Technical Appendix 2
Demographics in Support of Chapter 2

LIST OF FIGURES AND TABLES

INTRODUCTION AND STRUCTURE

This Technical Appendix to TCRP Research Report 201 presents a summary of a wide variety of sociodemographic changes which have, directly or indirectly, influenced the nature of the transit market over the past two decades, (with references to earlier periods as appropriate.) In general, it covers the same subject matter as provided in Chapter Two of the Final Report, but provides more detail for those interested, based on a wide variety of data sources.

INTRODUCTION

Scale of Change in Transit Use

By many measures, transit use has increased more than other modes. In the period from 1990 to 2010, transit ridership increased nearly 70% (from 4.8 billion linked trips to 8.1 billion), while transit passenger miles increased 30% (Bureau of Transportation Statistics). In the same period, the population aged 16 and older grew 26%, the employed population grew just 22% (Bureau of Labor Statistics 2017), and VMT grew 38% (Office of Highway Policy Information 2015).

Figure 1 shows the growth in these four measures expressed as an annual rate over two decades.

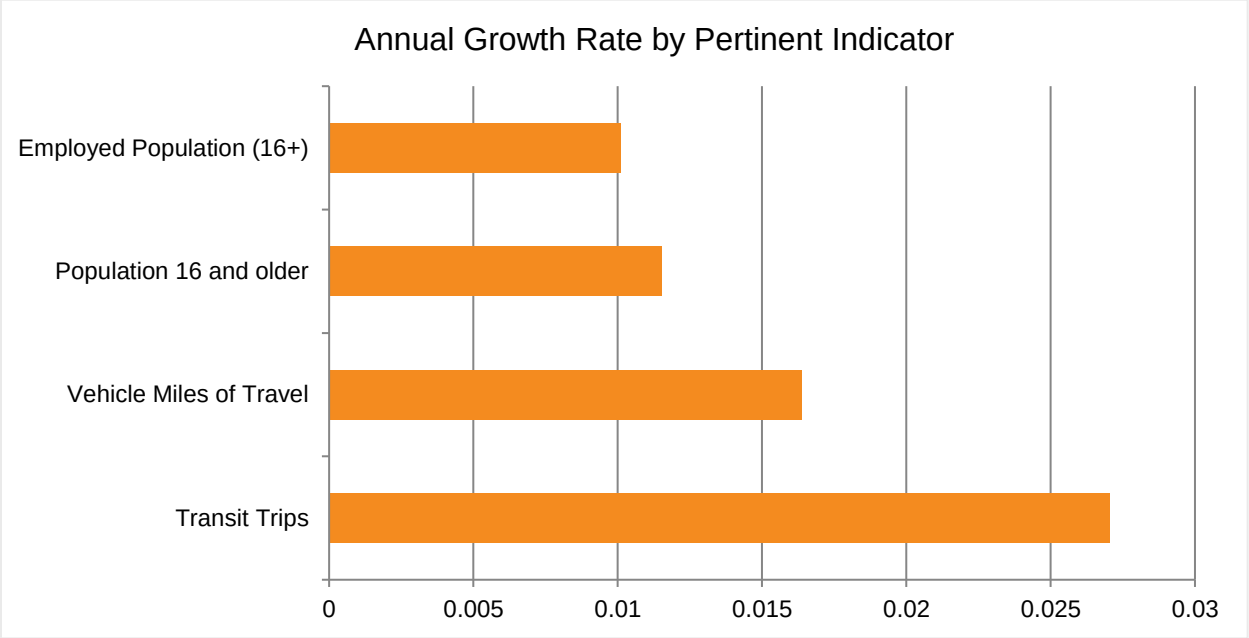

FIGURE 1: ANNUAL FRACTIONAL GROWTH RATE IN TRAVEL INDICATORS, 1990 TO 2010 (SOURCES IN TEXT)

In this century, cities in the US have included transit service in policies that focus on revitalization, livability, sustainability, and infill development. Recent research indicates that younger people especially—but also newly retired--seem to seek out multimodal options and denser urban areas where they can walk, bike, and take transit to serve their daily travel needs. Transit is clearly in a renaissance and the recent shifts in ridership and attitudes offers an opportunity for transit agencies to move thoughtfully into a future that serves this new constituency while retaining legacy markets.

Scale of Change in Auto Use

At the same time, the first decades of the new century are characterized by larger changes in the overall transportation behavior in the United States, and indeed around the world: a behavior characterized by a lessened use of the private automobile, as reflected in the lower amounts of VMT per person. Figure 2 previews a discussion later in this Appendix concerning the significant lowering of auto vehicle-miles traveled in the first decade of this century, primarily due to Millennials. As will be discussed in Part 3 of this Appendix, it should be noted that the survey year 2009 was characterized by a severe economic recession, which affected the level of auto use.

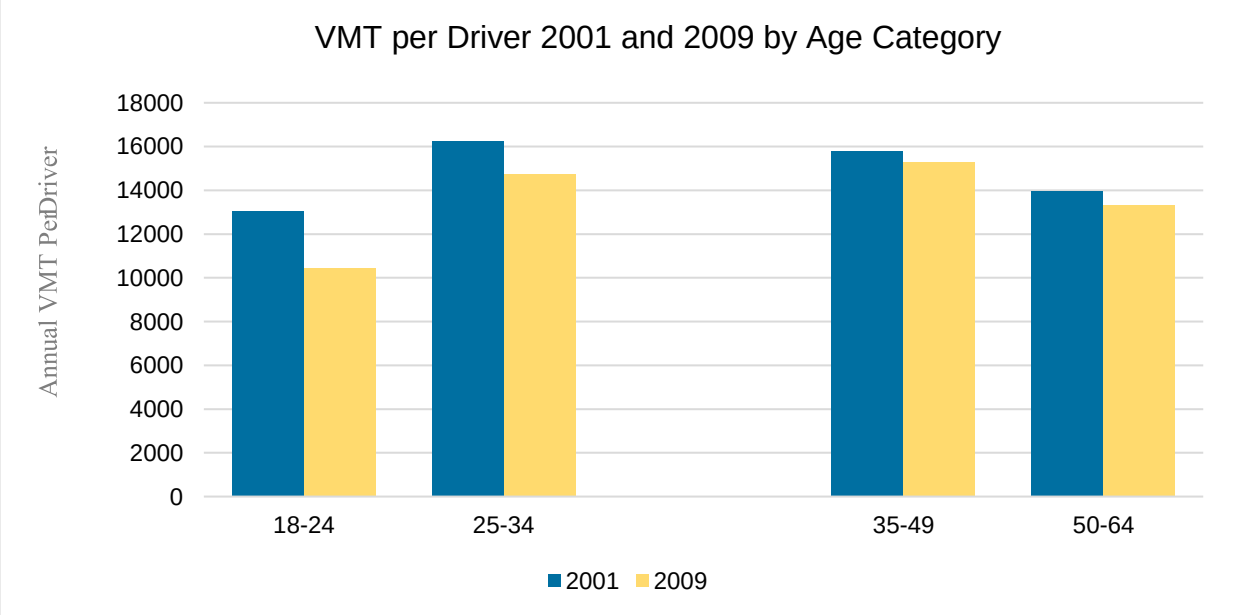

FIGURE 2. OVERVIEW OF THE DECREASE IN VMT BY AGE CATEGORY, BETWEEN 2001 TO 2009 (NHTS)

STRUCTURE

This Appendix includes four parts, three about trends and one about the present:

1. Part One summarizes *trends* in the characteristics of transit riders
2. Part Two summarizes *trends* in the characteristics of transit trips

3. Part Three summarizes *trends* in overall American travel patterns influencing the market for public transportation services.

4. Part Four summarizes *present use* of transit by key demographic groups

PART ONE: TRENDS IN TRANSIT USE

The research presented in this section attempts to put the recent travel behavior changes into the context of long-term trends. Some of the findings identified in the trends analysis are summarized in their order of presentation in this Appendix.

I. Highlights of Transit Rider Demographic Trends • The "average" transit rider has changed in the last few decades. Following trends in the US population, transit riders are now more diverse, nearly equally split nationwide **between white, African American, and Hispanic**, with recent growth in Asian and 'Other' identifiers.

- In terms of age, the data show that younger people have always taken more per capita transit trips than older people, but overall transit use has grown faster than the population growth of 18- to 34-year-old individuals and for the next youngest age category of 34- to 44-year-old individuals, meaning transit is growing faster than simply population trends.
- Legacy transit markets include single people, especially single parents, and people with no access to a vehicle or license to drive.

II. Highlights of Transit Trip Characteristic Trends

- About half of transit trips are work commutes or are work related—a proportion that has remained stable for many decades. Only recently has the proportion shifted slightly toward more non-work travel, led by travel for shopping and social/recreational purposes.
- While the trends in the commute distances show typical trip lengths of 10 miles or so, the time in transit has changed from around 35-40 minutes for a ten-mile commute to nearly 50 minutes for a ten-mile commute.
- With equal accessibility to transit, Hispanics are more likely than other ethnic groups to use transit, even when controlling for income differences.
- Evidence exists that more people are 'occasional' users of transit, and transit agencies will possibly see continued growth in occasional choice riders.

YOUNGER AND OLDER TRANSIT USERS

The discussion of the growing diversity of the US population and transit riders must include the interrelationship between age and key demographic variables.

For instance, 45% of Hispanics in the US are under age 30, meanwhile only 6.8 percent of people aged 65 and older are Hispanic (Administration on Aging 2015). The younger

age group—Millennials, who are the focus of much of the recent research--are the most diverse generation in many decades.

Figure 3 shows how the aging process affects per capita transit use, reading from left to right showing increasing age. This pattern of decrease in transit use with increase in age is portrayed for four separate points in time, from 1990 to 2009, with each survey year expressed in a different colored line. (The same information is expressed in a simplified graphic format in Chapter 2 of the Final Report.)

As shown in Figure 3, the most recent NHTS data show higher per capita rates for transit use by all age groups, except for the 16-24 age group, when compared to data from two decades ago. Per capita rates are useful for trend analysis since they normalize changes in the base populations by simply dividing the number of total transit trips by the number of people in each analysis group. The base populations are changing as the Millennials move through school and enter the workforce, and Baby Boomers move through the empty-nest stage and into retirement. For example, the number of people aged 16-34 (the two lowest age categories in Figure 3) fell slightly from 73 million people in 1990 to 70 million people in 2009. Conversely, the population aged 55 and older grew from 50 million people in 1990 to over 76 million people in 2009. Therefore, just measuring the number or percent of transit trips by each age group would conflate these changes with changes in transit use. Per capita rates compare just the changes in transit use per unit of population.

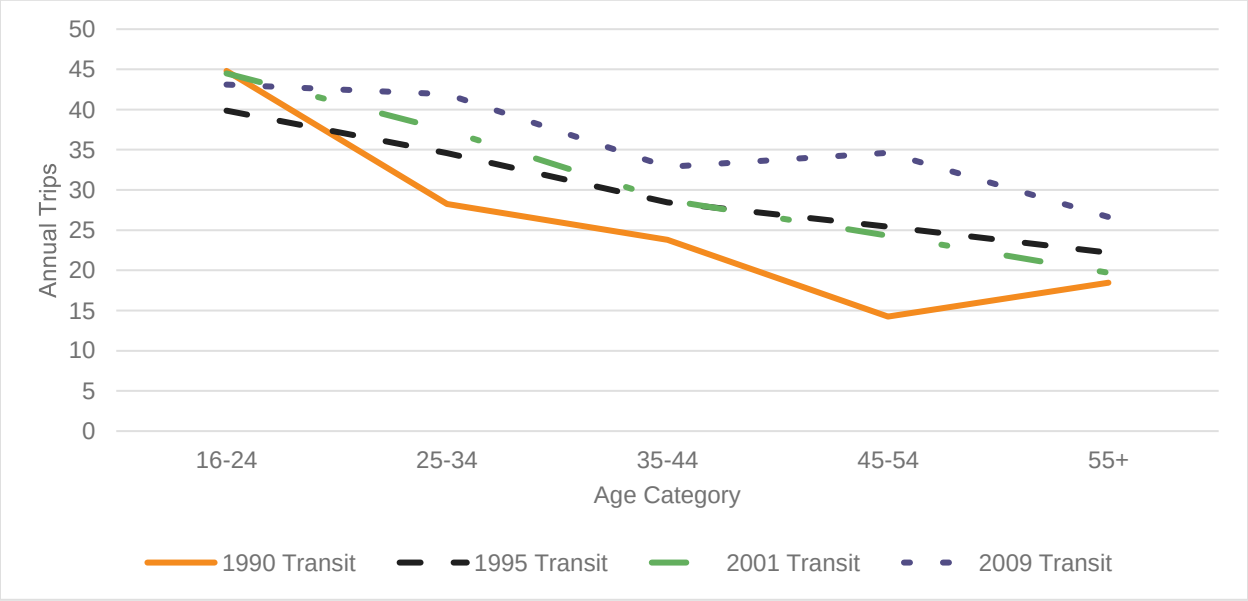

FIGURE 3. TRENDS IN PER CAPITA TRANSIT USE, BY AGE CATEGORY, 1990 TO 2009 (NHTS)

With changes in the number of people in different age groups and changes in ridership, the question remains as to how the growth in population interacts with changes in

ridership. According to the NHTS data series, more transit riders have been added from the younger age categories than simple population growth would account for.

Figure 4 shows that 40% of the added population between 1980 and 2010 was in the older age group—these are the Baby Boomers aging past 55—but only 20% of the added riders 1977-2009 were in this oldest age group. On the other hand, the youngest age group accounted for just 6 percent of the added people between 1980 and 2010 but 14% of the added transit riders. Note that the youngest age group includes 15-year-old respondents to match census historic data, while previous analysis included 16- to 34-year-old respondents. Perhaps surprisingly, people aged 35-44 accounted for 22% of the population growth but 35% of the added transit riders, showing that this age group may also be contributing to the renaissance of transit.

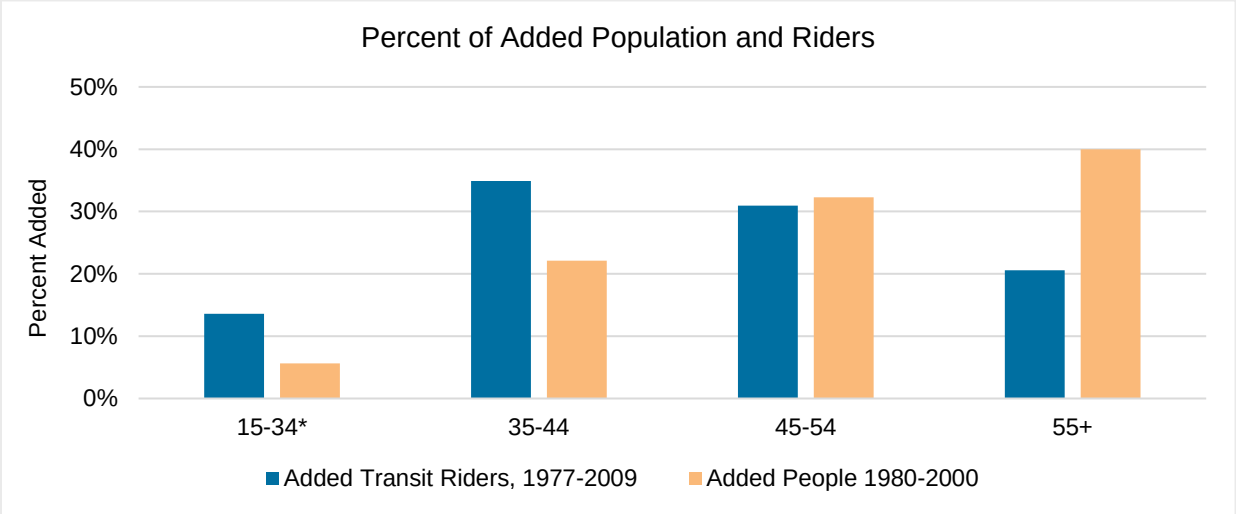

FIGURE 4. ADDED POPULATION AND ADDED TRANSIT RIDERS (NHTS)

Much research has tried to untangle the different effects that give rise to younger people's greater transit use: economic and life cycle factors, preferences and values, and use of devices supported by Information and Communication Technologies (ICT) have all been found as possible correlates.

The list of how young people today differ from young people from earlier generations is extensive: rate of holding a driver's license for younger men is at the lowest levels since 1970 and—for the first time—men between the ages 25 to 29 are less likely than women of the same age to hold a driver's license (McGuckin's Analysis of Highway Statistics). More young people attend college (as a% of all high school graduates) and many return home after getting a degree (the highest percent of people between the ages of 18 and 24 are living at home since 1960)

(McGuckin's Analysis of US Census TAD-1). Since the recession, the unemployment rate for younger people remains stubbornly high (Bureau of Labor Statistics). Other significant changes that affect travel choices have also been observed. For instance, the

age of women when they have their first child is the oldest it has ever been (National Center for Health Statistics), as is the age of their first marriage (Median First Age at Marriage). For the first time in history, for at least half of the younger generation, those life-changing events are in reverse order—first comes children then comes marriage.

While much of the public focus has been on younger people, at the other end of the spectrum are people in older age groups: The "Baby Boomers" (those born between 1946 and 1964) started turning 65 in 2011, and one million Baby Boomers will pass that milestone every year for the next 20 years. The older population cohort in 2030 is projected to be twice as large as their counterparts in 2000, growing from 35 million to 72 million and representing nearly 20% of the total US population (Federal Interagency Forum on Age-Related Statistics).

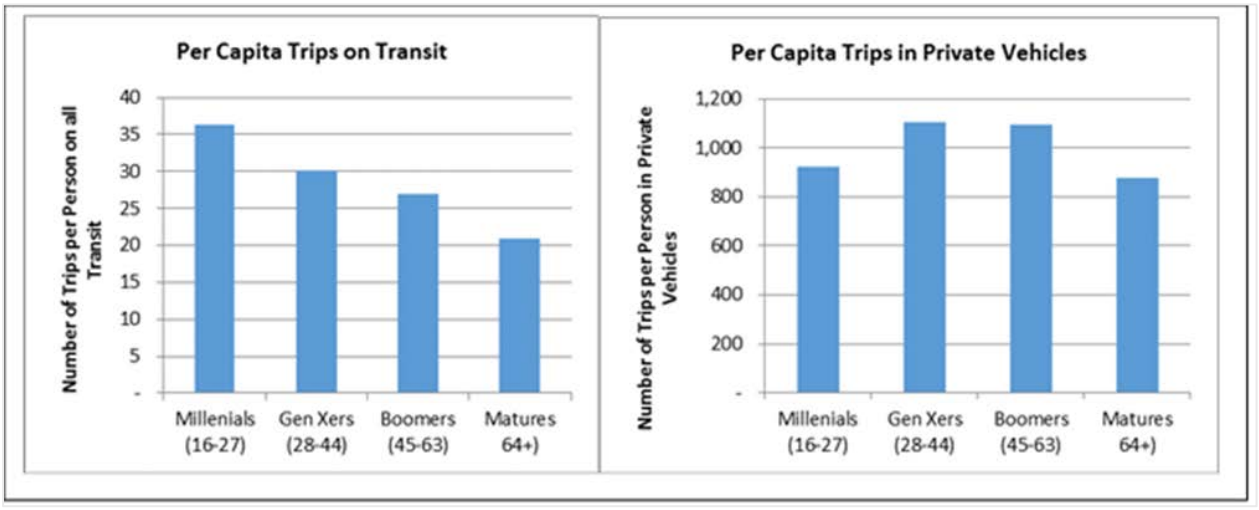

FIGURE 5. PER CAPITA TRANSIT AND VEHICLE TRIPS BY POPULATION GROUP (2009 NHTS)

Employment among people aged 65 and older is at a record high with nearly 27% of people aged 65-74 in the workforce and Baby Boomers are swelling those numbers (Toosi 2005). The number of people living well past retirement age has been dubbed the 'longevity revolution' and the mobility of older people has never been greater (Butler 2008). In fact, in 2009 the Baby Boomers had a high per capita vehicle use—much higher than previous generations of older Americans, as shown in Figure 5.

But research shows that while most people 'age in place,' Baby Boomers are also interested in mobility options as they age. It is interesting to note that Baby Boomers who have moved in the last five years are more likely than any other age group to cite being close to public transportation as one of the reasons they chose their current home location (McGuckin 2012).

III. Highlights of American Travel Pattern and Vehicle Miles Traveled Trends

- After a multi-decade increase in the rate of VMT per capita, this pattern of steady increase in driving "peaked" in the first decade of this century. This important indicator declined from 2006 to 2013 and is now showing a modest rebound.
- This pattern of lowered auto use occurred most strongly in urban areas, most strongly for those under 35 and for men.

TRENDS BY LIFE CYCLE

Over the last few decades, single people and especially single parents have used transit at higher rates than couples without children (including retired) and couples with children at home. Figure 6 shows that single parents have the highest transit use per capita (which includes everyone in the denominator—those who report transit use and those who do not).

This may illuminate some of the current transit use by younger people, who remain single longer than previous generations and delay marriage and child-bearing. Traveling alone is the optimal situation for transit. Meanwhile traveling with children on transit can be a challenge, and trends show that people in nuclear family households—two parents and children—take the fewest transit trips per capita.

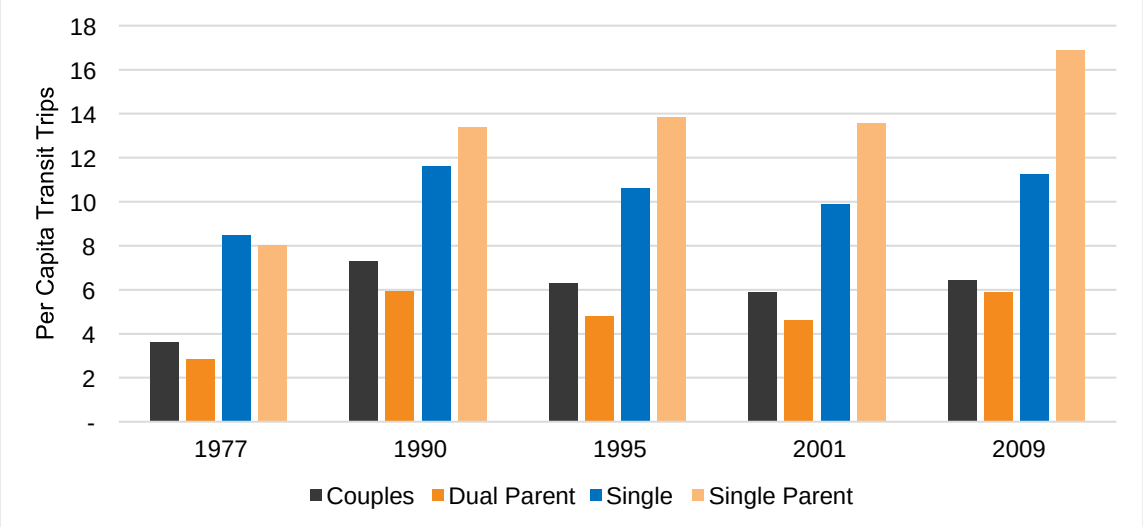

FIGURE 6. TRENDS IN PER CAPITA TRANSIT USE BY LIFE CYCLE (NHTS)

UNDERSTANDING THE PEOPLE WHO USE TRANSIT

This section describes the people who use transit—either bus or train—at least once for any purpose on the travel day. The data are weighted to represent people and not trips—so that people who ride more than once do not get counted more than once. Some of the

characteristics of transit riders have remained stable over many decades. For example, transit riders, compared to the overall population, have a lower licensure rate.

It is important to clarify that although we are using a combined measure of 'transit,' bus and rail can serve different ridership markets. As shown in Figure 8, the 2009 NHTS found that rail riders are more likely to be licensed than bus riders. Further, according to the 2009 NHTS, 4 percent of rail riders and about 17% of bus riders were non-drivers. Overall, low-income riders were less likely to be licensed than high-income riders. Low-income non-drivers comprise most of the market of transit and are more likely to ride the bus than the train.

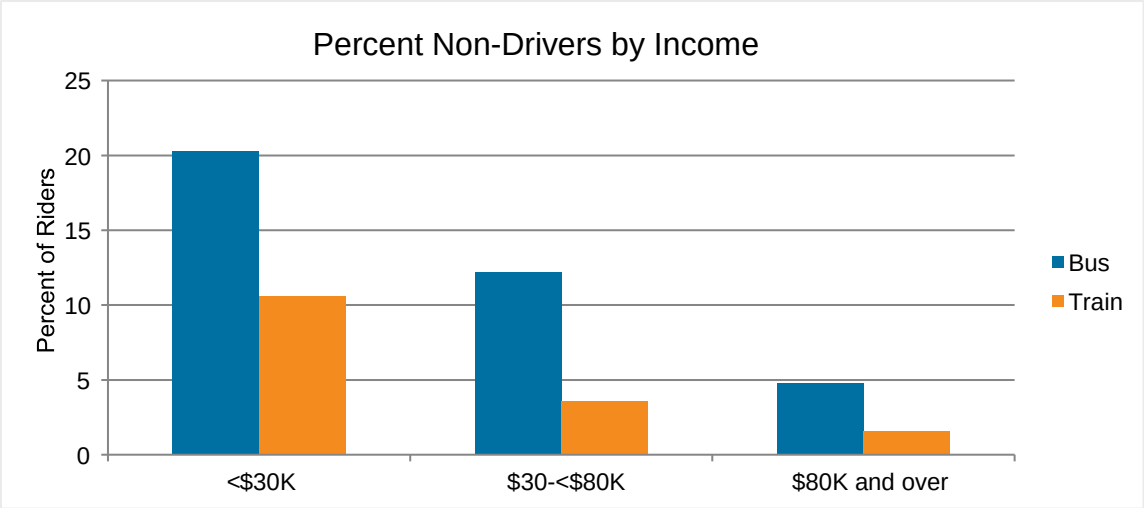

FIGURE 7. PERCENT OF BUS AND RAIL RIDERS WHO ARE NON-DRIVERS, (NHTS 2009)

And finally, the income disparities also intersect with race and ethnicity. The mean household income of bus and train riders by race/ethnicity will be discussed later: the poorest riders were African American bus riders, contrasted with the high-income white train riders. ("Other" includes Asian, but there were too few in this race category to separate out specifically).

Figure 8 shows trends in some traditional demographic indicators for transit riders since 1977: the percent who are employed, the percent in zero-vehicle households, and the percent in households with no workers have all remained relatively stable over time. The percent of transit riders who have a high school education or less declined between 1977 and 2001, but in the last iteration rose slight. Overall, transit users have less education than the broader US population. The data show that about 40% of transit riders had a high school degree or less in 2009, while only about 10% of the US population had a high school degree or less in 2010; in both the NHTS and the Census, this question is asked only of adults 18 and older (Russell Sage Foundation).

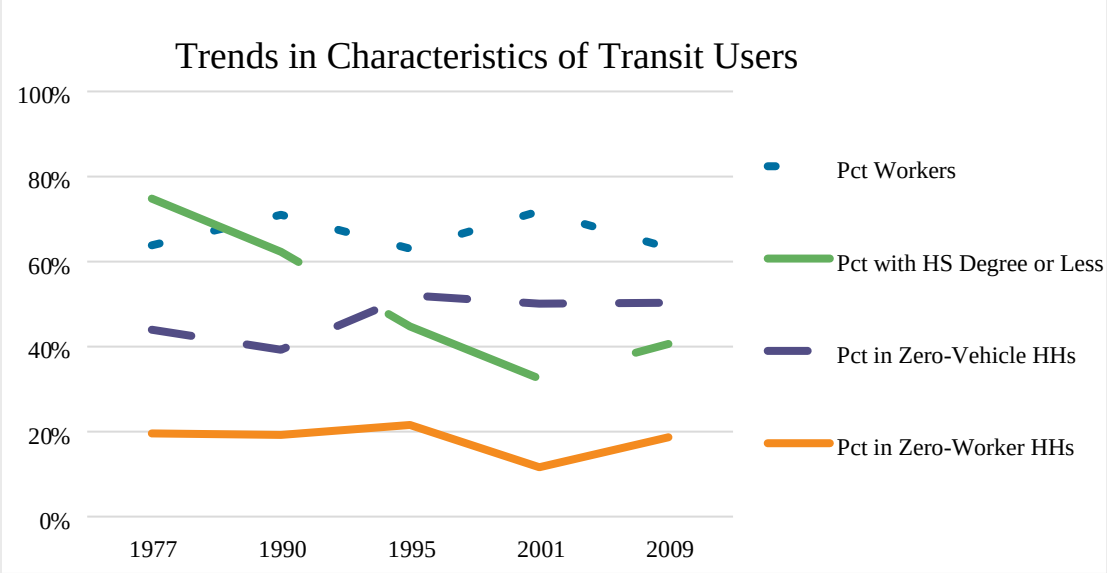

FIGURE 8. TRENDS IN SELECTED CHARACTERISTICS OF TRANSIT USERS, 1977–2009 (NHTS)

While Figure 9 shows that the percent of transit users who are workers has remained relatively stable over many decades—between 60% and 70%—the analysis shows that rail captures far more riders who are workers compared to local bus.

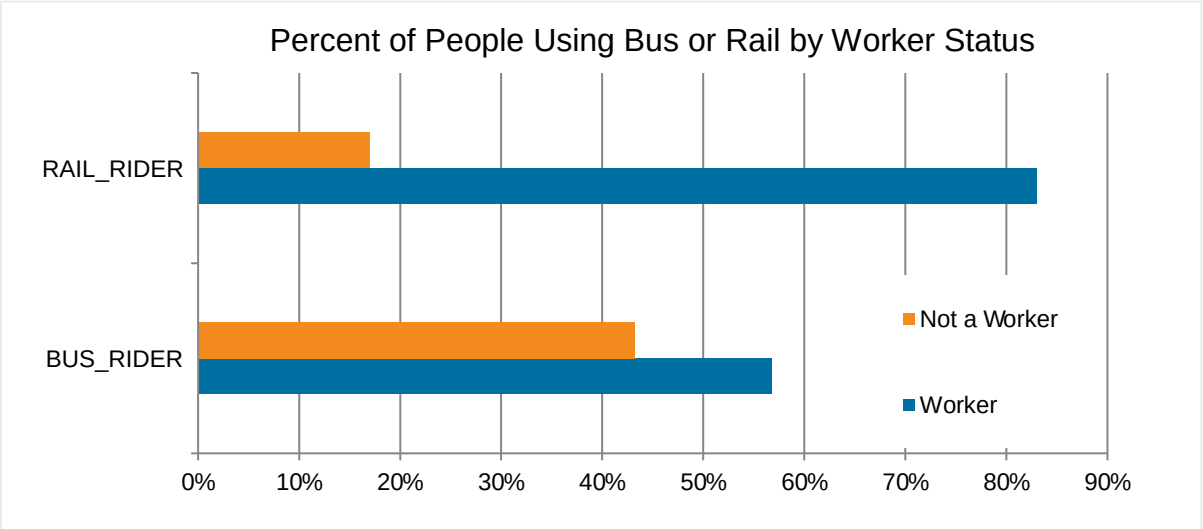

FIGURE 9. PERCENT OF BUS AND RAIL RIDERS WHO ARE WORKERS (NHTS, 2009)

TRENDS IN RACE AND ETHNICITY

As the population of the US and its metropolitan areas has become more diverse over the last few decades, so has the population of transit riders. Many people do not realize that

the Baby Boomers, born after the Second World War when immigration was strictly limited, were one of the least diverse generations in the 20th century. Since WWII, diversity has increased steadily— especially in the urban areas.

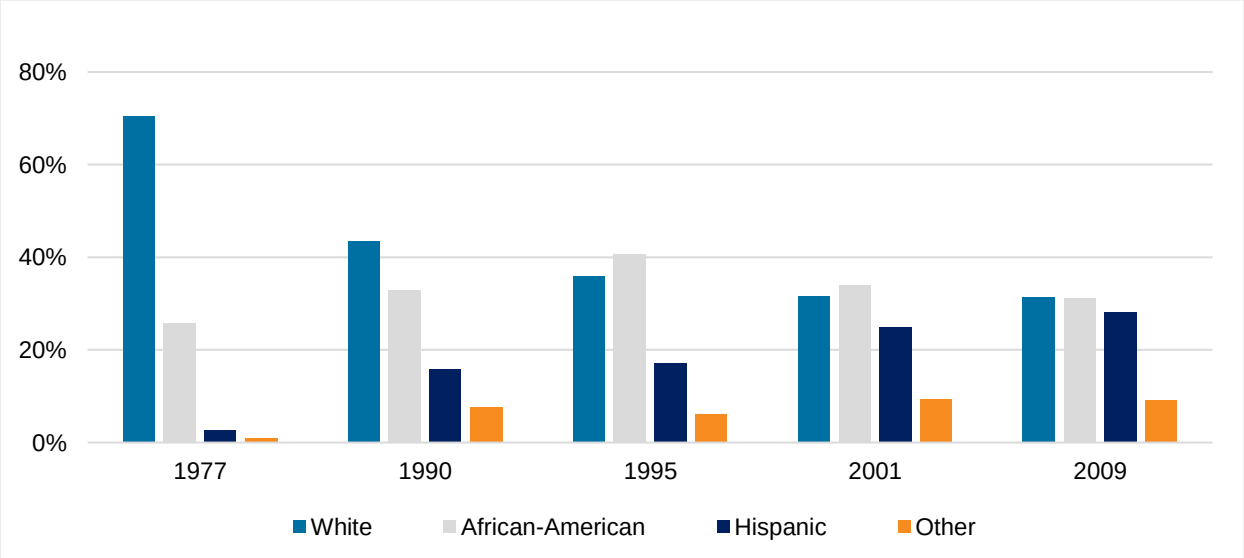

FIGURE 10. TRENDS IN RACE/ETHNICITY OF TRANSIT RIDERS (NHTS)

Figure 11 shows the shifts in the proportion of transit riders by race/ethnicity between 1977 and 2009. (Note: Hispanic is considered an ethnicity, Hispanics can be of any race). The decline in the percent of white transit riders is most pronounced in the 1980s and the growth in Hispanic riders is most pronounced in recent years.

Another way to look at the shifts in transit ridership by race/ethnicity is to track the added number of riders in each category.

Figure 11 shows the percent change in the number of riders by race/ethnicity between 1977 and 2009. The percent of transit users who are Hispanic doubled while the percent of transit users who are white declined by 80%.

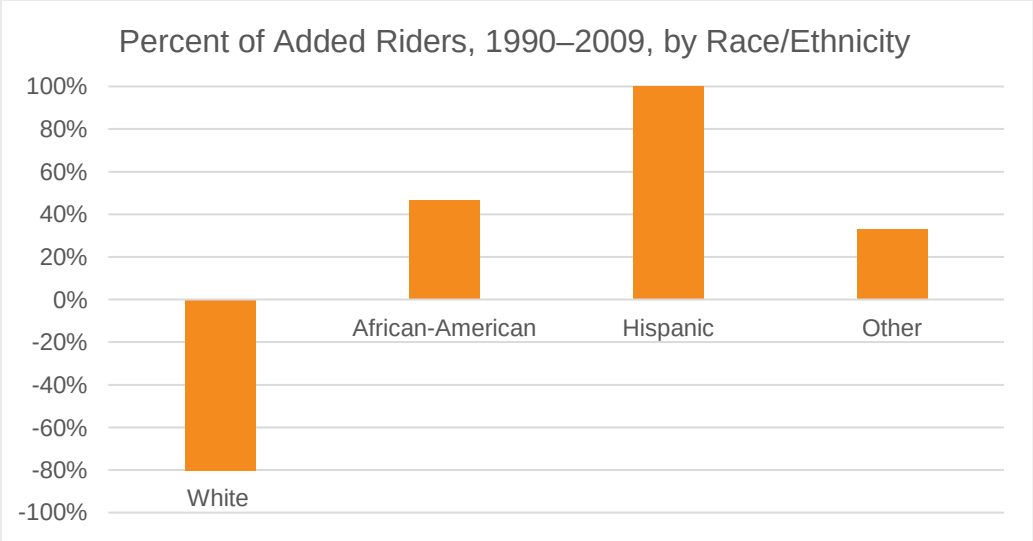

FIGURE 11. % CHANGE IN TRANSIT RIDERS BY RACE, 1990 TO 2009 (NHTS)

Migrant and Immigrant Patterns

The increase in diversity of the US population is fueled by increasing proportions of Hispanics and Asians, both native-born and immigrants. Immigrants, especially new immigrants, travel in significantly different ways than US-born residents. As shown in Figure 12 newer immigrants, for example, are more likely to live in a household without a vehicle compared to native-born individuals. However, after 10 years or so, the rates of auto ownership become comparable.

The twenty-year time frame used in Figure 12 illustrates a major concept in the study of either ethnic variation, or variation stemming from the years of acculturation of those who were not born here. The two lines are similar in showing how the pattern of acculturation (in this case the adoption of a car into the household) has various phases until it gets closer to that of the U. S. born group. The history of migration and acculturation in the United States shows that those on the lower end of the socioeconomic spectrum are transit-depended until a time when they are financially able to make a mode choice-- a real choice, taking into consideration inherent personal values, household size, age, employment, etc. It is important to note that economic-based categories, such as ethnicity represent a moveable target that shifts as economic conditions of ethnicities change in the United States. Just as the present focus on important subgroups (Hispanics, for example) is fitting, so is the notion that long-term decisions may need to re-pattern based on new ethnicities that meet these common socioeconomic and/or immigration status circumstances.

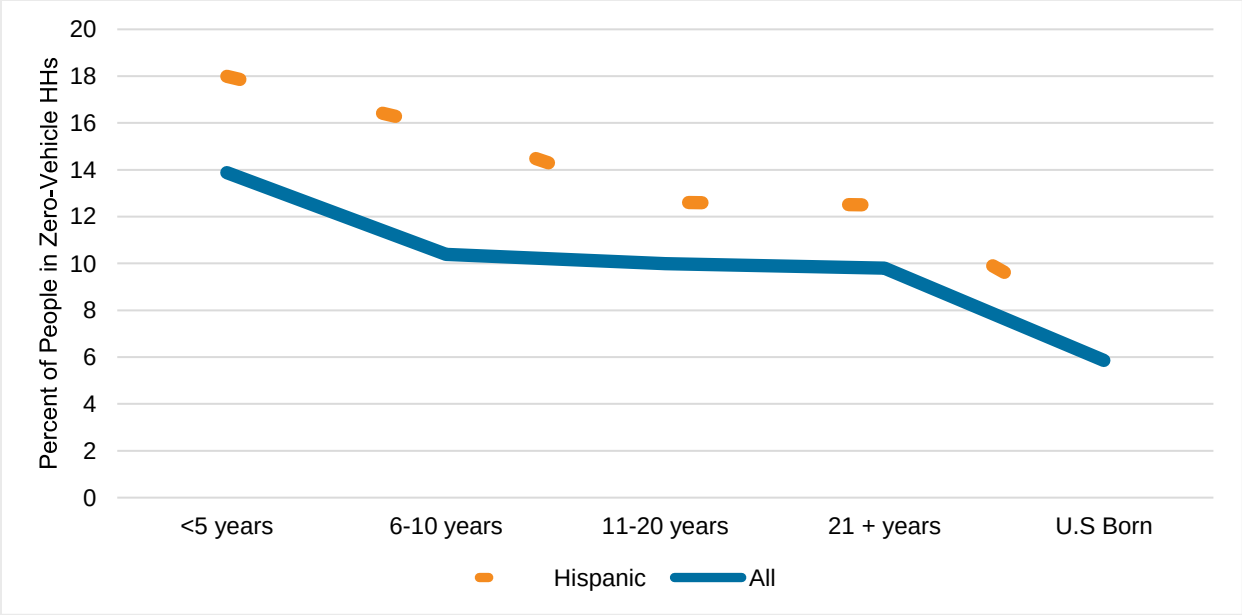

FIGURE 12. CHANGE IN ROLE OF ZERO-VEHICLE HOUSEHOLD OVER TIME WITH MIGRATION (NHTS)

PART TWO: TRENDS IN THE CHARACTERISTICS OF TRANSIT TRIPS

The analysis presented in this Appendix shows that the percent of transit riders who are employed has declined slightly while the percent who reside in households with no one employed rose slightly between 2001 and 2009. The findings could be an artifact of the timing of the 2009 NHTS which was conducted during the recession of late 2008 and early 2009.

TRENDS IN THE USE OF TRANSIT FOR THE WORK TRIP

The Census also reports the 'usual' means of transportation to work by US workers in the journey-to-work data, and those trends are illuminating. While US commuting has been dominated by private vehicle for half a century, transit share seems to have stabilized since 1990. The percent of Americans who use public transportation to commute to work was 5.1 percent in 1990, 5.2% in 2010 and 5.0 percent in the 2008-2013 American Community Survey (ACS) (Figure 13).

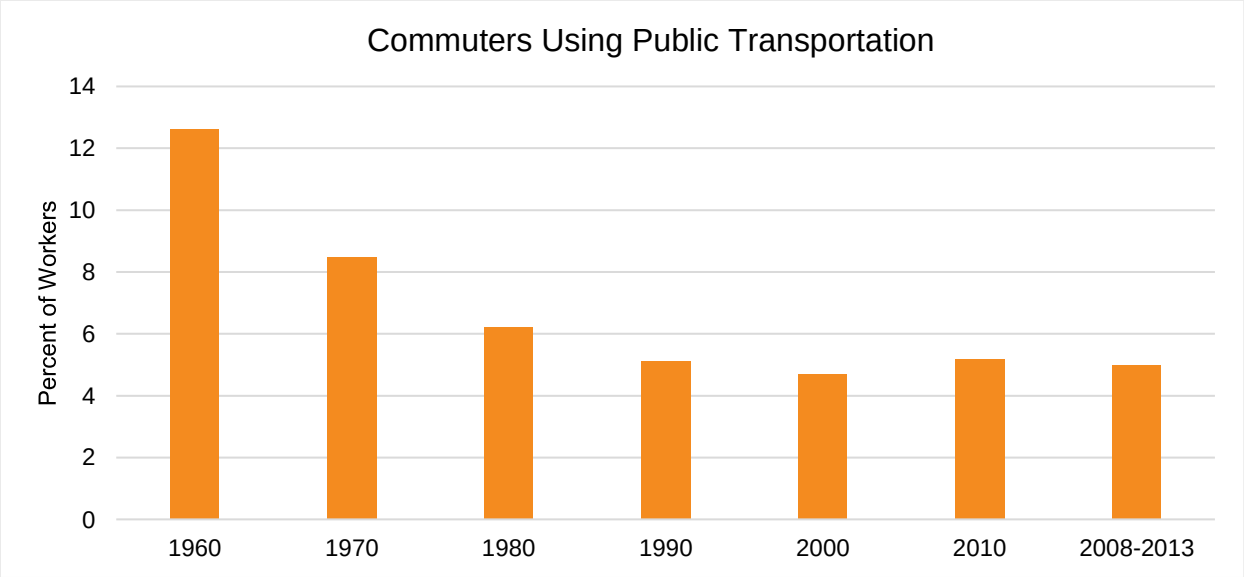

FIGURE 13. TRENDS IN THE USE OF TRANSIT FOR JOURNEY-TO-WORK, 1960-2013 (CENSUS)

Overall, commute travel is an important market for transit. It is confined in time and space, and the morning and evening demand peaks determines peak transit service. Work travel has been a declining portion of all person travel (by all means) in the last few decades as other purposes— shopping, errands, and recreational trips—have grown faster than work trips. But the percent of transit use for journey-to-work travel nationwide has remained a rather steady 'half' over the last few decades (Figure 14). Because transit serves the commuter market, there are strong ridership peaks during the 6:00 to 9:00 am and 3:00 to 6:00 pm periods, when nearly one-half of transit riders travel. The 2009 NHTS data show just a small shift to a greater percent of transit use for other purposes that will be explored in the next section.

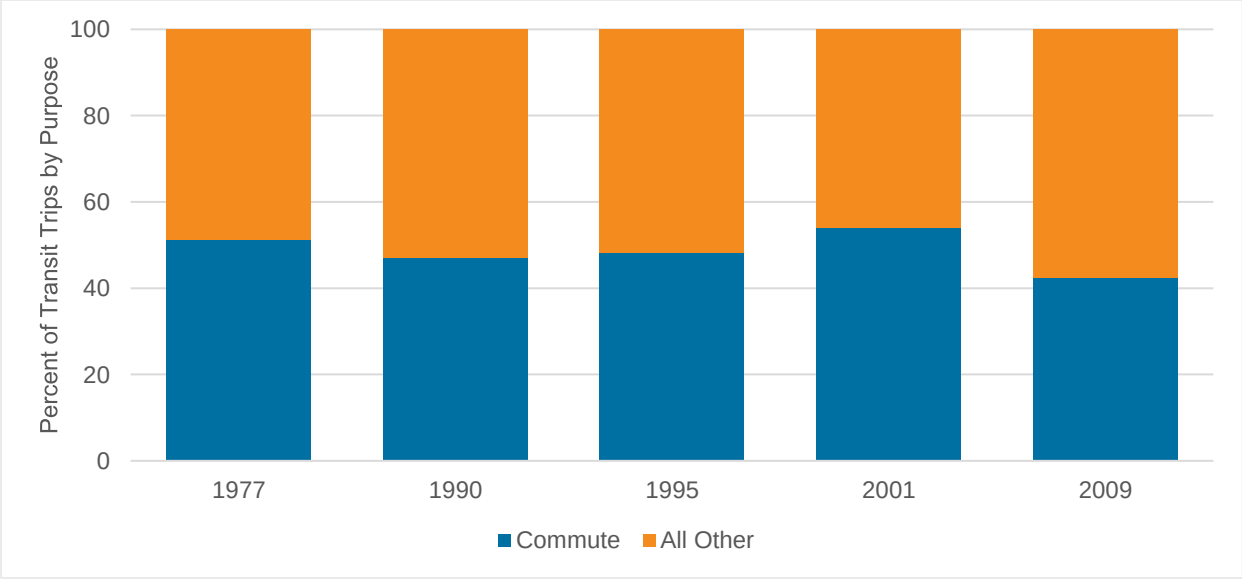

FIGURE 14. TRENDS IN THE PERCENT OF TRANSIT TRIPS BY COMMUTE AND OTHER PURPOSES (NHTS)

Figure 15 shows the trends in trip length for commutes and the time spent on the commute trip for people who used the bus (local or commuter) or train (light rail, subway, and commuter train). While the trends in the commute distances show typical work-trip lengths of 10 miles or so, the time to accomplish those trips grew from around 35-40 minutes for a ten-mile transit commute to nearly 50 minutes for a ten-mile commute. Caveats include the fact that times and distances in the NHTS data series are self-reported, and respondents of the NHTS are likely to round to the nearest round number. However, work-trip lengths and times tend to be better reported than other trips because of the frequency of the commute and the importance of being on time.

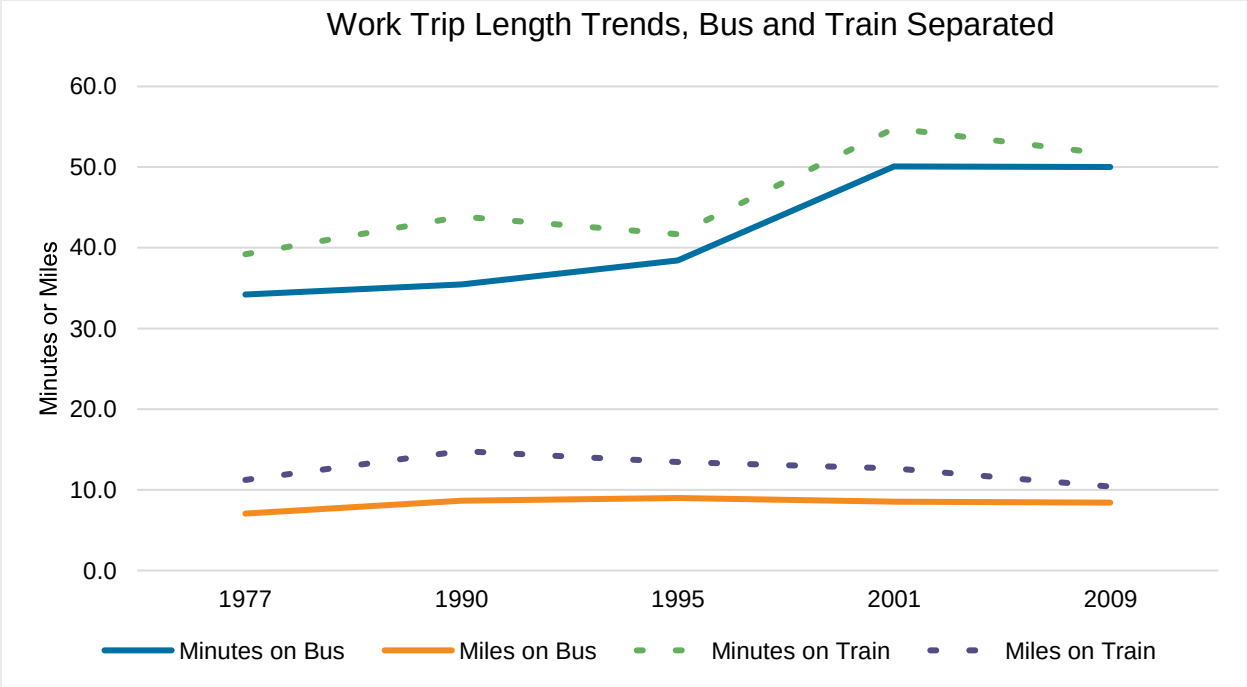

FIGURE 15. TRENDS IN WORK-TRIP LENGTH FOR BUS AND TRAIN, 1977-2009 (NHTS)

One of the factors complicating the commute trip is the role of trip chaining; that is incorporating non-work stops into a work-trip tour. In 2009, about 15% of men and 20% of women stopped during their commutes--either on the way to or from work, or (less often) in both directions. Women are more likely than men to trip-chain since the stops are often related to household duties and dropping/picking up children. The percent of workers stopping during their commute has remained stable since the 1995 Nationwide Personal Transportation Survey (NPTS), so while the proportion of workers who stop is significant it does not appear to be growing.

Importantly, whether related to the need to chain trips or not, transit shows the greatest day-today variation in the commute mode loyalty. The NHTS asks a similar question to the Census Journey-to-Work data: How did you commute to work last week? The data shows that workers who identify ‘drive alone’ as the usual means of commuting ‘last week’ are the most likely to drive alone for their commutes on the travel day. On the other hand, workers who report usual commutes by transit, walk, or bicycle are less likely than drivers to report using these same commuting modes on the actual travel day in the survey.

As shown in Table 1, of the workers who said they 'usually' used transit to commute, only 69.3% reported using transit on the assigned travel day, 13% drove alone, 9.2% rode with somebody in a vehicle (carpool), and 6.6 percent walked. Small shifts from dominant to less dominant modes can have a big effect. For example, say that 100 million workers usually drive alone and 7 million usually take transit (a mode share of 73% drive alone and 5 percent transit out of 130 million workers). If on any given day 1 percent of the

workers who drive alone shift to transit for commuting (10 times the 0.1 percent of workers who usually drive alone but use transit on the assigned travel day shown in Table 1Table 1 the result would be nearly 15% more transit users— added primarily in the peak period. Shifts like these were (anecdotally) experienced during the gas price spike in the summer of 2008 which resulted in new riders overwhelming some smaller transit systems

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TABLE 1: PERCENT OF WORKERS BY THEIR USUAL AND ACTUAL MEANS OF COMMUTING (NHTS)

Reported 'Usual' Means of Commute (workers only):	Percent of the Same Workers by Commute Mode on Travel Day:						
	Drive Alone	**Carpool**	**Transit**	**Walk**	**Bike**	**Other**	**Total (Usual Means)**
Drove Alone	**93.5**	5.6	0.1	0.5	0.1	0.4	72.9
Carpool	42.9	**54.8**	0.6	1	0	0.7	16.5
Transit	13	9.2	**69.3**	6.6	0.8	1.2	5.5
Walk	6.1	9.3	3.7	**80.2**	0.2	0.5	2.8
Bike	13.8	3.3	6	2.6	**73**	1.4	0.8
Other	66.5	19.3	3.8	4	0.3	**6.2**	1.6
Total (Actual Means)	77.2	14.4	3.9	3	0.7	0.8	100

TRANSIT USE FOR NON-WORK PURPOSES

Overall the trends in the percent of transit use for non-work purposes indicates that school and church trips comprised a larger share of non-work transit use in the 1977 data compared to later years (note that “school bus” is separate from “local bus” in all survey years, and not included in this transit analysis). On the other hand, like overall travel, shopping and social/recreational travel have increased in share (see Figure 16).

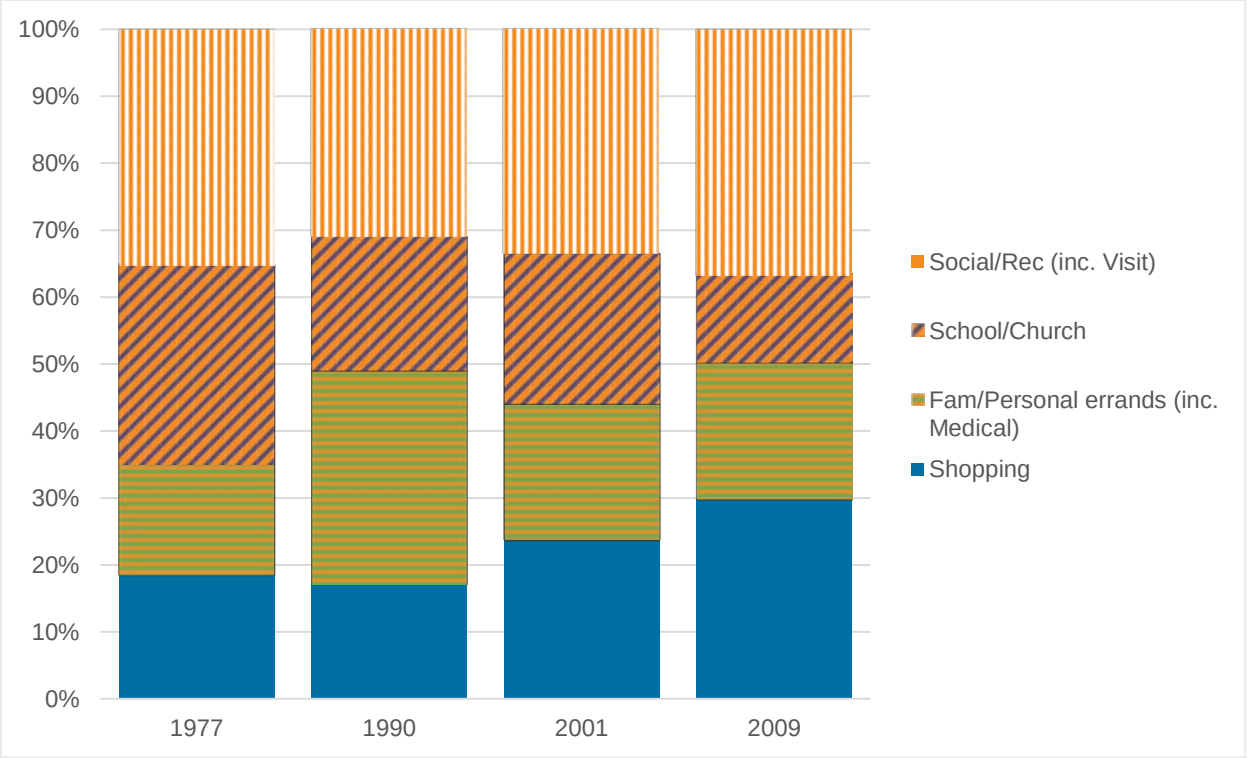


FIGURE 16. TRENDS IN THE SHIFT OF NON-WORK-RELATED TRANSIT TRIPS, 1977 TO 2009 (NHTS)

The change in the use of transit for non-work travel mirrors the overall growth in non-work trips over the last few decades—leading with shopping. It should be noted that the most recent NHTS data show per capita declines in travel (by all means) for shopping and family/personal errands, although medical travel has grown.

PART THREE: TRENDS IN OVERALL AMERICAN TRAVEL PATTERNS AND VEHICLE MILES TRAVELED

TRENDS IN VMT OVER TWO DECADES

This section of Technical Appendix 2 summarizes the changes which have taken place in the amount of vehicle travel over the past two decades, with attention to travel patterns in urbanized areas, i.e. places where fixed route and scheduled public transportation services have been primarily located. Figure 17 puts these patterns into a 22-year perspective.

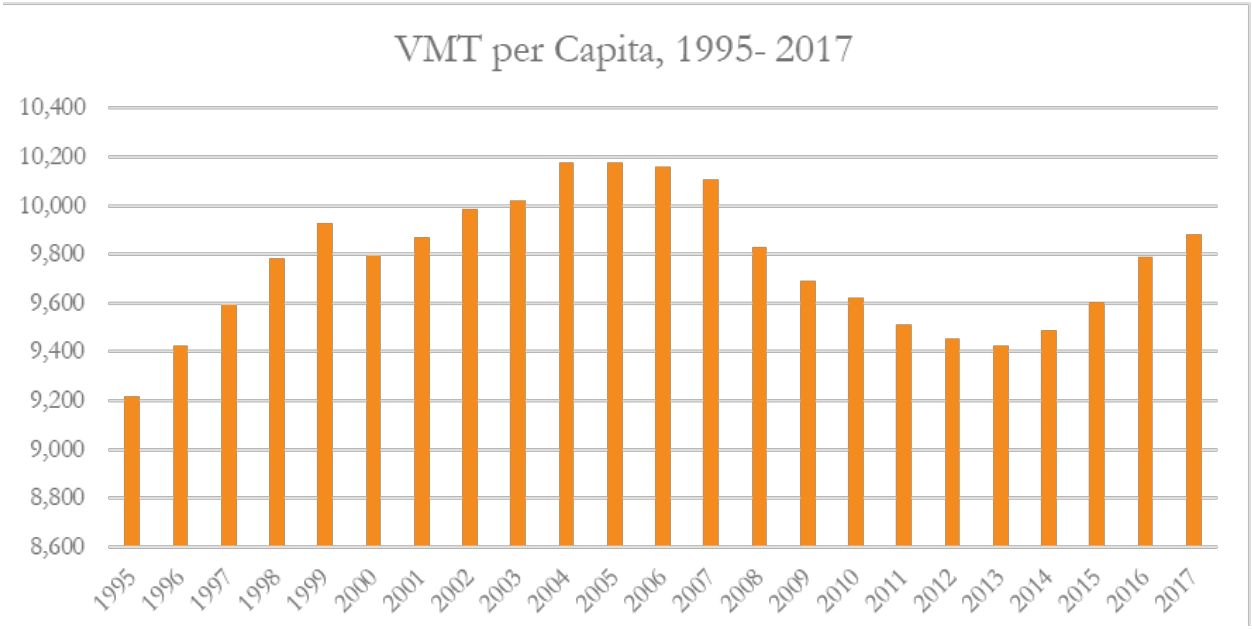


FIGURE 17. VARIATION IN TOTAL VMT PER CAPITA OVER TWO DECADES (FHWA)

Looking at total vehicle-miles of travel divided by *total* US population (VMT per capita), we can observe growth between 1995 and 2004. VMT per capita peaks between 2004 and 2007 and begins to decline with the recession of 2008 and 2009. Interestingly, this VMT measure continues to fall until about 2013, where a small rebound is now in place. To analyze what is happening on VMT, we have empirical survey data for 1995, 2001 and 2009 to better understand the roles of variables such as place, age, and gender. Updated survey data will be released in the 2016 survey.

For our analysis of NHTS data, we have chosen VMT per driver. This index includes the total personal VMT reported by the survey respondents, and thus does *not* include miles from vehicles operated for commercial purposes. The 'denominator' for the index includes only those with licenses, which effectively eliminates variation associated with those for who driving is not an option, such as the young, etc. We have applied the TCRP age categories used in this volume to examine variation in VMT per driver in urbanized areas only, as this is the geographic context most relevant to the content of the rest of this TCRP Report. Figure 18 shows how the five age categories relate to three survey years, 1995, 2001, and 2009. It becomes clear that the differences between 2001 and 2009 are most dramatic in terms of change in private vehicle travel behavior.

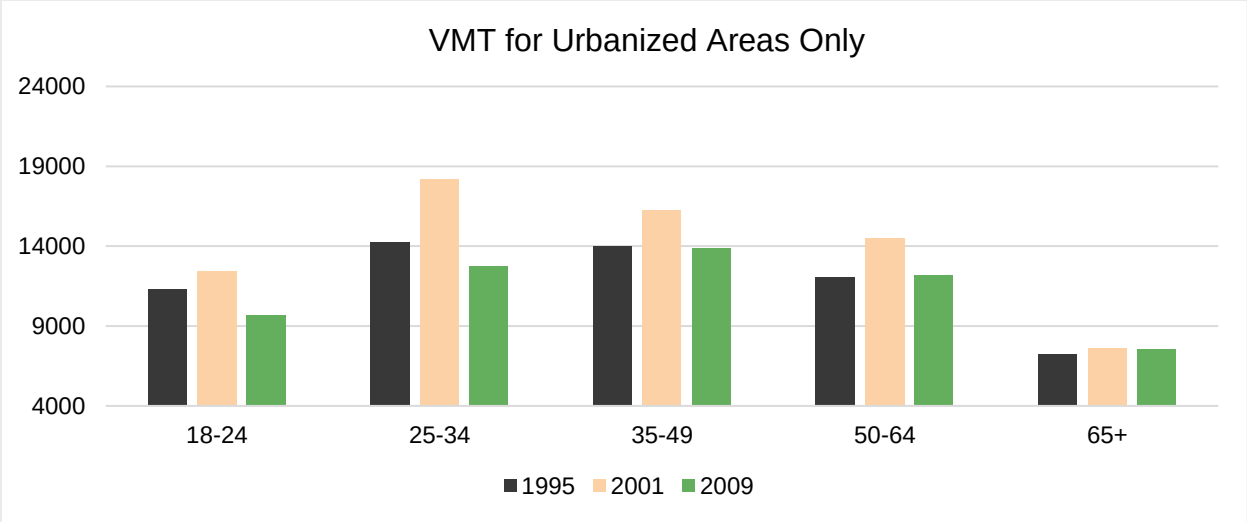


FIGURE 18. CHANGE IN VMT PER DRIVER FOR URBANIZED AREAS ONLY, BY AGE AND SURVEY YEAR (NHTS)

UNDERSTANDING VMT DECREASE, BY AGE AND GENDER

In general, VMT per driver fell more for urbanized areas than for rural or small-town settings. Figure 19 shows that the fall in vehicle travel between 2001 and 2009 was more dramatic for those under 35 in general, but particularly for those between 25 and 34. Other ongoing research examining the change in travel behavior of Millennials (including NHCRP's [National Highway Cooperative Research Program] study of the youth market) shows that the fall in VMT rates was far more pronounced for men than for women. Figure 19 illustrates this decrease in VMT rates for men in urbanized populations. In this graph, men of all age groups under 65 experience a significant decrease in auto "mobility" during the economically challenging years associated with the recession of 2008-2009; those between 25 and 34 saw the sharpest decrease.

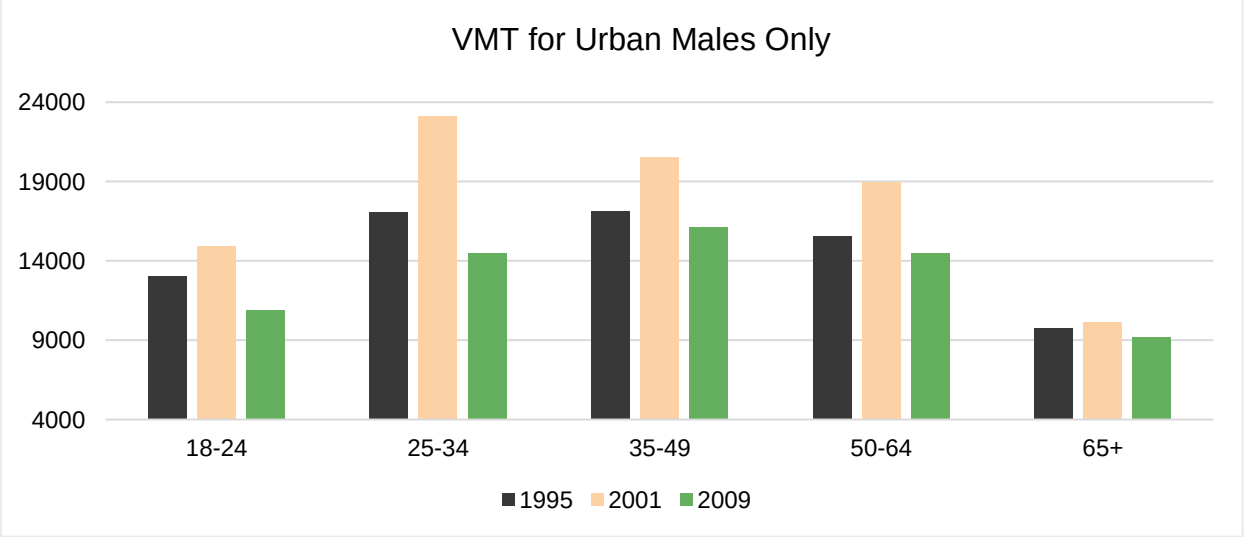


FIGURE 19. CHANGE IN VMT PER DRIVER FOR URBANIZED AREAS BY AGE, MEN ONLY (NHTS)

PART FOUR: PRESENT USE OF TRANSIT

DESCRIPTION OF THE 2014 TRANSITCENTER SURVEY

Part Four of Technical Appendix #2 presents an up to date summary of recent American transit ridership patterns. Part Four is entirely based on a 2014 survey of over 11,000 respondents undertaken for Transit Center by RSG, designed to understand both current transit use and the factors that will influence future use of transit. The survey sample was selected from 46 MSAs. Respondents were selected and invited to participate based on age and geography (by home ZIP Code) using quota sampling, which ensured a sufficient number of responses in each category to make meaningful statistical comparisons possible.

For sampling purposes, five “regions” and two levels of transit service were defined. Four of the five regions—the South, West/Southwest, West Coast, and Midwest—were defined geographically. A fifth “region” was created to differentiate cities with mature and widely used transit systems—namely, Boston, New York City, Chicago, San Francisco, Philadelphia, and Washington, DC—referred to as “Traditional Cities.” The two transit service levels are defined as “transit progressive” and “transit deficient,” and within each region equal numbers of respondents were sought from each type. Transit progressive cities were differentiated from transit deficient cities using commuting transit mode data from the US Census Bureau. The threshold was not constant nationwide; instead, the cities with the best transit service in each region were defined as transit progressive. No such distinction was made for the “traditional cities,” which were all were considered transit progressive.

While other national surveys, such as the NHTS, could be used to characterize current transit use, the 2014 Transit Center survey was unique in also capturing attitudes, beliefs, values, and preferences together with transit use and sociodemographics. It also includes a large national sample, making it especially useful for this study.

The research team created the summary chart template shown in Figure 20. These data are organized by age categories. Age categories are accompanied by more-loosely defined popular names for each generation. The generations names are not precisely associated with the age category labels; specifically, the over-65 group includes the oldest members of the "Boomer" generation, as defined in the year 2014. The generation names are presented to show overall relationship with the age definitions, not exact ones.

OVERALL TRANSIT USE, BY AGE AND GENDER

Variation in present (2014) use of transit, as shown in Figure 20, reveals that transit ridership decreases with age. (This Technical Appendix will present many variations on the theme of decreasing transit ridership with increasing age, and this graph "sets the stage" for such analysis). In each age category, men have a moderately higher propensity to take transit at least once a week than do women, and the difference between the rates of the two groups is significant.

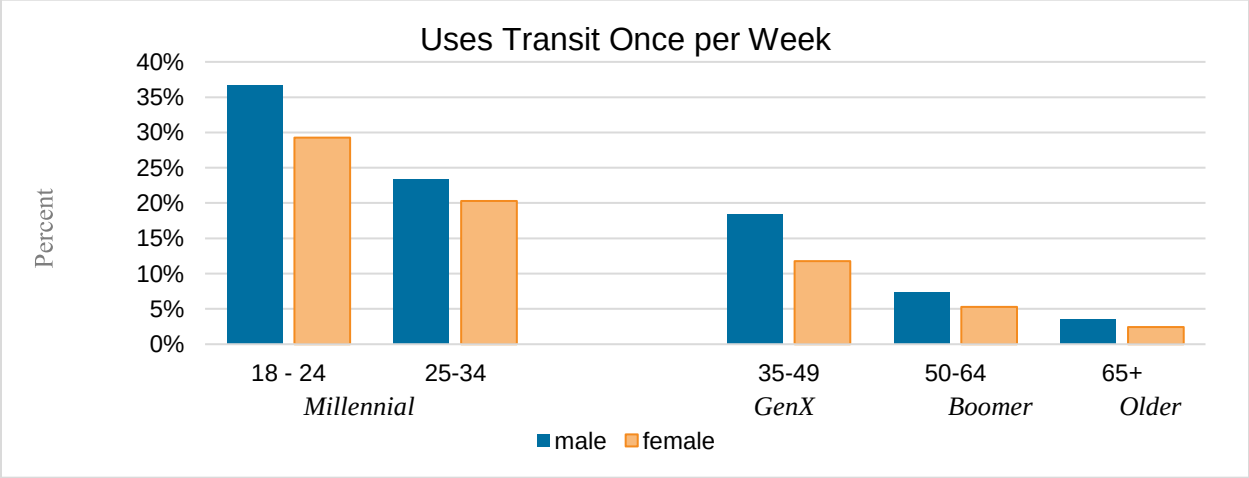


FIGURE 20. TRANSIT USE, BY AGE AND GENDER (TRANSITCENTER, 2014)

A transit mode share was created to show the ratio of all transit trips reported divided by all trips by all modes reported in the survey (Figure 21). The survey was not based on any kind of "daily diary" such as those used in the NHTS, so it is not meant to be a perfect representation of all trips, but can be used to compare respondents in the sample; these "shares" reflect the kinds of trip-making included in the survey, which includes trips by

car, walking, and bicycling. Again, the basic pattern repeats, showing that transit share decreases with increasing age, but here, the overall difference between men and women was *not* found to be statistically significant.

TRIP-MAKING BY AGE AND GENDER, BY MODE

Commute by Bus and Rail

The pattern of decreasing transit use rates with increase in age generally holds true for the trip to work by bus or rail, and in each case, it is true for men and women (Figure 22). At the upper end of the age spectrum, men in this survey over the age of 65 have a slight increase over late middle agers for rail services, but this is not the case for women over 65. Taken as whole, men have a statistically significantly higher rate of use of rail, but not of bus, than women.

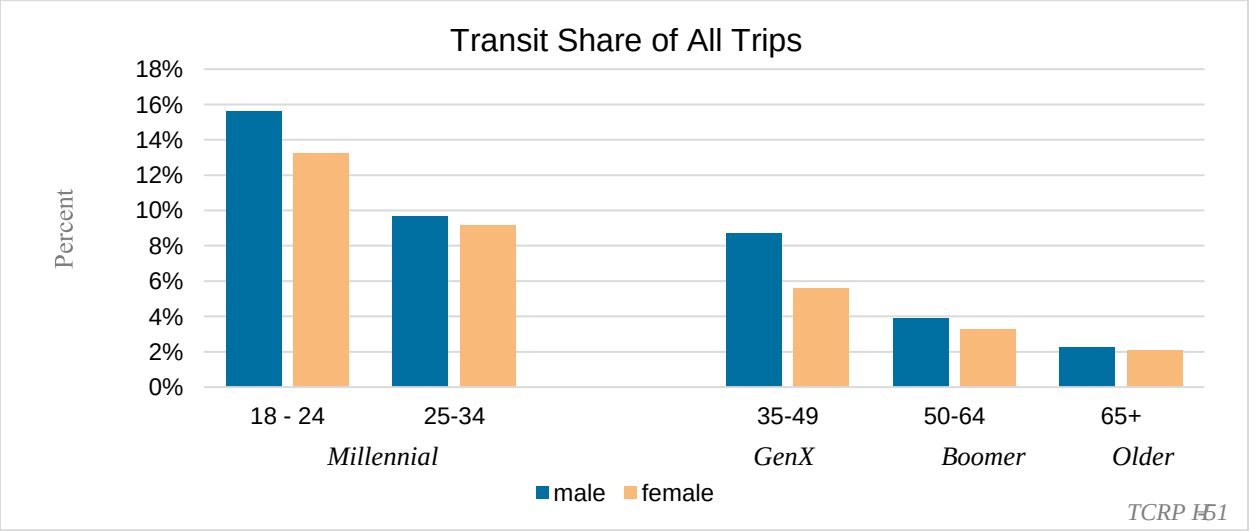


FIGURE 21. TRANSIT MODE SHARE FOR REPORTED TRIPS, BY AGE AND GENDER (TRANSITCENTER, 2014)

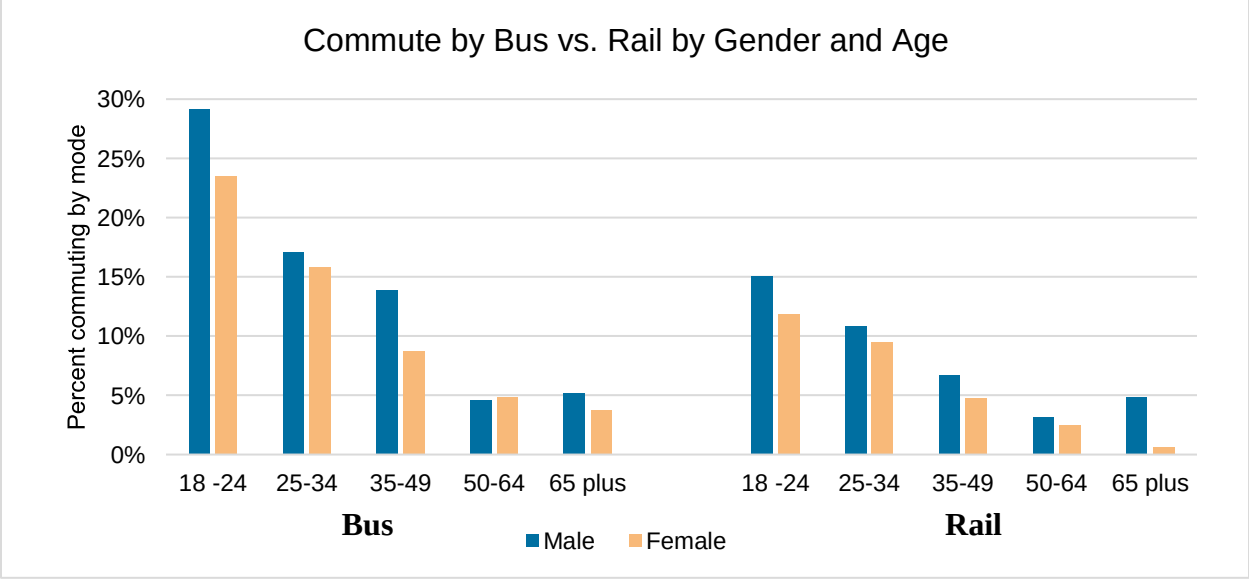


FIGURE 22. MODE SHARE FOR COMMUTE TRIP, BY AGE AND GENDER (TRANSITCENTER, 2014)

Trips by All Modes

The role of the younger age groups in the generation of total trips (Figure 23) is noteworthy. Given that younger groups have historically had lower rates of employment than older groups, a higher total trip generation for individuals between 35 to 49 years old *might* have been hypothesized. The scale of total trips is largely influenced by variations in automobile trips; while not pictured here, the younger groups have consistently higher rates of auto trip generation than older groups. A similar pattern is shown in Figure 24, which reflects the fact that the group under the age of 24 has high rates of walking and bicycling. Again, the progression of lower trip generation by increasing age is paralleled by the slightly lower trip generation rate for women compared to men in each age category.

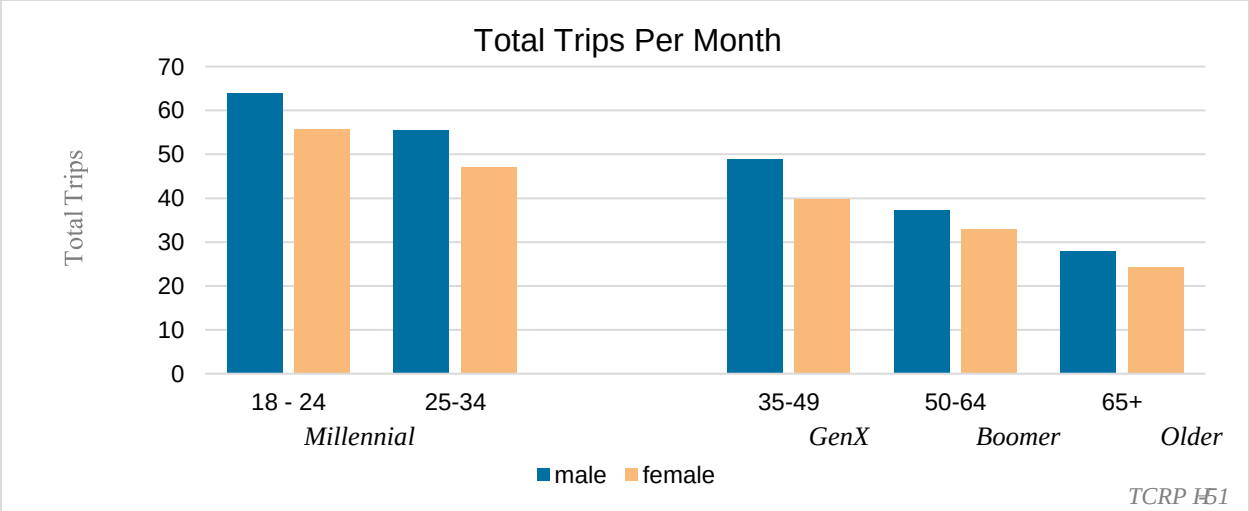


FIGURE 23. TOTAL MONTHLY TRIP-MAKING BY AGE AND GENDER (TRANSITCENTER, 2014)

Trips by Walk and Bike

Given that high rates of walking and bicycling are often associated with strong underlying markets for public transportation, the variation shown here by age and gender is particularly important. In this case the higher number of walk and bike trips by the youngest (18–24) age category was expected and consistent with the available literature. Women over the age of 35 seem to show minor variation in trip-making over the age categories. Neither men nor women show any "bump" in their retirement years of 65 and over. Taken as a whole, the walk/bike rates for men are significantly higher than those of women.

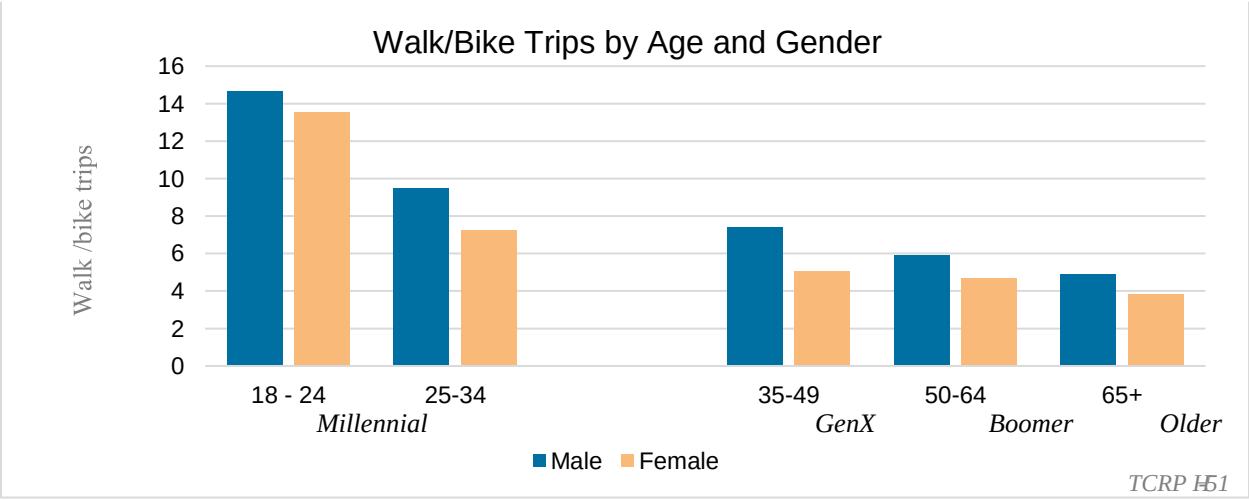


FIGURE 24. VARIATION IN WALK AND BIKE MONTHLY TRIPS, BY AGE AND GENDER (TRANSITCENTER, 2014)

THE ROLE OF AGE WITH OTHER VARIABLES

The following figures display the interrelated variation by age and several additional variables.

Based on the Transit Center dataset, the trend in transit ridership across age groups is clear; younger respondents are far more likely to use transit (at least once per week) than older respondents; this holds true for race, (Figure 25) and birth country (Figure 26).

Age with Race/ Ethnicity, and Place of Birth

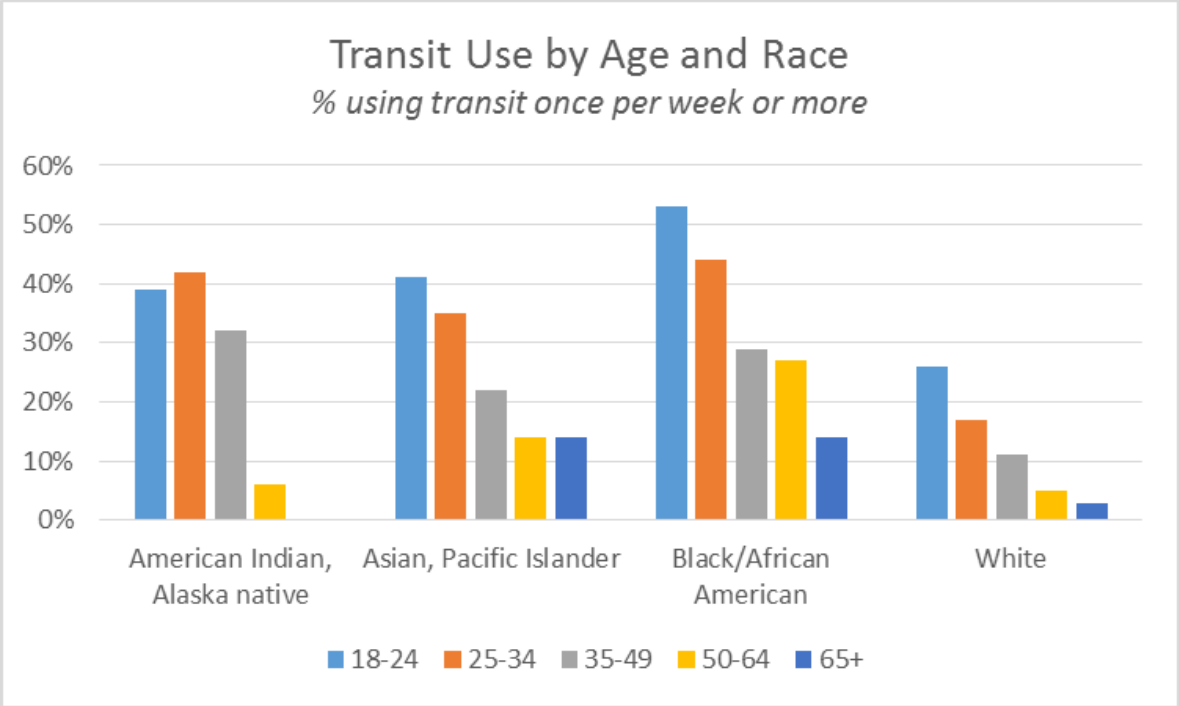


FIGURE 25. EFFECT OF AGE ON TRANSIT USE, BY ETHNICITY (TRANSITCENTER, 2014)

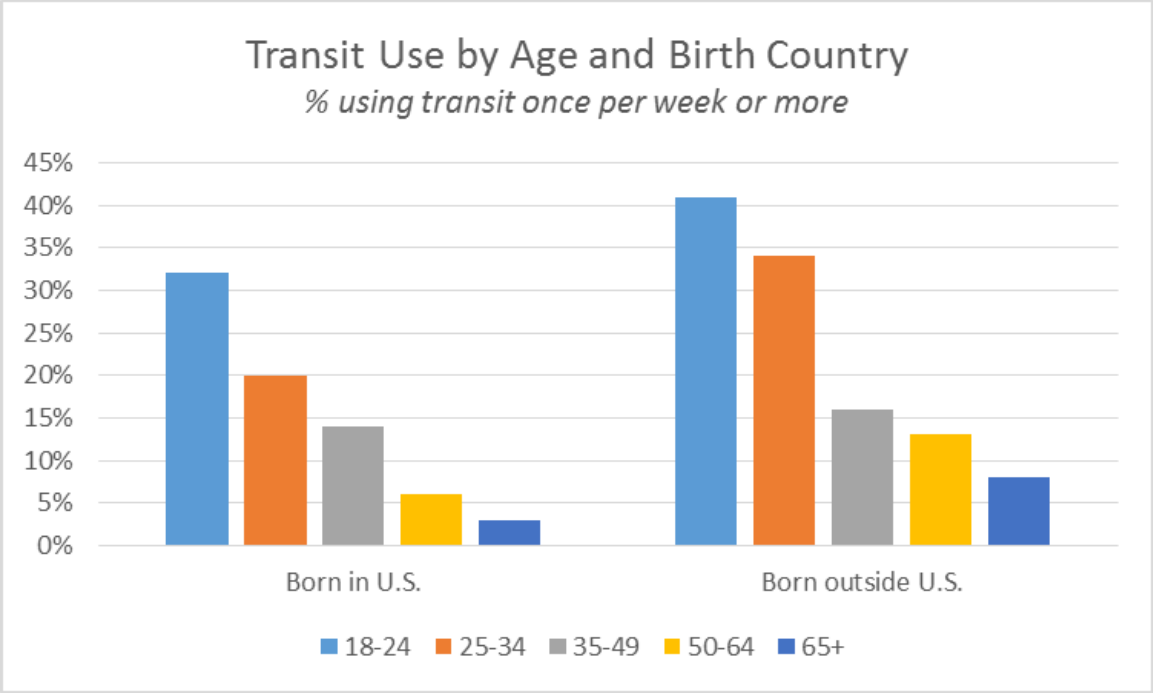


FIGURE 26. AGE AND TRANSIT USE, BY BIRTH LOCATION (TRANSITCENTER, 2014)

HISPANICS AND TRANSIT USE

The stronger pattern of transit use by Hispanics compared with non-Hispanics remains consistent when controlling for variation in income level, and variation in the quality of transit services offered in the neighborhood. Figure 27 shows that, while transit use by Hispanics does decline somewhat with increasing income, their use is higher for each income category. Again, for each category of neighborhood transit quality, Hispanic use is higher than non-Hispanic use, as shown in Figure 28.

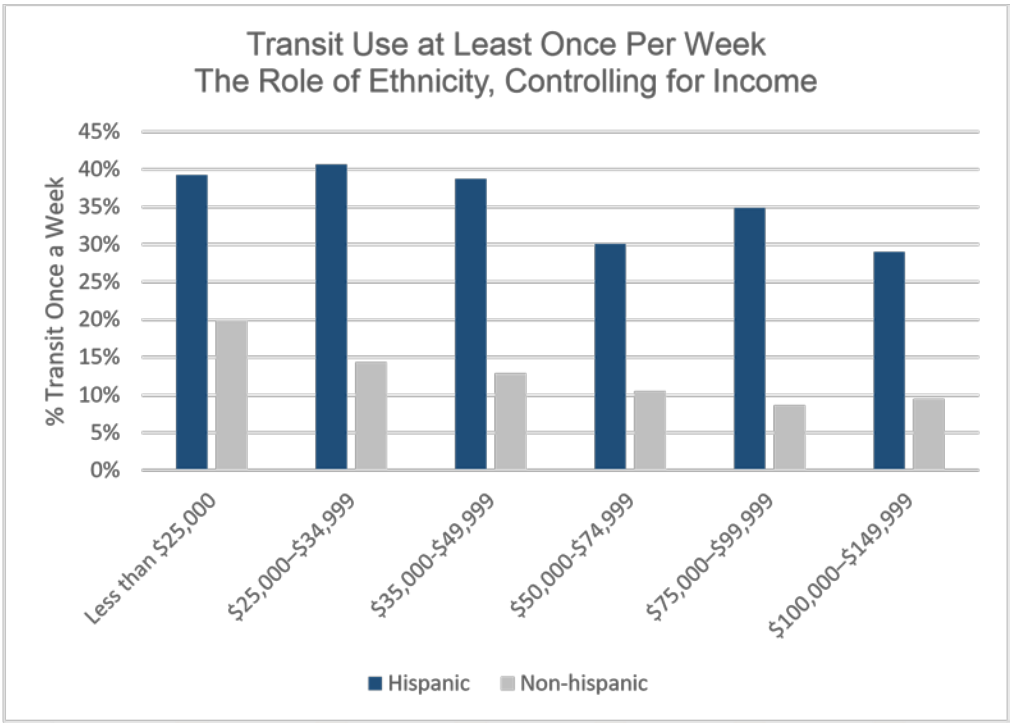


FIGURE 27. HISPANIC VS. NON-HISPANIC TRANSIT USE, BY INCOME LEVEL (TRANSITCENTER, 2014)

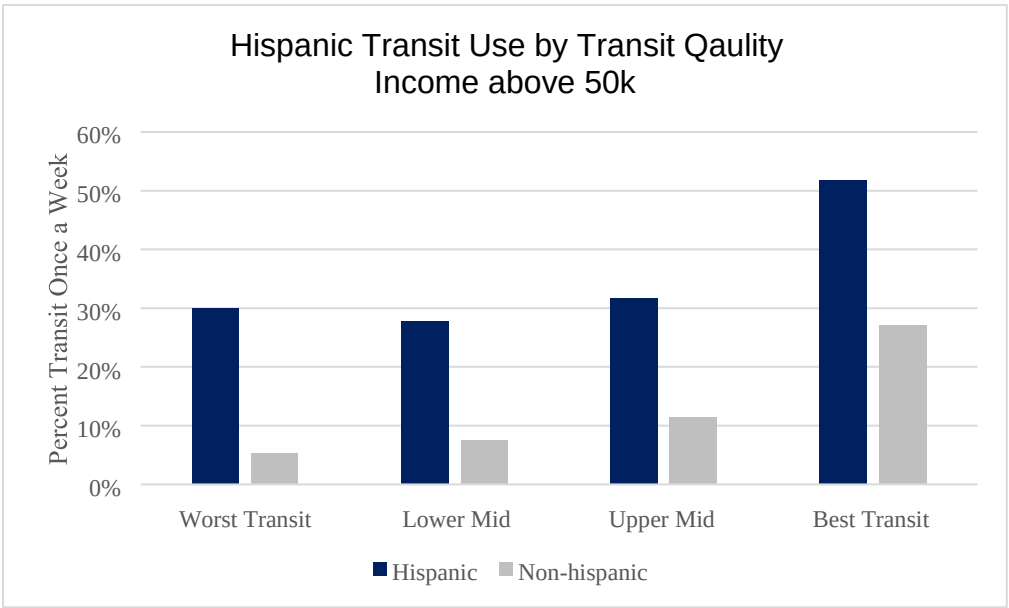


FIGURE 28. HISPANIC VS NON-HISPANIC TRANSIT USE, BY TRANSIT SERVICE QUALITY (TRANSITCENTER, 2014)

Age with Proximity to Transit Stop

As we age, we make location decisions that, in most cases, make use of transit more difficult. Figure 29 shows that average distance to a transit stop increases with increasing age, with a mild reversal for those over 65 years.

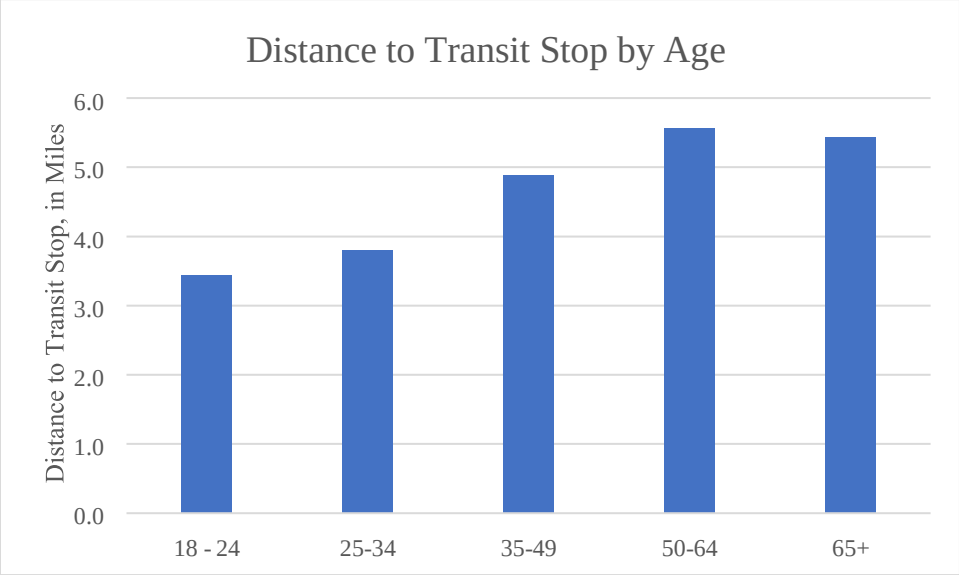


FIGURE 29. EFFECT OF AGE ON DISTANCE TO NEAREST TRANSIT STOP

As examined further in Technical Appendix #3, the geography of one's neighborhood has a profound effect on use of transit. This analysis shows that, when holding transit proximity constant, age *still* has a powerful effect on transit use, as can be seen in Figure 30. For example, when living a location with the highest quintile of closeness to a transit stop, the 18-24-year age group has a percent of transit use (43%) that is five times the percent of transit use of those over 65 (8%), for the same location conditions.

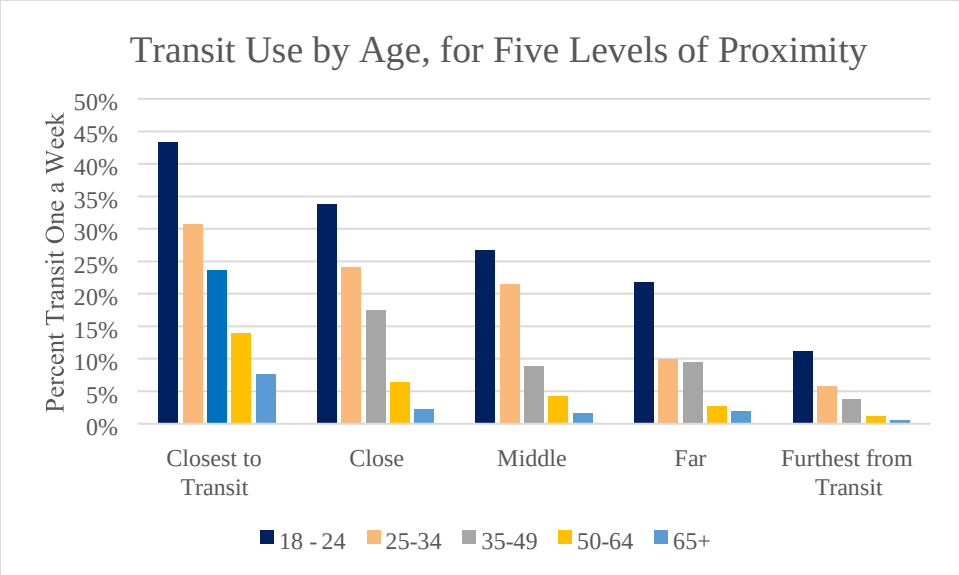


FIGURE 30. VARIATION IN TRANSIT BY AGE, BY PROXIMITY TO TRANSIT STOP (TRANSITCENTER 2014)

Using the same information, but graphed differently, the analysis shows that for any given age category, there is strong variation in transit use based on proximity to transit. For example, a given age group will show variation by proximity: within the age group 25-34, those closest to a transit stop have a transit use rate of 31% while those furthest have a rate of 6%, as shown in

Figure 31. Thus, it becomes clear that *both* age and location combine together in affecting the amount of transit taken. As one gets older, the amount of transit decreases – partially due to the characteristics of location, and partially due *other* characteristics intrinsic to age.

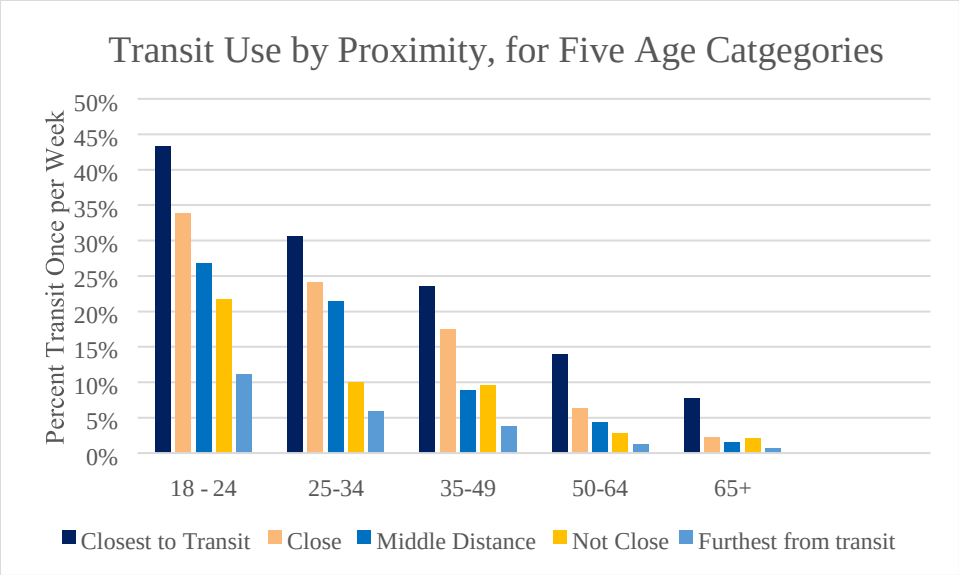
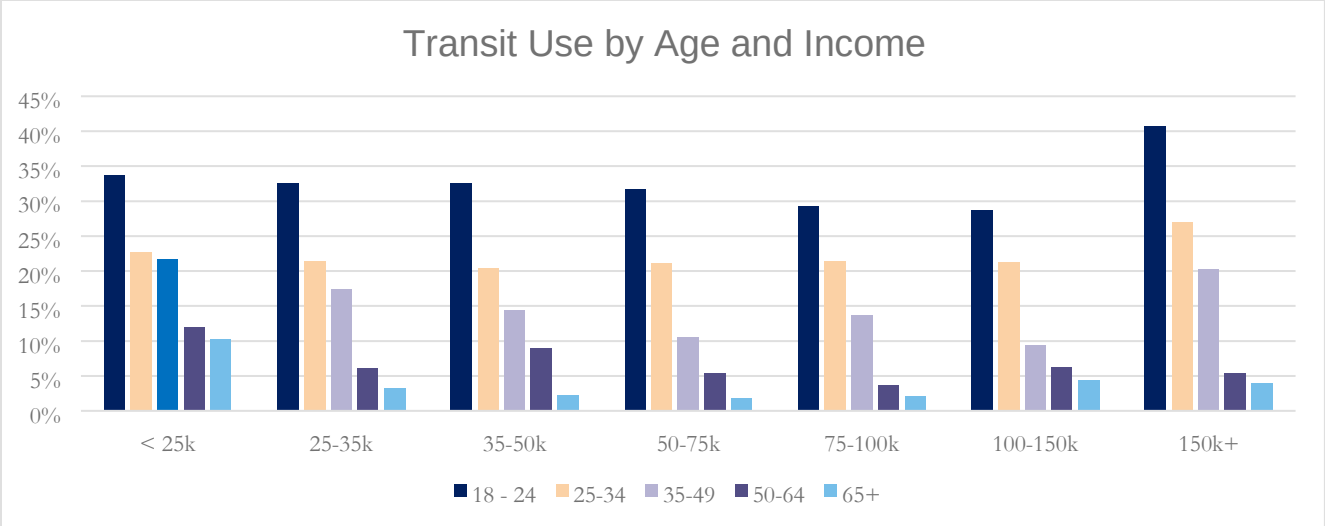


FIGURE 31. VARIATION IN TRANSIT BY PROXIMITY TO STOP, FOR FIVE AGE CATEGORIES (TRANSITCENTER 2014)

Age with Income

Consistent with other factors discussed in this section, age has an effect on propensity to use transit that is quite separate and distinct from that of income. In Figure 32, increasing age is associated with decreasing transit, no matter which of the seven strata of household income is examined.

While Figure 32 shows how the fundamental pattern of decreasing transit with increasing age holds true for all income levels, it is also important to explore the impact of income alone, this time without the complications of age variables. Figure 33 reveals a weak pattern of a 'bell shaped curve' when income is examined alone. Additional analysis shows that longer distance modes such as commuter rail (and sometimes express bus) are attractive to those making over $100,000 which partially explains the rise at the right-hand side of the graphic. It is clear, however, that any concept that transit ridership always declines linearly with increasing income is wrong, and potentially quite misleading: more variation in the role of income is revealed for those above 35, with less for those below.



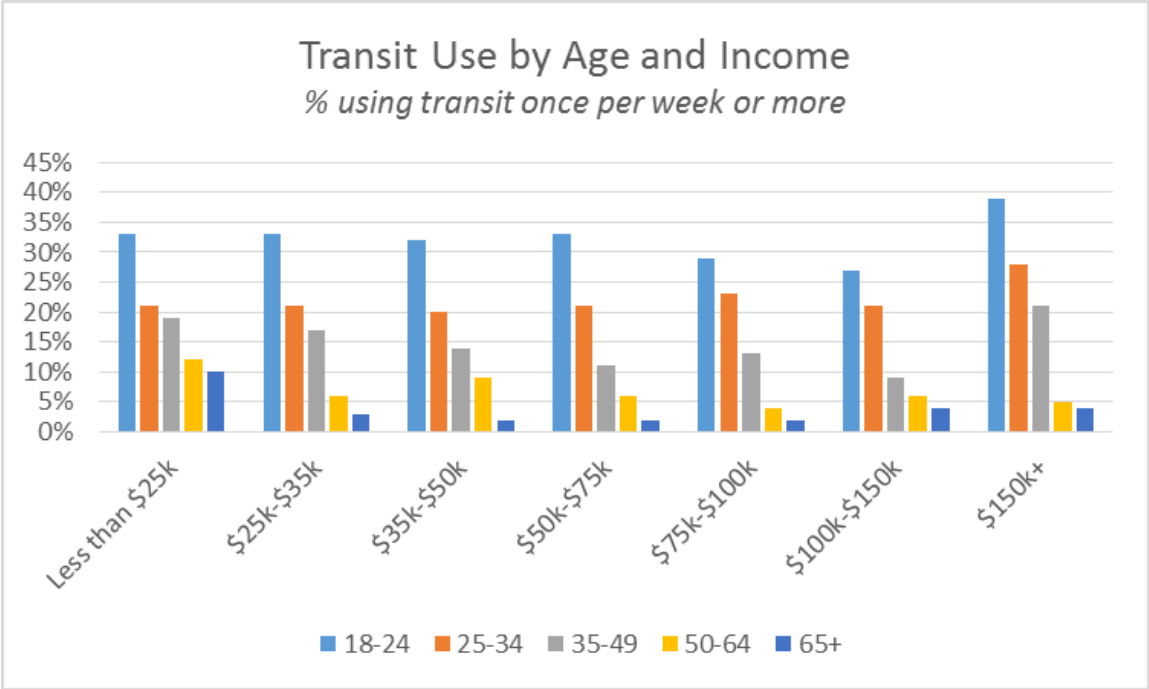


FIGURE 32. EFFECT OF AGE ON TRANSIT USE, BY INCOME LEVEL (TRANSITCENTER, 2014)

Income Alone

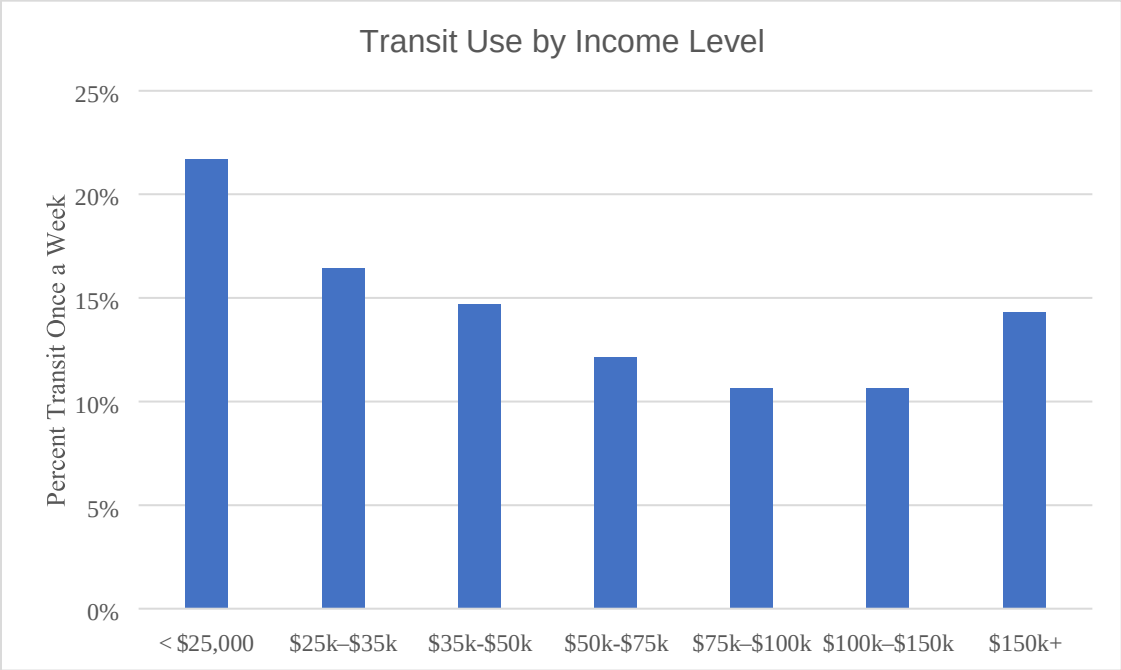


FIGURE 33. EFFECT OF INCOME ON TRANSIT USE (TRANSITCENTER, 2014)

INCOME CHARACTERISTICS OF TRANSIT USERS: BY MODE

Some interesting differences are apparent between the people taking bus trips and the people taking rail. This section details the characteristics of the people aged 16 years and older who report using the bus or train in the NHTS. Only 7.6 percent of total transit users reported riding both the bus and the train--so there is high single mode capture rate. For this analysis, the double-riders were excluded and people not reporting income were excluded (unless otherwise indicated). Figure 34 shows the marked difference between train and bus riders, most demonstrably for those income group under $30k.

Comparing Income Distributions for Bus and Rail

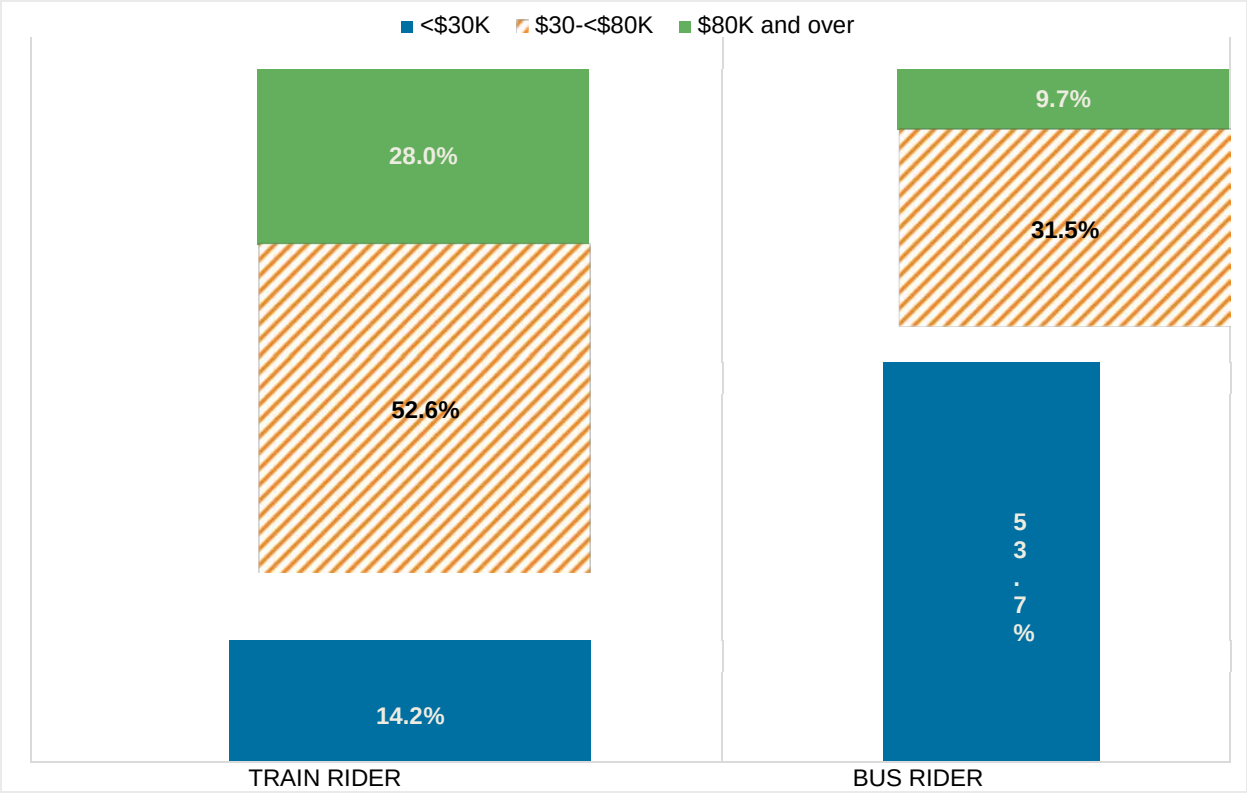


FIGURE 34. INCOME DISTRIBUTION FOR BUS RIDERS AND TRAIN RIDERS (NHTS, 2009)

Turning back now to data from the NHTS, the difference in the income of riders varies by city (metropolitan statistical area). Because of the large state add-ons in the 2009 NHTS, the income of riders of local bus or train could be separated for several areas, showing that in all cities poorer people were more likely to be bus riders, but the income disparity was starker in some cities (Figure 35). These differences are significant at the 95% confidence level.

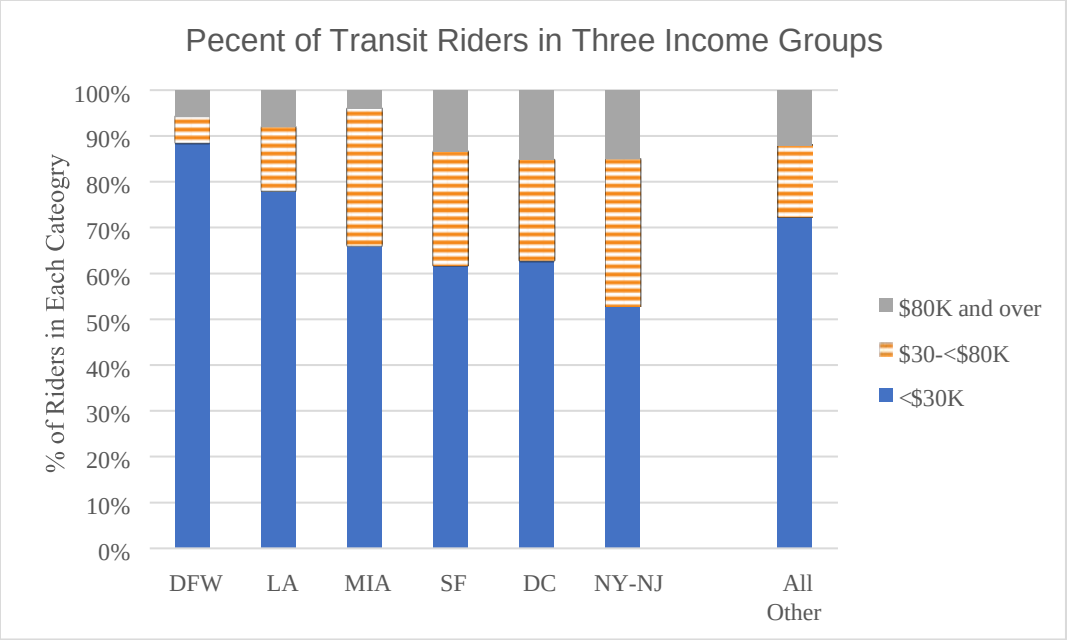


FIGURE 35. PECENT OF TRANSIT RIDERS BY INCOME, SELECTED CITIES (NHTS)

TABLE 2: COMPARISON OF INCOME BY TRANSIT MODE (NHTS)

METRO AREA	BUS RIDERS	TRAIN RIDERS	TRAIN RIDER INCOME AS A% OF BUS RIDER INCOME
Dallas–Ft. Worth	$19,145	$41,101	215%
Los Angeles	$25,754	$48,888	190%
Miami	$30,624	$46,416	152%
New York–New Jersey	$35,463	$69,854	197%
San Francisco	$39,053	$84,247	216%
Washington, DC	$44,299	$77,748	176%
All Other Metro	$29,770	$61,533	207%

Comparison of Income Levels, by Race and Ethnicity

The income disparities also intersect with **race and ethnicity**. Figure 36 shows the mean household income of bus and train riders by **race/ethnicity**. The **lowest income riders** were African American bus riders, while the wealthiest riders were white train riders.

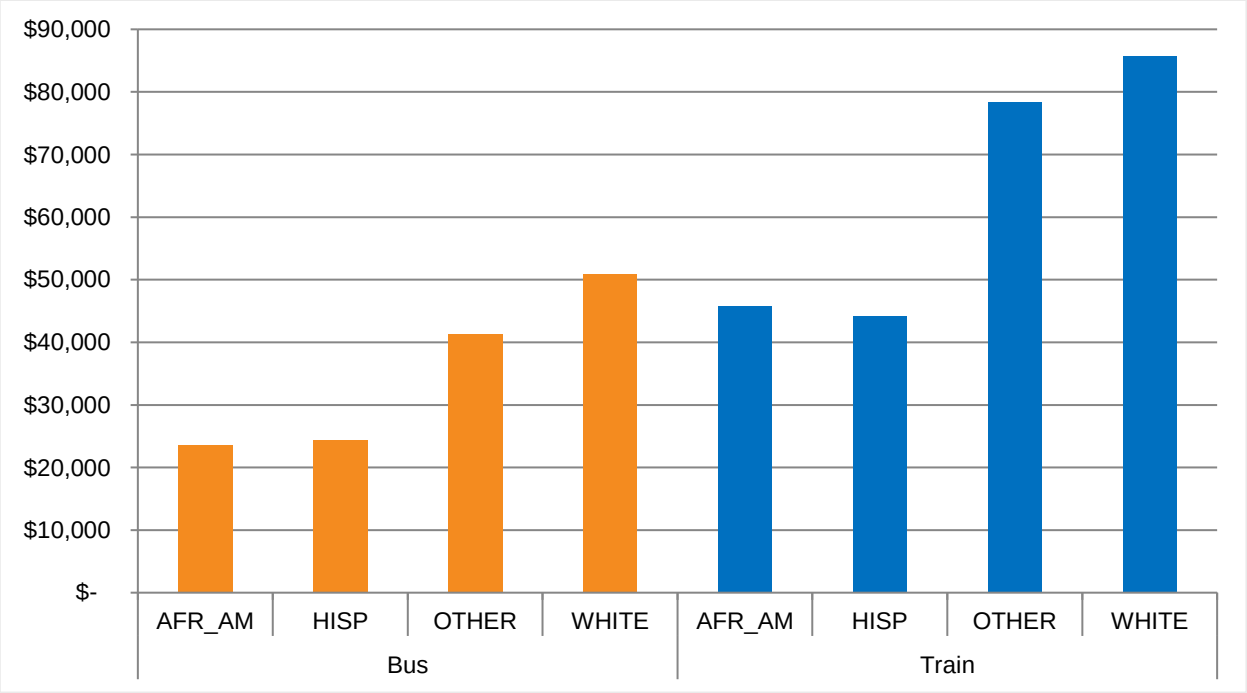


FIGURE 36. MEAN INCOME OF BUS AND TRAIN RIDERS BY RACE/ETHNICITY (NHTS)

NOTE ON NHTS DATA SOURCES FOR TECHNICAL APPENDIX 2

The NHTS (previously the NPTS) has obtained data on transit use as part of its core daily mobility data since 1977. One of the major concerns with sample surveys such as NHTS is that the results may not fully represent the real population because the sample does not reflect all households in the universe (coverage error) or because the people in the sample do not all respond to the survey (nonresponse error).

Coverage error in the NHTS results from housing units and people who are not included in the sample but are part of the reference population (e.g. residents of the 50 states and District of Columbia). From extensive research done on the national survey, it is known that the primary source of under-coverage in the 2009 NHTS is the result of the exclusion of cell phone only households from the sample frame. At the time of the NHTS fielding, about 18% of all households nationwide were thought to be cell phone only, but no reliable estimate was available for each of the states. Unfortunately, the households likely to be cell phone only are also likely to be in one or more of the populations that traditionally have low response to surveys, such as renters, people with lower incomes, African-Americans, and Hispanics. And, of even more concern in this project, these characteristics often overlap with transit users.

A separate cell phone only survey was conducted in conjunction with the 2009 NHTS to provide nationwide statistics on the characteristics and travel of people in the cell phone only households. The sample size (1,175 households) was not sufficient for separate statewide estimates. The results of analysis of the cell phone only sample at the national

level were used to inform the weighting categories that could capture differences in travel between households with landline telephones and those without, such as household size, renter/owner, worker status, Hispanics, presence of children, and householder age.

In addition to coverage concerns, the survey protocols and emphasis on some travel over others could affect the respondent's answers. In some survey years, especially in the 1977, 2001, and 2009 survey years; Federal Transit Administration was a sponsor in the two latest surveys) there has been greater emphasis on transit use. The added attention to transit in the survey protocols may have impacted the amount of transit trips reported by respondents—especially since these surveys all included personal interviews, either in person as in 1977 or by telephone as in 2001 and 2009.

Nonresponse is also an issue--not all sampled households and people completed the survey when they were selected. Hard-to-reach populations include renters, low- and high-income groups, people in large households, and African-Americans and Hispanics. These groups are traditionally underrepresented in the NHTS, and in recent years the problem of nonresponse has been exacerbated by the growth of cell phone only households in the same population groups.

The weighting process can compensate for some of the issues related to coverage and nonresponse, but only to a degree by adjusting the respondents to the total population in specific sociodemographic categories—those likely to have under-coverage in the sample frame and those likely to be low responders. However, the potential for bias exists if the responders in these groups do not have the same travel characteristics as the non-responders.

Therefore, the descriptive data and estimates provided in this document are approximations. Error ranges are commonly developed in the analysis of the 2001 and 2009 NHTS data series which are distributed by FHWA (Federal Highway Administration) with replicate weights. However, the 1990 and 1995 NPTS require a separate software (SUDAAN) to develop error ranges, and the 1977 data--compiled by the US Census—does not include information on developing margins of error in the documentation or data file. This project used data from all the surveys. The sample sizes for each data year used in this Appendix are noted in Table 3. The 1983 NPTS was a small national sample with insufficient transit data for the kind of data-mining this chapter produced.

TABLE 3: NUMBER OF TRANSIT TRIPS IN THE NHTS/NPTS SAMPLE YEARS

DATA SOURCE	NUMBER OF TRANSIT TRIPS
2009 NHTS	8,521
2001 NHTS	7,907
1995 NPTS	7,536
1990 NPTS	2,913
1977 NPTS	2,325

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