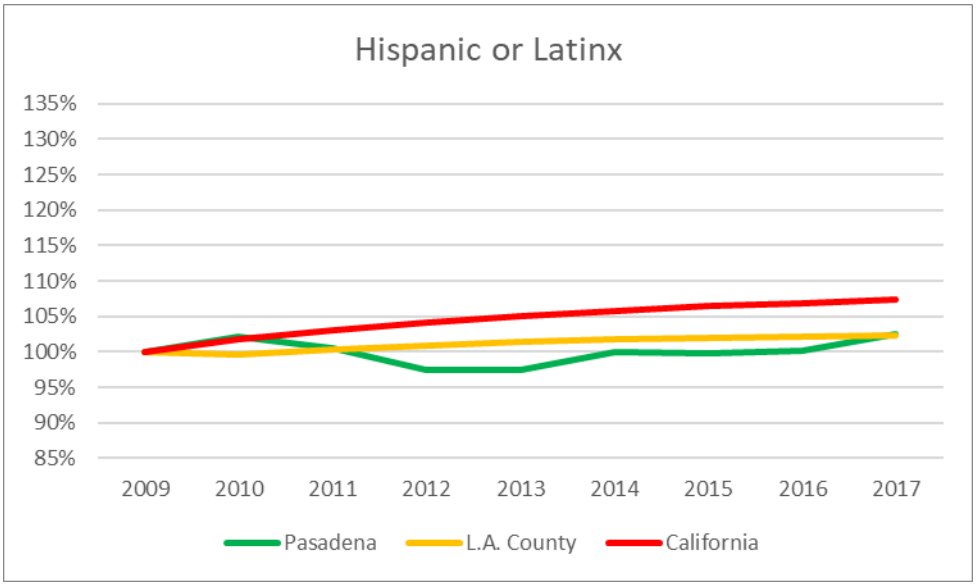

Figure F-8. Change in time of the proportion of Hispanic/Latinx people in the population (indexed to 2009).
Data source: U.S. Census Bureau.

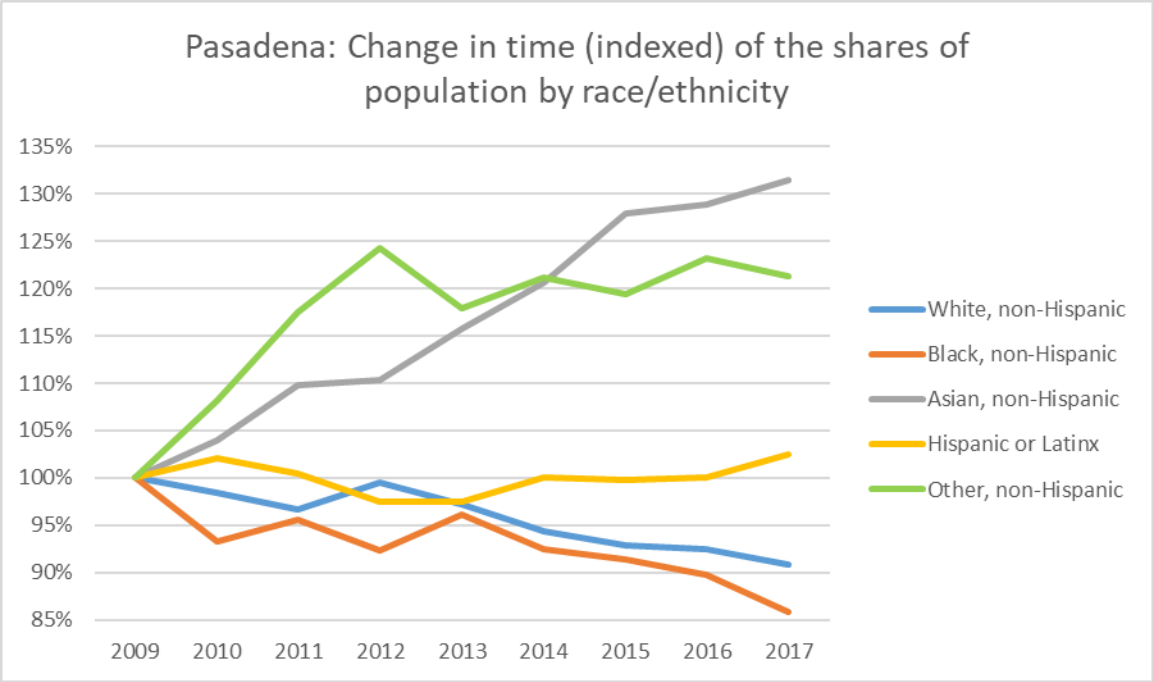

Figure F-9. Racial/ethnic composition of Pasadena throughout time.
This graph combines Pasadena's data displayed in Figures F-5 through F-8 and adds the "Other race/ethnicity" category. Data source: U.S. Census Bureau.

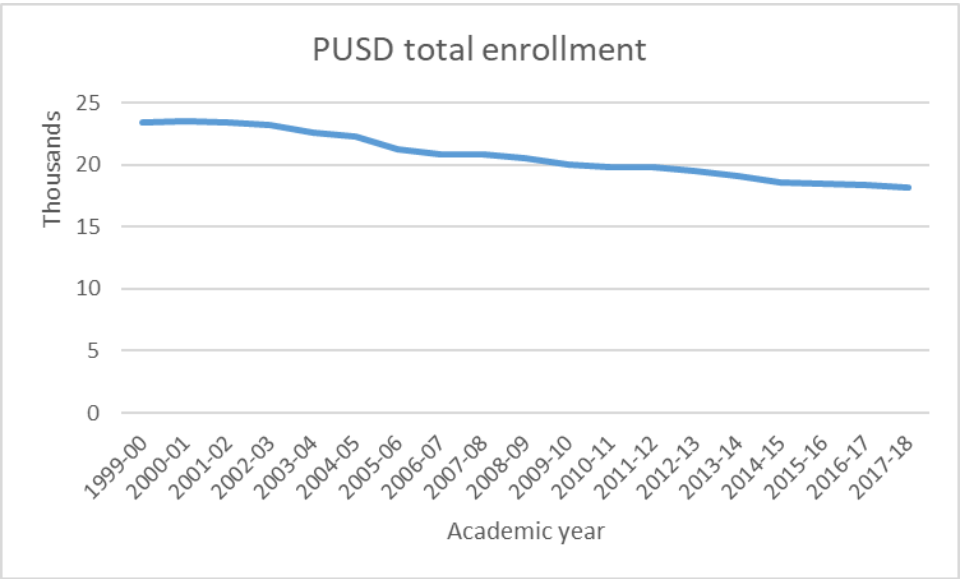

Figure F-10. Student enrollment in the Pasadena Unified School District.
This graph puts in evidence a trend of constant decline. Data source: California Department of Education.

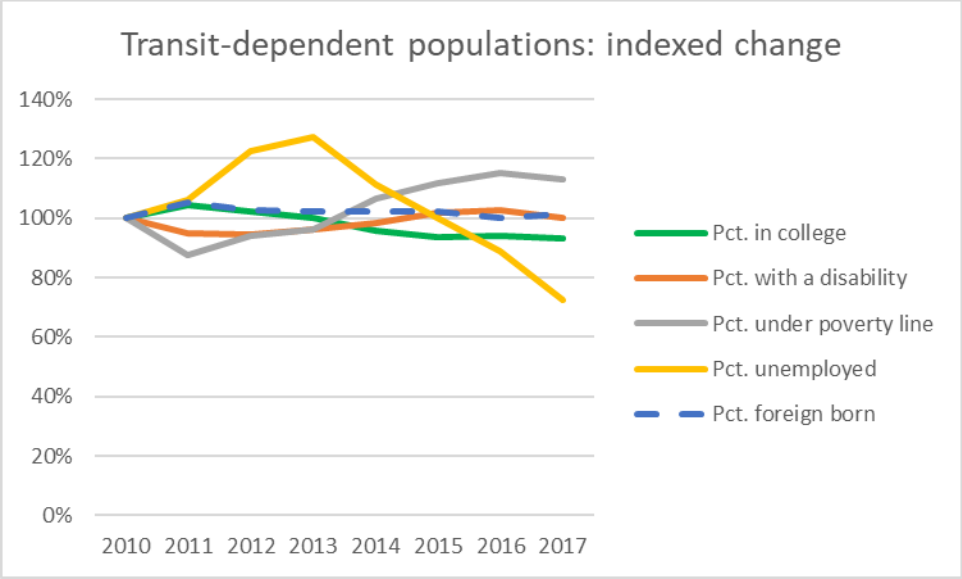

Figure F-11. Change in time of the proportion of Pasadena's population within transit-dependent groups (indexed to 2010).
All remain flat except poverty and unemployment; see corresponding discussion in the body (Section 5.8. Transit-dependent groups). Data source: U.S. Census Bureau.

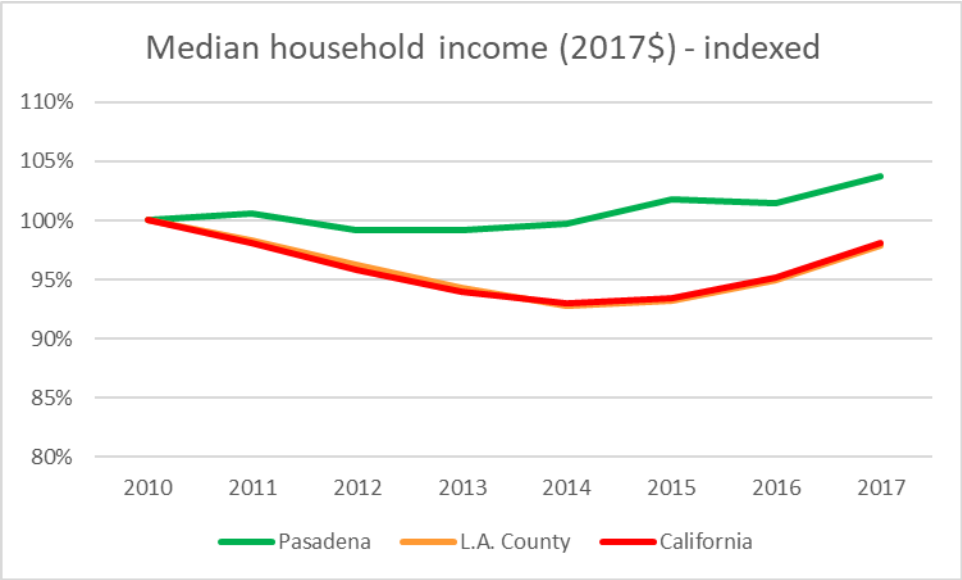

Figure F-12. Median household income (indexed to 2010).
The bust of the Recession is more obvious in state and county; recovering since 2014, but still below 2010 levels. Pasadena's incomes grew somewhat steadily. Data source: U.S. Census Bureau.

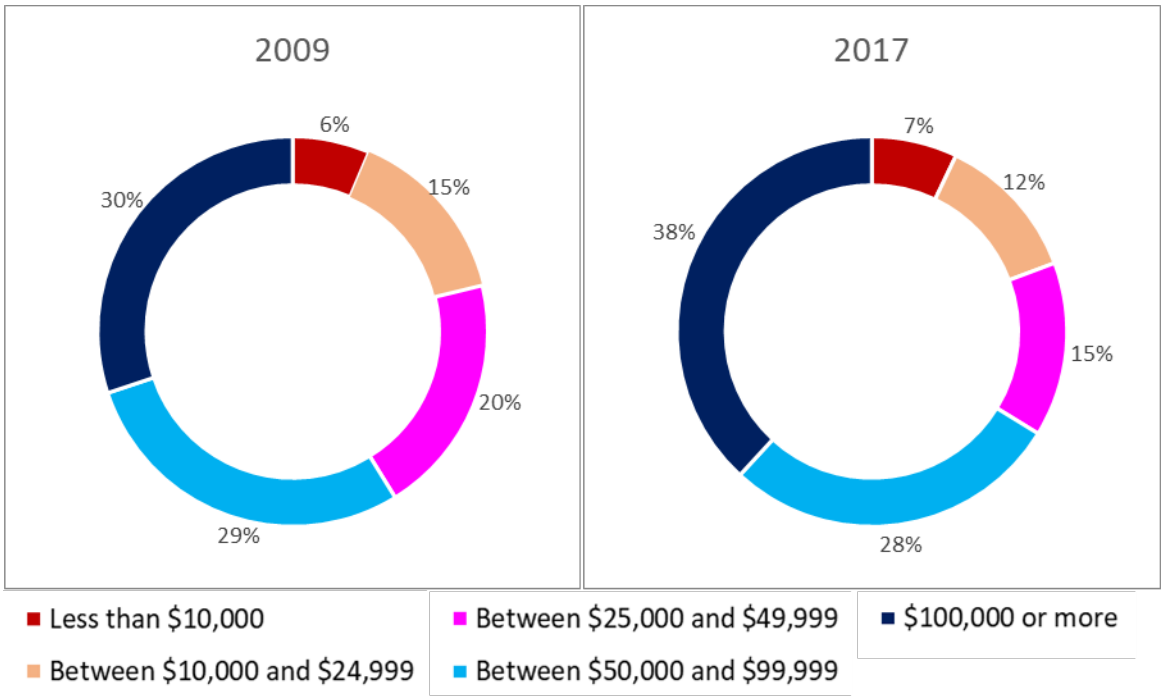

Figure F-13. Before-and-after snapshots of income distribution in Pasadena. ***Middle-income brackets shrink in favor of the top bracket and, to a lesser extent, the bottom bracket. Data source: U.S. Census Bureau.***

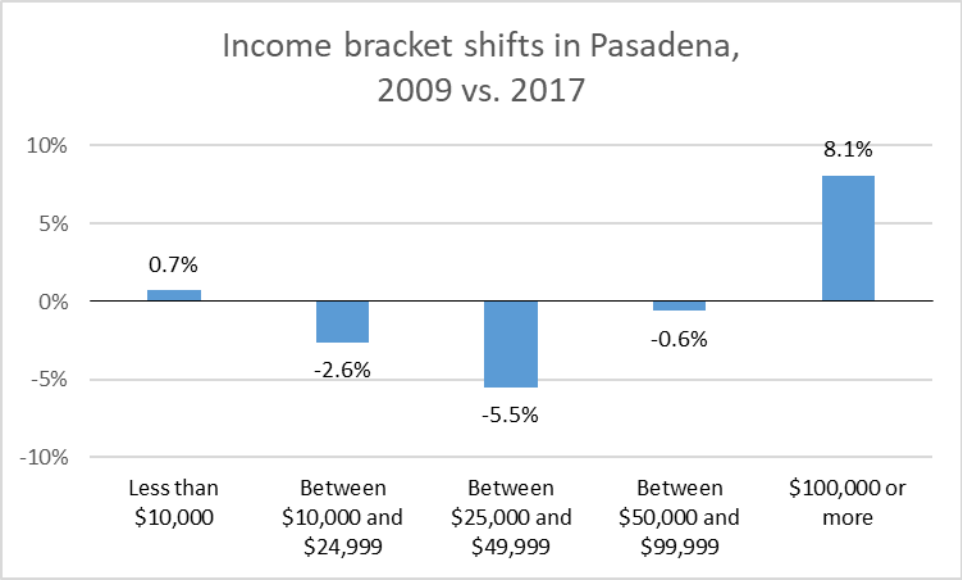

Figure F-14. Pasadena: income-bracket share shifts, 2009-2017 (percent point change). ***Most of the share shift away from lower-middle-income people shifted to very-high-income people. Data source: U.S. Census Bureau.***

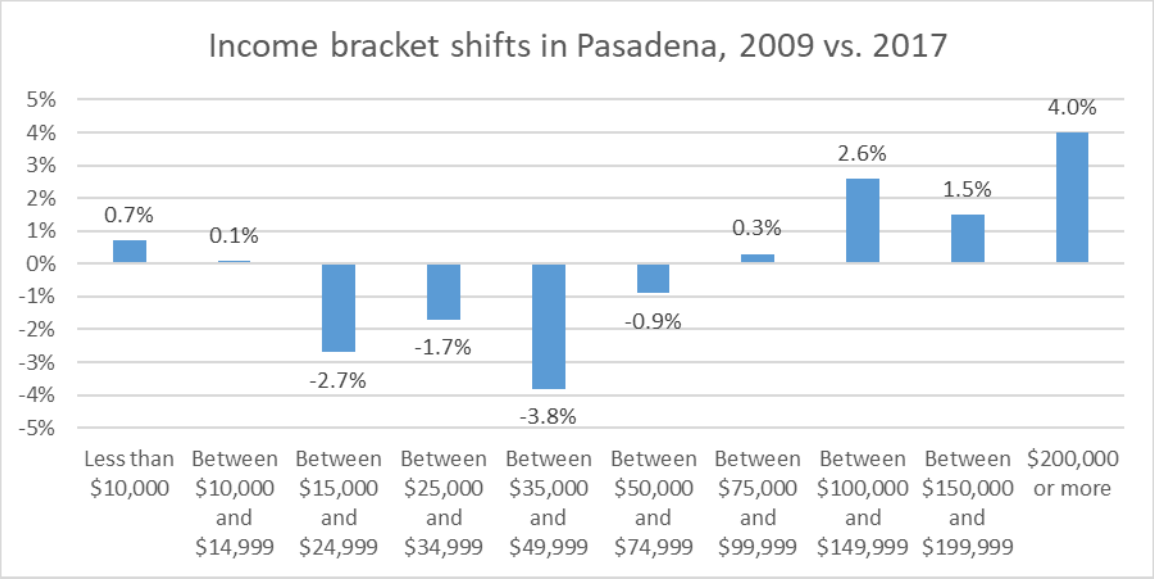

Figure F-15. Pasadena: income-bracket share shifts, 2009-2017 (percent point change); disaggregated.

Confirms what Figure F-14 showed. Data source: U.S. Census Bureau.

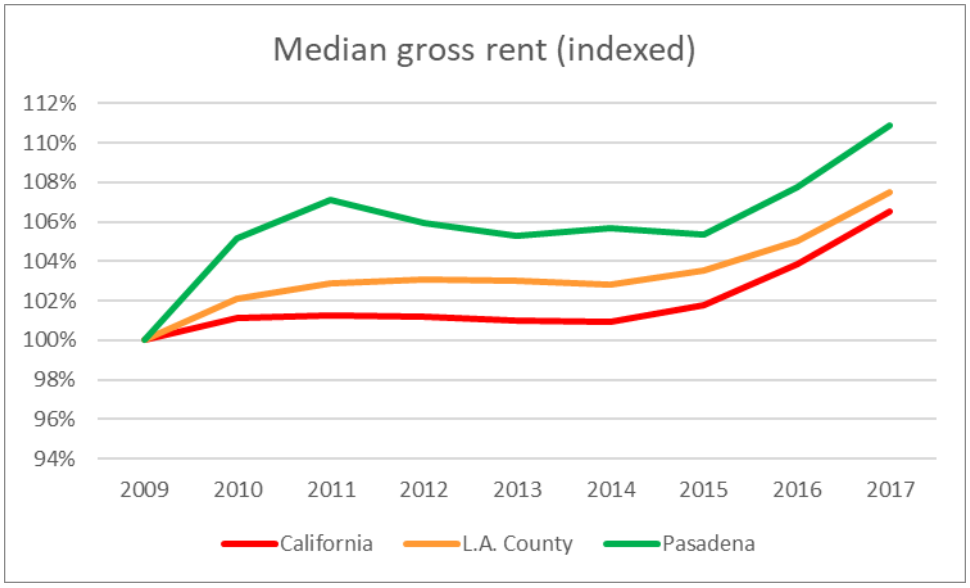

Figure F-16. Median gross rent in 2017$, indexed to 2009.

Rents are going up everywhere, more rapidly so since 2015. However, Pasadena's pace is much ahead, speeding up even more in the last couple of years. Data source: U.S. Census Bureau.

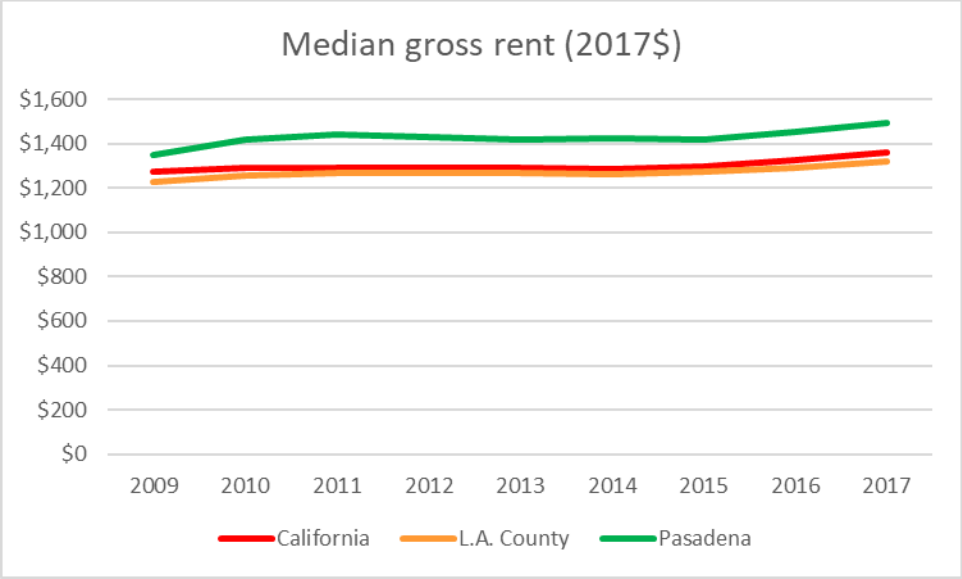

Figure F-17. Median monthly rent (inflation-adjusted to 2017).
This is the same information as that on Figure F-16 but not indexed, so that the absolute value can be visualized. Data source: U.S. Census Bureau.

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Appendix G:
Understanding displacement

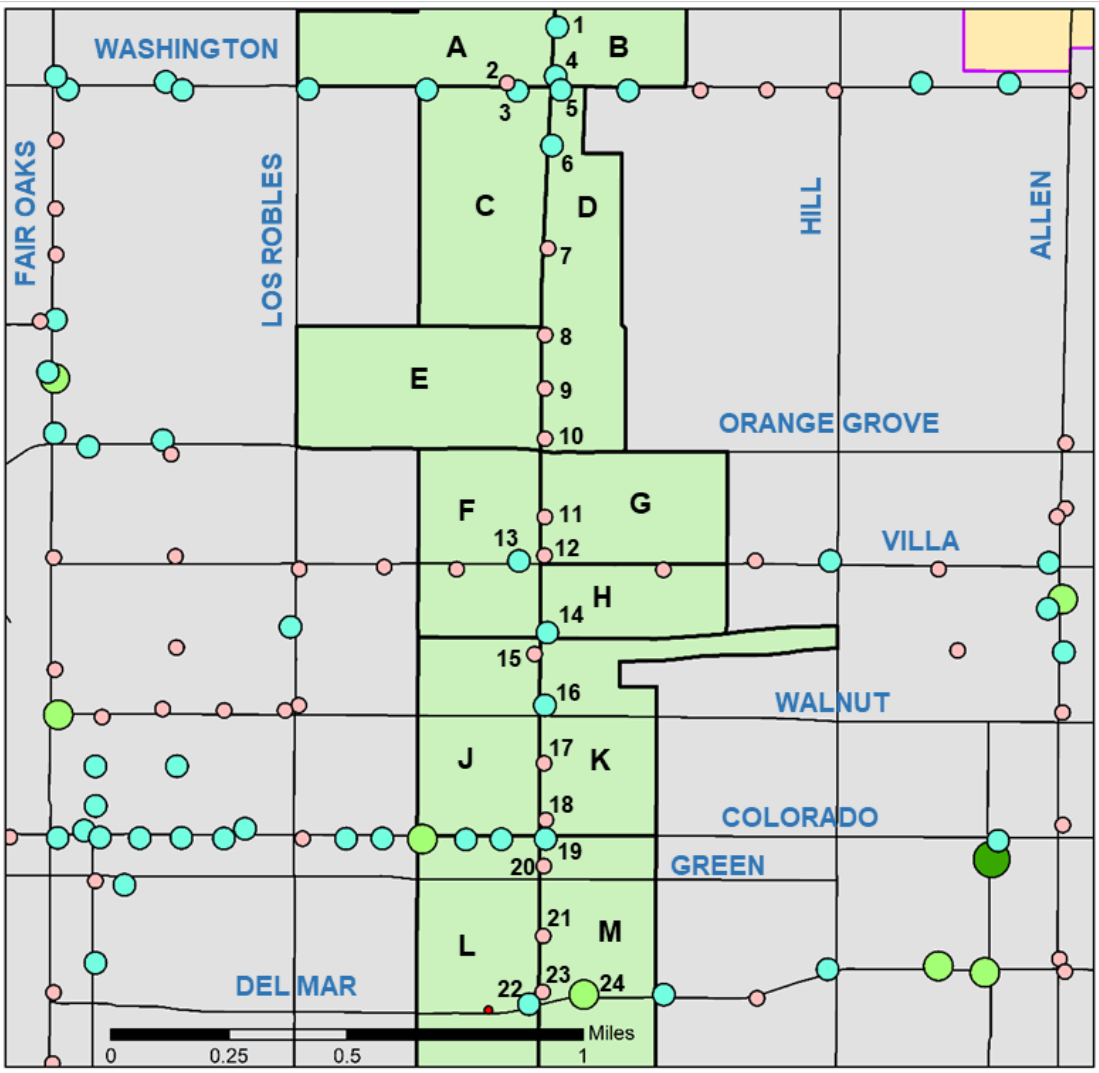

Figure G-1. Same image as Figure 33 but with relevant bus stops labeled. ***See Table G-1 for details on each labeled stop.***

Table G-1. Ridership change in the last fiscal year for the stops labeled in Figure G-1.

		PASADENA TRANSIT RIDERSHIP			
Ref. #	**Stop Name**	**FY17**	**FY18**	**Diff.**	**Pct. Diff.**
1	Lake Ave & Rio Grande St	3,078	3,499	421	14%
2	Washington Blvd & Hudson	2,312	2,233	(79)	-3.4%
3	Washington Blvd & Hudson	6,598	7,835	1,237	19%
4	Lake Ave & Washington Blvd	33,308	33,895	587	1.8%
5	Washington Blvd & Lake Ave	24,854	24,952	98	0.39%
6	Lake Ave & Claremont St	7,592	7,904	312	4.1%
7	Lake Ave & Belvidere St	7,069	6,370	(699)	-9.9%
8	Lake Ave & Mountain St	15,821	15,088	(733)	-4.6%
9	Lake Ave & Boylston St	6,486	4,999	(1,487)	-23%
10	Lake Ave & Orange Grove Blvd	16,152	15,970	(182)	-1.1%
11	Lake Ave & Santa Barbara St	1,244	1,042	(202)	-16%
12	Lake Ave & Villa St	19,085	18,920	(165)	-0.86%
13	Colorado Blvd & Hudson Ave	1,703	1,807	104	6.1%
14	Lake Ave & Maple St (Lake Station)	17,527	17,720	193	1.1%
15	Lake Ave & Corson St (Lake Station)	6,599	5,787	(812)	-12%
16	Lake Ave & Walnut St	6,541	6,618	77	1.2%
17	Lake Ave & Union St	6,043	5,552	(491)	-8.1%
18	Lake Ave & Colorado Blvd	34,109	33,278	(831)	-2.4%
19	Colorado Blvd & Lake Ave	7,180	7,472	292	4.1%
20	Lake Ave & Green St	7,345	7,150	(195)	-2.7%
21	Lake Ave & Cordova St	11,164	10,871	(293)	-2.6%
22	Del Mar Blvd & Lake Ave	5,747	6,850	1,103	19%
23	Lake Ave & Del Mar Blvd	27,557	26,941	(616)	-2.2%
24	Del Mar Blvd & Mentor Ave	831	1,242	411	49%

Data source: Pasadena Transit.

The following figures display the ***ratio of change*** for different indicators in Pasadena, mapped out by census block groups. All the data were obtained from the U.S. Census Bureau, including the GIS shapefiles (TIGER lines). Lake Avenue is displayed as a reference, so that the maps are comparable with other maps in the report, such as Figures 3, 4, 13, 32, 33, and G-1. Overlaying some of these maps appeared inappropriate because it would look too cluttered and would be hard to understand the phenomena displayed.

Also, please note the map categories (blue through red) are bounded in a way to make similar maps comparable (e.g., Asian and White, or Low-Income and High-Income). Since it is a ratio, the numbers in each map category indicate no change (if around 1), decrease (if lower than 1), or increase (if more than 1). For example, a range between three and seven means that the indicator at least tripled and at most increased seven times (+600%). A range of 0.50 to 0.75 means the indicator *at least* decreased 25% or, *at most*, halved (-50%).

These changes occurred in the time period indicated in each figure (either 2013-2017 or 2014-2017).

Lastly, these maps are important because they helped identify Lake Avenue as a good example of a corridor that experienced important demographic changes. This analysis could have observed many other places or done a citywide analysis but, in the interest of time, it focused on Lake Avenue.

G.1. Race and ethnicity

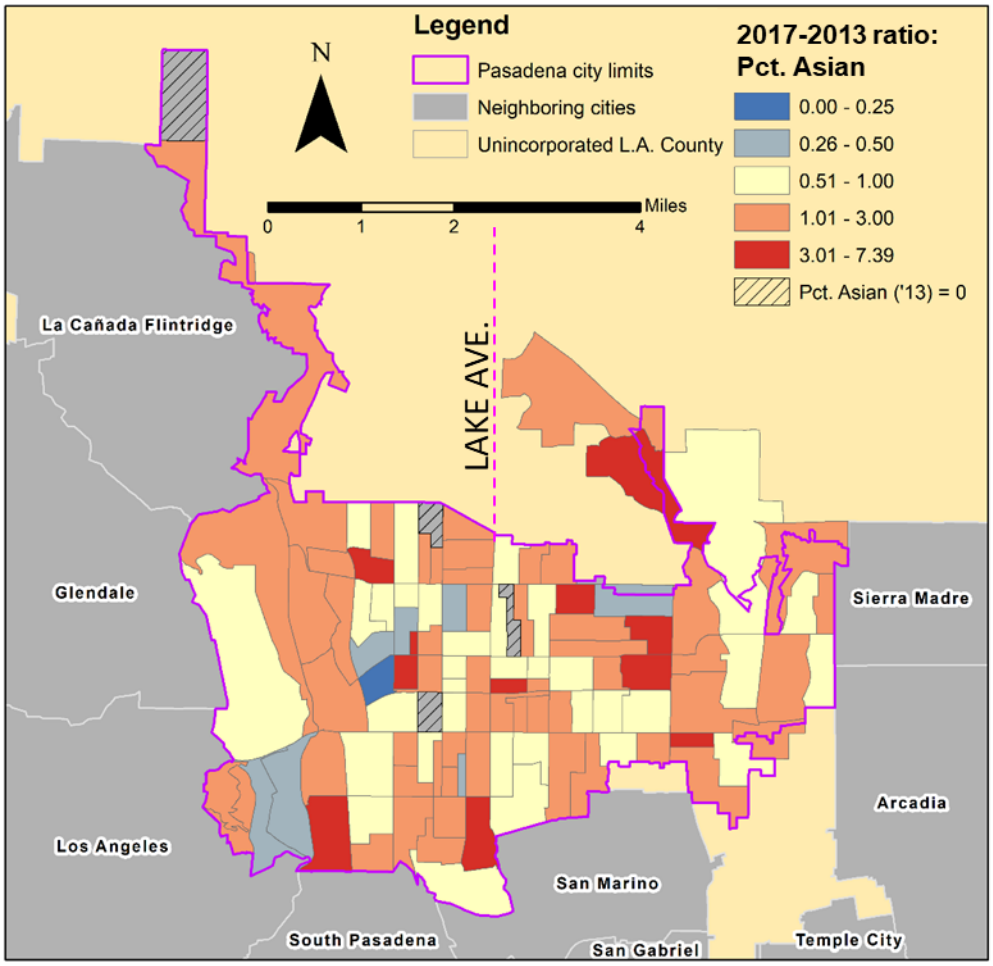

Figure G-2. Share of the population that identifies as non-Hispanic Asian.

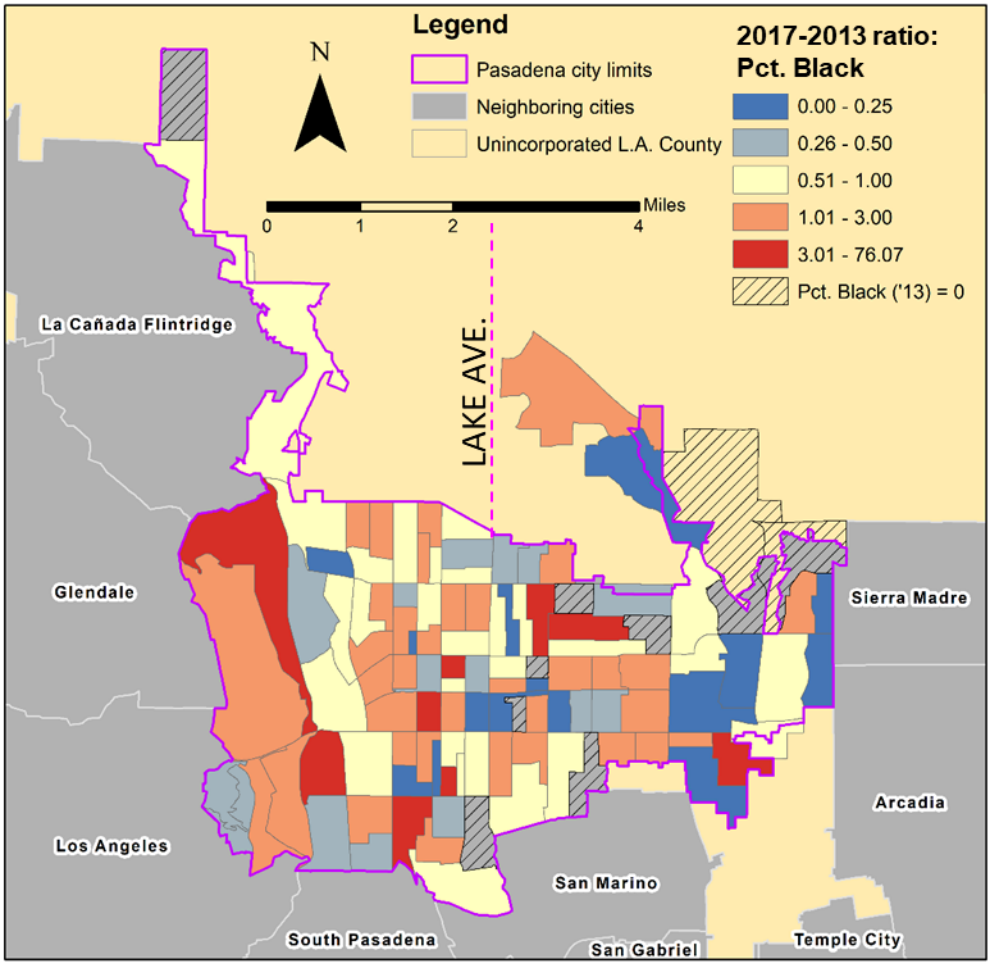

Figure G-3. Share of the population that identifies as non-Hispanic Black or African American.

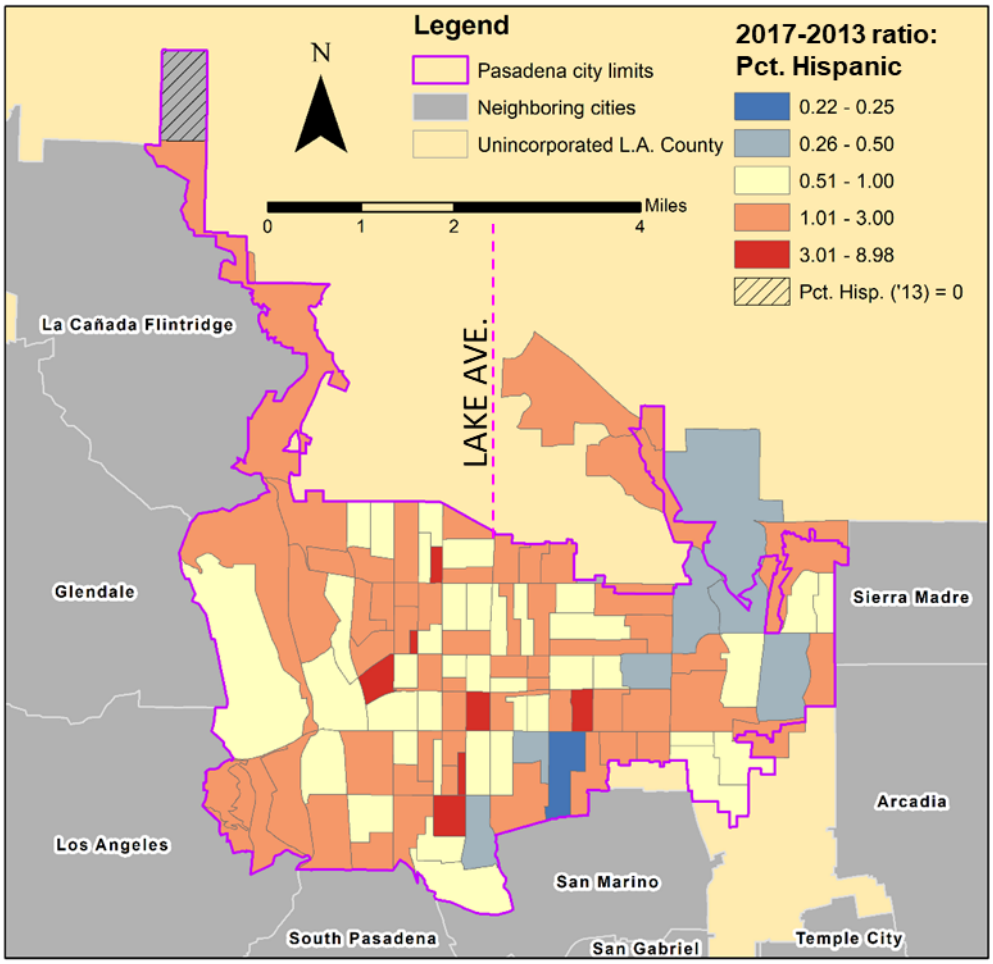

Figure G-4. Share of the population that identifies as Hispanic or Latinx.

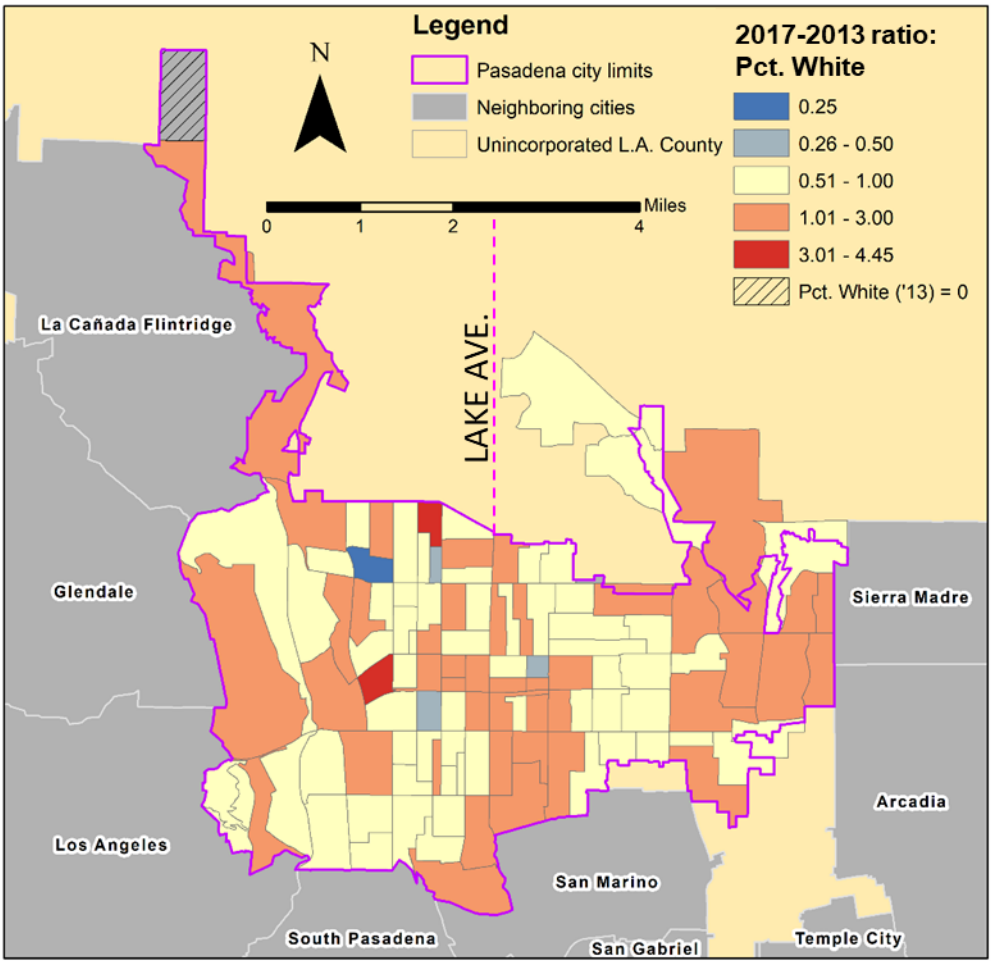

Figure G-5. Share of the population that identifies as non-Hispanic White.

G.2. Household income

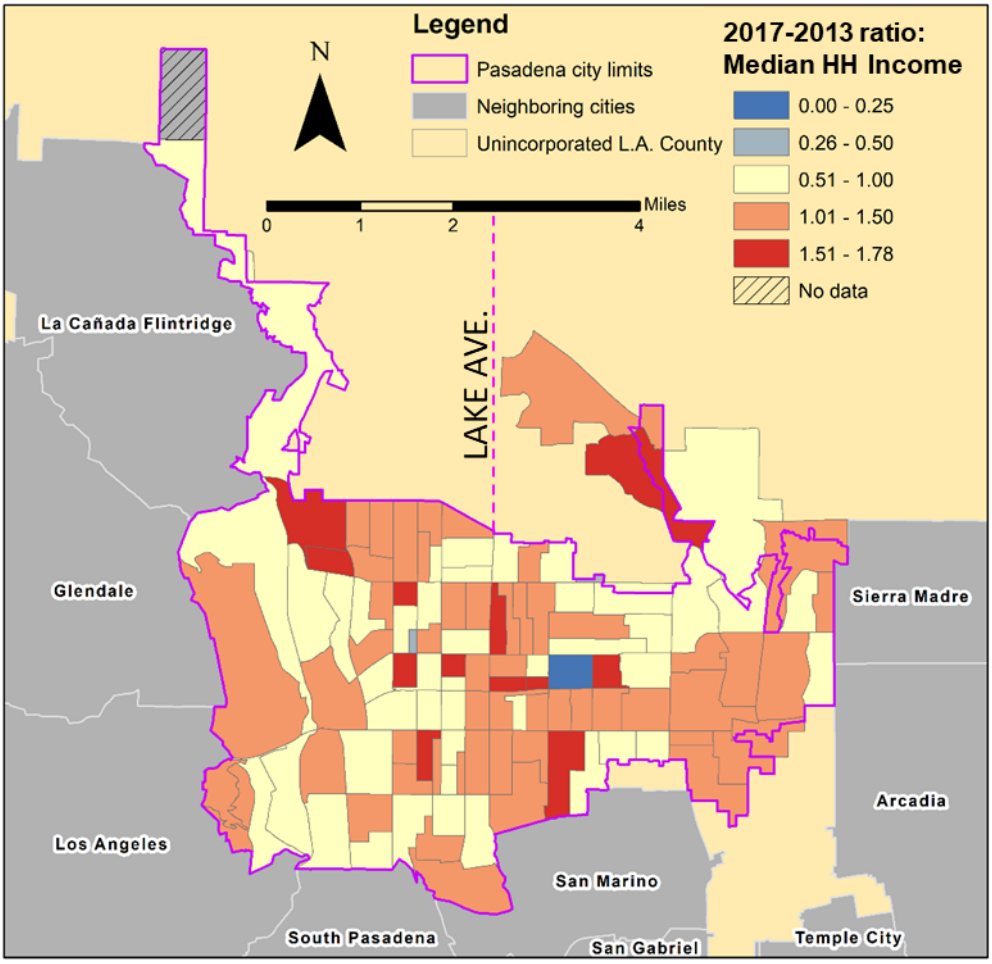

Figure G-6. Median household income.
Notice how median incomes rose at least 50% in several block groups in Northwest Pasadena, a historically disinvested neighborhood.

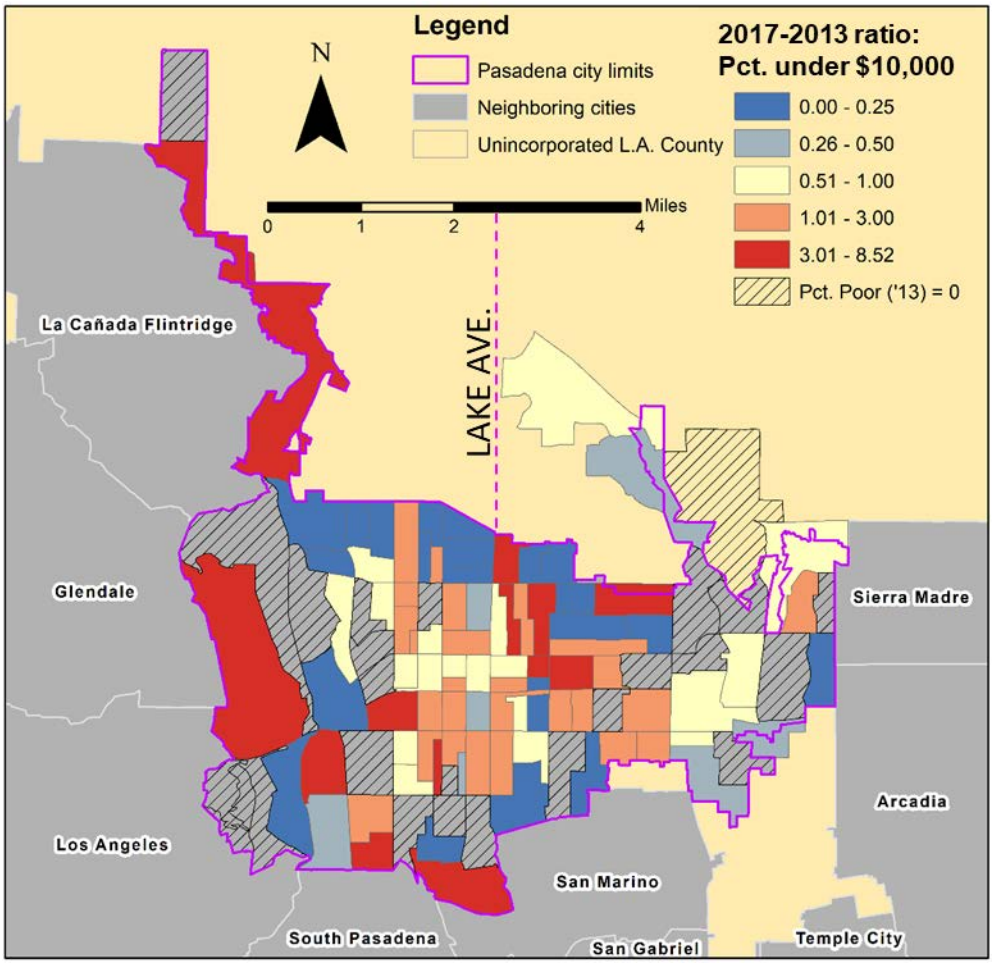

Figure G-7. Share of very-low-income households (less than $10,000).
Notice how this indicator diminished in many block groups throughout Northwest Pasadena.

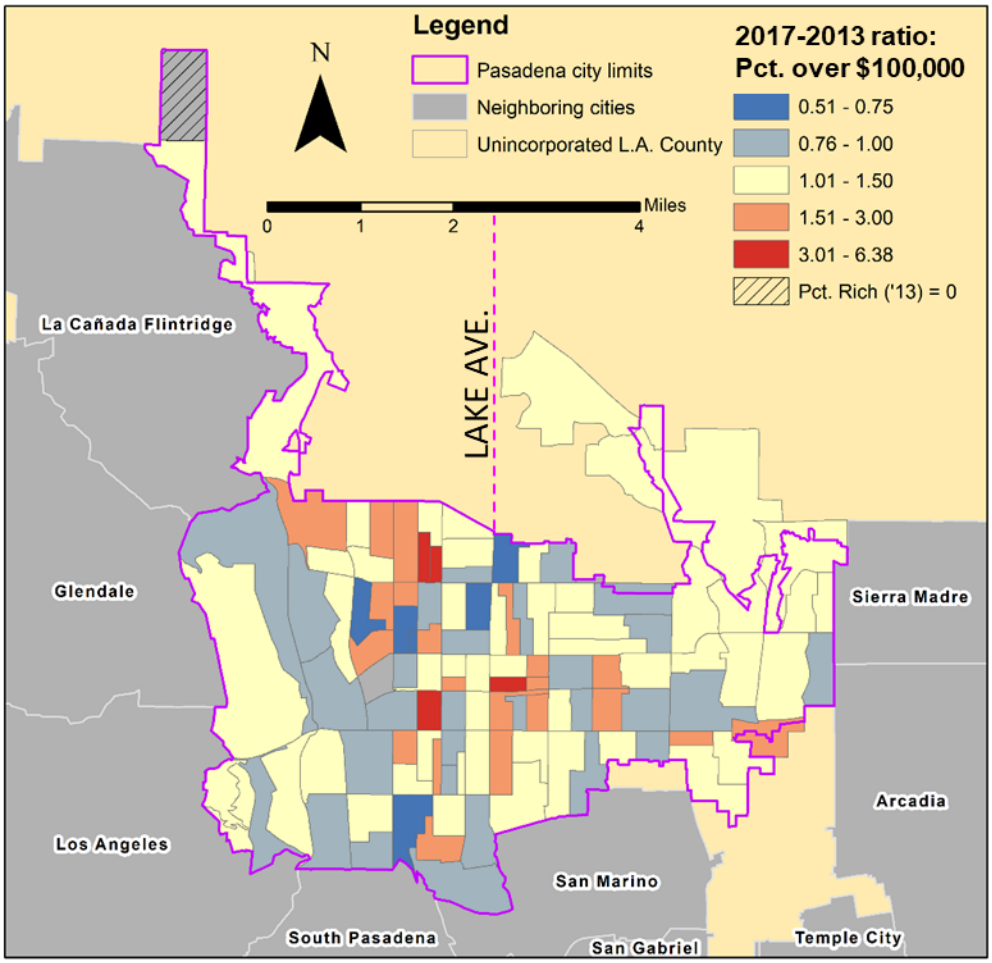

Figure G-8. Share of high-income households ($100,000 or more).
Notice the block groups where this indicator grew notably are clustered towards Northwest Pasadena.

G.3. Rents and rent burden

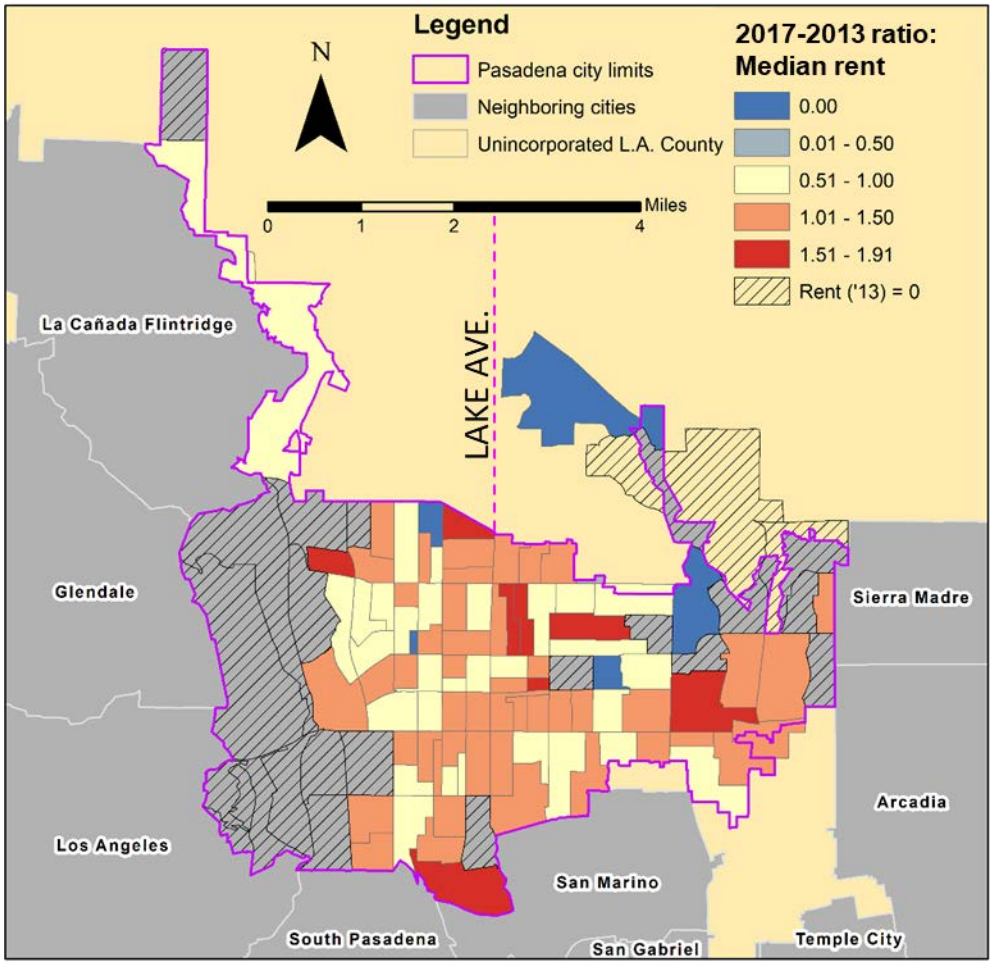

Figure G-9. Median gross rent.

Increases were nearly ubiquitous; some of the highest ones were in or close to Northwest Pasadena. Also, note that most of the block groups with diagonal lines (no color) are mainly inhabited by homeowners.

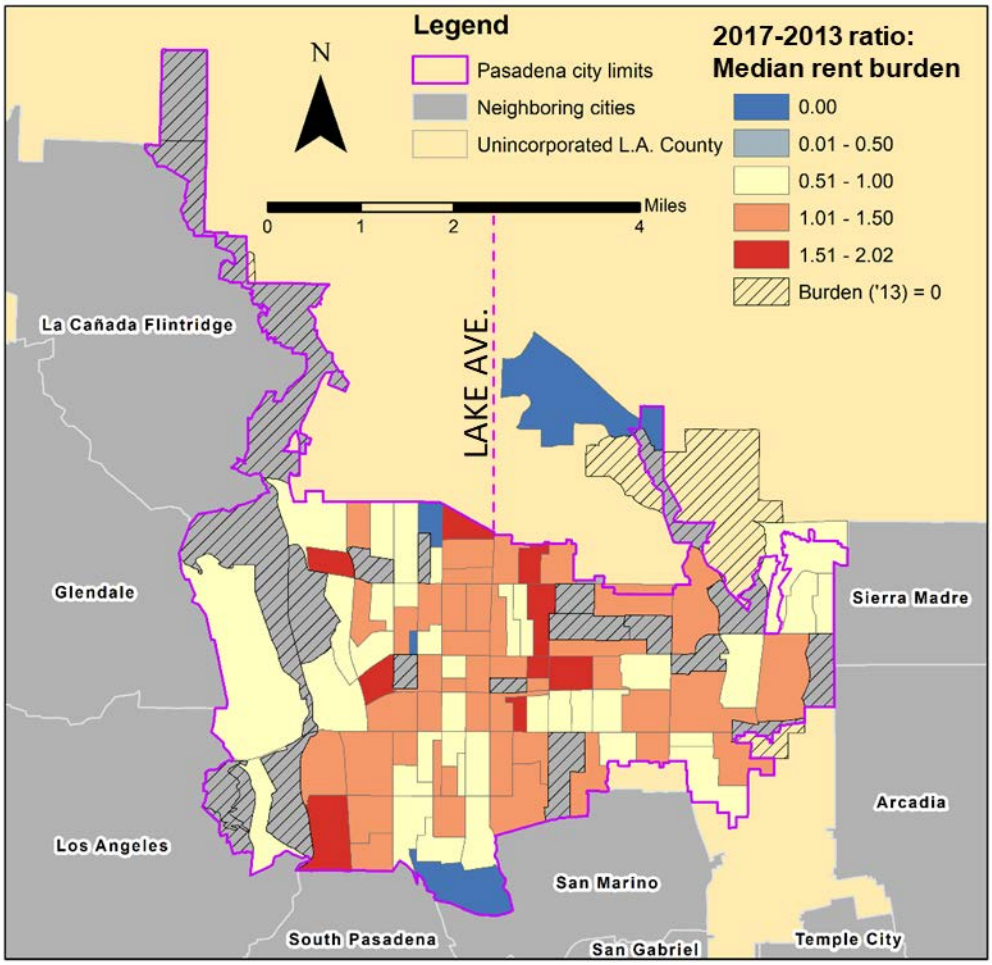

Figure G-10. Median rent burden.
Increases were nearly ubiquitous; some of the highest ones were in or close to Northwest Pasadena.

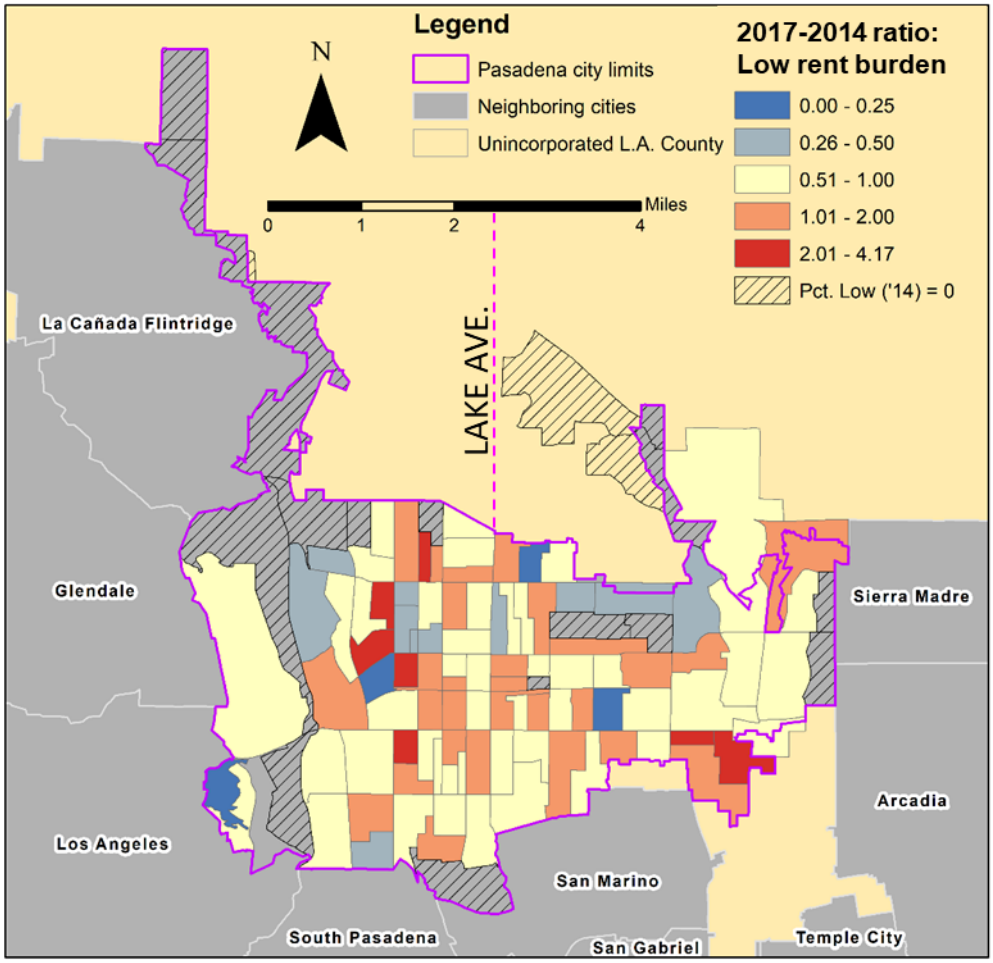

Figure G-11. Share of renter households who pay less than 20% of their income in rent.

Most of the significant decreases concentrated in Northwest Pasadena.

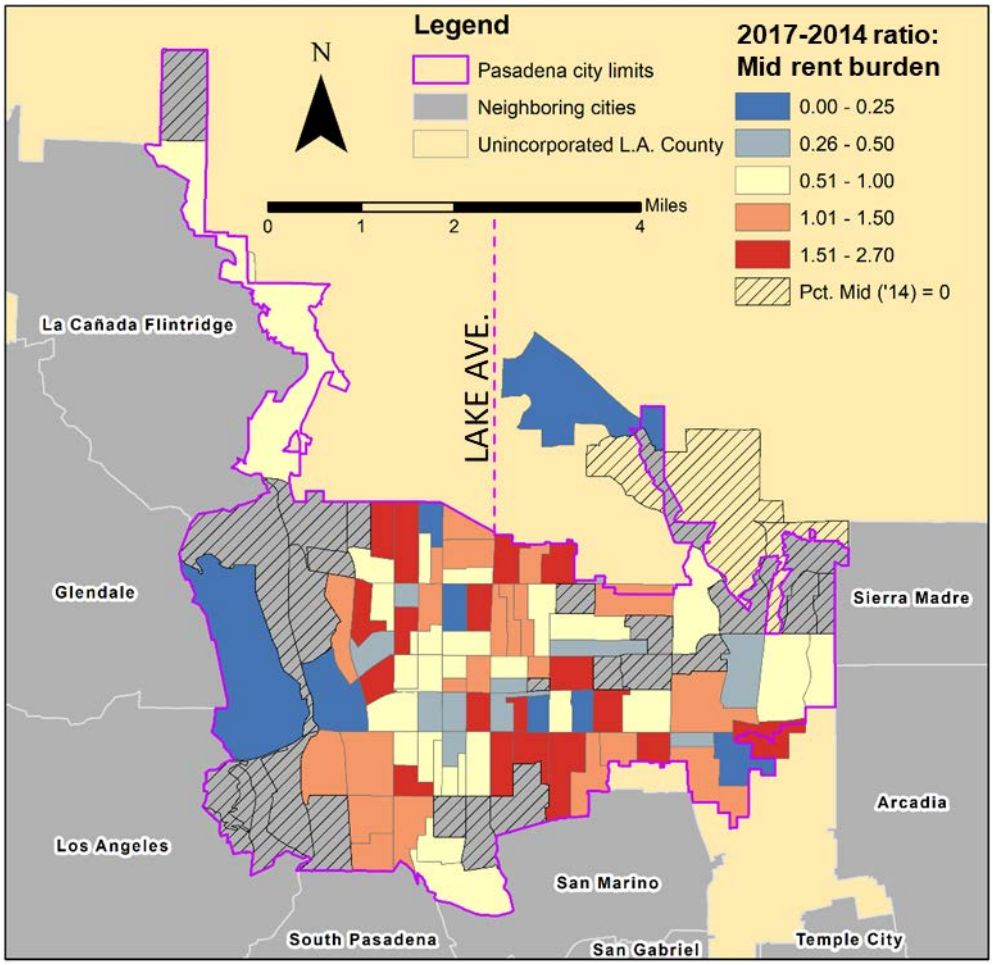

Figure G-12. Share of renter households who pay between 35% and 50% of their income in rent.

Important increases were almost ubiquitous.

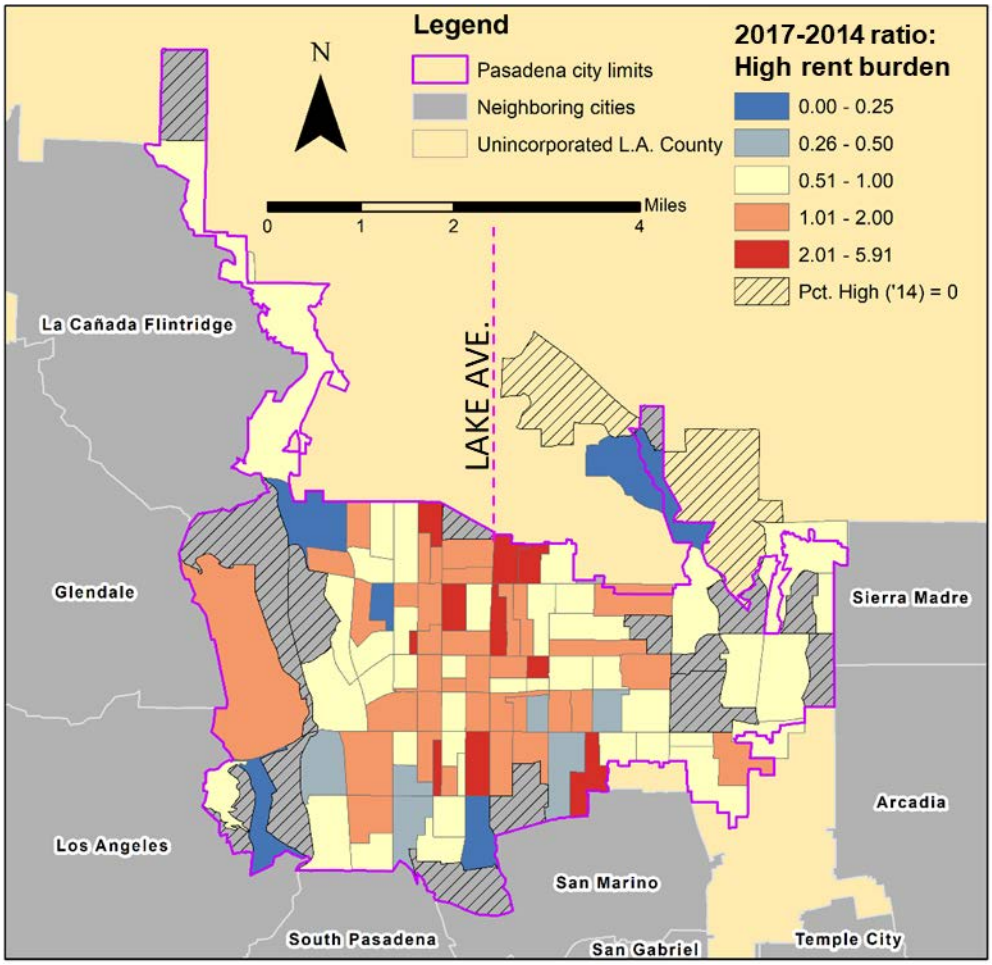

Figure G-13. Share of renter households who pay more than 50% of their income in rent.

Most of the significant increases concentrated in or around Northwest Pasadena.

Appendix H: Ridership by fare category

Pasadena Transit accepts different types of fare media and keeps record of their ridership by each kind. The base fares are (a) full ($0.75), (b) youth/K-12 student ($0.50), and (c) senior or disabled ($0.35). Then, there are (d) local transfers that are free, and (e) inter-agency transfers (IATs) that cost $0.25 for full-fare riders and students, and $0.10 for seniors and people with disabilities. Local transfers are for riders switching between Pasadena Transit routes and IATs include riders transferring from the Metro Gold Line, a Metro Bus, or a Foothill Transit bus. Pasadena Transit also accepts (f) EZ Pass, a regional monthly pass that riders can use in any participating transit agency, and (g) Metrolink tickets, which riders just flash at the bus operator. For the latter two, riders do not pay anything out of pocket when boarding the Pasadena Transit bus, and the City of Pasadena gets reimbursed by the corresponding agency (either L.A. Metro, who manages EZ Passes, or Metrolink, the regional commuter rail). Members of the (h) city and/or (i) regional paratransit systems (Pasadena Dial-A-Ride and Access, respectively) board Pasadena Transit for free. Access Services reimburses Pasadena Transit for this ridership. Finally, non-paying riders (who do not belong to any of the special groups mentioned above) — e.g., city employees — are recorded under a (j) free fare category.

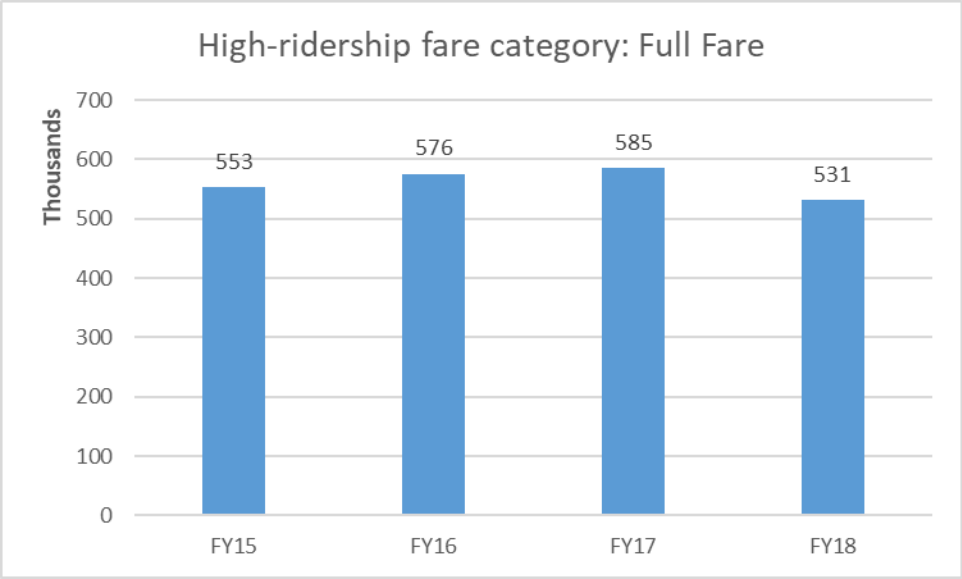

Figure H-1. Ridership on the full-fare category.

The fare categories were aggregated in three groups in order to make the bars visible. If all ten categories were plotted on a single graph, the full-fare bar would overshadow all others, making them hard to read.

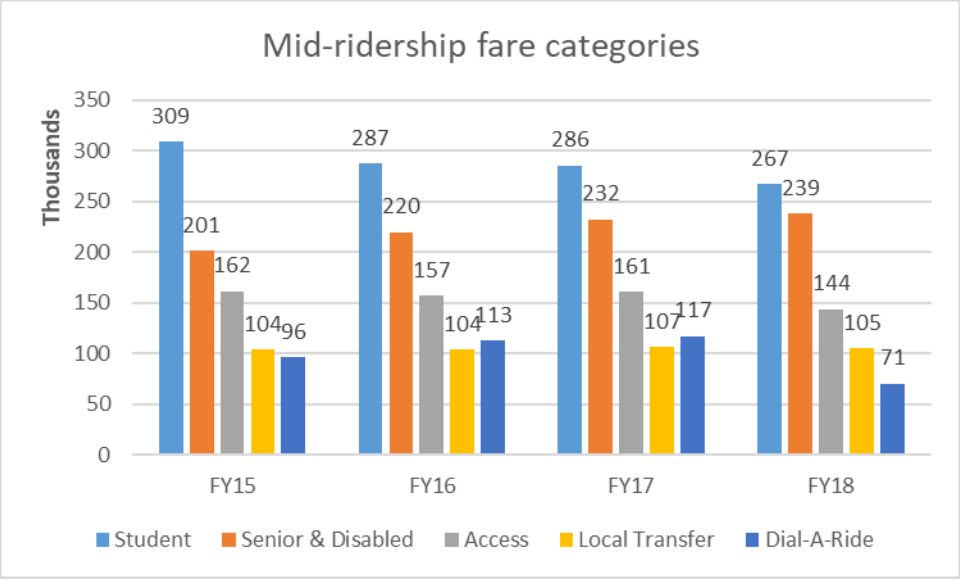

Figure H-2. Ridership on the "medium-sized" fare categories.

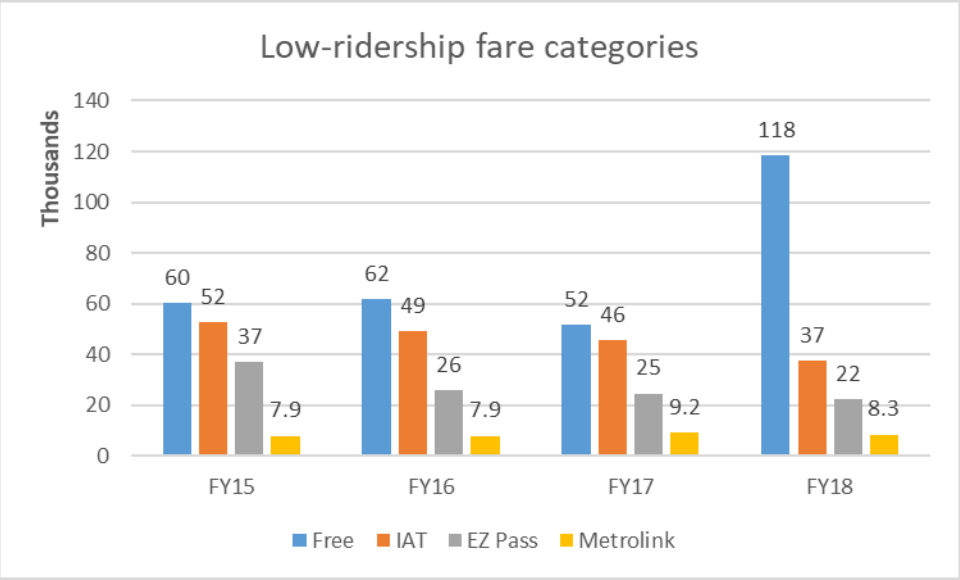

Figure H-3. Ridership on the "low-ridership" fare categories.

The following graphs show the same information as Figures H-1, H-2, and H-3 but indexed to FY15. This helps to more easily interpret the changes in ridership for each fare category. For simplicity, they are still aggregated in the three arbitrary groups mentioned earlier.

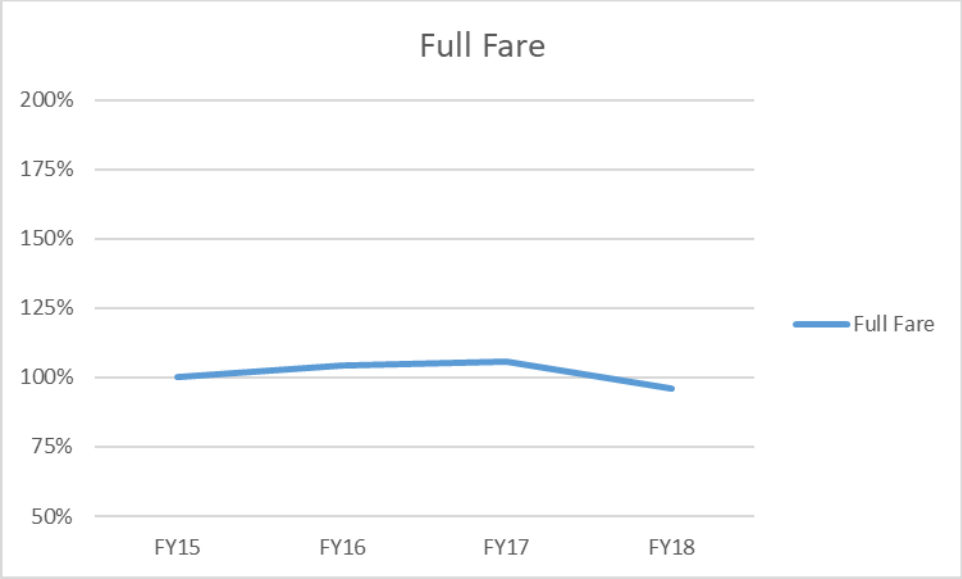

Figure H-4.
Full-fare ridership has stayed relatively flat, and fell when system-wide patronage did as well.

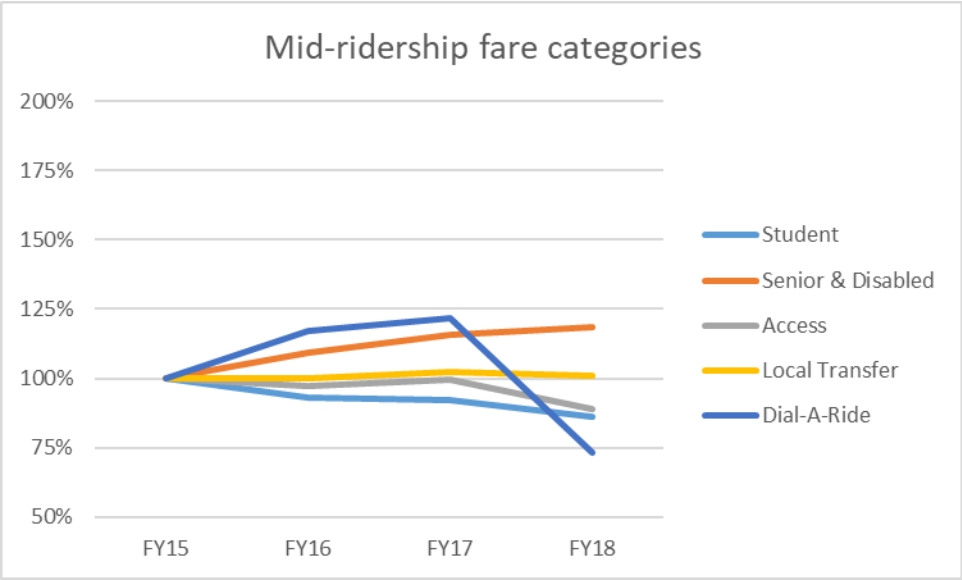

Figure H-5.
Local transfers and Access riders remained relatively flat (Access felt the FY17-FY18 drop more strongly). Senior-and-disabled is on the rise (even after the recent drop — likely due to the influx of an increasingly senior population into Pasadena) and Dial-A-Ride fell dramatically (likely due to some policy changes implemented: migrating from a flash pass to the regional smartcard program). Lastly, the Student fare category has fallen since FY15.

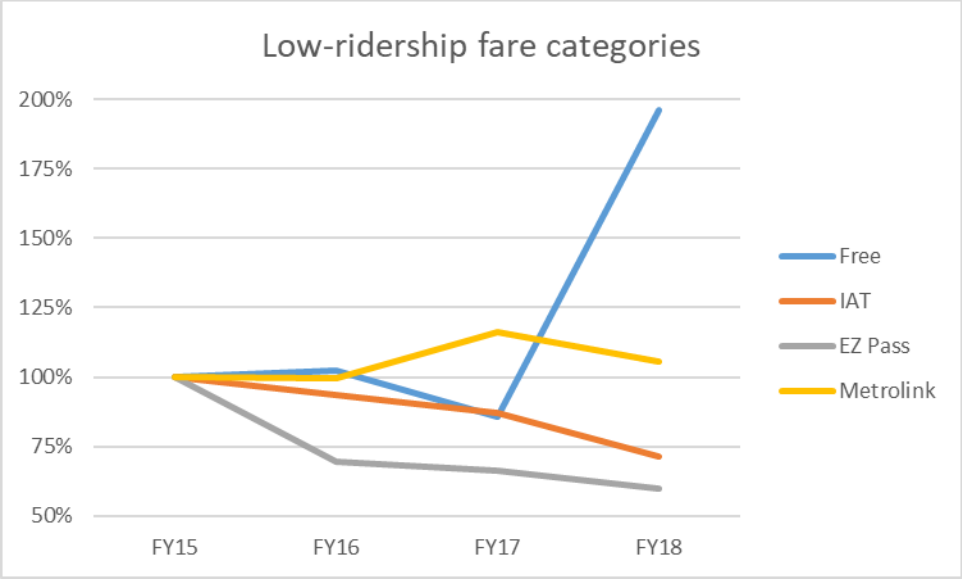

Figure H-6.

Inter-agency transfers and EZ Pass holders were declining since FY15, much before than the recent FY17-FY18 drop. This might be due to the overall regional decline in transit ridership that manifested in 2014. On the contrary, Metrolink riders increased considerably up to FY17 and then dropped, almost back to the FY16 value. This could be considered nearly flat since the base is very small (very few people use Pasadena Transit with Metrolink tickets, compared to other fare categories; see Figure H-3). Finally, free boardings were also decreasing up to FY17, but rose significantly between FY17 and FY18. Many factors might explain this, but one that stands out is the college-pass pilot that Pasadena Transit introduced that fiscal year, which was free for higher-education institutions until the end of the trial period (this scheme changed for FY19).

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J.E.P.G., 06/06/2019