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Work Trips on Public Transportation: An Analysis of Trends, Select Markets, and Users Using the National Household Travel Survey Series

Kyle Ken Taniguchi
University of South Florida, kyle.k.taniguchi@gmail.com

Work Trips on Public Transportation: An Analysis of Trends, Select Markets, and Users Using the National Household Travel Survey Series

by

Kyle Taniguchi

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Co-Major Professor: Steven Polzin, Ph.D.
Co-Major Professor: Abdul Pinjari, Ph.D.
Xuehao Chu, Ph.D.

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Abstract

Work trips are considered one of public transportation's biggest markets. It is important to understand this market as fully as possible because of the potential for congestion mitigation or air quality improvements, among other things. While much effort has been invested in researching travel on public transit, very little effort has been concentrated in understanding the work travel market. This document attempts to be a comprehensive resource which can provide current information on the persons and trips being taken on public transit for travel to/from work.

This research looks at the 2009 National Household Travel Survey (NHTS) to examine the difference between work and non-work transit trips and riders, choice and captive work trips and riders, and New York City (NYC) and non-NYC work trips and riders. In addition, transit mode share for work trips across an array of socio-demographic factors is examined. As a supplement, historical trend data utilizing past NHTS/Nationwide Personal Transportation Surveys (NPTS), the American Community Survey, and American Public Transportation Association data is used.

The data analysis is primarily descriptive in nature and is performed in SPSS (a statistical analysis software) and then graphed in Microsoft Excel. Interpretation of the results is based upon a comprehensive literature review and the author's knowledge and familiarity in the field of public transit.

There were several interesting and noteworthy findings uncovered during this research.

In the historical trend analysis, it was discovered that the proportion of transit trips being for travel to/from work has declined since 1983. Further analysis appears to indicate that the decline is

being caused by new riders who are making new non-work trips. This comes as the existing work riders and trip numbers appear to be holding steady. More research is needed to confirm this finding and to probe for more specific reasons on why this is occurring.

In terms of work transit trips, it was discovered that they tend to be taken on faster modes (such as commuter rail and elevated/subway) resulting in slightly higher in-vehicle speeds than non-work transit trips (11.8 MPH versus 11.2 MPH). The analysis also showed that those commuting via non-transit modes were 20 percent more likely to make a stop on their commute than those that took transit. Of those commuting on transit, riders were more likely to make a stop on their way home from work rather than to work.

An analysis of choice and captive riders found that in the 16-24 year old age group, 85 percent of riders were choice riders. This finding could perhaps signify that more young adults are choosing to ride transit. However, this result should be interpreted with caution because of the small sample size and potential data issues with the 2009 NHTS dataset. More research should be carried out in the future to verify these results.

Chapter 1: Introduction

Trips to and from work are considered one of public transportation's biggest markets. Research has shown that anywhere from 30 percent (2009 National Household Travel Survey analysis) to 59 percent (American Public Transportation Association – *Profile of Public Transportation Demographics* 2007) of all public transportation (transit) trips are for travel to/from work.

Historically, there has been an emphasis on getting people to take transit to work because of the potential to reduce congestion and improve air quality. Today however, transit agencies are facing declining financial support from local governments while also seeing increased demand for transit service. With funding spread thin, transit agencies need to make informed decisions when cutting or modifying service. Since work trips constitute such a large portion of trips on transit, it is important to understand this market as fully as possible.

This research examines work trips on transit using the 2009 National Household Travel Survey (NHTS). Historical data from the 2001, 1995, 1990, 1983, 1977, and 1968 NHTS/NPTS (Nationwide Personal Transportation Survey) were used to provide trend data. More information on the NHTS is presented in Chapter 3.

Objectives

The overarching goal of this research is to explore the latest information regarding work trips on transit. Work trips are one of transit's biggest markets and it is important to understand both the users of the service and the attributes of the trips themselves. Ultimately, this knowledge will be helpful in understanding needs, marketing, designing, and operating public transportation services. As part of this research, the NHTS data is examined to:

1) Provide a snapshot of transit's current mode share across a variety of demographics
2) Examine historical trends as they relate to work trips on transit
3) Compare riders and trip attributes for work and non-work trips on transit
4) Examine the effect of the quality of transit service on work trips on transit
5) Compare the demographics between choice and captive riders and the transit trips they take to work
6) Compare riders in the New York City (NYC) metropolitan area with the rest of the country (non-NYC) and the transit work trips they take.

It is hoped that this research will provide good data on areas of public transportation, particularly for work travel, that have not received much past examination. This includes transit travel associated with choice/captive riders, travel in NYC and elsewhere, and the travel patterns of young adults. The aspect of travel patterns of young adults is of particular interest because there has been much discussion of this generation's preference to non-auto modes, although little research has actually been conducted in that area.

Methodology

The analysis uses the 2009 NHTS as the primary data source, which is explained in greater detail in Chapter 3. To analyze the fourth research component (effect of transit quality of service), National Transit Database (NTD) data is used. More information on this dataset is presented in Chapter 8.

The final research hypotheses have evolved substantially since they were first proposed at the start of the research project. At the beginning, four initial research hypotheses were developed based on a review of contemporary literature. These hypotheses were analyzed by conducting a descriptive analysis of the data trends and conditions. Several key elements of this descriptive analysis were ultimately selected for further analysis. The final research hypotheses build upon the prior descriptive analyses and attempts to provide a more comprehensive and meaningful set

of results to explain transit usage and commuting. The sociodemographic factors (both at the person and household level) that were used as part of the analysis were selected based upon a literature review and past experience of factors known to influence transit ridership.

The analysis of the NHTS data was performed in SPSS (a statistical analysis software) and then graphed in Microsoft Excel.

The reader is cautioned against making strong interpretations based upon some of the results presented in this document. During the analysis process, it was discovered that there may be some potential data problems associated with the 2009 NHTS. These problems primarily stem from the driver licensure variable which affects the choice/captive analysis. This issue is discussed in further detail in Chapter 3 in the “Potential Data Issue with the 2009 NHTS” section.

Chapter 2: Literature Review

Transit Mode Share

According to an analysis of the 2009 NHTS, public transportation accounts for approximately 1.9 percent of all trips taken in the United States. In terms of trips to work, the share is markedly larger. The 2009 NHTS reports that about 3.7 percent of all trips to/from work were taken on transit. This number is commonly referred to as the "actual transit mode share" (Chu and Polzin 2008).

In terms of persons, also referred to as the "usual transit mode share" (Chu and Polzin 2008), the 2009 NHTS reports that nationally, about 5.1 percent of respondents indicated that their "usual mode for commuting last week" was transit. The 2011 American Community Survey (ACS) estimates that number to be about the same, at 5.0 percent.

The discrepancy between the usual and actual transit mode share is primarily due to the way each is measured. NHTS trip data represents actual trips on transit (in other words, transit trips taken by people on the day they were surveyed). NHTS person data, as well as the ACS, represents the mode a person typically takes to work during their prior work week (presumably meaning half or more of the time). For example, someone who normally commutes using transit but instead opts to take the car on Mondays to run errands after work would respond to the ACS and on the NHTS person file that transit is their usual commute mode. But, if this same individual is assigned a travel day on Monday by the NHTS, that person would respond that he or she drove to work, which is then recorded in the day trip file.

Recent research has indicated that transit commuters are less loyal to their mode than those that commute by auto (Polzin and Chu 2005). Usual transit commuters were cited as frequently utilizing carpools, walking, and driving alone in addition to using transit.

Work trips constitute a large portion of the trips served by transit. While there is some inconsistent data regarding what the actual percentage is, it is estimated that between 30 to 59 percent of all transit trips are for travel to/from work (2009 NHTS, American Public Transportation Association 2007).

This data discrepancy stems from the different data collection methods. The NHTS uses trip diaries which captures all transit trips by the entire sample group. The data from the American Public Transportation Association (APTA), however, utilizes aggregated data collected from on-board ridership surveys. One problem with ridership surveys is that the surveys are administered by different transit agencies across the country. Different sample sizes, methodology (time of day, how data is collected), routes chosen for analysis, and other uncontrolled variables, can help to explain some of the disparity. It has been hypothesized by some academics that some transit agencies are administering their ridership surveys during the rush hour commute so that they are able to get more responses with less effort, which may help to explain the higher percentage in the APTA data.

The Importance of Transit for Work Trips

Historically, work travel has been a priority market for public transportation services. There are a number of reasons for this.

First and foremost, transit is often seen as a way to potentially reduce congestion on roadways during peak periods. As such, the government is interested in shifting some vehicle trips to transit, thus reducing vehicular demand on existing roadways and the need for expensive

roadway projects. In addition to reducing congestion, shifting some trips to transit can help cities to help improve air quality, especially in non-attainment areas.

Second, since travel to/from work tends to occur during peak time periods when roadways can be congested, people might also be motivated to take transit because it is faster. Express buses can use carpool/toll lanes and rail systems (which includes commuter rail, subway/elevated, and most light rail systems), which typically operate in their own right of way, generally have competitive travel times with the auto. Commuters who do not wish to drive in traffic might choose to take transit so they can do other things during their commute such as sleeping, catching up on email, or reading. These types of commuters drive up demand for transit service during peak hours.

Third, employment is often clustered in downtowns or other concentrated areas. Since there is a concentrated activity center, it is easy for transit agencies to provide service to meet the potential demand. By running multiple routes to the employment center, not only is there great connectivity from the work site to residential areas, but there is a high likelihood that individuals taking transit will not need to transfer.

Fourth, work trips are a reoccurring type of activity that usually takes place at a consistent time. Since workers generally have fixed schedules, one can expect that as long as the existing transit service is convenient and goes where individuals want to travel, it can meet a worker's travel needs throughout the work week.

Fifth, work trips can be more expensive than other trips if individuals choose to drive. Work trips, especially those to downtowns, require paid parking which incentivizes someone to take transit instead of driving. In addition, driving to/from work during rush hour is often in stop-and-go traffic, which reduces fuel economy and increases fuel costs, further incentivizing someone to take transit.

Sixth, downtowns are generally conducive to transit use. The presence of bike lanes and sidewalks enables individuals to easily get from the transit stop to their work place with ease. Street lighting, lots of people, and perhaps a larger police presence can also make downtowns seem safe to individuals hesitant to take transit.

Finally, work trips are usually easy for people to take on transit. Since work trips typically involve only a single person, it makes it easy to plan activities around the transit schedule without the added complexity of other people's schedules. In addition, there is seldom any luggage or extra items to carry which would discourage people from taking transit. Furthermore, the rush hour is often when transit has the best service (frequency and coverage).

Factors Influencing Transit Usage – The Built Environment and Other External Factors

There have been numerous studies that have identified and examined factors that influence whether or not an individual will choose to ride transit.

Gasoline prices have been shown to have a strong influence on transit ridership. Lane (2012) found that for every 10 percent increase in gasoline prices, there was a 4 percent increase in bus ridership and an 8 percent increase in rail ridership in the months following the price increase. Geographically speaking, ridership increases due to increasing gasoline prices were more pronounced in areas that were more auto-dependent and had less transit service available (Lane 2010).

Transit fares also influence ridership. Wang and Skinner (1984) and Taylor et al (2009) found that as fares were increased, transit usage decreased. A general rule-of-thumb in measuring this relationship is the Simpson-Curtin rule, which states that for every 3 percent increase in fare, ridership decreases by 1 percent (Litman 2004). An analysis of transit fare increases by peak and off-peak bus ridership by Pham and Linsalata (1991) found that peak hour bus riders tend to be less sensitive to fare increases than off-peak bus riders. Goodwin (1992) found that demand

for rail services declined more severely than for bus services whenever fares were increased. He also found that the ridership declines tend to increase over time because consumers explore other options for their commute.

The quality and extent of transit service are important factors in transit ridership. Taylor et al (2009) found that an increase in frequency of vehicles would result in an increase in ridership. TCRP (2004) found that for a 10 percent increase in frequency, transit ridership will rise 5 percent. De Grange et al (2012) found that after controlling for socioeconomic and demographic variables, increasing a metro (train) network by 10 percent will reduce auto usage by 2 percent.

TCRP (2004) found that for a 1 percent increase in transit vehicle miles or vehicle hours, there is a 0.6 to 1.0 percent increase in ridership. On the other hand, research has shown that service cuts can also decrease ridership and potentially even result in larger subsidy costs for each rider than before the cuts were instituted (Voith 1991).

In line with quality and coverage is the speed of the transit service. One hindrance with taking transit is that vehicle speeds are so low, making trips take longer than they would when completed by auto. Basso et al (2011) found that by installing bus only lanes (thereby increasing transit speed), transit demand (measured in passengers per kilometer) can increase by as much as 38 percent.

Stringent regulations on vehicle ownership and use can also impact transit use. De Grange et al (2012) found that implementing roadway pricing and increasing taxes on car purchases increased transit usage. In the cities that implemented these policies, auto usage dropped by 20-30 percent on average, with transit usage picking up most of those lost auto trips. Parking prices can discourage driving and usage of transit in certain scenarios. In preferred areas within a central business district, a 10 percent increase in parking costs will cause a 2.9 percent increase in transit ridership (Hensher and King 1998).

Factors Influencing Transit Usage to Work

There are a number of factors that affect an individual's propensity to use transit travel to work.

Dill and Wardell (1994) conducted a study examining transit usage for work trips within the Portland, Oregon metropolitan area. They found that employers that offered reduced cost transit passes (due to bulk purchasing for the entire firm) had the biggest impact on getting employees to commute using transit. Similarly, employers that offered commuting benefits (such as flex time, a compressed work week schedule, or a guaranteed ride home), also saw a larger portion of their employees using transit compared to employers that did not offer those benefits.

Another study conducted by Cervero (2006) for the state of California took a look at factors that influenced whether or not workers would use rail transit to commute to work. Cervero found that less parking at the work site, lower auto ownership levels, and employer assistance with transit costs resulted in higher transit usage among employees. Frequent feeder bus service at the work-end of the station also resulted in higher transit usage by employees.

Bhat and Sardesai (2006) examined commuting mode choice in Austin, Texas. They found that if an individual needs to take mid-day trips or needed to stop on the way to/from work, they were more likely to drive alone to work. They also discovered that travel time reliability is an important consideration in choosing which mode to take to work. It was observed that commuters with inflexible work schedules were particularly sensitive to variations in travel time. This finding is particularly important because if transit service is not always reliable, some individuals may not want to take it.

Frank et al (2007) found that commute time, fuel, and parking costs influenced demand for transit. For every 10 percent increase in drive alone commute time, there was a 3.1 percent increase in demand for transit. For each 10 percent increase in fuel and parking costs for solo commuters, transit demand increased by 3.7 percent.

Trip Chaining

Trip chaining is the concept of linking multiple trips together, thereby decreasing travel time and costs. Research has shown that needing to make intermediate stops often discourages transit usage. Hensher and Reyes (2000) found that as the number of trips in a tour increase, the likelihood of using transit decreases. That finding correlates with work trips as well. McGuckin et al (2005) found that of workers that travel non-stop to/from work, 6.3 percent took transit. This compared to 3.6 percent of workers that stopped at least once.

In addition to the travel needs of an individual, it has been widely documented that individual and household factors influence trip chaining (Krizek 2003, O'Fallon and Sullivan 2005, Primerano et al 2008, Strathman and Dueker 1995). However, even after controlling for household, individual, and trip level factors, trip chains involving transit are still simpler than those taken by a private auto (Wallace et al 2000). Upon closer examination of the issue, research has shown that it is not that the mode of transportation that dictates the complexity of the trip chain but rather the other way around (Ye et al 2007).

Choice versus Captive Riders

Much effort today has focused on getting more choice users to take transit due to the supposed air quality and congestion reduction benefits. By definition, choice riders are travelers that choose transit when it is superior to other modes of travel (based on their personal opinion of cost, time, etc.). Captive riders are defined as those who are forced to take public transportation because they do not have access to a vehicle or cannot drive.

According to Beimborn et al (2003), there are five basic criteria that need to be met by each choice rider before they take transit:

- Accessibility – The transit service must be within reasonable distance from home/destinations to use

- Connectivity – The service between the origin and destination must exist and match a rider's schedule
- Knowledge – The rider must know service exists between the destinations as well as know the scheduling, fare payment, and stop locations
- Usability – The rider must be able to physically and mentally be able to use the fixed route service as well as transfer when necessary
- Security – The rider needs to feel safe when riding on the vehicle, waiting at the transit stop, and accessing the stop.

Research by Beimborn et al (2003) shows that choice riders are not necessarily influenced by the differences in travel times between transit and auto modes. Instead, they seem to be more heavily influenced by the amount of time they spend outside the vehicle (waiting). Choice riders are also more likely to be sensitive to fares than captive riders (Jin 2005). Ben-Akiva and Morikawa (2002) found that transit systems that require multiple transfers or have low scheduled frequencies do not attract many choice riders.

The trips taken on transit by choice riders are dramatically different than trips taken by captive riders. Captive riders make shorter trips (in terms of travel time and distance), travel at slower speeds, and transfer more frequently than choice riders. Captive riders also use transit for a wider variety of trip purposes, resulting in a lower proportion of their transit trips being for travel to/from work (Polzin et al 2000).

Captive riders are also public transit's most frequent riders. According to research by Polzin et al (2000) the transit captive population accounts for roughly 30 percent of the nation's population but takes about 70 percent of all transit trips. Choice riders, on the other hand, represent 70 percent of the nation's population but takes only 30 percent of all transit trips.

If transit expects to play a more important role in meeting travel demand, it needs to grow its ridership base by attracting more choice riders. Presently, the majority of transit riders are captive. Assuming that the captive ridership base remains relatively stable, future transit ridership growth will depend on attracting choice riders.

Emerging Factors that may Affect Transit Usage

There are two emerging trends worth watching in coming years as they likely will have a huge impact on transit usage. If these trends become the "new normal", they could have profound impacts on the transit market.

The first emerging trend is that young adults (age 16-34) are driving less while walking, biking, and taking transit more than other age groups (Davis et al 2012). Some of this may be attributed to this generation's lifestyle preferences which include being connected on the go (taking transit can enable a person to complete tasks not doable while driving). Moving forward, as these adults complete college and begin to work full-time, we may begin to see a rise in transit usage, especially for work trips. Some of this may already be evident with the recent rise in transit ridership nationwide.

Another developing trend is a desire by many Americans to move to more urbanized areas which allows them to drive less. A 2010 report by the Environmental Protection Agency (EPA) on construction trends throughout the country highlighted a fundamental change in where new housing is being constructed. In examining residential building permits, the EPA found that in 15 regions of the country, the central city more than doubled the number of new permits. A few examples cited in the report compared early 1990's averages with 2003-2008 averages. The findings showed:

- In New York City, residential building permits increased from 15 percent of all permits issued in the region to about 48 percent.
- In the City of Chicago, permits jumped from 7 percent to 27 percent.

- In Portland, Oregon, permits rose from 9 percent to 26 percent.
- In Atlanta, permits went from 4 percent to 14 percent.

Other areas with significant increases in urban residential building permits included Dallas, Los Angeles, Miami, Norfolk/Virginia Beach, San Diego, and San Francisco.

The shift in where residential permits being issued are just one piece of this emerging trend. A recent study conducted by Beldon Russonello LLC (2011) showed that a majority (58 percent) of the public prefers to live in neighborhoods where there are stores within walking distance of their home. Roughly 77 percent stated that it was important that their community allow them to be able to take walks. Respondents cited walking to the grocery store, the pharmacy, a hospital, and restaurants as some of the key places they would like to be able to walk to.

Generationally speaking, "retirement-minded adults" (age 50-77) in the study were more likely to choose to live in a smart growth community over a sprawl community (54 percent compared to 45 percent). Young singles (defined as those not married and under age 35) also were found to be more likely to pick a smart growth community over a sprawl community (68 percent compared to 31 percent). These younger adults were found to "prefer an apartment or townhouse within an easy walk of places over a single family home that required more driving".

Fundamentally, this increase in demand has driven up housing prices in urbanized areas. According to Leinberger (2011), the most expensive housing in the late 1990's used to be in the outer suburbs. Today, the most expensive housing is located in "high-density, pedestrian-friendly neighborhoods of the center city and inner suburbs".

Collectively, if there is indeed a shift in the housing preferences of the nation, there may also be an uptick in the utilization of transit services. These urban, pedestrian friendly neighborhoods, often located in areas where there is already high quality transit service, could change the transit market dramatically. If these new trends are true, existing transit service will probably be more

heavily utilized and rising demand may result in improvements in transit quality. In addition, the utilization of transit to commute to work may grow and see an expanding ridership base.

Contributions of this Study

While much effort has been invested in researching travel on public transit, very little effort has been concentrated in understanding the work travel market. This research attempts to be a comprehensive resource which can provide current information on the persons and trips being taken on public transit for travel to/from work. There are three particular areas that have received special attention in this report since very little, if any, research has been conducted in these areas of interest.

The first area is in the area of historical trend analysis. A literature review did not uncover historical trend data about the people and trips on transit for travel to/from work. From a policy perspective, it is important to understand how the transit work market is changing so that appropriate action can be taken.

The second area is in the area of choice and captive travel. Past research has primarily focused on choice and captive riders, irrespective of their trip purpose. This research attempts to go one step further and analyze whether or not the persons and trips being taken for work travel are markedly different from those for non-work purposes.

The last area is the examination of work transit trips in the New York City metropolitan area. The New York City region (NYC) constitutes a large portion of the nation's transit travel but yet little research has been devoted to examine this metropolitan area, especially as it relates to work trips. Since this region is markedly different than the others, it is important to examine the trips/persons using transit for work travel in NYC separately from other regions to perform a thorough analysis.

Chapter 3: Background Information on the National Household Travel Survey (NHTS)

The NHTS is the nation's most comprehensive dataset that allows researchers to learn and understand how Americans travel. The first travel survey was undertaken in 1969 and has been repeated every five to eight years by the U.S. Department of Transportation's Federal Highway Administration. This research primarily looks at the most recent dataset, the 2009 NHTS.

Historical demographic trends analyzed in this report examine 2001, 1995, 1990, 1983, 1977, and 1969 data. These datasets will not be discussed in much detail as the data collection and processing methods are similar to the 2009 dataset. More information on these datasets can be obtained from the user's guides online: http://nhts.ornl.gov/publications.shtml. The subsequent sections (Data Collection, NHTS Data Collected, and NHTS Survey Weights) are a summary of the 2009 NHTS dataset. More detailed information can be obtained from the *2009 NHTS User's Guide*.

Data Collection Process

Data collection for the NHTS was a very long and arduous process, spanning a period of 15 months (March 2008-May 2009). Similar to past NHTS datasets, the data collection process involved a random sample of residential land line telephone numbers from all 50 states and the District of Columbia. Telephone numbers associated with medical institutions, prisons, and military barracks were excluded from the sample. Dormitories and fraternity/sorority houses were included as long as no more than 10 people shared that telephone number.

For each valid telephone number, a recruitment interview was conducted. During the interview, the household was assigned a date in which they were asked to report data on their travel.

Travel days were assigned for all seven days of the week, including holidays, throughout the period from March 2008 and May 2009. The oversampling of a few months was addressed through the use of survey weights (discussed in a subsequent section). On the assigned travel day, the household was asked to report trips by all household members that occurred from 4:00 am until 3:59 am the next day.

After the household's travel day had passed, a follow-up interview was conducted to collect that information. Data collection was done using Computer-Assisted Telephone Interviewing technology, which enabled the interviewer to screen out suspect entries as the interview proceeded.

NHTS Data Collected

The 2009 NHTS features 150,147 households, 308,901 people, and 1,167,321 trips. This data came from both the national sample as well as 20 additional add-on samples which were purchased by various states, regional planning agencies, and metropolitan planning organizations. The add-on samples were purchased primarily to allow for a larger and more robust dataset to be used by the respective organizations for more accurate regional analyses. The add-on samples were included in the 2009 NHTS, however, to account for oversampling of certain regions, survey weights had to be adjusted accordingly. Survey weights are discussed in greater detail in the next section.

The NHTS collected a vast array of information ranging from trip information (trip length, mode of travel, travel time, etc.), person level demographics (age, race, gender, occupation, etc.), household level demographics (number of people, household income, dwelling type, etc.), and vehicle information (if applicable). This data, in the form of numerous variables, is stored in four data files: daily trips, household, person, and vehicle. Each file contains variables that are relevant to the particular category of interest. For the purposes of this research, only the daily trips, person, and household files were used.

NHTS Survey Weights

Survey weights are an important component of the NHTS to ensure that the dataset is representative of the population as a whole. The survey weights in the dataset are designed to account for under sampling or lower response rates from certain groups, non-response, or over sampling. As an example, if a state was oversampled by a ratio of 3 to 1, the computed weights for that state were reduced by a third of its original value. Weights were computed for all four files and are required to be used to obtain a statistically valid sample.

Defining the Datasets for Analysis

As mentioned previously, this research used the daily trips, person, and household files. To analyze work and non-work trips on public transit, two datasets were created from the U.S. daily trip file. To screen for public transit trips, the mode of travel variable, TRPTRANS, was used. Only trips that took place on a local public bus, a commuter bus, a commuter train, a subway/elevated train, or a street car/trolley were selected. Work trips were identified using the WHYTRP90 variable. Work-related trips are not included in the work trip category and fall under the non-work trip category. All other transit trips, with the exception of those in which the trip purpose was not known, were classified as a non-work transit trip.

Identifying the users who take transit to work and those that use transit for non-work purposes required some extra work. Within the person file, there is a variable to identify how many times a person had used transit within the month prior to being surveyed (PTUSED). However, if the transit trip occurred on a day other than the respondent's assigned travel day, there is no way of knowing what the trip purpose of the transit trip(s) was/were. Instead, the daily trips file was used to generate a person file of unique users who took transit to work and those that took transit for non-work purposes. Individuals were categorized into two groups (transit to work riders and non-work transit riders) using the WHYTRP90 variable. Since some individuals may have ridden transit to commute to work as well as to perform non-work trips, there are some individuals who are present in both datasets.

For analyzing household level characteristics, a transit rider household file was created. The household file was created by picking unique family ID's from the person file. The household file was used in analyzing household level characteristics, such as household income.

The dataset used in the evaluation of transit quality of service will be discussed in Chapter 8. The datasets used in analyzing trip chaining will be presented in Chapter 7.

Sample Sizes

As mentioned previously, the total number of trips on public transit constitutes a very small share of total travel in the United States. As such, the sample size for the both the daily trip file and the person file are rather small. In total, there are 8,521 total transit trips within the travel day file with 2,329 of those trips being for travel to/from work and the remaining (6,192 trips) being for non-work travel. In terms of transit users, there are 1,414 individuals in the transit to work riders dataset and 3,071 non-work transit riders in the other dataset. Only 30 riders were both work transit riders and non-work transit riders. There are 1,318 work transit rider households and 2,509 non-work transit rider households. While these sample sizes are adequate for the purposes of this research, it does not allow for further segmentation into additional categories. Sample sizes for most figures/tables are presented in Appendix A. In cases where there are extremely small sample sizes, this is noted with the figure/table label.

Potential Data Issue with the 2009 NHTS

When this research was conducted, it was discovered that the 2009 NHTS showed that over 90 percent of all transit work commuters have driver's licenses, significantly up from previous years where the number was roughly 60 percent (including the 2001 NHTS). This is most likely a data collection/coding issue, as it is very rare to see such large changes in a short period of time. Conversations with NHTS staff revealed that the question asked to obtain driver licensure data in the 2009 dataset was similar to previous datasets.

At this point, there is nothing that can be done to verify the accuracy of this data. The reader is warned that many of the trend analyses in this document are heavily influenced by this variable, including the choice/captive analyses. This issue prevents definitive conclusions from being drawn from the dataset. It is unknown whether other variables within the 2009 NHTS might be affected as well.

For comparison purposes, a select set of analyses were performed using the 2001 NHTS which was then compared to the 2009 NHTS. The results from this analysis can be found in Appendix B. The data presented indicates that the changes witnessed by some of the variables between the two datasets seem much too large to have occurred in reality and warrants caution in the interpretation of the results.

Geography of Transit Trips

Examining the geographic spread of the dataset provides some context for the results that are ultimately generated. As mentioned previously, several states and MPO's purchased add-ons. While it is unknown whether the weights provided in the dataset fully account for this oversampling (especially among a very uncommon travel mode) the analysis was conducted assuming this was the case.

Table 1 shows the number of work transit trips captured by Metropolitan Statistical Area (MSA) as well as the respective percent of the overall dataset (weighted and unweighted). It can be seen that the New York metropolitan area constitutes a large portion of the sample. What is also noticeable is that several strong transit markets, such as Boston and Chicago, appear to have very small sample sizes, which were ultimately scaled up after the weights were applied. The opposite is true for weak transit markets such as Phoenix, Houston, and Dallas, in which the weights scaled down the number of transit trips in each respective region.

Table 1 Sample sizes of 2009 transit work trips by MSA

Census Defined MSA	Sample Size (Number of Work Transit Trips)	Percent of Un-weighted Sample	Percent of Weighted Sample
Atlanta, GA	6	0.3%	0.3%
Austin-San Marcos, TX	8	0.3%	0.2%
Boston-Worchester-Lawrence, MA-NH-ME-CT	16	0.7%	2.1%
Buffalo-Niagara Falls, NY	6	0.3%	0.1%
Charlotte-Gastonia-Rock Hill, NC-SC	1	0.0%	0.0%
Chicago-Gary-Kenosha, IL-IN-WI	33	1.4%	5.2%
Cincinnati-Hamilton, OH-KY-IN	4	0.2%	0.8%
Dallas-Fort Worth, TX	55	2.4%	0.9%
Denver-Boulder-Greeley, CO	8	0.3%	1.4%
Detroit-Ann Arbor-Flint, MI	3	0.1%	1.2%
Greensboro-Winston-Salem-High Point, NC	17	0.7%	0.1%
Houston-Galveston-Brazoria, TX	54	2.3%	1.1%
Indianapolis, IN	3	0.1%	0.1%
Jacksonville, FL	2	0.1%	0.1%
Las Vegas, NV-AZ	1	0.0%	0.2%
Los Angeles-Riverside-Orange County, CA	200	8.6%	9.0%
Miami-Fort Lauderdale, FL	69	3.0%	1.2%
Milwaukee-Racine, WI	10	0.4%	0.8%
Minneapolis-St. Paul, MN-WI	3	0.1%	0.4%
New Orleans, LA	1	0.0%	0.1%
New York-Nortn New Jersey-Long Island, NY-NJ-CT-PA	842	36.2%	38.9%
Norfolk-Virginia Beach-Newport News, VA-NC	4	0.2%	0.1%
Orlando, FL	9	0.4%	0.3%
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	25	1.1%	5.2%
Phoenix-Mesa, AZ	63	2.7%	0.3%
Pittsburg, PA	8	0.3%	2.1%
Portland-Salem, OR-WA	2	0.1%	0.6%
Providence-Fall River-Warwick, RI-MA	1	0.0%	0.1%
Raleigh-Durham-Chapel Hill, NC	2	0.1%	0.0%
Rochester, NY	2	0.1%	0.0%
Sacramento-Yolo, CA	33	1.4%	0.6%
St. Louis, MO-IL	2	0.1%	1.2%
Salt Lake City-Ogden, UT	8	0.3%	0.5%
San Antonio, TX	29	1.2%	0.6%
San Diego, CA	116	5.0%	1.0%
San Francisco-Oakland-San Jose, CA	184	7.9%	4.8%
Seattle-Tacoma-Bremerton, WA	9	0.4%	1.7%
Tampa-St. Petersburg-Clearwater, FL	12	0.5%	0.3%
Washington-Baltimore, DC-MD-VA-WV	169	7.3%	7.4%
West Palm Beach-Boca Raton, FL	11	0.5%	0.4%
Area suppressed-MSA population of less than 1 million	219	9.4%	8.0%
Area not known	79	3.4%	0.9%
Total	2329		

Chapter 4: Mode Share for Work Trips and Non-Work Trips

To provide some context for how much transit is utilized for work trips (when compared to other daily travel), this chapter presents a descriptive overview of transit mode share for both work and non-work trips against a variety of different sociodemographic factors. This will help in understanding some of the analyses later in this document.

An analysis of mode share (Figure 1) reveals that transit usage remains quite low, even among work trips. As can be seen in the figure, the work trip transit share (3.6 percent) is over double the non-work transit share (1.6 percent). Transit usage remains low nationwide due to a number of different factors such as limited transit availability, infrequent service, a limited service area, rising fares, and slower service (relative to travel by the auto). It is important to note that areas where transit service is strong (such as San Francisco or New York City) have higher transit mode shares.

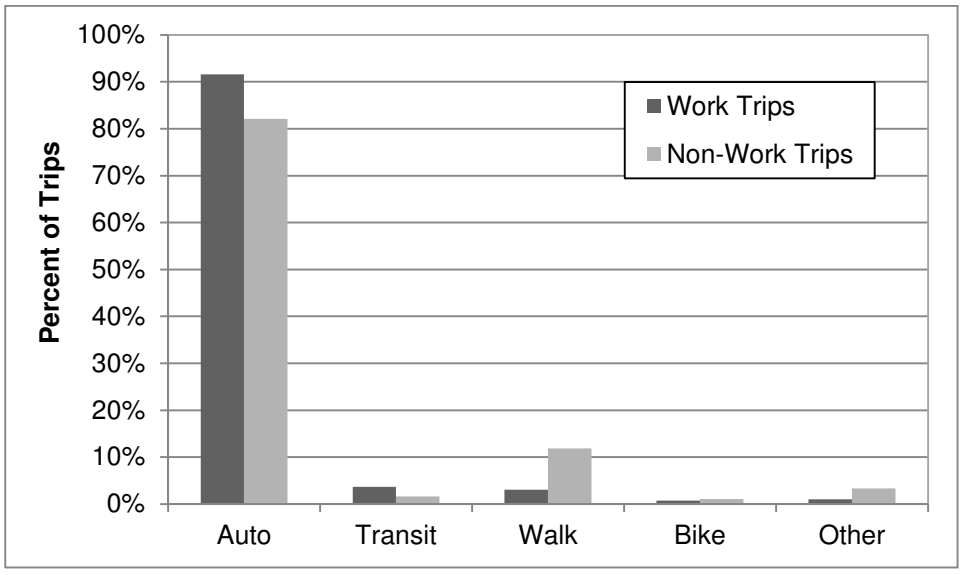


Figure 1 2009 U.S. mode share of work and non-work trips

Figure 2 presents the mode share by age for both work and non-work trips. Not surprisingly, transit mode share to work is highest during one's working years. The transit mode share for non-work trips is highest in the 16-24 age group. This can be expected because these individuals often can't afford to own a car since they are in school or are just starting to work. Interestingly, the non-work transit mode share remains relatively constant across those aged 40 and higher.

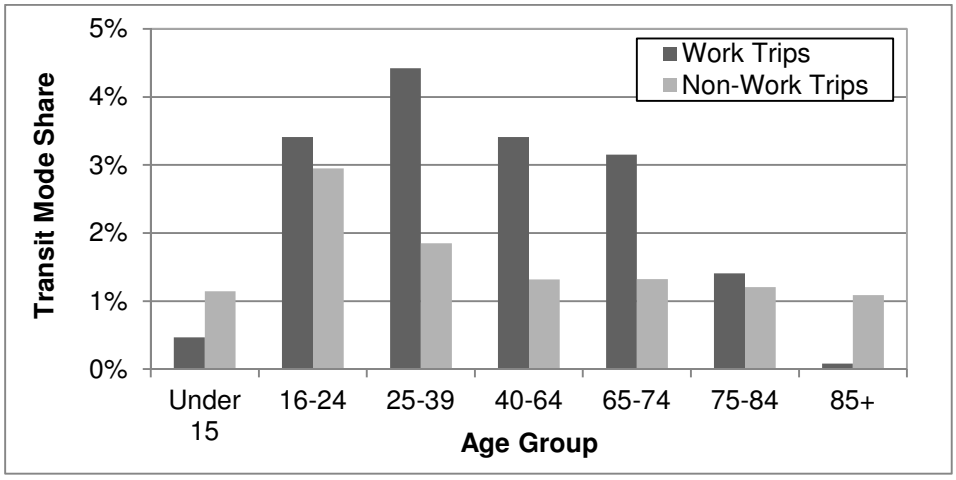


Figure 2 2009 U.S. transit mode share for work and non-work trips by age

An analysis of gender and mode share (Figure 3) shows that a larger share of female daily trips is on transit when compared to male daily trips. This effect can be due to females being more likely to hold transit passes (Vance and Peistrup 2011) or being more willing to reduce their automobile use (Matthies et al 2002).

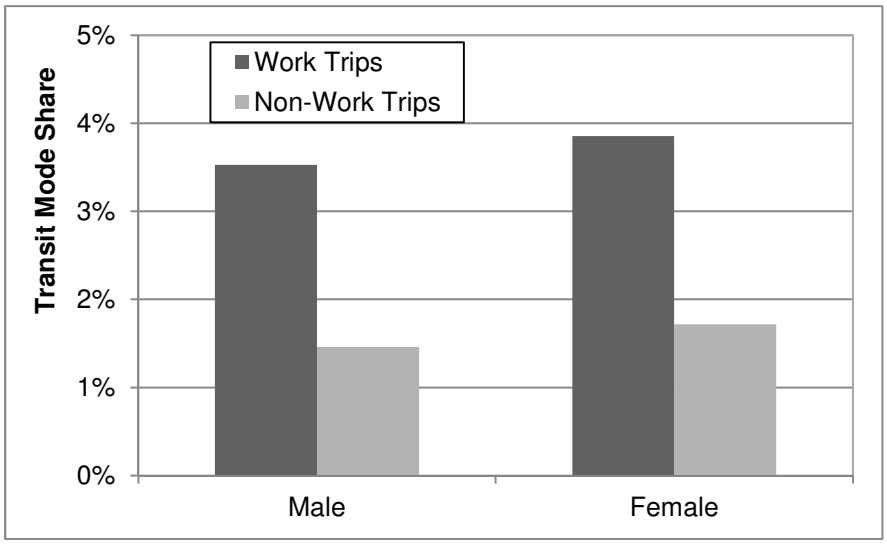


Figure 3 2009 U.S. transit mode share for work and non-work trips by gender

Looking at race/ethnicity (Figure 4), it can be seen that non-Hispanic blacks have the highest transit usage while non-Hispanic whites have the lowest. This is also consistent with existing research that shows that minorities are frequent users of transit.

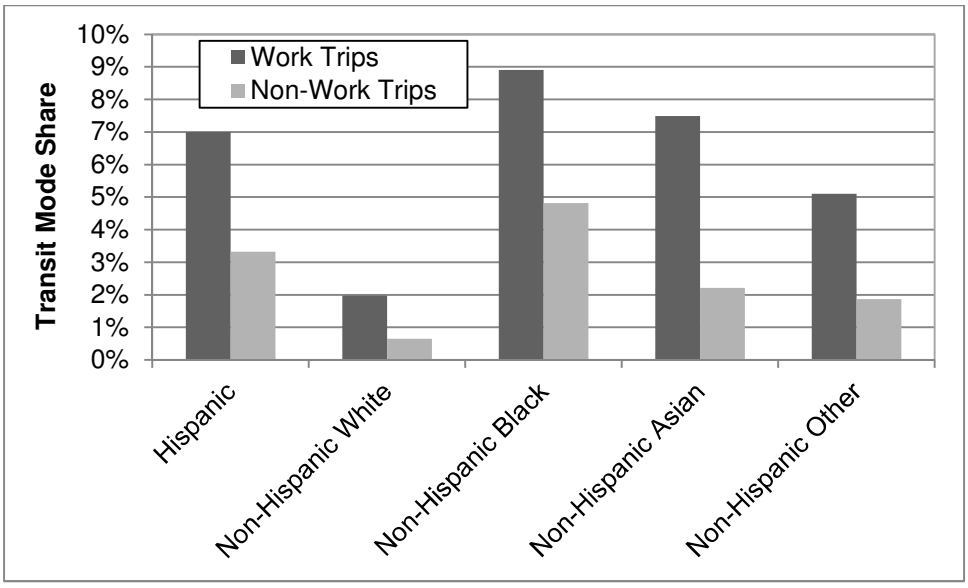


Figure 4 2009 U.S. transit mode share for work and non-work trips by race/ethnicity

An examination of educational attainment and transit mode share (Figure 5) shows that those without a high school diploma are more likely to use transit. Those who are college educated are nearly twice as likely to utilize transit for work trips as for non-work trips. Part of this increase in transit usage for work trips can be correlated with occupation and job location.

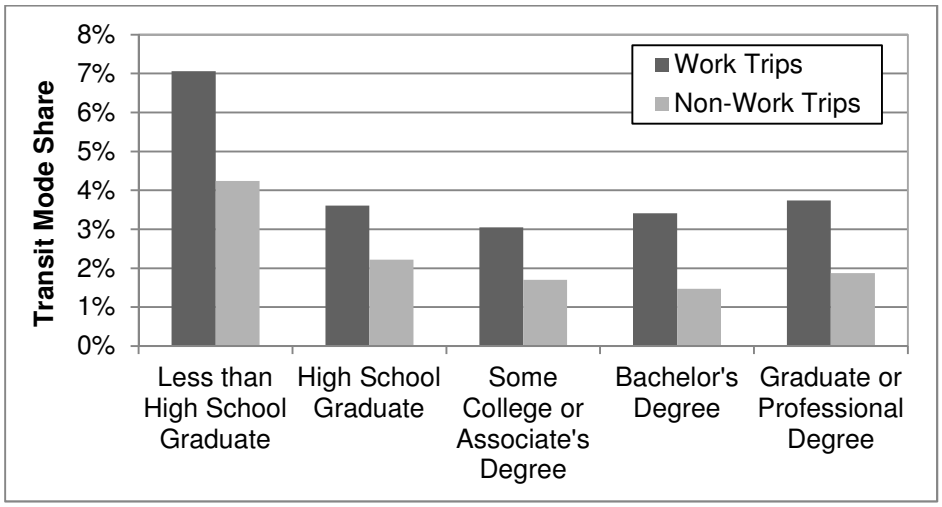


Figure 5 2009 U.S. transit mode share for work and non-work trips by educational attainment

An analysis of mode share by household income (Figure 6) shows that transit usage for non-work trips is highest amongst low income riders. While that is also true for work trips, a fair number of middle and high income riders also take transit to work. Part of the reason for the higher usage of transit among middle and high income riders could be because of the need to travel to city centers for specialized employment, which can have competitive transit service.

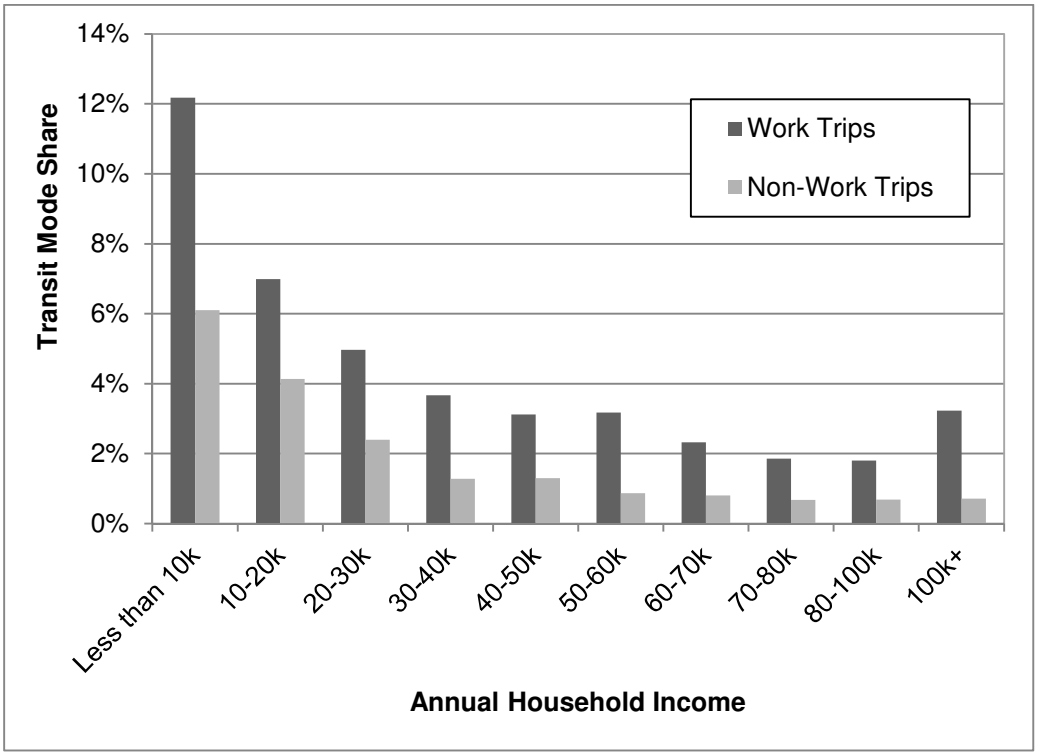


Figure 6 2009 U.S. transit mode share for work and non-work trips by annual household income

Figure 7 presents the mode share by household size. The data shows that one person households are the most likely to use transit for both work and non-work trips. The higher transit mode share among single person households could be due to a number of factors. Two potential reasons include running fewer household errands which lessens the need for trip chaining (which ultimately discourages transit usage) or a lower household income (when compared to a household with two working individuals) which makes it difficult to purchase/maintain a vehicle. Another possibility is that some people in one person households cannot drive and since there are no other household members to drive them around, they are forced to take transit.

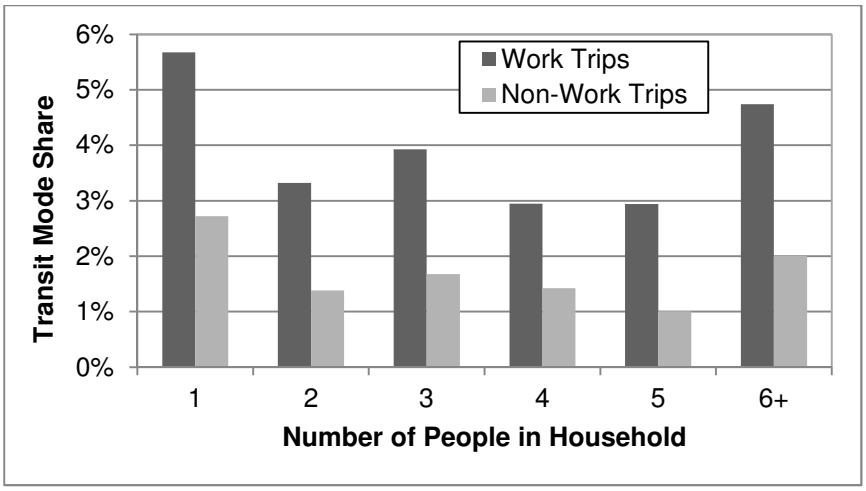


Figure 7 2009 U.S. transit mode share for work and non-work trips by household size

When examining mode share by household vehicle count (Figure 8), it can be seen that those with no access to a household vehicle use transit the most. The data shows that even if an individual comes from a household without a car, a majority of their travel still occurs on non-transit modes of transport (mainly walking).

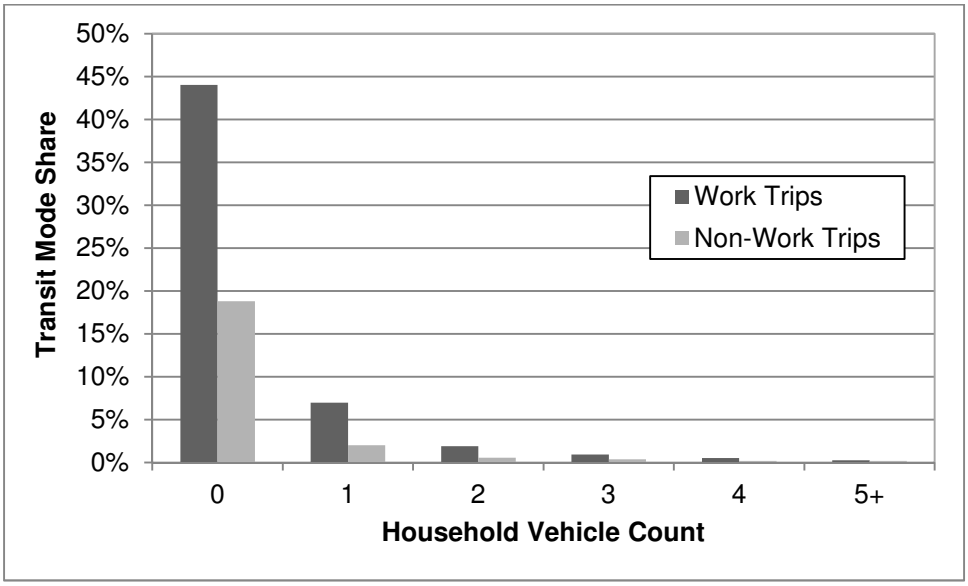


Figure 8 2009 U.S. transit mode share for work and non-work trips by household vehicle count

Figure 9 presents the mode share by driver status. As the graph shows, non-drivers tend to take a larger percentage of their trips on transit than licensed drivers. This is expected because individuals that cannot drive are somewhat captive to transit.

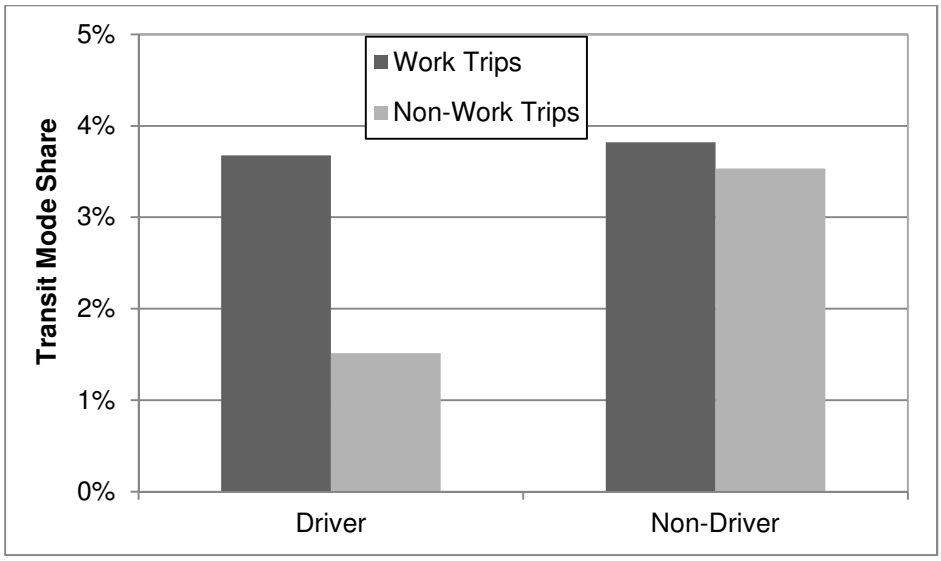


Figure 9 2009 U.S. transit mode share for work and non-work trips by driver status

An analysis of the transit mode share by life cycle shows that riders that come from households with children tend to be the least likely to utilize transit (Figure 10). The data points out that empty nesters (households whose children have grown up and left home) are more likely to take transit than households with children. This result suggests that these adults may be more flexible in their travel plans since they do not have children and are opting to take transit more frequently. While this higher usage can also be attributed to giving up driving, it is not very likely as those that cannot drive usually are not mentally or physically able to take fixed route transit (which is what was analyzed here).

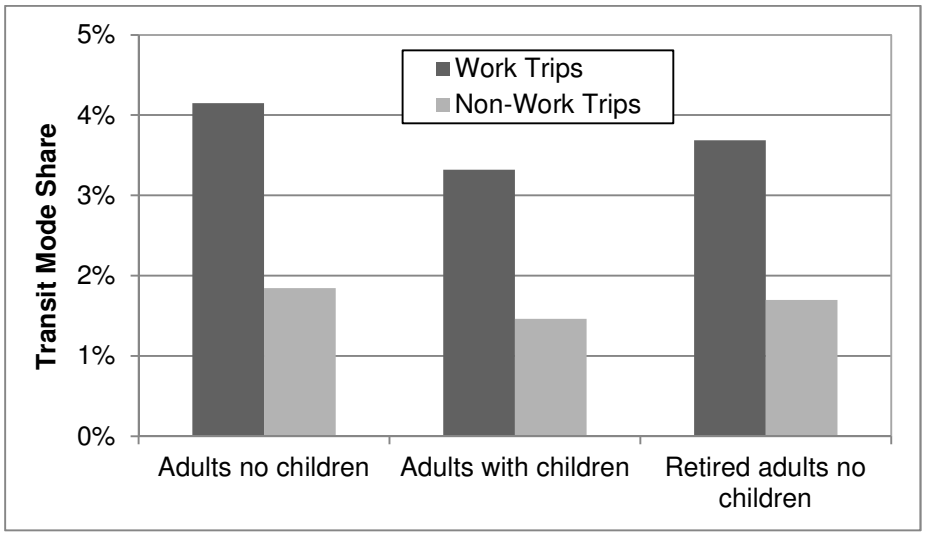


Figure 10 2009 U.S. transit mode share for work and non-work trips by life cycle

How captive an individual is to transit is often a very important indicator of transit usage. Mode share was computed based upon how captive an individual is to transit. As part of this analysis, there were four potential groups that an individual could fall into: choice rider, semi-choice rider, semi-captive rider, and captive rider. Each category was computed in SPSS using the parameters identified in Table 2. One shortcoming of this analysis that readers should be aware of is that this analysis does not account for the individual/household that chooses to be a captive rider by not owning vehicles.

Table 2 Criteria for defining the captivity of a rider

Category of Rider	Rider's Driving Status	Other Conditions	Remarks
Choice Rider	Driver	HHVEHCNT >= DRVRCNT	Person can drive and always has access to a vehicle
Semi-Choice Rider	Driver	DRVRCNT > HHVEHCNT and HHVEHCNT > 0	Person can drive but may have to share a vehicle with a family member
Semi-Captive Rider	Non-Driver	HHVEHCNT >= 1 and DRVRCNT >= 1	Person does not drive but at least one person in the household owns a car and can drive
Captive Rider	Non-Driver	HHVEHCNT = 0 or DRVRCNT = 0	Entire household does not drive and/or the household does not own a vehicle
Note: HHVEHCNT = Number of vehicles available in the household, DRVRCNT = Number of drivers in the household (including the rider in question)			

Based upon the previously defined criteria, it can be seen in Figure 11 that choice riders have the lowest levels of transit usage among the different groups. This result is somewhat significant because it underscores just how difficult it is to attract true choice riders. Since these individuals always have access to a car, it can be expected that they will utilize it for nearly all of their trips unless other external factors (such as parking fees or faster travel time on transit) change their decision. Of course, part of the decision-making process to take transit is also the accessibility and attractiveness of transit service, both of which cannot be measured using the NHTS dataset.

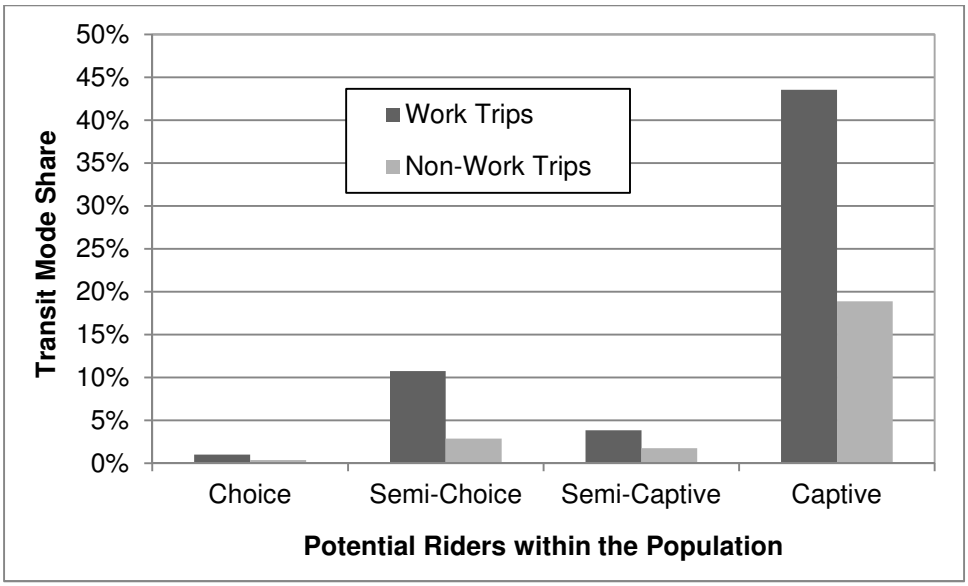


Figure 11 2009 U.S. transit mode share for work and non-work trips by captivity level

Chapter 5: Historical Transit Data

It is often important to look at historical data to get a sense of what has happened in the past and whether or not the transit market has been changing with time. This analysis, in part, may help to answer questions such as whether more young adults are utilizing transit to get to work. The results generated from this section can also be used to see where the transit to work market is heading, based on historical records.

Historical Transit Usage

Accurate historical transit ridership data is often very difficult to obtain. Figure 12 represents the best guess of American transit ridership since the 1900's, as compiled by the American Public Transportation Association (Fact Book 2007). According to the American Public Transportation Association (Fact Book 2007), transit ridership peaked in 1946 when transit provided more than 23.4 billion trips on transit vehicles nationwide. From 1946 to 1973, transit ridership nationwide fell precipitously. Since 1973, transit has seen gradual increases in ridership (American Public Transportation Association 2007). Ridership has recently started to rebound with 2009 marking the best year for transit ridership since the decline with 10.4 billion unlinked trips provided nationwide (American Public Transportation Association 2011).

Utilizing historical NHTS/NPTS data, a graph can be constructed to examine transit's mode share of work trips (Figure 13). It can be seen that since 1977, transit mode share for work trips has been hovering in the 4 percent range.

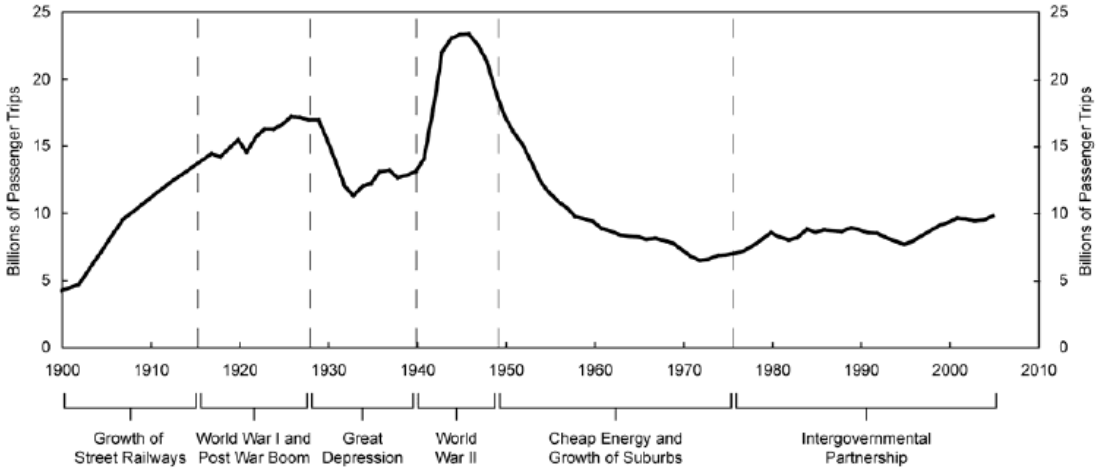


Figure 12 Historical U.S. transit ridership data for all trips (Courtesy of APTA Fact Book, 2007)

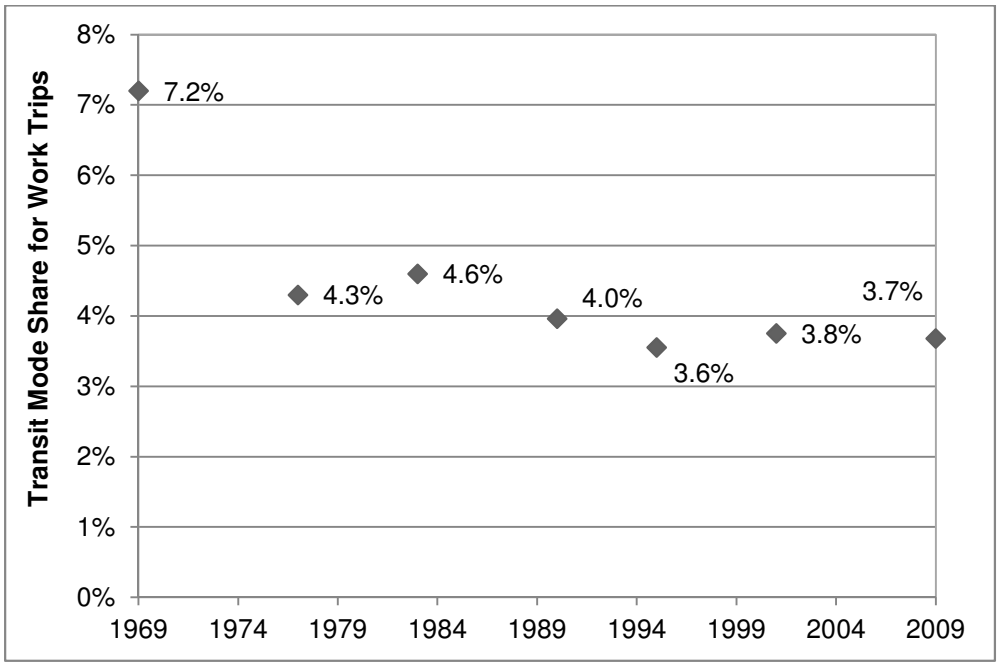


Figure 13 Historical U.S. transit mode share for work trips (NHTS/NPTS)

For comparison purposes, transit mode share by other trip purposes is presented in Figure 14. It can be seen that while transit mode share for work trips has declined somewhat since 1983, other trip purposes have seen increases in transit mode share (especially shopping and medical/dental trips).

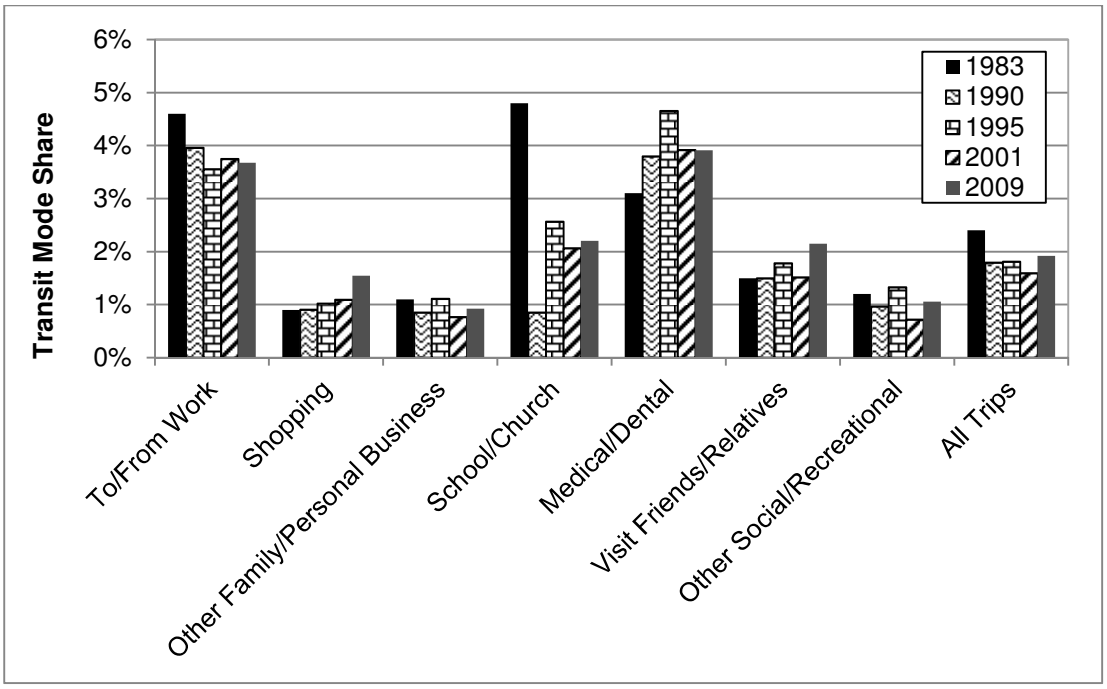


Figure 14 Historical U.S. transit mode share by trip purpose

Figure 15 looks at transit mode share of work trips during the last decade. The results, compiled from different sources, reinforce the relative accuracy in the mode share. The early years of the American Community Survey (ACS) are not very reliable and should be interpreted with caution. As mentioned previously, some of the discrepancy between the ACS/Census and the NHTS are due to the way in which data was collected (usual vs. actual mode used). For a more detailed discussion on this issue, please refer to the "Transit Mode Share" section of Chapter 2.

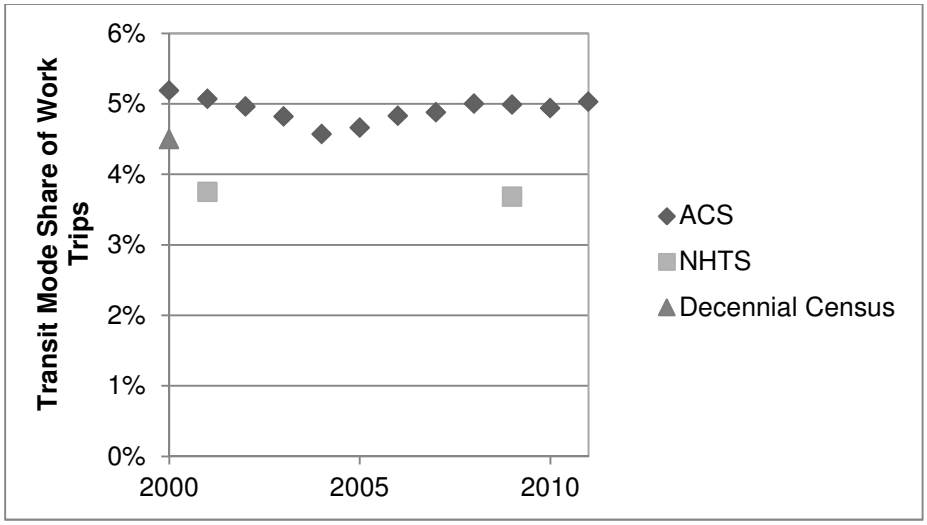


Figure 15 Historical U.S. transit ridership for the last decade

Figure 16 presents the proportion of transit trips being for travel to/from work. It can be seen that despite transit usage generally increasing nationwide (Figure 13), the share of transit trips being taken for travel to/from work has been steadily decreasing. The data shows that while work trips still constitutes transit's largest market, it is no longer as large as it once was. Part of this issue stems from transit's declining mode share for work trips (Figure 13). This issue was investigated further and the results are presented in the next section of this chapter.

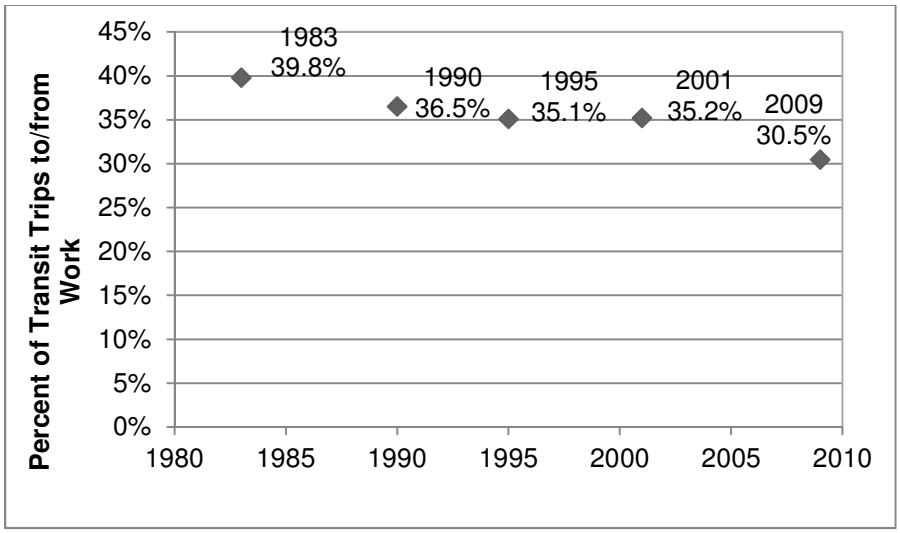


Figure 16 Historical percent of transit trips for travel to/from work in the U.S.

Why is Transit to Work Usage Declining?

There are a number of potential reasons why the proportion of transit trips for travel to/from work has been declining over time. This section attempts to test some potential theories for why this may be.

First, a historical analysis was conducted on transit ridership. Figure 17 shows that since 1983 there has been a slight increase in the proportion of the population taking transit. This data accounts for the number of unique individuals within the U.S. that take transit in a given year. This could be an indication of a diversification of the ridership base which will subsequently shift the trip types being taken on transit.

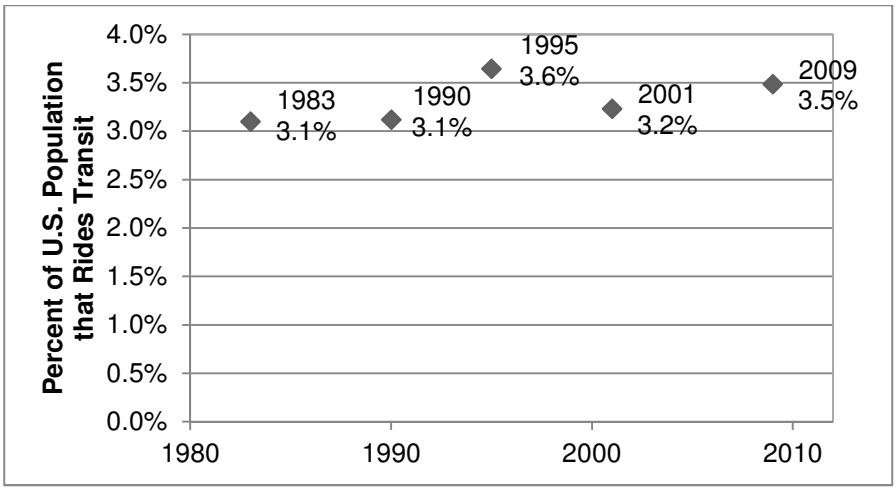


Figure 17 Historical percentage of U.S. population that rides transit

Next, transit trip rates were calculated for various trip purposes (Figure 18). These trip rates are one-way trips meaning that a round trip is counted as two trips. It can be seen that weekly transit trip rates per rider have been relatively stable since 1983, hovering at around 14 transit trips a week per person. What is interesting, however, is that during that same time period, there has been a decline in work and school/church trips per rider. These declines coincide with increasing transit trip rates for shopping and medical/dental trips.

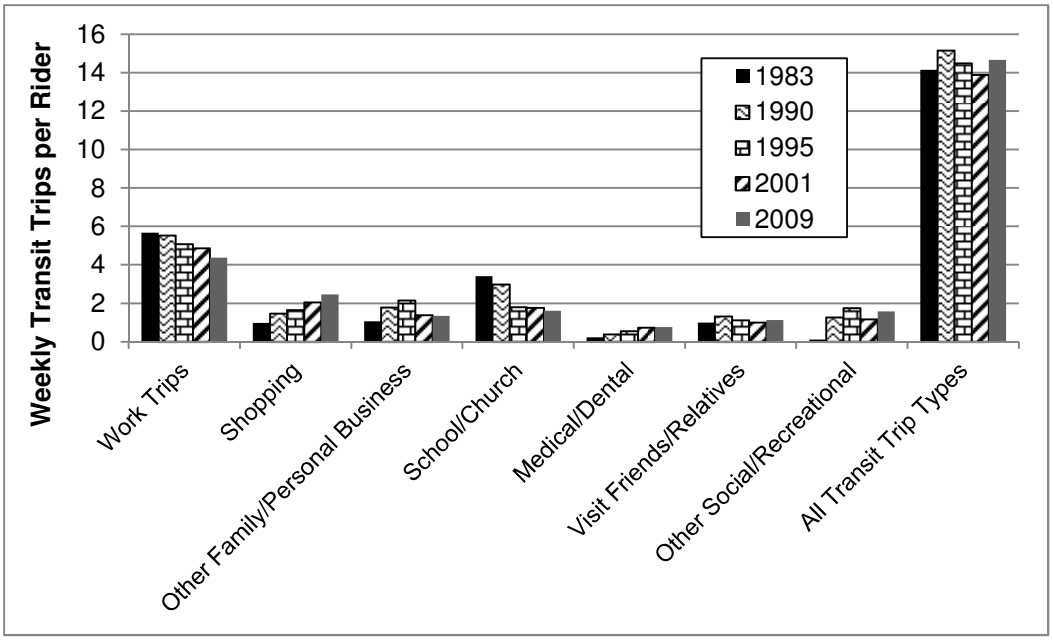


Figure 18 Historical U.S. weekly transit trip rate by trip purpose

Analyzing specifically work trips and work riders, Figure 19 shows that transit to work usage amongst work riders seems to indicate that there is little to no change in the commuting behavior of work riders. This data was obtained without the use of trip weights.

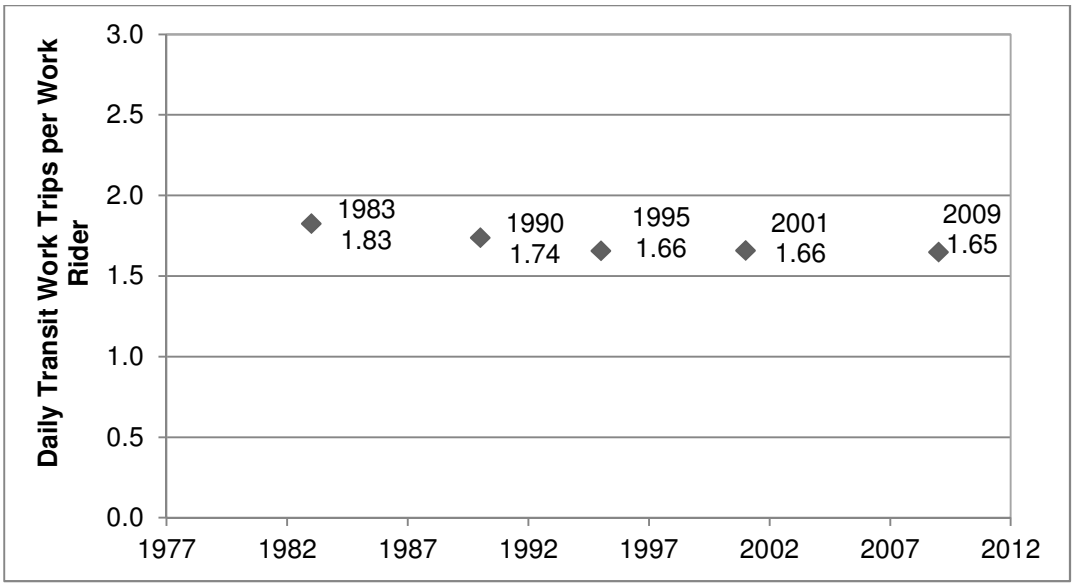


Figure 19 Historical U.S. daily work trip rate for work riders (unweighted)

Analyzing the historical number of unique riders (Figure 20) and the number of transit trips (Figure 21) reveals that the work transit market has been relatively stable since 1983. These two figures show that much of the increase in unique riders and number of transit trips are due to non-work related travel.

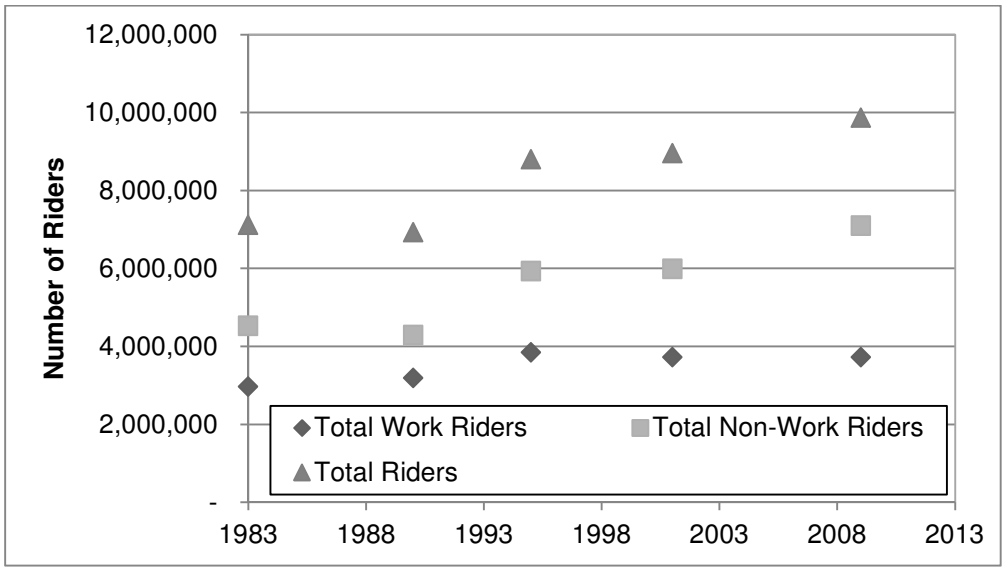


Figure 20 Historical U.S. unique transit riders (work and non-work)

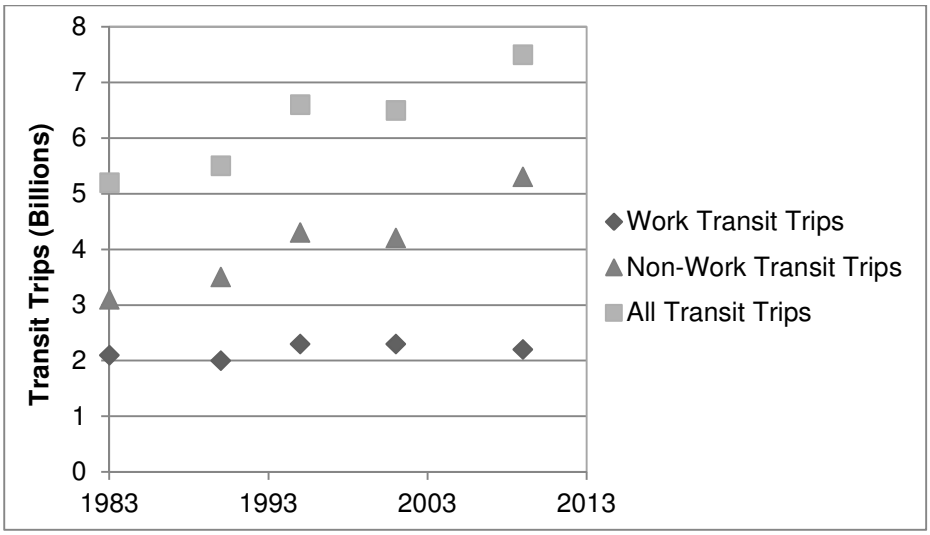


Figure 21 Historical U.S. transit trips (work and non-work)

Collectively, these results seem to indicate that the transit industry is gaining new riders who seem to be taking transit for purposes other than to/from work.

Historical Demographics for Transit Commuters

The age distribution of transit commuters from 1990 to 2009 is shown in Figure 22. The data shows that there are more riders in the 40-64 age group than back in 1990. This finding is somewhat expected since the baby boomers are slowly aging and will eventually be retiring. If transit does not attract new riders, one can reasonably expect the number of transit trips for work to decline.

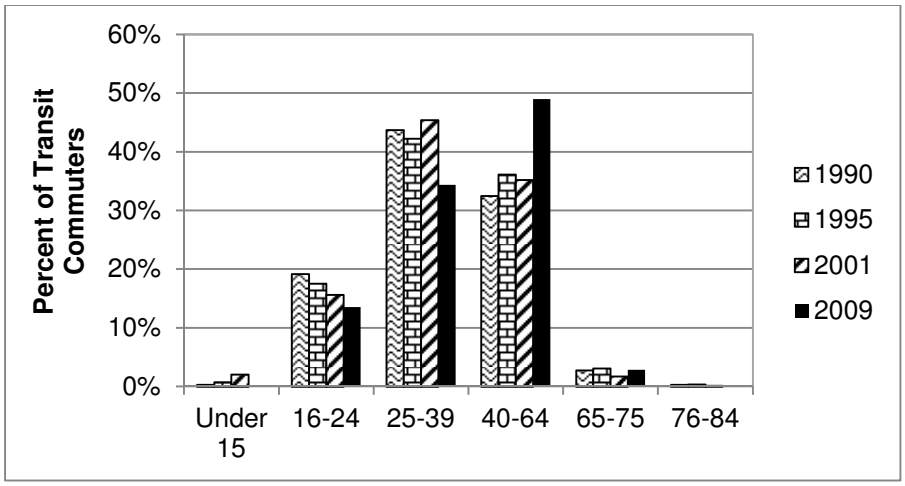


Figure 22 Historical U.S. age distribution of transit commuters

An analysis of gender (Figure 23) shows no significant change in the proportion of male and female riders over the course of two decades.

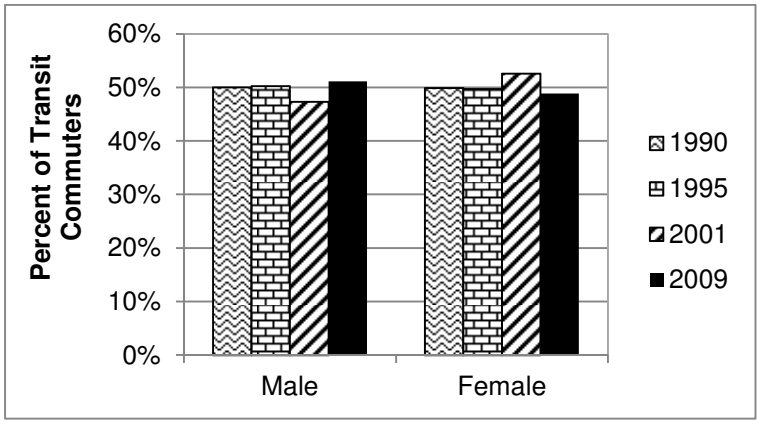


Figure 23 Historical U.S. gender distribution of transit commuters

Figure 24 presents the racial/ethnic background of transit commuters. Most notable is the fact that today there is a larger share of Hispanic commuters than back in 1990. This increase corresponded to a decrease in the number of non-Hispanic whites, blacks, and Asians during that same time period.

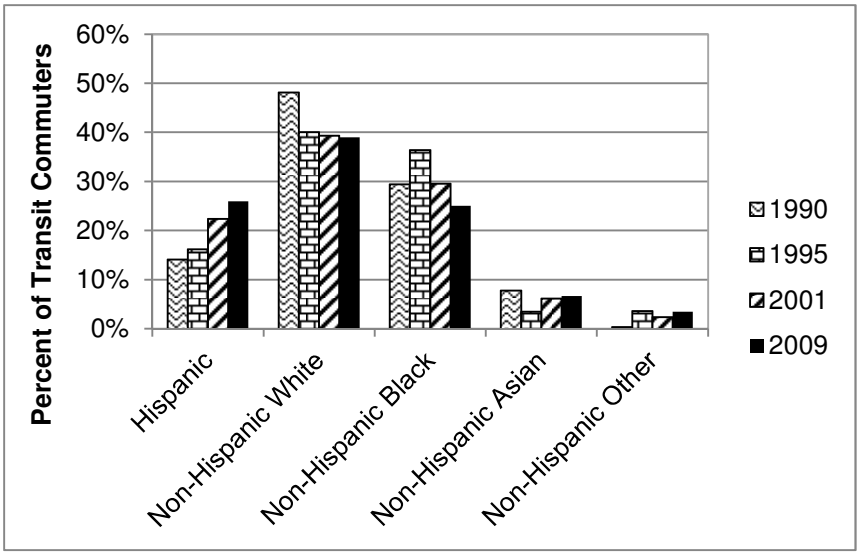
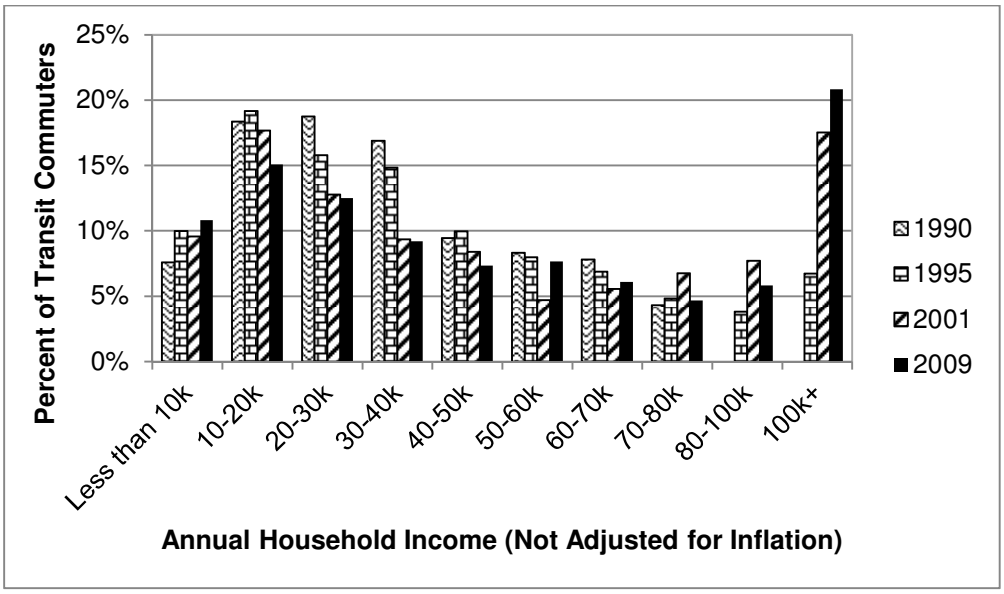


Figure 24 Historical U.S. racial/ethnic profile for transit commuters

An examination of rider's household income (Figure 25) reveals two interesting changes, despite not adjusting for inflation. First, and perhaps more surprising, is that the proportion of transit commuters who make less than $10,000 a year has actually increased since 1990. Second, the proportion of high income commuters (those with household incomes greater than or equal to

$80k a year) taking transit to work has more than doubled since 1995 (the most recent year data was available). As a result, the number of middle income users has shrunk since 1990.

These results indicate ever increasing polarization in serving work trips. On one hand, there are those with low incomes (presumably captive riders) who require good connectivity and access to transit service at both their origin and destination. On the other hand, there are those with higher incomes (presumably choice riders) who demand convenient, cost-effective, and speedy transit service. Attempting to meet the demands of both of these groups may be near impossible, especially in tough economic times. If these trends continue, transit agencies should attempt to prioritize/retain service for those who need it most.



Note: 1990 data is not available for income categories greater than $80k due to different income categories.

Figure 25 Historical U.S. annual household income for transit commuters

Figure 26 shows the proportion of transit commuters who can drive. Historically, about two-thirds of riders had a driver's license. The results for 2009 seem to indicate that today most transit riders have a driver's license. This result seems extremely high but conversations with NHTS staff indicate the data results are indeed valid. NHTS staff indicated that the wording for the driver license question in the 2009 dataset was the same as in previous years. Part of this discrepancy perhaps can also be attributed to weight calculations in the 2009 NHTS dataset. If

there are indeed more licensed drivers taking transit, it certainly has an impact on the proportion of choice/captive riders taking transit to work (see next figure).

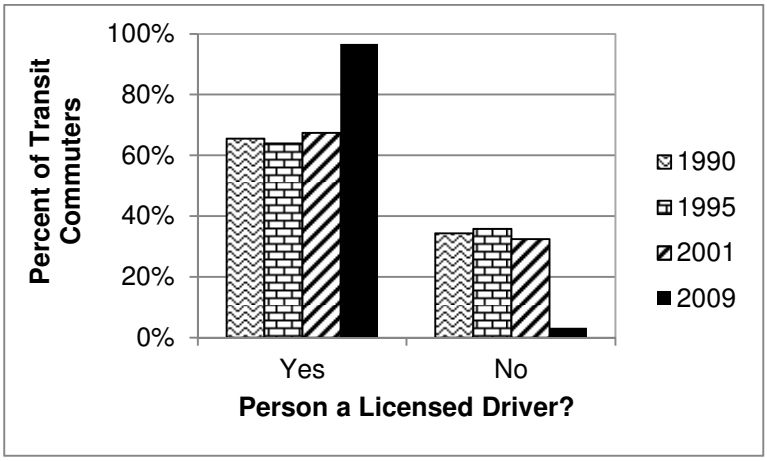


Figure 26 Historical U.S. driver status for transit commuters

Historically, there was almost an even number of choice and captive transit commuters. Today, however, the data seems to indicate that most (almost 62 percent) transit commuters are choice riders. At this point, it is premature to conclude that transit is managing to attract more choice riders. More research must be done on this issue to determine if it is an artifact of the 2009 NHTS data collection or weighting techniques or is indeed an early indicator of a shift in the transit ridership demographic.

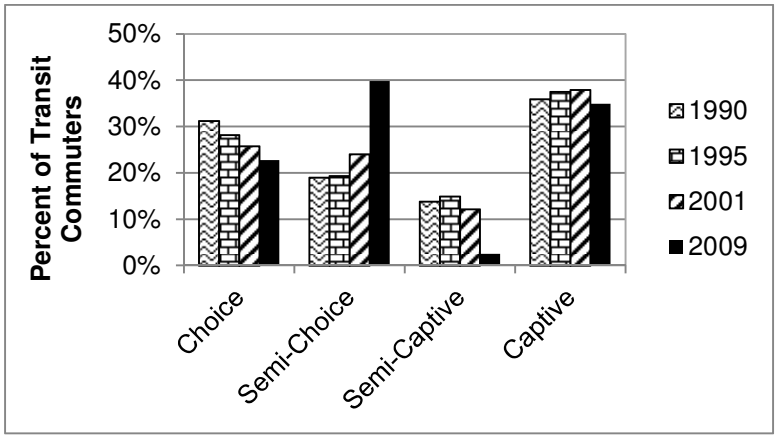


Figure 27 Historical U.S. choice/captive status for transit commuters

Chapter 6: Comparing Work Riders and Non-Work Riders

This section presents the results of the analysis comparing the demographics of individuals who take transit to work and those that take transit for non-work purposes. Learning about the rider is often a critical component in tailoring service to meet the rider's needs and expectations.

This chapter is divided into three main sections: person level demographics, household level demographics, and captivity analysis of transit riders.

Person Level Demographics

This section presents data on the demographics of transit users that take transit for work and non-work purposes. Age, gender, race/ethnicity, and educational attainment are presented. At the end of this section, personal opinions on transportation issues are examined.

Age often has a large influence on travel. Considerations such as physical stamina to walk to a transit stop, tolerance to fare increases or peak fare charges, are some factors that are correlated with age. As Figure 28 shows, individuals who take transit to work are predominantly within the 25-64 age range, typical working years for most individuals.

When gender is analyzed (Figure 29), it shows that there is a fairly even number of males and females taking transit to work compared with those taking transit for non-work purposes. Gender can sometimes have an influence on transit usage, especially among females who are concerned about their safety. One study conducted in St. Louis at light rail stations found that crime caused females to be more likely to get picked up/dropped off at stations. Similarly, females were more

likely than males to be picked up/dropped off at stations during the night (Kim, Ulfarsson, Hennessy 2007).

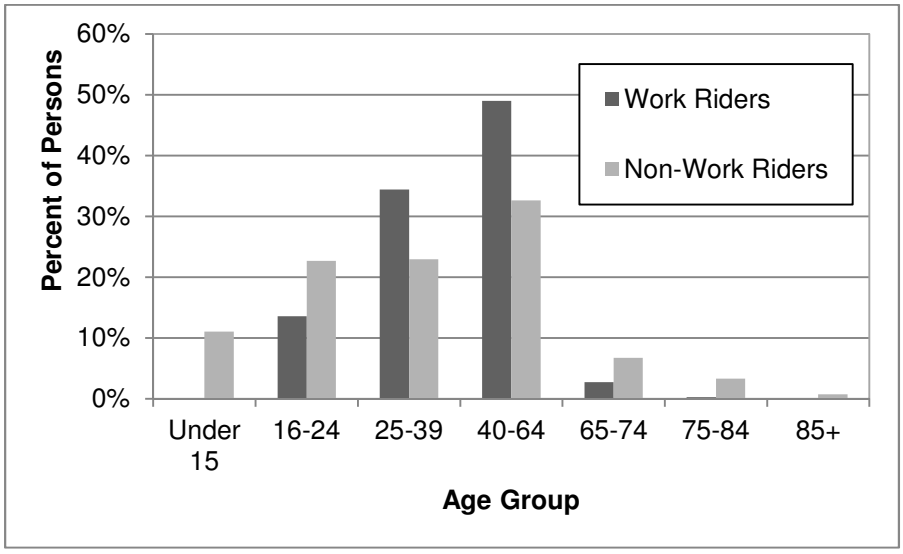


Figure 28 2009 U.S. age distribution of work and non-work transit riders

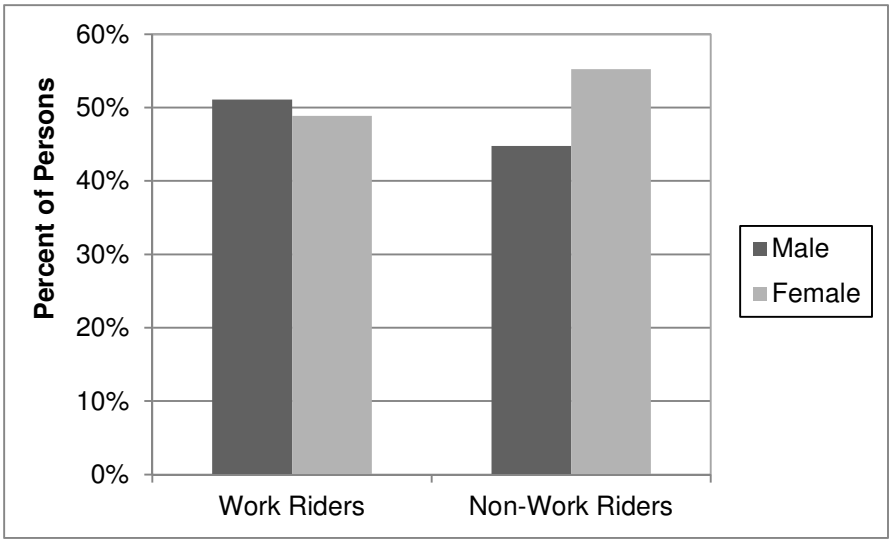


Figure 29 Gender of U.S. work and non-work transit riders (2009)

Race and ethnicity often play a factor in transit usage. Traditionally, minorities have been more frequent users of transit. Figure 30 shows that there is a fairly equal split between Hispanics, non-Hispanic whites, and non-Hispanic blacks in the non-work transit group. However, in the transit to work group, non-Hispanic whites constitute a majority (39 percent) of all riders.

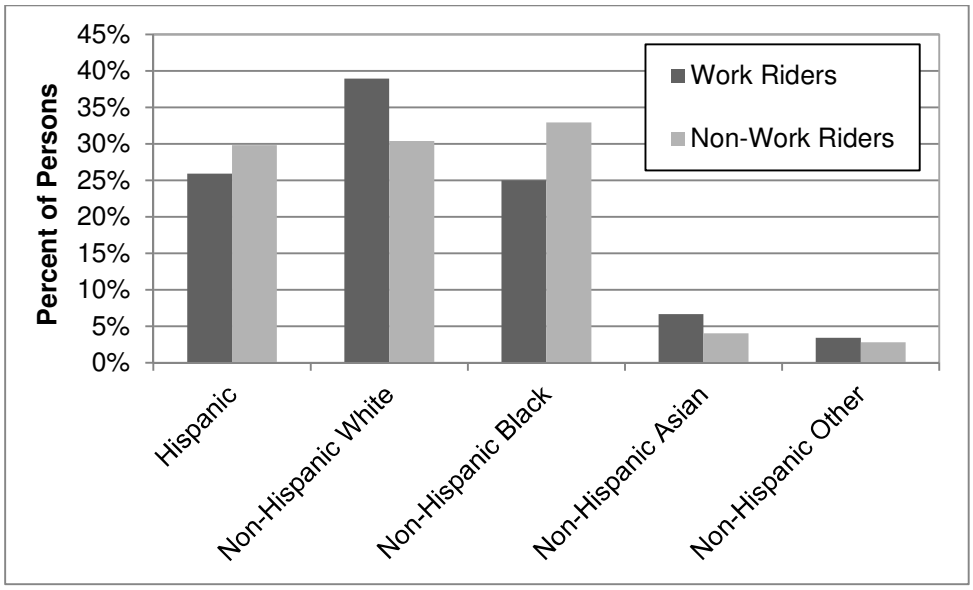


Figure 30 2009 U.S. race and ethnicity of work and non-work transit riders

Education is often correlated with race/ethnicity and household income. As Figure 31 shows, transit to work riders tend to be slightly more educated with 63 percent having at least some college education (compared to just 53 percent of non-work transit riders).

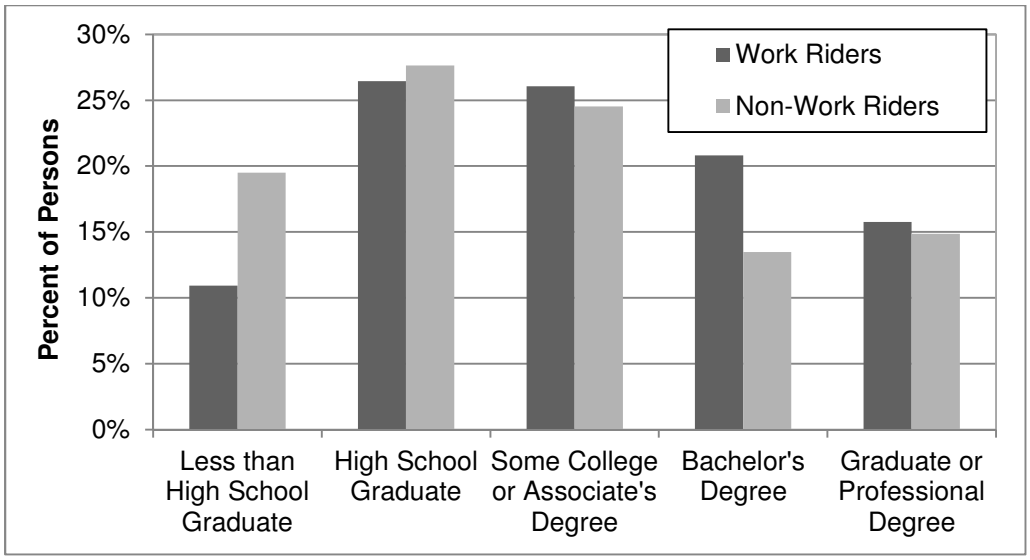


Figure 31 2009 U.S. educational attainment of work and non-work transit riders

In the 2009 NHTS, respondents were asked what they felt was the most important transportation issue. Figure 32 presents the responses for commuters who take transit and those that do not. Not surprisingly, the transit rider group cites access and availability to transit as the most

important issue. On the other hand, workers that do not use transit cite the price of travel as the most important issue.

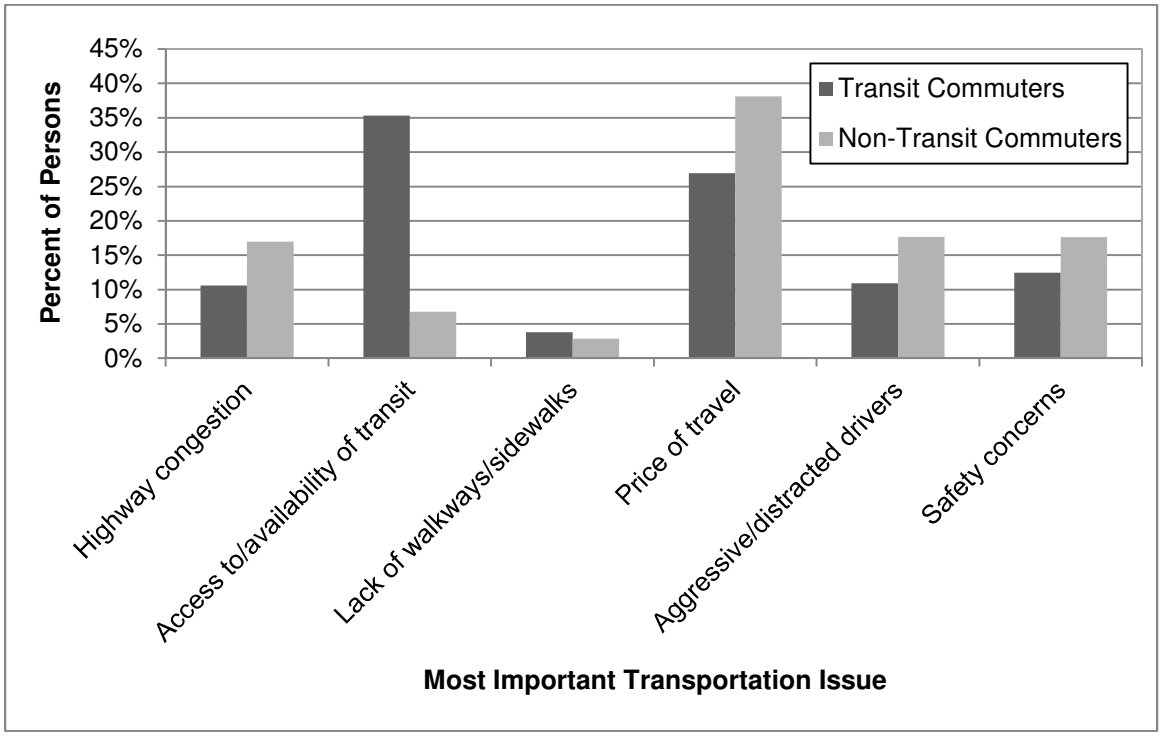


Figure 32 2009 U.S. transit and non-transit commuter's most important transportation issue

Household Level Demographics

This section presents demographics of transit user households for both groups of transit riders. To examine household-level characteristics, two new datasets were created from the person file (transit to work rider households and non-work transit rider households). Households were included in the datasets if at least one individual used transit for work or non-work purposes, respectively. As part of this analysis, household size, number of drivers, number of vehicles, and annual household income are presented.

An analysis of the number of persons in a household revealed some interesting results (Figure 33). The average household size for transit to work households was slightly larger, containing an

average of 2.84 persons, when compared to non-work transit households, which had an average of 2.75 persons.

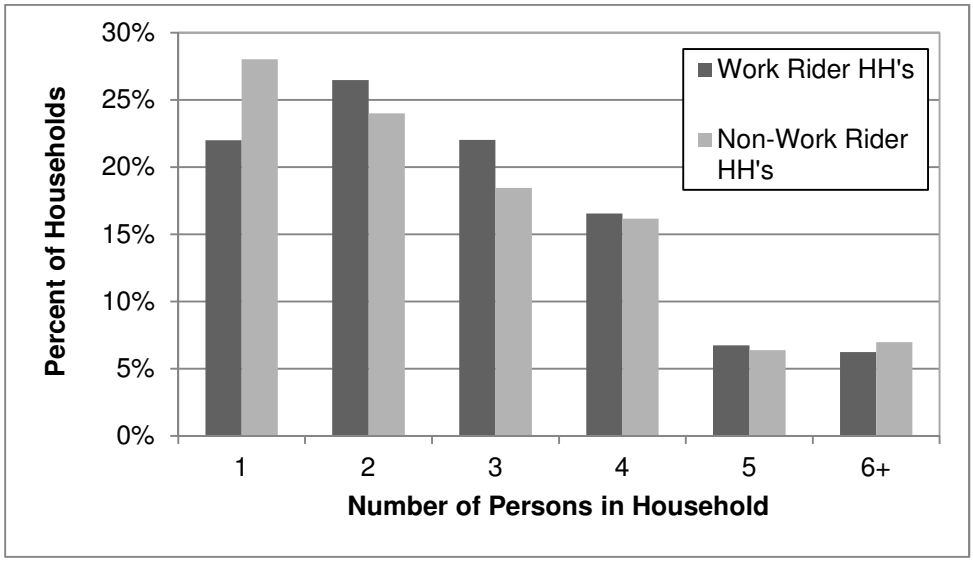


Figure 33 Number of persons in work and non-work transit rider's household nationally (2009)

The number of licensed drivers is an important metric (along with an individual's driver status and household vehicle availability) in determining whether or not the transit rider has access to personal vehicle travel. This information is useful in providing context to the transit captivity analysis which will be presented in the next section. As Figure 34 shows, transit to work households are more likely to have at least one driver in the household than non-work transit households.

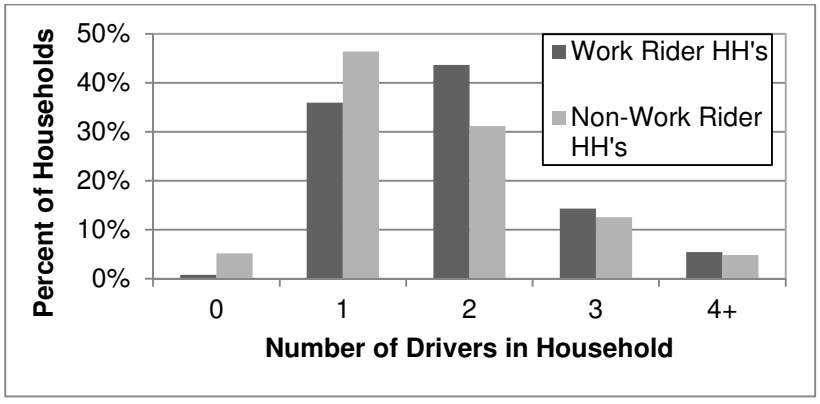


Figure 34 Number of drivers in work and non-work transit rider's household nationally (2009)

Similar to the number of licensed drivers, transit to work households are more likely to own at least one vehicle (Figure 35). The lower percentage of transit to work households without a vehicle is an indication that some users are choice riders.

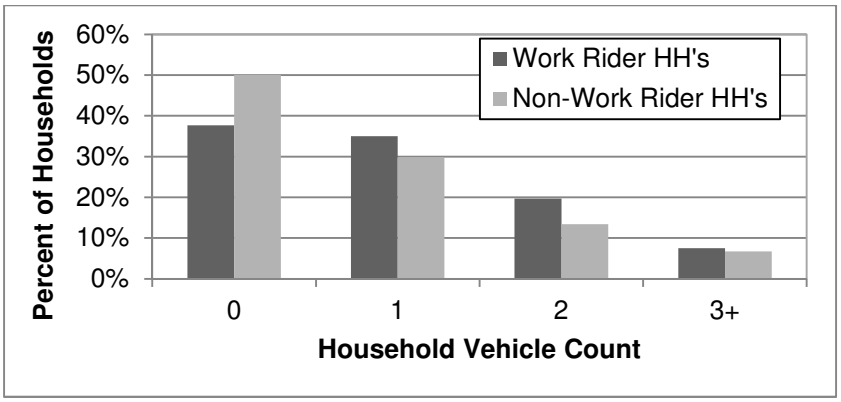


Figure 35 Number of vehicles in work and non-work transit rider's household nationally (2009)

Household income is another factor that can influence an individual's choice to take transit. Traditionally, transit users are lower income individuals. In Figure 36, however, it can be seen that transit to work households do not fit that stereotype. In order for higher income individuals to take transit, there must be some travel benefit (faster commute, reduced cost, etc.) that makes transit more appealing than driving. Another potential reason for higher household incomes among work rider households is that employers may be subsidizing or providing free transit passes for employees which encourage transit use.

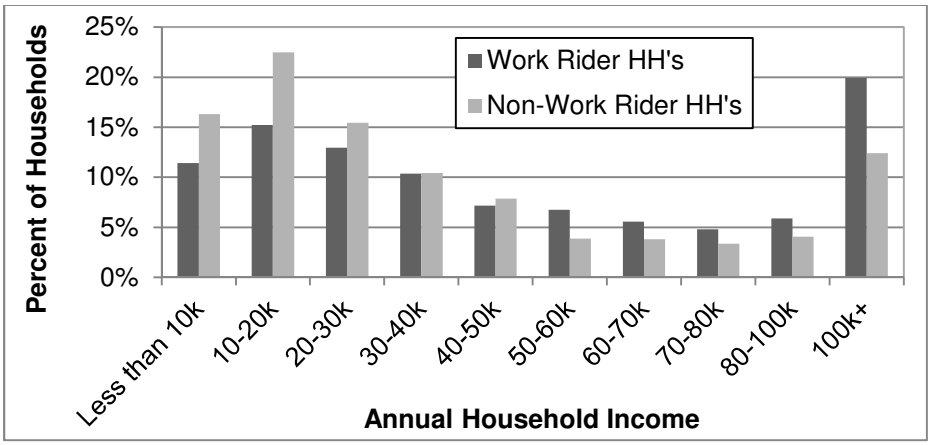


Figure 36 Annual household income of work and non-work transit rider's household nationally (2009)

Captivity Analysis

A captivity analysis was performed to see what proportion of riders from each group were choice riders. In recent years, there has been an increasing emphasis in trying to get more choice riders to ride transit because of the potential environmental and congestion relief benefits of taking single occupant vehicles off the road.

The analysis indicates that a majority (63 percent) of riders taking transit to work are choice or semi-choice riders. Only 44 percent of non-work transit riders were choice or semi-choice riders. This result indicates that there are external factors that are influencing choice riders to take transit to work. This can include things such as more competitive travel times with the auto (express buses using toll lanes, subway systems with faster travel times), reduced travel expense (cost of downtown parking or fuel), reduced stress from not driving, increased frequency of vehicles during commute (and thus less waiting) or more productivity on the commute (working on laptop, taking a nap).

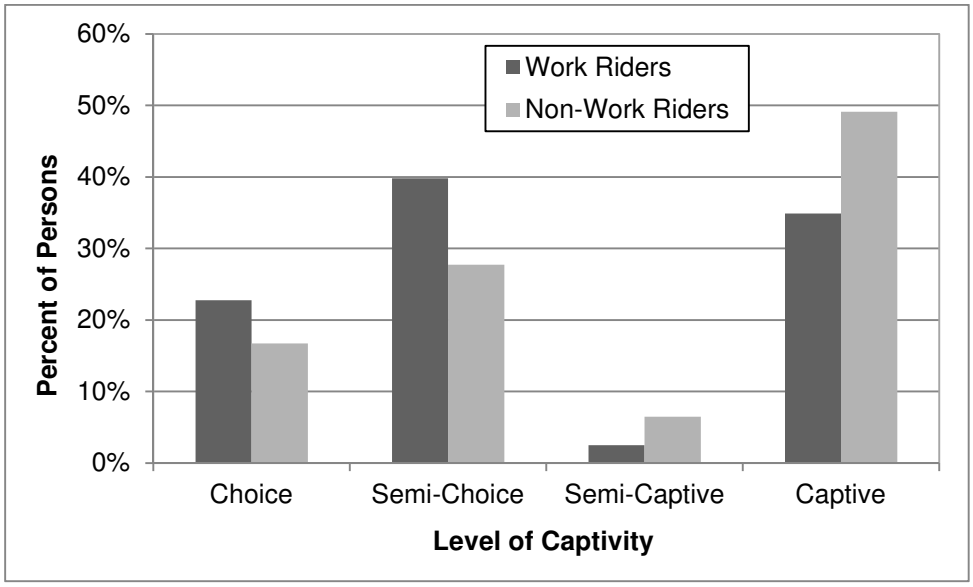


Figure 37 2009 Captivity level of U.S. work and non-work transit riders

Chapter 7: Comparing Work Trips on Transit to Non-Work Trips on Transit

This section presents the results of the analysis comparing the attributes of work trips on transit to non-work trips on transit. Specifically, market share, trip length, travel time, speed, and access/egress to transit will be examined.

First, trips by transit mode are examined. As can be seen in Figure 38, local bus service remains the predominant mode for transit trips across the country. Work trips tend to utilize faster transit modes (commuter rail and elevated/subway in particular) when compared to non-work trips. One may also notice that streetcars represent a very small portion of transit travel nationwide. Since the sample size is very small, streetcar trips are excluded from subsequent mode-specific analyses.

Figure 38 2009 U.S. transit market share by vehicle type

Trip length and travel time are analyzed next. As Figure 39 shows, work trips on transit tend to be slightly longer in length and take more time to complete than non-work trips. The longer trip

length can be partially be attributed to the need to commute longer distances for specialized employment which often is not located close to an individual's home. The increased travel time for work trips could be due to both the longer commute and also traveling in more congested conditions, resulting in slower travel speeds.

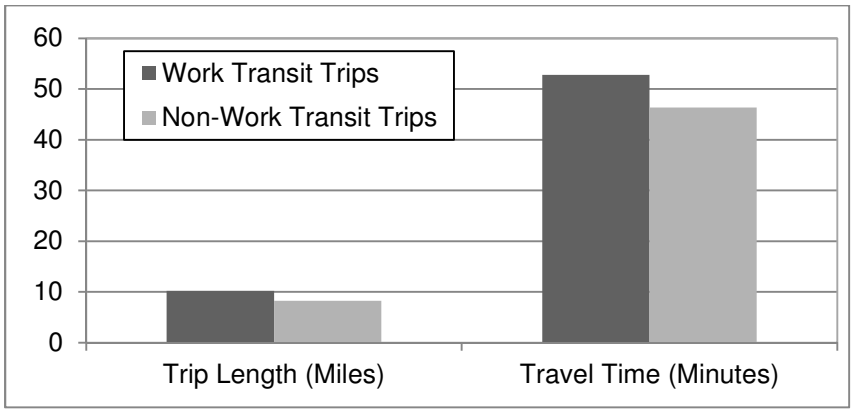


Figure 39 2009 U.S. average trip length and travel time for transit work and non-work trips

Looking by mode and comparing work and non-work trips, average travel times are computed (Figure 40). Not surprisingly, travel times for most modes of travel are less for non-work trips than for work trips. Commuter rail could have higher travel times for non-work trips due to less express service (resulting in more stops on each train run).

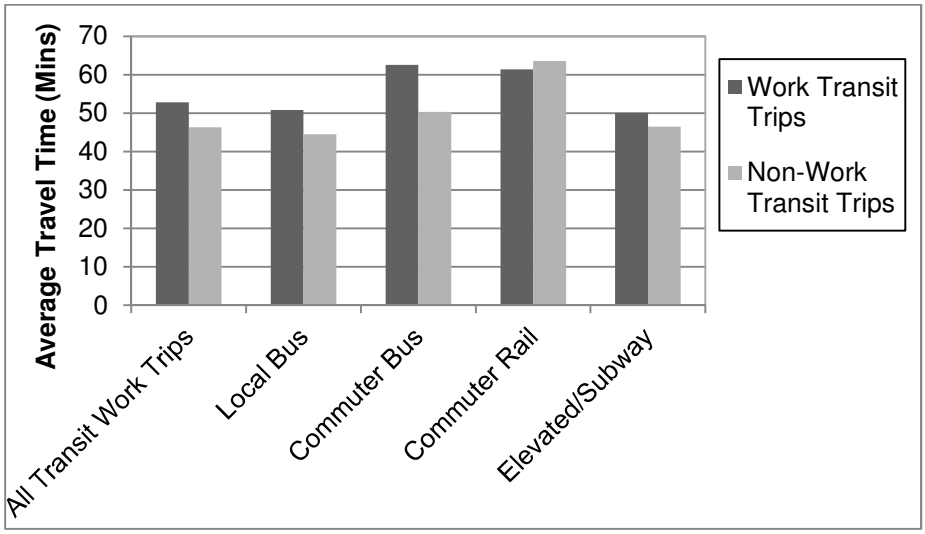


Figure 40 2009 U.S. average trip length and travel time by transit mode for work trips

Using trip length and travel time, in-vehicle speed can be computed. As shown in Figure 41, work trips are somewhat faster, most likely due to the higher utilization of commuter buses and

commuter trains which provide faster transit service than other transit modes. It is important to note that the calculation of speeds used in this research did not include wait, access, or egress times for transit. If these times were included in the speed calculation, one can expect transit speeds to be even lower than the values that are presented.

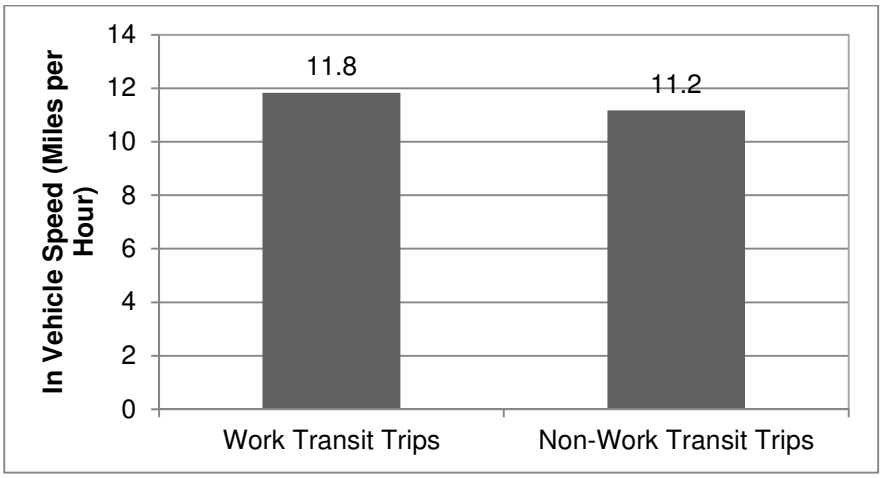


Figure 41 2009 U.S. average travel speed for transit work and non-work trips

Looking at speeds by transit mode for work trips illustrates just how much faster commuter bus and commuter rail service is. As can be seen in Figure 42, commuter bus service is approximately 40 percent faster than regular (local) bus service while commuter rail service is approximately 69 percent faster than regular bus service. Not surprisingly, the auto has higher travel speeds when compared to transit; almost triple the speed of transit service for work trips. Even commuter rail's average speed is half that of an auto.

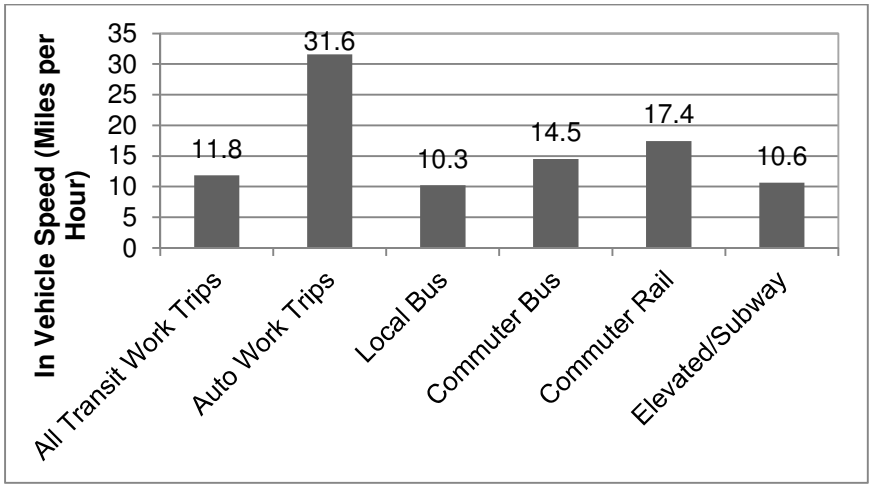


Figure 42 2009 U.S. average travel speed by transit mode for work trips

Access and egress is another important aspect of transit trips. Analyzing the access and egress modes proved a little tricky. The 2009 NHTS allows each trip to have up to five access modes and five egress modes reported for each transit trip. For analysis purposes, only the last transit access mode and the first transit egress mode are examined. This methodology is adopted from *An Assessment of Public Transportation Markets Using NHTS Data* (Chu 2012). One thing that is unclear is whether or not the transit trips that are reported include multiple boardings (transfers between similar vehicles). When comparing the NHTS to on-board surveys, the transfer rate is typically lower because respondents do not distinguish different segments of their transit trip. As such, it is unknown whether or not the transit access and egress mode shares that are presented are reasonable estimates.

Figure 43 shows that most transit trips, for both work and non-work purposes, are accessed via walking. Work trips have slightly more trips being accessed by auto, most likely due to getting dropped off or utilizing park-and-ride services.

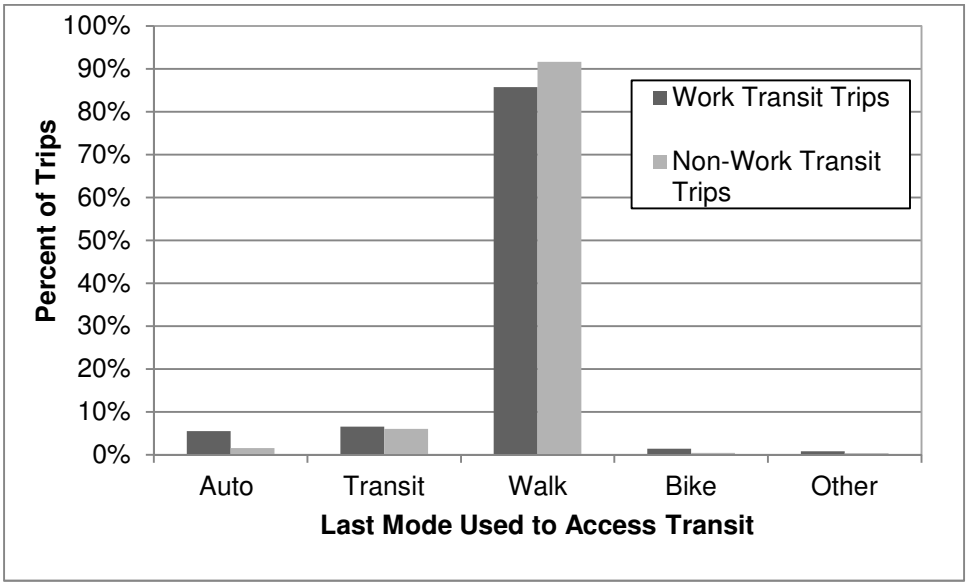


Figure 43 Last mode used to access transit for work and non-work trips nationally (2009)

For egressing transit, the results are pretty similar (Figure 51). Walking remains the predominant mode of choice with auto, transit, and bike showing larger shares for work trips than non-work trips.

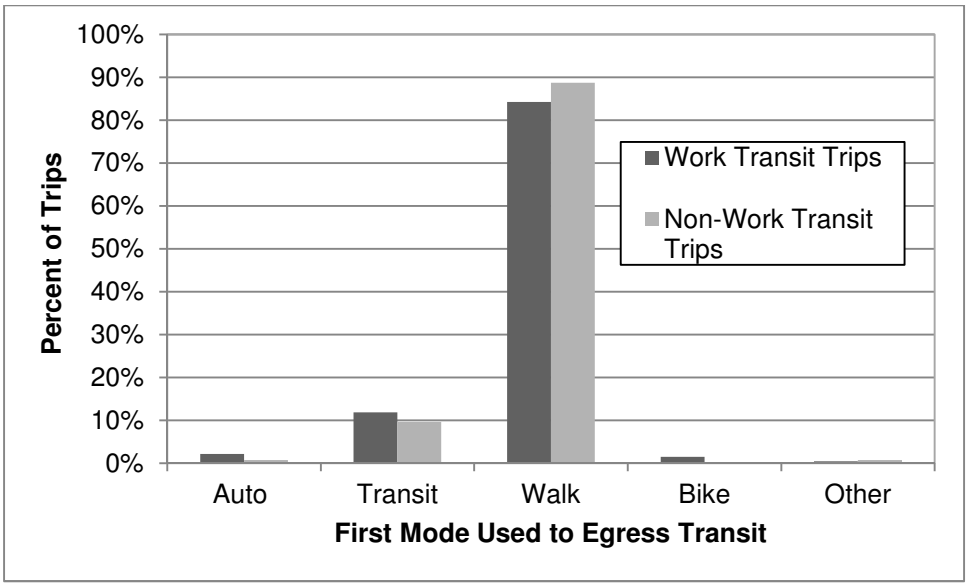


Figure 44 First mode used to egress transit for work and non-work trips nationally (2009)

Looking at how riders access and egress transit for the various transit sub modes offers more insight into the uniqueness of each type of transit service. As seen in Figure 45, commuter bus, commuter rail, and elevated/subway have higher shares of auto and transit (and subsequently lower walk shares) than local bus. This data indicates that some modes, especially commuter rail, are potentially more attractive to choice riders.

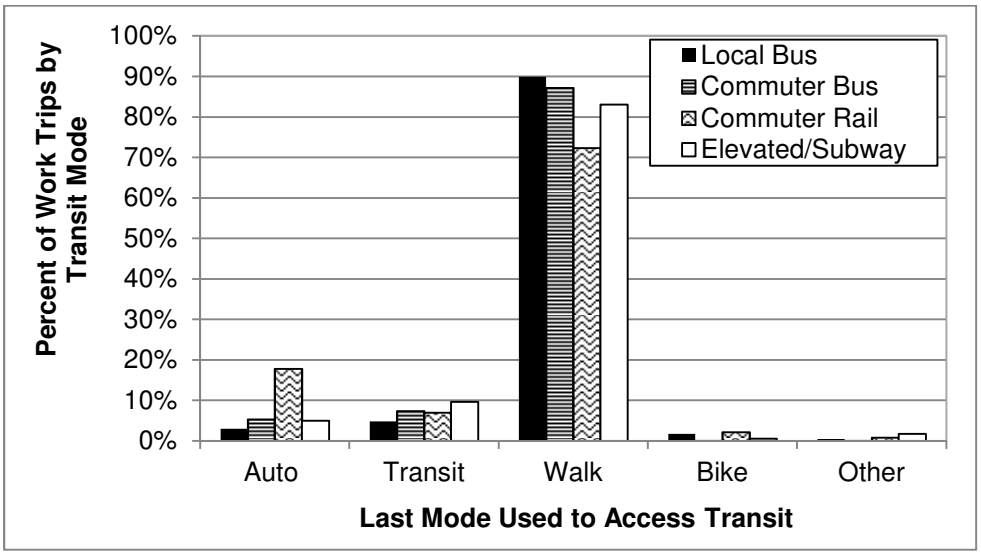


Figure 45 Mode used to access transit for work trips by transit mode nationally (2009)

For the egress of work trips on transit, the differences are less noticeable. In Figure 46, one can see that commuter rail is the only anomaly. It can be speculated that the egress of work trips on

commuter rail are less likely to be taken by walking due to the fixed nature of the drop-off point. In other words, commuter rail has fewer stops within a central business district (when compared to a bus), thus decreasing the likelihood of being located within walking distance of one's destination.

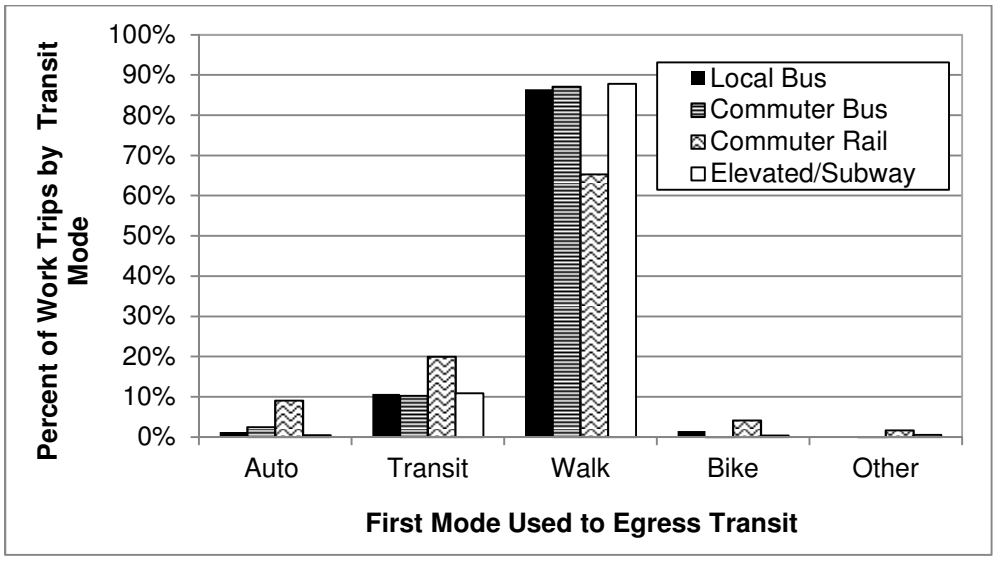


Figure 46 Mode used to egress transit for work trips by transit mode nationally (2009)

A crosstab analysis of work trips (Table 3) looks at the access and egress pairs together. The table calculates percentages based upon the table total. One interesting thing to note is that almost 75 percent of transit work trips utilize walking for both access and egress.

Table 3 Crosstab of transit access and egress mode for transit to work trips nationally (2009)

		First Transit Egress Mode					
		Auto	***Transit***	***Walk***	***Bike***	***Other***	***Total***
Last Transit Access Mode	***Auto***	0.0%*	1.1%	4.3%	---	0.1%	5.5%
	Transit	0.2%	2.0%	4.1%	0.3%	---	6.6%
	Walk	1.8%	8.7%	74.5%	0.4%	0.3%	85.8%
	Bike	---	0.1%	0.5%	0.7%	---	1.3%
	Other	0.0%*	0.0%*	0.8%	---	0.0%*	0.8%
	Total	2.1%	12.0%	84.1%	1.4%	0.4%	100.0%
* Note: Percentage is too small to be displayed to a tenth of a percent							

Trip Chaining Analysis

Trip chaining is a term used to define the linking of multiple trips into one tour. Trip chaining is often done by an individual to save time and/or money associated with travel. The 2009 NHTS recently released two separate datasets that allows analysis on trip chaining; one is for chained trips and the other for tours. The NHTS designated anchors to determine what was the start and end of a tour. Trips that ended at home or work terminated a tour. Trips that ended in all other places and had a dwell time of more than 30 minutes also terminated a tour. For purposes of this analysis, only the number and purpose of stops on a tour are analyzed.

There is a dramatic difference in the number of stops that take place on work tours compared to non-work tours. As seen in Figure 47, a majority of transit work tours do not have stops. Non-work tours also have a large number of zero stop tours, but at a slightly smaller occurrence.

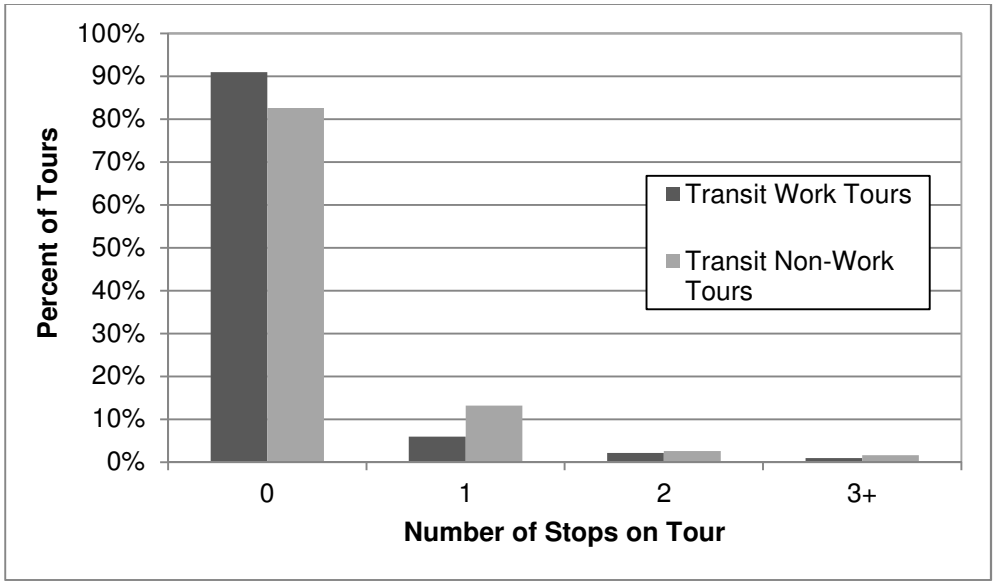


Figure 47 Number of stops on transit work and non-work tours nationally (2009)

Work tours are then broken down into “home to work” and “work to home” tours for further analysis. As shown in Figure 48, there is a slight difference in the distribution of stops. The analysis shows that individuals are more likely to make stops when traveling from work to home rather than from home to work. This is no doubt because there is less urgency with needing to

complete a stopover when you are heading home, versus trying to making it into the office on-time.

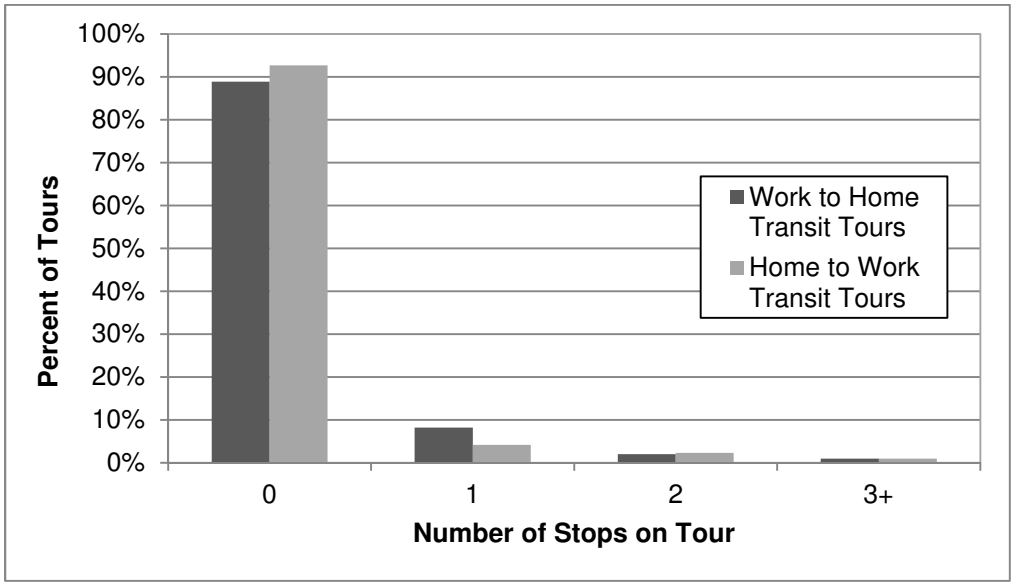


Figure 48 Number of stops on transit home to work and work to home tours nationally (2009)

To determine what effect using transit has on trip chaining, transit and non-transit work tours were examined. As seem in Figure 49, non-transit tours are more likely to have trip chaining than transit tours. This confirms existing literature which states that transit is not conducive to trip chaining.

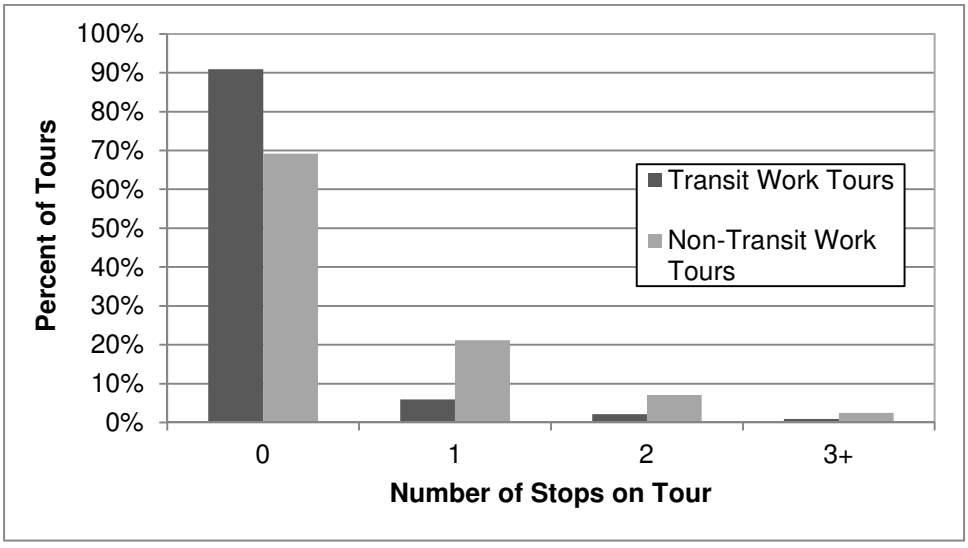


Figure 49 Number of stops for transit and non-transit work tours nationally (2009)

An analysis of the stops for both work transit trip tours and non-work transit trip tours (Figure 50) shows that both types of tours have a similar distribution of stopovers. Some types of stopovers, such as school/church or vacation, may seem suspicious upon first glance (since these types of trips often have dwell times longer than 30 minutes). However, further analysis shows that these school/church trips include going to a library or attending a school/religious activity. Similarly, vacation trips could include leaving from work directly to go on vacation. Without further information, these potentially could be valid stopovers and are included in the analysis.

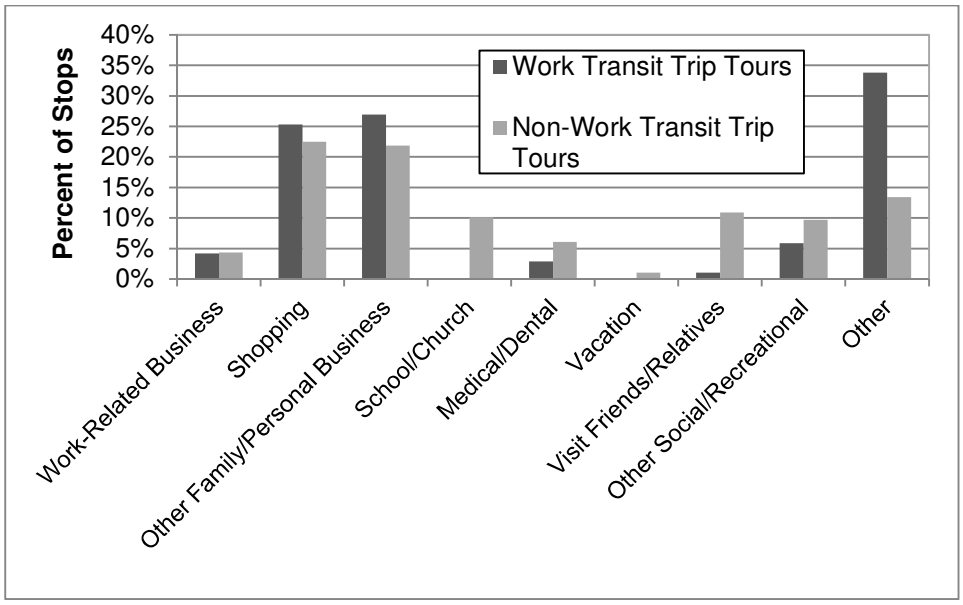


Figure 50 Purpose of stops for work and non-work tours nationally (2009)

A detailed analysis of the stopovers of transit work tours was also performed and compared to non-transit work tours. As Table 4 shows, there is a very diverse set of reasons for stopovers on work tours. When comparing transit work tours to non-transit work tours, it is not surprising that non-transit tours tend to have stopovers that are more auto-centric (dropping or picking up people).

Table 4 2009 top ten trip purposes for work tour stopovers nationally (transit and non-transit)

Transit Tours		Non-Transit Tours	
Detailed Trip Purpose	**Percent of Work Tour Stops**	**Detailed Trip Purpose**	**Percent of Work Tour Stops**
Other reason	33.9%	Drop someone off	20.8%
Pick up someone	20.2%	Buy goods: groceries/clothing/hardware store	17.4%
Buy goods: groceries/clothing/hardware store	18.6%	Pick up someone	14.8%
Shopping/errands	6.8%	Buy gas	8.8%
Other work related	4.2%	Buy services: video rentals/dry cleaner/post office/car service/bank	8.3%
Go to gym/exercise/play sports	3.6%	Get/eat a meal	6.1%
Medical/dental services	2.9%	Coffee/ice cream/snacks	4.7%
Get/eat meal	2.2%	Shopping/errands	3.8%
Drop someone off	2.1%	Other work related	3.7%
Buy services: video rentals/dry cleaner/post office/car service/bank	1.8%	Other reason	2.1%

Chapter 8: Analyzing Transit Trips in Transit Friendly Cities

The quality of transit service in a metropolitan area can often have an impact on whether or not an individual chooses to take transit to work. In this chapter, the NHTS data was analyzed in two groups: areas with good transit service ("transit friendly" areas) and areas with poor transit service ("non-transit friendly areas"). To determine whether a metropolitan area has good transit service, National Transit Database (NTD) data was used. The metrics used as part of the analysis came from the *Transit Capacity and Quality of Service Manual (2nd Edition)*. Once transit friendly areas were identified, an appropriate analysis of work transit trips was performed using the NHTS.

It should be noted upfront that the results of the analysis did not yield any meaningful results. As one can expect, the results showed that transit was utilized for a greater share of daily trips when there was higher quality service. Since the NTD supply data was not normalized, it is difficult to definitively say that the service provided in transit friendly cities was not in direct response to larger demand. Nonetheless, an abridged set of analyses and the methodology used are presented subsequently.

The Transit Capacity and Quality of Service Manual

In the context of this report, the *Transit Capacity and Quality of Service Manual* is a publication that defines what is considered high quality transit service. Out of the many metrics that are available for evaluating transit quality of service, there are only a few that can applied in this research project due to the lack of available data. Given these constraints, headway and weekday hours of service, were used. Metropolitan areas that had a Level of Service (LOS) A for both headway and weekday span of service were defined as transit friendly areas. As part of the

analysis, only fixed route (bus, trolley bus, light rail, heavy rail, commuter rail, cable car, and automated guideway) transit service was analyzed.

Headway is defined as the time between successive transit vehicles. Headway is calculated by taking the directional route miles and dividing it by the average speed (vehicle revenue miles/vehicle revenue hours). This metric is then divided by vehicles operated in maximum service and then multiplied by 60 (to get minutes). Transit friendly metropolitan areas (LOS A) were required to have headways that were less than 10 minutes. This metric was computed for each urbanized area directly from the raw NTD data.

Weekday span of service is defined as the number of hours on a typical weekday that transit service is provided. Transit friendly metropolitan areas (LOS A) had at least one system within the given area that had fixed route service for at least 19 hours out of a given day. This metric was obtained using the Integrated National Transit Database Analysis System (INTDAS). INTDAS is a web-based tool that can automatically compute the fixed route span of service for any given agency within a metropolitan area.

The National Transit Database (NTD)

The NTD is considered the nation's most comprehensive source for transit data. Transit agencies that receive federal funding are required to submit annual data (ridership, safety, service provided, financial data, etc.) to the Federal Transit Administration. Agencies operating nine or fewer vehicles, as well as those that do not receive federal funding, do not typically report data to the NTD.

As part of the analysis in determining whether a metropolitan area met LOS A standards, transit agency data was extracted from the 2010 NTD for fixed route service. The data was then aggregated by urbanized area (defined by the U.S. Census Bureau). Once the urbanized areas with high quality transit service were identified, they were used to identify metropolitan statistical

areas (MSAs) in the NHTS dataset that had high quality transit service. These MSA's were then flagged accordingly. Given that the two datasets used different levels of geography, the results are not as precise as they could be. Nonetheless, the dataset that is generated should still be sufficient for providing a fairly comprehensive picture of the transit service in various metropolitan areas throughout the country. In the future, if the NTD and NHTS datasets can be coded using the same geography, there may be enhanced accuracy performed in this area of the analysis.

Metropolitan Areas Selected for Analysis

Using the criteria and methodology specified previously, five metropolitan areas were identified as being transit friendly. These metropolitan areas, along with the computed headway and sample size, are presented in Table 5. It can be seen that the New York City area not only has the shortest average headway but also comprises a significant portion of the sample of the transit friendly group.

Table 5 2009 U.S. sample size and average headway for transit friendly areas

	Work Trips on Transit Sample Size	Computed Average Headway (Minutes)
Boston-Worchester-Lawrence, MA-NH-ME-CT	16	8.47
Chicago-Gary-Kenosha, IL-IN-WI	33	6.36
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	842	4.14
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	25	8.87
San Francisco-Oakland-San Jose, CA	184	6.98

The non-transit friendly MSA group consisted of trips that were not in one of the five transit friendly groups as well as trips that did not take place in an MSA. Trips that were not in an MSA are included in this category because the analysis revealed that there are no urbanized areas (urbanized areas have a smaller population threshold and thus don't fall into an MSA category)

that had transit service with LOS A headway and weekday span of service. Trips where the location could not be determined were excluded from the analysis.

Table 6 2009 U.S. sample size for analysis

Geographic Group	Transit Work Trips Sample Size
Transit friendly MSA's	1,100
Non-transit friendly MSA's and All Non-MSA areas	1,150
Location not known (excluded from analysis)	79

Analysis of Transit Friendly Areas

One of the most noticeable differences between transit friendly and non-transit friendly areas is the difference in transit mode share for work trips. As Figure 51 indicates, transit friendly areas have a lower portion of work trips being taken by auto and a greater transit and walk share than non-transit friendly areas. The larger mode shares in transit friendly areas could be due to the higher frequency and availability of transit service, more readily available premium transit service (subway, commuter rail, or express bus service), or expensive/limited parking at the worksite.

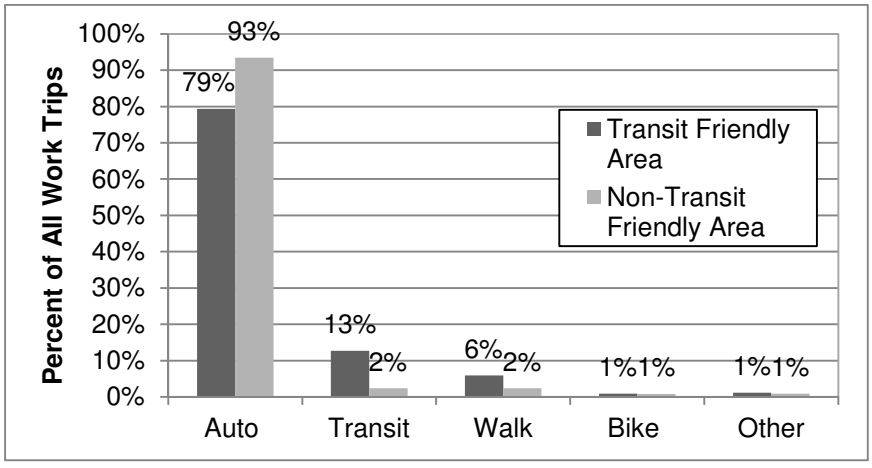


Figure 51 2009 U.S. mode share of work trips by transit friendliness

In terms of the type of transit service used, Figure 52 shows that commuters in non-transit friendly areas tend to rely heavily on local public bus. Those living in transit friendly areas generally tend to use faster transit modes (commuter train and subway/elevated train).

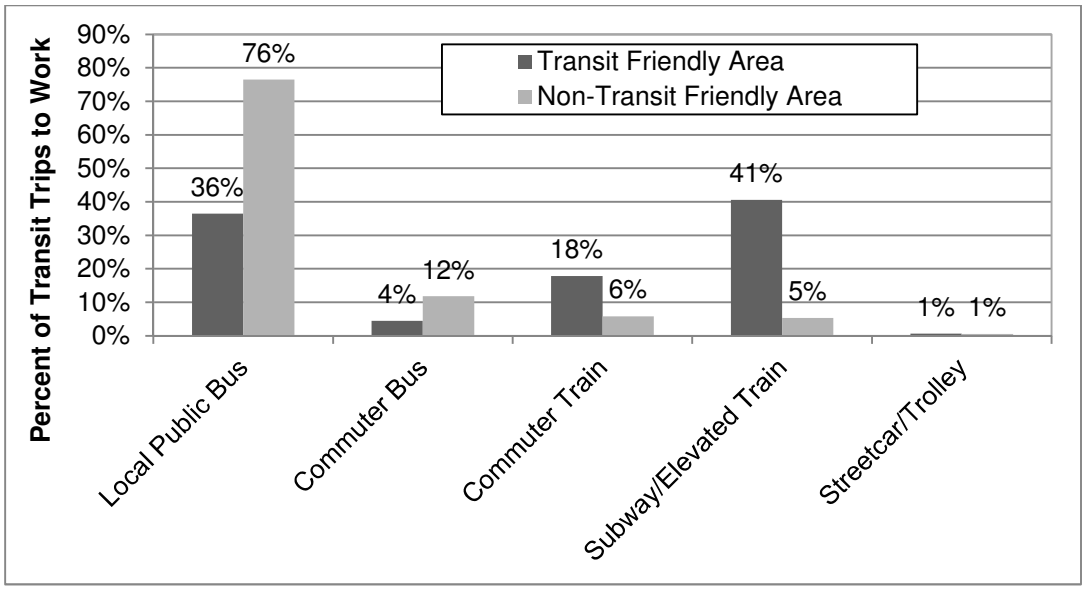


Figure 52 2009 U.S. transit market share for work trips by transit friendliness

Trip length and travel time are computed for transit friendly and non-transit friendly areas and are presented in Figure 53 and Figure 54. The results indicate that transit work trips occurring in transit friendly areas are shorter in length and generally have a shorter travel time than trips taking place in non-transit friendly areas. Part of this could be explained by the built environment as the five transit friendly areas that were identified are located in fairly dense urban areas.

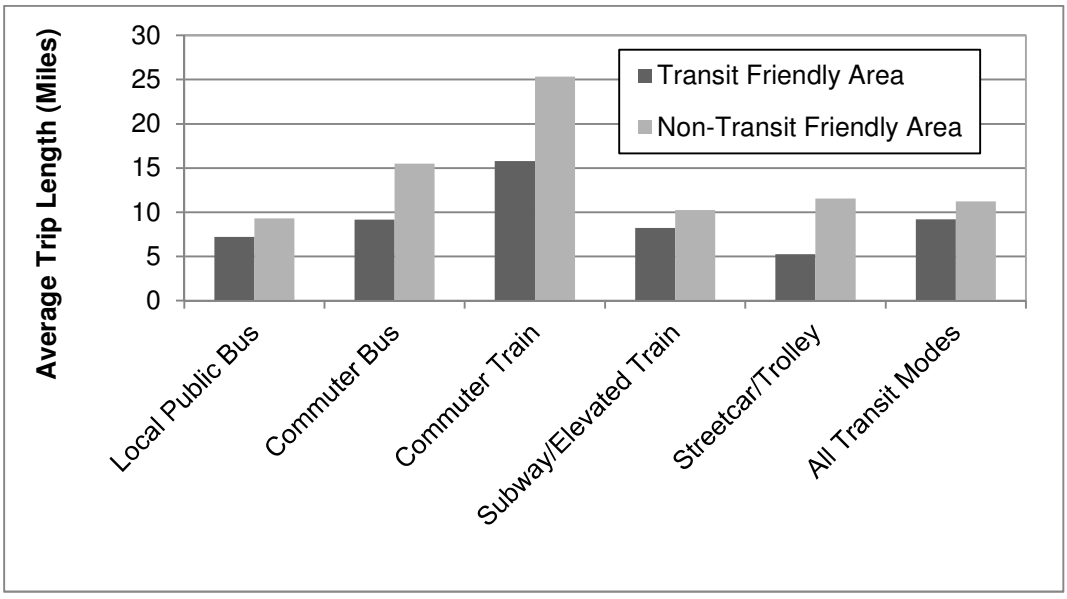


Figure 53 2009 U.S. average work trip length by transit friendliness

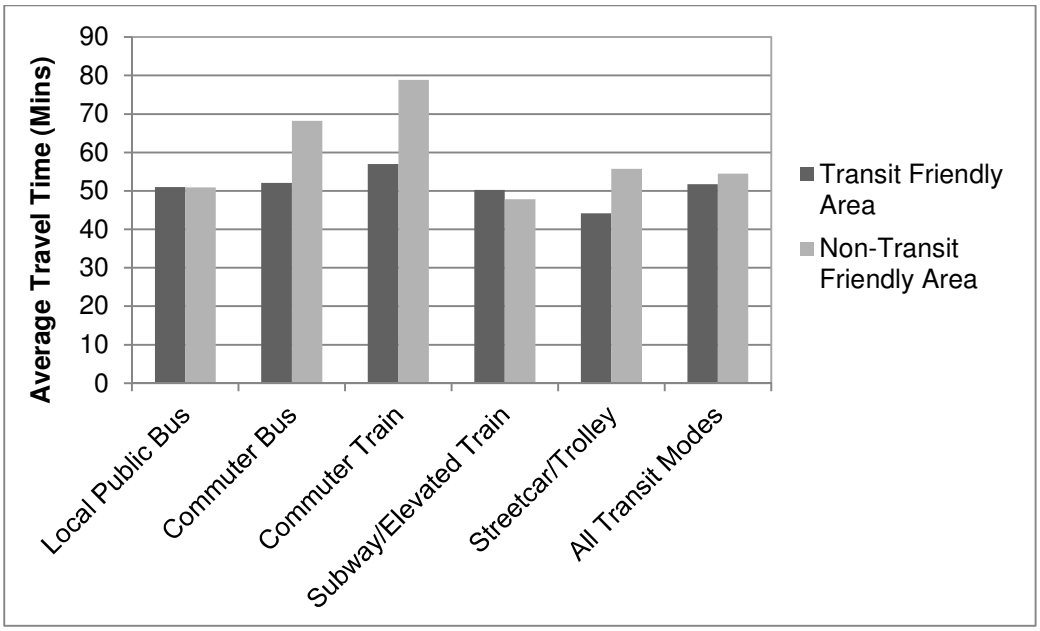


Figure 54 2009 U.S. transit travel time for work trips by transit friendliness

By aggregating travel time and travel distance together, in vehicle travel speed can be computed. The results, presented in Figure 55, indicates that travel occurring in non-transit friendly areas have higher in vehicle travel speeds than travel occurring in transit friendly areas. Part of this difference could perhaps be attributed to the built environment also.

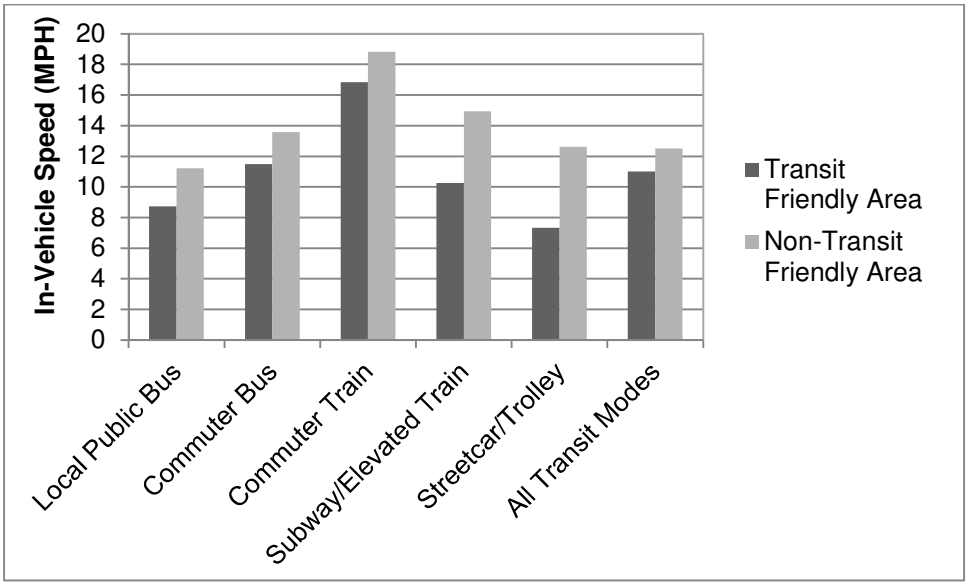


Figure 55 2009 U.S. work travel speeds on transit by transit friendliness

The ease of access and egress to/from transit as well as how long passengers wait for a vehicle could play some role in transit mode share. In Table 7, it can be seen that access and egress

times are similar between transit friendly and non-transit friendly areas, indicating there is some level of tolerance in accessing transit. The wait time, however, is noticeably smaller in transit friendly areas, most likely due to the more frequent service.

Table 7 2009 U.S. transit access, egress, and wait times for work trips by transit friendliness

	Transit Friendly Area	Non-Transit Friendly Area
Average Access Time (Minutes)	7.3	7.1
Average Egress Time (Minutes)	9.4	10.2
Average Wait Time (Minutes)	7.6	9.0

Chapter 9: Comparing Choice and Captive Riders Commuting to Work

Recent efforts in travel demand management have often focused on getting more choice riders out of their cars and onto public transit. In this chapter, demographic differences between the two groups of people are presented. This information is extremely useful in determining who should be targeted to increase choice ridership. The next chapter, Chapter 10, will analyze the transit trips taken by the two groups.

All analyses performed in this chapter utilize the four choice/captive rider categories that were presented previously. In order to simplify the analytical process, choice and semi-choice riders were reclassified as “choice riders” while semi-captive and captive riders were reclassified as “captive riders”.

Person Level Demographics

Figure 56 shows the age distribution for both choice and captive riders. For both groups, the majority of riders fall in the 25-64 age range. One interesting thing to note is that in the choice rider group, there is a large portion of 16-24 year olds (when compared to the distribution of captive riders).

Further analysis (Figure 57) was performed to determine what proportion of each age group were choice riders. Interestingly, the data revealed that workers between the ages of 16-24 had the highest proportion of choice riders out of any age group. Of those between the ages of 16-24, 77 percent were semi-choice riders and 8 percent were choice riders. This result could be further evidence of younger adults choosing to take transit.

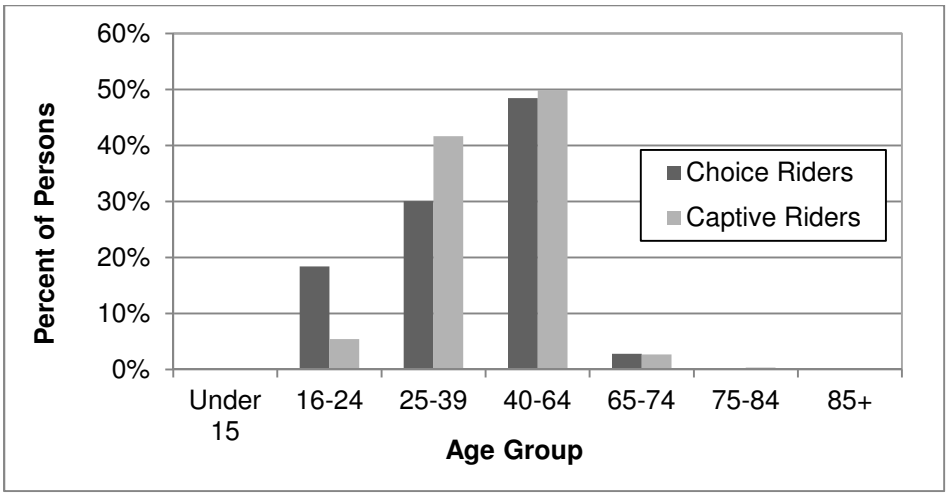
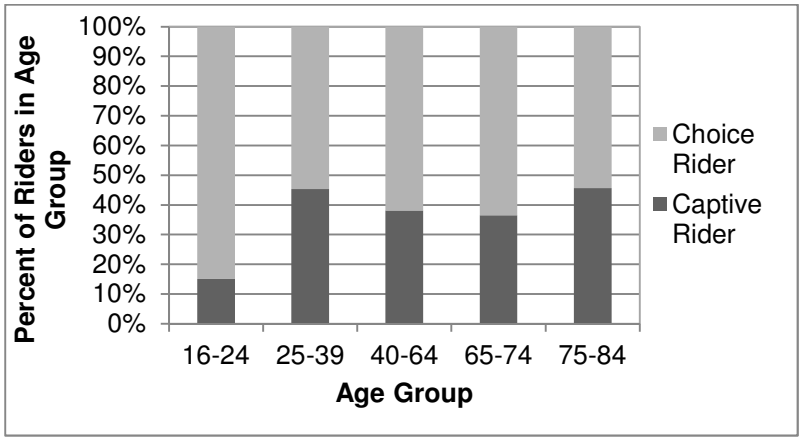


Figure 56 2009 U.S. age distribution of choice and captive riders commuting to work

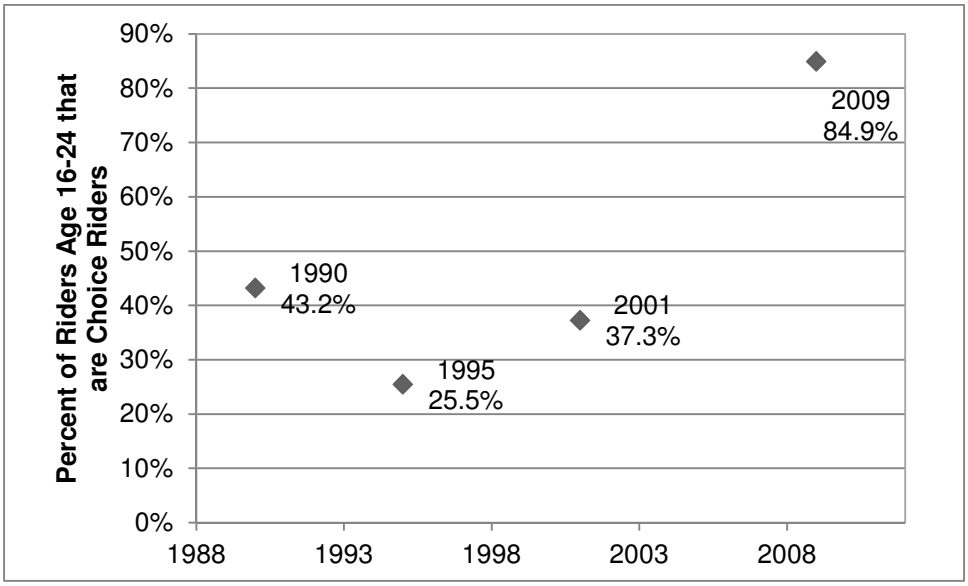
There are a few caveats to this finding. First, the analysis does not take into account whether or not a given individual owns a car, merely that he or she resides in a household that has at least one. Second, the small sample sizes for select groups may not make the data representative for the entire population (see Appendix A for sample sizes). Third, the analysis does not take into account who owns a vehicle (when the person is classified as a semi-choice rider). One can assume that the person that owns the vehicle will be more likely to travel by auto than those that do not own a vehicle. This caveat is especially relevant to those between the ages of 16-24 where they may be more likely to share cars with parents.



Caution: Small sample size for 16-24, 65-74, and 75-84 age groups

Figure 57 2009 U.S. proportion of choice and captive riders by age group commuting to work

A closer examination of past NHTS/NPTS datasets (Figure 58) seems to confirm that there has been an increase in choice riders amongst the age 16-24 rider group between 1990 and 2009. Again, since the sample size for this age group being studied is rather small, this cannot be said definitively by any means. Further research and a larger sample size should be completed to verify if this is indeed a valid result. Sample sizes for Figure 58 are provided in Appendix A.



Caution: Small sample sizes

Figure 58 U.S. historical proportion of choice riders commuting to work between age 16-24

Gender is analyzed next. Figure 59 shows that males constitute a slightly larger share of the choice rider group while females constitute a slightly larger share of the captive rider group.

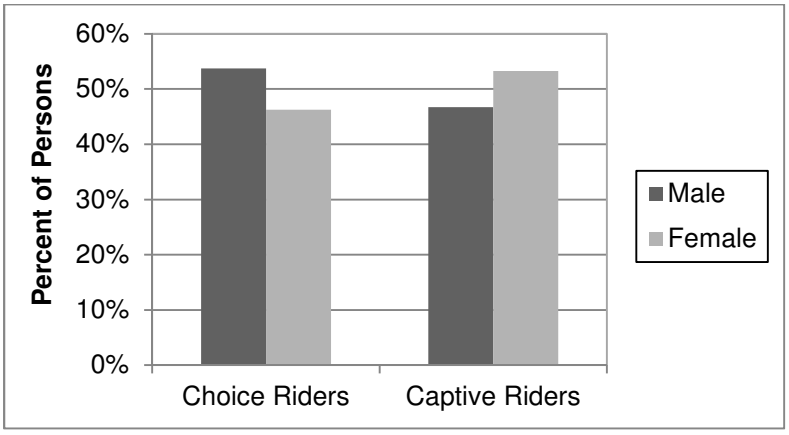


Figure 59 2009 U.S. gender of choice and captive riders commuting to work

Race and ethnicity for choice and captive riders was analyzed in Figure 60. As seen in previous chapters, non-Hispanic whites constitute a larger proportion of choice riders.

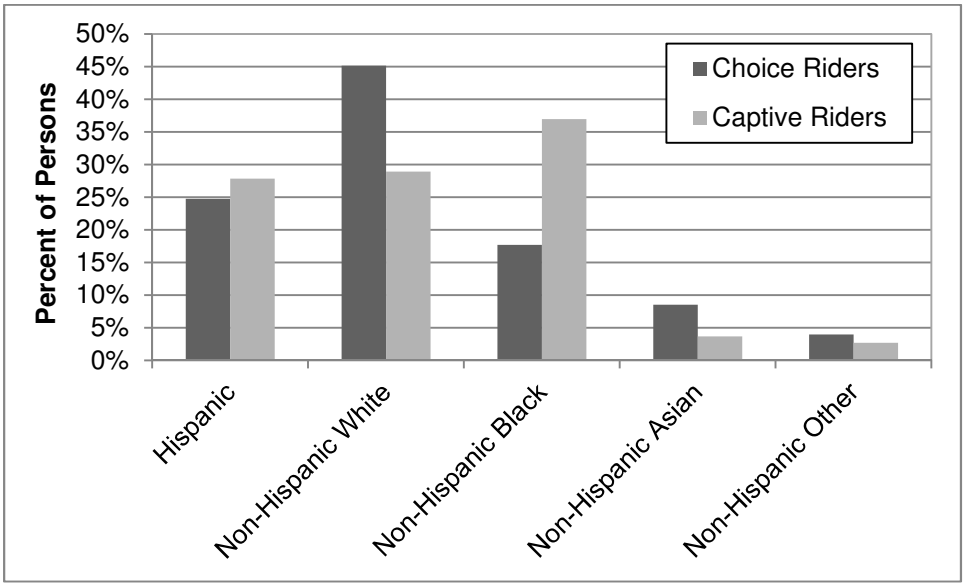
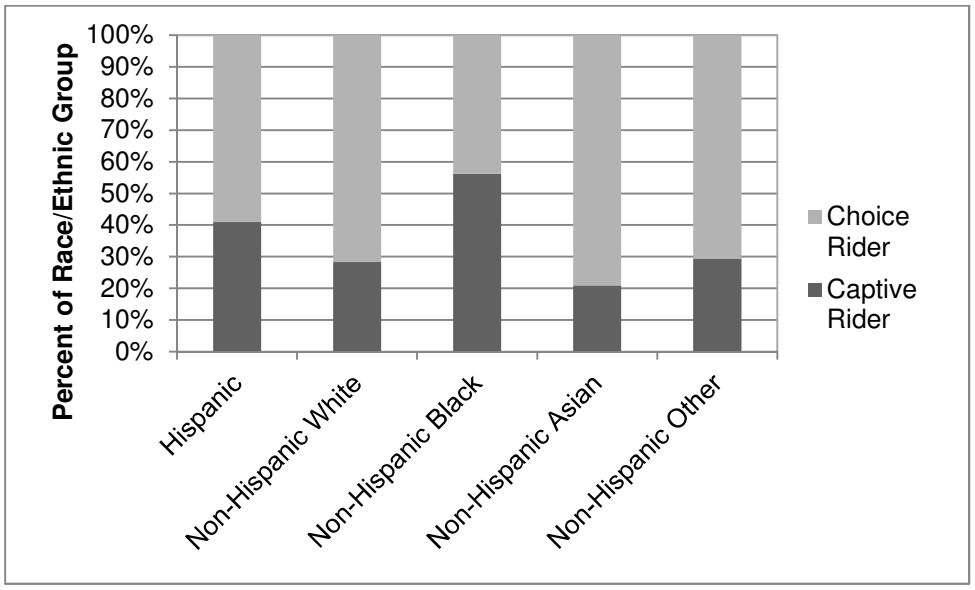


Figure 60 2009 U.S. race and ethnicity of choice and captive riders commuting to work

Upon further analysis, the data revealed that most racial/ethnic groups consisted of primarily choice riders (Figure 61). Caution is urged with examining the non-Hispanic Asian and non-Hispanic Other categories due to the small sample size (see Appendix A for sample sizes).



Caution: Small sample size for Non-Hispanic Asian and Non-Hispanic Other groups

Figure 61 2009 U.S. proportion of choice and captive riders commuting to work by race/ethnicity

Figure 62 presents the educational attainment for both choice and captive riders. Not surprisingly, choice riders are more educated when compared to captive riders.

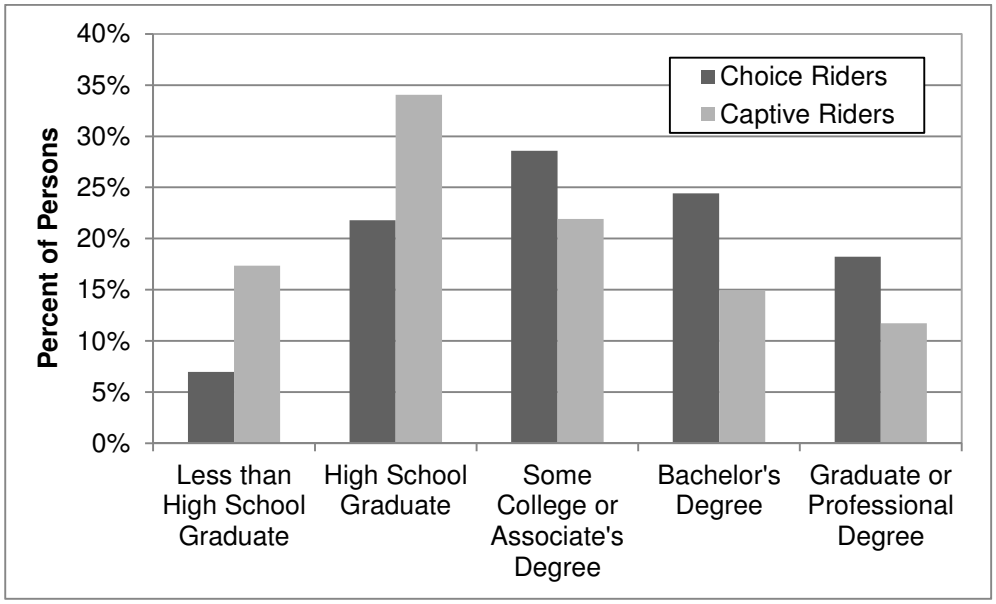


Figure 62 2009 U.S. educational attainment of choice and captive riders commuting to work

Further analysis of the individual subgroups shows there is a distinct correlation between educational level and the proportion of choice riders (Figure 63). The group of riders that have education levels less than a high school diploma have the highest percentage of captive riders (about 60 percent) while those with bachelor's or graduate degrees have the lowest percentage.

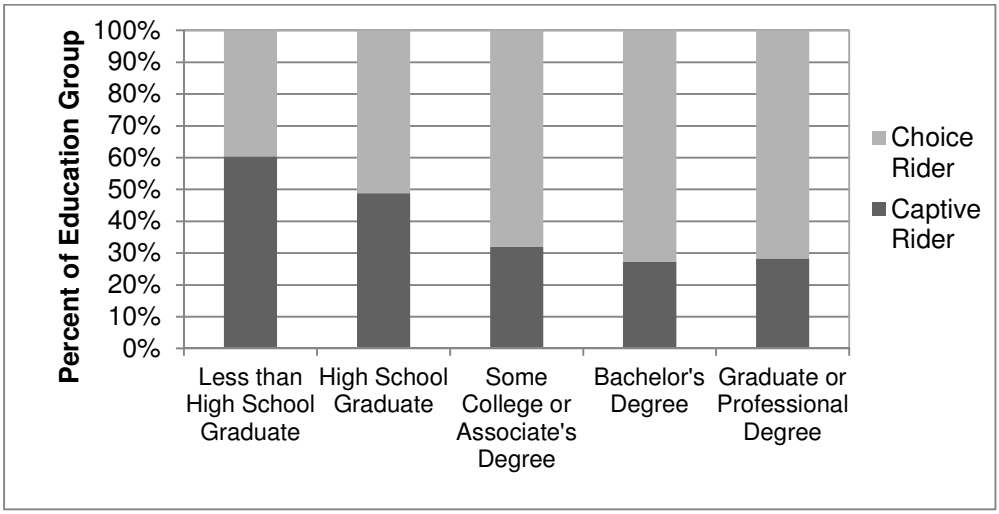


Figure 63 2009 U.S. proportion of choice and captive riders commuting to work by educational attainment

Household Level Demographics

An analysis by household size (Figure 64) shows that choice riders were more likely to come from smaller households. There is no discernible trend with respect to choice riders. It is hypothesized that captive riders are more likely to come from smaller households because they lack a family support network which can drive them or provide a vehicle for them to use.

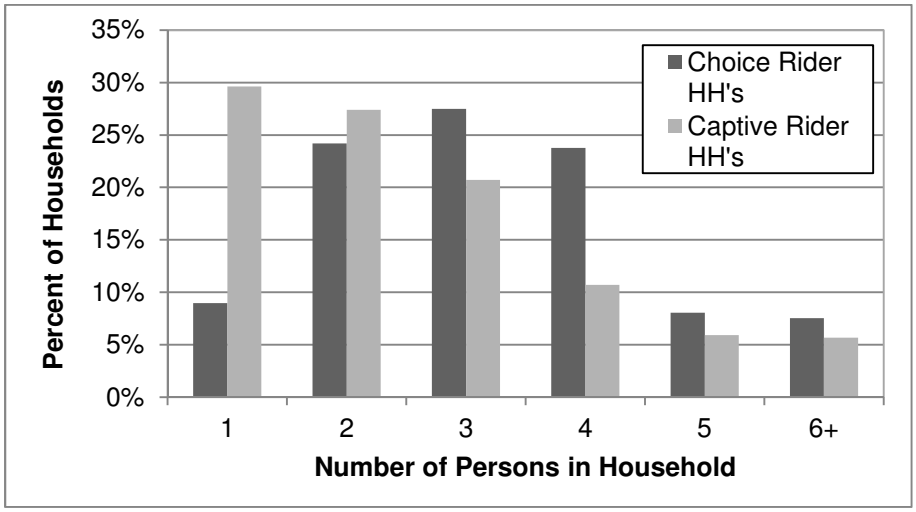


Figure 64 2009 number of persons in work transit rider's household nationally (choice vs. captive)

Figure 65 shows that choice riders are more likely to come from higher income households while captive riders are more likely to come from low income households. This outcome is expected as low income households often are unable to afford to own a car.

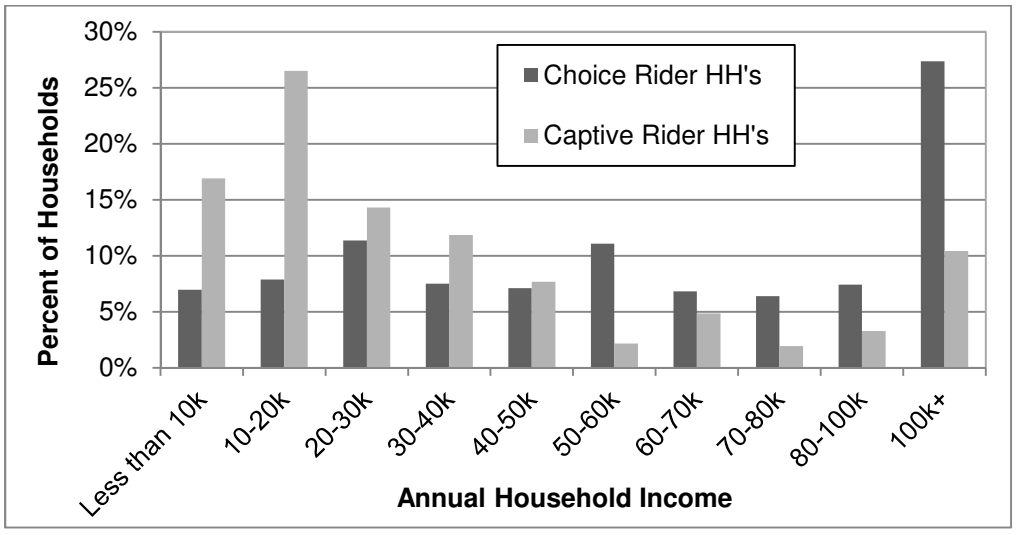


Figure 65 2009 annual household income of work transit rider's household nationally (choice vs. captive)

A look at the household life cycle reveals that most captive riders come from households that do not have children (Figure 66). A majority of choice riders come from households that have children.

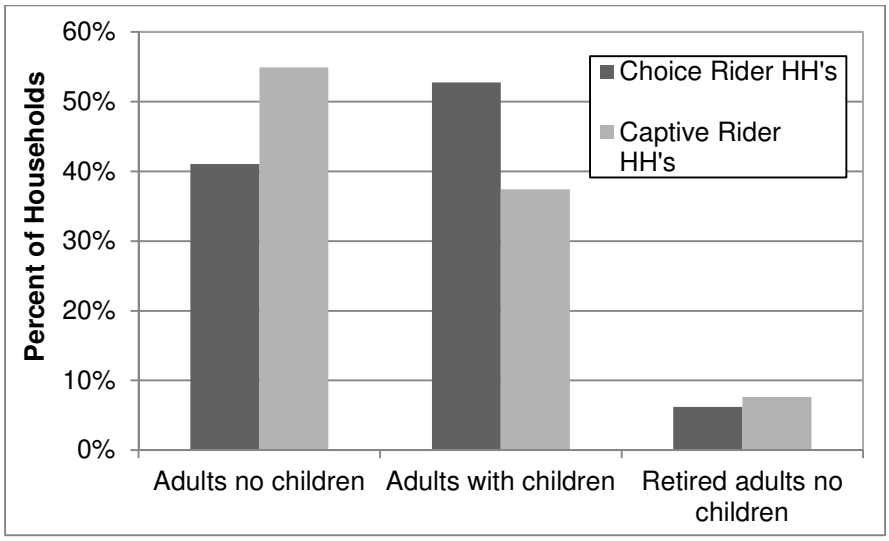


Figure 66 2009 life cycle of work transit user's household nationally (choice vs. captive)

Chapter 10: Analyzing Transit Work Trips by Choice and Captive Riders

Now that choice and captive riders have been examined, it is time to examine the trips they take to/from work.

First, an analysis is performed on the transit modes both captive and choice riders selected for their commute. Figure 67 shows that captive riders are more likely to utilize buses to get to work than choice riders. Not surprisingly, choice riders take a larger share of their trips on commuter trains than captive riders. Commuter trains are often ideal for choice riders which often commute from the suburbs into city centers for specialized employment.

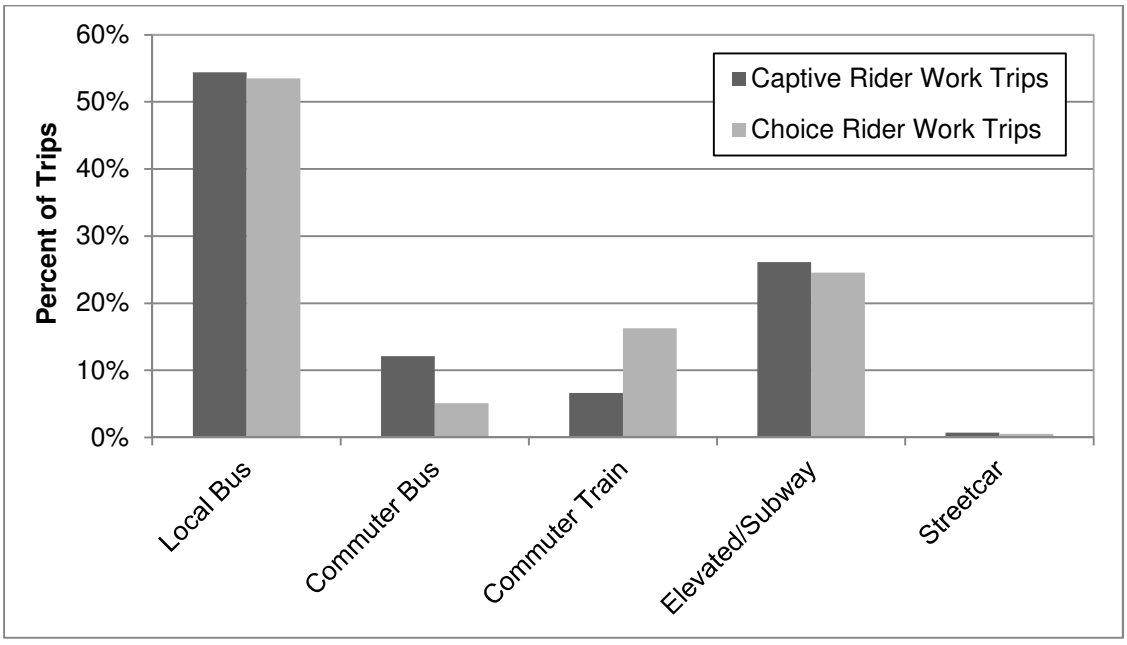


Figure 67 2009 U.S. transit market share for choice and captive rider work trips

A look at trip length and travel time shows that choice riders (Figure 68) tend to have longer trip lengths despite having similar travel times on transit as captive riders.

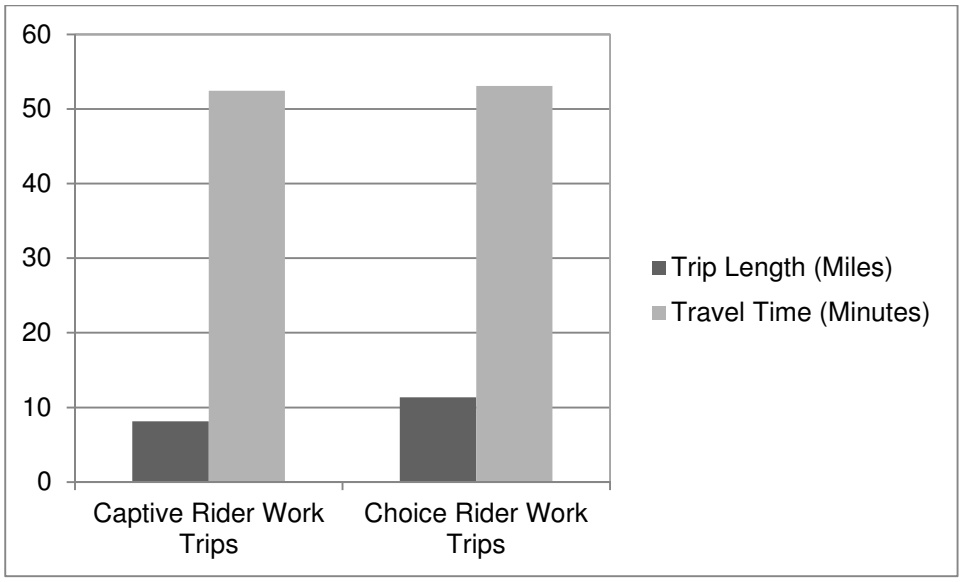


Figure 68 2009 U.S. average trip length and travel time for choice and captive rider work trips

Given the data on trip length and travel time, it is not surprising that choice riders often travel at faster speeds than captive riders (Figure 69). Choice riders travel about 3 miles per hour faster than captive riders on transit.

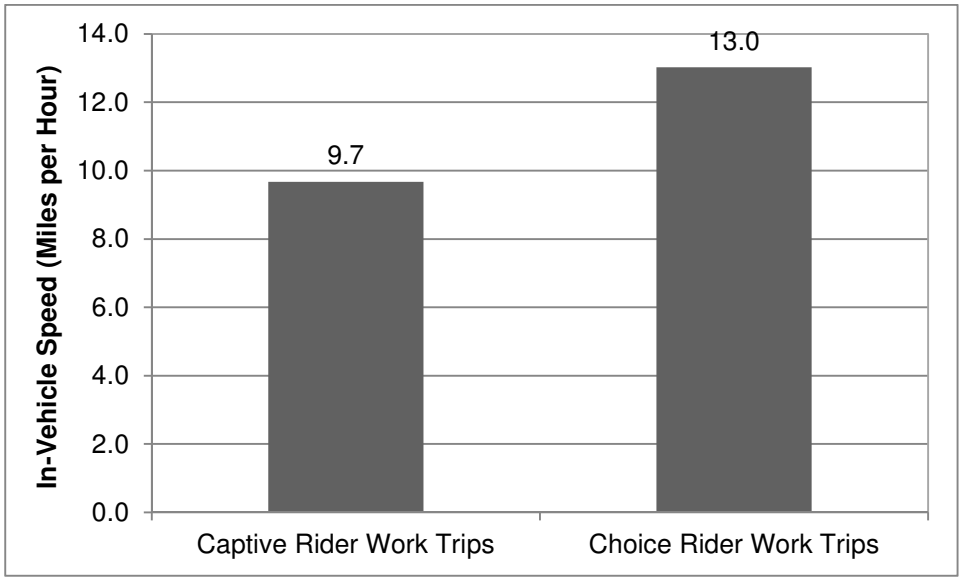


Figure 69 2009 U.S. average travel speed for choice and captive rider work trips

An analysis of the access and egress modes to/from transit did not yield much difference between the two groups (Figure 70 and Figure 71). Not surprisingly, choice riders are more likely to use automobiles while captive riders are more likely to use other transit modes.

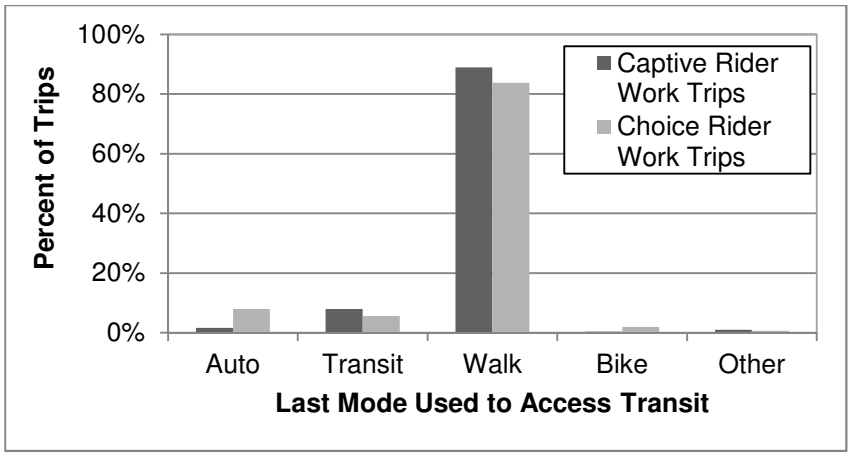


Figure 70 Last mode used to access transit for choice and captive rider work trips nationally (2009)

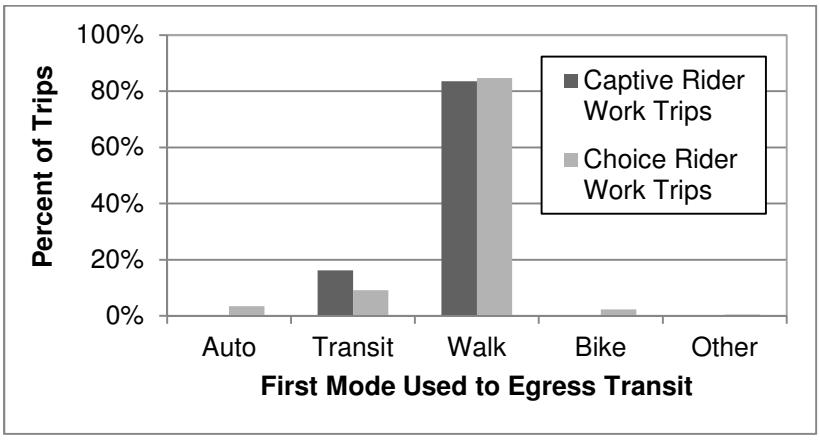


Figure 71 First mode used to egress transit for choice and captive rider work trips nationally (2009)

An analysis of access and egress times reveals that both rider groups appear to have similar levels of tolerance in getting to/from transit stops (Table 8). Interestingly, choice riders have shorter average wait times than captive riders. Part of this may be due to the fact that choice riders have a strong negative perception of out of vehicle travel time and will not tolerate long waits when they can drive instead. This difference may also be due to differences in the travel patterns of choice and captive riders. The data showed that captive riders are more likely than choice riders to take transit to work on weekends and during off-peak travel times, times when transit coverage is more limited (which may require more time to access/egress) and less frequent.

Table 8 2009 U.S. average access, egress, and wait times for choice and captive rider work trips

	Captive Rider Work Trips	Choice Rider Work Trips
Transit Access Time (Minutes)	7.2	7.2
Transit Egress Time (Minutes)	10.1	9.5
Wait Time (Minutes)	9.1	7.6

Figure 72 presents the number of stops taken on work tours for choice and captive riders. The two groups exhibit nearly the same behavior with choice riders being slightly more likely to add a stop on their tour.

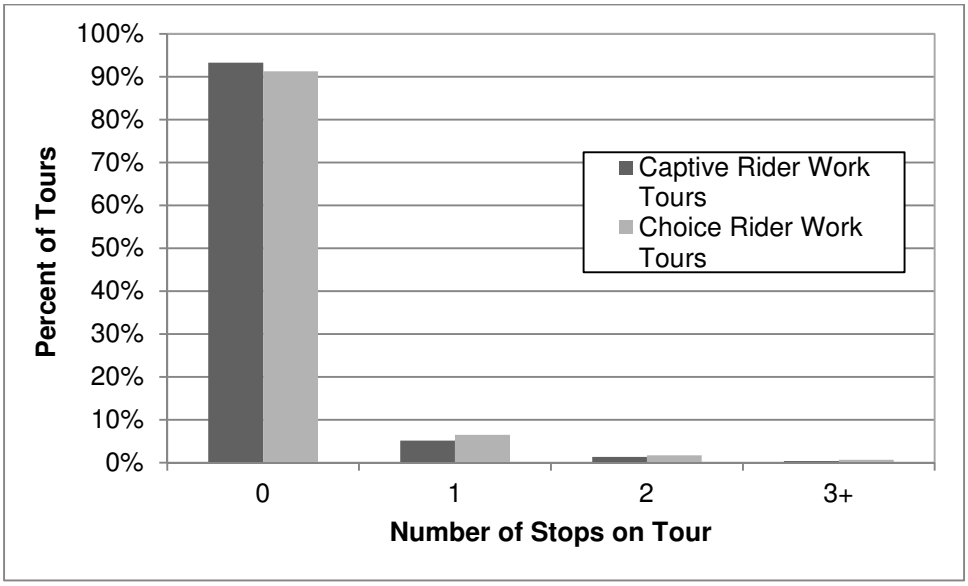


Figure 72 Number of stops on choice and captive rider work tours nationally (2009)

An analysis of the purposes of the stops is presented in Figure 73. The data shows that captive riders are more likely to stop and shop on their tour while choice riders are more likely to take care of family/personal business on their tour. It can be hypothesized that the large number of captive riders stopping to shop could be because they would like to take advantage of the frequent transit service. Shopping is often difficult to coordinate with transit because there is no set duration for the activity. Since transit vehicles come more frequently during rush hours, captive users who shop on the way to/from work will most likely experience lower average wait times than in off-peak hours.

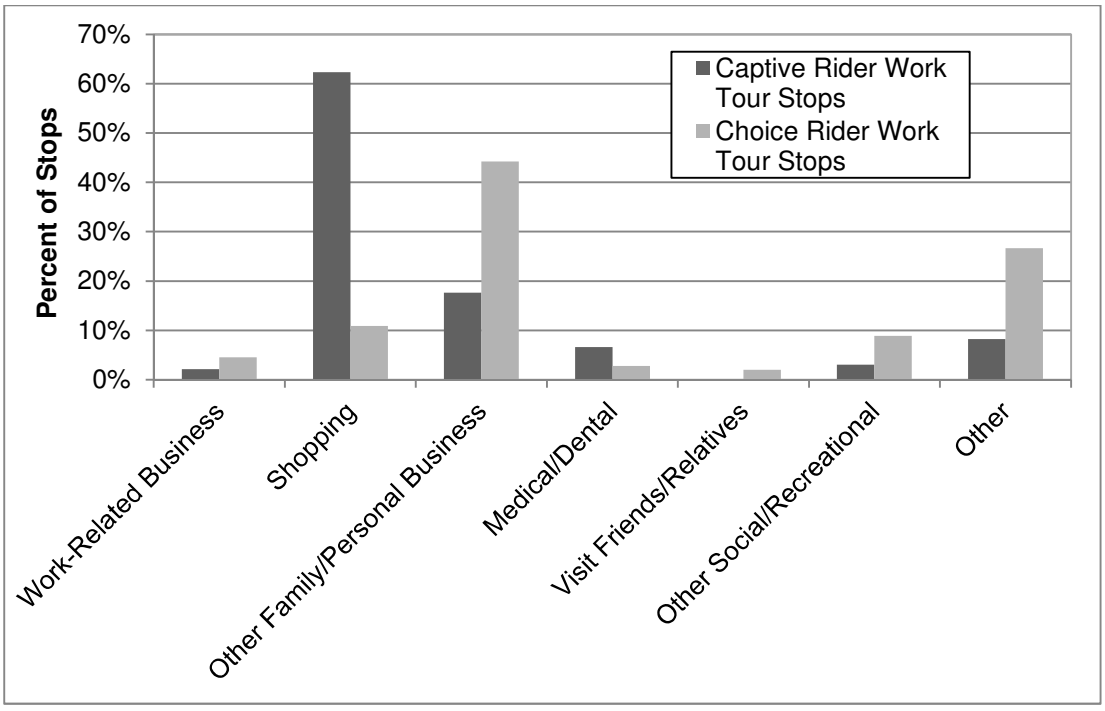


Figure 73 Purpose of stops for choice and captive rider work tours nationally (2009)

Chapter 11: Comparing Work Riders in New York City (NYC) and Elsewhere

Since the New York City metropolitan area constitutes the country's largest transit market, an analysis was conducted to determine what differences, if any, exist in transit trips to work in New York versus the rest of the country. The New York City metro area (NYC) sample was defined using metropolitan statistical areas (MSA's) defined by the Census Bureau. The NYC sample utilized the New York-Northern New Jersey-Long Island, NY-NJ-CT-PA MSA. All other samples were classified as Non-NYC.

Person Level Demographics

To start with, age is examined first. Figure 74 shows that the age distribution between NYC and the rest of the country is fairly similar.

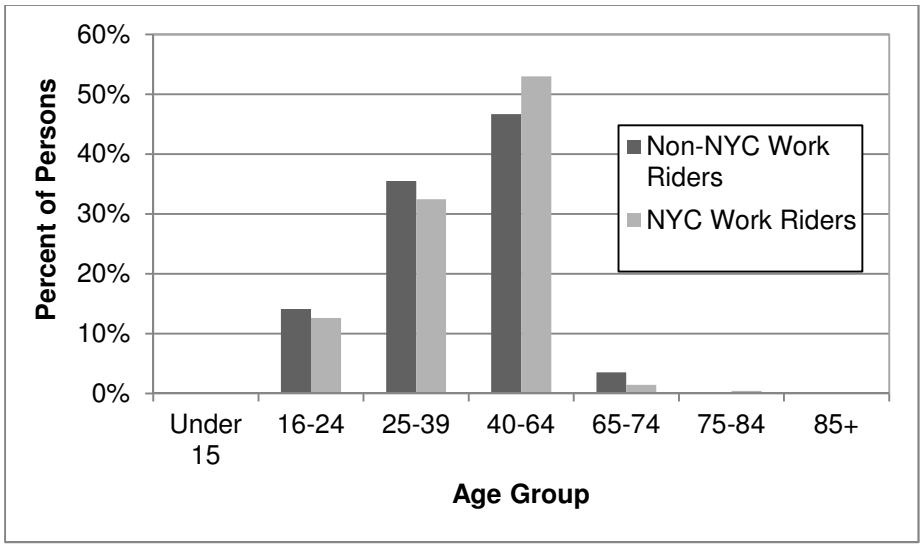


Figure 74 2009 age distribution of NYC and non-NYC work riders

An analysis of gender (Figure 75) reveals that both groups have a similar proportion of males and females taking transit to work.

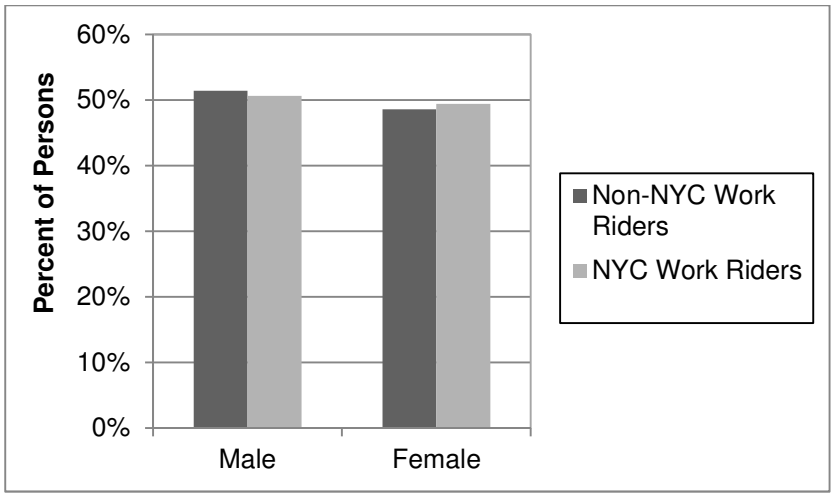


Figure 75 2009 gender of NYC and non-NYC work riders

Figure 76 shows the race/ethnicity of both NYC and non-NYC riders. As the graph indicates, non-Hispanic whites constitute the majority of both NYC and non-NYC work riders. However, NYC has a larger proportion of minority riders than the rest of the country.

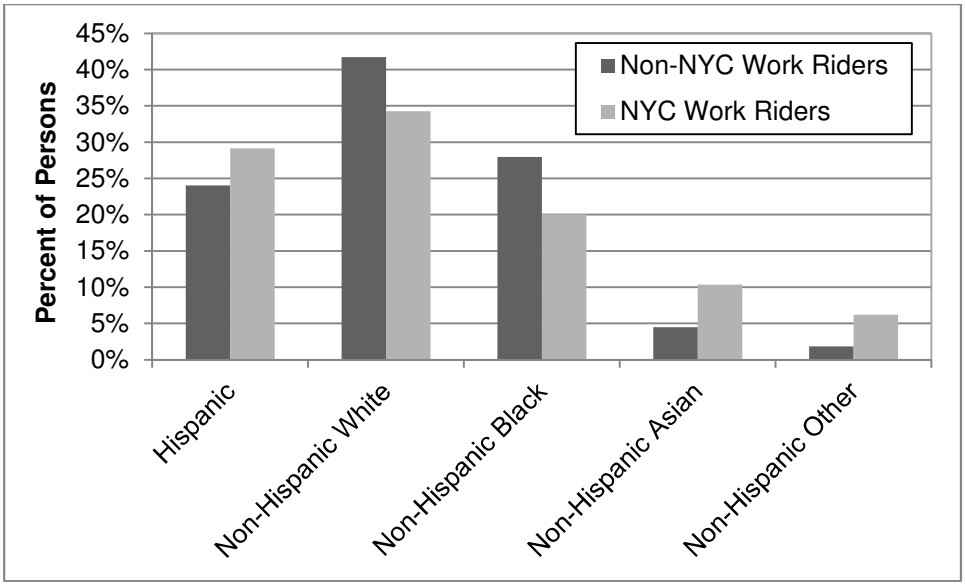


Figure 76 2009 race/ethnicity of NYC and non-NYC work riders

Examination of the educational attainment of the two groups reveals that those taking transit in NYC have slightly higher levels of education than riders elsewhere in the country (Figure 77). This can be expected given that NYC has a large concentration of high paying white collar jobs in downtown Manhattan.

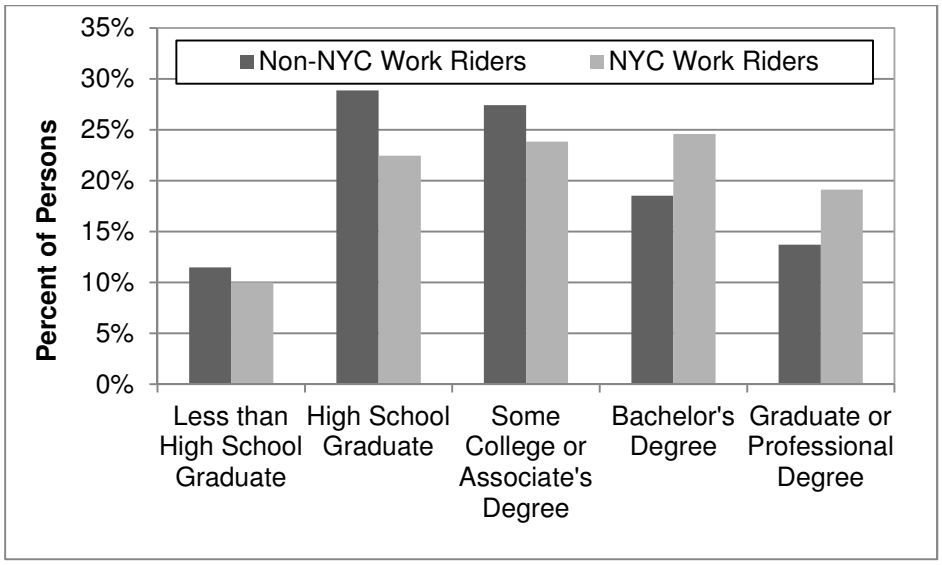


Figure 77 2009 educational attainment of NYC and non-NYC work riders

New York City was traditionally a city of immigrants. Figure 78 shows that NYC has a larger share of its commuters being immigrants than the rest of the country. Immigrants often have different travel patterns than those born in the country, depending on how long the immigrants have been in the U.S. Immigrants who have been here longer tend to adopt American travel behavior and patterns (such as owning a car and walking/taking transit less). Further analysis cannot be performed on these individuals due to a small sample size.

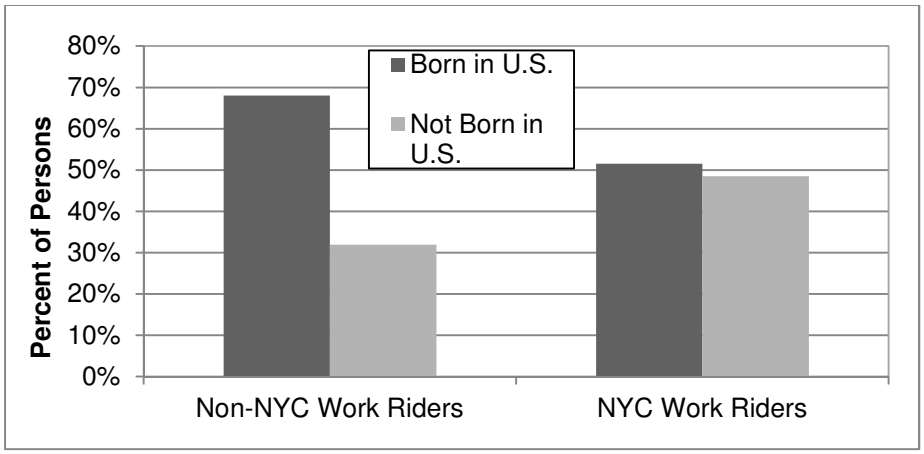


Figure 78 2009 immigration status of NYC and non-NYC work riders

Respondents of the survey were asked what they perceived as the most important transportation issue. As Figure 79 shows, both groups seem to agree that access to/availability of transit is the most important issue. One interesting thing to note is that NYC transit riders perceive congestion

being less of a problem than other transit riders nationwide. This could perhaps be due to less utilization of roadways (walking or taking transit instead of driving) or taking transit modes which are not dependent on roadway congestion (taking subways rather than riding buses).

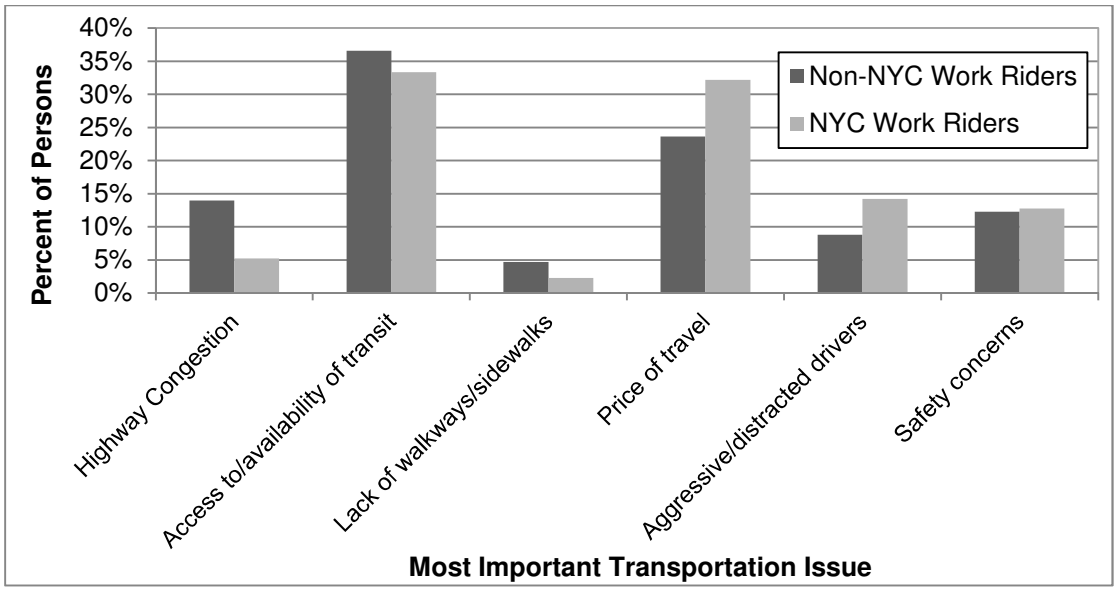


Figure 79 Most important transportation issue for NYC and non-NYC work riders (2009)

Household Level Demographics

Data on household size indicates that NYC rider households are often smaller than other rider households nationwide (Figure 80). The computed average NYC household size was 2.7 persons compared with non-NYC households (HH's) which had 2.9 persons. It is hypothesized that this is predominantly due to the built environment within the city, where apartments can make it difficult to house larger families.

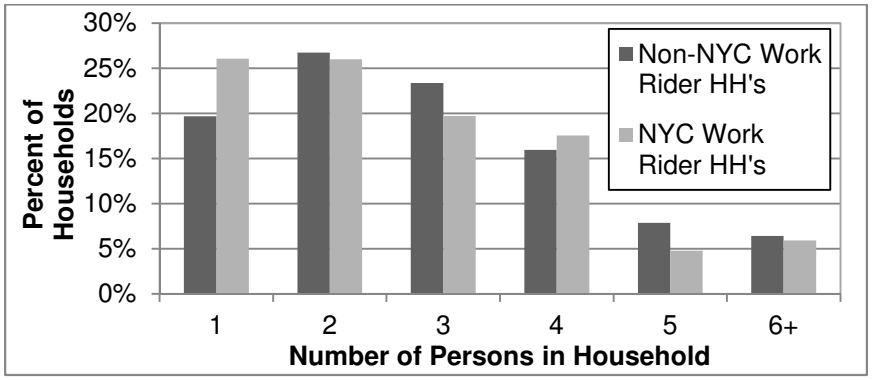


Figure 80 2009 household size for NYC and non-NYC work rider households

An analysis of the number of licensed drivers is important in setting the context for determining who is a captive or choice rider. As Figure 81 shows, both distributions show that many households have at least one driver, making it possible for nearly every household to get around by auto (either by renting or owning a vehicle).

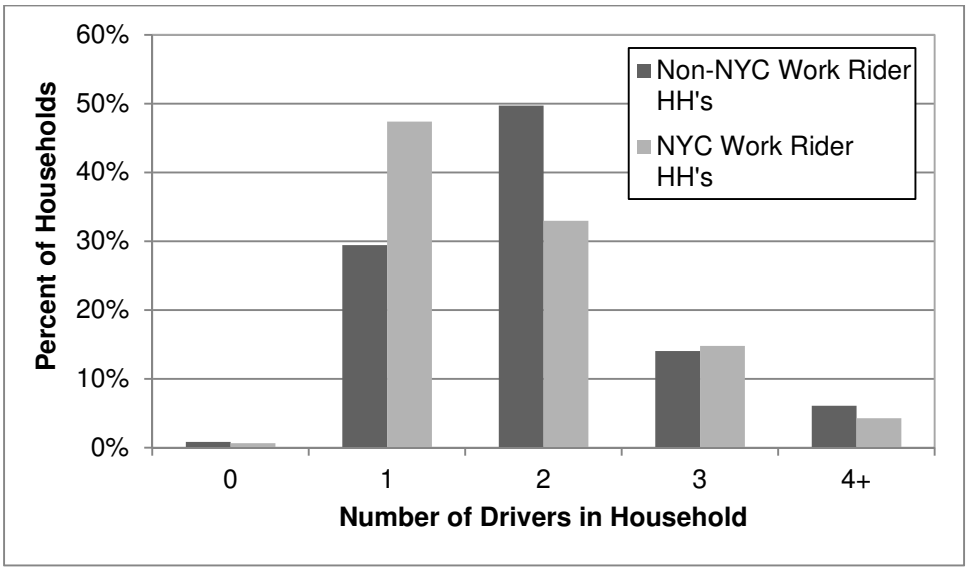


Figure 81 Number of drivers for NYC and non-NYC work rider households (2009)

Figure 82 shows the distribution of the number of household vehicles. Not surprisingly, NYC households are more likely to be car-less than the rest of the country.

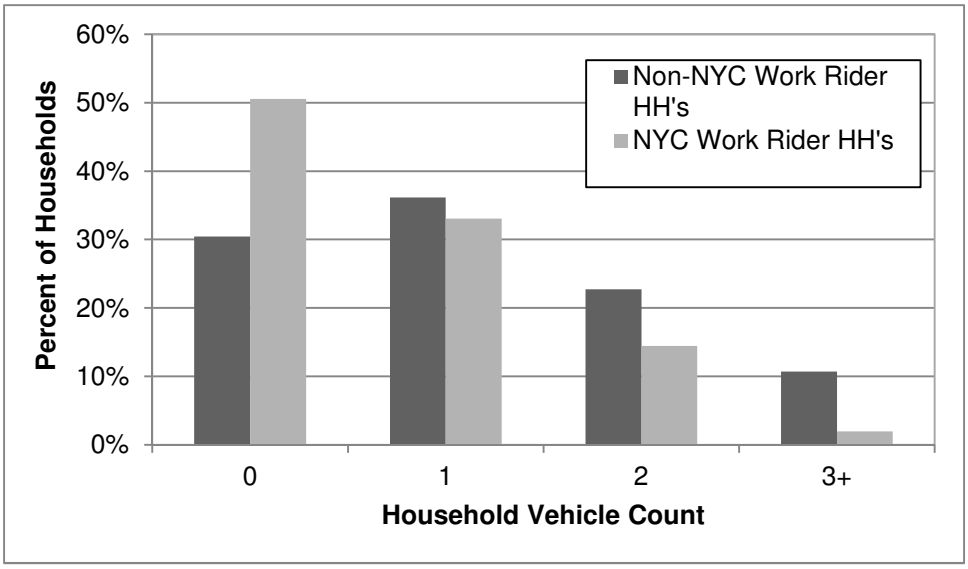


Figure 82 2009 household vehicle count for NYC and non-NYC work rider households

Income is the last household level demographic that was analyzed (Figure 83). As the graph shows, NYC households have higher income levels than other households nationwide. This is mainly due to the higher cost of living as well as higher income associated with more specialized employment.

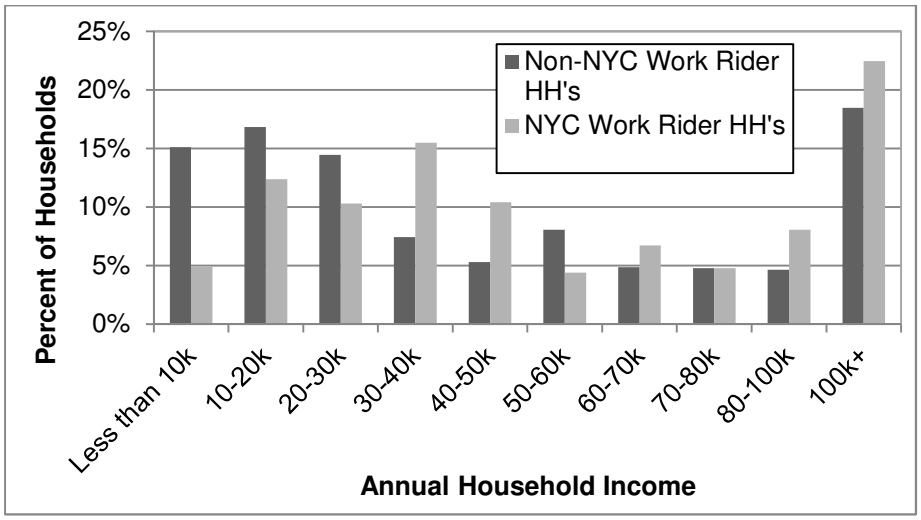


Figure 83 Annual household income for NYC and non-NYC work rider households (2009)

Captivity Analysis

Finally, a captivity analysis is performed. As Figure 84 illustrates, NYC riders are more likely to be captive riders than other riders throughout the country. This is primarily attributed to the lower household vehicle ownership rates which were presented earlier in this chapter.

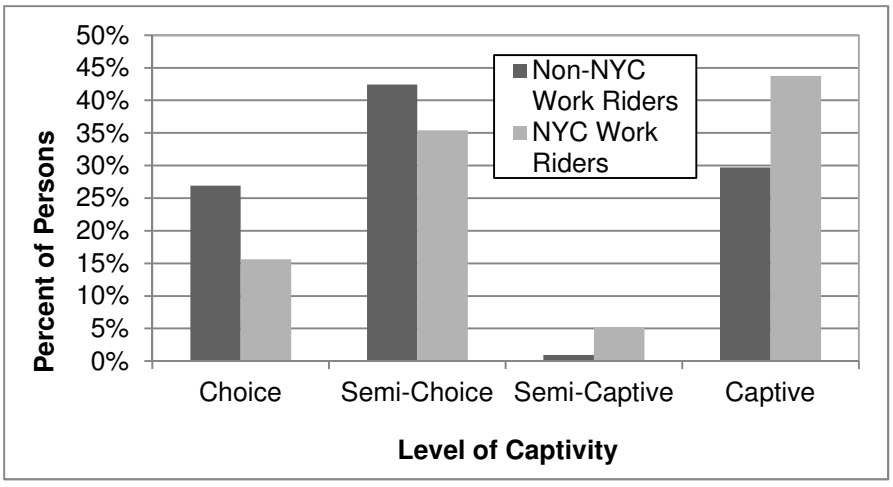


Figure 84 2009 captivity level for NYC and non-NYC work riders

Chapter 12: Comparing Transit Work Trips in New York City (NYC) and Elsewhere

Chapter 11 focused on the demographics of those using transit in NYC and outside NYC. This chapter examines the actual transit trips to work between the two areas.

Figure 85 presents the market share for transit work trips for the two groups. Not surprisingly, most NYC transit trips take place on the elevated/subway while most non-NYC trips take place on local buses.

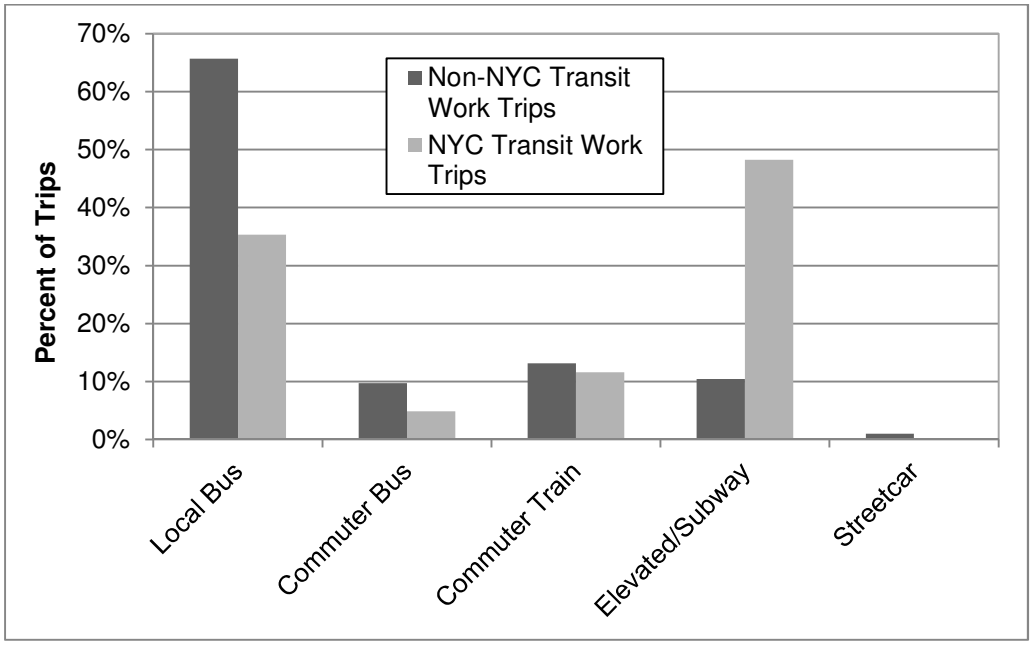


Figure 85 2009 transit market share for NYC and non-NYC work trips

An analysis of the average trip length and travel time (Figure 86) reveals that transit trips in NYC take more time to complete yet travel for a shorter distance. These results will no doubt reveal definitive differences between the average speeds between the two geographies.

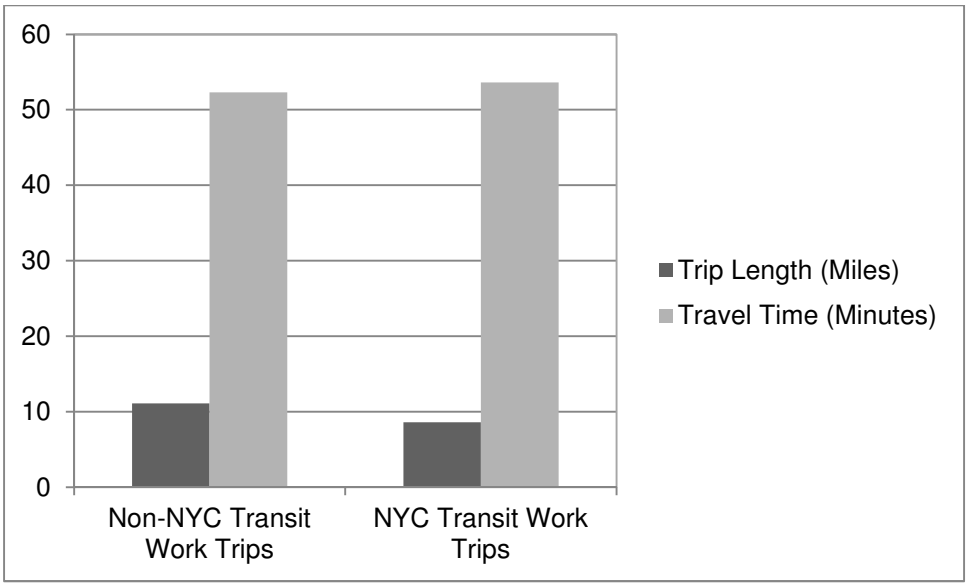


Figure 86 2009 average transit trip length and travel time for NYC and non-NYC work trips

An analysis of the average in-vehicle travel speeds for transit trips was then performed for the two geographies. As Figure 87 shows, in-vehicle transit speeds in NYC are consistently lower than those elsewhere in the country. Much of this can probably be attributed to more crowded conditions on the transit network (resulting in more dwell time at stations) or being stuck in more frequent or widespread congestion on surface streets.

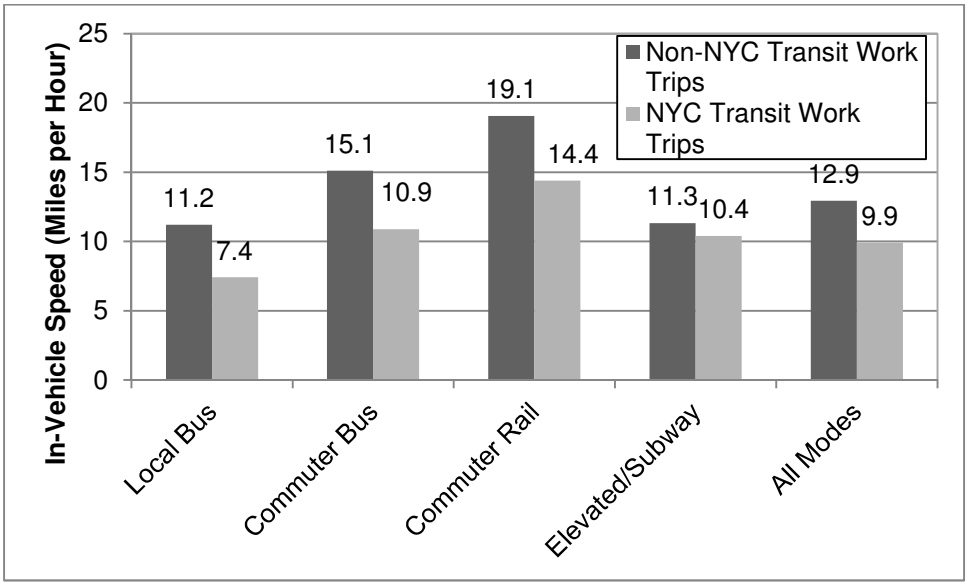


Figure 87 2009 average travel speed for NYC and non-NYC transit work trips

Figure 88 and Figure 89 show the access and egress modes for transit trips in NYC and elsewhere in the country. It can be seen that NYC transit trips have a greater share of people walking to/from stations or bus stops. This is most likely due to lower auto ownership and more transit stops being within walking distance to more riders.

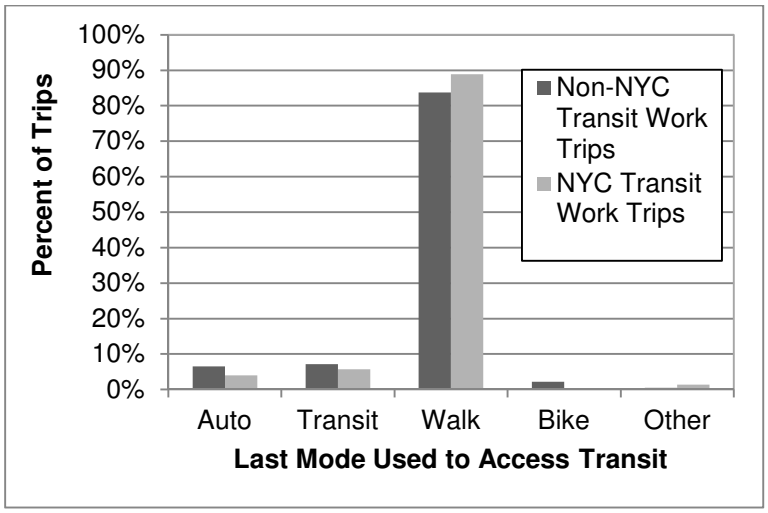


Figure 88 Last mode used to access transit for NYC and non-NYC work trips (2009)

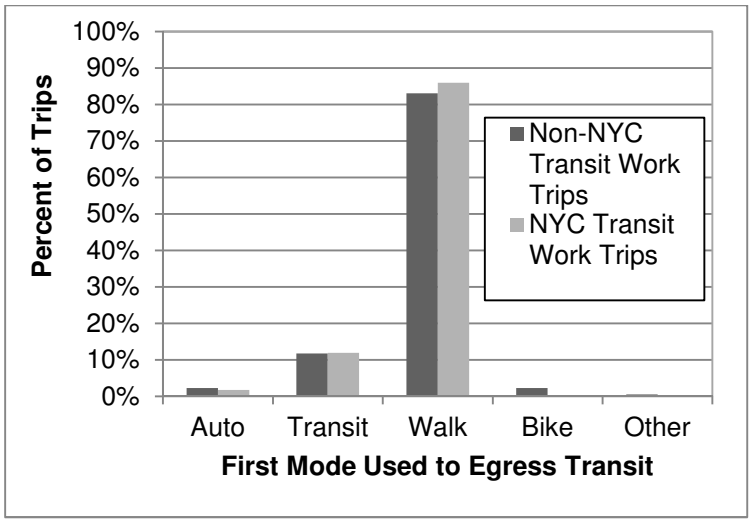


Figure 89 First mode used to egress transit for NYC and non-NYC work trips (2009)

An analysis of transit work tours shows that tours in NYC are more likely than the rest of the country to be without stops (Figure 90). This result is somewhat surprising given that the frequency of transit service, especially during the rush hour, should make it more enticing to make stops on the journey to/from work. One possible reason for this result could be that NYC

transit riders live or work near retail or other destinations of interest that can be reached by walking and do not need to be completed on transit. Another possibility is that since transit service is still quite good in the off-peak, some individuals are choosing to complete other activities as separate trips.

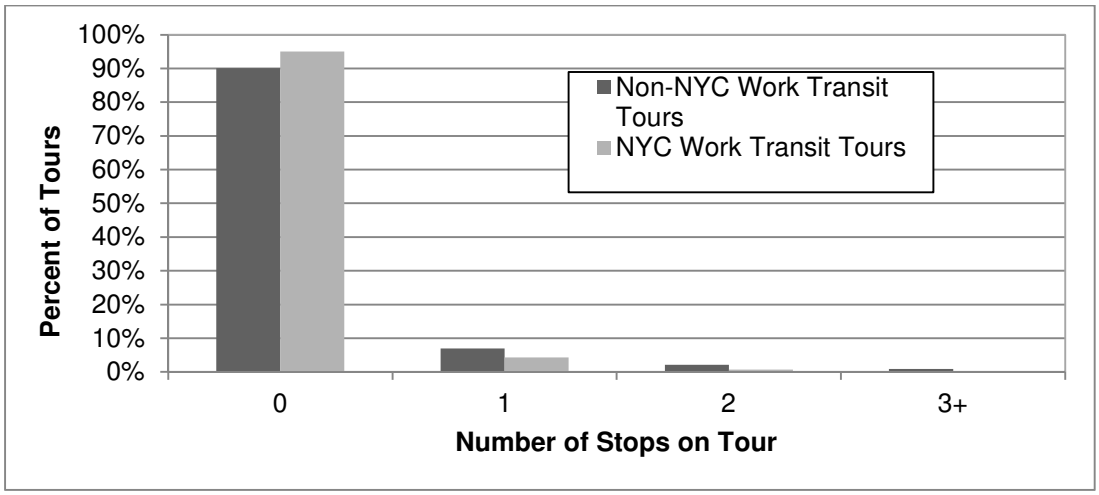


Figure 90 Number of stops on NYC and non-NYC transit work tours (2009)

Figure 91 presents the purpose for the stops of work transit tours. As the data shows, NYC tour stops are usually for shopping or other business while non-NYC tour stops are mostly for family/personal business or other purposes.

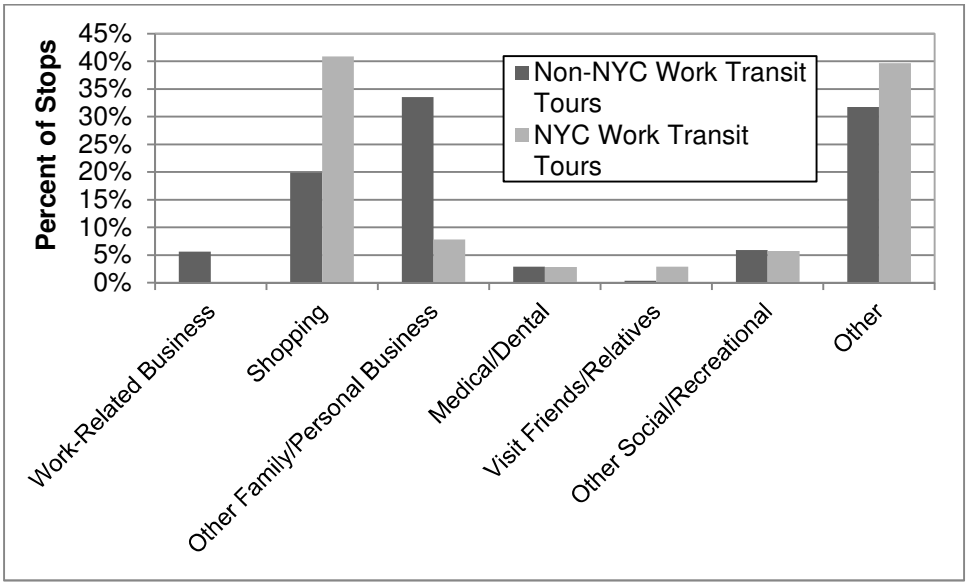


Figure 91 Purpose of stops for NYC and non-NYC transit work tours (2009)

Chapter 13: Conclusions and Closing Thoughts

The aim of this research was to gain a better understanding of work trips that are served on public transit. Specifically, this research attempted to:

1) Provide a snapshot of transit's current mode share across a variety of demographics
2) Examine historical demographic trends as they relate to work trips on transit
3) Compare riders and trip attributes for work and non-work trips on transit
4) Examine the effect of the quality of transit service on work trips on transit
5) Compare the demographics between choice and captive riders and the transit trips they take to work
6) Compare riders in the New York City (NYC) metropolitan area with the rest of the country (non-NYC) and the transit work trips they take.

As mentioned previously, there appears to be an issue with the 2009 NHTS dataset in regards to the licensed driver data. Many of the findings in this document, including the choice/captive analysis, are influenced by this variable. Caution is advised when interpreting the results.

Major Findings from each Research Objective

Chapter 4: Transit Mode Share

Transit mode share for work trips is:

- Roughly 3.6 percent nationwide, over double the non-work transit mode share of 1.6 percent.
- Highest for those with less than a high school diploma.
- Highest among those who are low income. Transit mode share for those earning more than $100k a year was nearly triple the non-work transit trip mode share.

- Highest for those that do not own a car (44 percent).
- Higher among empty nesters than adults with children. The same held true for transit non-work trips.
- Lower amongst potential choice riders (1 percent mode share). On the other hand, transit accounts for almost 44 percent of work trips taken by potential captive riders.

One of the major findings from this chapter was that empty nesters had a higher transit mode share than adults that had children. While the differences were not that large, the result seems to support an existing body of literature that has shown households with children are more likely to utilize an automobile for travel. As the baby boomers continue to age, it could indicate future ridership increases on transit (although not necessarily an increase in work trips).

The other major finding from this chapter is that only 1 percent of all work trips are being taken on transit by potential choice riders. This result indicates how difficult it is to get choice riders to use transit when commuting to work. The reasons could be endless (lack of coverage, slow or infrequent service, etc.) however the main point is that this is a very difficult ridership market to crack.

With funds getting tighter, transit agencies should be focusing on connecting captive riders with work locations. This is because the money invested in improved transit service will yield greater benefits to this group of individuals than they would to choice riders. Choice riders have a personal vehicle and can choose to use it if there is no transit service available. Captive riders, on the other hand, may not have access to an automobile and stand to lose the most if their transit service gets cut. Places such as Detroit, which is currently struggling to maintain its operating schedule, is hurting those who are dependent on transit to get to work. If transit cannot be relied on as a means to get to/from work, a region's economy can be negatively impacted as well.

Chapter 5: Historical Transit Data

The highlights from this chapter are:

- Transit mode share of work trips has been relatively steady since the 1970's at approximately 4 percent.
- Using the ACS to track transit usage for travel to work, it appears that transit mode share has been declining from 2000-2004 and has been increasing steadily since then.
- Transit's share of trips being for work purposes has been steadily declining since the 1983 NPTS (39.8 percent). Work trips currently constitute about 30.5 percent of transit trips nationwide.
- Today's transit commuters are older than they were in the 1990 survey. This can be somewhat expected because of the aging baby boomer generation. Essentially, if new riders do not replace these retiring baby boomers, there may be a dip in transit usage to work.
- The share of Hispanics taking transit to work has been steadily increasing. This increase has resulted in declines in the share of non-Hispanic whites, blacks, and Asians.
- Without adjusting for inflation, today there are more transit commuters who come from households making less than $10,000 a year than back in 1990. On the other hand, the number of individuals coming from households earning more than $80,000 a year has more than doubled since 1995.
- The percent of transit commuters with licenses has shot up in 2009 to nearly 97 percent. This data seems suspect and warrants further investigation, however, if this is indeed accurate, indicates that the majority of riders traveling to work are choice riders (almost 62 percent). As mentioned previously, this result should be interpreted with caution as there appears to be some problem with the 2009 NHTS.

Chapter 6: Transit Riders for Work Trips and Non-Work Trips

The highlights from this chapter are:

- Transit to work riders are slightly more educated with 63 percent of riders having at least some college education (compared with just 53 percent of non-work transit riders).
- When comparing workers who take transit with workers who do not, it was found that personal opinions on transportation issues differed. Workers who took transit cited access and availability to transit as the most important issue. Workers that did not use transit cited the price of travel as the most important issue.
- Transit to work households are more likely to have at least one licensed driver and at least one vehicle in the household.
- Transit to work households have higher household incomes when compared with those households just taking non-work transit trips.

Chapter 7: Comparing Transit Work Trips and Non-Work Trips

The highlights from this chapter are:

- Local bus remains the predominant mode for all transit trips nationwide. However, work trips tend to utilize faster transit modes such as commuter rail and elevated/subway.
- Work trips tend to be longer in both length and time than non-work trips.
- The average in-vehicle travel speed for work trips was slightly faster than non-work trips (11.8 MPH compared to 11.0 MPH). This could be due to the utilization of faster transit service.
- A majority of riders access and egress transit via walking.
- Transit work tours are less likely to include a stop than non-work transit tours. If people do stop on a tour, they are more likely to do so on the way home from work rather than to work.
- Those commuting via non-transit modes were about 20 percent more likely to make at least one stop on their commute to/from work compared to those that took transit.

Chapter 8: Analyzing Transit Trips in Transit Friendly Cities

The highlights from this chapter are:

- The analysis did not yield meaningful results as there was no way to normalize the NTD supply data. The results basically reiterated that transit service is utilized for a greater portion of daily travel in areas where there is higher quality service.
- Five metropolitan areas within the United States were defined as "transit friendly" (Level of Service A for both headway and weekday span of service): Boston, Chicago, New York City, Philadelphia, and San Francisco. The New York metro area had the best average headway (computed at 4.1 minutes).
- Transit's mode share of work trips was higher in transit friendly cities than in non-transit friendly cities (13 percent versus 2 percent).
- Transit work trips in transit friendly cities tend to be shorter in length and time as well as have slower travel speeds.

Chapter 9: Comparing Choice and Captive Riders Commuting to Work

The highlights from this chapter are:

- There are a larger portion of 16-24 year olds in the choice rider group than in the captive rider group. An analysis of all 16-24 year old riders reveals that 85 percent of them are choice riders. Again, this result should be interpreted with caution due to potential data issues associated with the 2009 NHTS.
- Choice riders are more educated than captive riders. An analysis by individual subgroups (based on educational attainment level) revealed a distinct correlation between educational level and the proportion of choice riders. The group of riders who had less than a high school diploma had the largest proportion of captive riders (about 60 percent). The group with bachelor's or graduate degrees had the lowest proportion of captive riders.

- Captive riders are more likely to come from single person households and low income households. Choice riders are more likely to come from high income households and households with children.

Chapter 10: Analyzing Transit Work Trips by Choice and Captive Riders

The highlights from this chapter are:

- Choice riders tend to have longer trip lengths despite having similar travel times as captive riders.
- Correspondingly, choice riders tend to enjoy higher travel speeds on transit (about 3 MPH faster).
- The access and egress times for choice and captive riders are remarkably similar, indicating there is a maximum distance at which people are willing to travel to access transit. The wait times for the two groups, however, shows that choice riders tend to enjoy lower wait times, presumably because they will not tolerate longer out of vehicle travel times.
- Choice riders are slightly more likely to add a stop on their tour to/from work. Captive riders who do stop tend to go shopping while choice riders tended to conduct family/personal business. It is hypothesized that captive riders are choosing to trip chain a shopping trip to take advantage of the more frequent transit service.

Chapter 11: Comparing Riders in NYC and Elsewhere

The highlights from this chapter are:

- Minorities constitute a larger share of NYC riders than they do nationally.
- NYC riders tend to be more educated than others nationwide.
- Immigrants tend to make up about half of the transit riders in NYC compared with just one-third of riders nationally.

- NYC rider households have higher incomes than households elsewhere in the country. This is probably due to higher cost of living as well as higher income associated with better paying jobs.
- NYC riders are more likely to be captive riders than other riders nationwide. This is partially because NYC rider households own fewer automobiles.

Chapter 12: Comparing Transit Work Trips in NYC and Elsewhere

The highlights from this chapter are:

- NYC transit trips take more time to complete yet travel a shorter distance.
- NYC transit trips have slower speeds than trips taking place elsewhere. Some of this can be attributed to higher passenger volumes which can result in more dwell time at stations or more widespread (and longer in duration) traffic on surface streets.
- Work tours taking place in NYC are more likely than the rest of the country to be without stops. It is hypothesized that some of this is due to transit riders living and working near retail or other destinations, reducing the need to use transit to complete these activities. Another possibility is that transit service is frequent that they can easily complete these activities as separate trips rather than trip chaining.

Sample Size Issue

In general, the 2009 NHTS dataset had adequate sample sizes for the transit analyses that were performed. However, given that the transit sample size was still very small (especially compared to the auto sample size), the dataset was not acceptable for segmentation into further categories. When examining niche markets, such as young adults or choice/captive riders, it was often difficult to reach conclusions from the dataset with confidence. This problem illustrates a problem with small market analyses in general and demonstrates a potential benefit from a more robust dataset. Geographic diversity is also a big issue with transit analyses, as is demonstrated by the work trip sample sizes by MSA (Table 1). One way to address this problem may be to conduct a transit add-on sample for the next NHTS dataset.

What do the Results Indicate about the Future of the U.S. Transit Market?

The research suggests that the transit to work market continues to remain strong, holding steady on a per rider basis. Despite this, the percentage of transit trips for travel to/from work has declined steadily over the past three decades. This decline was found to be the introduction of new riders whom ultimately took transit for trips other than for work. This finding is very significant because it may signify that transit agencies are starting to diversify their ridership base. Provided transit can continue to attract new riders and the transit to work market remains steady, this could portend future ridership increases in the years to come.

It is unknown why transit ridership is increasing. Could federal investments (New Starts and Small Starts programs) be making transit accessible to more people? Could new development (such as sports stadiums) being built near transit lines be enticing individuals to take transit instead of driving? Could university passes or other transit incentives be encouraging people to take transit more frequently since it is free? More research should be done to examine why this change is occurring so that the transit industry can continue building on this momentum.

Another significant finding is that more 16-24 year old riders (traveling to work) are choice riders than any other age group. Historically speaking, the proportion of 16-24 year old choice riders is at its highest since 1983. One can argue that the higher proportion of choice riders among this age group indicates a higher level of loyalty to transit service when compared to other generations. If this is true, we may start to see a shift in living preferences (to more urbanized areas) which ultimately can affect how land is developed throughout the country. In addition, if this generation believes strongly in transit, one might expect their offspring to also be likely to adopt their habits, which over time, could help to grow the U.S. transit rider base.

It is important to remember that the sample size used to make this conclusion was very small and the dataset used to make this conclusion may be flawed (the driver license variable). Furthermore, it is difficult to know if this result is representative of the population as a whole,

especially when the 2009 NHTS relied on land line phones and most people in this age range have cell phones (and some probably do not even have a land line).

Future research needs to be done using larger sample sizes to validate this result, and if this is true, find out why this change is happening. Is it something transit agencies are doing (providing good connections between home and work, or perhaps improved transit service)? Is it really a generational preference? Could this simply be a short-term phenomenon where young adults cut back on expenses in reaction to a sluggish economy?

Future Research

Two items uncovered as part of this research project warrant future research.

The first involves an anomaly found in the 2009 NHTS dataset. In the analysis of transit work riders, it was observed that over 90 percent of transit commuters had a driver's license. More research needs to be done to determine whether this is indeed a valid result and if so, why the number has increased so much since the last NHTS survey. This result impacts the analysis in determining the number of choice riders taking transit. Having good data is important in order to enact policy or improve public transit service and it is critical that this issue be addressed.

The second item involves the discrepancy between the NHTS and APTA regarding the percentage of transit trips being for travel to/from work. With NHTS reporting 30 percent and APTA reporting 59 percent, the difference in values is much too large to go unexplained and renders the data suspicious. While academics have hypothesized that it may be due to APTA's data sources and methodology, a more comprehensive look at both data sources should be undertaken. One way to address this may be to compare a metropolitan area's regional NHTS add-on samples to on-board surveys conducted within the same region.

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Appendices

Appendix A Sample Sizes for Figures and Tables

This appendix is designed to present the sample sizes for select analyses presented in the report.

Chapter 5 Sample Sizes

Table A Sample size for historical transit trips

	1990	1995	2001	2009
Work Transit Trips	1,248	2,684	2,685	2,329
Non-Work Transit Trips	1,624	4,815	5,222	6,192
Total Transit Trips	2,872	7,499	7,907	8,521

Table B Sample size for historical transit riders

Transit Rider Type	1990	1995	2001	2009
Work Riders	718	1,620	1,619	1,414
Non-Work Riders	892	2,466	2,670	3,070
Total	1,489	3,661	3,934	4,134
Note: Summation of work and non-work riders does not equal total due to some riders being both work and non-work riders.				

Table C Sample size for historical trips (all trips, transit trips, work trips)

	1990	1995	2001	2009
All Trips in Dataset	149,546	409,025	642,292	1,167,321
All Transit Trips	2,872	7,499	7,907	8,521
All Work Trips (All modes)	29,882	73,897	98,954	151,635

Table D Sample size for historical transit commuters by age

Age Group	1990	1995	2001	2009
Under 15	3	5	39	2
16-24	141	214	164	112
25-39	310	680	599	333
40-64	233	663	775	892
65-74	19	49	36	61
75-84	2	9	6	13
85 or older	1	0	0	1
Unknown	9	0	0	0
Total	718	1,620	1,619	1,414

Appendix A (Continued)

Table E Sample size for historical licensed drivers for transit commuters

	1990 NPTS	1995 NPTS	2001 NHTS	2009 NHTS
Licensed Driver	475	1,074	1,086	1,375
Not Licensed Driver	238	546	531	39
Unknown	5	0	2	0

Table F Sample size for historical choice/captive work riders

	1990 NPTS	1995 NPTS	2001 NHTS	2009 NHTS
Choice Rider	233	461	476	492
Semi-Choice Rider	142	324	347	514
Semi-Captive Rider	101	206	183	24
Captive Rider	237	629	611	384
Unknown	5	0	2	0

Chapter 6 Sample Sizes

Table G Sample size for work and non-work transit riders by age (Figure 28)

Age Group	Work Rider Sample Size	Non-Work Rider Sample Size
Under 15	2	366
16-24	112	447
25-39	333	413
40-64	892	1,246
65-74	61	328
75-84	13	212
85 or older	1	58
Total	1,414	3,070

Table H Sample size for work and non-work riders by gender (Figure 29)

Gender	Work Rider Sample Size	Non-Work Rider Sample Size
Male	714	1,332
Female	700	1,738
Total	1,414	3,070

Appendix A (Continued)

Table I Sample size for work and non-work riders by race/ethnicity (Figure 30)

Race/Ethnicity	Work Rider Sample Size	Non-Work Rider Sample Size
Hispanic	309	745
Non-Hispanic White	731	1,495
Non-Hispanic Black	206	561
Non-Hispanic Asian	91	125
Non-Hispanic Other	43	101
Unknown	34	43
Total	1,414	3,070

Table J Sample size for work and non-work riders by educational attainment (Figure 31)

Highest Grade Completed	Work Rider Sample Size	Non-Work Rider Sample Size
Less than High School Graduate	136	404
High School Graduate	292	630
Some College or Associate's Degree	301	634
Bachelor's Degree	314	434
Graduate or Professional Degree	329	429
Unknown	42	539
Total	1,414	3,070

Table K Sample size for work and non-work riders by transportation issue (Figure 32)

Most Important Transportation Issue	Work Rider Sample Size	Non-Work Rider Sample Size
Highway Congestion	149	212
Access to/Availability of Transit	395	717
Lack of Walkways/Sidewalks	36	101
Price of Travel	321	604
Aggressive/Distracted Drivers	101	225
Safety Concerns	136	349
Unknown	276	862
Total	1,414	3,070

Appendix A (Continued)

Table L Sample size for work and non-work rider households by household size (Figure 33)

Household Size	Work Rider HH Sample Size	Non-Work Rider HH Sample Size
One	223	677
Two	438	706
Three	277	435
Four	216	377
Five	96	170
Six or more	68	143
Total	1,318	2,508

Table M Sample size for work and non-work rider households by driver count (Figure 34)

Household Driver Count	Work Rider HH Sample Size	Non-Work Rider HH Sample Size
Zero	11	116
One	352	1,013
Two	646	911
Three	224	328
Four	66	107
Five or more	19	33
Total	1,318	2,508

Table N Sample size for work and non-work rider households by vehicle count (Figure 35)

Household Vehicle Count	Work Rider HH Sample Size	Non-Work Rider HH Sample Size
Zero	352	1,030
One	425	657
Two	358	518
Three	133	210
Four	38	57
Five or more	12	36
Total	1,318	2,508

Appendix A (Continued)

Table O Sample size for work and non-work rider households by income (Figure 36)

Income Category	Work Rider HH Sample Size	Non-Work Rider HH Sample Size
Less than 10k	95	392
10-20k	151	467
20-30k	137	281
30-40k	97	149
40-50k	77	162
50-60k	72	110
60-70k	79	93
70-80k	76	103
80-100k	116	154
100k+	343	438
Missing	75	159
Total	1,318	2,508

Table P Sample size for work and non-work riders by captivity level (Figure 37)

Captivity Level	Work Rider Sample Size	Non-Work Rider Sample Size
Choice Rider	492	718
Semi-Choice Rider	514	707
Semi-Captive Rider	24	177
Captive Rider	384	1,181
Unknown	--	287
Total	1,414	3,070

Chapter 7 Sample Sizes

Table Q Sample size for work and non-work trips by transit mode (Figure 38)

Transit Mode	Work Trip Sample Size	Non-Work Trip Sample Size
Local Bus	1,265	4,149
Commuter Bus	254	609
Commuter Rail	290	375
Elevated/Subway	486	922
Streetcar	34	132
Total	2,329	6,187

Appendix A (Continued)

Table R Sample size for work and non-work trips by access mode (Figure 43)

Last Mode Used to Access Transit	Work Trip Sample Size	Non-Work Trip Sample Size
Auto	196	174
Transit	162	450
Walk	1,877	5,344
Bike	37	36
Other	26	41
Missing	31	142
Total	2,329	6,187

Table S Sample size for work and non-work trips by egress mode (Figure 44)

First Mode Used to Egress Transit	Work Trip Sample Size	Non-Work Trip Sample Size
Auto	95	71
Transit	269	732
Walk	1,876	5,171
Bike	34	23
Other	27	48
Missing	28	142
Total	2,329	6,187

Table T Sample size for work transit trips by access mode (Figure 45)

Last Mode Used to Access Transit	Work Trips Only			
	Local Bus Sample Size	Commuter Bus Sample Size	Commuter Rail Sample Size	Elevated/Subway Sample Size
Auto	59	43	69	23
Transit	69	22	23	44
Walk	1,088	182	179	402
Bike	20	2	10	4
Other	8	2	6	10
Total	1,244	251	287	483

Table U Sample size for work transit trips be egress mode (Figure 46)

First Mode Used to Egress Transit	Work Trips Only			
	Local Bus Sample Size	Commuter Bus Sample Size	Commuter Rail Sample Size	Elevated/Subway Sample Size
Auto	28	17	39	11
Transit	118	33	51	61
Walk	1,073	198	176	403
Bike	19	2	9	3
Other	9	2	8	8
Total	1,247	252	283	486

Appendix A (Continued)

Table V Sample size for crosstab of access and egress modes (Table 3)

		First Transit Egress Mode					
		Auto	***Transit***	***Walk***	***Bike***	***Other***	***Total***
Last Transit Access Mode	***Auto***	8	40	141	0	4	193
	Transit	12	42	106	2	0	162
	Walk	73	181	1,592	5	17	1,868
	Bike	0	3	7	26	0	36
	Other	2	1	17	0	6	26
	Total	95	269	1,863	33	27	2,285

Table W Sample size for transit work and non-work tours (Figure 47)

Number of Stops on Tour	Work Tour Sample Size	Non-Work Tour Sample Size
Zero	1,889	4,255
One	177	667
Two	79	205
Three or More	25	101
Total	2,170	5,228

Table X Sample size for home to work and work to home tours (Figure 48)

Number of Stops on Tour	Home to Work Tour Sample Size	Work to Home Tour Sample Size
Zero	1,015	874
One	89	88
Two	38	41
Three or More	15	10
Total	1,157	1,013

Table Y Sample size for transit work tours and non-transit work tours (Figure 49)

Number of Stops on Tour	Transit Work Tour Sample Size	Non-Transit Work Tour Sample Size
Zero	1,889	110,058
One	177	16,669
Two	79	3,592
Three or More	25	1,104
Total	2,170	131,423

Appendix A (Continued)

Table Z Sample size for transit and non-transit work tour stops (Figure 50)

Purpose for Stops	Transit Work Tour Sample Size	Non-Transit Work Tour Sample Size
Work-Related Business	8	1,145
Shopping	54	8,833
Other Family/Personal Business	36	15,377
School/Church	0	180
Medical/Dental	5	444
Vacation	0	17
Visit Friends/Relatives	3	479
Other Social/Recreational	7	1,740
Other	138	362
Total	256	28,687

Chapter 9 Sample Sizes

Table AA Sample size for choice/captive work riders by age group (Figure 56 and 57)

Age Group	Choice Work Rider Sample Size	Captive Work Rider Sample Size	Total Sample per Age Group
Under 15	1	1	2
16-24	93	19	112
25-39	236	97	333
40-64	629	263	892
65-74	36	25	61
75-84	10	3	13
85 or older	1	0	1
Total	1,006	408	1,414

Table BB Sample size for historical age 16-24 commuters taking transit (Figure 58)

NHTS/NPTS Dataset Year	Choice Work Riders Age 16-24	Total Age 16-24 Commuters
2009	93	112
2001	58	164
1995	57	214
1990	60	140

Appendix A (Continued)

Table CC Sample size for choice/captive work riders by gender (Figure 59)

Gender	Choice Work Rider Sample Size	Captive Work Rider Sample Size
Male	541	173
Female	465	235
Total	1006	408

Table DD Sample size for choice/captive work riders by race/ethnicity (Figure 60 and 61)

Race/Ethnicity	Captive Work Riders	Choice Work Riders	Total Sample per Group
Hispanic	121	188	309
Non-Hispanic White	150	581	731
Non-Hispanic Black	106	100	206
Non-Hispanic Asian	13	78	91
Non-Hispanic Other	11	32	43
Missing	7	27	34
Total	408	1006	1414

Table EE Sample size for choice/captive work riders by educational attainment (Figure 62 and 63)

Educational Attainment	Captive Work Riders	Choice Work Riders	Total Sample per Group
Less than High School	77	59	136
High School Graduate	113	179	292
Some College or Associate's Degree	93	208	301
Bachelor's Degree	60	254	314
Graduate or Professional Degree	54	275	329
Missing	11	31	42
Total	408	1006	1414

Appendix A (Continued)

Table FF Sample size for choice/captive work rider households by household size (Figure 64)

Household Size	Choice Work Rider HH Sample Size	Captive Work Rider HH Sample Size
One	84	139
Two	327	111
Three	229	48
Four	183	33
Five	77	19
Six or more	48	20
Total	948	370

Table GG Sample size for choice/captive work rider households by household income (Figure 65)

Income Category	Choice Work Rider HH Sample Size	Captive Work Rider HH Sample Size
Less than 10k	36	59
10-20k	61	90
20-30k	67	70
30-40k	61	36
40-50k	56	21
50-60k	59	13
60-70k	70	9
70-80k	67	9
80-100k	101	15
100k+	311	32
Missing	59	16
Total	948	370

Table HH Sample size for choice/captive work rider households by life cycle (Figure 66)

Household Life Cycle	Choice Work Rider HH Sample Size	Captive Work Rider HH Sample Size
Adults no children	410	221
Adults with children	421	111
Retired adults no children	117	38
Total	948	370

Appendix A (Continued)

Chapter 10 Sample Sizes

Table II Sample size for choice/captive work trips by transit mode (Figure 67)

Transit Mode	Choice Work Trip Sample Size	Captive Work Trip Sample Size
Local Bus	825	440
Commuter Bus	181	73
Commuter Rail	265	25
Elevated/Subway	328	158
Streetcar	23	11
Total	1,622	707

Table JJ Sample size for choice/captive work trips by access mode (Figure 70)

Last Mode Used to Access Transit	Choice Work Trip Sample Size	Captive Work Trip Sample Size
Auto	192	4
Transit	117	45
Walk	1,242	635
Bike	35	2
Other	19	7
Missing	17	14
Total	1,622	707

Table KK Sample size for choice/captive work trips by egress mode (Figure 71)

First Mode Used to Egress Transit	Choice Work Trip Sample Size	Captive Work Trip Sample Size
Auto	93	2
Transit	188	81
Walk	1,266	610
Bike	34	0
Other	23	4
Missing	18	10
Total	1,622	707

Table LL Sample size for choice/captive work tours by number of stops (Figure 72)

Number of Stops on Tour	Choice Work Tour Sample Size	Captive Work Tour Sample Size
Zero	1,309	580
One	133	35
Two	37	5
Three or More	10	3
Total	1,489	623

Appendix A (Continued)

Table MM Sample size for choice/captive work stopovers by purpose (Figure 73)

Purpose for Stops	Choice Work Trip Sample Size	Captive Work Trip Sample Size
Work-Related Business	4	1
Shopping	27	18
Other Family/Personal Business	23	7
School/Church	0	0
Medical/Dental	2	2
Vacation	0	0
Visit Friends/Relatives	3	0
Other Social/Recreational	4	1
Other	64	4
Total	127	33

Chapter 11 Sample Sizes

Table NN Sample size for NYC and non-NYC work riders by age (Figure 74)

Age Group	NYC Work Rider Sample Size	Non-NYC Work Rider Sample Size
Under 15	1	1
16-24	38	74
25-39	96	237
40-64	320	572
65-74	21	40
75-84	6	7
85 or older	1	0
Total	483	931

Table OO Sample size for NYC and non-NYC work riders by gender (Figure 75)

Gender	NYC Work Rider Sample Size	Non-NYC Work Rider Sample Size
Male	255	459
Female	228	472
Total	483	931

Appendix A (Continued)

Table PP Sample size for NYC and non-NYC work riders by race/ethnicity (Figure 76)

Race/Ethnicity	NYC Work Rider Sample Size	Non-NYC Work Rider Sample Size
Hispanic	91	218
Non-Hispanic White	257	474
Non-Hispanic Black	69	137
Non-Hispanic Asian	28	63
Non-Hispanic Other	20	23
Unknown	18	16
Total	483	931

Table QQ Sample size for NYC and non-NYC work riders by educational attainment (Figure 77)

Highest Grade Completed	NYC Work Rider Sample Size	Non-NYC Work Rider Sample Size
Less than High School Graduate	37	99
High School Graduate	86	206
Some College or Associate's Degree	95	206
Bachelor's Degree	131	183
Graduate or Professional Degree	129	200
Unknown	5	37
Total	483	931

Table RR Sample size for NYC and non-NYC work riders by immigration status (Figure 78)

Born in U.S.?	NYC Work Rider Sample Size	Non-NYC Work Rider Sample Size
Yes	314	635
No	167	294
Unknown	2	2
Total	483	931

Appendix A (Continued)

Table SS Sample size for NYC and non-NYC work riders by transportation issue (Figure 79)

Most Important Transportation Issue	NYC Work Rider Sample Size	Non-NYC Work Rider Sample Size
Highway Congestion	31	118
Access to/Availability of Transit	120	275
Lack of Walkways/Sidewalks	4	32
Price of Travel	143	178
Aggressive/Distracted Drivers	31	70
Safety Concerns	49	87
Unknown	105	171
Total	483	931

Table TT Sample size for NYC and non-NYC work rider households by household size (Figure 80)

Household Size	NYC Work Rider HH Sample Size	Non-NYC Work Rider HH Sample Size
One	79	144
Two	149	289
Three	85	192
Four	73	143
Five	31	65
Six or more	18	50
Total	435	883

Table UU Sample size for NYC and non-NYC work rider households by driver count (Figure 81)

Number of Drivers in HH	NYC Work Rider HH Sample Size	Non-NYC Work Rider HH Sample Size
Zero	3	8
One	129	223
Two	213	433
Three	66	158
Four or more	24	61
Total	435	883

Appendix A (Continued)

Table VV Sample size for NYC and non-NYC work rider households by vehicle count (Figure 82)

Number of Vehicles in HH	NYC Work Rider HH Sample Size	Non-NYC Work Rider HH Sample Size
Zero	144	208
One	153	272
Two	101	257
Three or more	37	146
Total	435	883

Table WW Sample size for NYC and non-NYC work rider households by income (Figure 83)

Income Category	NYC Work Rider HH Sample Size	Non-NYC Work Rider HH Sample Size
Less than 10k	15	80
10-20k	24	127
20-30k	31	106
30-40k	38	59
40-50k	26	51
50-60k	23	49
60-70k	31	48
70-80k	26	50
80-100k	44	72
100k+	143	200
Missing	34	41
Total	435	883

Table XX Sample size for NYC and non-NYC work riders by captivity level (Figure 84)

Captivity Level	NYC Work Rider Sample Size	Non-NYC Work Rider Sample Size
Choice Rider	135	357
Semi-Choice Rider	182	332
Semi-Captive Rider	9	15
Captive Rider	157	227
Total	483	931

Appendix A (Continued)

Chapter 12 Sample Sizes

Table YY Sample size for NYC and non-NYC work transit trips by mode (Figure 85)

Transit Mode	NYC Work Trip Sample Size	Non-NYC Work Trip Sample Size
Local Bus	276	989
Commuter Bus	84	170
Commuter Rail	141	149
Elevated/Subway	341	145
Streetcar	0	34
Total	842	1,487

Table ZZ Sample size for NYC and non-NYC work transit trips by access mode (Figure 88)

Last Mode Used to Access Transit	NYC Work Trip Sample Size	Non-NYC Work Trip Sample Size
Auto	48	148
Transit	51	111
Walk	722	1,155
Bike	2	35
Other	13	13
Missing	6	25
Total	842	1,487

Table AAA Sample size for NYC and non-NYC work transit trips by egress mode (Figure 89)

First Mode Used to Egress Transit	NYC Work Trip Sample Size	Non-NYC Work Trip Sample Size
Auto	30	65
Transit	111	158
Walk	684	1,192
Bike	2	32
Other	10	17
Missing	5	27
Total	842	1,487

Appendix A (Continued)

Table BBB Sample size for NYC and non-NYC work transit tours by number of stops (Figure 90)

Number of Stops on Tour	NYC Work Tour Sample Size	Non-NYC Work Tour Sample Size
Zero	1,200	689
One	123	45
Two	33	9
Three or More	11	2
Total	1,367	745

Table CCC Sample size for NYC and non-NYC work transit stops by purpose (Figure 91)

Purpose for Stops	NYC Work Chain Trip Sample Size	Non-NYC Work Chain Trip Sample Size
Work-Related Business	1	7
Shopping	16	38
Other Family/Personal Business	7	29
School/Church	0	0
Medical/Dental	2	3
Vacation	0	0
Visit Friends/Relatives	1	2
Other Social/Recreational	2	5
Other	39	99
Missing		
Total	818	1,540

Appendix B Comparison Analyses from the 2001 NHTS

This section utilizes the 2001 NHTS to perform select analyses to compare and validate portions of the 2009 NHTS analysis.

First, an examination of transit mode share for work trips by age group for work trips is shown in Figure A. It can be seen that the results are comparable, with the exception of the under 15 age group.

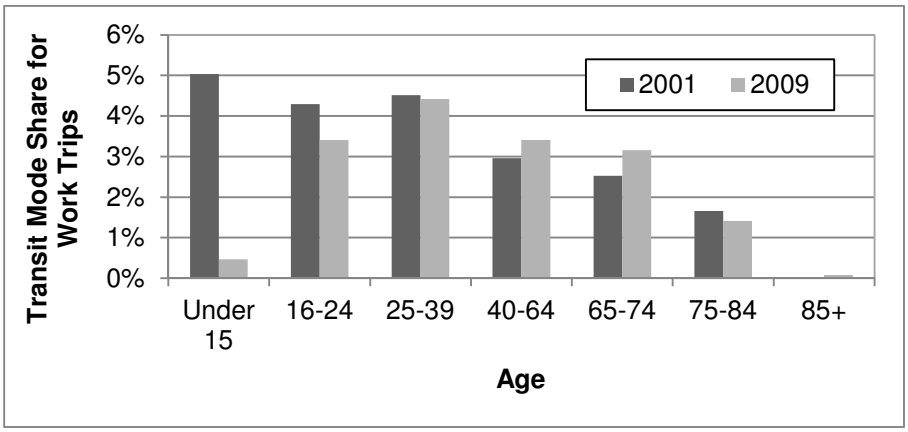

Figure A 2001 and 2009 comparison of the transit mode share for work trips by age

Next, an examination is performed on the household vehicle count. It can be seen in Figure B that the distributions of the 2001 and 2009 datasets are very similar.

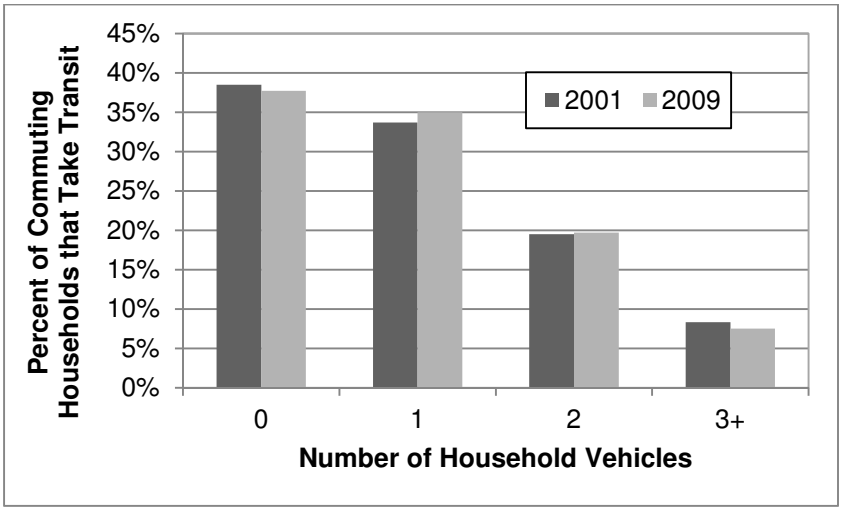

Figure B 2001 and 2009 comparison of household vehicle count

Appendix B (Continued)

An examination of the number of drivers per transit commuting household shows some dramatic differences between the 2001 and 2009 datasets (Figure C). This figure shows that one should interpret any data findings involving the 2009 NHTS driver licensure variable with caution.

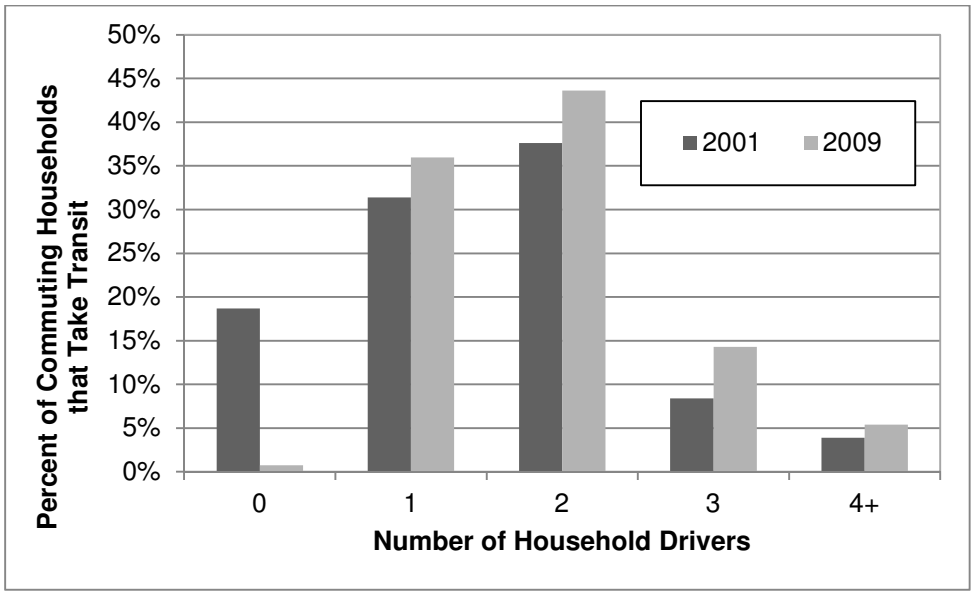

Figure C 2001 and 2009 comparison of household licensed drivers

The number of licensed drivers has an impact on the choice/captive distribution. As shown in Figure D, there appears to be some change in the proportion of semi-choice and semi-captive riders from 2001 to 2009.

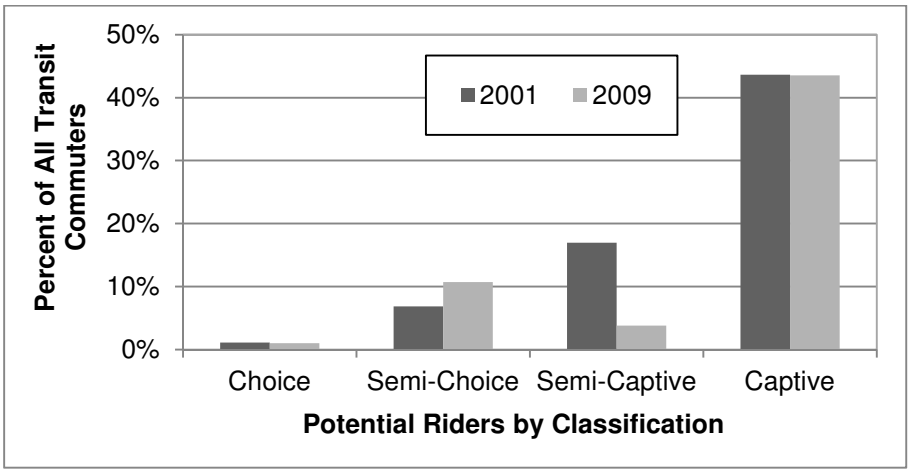

Figure D 2001 and 2009 choice/captive classification

Appendix B (Continued)

Looking at the distribution of choice and captive work riders, it can be seen that there are dramatic differences between the two datasets. This reinforces the need for caution when interpreting results from the 2009 NHTS.

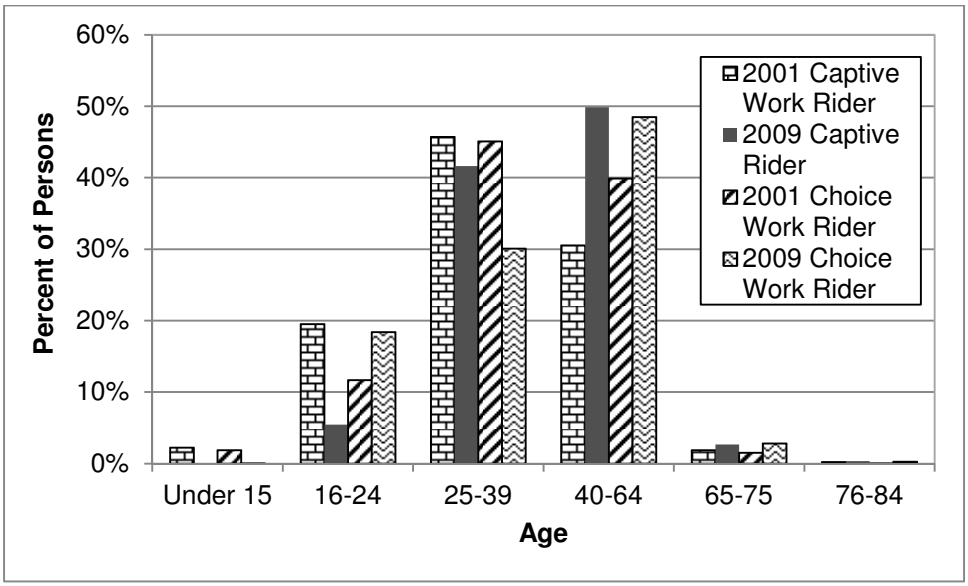

Figure E 2001 and 2009 choice/captive rider comparison by age

Looking at the proportion of work riders who are choice and captive is another method to assess the validity of the 2009 NHTS. Comparing Figure F to Figure G shows the 2009 NHTS has more choice riders overall.

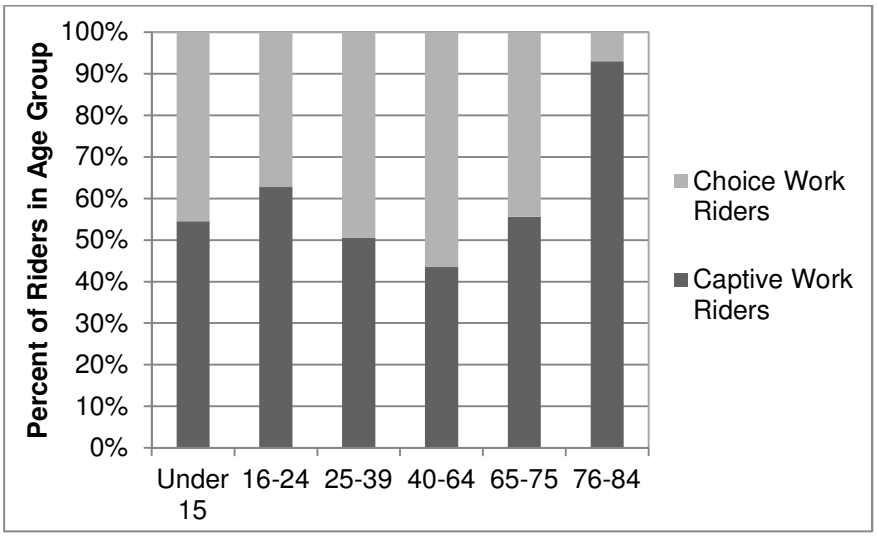

Figure F 2001 proportion of choice and captive riders by age group

Appendix B (Continued)

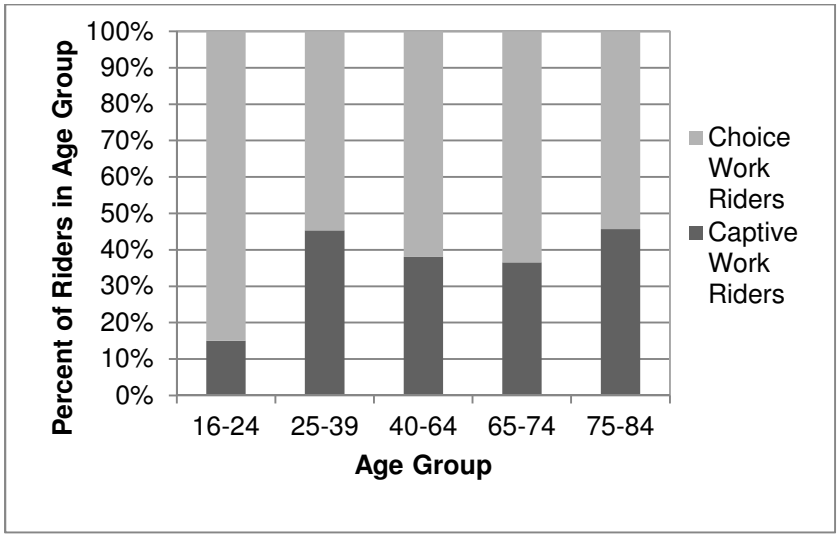

Figure G 2009 proportion of choice and captive riders by age group