THE ROLE OF PUBLIC TRANSIT IN THE MOBILITY OF LOW INCOME HOUSEHOLDS

FINAL REPORT

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ABSTRACT

Despite substantial and increasing subsidies, public transit's market share continues to decline; public transit's share of person trips is less than two percent. The remaining transit market has two components: downtown commuters in the largest U.S. metropolitan areas, and transit dependents — those who are either unable or unwilling to drive, and those who do not have access to a private vehicle. Car ownership is a function of income. A fundamental justification for transit subsidies is to provide a basic level of mobility to all persons, especially the transportation disadvantaged, yet even among the disadvantaged, most travel is by private vehicle, and public transit accounts for just five percent of all person trips.

This report examines the use of public transit by low income households. Using the 1995 Nationwide Personal Transportation Survey, we analyze both stated behavior regarding usual travel and actual journey to work mode to understand the role of public transit in the mobility of low income households. We find that public transit is not a reasonable substitute for the private vehicle for most people, poor or not poor. Regular transit is associated with less trip making and less distance traveled, and the effect is more pronounced for the poor. A second major barrier to transit use is lack of access: about one-third of NPTS respondents stated that transit was not available in their town or city. Other barriers include off-peak commuting and trip patterns that are inconsistent with transit use. We conclude that transit policy should focus on retaining existing markets by improving service frequency and quality in high demand markets, by exploring more effective ways of providing transit in low demand markets, and by expanding transit to serve off-peak and off-direction commutes. We note that in most circumstances, private vehicle access is the key to improved mobility for the poor as well as the non-poor. Economic development policies to increase the supply of jobs, goods and services in low income neighborhoods are also encouraged.

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CHAPTER ONE
INTRODUCTION

The secular decline in transit demand that began in the 1930s and continues today has left the public transit industry with two major markets: downtown commuters and transit dependents (Jones, 1985). The downtown commuter market remains because of the cost and limited availability of parking in downtown areas, road congestion, and the large concentration of jobs that makes transit access relatively convenient.

Transit dependents — those who do not have access to a private vehicle — are the second major market. However, data show that this market is shrinking: as car ownership continues to increase, fewer households have no cars. Even among households without cars, more trips are made by walking and by private car than by transit or other modes (Lave and Crepeau, 1995). The transit-dependent market is increasingly an inner city, minority market. The 1995 Nationwide Personal Transportation Survey (NPTS) data show that Hispanics and Blacks account for about 60 percent of all transit riders, and most of these riders are residents of central cities (Pucher, Evans, and Wenger, 1998).

Information on how limited mobility and accessibility affects low income households, particularly those households that do not have access to a private vehicle, is limited. National survey data indicate that members of low income households make fewer daily trips and travel fewer miles than comparable members of non-low income households. Low income households that do not have cars exhibit even lower rates of travel and trip making. Low income individuals are more dependent on public transit, yet, even within the lowest income class (less than $15,000 in 1995), just 6.8 percent of all person-trips are made by transit (Pucher, Evans, and Wenger, 1998).

These statistics suggest that public transit does not play a major role in serving the needs of the transit-dependent population. Those with limited or no access to privately owned vehicles sacrifice mobility; the results of limited travel resources are shorter and fewer trips. However, public transit's role in providing basic mobility for the transportation disadvantaged is a major justification for subsidies (Meyer and Gomez-Ibañez, 1981). Mobility is essential for access to jobs, services, and social activities, hence there is public responsibility for supplying some basic level of transportation services to those who do not or cannot drive. Concern has grown over the past decade that public transit agencies have shifted resources from basic local transit services to more costly commuter services designed to attract discretionary riders. Since local transit services are used more by low income and minority patrons, it is argued that the benefits of public subsidies are inequitably distributed (Hodge, 1995). This issue has been the basis of federal lawsuits in several large metropolitan areas, including Los Angeles.

The recent changes in welfare policy add to concerns regarding the effectiveness of public transit. Many argue that public transit must play a major role in providing access to jobs for welfare recipients, as the majority of these new workers will come from households that do not own a car. Given the large public investment in public transit and its stated purpose of providing basic mobility, it is important to understand the role of public transit in providing mobility for low income persons. Under what conditions is transit used? What are the barriers to more extensive transit use? Are these barriers the result of travel demand characteristics, or other factors?

The purpose of this project was to examine the travel patterns of low income households, with a particular focus on transit use. Using data from the 1995 Nationwide Personal Transportation Survey (NPTS), we examined patterns of total daily travel and work travel. Our research had the following objectives:

1. Document the extent and frequency of transit use among low income travelers
2. Within the segment of low income households, examine the role of demographic, life cycle and location factors associated with transit use
3. Examine the role of transit in overall levels of mobility for the same population segment
4. Evaluate the market for transit among low income and minority households.

This report presents the results of our research. Our results show that barriers to transit use are fundamental. Public transit is not a reasonable substitute for the private vehicle for most people, poor or not poor, under most circumstances. Regular transit use is associated with less trip making and less distance traveled, and the effect is more pronounced for the poor. A second major barrier to transit use is lack of access: about one-third of NPTS respondents stated that transit was not available in their town or city. Other barriers include off-peak commuting and trip patterns that are inconsistent with transit use. We conclude that transit policy-makers should focus on retaining their existing markets by improving service frequency and quality, by exploring more effective ways to provide transit in low-demand markets, and by expanding transit to serve off-peak and off-direction commutes. Economic development policies to increase the supply of jobs as well as of basic goods and services in low income neighborhoods are also encouraged. Finally, we note that in most circumstances private vehicle access is the key to improved mobility for the poor as well as the non-poor.

The remainder of this report is organized as follows. Chapter Two presents a review of the literature on the role of public transit and trends in transit use, and discusses the concept of transportation disadvantage. Chapter Three presents our research approach, describes the NPTS data, and provides a descriptive analysis of travel patterns across income groups. Chapter Four presents our analysis of transit use for all travel and of transit use for the work trip. We develop and estimate models to test the effect of individual, geographic, and trip characteristics on the likelihood of using transit. The final chapter summarizes our major findings and discusses their policy implications.

CHAPTER TWO
LITERATURE REVIEW

THE ROLE OF PUBLIC TRANSIT

Despite substantial and increasing public subsidies, public transit's market share continues to decline (Fielding, 1995). Most recently available national survey data indicates that transit's market share is less than 2 percent of all person-trips. This tiny market share is composed of two major markets: downtown commuters in the largest US metropolitan areas and transit dependents — those who are either unable or unwilling to drive, and those who do not have access to a privately owned vehicle (Jones, 1985). Furthermore, U.S. transit ridership is heavily concentrated in a few of the largest cities: New York accounts for 40 percent of U.S. daily transit ridership; and adding Los Angeles, Chicago, Boston, San Francisco, and Washington, DC, accounts for two-thirds of the nation's total (American Public Transit Association, 2000).

Subsidization of public transit has historically been based on two different and often conflicting objectives: 1) to provide a basic level of mobility for all persons, but especially the transportation disadvantaged, and 2) to provide an effective substitute for the private car in order to reduce automobile travel and its associated externalities, including traffic congestion, air pollution, and "urban sprawl" (Meyer and Gomez-Ibañez, 1981; Hodge, 1995; Fielding, 1995). This latter objective has emphasized the provision of rail transit, which is argued to be more attractive to choice riders and therefore more effective in achieving environmental goals. Most recently, sustainability concerns and the "smart growth" movement have placed even more emphasis on rail transit (Newman and Kenworthy, 1998).

The emphasis on rail transit is evident in transit investments. Between 1991 and 1998, total revenue vehicle miles of light rail, commuter rail, and heavy rail service increased 59, 20, and 8 percent respectively. Over the same period, bus service increased by 6 percent (U.S. Department of Transportation, Federal Transit Administration, 1998). Unfortunately, however, there is little evidence that these investments are generating the desired increases in transit ridership (Rubin, Moore, and Lee, 1999). On the contrary, new rail service generally replaces pre-existing bus service and attracts few new riders from cars (Kain, 1999; Pickrell, 1992). New rail systems are oriented to long distance, downtown commuters, who are disproportionately affluent and white (Webber, 1976; Gomez-Ibañez, 1985). In contrast, the transportation disadvantaged are concentrated in central cities, and would benefit more from increased service frequency, lower fares, and fewer transfers. In some cases, the high costs of building and operating rail systems have led to the perverse outcome of reducing transit ridership, as fares are increased and bus service is cut back in response to budget constraints. The obvious social equity consequences of these outcomes have led to a series of lawsuits against major transit operators in Los Angeles, New York, and Pennsylvania (Taylor and Garrett, 1998). In the case of Los Angeles, the Los Angeles County Metropolitan Transportation Authority (LACMTA) is currently under court order to expand and improve bus service in high-demand areas. The courts found that LACMTA's policy of expanding rail service and not expanding bus service was discriminatory: the County's bus passengers are on average poorer and more likely to be minorities than the County's rail passengers.

WHO USES TRANSIT

Transit share is declining across all metropolitan areas and across all income classes. However, the loss of middle- and higher-income passengers has been greater than the loss of low income passengers, hence the poor make up an increasing share of transit users (Pucher, Evans, and Wenger, 1998). Poor and minorities now constitute the majority of transit passengers. For example, Table 2-1 gives the distribution of transit ridership by income quintile, 1980 and 1992, for Los Angeles County. By 1992, the majority of Los Angeles County transit riders were from households in the lowest income quartile; all other income categories showed a decrease in share of total boardings.[1]

[1] Los Angeles County may not be representative of other California metropolitan areas, but the trend is consistent with national data.

Table 2-1: Distribution of Total Boardings by Income Quintile, 1980 and 1992, Los Angeles County

Income Quintile	1980 (%)	1992 (%)
Lowest	37.4	56.3
Second	27.7	21.4
Middle	17.0	11.4
Fourth	10.0	6.5
Highest	7.9	4.5

Source: Luo, 2000

Although the majority of transit riders are poor, the poor do not use transit for the majority of their trips. Using the 1995 NPTS data, Pucher, Evans, and Wenger (1998) show that average trips per day per person range from 3.4 for the lowest income category to 4.2 for the highest income category, and average miles per day per person range from 17.4 to 28.6. The greater difference in travel mileage across income categories is explained by differences in car ownership and modal use. While just 8.5 percent of all households do not have cars, one-third of the lowest-income households have no car, and almost half have one car. Limited resources leads to relatively more use of alternative modes — walking and transit — but the vast majority of all person-trips take place in private vehicles, even among the lowest-income households. While 32 percent of the poorest households (income less than $15,000) have no vehicle, 15 percent have two cars, and 5 percent have three or more cars. A car is clearly one of the first purchases that households desire to make; the car ownership rate jumps from 68 percent to 92 percent in the next-lowest income category ($15,000-$29,999) (Pucher, Evans, and Wenger, 1998).

Giuliano and Moore (1999) conducted a case study of a Los Angeles inner-city neighborhood. Interviews with local residents revealed that carpooling and paying others to get a ride were common forms of work travel for those without cars. Field observations at work sites showed a roughly even split between drive alone, carpool, and walking or transit (the two modes could not be distinguished, since transit stops were not always adjacent to work sites). Field observations at shopping centers showed a roughly even split between drive alone, carpool, and walking. Transit use was extremely low, despite the very high level of transit accessibility within the study area.

In addition to car access and income, prior research shows that transit use is related to age, sex, and race. Children and the elderly are more likely to use transit than adults under the age of 65 (Pucher, Evans, and Wenger, 1998). Gender variation on transit ridership is expected due to differences in social roles and household responsibilities. Traditional perceptions have been that women are more dependent on transit than men (Giuliano, 1979; Michelson, 1985; Pickup, 1985). However, increased female labor force participation has resulted in more complex travel patterns and consequently more demand for private vehicle use (Rosenbloom and Burns, 1993; Hayghe, 1996; Taylor and Mauch, 1996). Finally, several studies show that Blacks and Hispanics are more likely to use transit than other race/ethnic groups (Pisarski, 1996; Millar, Morrison, and Vyas, 1986; Rosenbloom, 1998). McLafferty and Preston (1997) found that Black women residing in the central city have the longest average commute times among all race and gender groups.

THE CONCEPT OF TRANSPORTATION DISADVANTAGE AND ITS CONSEQUENCES

Mobility is largely a function of resources; car ownership is correlated with income. As household income increases, car ownership also increases, and as car ownership increases, so does trip making and miles traveled. Conversely, households adapt to limited mobility resources by making fewer and shorter trips. In a case study of low income households in Austin, Texas, Clifton and Handy (1999) found that low income households have less access to a variety of goods and services due to limited mobility. Transit access is low due to limited and infrequent service. Walk access is inherently limited. Car availability is the critical factor in determining accessibility. Hence low income households engage in various forms of car sharing, from borrowing cars to taking rides.

The poor may be disadvantaged in at least three ways as a result of limited mobility. First, the poor may be “captive consumers” of goods, services, or medical care. Retail establishments may be able to charge higher prices when consumers are limited to local neighborhood stores. Households may be limited to the parks, movie theaters, and other recreational facilities close to home. Social networks may be limited to the local neighborhood. And choice of medical or dental services may be limited not simply to what one may afford, but to nearby destinations.

Research on these issues is quite limited. Studies have demonstrated the scarcity of major supermarkets and banks in inner-city areas (Cotterill and Franklin, 1995; Alwitt and Donley, 1996; Caskey, 1994). An analysis of accessibility to parks revealed lower levels of access among inner-city residents, due to both fewer local parks and limited resources to travel to more distant parks (Talen and Anselin, 1998).

The second dimension of disadvantage is what has come to be called "spatial mismatch." The concept of spatial mismatch was developed by Kain (1968). The argument is that suburbanization has been selective — the more affluent white population has suburbanized, while the minority (and predominantly poor) population has remained in the central city. Differential rates of suburbanization are explained by many factors, including exclusionary zoning practices and discrimination in the housing market. As jobs have suburbanized (particularly low-wage jobs), central city workers have experienced a relative decline in job accessibility, which has in turn led to both higher unemployment rates and longer commutes for those who are employed. Less job accessibility implies fewer job opportunities, and hence less likelihood of finding a job, while longer commutes imply lower net wages.

Kain's work touched off an extended academic debate that has persisted to this day. Are the higher unemployment rates observed among central city Blacks and other minorities the result of this spatial mismatch, or the result of discrimination by employers, lack of job skills, lack of access to social networks which provide access to job opportunities, or some combination of these factors? The spatial mismatch hypothesis has been tested by comparing unemployment rates, commute distances, or net wages across otherwise similar workers living in central cities and suburbs.[2] There is some evidence of spatial mismatch in studies using average commute distance of low-wage workers, meaning that workers residing in central cities have longer commutes than workers residing in the suburbs (Ong and Blumenberg, 1998). Taylor and Ong

[2] For recent reviews, see Holzer, 1991; Kain, 1992; Ihlandfeldt and Sjoquist, 1998.

(1995) explain observed shorter commute distances but longer commute travel times as the result of lower rates of car ownership and greater use of public transit by minority central-city residents. Evidence based on unemployment rates is mixed; lack of access to jobs explains very little of the differences in unemployment rates between central-city and suburban residents (O'Regan and Quigley, 1996; 1998). In a related study, however, Ihlandfeldt (1996) found that transit access to suburban low-wage jobs was significantly related to the probability of Black workers filling those jobs. Despite extensive research on this issue, the evidence on spatial mismatch remains mixed.

The third source of disadvantage is the cost of transport services. With regard to public transit, the poor pay relatively higher fares per unit of service than the non-poor. The poor take shorter trips and are less likely to travel during peak periods. The non-poor take longer trips and are more likely to travel during peak periods. Flat fares, or fares only loosely based on trip distance, mean that short trips have a higher price per unit (Wachs, 1989). Because transit demand is higher in poor areas, transit productivity is higher, fares contribute a higher proportion of operating costs, and subsidies per trip are lower. Shifts in transit financing have further increased the financial burden on the poor. Federal subsidies have declined, and local subsidies have increased. Federal subsidies come primarily from general revenue funds and hence are a relatively progressive income source. Local subsidies typically come from various types of use taxes, which tend to be regressive in incidence.

Results from a recent Los Angeles case study are illustrative (Luo, 2000). Table 2-2 gives the distributional incidence of total transit costs (capital and operating, calculated as three year averages) for Los Angeles County residents, for 1980 and 1992. The big changes in revenue sources between the two periods were fares, reduced federal subsidies, and new local revenues from two sales tax measures. Since relatively more poor people were using transit (see Table 2-1) and transit fares had been increased, the lowest quintile contributed a greater share of fare revenue. In addition, sales taxes are highly regressive, and the shift to a sales tax resulted in greater tax contributions from the lowest quintile. The middle quintiles were hardly affected, while the contribution of the highest income quintile declined.

Table 2-2: Distribution of Total Transit Costs by Income Quintile, 1980 and 1992, Los Angeles County

Income Quintile	1980 (%)	1992 (%)
Lowest	16.8	22.1
Second	15.6	14.7
Middle	15.7	15.8
Fourth	19.0	18.9
Highest	32.9	28.6

Source: Luo, 2000

Low income households also spend a much higher proportion of after-tax income on transportation — about one-third — than the average household, which spends about 17 percent (Deka, 2001, calculated from 1993 Consumer Expenditure Survey). Relatively high expenditures are explained by the high cost of car ownership. The poor are more likely to own older, less reliable and less fuel-efficient vehicles. Lower purchase costs are offset by higher repair and running costs.

It has been argued that one explanation for extensive car ownership even among the poorest households is the lack of high-quality transit service. Essentially, public transit is such a poor substitute for the automobile that the poor incur the expense of car ownership in order to obtain the mobility a car provides. If this is the case, then we should observe lower rates of car ownership in areas where transit service is more available. Deka (2001) conducted a Los Angeles case study to determine the relationship between transit access and car ownership. Transit access was measured with respect to census tract of residence as a gravity formulation incorporating route density and service frequency. Controlling for the dependency between the two variables (e.g., transit providers will supply more service in response to greater demand, and households without cars will locate in areas with more transit), Deka (2001) found that the relationship is small but significant. The probability of auto ownership decreases only slightly with increases in transit availability.

Another way of assessing impacts of transportation disadvantage is to look at the households who do not own cars. The share of households without cars has dropped from 21 percent in 1969 to about 9 percent in 1995. Lave and Crepeau (1995) examined households without vehicles using the 1990 NPTS data. Households residing in the New York Metropolitan Statistical Area (MSA) were excluded, because New York is so different from the rest of the US. Elderly, retired persons make up the majority of zero-vehicle households. Most of the remainder are single persons without children, and two-thirds of zero-vehicle households have no workers. As expected, persons in zero-vehicle households make an average of 1.8 trips per day, compared to the average of 3.2 trips per day. Persons in zero-vehicle households also were more likely not to have traveled at all on the survey day (40 percent vs. 21 percent for the general population).

Most zero-vehicle households are low income households, but most low income households own at least one car, as noted earlier. Therefore the question is, to what degree does no car indicate travel disadvantage vs. reduced demand for travel? Research on the elderly show that they make fewer trips and travel fewer miles than the non-elderly, whether or not they own cars (Rosenbloom, 1994a). The Lave and Crepeau (1995) analysis suggests that only a small segment of zero-vehicle households are truly disadvantaged.

THE LIMITED MARKET FOR TRANSIT

Transit's limited market share, even among the poor and among those who do not own cars, leads to the obvious question of why. Several possible explanations have been explored. First, decentralization and the dispersion of activities make contemporary land-use patterns difficult to serve with conventional fixed-route transit. Cost-effective transit requires concentrated origins and destinations, so that transit capacity is effectively utilized. Several studies have documented the relationship between metropolitan density and transit use (e.g., Pushkarev and Zupan, 1977; Newman and Kenworthy, 1998). Dispersed origins and destinations require extensive route systems. The high costs of operating such systems leads transit agencies to offer infrequent service that cannot compete with the automobile (Meyer and Gomez-Ibañez, 1981; Fielding, 1995). Comparisons of transit travel time with auto travel time indicate that a transit trip takes 2 to 3 times as long as the same trip by car, even in areas where transit service is reasonably available (e.g., Taylor and Mauch, 1996). In suburban areas, many destinations simply cannot be reached by transit.

A second possible explanation is that even in areas where demand is adequate to support high quality transit, poor service quality, crowded buses, and fear of crime may deter transit use. There is little research on this issue. Levine and Wachs (1986) conducted an extensive study of crime in and around transit in Los Angeles, and found that fear of crime was particularly a problem for transit dependents. In a series of interviews with low income shift workers in Los Angeles, Giuliano and Moore (2000) found that long travel times, high fares, personal safety, and lack of service were the most frequent explanations given for not using transit. Crowded buses adversely affect service quality. Dwell time increases, making schedule reliability deteriorate. Heavily crowded buses may skip stops, leaving passengers stranded at bus stops. Standing on a bus is difficult for the elderly or for people carrying packages or small children.

A third explanation is spatial mismatches between where people live and where people work, as discussed in the previous section. A classic example is the reverse commute, in which central-city residents commute to suburban jobs. Transit service is oriented to the downtown commuter, and consequently reverse commuters experience a much lower level of service (Ong and Blumenberg, 1998). There is also the possibility of a temporal mismatch. Many low-wage jobs have non-traditional work hours. Office janitorial services are performed at night and on weekends. Retail jobs often require evening or weekend work. Swing and graveyard shifts still exist in manufacturing. Public transit is oriented to the traditional commute — to work (inbound) in the early morning and from work (outbound) in the late afternoon.

Finally, it is possible that contemporary lifestyles are simply incompatible with conventional transit service. Research shows that travel patterns have become more complex — people often combine a series of activities in a single travel "tour", and many incidental stops are made in conjunction with the work trip (Hanson, 1995; Vincent, Keyes, and Reed, 1994). The extent to which these observations are true for low income households or for the transportation disadvantaged is unknown.

CHAPTER THREE
RESEARCH APPROACH, DATA AND DESCRIPTIVE STATISTICS

RESEARCH APPROACH

The purpose of this research is to evaluate the role of public transit in providing mobility for low income households.

Measuring Mobility

What is the appropriate measure of overall mobility? This is a matter of current debate (e.g., Hanson, 1995; Handy and Niemeier, 1997). On the one hand, it can be argued that the more one travels, the more benefits from travel one obtains. However, travel is costly, both in time and money, so the rational individual seeks to minimize these costs. Travel demand is an indirect demand — one travels in order to consume goods and services that are spatially dispersed.[3] Willingness to travel reflects willingness to pay for the expected benefits of the activity at the destination. Discussions of mobility often involve accessibility — to the extent that activities are more concentrated in space, less travel (mobility) is required to achieve a given level of activity benefits. However, controlling for land-use pattern, more travel should indicate more consumption of goods and services (activities), or more investment in travel in order to consume preferred bundles of goods and services.

Consider an ideal measure of mobility. Following the work of Hägerstrand (1970), mobility reflects an individual's "activity sphere" — the geographic range of activities conducted over the course of the day. The activity sphere is determined by resources and constraints of the individual and by the spatial distribution of activity locations. Resources include such things as income, supply of transportation services, and time. Constraints may be resource related (e.g., no car, no transit available) or schedule related (e.g., fixed work hours, fixed operating hours of business establishments). The spatial distribution of activities determines the number of opportunities that may be accessed for a given quantity of travel resources. Travel outcomes are the result of the individual's activity choices, given his/her set of resources, constraints, and

[3] Recent survey research by Mokhtarian and Salomon (1999) suggests that travel may be perceived as a benefit more often than thought by travel behavior researchers.

spatial opportunities. An ideal measure of mobility would capture all of these factors. Unfortunately, however, the data are not available to construct such a measure.

It is clear that an appropriate measure should capture travel for all purposes. Total travel can be measured in terms of trips, distance, and time. Trips capture the total number of activities conducted, but provide limited information. Many trips are mandatory, in the sense that household maintenance requires some amount of trip making, and most jobs require traveling to work, hence the greater regularity of trip frequency across population segments. The more interesting question is *where* people choose to shop or work. The spatial range of travel over the course of the day is captured by distance and time. Of these, distance is the more appropriate measure of mobility. Travel time is problematic, because it is determined both by distance and speed. In this analysis we measure mobility as total distance traveled over the course of one-day period.

From a public policy perspective, work trips are particularly important. We are concerned about whether low income households must incur higher commuting costs due to spatial mismatch, and what this may mean for employment opportunities and job retention. However, work trips are also important from a behavioral perspective, because work location and schedule are critical factors in defining daily activity and travel patterns. Therefore our analysis includes total daily travel as well as travel associated with the journey to and from work (e.g., a subset of total daily travel).

Transit Users vs. Non-Transit Users

Our literature review has shown that use of public transit has declined even among low income households, as more such households own and use private vehicles. We reviewed a series of explanations regarding why this is the case, and we noted that evidence to support some of these explanations is limited. Focusing our attention on those who use transit would provide only partial information. We would learn something about how and why these individuals use transit, but we would learn nothing about why other similar individuals do not use transit. Therefore it is appropriate to include all travel in our analysis. We are interested in such questions as,

- Under what conditions is transit used?
- Are patterns of travel and transit use different across income groups, holding relevant factors constant?
- What are the barriers to more extensive transit use? Are they the result of travel demand characteristics, or other factors?

Target Population

A third measurement issue is which population segments should be included in the analysis. Our focus is low income households, and a case could be made for restricting the analysis to such households. However, comparing travel patterns across low income and not-low income populations may provide a clearer understanding of differences in travel between these groups. Transportation disadvantage is a relative concept. Therefore all households are included in our analysis.

How do we define the low income population? After reviewing several possibilities, we selected two measures. The first measure is based on the 1995 poverty threshold, adjusted for household size, as defined by the U.S. Census Bureau. The Census definition is based on food consumption requirements. Annual costs of food consumption are used as the basis for factoring up annual income to determine the poverty definition. The poverty threshold does not vary geographically. It is based on money income before taxes, and excludes capital gains and non-cash benefits. The poverty threshold is updated annually based on the Consumer Price Index.[4] There are many problems with the U.S. Census definition (Citro and Michaels, 1995); however we decided that it was sufficiently valid for our purposes.

The second measure is based on the Department of Housing and Urban Development's (HUD) definition of low income. HUD defines "low income" and "very low income" in order to determine eligibility for housing subsidies. HUD definitions are adjusted both for household size and geographic region, to account for especially high-cost or low-cost housing markets. The "low income" definition is approximately 80 percent of the region's median household income.[5]

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[4] For details, see Dalaker and Naifeh (1998), Appendix A.
[5] The calculation for low income is actually based on the calculation for very low income. See HUD Notice PDR-95-05 (1995) for details.

HUD definitions are adjusted annually, as median income is estimated annually. The HUD definition provides a less restrictive low income category.

DATA

We use the 1995 NPTS survey for this research. The NPTS is a household-based travel survey conducted periodically by the Federal Highway Administration (FHWA). The 1995 survey included 42,000 households and 95,360 persons. The sample was drawn from a stratified random digit dial telephone sample. In addition, several metropolitan areas paid FHWA to over-sample their areas. Areas with high transit use are also over-sampled, in order to obtain as large a sample as possible of transit trips. The survey includes household, individual and vehicle information, as well as a one-day travel diary for each person 5 years old or older. The travel data were collected in a two-stage process. Households were given one-day travel diaries to complete for each eligible member of the household. The diaries were reported to the interviewer via telephone. The travel diary data includes a total of 409,025 trips. The data files also include basic geographic and demographic data drawn from the U.S. Census and updated for 1995, provided at both block and census tract level and linked to each household record. In addition to the actual one-day travel information, the survey includes information on the journey to work, transit use, and a variety of attitudinal information. NPTS is therefore an exceptionally rich dataset.

Despite its richness, however, NPTS has some serious shortcomings for this research. First, indicators of transit accessibility are very limited — access to bus or rail stops is recorded, but there is no way to measure transit network accessibility. Second, attitudinal data on transit is recorded only for those who use transit. It is therefore not possible to measure attitudes that may prevent transit use (e.g., fear of crime). Attitudes and perceptions are known to be important explanatory factors in travel behavior (Kitamura, Mokhtarian, and Laidet, 1997). Finally, job-related data are limited. There is no information on job tenure. Respondents were asked to provide the Zip Code of their place of work, but this information is not released to the public. The Zip Code information is used to generate a variable to indicate whether or not the person works in a central city. There is also information on whether the work place is fixed or variable, or at home. The occupation data were never categorized, and therefore cannot be used. There is no information on work schedule, except what can be surmised by the time the individual starts and ends his/her work trip.

A very complex weighting procedure was developed for the NPTS data, as the weights must adjust for various types of response bias as well as the over-sampling of large metropolitan areas with rail transit and of areas that contracted with NPTS for larger samples.[6] The weights also expand the sample to estimates for the US population. In order to conduct statistical tests, we adjusted the person weights to scale the sample down to its original size.[7] This is a second-best procedure, as the weighting scheme in theory requires statistical calculations that are not available in most statistics software packages. The effect of using conventional statistics is to bias downward estimates of variance, and therefore increase the probability of Type I errors (reject the null hypothesis when it should be accepted).[8] Increasing the stringency of statistical significance tests compensates for this problem.

A total daily travel data file was constructed by aggregating all travel day trips and their characteristics for each person, using the 93,560 observation NPTS person file as the working file. Travel period trips and trips longer than 75 miles were excluded from the analysis. Most of the results reported here are based on the person file, and all are based on the adjusted weights described above. Because of missing data on key variables, actual sample size varies by type of analysis.

DESCRIPTIVE STATISTICS

We begin by identifying poor and low income households. As noted earlier, poverty status is adjusted for household size. We matched the reported household income categorical data as closely as possible to the income limits defined by the U.S. Census Bureau. Table 3-1 gives the results. The highest shares of poor households are found among single-person

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[6] See NPTS Users Guide, Chapter 3 for a description of the weighting procedure. See NPTS Users Guide, Appendix G on estimating sampling errors.

[7] The adjusted weights are obtained by dividing the person weight by its mean value.

[8] Specifically, the standard deviation of a given variable is biased by a factor of $1/\sqrt{a}$, where a = mean value of the weight variable. Correct calculation requires replication techniques or Taylor Series estimation procedures, neither of which is available in standard statistical software packages. Comparisons with results based on conventional procedures show that differences are quite small and do not affect results except in cases of borderline significance.

households (reflecting many single persons retired or unemployed), and among the largest households (reflecting households with many children). In terms of numbers, however, there are relatively few large households; single-person households make up 40 percent of all poor households.

Table 3-1: Distribution of Households by Poverty Status and Size

	Number of persons in household						
	1	2	3	4	5	6	Total
Poverty HH income cut-off ($ 1995)	10,000	10,000	15,000	15,000	20,000	> 20,000	
Poor (col %)	20.7	7.2	12.6	9.3	18.9	22.6	13.2
Not poor (col %)	79.3	92.8	87.4	90.7	81.1	77.4	86.8
Total (row %)	25.6	31.3	17.2	16.1	6.8	3	100

Similar information for low income households is given in Table 3-2. In this case, household income was adjusted both for geographic region (state) and household size, so income cut-off levels are given relative to the "base". Overall, about 37 percent of all households in the sample are defined as low income. The pattern across household size is similar. Single-person households account for about 35 percent of all low income households.

Table 3-2: Distribution of Households by Low Income Status and Size

	Number of persons in household						
	1	2	3	4	5	6	Total
Median family income factor (% of base)	70	80	90	base	108	116+	
Low income (col %)	51.2	30.47	31.5	30.5	41.2	48.3	37.2
Not low income (col %)	48.8	69.5	68.5	69.5	58.8	51.7	62.8

Characteristics of Poor and Low Income Households

Poverty and low income status are related to life cycle, race/ethnicity, and employment. The poverty rate is highest among single-adult households with children, followed by single-adult retired households, as shown in Table 3-3. The lowest poverty rate is among households with at least two adults. The pattern is similar for low income status. Nearly two-thirds of single-adult households with children are low income, and close to three-fourths of retired single-person households fall into this category. Two-adult households, with or without children have the smallest share of low income households.

Table 3-3: Households by Life Cycle, Poverty, Low Income Status

	1 adult no kids	≥2 adults no kids	1 adult + kids	≥2 adults + kids	1 adult retired	≥2 adults retired	Total
Poor	15.6	5.8	34.8	9.9	33.3	10.6	13.2
Not poor	84.4	94.2	65.2	90.1	66.7	89.4	86.8
Low income	42.6	22.8	65.7	20.4	72.4	42.1	37.2
Not low income	57.4	77.2	34.3	69.6	27.6	57.9	62.8
Share of total sample	18.2	23.0	5.5	34.7	7.4	11.1	100

The relationship between race/ethnicity and poverty is well documented. Table 3-4 gives shares of poor/non-poor and low income/not low income by race/ethnicity for the NPTS sample. The poverty rates for non-Hispanic Blacks and Hispanics are much higher than those for non-Hispanic Whites and Asians.

Table 3-4: Persons by Race/Ethnicity, Poverty, Low Income Status

	White	Black	Hispanic	Asian	Other
Poor	8.6	26.2	25.1	8.7	16.1
Not Poor	91.4	73.8	74.8	91.3	83.9
Low income	30.1	54.4	48.7	38.1	40.6
Not low income	69.9	45.6	51.3	61.9	59.4
Share of total sample	73.7	12.0	10.0	2.1	2.3

Poverty status is also related to employment. Figure 3-1 shows number of workers in the household by poverty status and low income status. Over half of all poor households have no workers, and an additional one-third have just one worker. Among low income households, 38 percent have no workers and 37 percent have one worker.

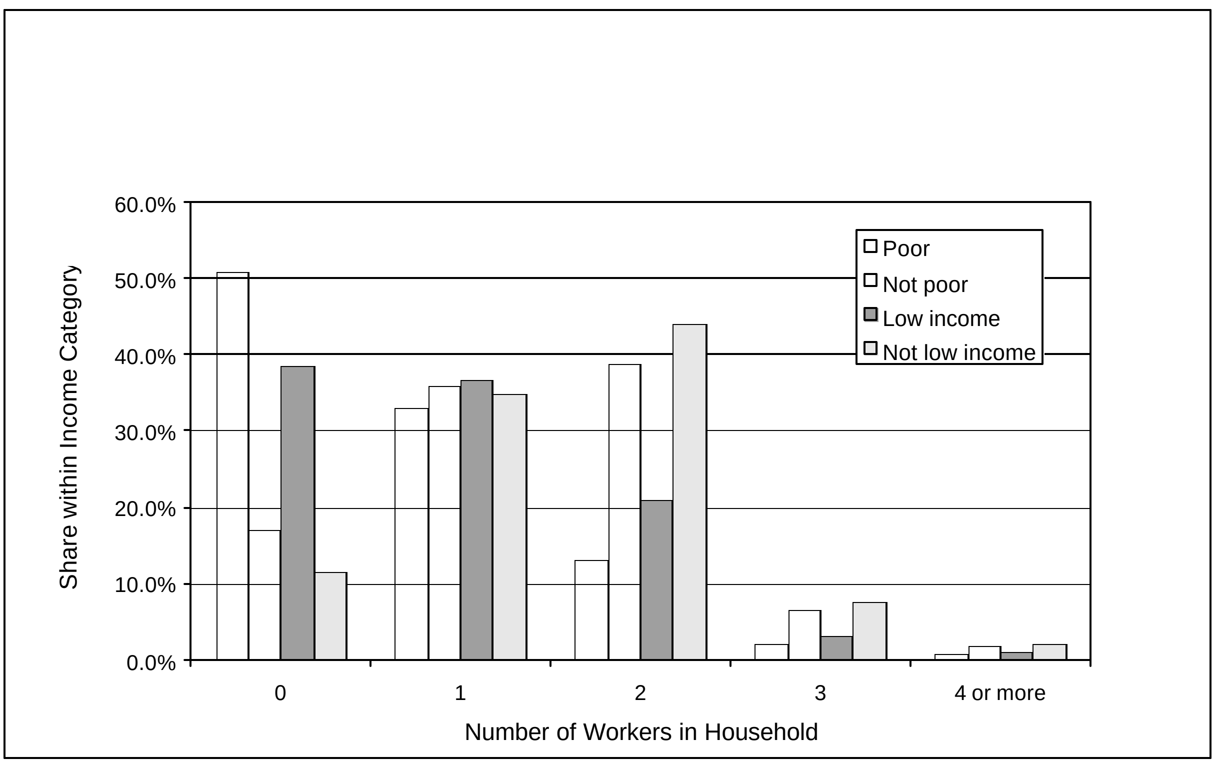


Figure 3-1: Poverty, Low Income Status by Numbe r of Workers in Household

We compared residence location patterns across income categories. The poor are concentrated in the largest metropolitan areas, and in non-metropolitan areas. Figure 3-2 shows that the non-poor are relatively more concentrated in the largest metropolitan areas, but relatively less concentrated in non-metropolitan areas. Within metropolitan areas, the poor are more concentrated in the central city, and hence are more likely to reside in high-density areas, defined here as census tracts with population density of 10,000 persons per square mile or more — about 17 percent of the poor live in high-density areas, compared to 8 percent for the non-poor.

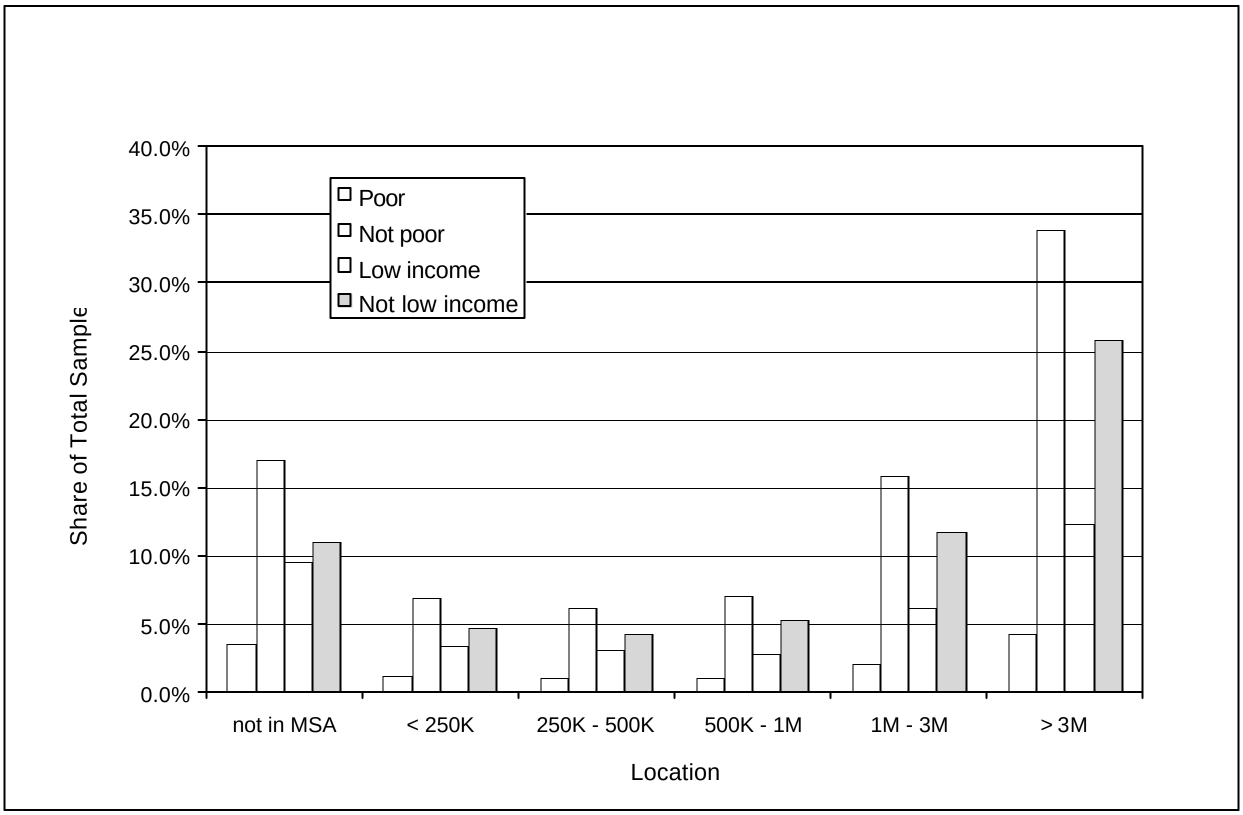


Figure 3-2: Poverty, Low Income Status by MSA Location

It is well known that persons from low income households have less access to private vehicles. Just 5 percent of all households do not have any drivers (defined as person having a valid driver's license), but 12 percent of low income households and 22 percent of poor households have no drivers. This is in part a function of older, retired persons (more likely female) making up a large portion of poverty households. Similarly, our sample has 7.7 percent of households having no private vehicle, but 17 percent of low income households and 30 percent of poor households have no private vehicle. Fully three-fourths of poor households have one or zero vehicles, indicating limited car access. In contrast, almost two-thirds of non-poor households have two or more private vehicles.

Travel Characteristics

We turn now to a description of basic travel characteristics. We describe total daily travel, travel by mode, and travel by purpose. Also included is a description of transit use, access to transit, and attitudes regarding transit.

Total Daily Travel

Table 3-5 gives mean and median values for total daily trips, travel distance and travel time. The averages include zero trips, e.g., persons who did not travel on the diary day. Table 3-5 shows clearly that poor or low income persons travel less by any measure than non-poor or non-low income persons. About one-fourth of the poor made no trips on the travel day. Since many more poor or low income persons did not travel, average travel distance and travel time are significantly lower as well. Differences between poor and non-poor are shown graphically in Figures 3-3 and 3-4, which give cumulative distributions for total trips and total daily travel time respectively.

Table 3-5: Total Daily Trips, Travel Distance, Travel Time

	Trips			Distance (miles)		Time (minutes)	
	% no trips	mean	Median	mean	median	mean	Median
Poor	25.4	3.1	2	18.1	6	47.3	30
Not poor	13.2	4.0	4	30.9	20	61.1	50
Low income	20.0	3.5	3	23.3	12	52.3	40
Not low income	11.9	4.2	4	32.6	22	63.2	52

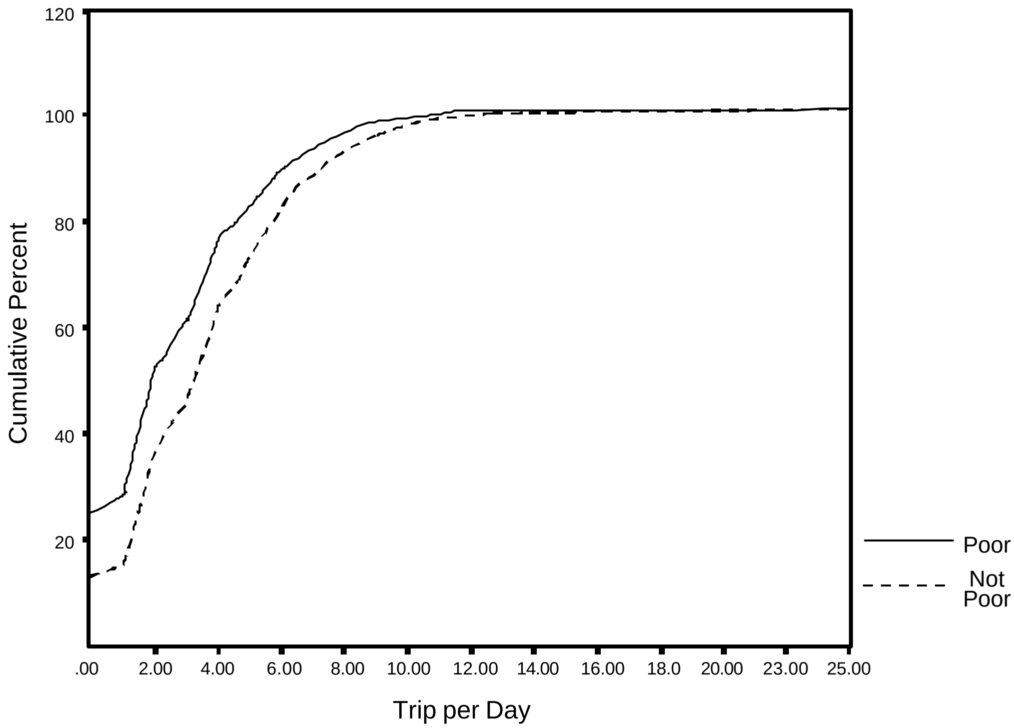


Figure 3-3: Trips per Day by Poverty Status

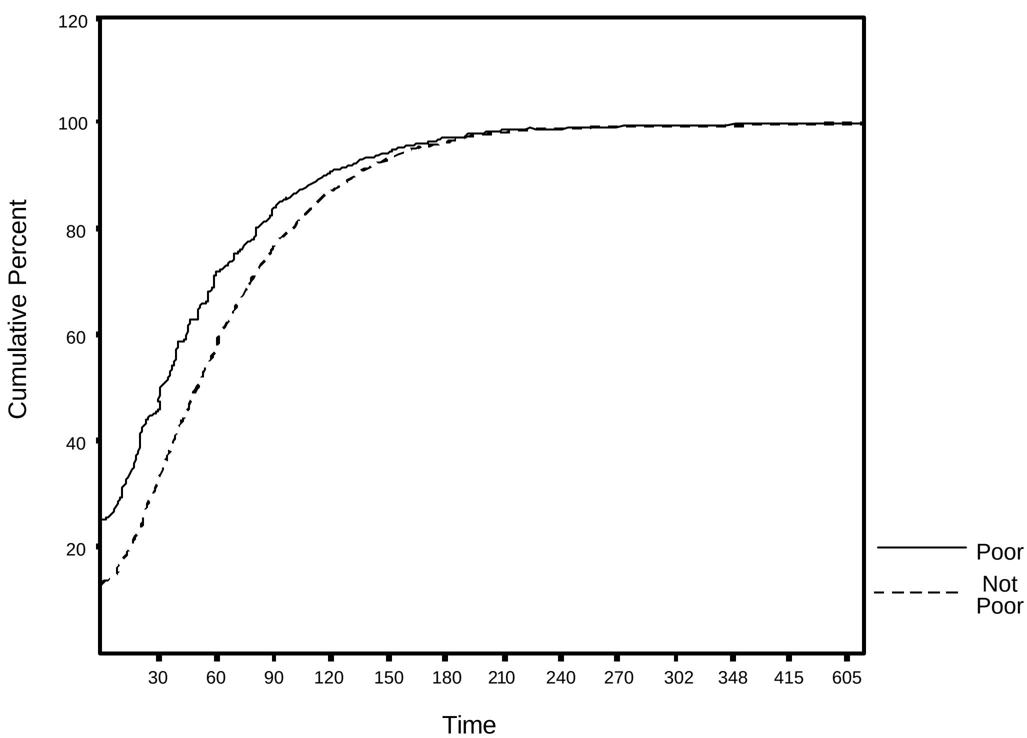


Figure 3-4: Daily Travel Time by Poverty Status

When the poor or low income do travel, they travel shorter distances and spend less time traveling, as shown in Table 3-6. Less time spent traveling is the result of fewer trips — note that average trip time is virtually the same for all groups. However, average trip distance is shorter for the poor and low income groups, indicating that lower-income travelers take more trips on slower modes, e.g., transit and non-motorized modes.

Table 3-6: Travel Characteristics for Those Who Made at Least One Trip

	Daily Distance (miles)		Daily Time (minutes)		Average Trip Distance		Average Trip Time	
	mean	median	Mean	median	mean	Median	mean	median
Poor	24.3	12.0	63.4	49	6.2	3.7	16.3	13.3
Not poor	35.6	25.0	70.4	60	8.4	5.7	16.5	13.3
Low income	29.0	17.9	65.3	50	7.2	4.5	16.2	13.2
Not low income	37.0	26.4	71.8	60	8.6	6	16.6	13.4

Trip shares by mode are given in Table 3-7. Limited car access is evident for the poor. Although the vast majority of all trips are taken by POV even among the poor, less than half of these trips are made as the POV driver. About two-thirds of all trips by non-poor or non-low income are made as the POV driver, and only about one-quarter of trips are made as a POV passenger. In contrast, close to 90 percent of all trips are made by POV for the non-poor. The poor also make a large share of trips by non-motorized modes; note that the walk/bike share is more than twice as large as the transit share. The poor are the heaviest users of transit, yet transit trips account for only about 5 percent of all their trips. Tables 3-5 through 3-7 suggest that the poor compensate with limited travel resources by traveling less overall (fewer, shorter trips), and by using alternative modes.

Table 3-7: Mode Shares

Mode	Poor	Not poor	Low income	Not-low income
POV - driver	47.0	64.7	56.3	65.9
POV - pass	30.6	25.9	28.1	25.6
Bus/rail	5.2	1.4	3.1	1.1
Walk/bike	13.9	5.7	9.6	5.1
Other	3.3	2.3	2.9	2.2

Differences in trip purpose across income groups are mainly for work and school/church (Table 3-8). Persons from poor households are less likely to be employed, hence the poor make fewer work trips. The difference in work trips is partially offset by a relatively greater share of school/church trips among the poor

.

Table 3-8: Trip Purpose

Purpose	Poor	Not poor	Low income	Not low income
Work/work related	13.9	21.9	17.4	22.8
Shop	20.9	19.7	20.9	19.4
Personal business	27.5	25.5	26.2	25.4
School/church	12.6	8.4	10.2	8.2
Social/recreational	25.0	24.3	25.1	24.0
Other	0.1	0.2	0.1	0.1

Transit Use: Actual Trips

Given the small share of transit trips that were taken on the travel diary day (about 1.2 percent of all trips for the entire sample), it is difficult to learn very much about transit use within any population segment. However, for completeness, we present some basic information on transit use from the day trip file. Of the trips taken by transit on the travel day, the shares by mode and income group are given in Table 3-9. Sample shares of the income groups are given in the last row of the table for comparison purposes. The poor account for about one-quarter of all transit trips, which implies about twice the rate of transit use as the non-poor. The low income group accounts for over half of all transit trips, also proportionately greater than their sample share. More interesting is the split across modes, with the poor making over 80 percent of their transit trips by bus, and the non-poor making 60 percent of their trips by bus. The greater use of bus by the poor has been documented in prior research, and it is at the center of social justice controversies.

Table 3-9: Transit Trips by Income Group

	Poor	Not poor	Low income	Not low income
Share of transit trips	26.7	73.3	52.9	47.1
Share bus (col %)	82.0	60.0	77.0	53.4
Share rail (col %)	18.0	40.0	23.0	46.4
Share persons	13.2	86.8	37.2	62.8

We examined trip purpose for those who used transit on the travel day. The largest category is work or work related (35.7 percent), followed by social or recreational activities (19 percent), family or personal business (14 percent), shopping (12 percent), and school (10 percent). The remainder of trips is spread across six additional trip purpose categories. Transit trip purpose is different from trips by all modes (see Table 3-8). Transit is more likely to be used for work travel and less likely to be used for other purposes. Table 3-10 gives trip purpose divided into work and non-work by income group. Since the poor are less likely to be employed, they are less likely to use transit for a work trip. As income goes up, so does the use of transit for the work trip.

Table 3-10: Trip Purpose by Income Group

Trip purpose	Poor	Not poor	Low income	Not low income
Work & related	16.4	41.1	22.2	47.1
Non work	83.6	58.9	77.8	52.9

The NPTS asks respondents about access to a transit stop (for those who stated that they had access to public transit). They are asked the distance to the nearest bus stop and rail transit stop or station from their residence.[9] Average reported distances by MSA size are given in Table 3-11. We also computed average reported distance to a transit stop, which was the average distance to the closest stop, whether bus or rail. It turned out that even in the largest MSAs, the average to the closest stop is equivalent to the average to a bus stop, meaning that even in the few metropolitan areas that have extensive rail transit systems, the bus system is more ubiquitous. The data in Table 3-11 is as expected, in that distance to a transit stop declines with increasing metropolitan size, and access to rail transit is quite limited for all but the largest MSAs. However, Table 3-11 also shows surprisingly long average distances. It turns out that the distribution is skewed towards a few large values, and the median for each category is much shorter than the mean.

[9] Respondents were asked how far the nearest bus or rail stop was located from their place of residence. Distance intervals were given in blocks up to one mile, and in 1/4–mile increments for distances over one mile. NPTS staff converted blocks to fractional miles.

Table 3-11: Distance to Transit Stop by MSA Size

MSA Size	Distance to bus (miles)	Distance to rail (miles)
Not in MSA	2.5	4.0
< 250K	1.8	5.5
250K - 500K	1.2	4.0
500K - 1 M	1.3	6.8
1 M - 3 M	0.8	6.5
> 3 M	0.7	2.6

Table 3-12 gives average and median reported distance to a bus stop, by MSA size category, and by income status. We use three categories for MSA size, as the middle categories are quite similar to one another. Table 3-12 shows: 1) that the poor or low income groups live closer to a bus stop than the not poor or not low income groups, regardless of MSA size, 2) that most people live closer to a bus stop than the average would indicate, 3) that more than half of the entire sample live within 1/2 mile of a bus stop (meaning more than half of those for whom transit is available in their town or city). Those who are dependent on transit locate near stops, as would be expected. We also computed average distance to a stop for those who actually used transit, and that average was 1/2 mile or less for all but the smallest MSAs and those living outside MSAs.

Table 3-12: Distance to Bus Stop by Income Category and MSA

	Poor		Not poor	
	Average	Median	Average	Median
MSA > 3 M	0.35	0.10	0.71	0.30
Other MSAs	0.87	0.20	1.12	0.50
Not in MSA	1.85	0.30	2.46	0.50
	Low income		Not low income	
MSA > 3 M	0.52	0.20	0.74	0.30
Other MSAs	0.84	0.20	1.22	0.50
Not in MSA	2.29	0.50	2.44	0.50

Transit Use: Usual Behavior

The travel diaries were recorded on varying days of the week, so the daily trip patterns reflect both weekday and weekend activity patterns. As was indicated in Table 3-5, about 25 percent of poor persons did not travel at all on the survey day. Others may use transit irregularly, and therefore would be unlikely to have taken a transit trip on the survey day. We therefore chose another approach. The NPTS also included questions on usual travel behavior. Among these were questions on transit use and availability. We expected that many more people were at least occasional users of transit than took a transit trip on the survey day. We use these questions to examine transit use.

Table 3-13 gives transit use by frequency of use. We define "regular user" as a person who uses transit at least once per week, and "occasional user" as using transit at least once per month. The other categories are self-explanatory. As expected, a much larger proportion of respondents are transit users to some degree; about 14 percent of the entire sample uses transit at least occasionally. Table 3-12 shows that the share of respondents who state that transit is not available is about the same for all groups.[10] This may seem surprising, given that we would expect that those with limited car access would locate in areas where transit service is available. However, a large portion of the poor live in non-urban areas, hence it is not unreasonable that many poor persons do not have access to transit. Among those for whom transit is available, poor or low income persons are more likely to be regular transit users.

Table 3-13: Transit Use

Transit Use	Poor	Not poor	Low income	Not low income
Regular user	16.7	7.0	11.7	6.3
Occasional user	6.6	5.8	5.5	6.1
Not a user	38.8	48.7	44.5	49.1
Transit not available	37.9	38.5	38.3	38.5

As expected, regular use of transit is associated with shorter travel distance, but longer travel time, as shown in Table 3-14 for poor and non-poor only. The relative difference in travel distance between regular transit use and no transit use is slightly greater for poor, but the relative difference in travel time is much greater for the poor. This may be result of less POV use by the poor. For those with limited access to a car, most trips are taken by transit or walking. In contrast, the regular transit users among the non-poor are likely making other trips by POV. Note that persons may or may not have used transit on the survey day, hence these numbers are indicative of general levels of mobility associated with transit use.

[10] The question about transit use allows the respondent the choice of "transit is not available." The answer is based on the subjective judgment of the respondent, rather than any measure of distance to a transit stop, whether transit service operates in the census tract of residence, etc.

Table 3-14: Transit Use and Travel Distance, Time

		Regular user	Occasional user	Not a user
Daily travel Distance	Poor	14.0	15.3	18.9
	Not poor	23.9	31.9	31.2
Daily Travel Time	Poor	65.6	50.7	45.7
	Not poor	70.8	71.9	62.3

It is well known that attitudes are an important explanatory factor in travel behavior. The NPTS includes a series of questions on attitudes regarding the use of public transit. Respondents are asked how big a problem it is to get a seat, transfer, etc. There is one question on being worried about crime. Unfortunately, however, these attitudinal questions were asked only of those who stated they used transit at least once per month, and they were asked in alternating blocks. The survey gives us information on people who use transit, but not on people who do not use transit. We therefore cannot use the attitudinal information in our later analysis. Even for people who use transit, there are relatively few responses for any given question. The information provided is therefore only suggestive. We provide descriptive information for illustration.

Figures 3-5A through 3-5C show results on measures of the cost of using public transit. In each case, the respondent is asked, "Thinking about your use of public transit, please tell me whether this is a large problem, small problem, or no problem at all for you…." In all cases the poor view the measure as a large problem more than the non-poor, with the biggest difference on cost. Transferring is not a problem for most transit users, and the time it takes to use public transit is slightly more of a problem for the poor.

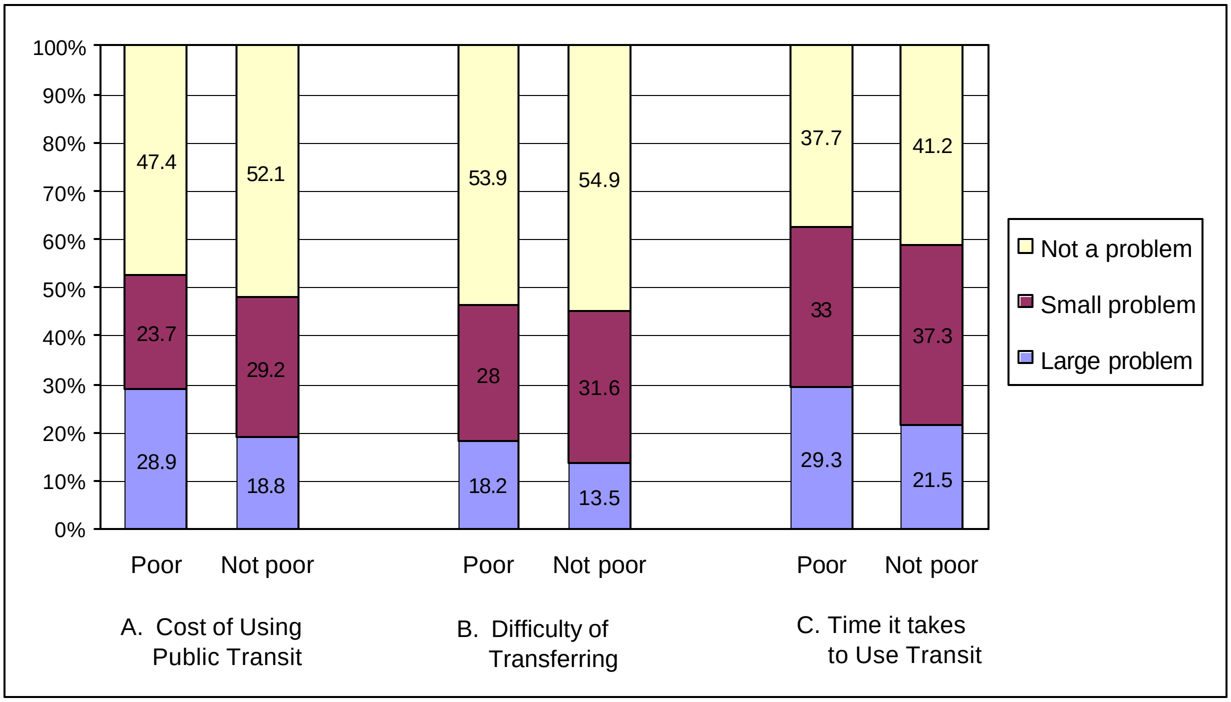


Figure 3-5: Problem When Using Transit

Figures 3-6A through 3-6D show results on measures of service quality. Somewhat more of the poor find crowding or getting a seat a large problem. The biggest difference between poor and non-poor is on the cleanliness of stations and vehicles. This may be the result of the poor being more likely to use inner-city services. Interestingly, there is little difference in perceptions about the availability of transit. This is counter to the hypothesis that the poor have more difficulty commuting to work via transit, but note that the poor (as we have defined them) are less likely to be employed. A major concern for planners and policy makers is fear of crime. Although a larger proportion of the poor consider fear of crime a large problem, about the same proportion of poor and non-poor do not consider crime a problem. All this tells us is that those who use transit do not worry a lot about crime. Presumably, those who do worry about transit crime would not use transit if at all possible. We might speculate that while crowded or dirty buses are an inconvenience, they are not a deterrent to transit use to the extent that fear of crime might be a deterrent. The greater propensity of the poor to perceive these factors as problems may be the result of more regular use of transit, or may reflect transit dependency. The poor may use transit even if they do not like to use it, because they have no other choice, whereas the non-poor have other choices and will not use transit if it is perceived to be inconvenient, uncomfortable or dangerous.

Finally, respondents were asked about having access to a car when needed. Not surprisingly, almost 40 percent of the poor viewed access to a car as a large problem, compared to less than 20 percent of the non-poor — an expected result consistent with the greater likelihood of the poor being transit dependent.

The descriptive analysis has presented basic information on travel patterns and transit use among poor and low income persons. We now turn to a more formal analysis of transit use.

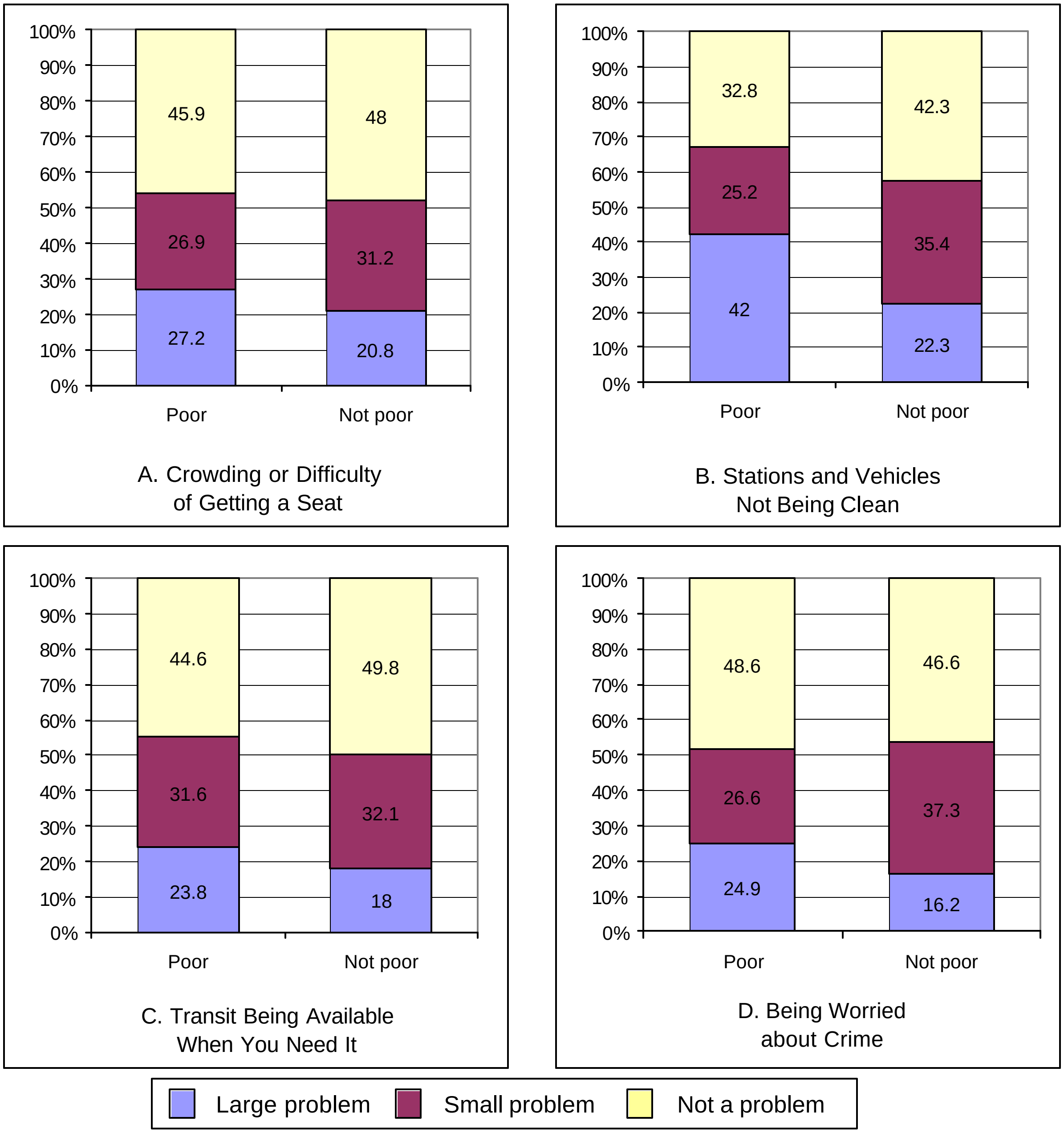


Figure 3-6: Measures of Transit Service Quality

CHAPTER FOUR
DATA ANALYSIS

INTRODUCTION

This chapter presents our data analysis of transit use. We conducted two types of analyses. As noted previously, only a very small share of trips were made by transit on the survey day. Restricting our analysis to those who actually used transit on the survey day would provide limited insight on why people use transit. We therefore used the data on frequency of transit use for one type of analysis. This allows us to compare those who use transit regularly, those who use transit occasionally, and those who do not use transit at all. Although transit accounts for less than 2 percent of all trips, it accounts for about 6 percent of work trips. Our second type of analysis examines actual use of transit for the journey to work.

EXPLAINING FREQUENCY OF TRANSIT USE

The first part of our analysis estimates a series of models to explain frequency of transit use. We begin by developing a set of hypotheses regarding factors that may be related to transit use, based on the literature. We identify five groups of factors:

1. Demographic characteristics
2. Economic factors
3. Geographic factors
4. Travel characteristics
5. Attitudes

The three "TOO groups" (too old, too young, too handicapped) are often captive transit riders. Thus we expect children and the elderly to use transit more frequently than non-elderly adults. Based on prior literature, we also expect Blacks, Asians, and Hispanics to be more likely transit users. The role of gender is not clear. On the one hand, some population segments (single mothers) are likely to have low incomes and hence be more dependent on transit. On the other hand, women's increasingly demanding social and household roles increases demand for auto travel. Many travel behavior theorists argue that travel choices are joint choices made at the household level. Household members decide who gets the car, who takes the children to school, etc., and allocate travel resources and responsibilities accordingly. The composition of the household therefore may affect transit use.

The major economic factors known to affect transit use are household income and car ownership. Household income is related to employment status and number of workers in the household. Employment status is also important, since transit is more likely used for the work trip, and transit service is oriented to serve the traditional peak period work trip. As household income increases, so does car ownership. The key factor for the individual is car access, or the availability of cars for household drivers. If there are fewer cars than drivers, there is more likelihood of using transit.

It was noted earlier that the largest U.S. metropolitan areas account for most U.S. transit ridership. This is due to the higher cost of using private vehicles (congested roads, limited and costly parking), particularly in downtown areas. In addition, the central parts of the largest MSAs have relatively high development densities and more extensive transit service, making transit more competitive with the private auto. Finally, a large share of poor and minority households live in the central parts of the largest MSAs. Therefore we include measures of metropolitan size and density. Access to transit service is of course a necessary condition for using transit. Distance to stops and transit headways are typical measures of transit availability. Since we have no information on headways, we consider only distance to the nearest transit stop.

It is argued that complex travel patterns — making several trips per day and combining trips into multi-stop tours — are dependent upon the private vehicle. Therefore multiple stop should reduce the likelihood of transit use. Strathman and Dueker (1995) found that commuters were reluctant to use transit because of the stops they made on the way to or from work. Trip scheduling may affect transit use — travel late at night or on weekends is unlikely to be made by transit.

Prior literature shows that attitudes are important predictors of travel behavior. As we noted earlier, fear of crime or other negative perceptions of transit may prevent transit use. It is unfortunate that the NPTS data preclude our consideration of attitudes.

Model Form

The dependent variable constructed from the survey responses is categorical (see Table 3-12 in previous chapter), hence OLS regression is not appropriate. We estimated three different model forms.

Model 1: Binary Logistic

The first model is a simple binary logistic regression model, where the dependent variable is simplified to "transit user" (anyone who uses transit bimonthly or more frequently) and "not a transit user" (everyone else). An individual is able to use transit only if it is available. In one sense we are modeling a conditional choice (using transit given that it is available). We do not consider a conditional choice model, because transit availability is determined by residential location — a long-term decision. We are more interested in the choice of using transit when it is available, so we restrict our model to the transit use choice. We therefore exclude from our sample those who do not have access to transit.

The binary model estimates the probability that an individual is a transit user as a function of the four groups of factors discussed above. It has the following form:

$$P_1 = \frac{\exp(b_0 + \sum_j b_j x_j)}{1 + \exp(b_0 + \sum_j b_j x_j)} \qquad (1)$$

or equivalently

$$P_1 = \frac{1}{1 + \exp(-b_0 - \sum_j b_j c_j)} \qquad (2)$$

where

P_1 = estimated probability of being a transit user

x_j = independent variables

b_j = estimated coefficients

This functional form guarantees that P_1 will always be a number between 0 and 1. The functional form assumes independence among the observations and extreme value distributed error terms. The logistic model is estimated via maximum likelihood, and model significance is tested via the likelihood ratio test. In logistic regression, the estimated coefficients can be interpreted as the change in the log odds associated with a change in the independent variable of one unit.

Model 2: Multiple Category Logistic

Although the binary logistic model is relatively easy to estimate and interpret, it does not take advantage of the three categories of transit users. It seems quite reasonable that people who use transit regularly may differ in some significant ways from people who use transit occasionally. In this case we have what we may define as an ordered categorical dependent variable, since the categories can be rank ordered from highest (regular user) to lowest (not a user). There are two possibilities for estimating models with ordered categorical dependent variables. The first is a multiple category logistic model. This is an extension of the binary logistic model that takes advantage of the IIA (Independence of Irrelevant Alternatives) property of the logit model, e.g., that the ratio of choice probabilities for any two alternatives is independent of the probabilities of all other alternatives in the choice set.

Taking equation (1) and expanding to R categories,

$$P_{r|j} = \frac{e^{a_r + b_r x_j}}{\sum_{r=1}^{R} e^{a_r + b_r x_j}} \quad r = 1, 2, \ldots R \tag{3}$$

We estimate binary models for each category pair, using one category as the reference category in each case. For three categories, two non-redundant logits can be formed:

$$g_1 = \log\left(\frac{P(regular)}{P(never)}\right) = b_{R0} + b_{R1}x_1 + b_{R2}x_2 + \ldots + b_{Rj}x_{Rj} \tag{4}$$

$$g_2 = \log\left(\frac{P(occasional)}{P(never)}\right) = b_{O0} + b_{O1}x_1 + b_{O2}x_2 + \ldots + b_{Oj}x_{Oj} \quad (5)$$

where,

b_0 = intercept

x_1 to x_j = independent variables

b_{R0} to b_{Rj} = regression coefficients of regular user

b_{O0} to b_{Oj} = regression coefficients of occasional user

The resulting estimated coefficients are interpreted with respect to the log odds of the pairwise comparison. For example, if never using transit is the reference category, the coefficients of the frequent user equation tell us the effect of the given independent variable on the probability of being a frequent user relative to the probability of never using transit.

Model 3: Ordered Logit

Another way of modeling an ordered dependent variable is to consider the choice process as

$$y = b_j x_j + e \quad (6)$$

As in the previous choice models, y is unobserved. Rather, we observe

$$\begin{aligned} y &= 0 \text{ if } y \le 0, \\ &= 1 \text{ if } 0 < y < m_1, \\ &= 2 \text{ if } m_1 < y < m_2, \ldots \end{aligned} \quad (7)$$

The m are unknown parameters to be estimated from the b_j. Depending upon our assumptions on error terms, we obtain a probability model with the general form of

$$P_j = \Pr(Y \le j|x)$$

$$P_j = m_j - [b_1 x_1 + b_2 x_2 + \ldots + b_k x_k] \qquad (8)$$

where, P_j = cumulative probability for the j^{th} category

m_j = threshold for the j^{th} category

x_k = predictor variables

b_k = regression coefficient of the predictor variable x_k

The thresholds or constants in the model, m_j (corresponding to the intercept in linear regression models) depend only on which category's probability is being predicted. Rather than predicting the actual cumulative probabilities, the model predicts a function of those values. This function is called the link function, which is a transformation of the cumulative probabilities that allows estimation of the model. We tried both the logit and probit link functions. The probit function assumes normally distributed errors with mean of 0, a strong assumption for non-linear data. We therefore decided to use the logit function. With the logit function, the probabilities are,

$$\text{Logit}(P_i) = \log \frac{P_i}{1-P_i} \qquad (9)$$

Testing for Income Effects

How should income be incorporated into the model, given that we are interested in transit use among the low income population? For the binary model, we can simply include an income dummy variable. Including such a variable implies that income only has a scale effect (increasing or decreasing the probability of being a transit user). However, it is also possible that interaction effects may exist. For example, low income may have more effect on using transit for women than for men. Results of prior studies do not preclude such effects, hence a correctly specified model should consider them. There are two ways to test for joint effects. One way is to estimate separate models for each income group and test for differences between coefficients.

From equation (1) we specify the exponential of $b_0 + \sum b_j x_j$ as

$$b_{l0} + \sum b_{lj} x_j \qquad \text{for low income,}$$

$$b_{nl0} + \sum b_{nlj} x_j \qquad \text{for not low income,} \tag{10}$$

and we test whether $b_{lj} = b_{nlj}$ for each b_j.

The second way is to estimate a single model,

$$b_0 + \sum_j b_j x_j + b_l x_l + \sum_l b_k x_j x_l \tag{11}$$

where x_j = independent variables

x_l = low income dummy variables

$x_j x_l$ = independent $\times$ low income interaction variables

b_l tests the independent effect of low income, and the b_k tests the joint effect of low income with each of the independent variables. The two methods are equivalent. Estimating equation (10) separately for each group generates the same coefficients as equation (11) for the base group (in our case the not low income group). For the binary model, we use the second method.

For ordered logit, there is a third alternative. It is possible to test for differences in variability of the independent variables, as for example if there is more variation in transit use among low income households. Since we have no reason to expect such differences in variation, we restrict our tests to the independent and joint income effects, using a model of the form of equation (11).

Data

The data for this analysis were drawn from the original sample of 93,560 persons. This sample yielded 48,546 valid cases for the transit use analysis. Figure 4-1 illustrates the process of filtering data. The first filter was based on the household survey question, “is transit available in your town or city?” The second filter was based on the question regarding usual behavior.

This question was asked only of persons 16 years old or older, and only of persons completing their own questionnaires. This left a sample of 50,035 observations. Additional missing data on key variables further reduced the sample, ultimately yielding 48,546 observations distributed across the three transit use categories as shown in the bottom panel of Figure 4-1. Variable descriptions and definitions are given in Table 4-1.

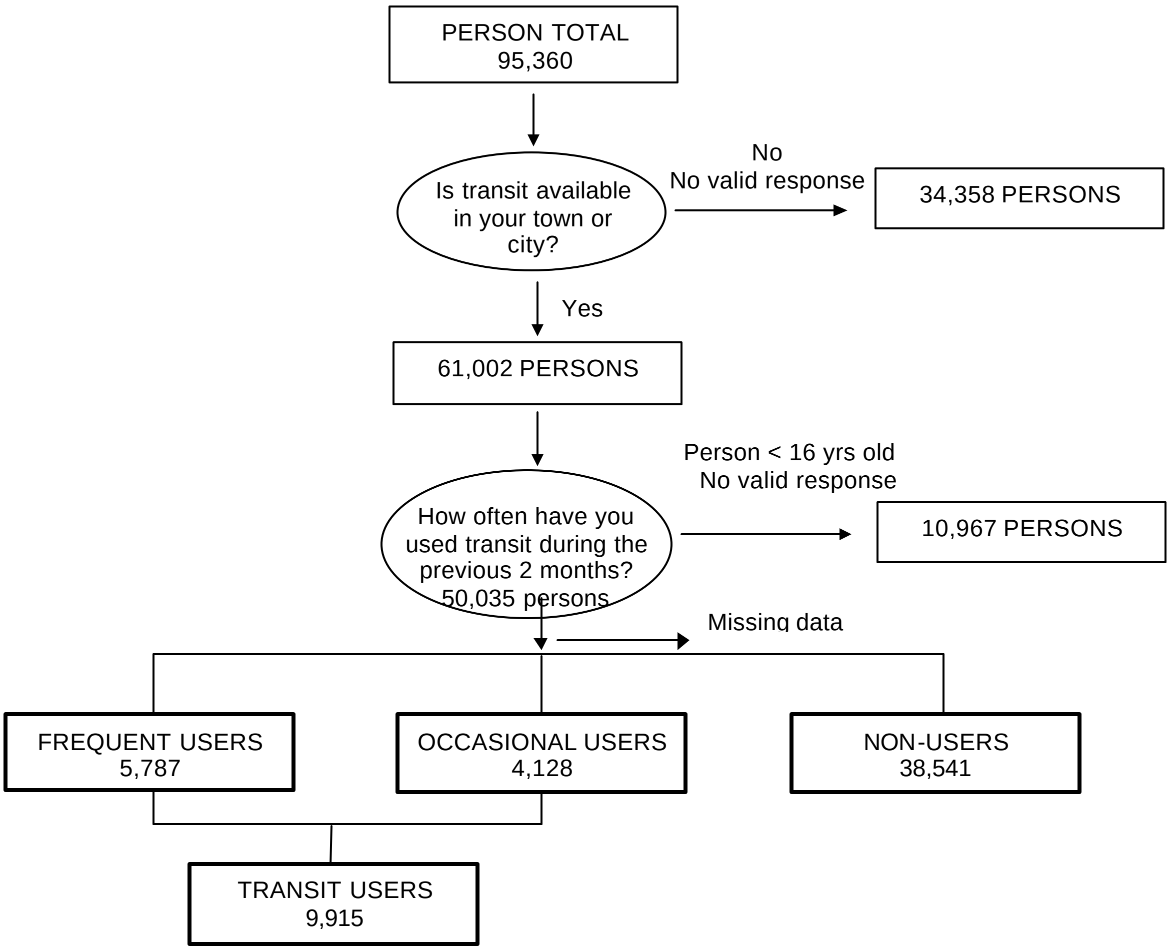


Figure 4-1: Development of Transit User Analysis Sample

Table 4-1: Variable Description

Variable Name	Description
Dependent variables	
TUSER	1= transit user, 0= non user
PTUSED	1= non user, 2= occasional user, 3= regular user
Demographic characteristics	
AGO	1= age 65 and older
BLACK _M	1= black male
BLACK_F	1= black female
HISPANIC_M	1= Hispanic male
HISPANIC_F	1= Hispanic female
HHSIZE1	1= single person household
Economic characteristics	
LOWINC1	1= Low income household member
NOEMP	1= retired or not employed
NOCAR	1= no cars and no drivers in household
MORECAR	1= more cars than drivers in household
Geographic characteristics	
LARGMSA	1= Living in MSA size with more than 3 million population
LOWDENS	1= Living in a census tract with population density < 500 persons/mi^2
HIGHDENS	1= Living in a census tract with population density >10,000 persons/mi^2
S_DIST	1= Access to transit within 0.5 mile of home
Trip characteristics	
FRQ	Total trips/day

Results

We present results for Model 1 and Model 3. Model 2 results are summarized in Appendix 4B.

Model 1 Results

Table 4-2 gives results for the binary model with the full sample and low income dummy variable. The table gives coefficient values (first column of numbers) and their standard errors (second column of numbers). Coefficients in bold are significant at $p < .05$. The overall model is significant. We provide the Cox & Snell (Psuedo-R) R-square, and percent of observations correctly predicted. However, these goodness-of-fit measures should be used with caution because of the large sample size and because we are using weighted data.

The coefficient of the low income dummy is significant and of the wrong sign, though of relatively small magnitude. Older age is significant and negative, also contrary to expectations. The result suggests that controlling for all other factors (including car ownership), the elderly are less inclined to use transit. These issues are further discussed in a later section. Also contrary to expectations, single person household status is not associated with the likelihood of being a transit user. We used several different combinations of household composition variables in other models (not shown here), and none of them were consistently significant. Apparently household composition is not a significant factor, once other demographic, economic and demographic factors are controlled.

The coefficients for Blacks, and Hispanics, both male and female, are significant. The value of the two Black coefficients suggests that sex is not significant, while the opposite is the case for Hispanics. We used joint race/sex variables in order to test for such differences. When we estimate models with separate variables for sex and race, the coefficient for sex is not significant (results not shown).

The coefficient for employment status is significant and positive, suggesting that those who are not employed are more likely to be transit users. The coefficients for the car access variables are strongly significant. Having no car in the household is the single greatest predictor of being a transit user, as expected. Having more cars than drivers in the household is associated with less likelihood of being a transit user, also as expected.

All of the coefficients for our geography measures are significant and of the expected sign. The largest MSAs have the most transit service, and the relative attractiveness of transit is increased by the scarcity and price of parking and by the availability of commuter express services. Note that our sample contains only those people who stated that transit is available to them. Hence these results do not reflect differences in the availability of transit across MSAs or neighborhood density.

Our transit access variable coefficient also has the expected sign. People who live close to a transit stop are more likely to be transit users. In contrast, our measure of complex travel, trips per day, has a significant coefficient with unexpected sign. This issue is further discussed below.

Table 4-2: Binary Model with Low Income Dummy

Variable	B[a]	S.E.
Constant	**-2.466**	.049
Demographic		
Age ? 65	**-0.526**	.056
Single person HH	0.002	.042
Black female	**0.482**	.051
Black male	**0.425**	.058
Hisp female	**0.229**	.060
Hisp male	**-0.157**	.062
Economic		
Low income	**-0.073**	.034
Not employed	**0.087**	.038
No cars	**2.246**	.061
Cars > drivers	**-0.347**	.050
Geography		
Large MSA	**0.745**	.032
High density	**0.974**	.039
Low density	**-0.474**	.063
Transit access		
Stop within .5 mi	**0.518**	.038
Travel		
Trips/day	**0.021**	.005
N		34442
- 2 Log Likelihood		29450.89
Psuedo-R		0.177
Percent correct		81.5

[a]Bold = sig. at p < .05

Table 4-3 gives results for the binary model with joint interaction terms. This model was estimated using a 60 percent random sample of the data, as computer memory limits precluded using the entire sample. Even with the addition of the joint interaction terms, the coefficient of the low income dummy remains negative and significant. Ten of the 14 interaction term coefficients are significant, indicating that there are many differences between the two groups. As noted in the previous section, the independent effect variable coefficients are equivalent to the coefficients of the "not low income" group, had we estimated the model separately for each group. The interaction term coefficients are therefore the difference between the effects for the two groups. The sum of the two coefficients (the independent plus the interaction for a given variable) corresponds to low income group coefficients. For example, older age has a significantly more negative effect on the likelihood of being a transit user for the low income group than for the not low income group. This may reflect the low rates of trip making among the low income elderly. Not only are they less likely to be transit users, they are less likely to travel at all. Continuing with the race/sex variables, we note that the coefficients are different between the income groups in every case. It is the interaction of poverty and race that is associated with higher likelihood of transit use for Blacks of both sexes and for female Hispanics.

Low income persons who are not employed are more likely to be transit users than others, suggesting greater transit dependency among those not employed. There is no difference in the effect of car ownership between the two groups. Turning to geography, the effect of living in the largest MSAs has a weaker effect for the low income group, but residential density has a greater effect. The density results suggest that low income persons are more sensitive to whatever factors density measures. However, the causality could be in the opposite direction, e.g., transit dependents are more likely to live in high-density neighborhoods and less likely to live in low-density neighborhoods. The same argument could be made for the result on transit access. In Chapter Three we noted that low income persons live closer on average to a transit stop than not low income persons. Finally, the trip measure is significant and negative for the low income group, as expected.

Table 4-3: Binary Model with Joint Effects

Base = Not low income

	Independent effects		Low income	
Variable	B[a]	S.E.	B	S.E.
Constant	**-2.414**	.074		
Low income dummy	**-0.402**	.150		
Demographic				
Age ? 65	**-0.283**	.093	**-0.605**	.147
Single person HH	-.067	.068	-.155	.117
Black female	**0.209**	.091	**0.750**	.138
Black male	0.156	.099	**0.660**	.155
Hisp female	**-.486**	.116	**1.050**	.170
Hisp male	**-.226**	.105	.262	.163
Economic				
Not employed	-.047	.063	**.514**	.101
No cars	**2.038**	.140	.201	.171
Cars > drivers	**-0.331**	.071	-0.004	.164
Geography				
Large MSA	**0.901**	.050	**-.471**	.091
High density	**.834**	.064	**0.446**	.107
Low density	**-.206**	.093	**-0.403**	.184
Transit access				
Stop within .5 mi	**0.424**	.055	**0.510**	.120
Travel				
Trips/day	**.021**	.008	**-.044**	.015
N				20219
- 2 Log Likelihood				17450.83
Psuedo-R				.183
Percent correct				81.9

[a]Bold = sig. at $p < .05$

Model 3 Results

As with Model 1, we estimate two versions of Model 3, a model with low income dummy, and a model with joint interaction terms. Results for the first ordered logit model are given in Table 4-4, and results for the second are given in Table 4-5. Overall the results are consistent with the binary model results. In both cases, the ordered model does a good job of distinguishing between levels of transit use, as indicated by the significance of the threshold coefficients and their different values with respect to one another. The model in Table 4-4 shows the low income dummy coefficient as significant and again of the wrong sign. We suspect that this result may be due to the correlation between car ownership and income. As before, older age is associated with less likelihood of being a regular transit user. The coefficients for Blacks of both sexes and for Hispanic females are significant and positive. Note that the coefficient values indicate that for Blacks, race is the key factor, not sex. As in the binary models, not having a car is the most powerful predictor of transit use; the negative effect of having more cars than drivers is much smaller than the positive effect of having no cars. All the geography variable results are as expected and are consistent with the binary model. It bears noting that we have already controlled for transit being available, hence these results indicate that among those for whom transit is available, living in a large MSA and/or in high-density residential areas is associated with a higher probability of being a regular transit user. And, all else equal, having a transit stop nearby increases the probability of transit use. As in the binary model, our trip frequency variable coefficient is significant and positive, contrary to expectations.

Table 4-4: Ordered Logit Model with Low Income Dummy

Variable	B[a]	S.E.
Threshold 1	**2.446**	.049
Threshold 2	**3.346**	.051
Demographic		
Age ? 65	**-0.531**	.054
Single person HH	-0.036	.041
Black female	**0.521**	.048
Black male	**0.444**	.055
Hisp female	**0.243**	.057
Hisp male	**-0.123**	.060
Economic		
Low income	**-.073**	.033
Not employed	0.052	.037
No cars	**2.380**	.054
Cars > drivers	**-0.371**	.049
Geography		
Large MSA	**0.749**	.032
High density	**1.033**	.037
Low density	**-0.476**	.063
Transit access		
Stop within .5 mi	**0.539**	.038
Travel		
Trips/day	**0.015**	.005
N		33651
- 2 Log Likelihood		15870.39
Psuedo-R		0.205

Results for the ordered logit joint interaction model (Table 4-5) are similar to that of the comparable binary model. There is no low income dummy variable; independent low income effects are captured in the threshold variables. Most of the interaction coefficients are significant, again indicating that there are many differences between the two income groups with regard to using transit. Many of the coefficients of the demographic variables are different. As with the binary model, the negative effect (e.g., reducing likelihood of using transit) of age is greater for low income persons, as is single-person household status. The effect of race is more positive for low income Blacks and Hispanics. Again, it is the combination of low income and race that matters. Not being employed increases the probability of using transit for low income persons, but not for others. The effects of car ownership are the same across both groups.

The results on the geography variable coefficients are also similar to the binary model results. Living in the largest MSAs has a less positive effect, while living in a low-density neighborhood has a more negative effect. As before, access to a transit stop has a more positive effect for the low income group. We noted above that these results may be indicative of more transit dependency and hence greater likelihood to live near a transit stop, regardless of MSA size. In contrast, the not low income group, who we presume are largely choice riders, are more sensitive to service quality, and therefore more likely to use transit where it is most convenient. Also as before, the trip frequency variable coefficient is significant and negative for the low income group, but significant and positive for the higher-income group.

Table 4-5: Ordered Logit Model with Joint Effects

Base = Not low income

	Independent effects		Low income	
Variable	B[a]	S.E.	B	S.E.
Threshold vars				
Threshold 1	**2.531**	.049		
Threshold 2	**3.427**	.051		
Demographic				
Age ? 65	**-0.248**	.072	**-0.535**	.109
Single person HH	.082	.051	**-.266**	.085
Black female	**0.324**	.069	**0.461**	.098
Black male	**0.206**	.076	**0.610**	.113
Hisp female	-.160	.082	**.790**	.117
Hisp male	**-.233**	.081	**.284**	.121
Economic				
Not employed	-.075	.049	**.261**	.074
No cars	**2.374**	.100	-.037	.119
Cars > drivers	**-0.384**	.055	.049	.122
Geography				
Large MSA	**0.920**	.038	**-.501**	.064
High density	**1.009**	.047	.069	.076
Low density	**-0.257**	.073	**-0.684**	.141
Transit access				
Stop within .5 mi	**0.443**	.042	**0.389**	.069
Travel				
Trips/day	**.029**	.006	**-.044**	.009
N				33651
- 2 Log Likelihood				15633.81
Psuedo-R				.211

[a]Bold = sig. at $p < .05$

Conclusions on Frequency of Transit Use

The results here are mostly consistent with the literature. First, for the entire sample, demographic, economic, and geographic factors all affect the likelihood of being a transit user. Contrary to the literature, older age is associated with a lower probability of being a transit user, although we know that the elderly are often transit dependent. We think our results are a function of the dependent variable — how often people use transit — and likely reflect the lower propensity to travel by any mode among the elderly. Other model specifications not shown in this report revealed that sex by itself was not significant. We noted in our literature review that recent research has indicated mixed results on women's use of transit. Race/ethnicity is positively associated with the likelihood of using transit, even when economic status and geography are taken into account. As expected, car availability is a powerful predictor of transit use. We noted that there is an element of interdependency here, since those who prefer to use cars are more likely to have them, and those who prefer to use transit are less likely to have them. However, given overwhelming preferences for auto travel, this effect is likely to be rather small. The geography and transit access variables performed as expected.

The joint interaction models showed that there are differences in the relationships between demographic factors and probability of transit use between the two income groups. Race/ethnicity effects are more pronounced within the low income group, suggesting that it is the intersection of poverty and race that is associated with difference transit use patterns. There are also differences in the effect of geography, with residence in large MSAs associated with greater likelihood of being a transit user for those with higher incomes. We noted that this is likely a choice rider effect, with transit a relatively attractive option for commuters in the largest MSAs. Living in low-density residential areas has a more negative effect for the low income group. This is difficult to interpret. We might speculate that this is a function of the greater propensity of the low income group to be regular transit users. This is consistent with the strong effect of access to a transit stop for the low income group.

Our efforts to capture the effect of complex travel behavior were not effective. The trips per day variable was either not significant or had the wrong sign. Part of the problem is the small number of people who are regular transit users, and, among them, the lack of variability in trip making. We thought that the problem was that the measure was too gross; we wanted something to capture chained or sequenced trips. However, measures of chained trips or the number of tours made per day did not perform any better. Perhaps trip chaining is simply not a significant factor in usual transit use.

TRANSIT USE FOR COMMUTING

In this section we use data from the day trip file to examine transit use for the work trip. Our analysis is based on home-to-work and work-to-home trips which include all stops made between home and work and between work and home.

MODEL DEVELOPMENT

We follow a similar process to develop and estimate models of transit use for the journey to work. In this case, the modeling task is straightforward, as we wish to model the choice of using transit for the trip to/from work. We are concerned only with the choice of whether or not transit is used. We have no information on the alternatives available to each individual, so we cannot estimate a modal choice model. This is a simple binary choice, and the logistic model presented in the previous section is appropriate.

What are the factors that may influence transit use for the work trip? The extensive literature on this topic suggests four groups of factors:

1. Demographic characteristics
2. Level of service and availability of modes
3. Residence and work location
4. Travel and schedule characteristics

Demographic characteristics include sex, race, age, and household composition. Women are more likely to work closer to home, to work part-time, and have more household responsibilities than men. In addition, in households where the number of drivers exceeds the number of cars, the male is more likely to have access to the car. These considerations lead to mixed expectations. To the extent that women have more binding schedule constraints, we expect lower probability of transit use. To the extent that women have lower wages (associated with part-time work) and less access to cars, we expect higher probability of transit use.

Prior research shows that Blacks use transit at higher rates than any other race/ethnic group. Hispanics and Asians also use transit more than Whites. We also expect transit use to be associated with age: younger workers are more likely to have lower wages and hence may be more inclined to use transit. Older workers are likely at the peak of their earning years, and therefore may be less inclined to use transit.

We noted in the previous section that household composition is important, because travel decisions are made at the household level. For the journey to work, the circumstances and responsibilities of each worker may affect modal choice. Single persons with children generally have the lowest household income and therefore are likely to be transit dependent. Households with more than one worker and with children have higher incomes, more complex family schedules, and more access to cars. These households are less likely to use transit for the journey to work.

Level of service and availability of modes includes car availability, transit access, and transit availability. Our previous analysis showed that not having a car was the most powerful predictor of being a regular transit user. Few employed people live in households with no cars, but for those few, we expect transit use. Conversely, those in households with high car access are not likely to use transit. Our previous analysis also showed that access to a transit stop was a significant predictor of transit use. We expect the same here.

As noted in our literature review, the availability of transit for low-wage workers has become a major policy issue. The argument is that low-wage workers often have work schedules that require off-peak commuting, and their commutes are often in the reverse direction. We use the start work time as an indicator of commuting schedule. If a person starts work outside of the traditional AM peak period, we expect less likelihood of using transit.

Our previous analysis also showed that living in a high-density neighborhood, or living in the largest metropolitan area, is positively related to being a regular transit user. We expect the same results for commuting. In addition, we know from previous research that commutes to jobs in the central city are more likely to be made by transit. Transit systems are oriented to central city commutes, and the often-high price of parking in central cities provides a disincentive for car commuting.

Finally, there is the issue of complex travel patterns and household schedule constraints. If an individual has many responsibilities and schedule constraints, we hypothesize that it becomes more difficult to use transit. In the previous analysis, we used the simple measure of total trips per day, and our results were unsatisfactory. In this case we have more choices, since we have data on the actual trip made, and on the sequence of trips included in both the trip from home to work, and the trip from work to home. We therefore use the total number of stops in the home to work and work to home chains as our indicator of complex travel patterns. In addition, we use part-time work as an indicator of a possibly irregular work schedule. The list of variables used in our model is given in Table 4-6.

DATA

The data for the logistic model estimations were also drawn from the original sample of 93,560 persons. This sample yielded 11,709 valid cases for analysis, after screening for those who made a work trip on the travel day, had transit available, and who had information on whether or not their job was located in the central city. Figure 4-2 illustrates the process of screening the data. About 45 percent of the sample is employed, and of those who are employed, about 56 percent made a trip on the survey day. Recall that the survey was conducted across all days of the week. In addition, people may have been on vacation or taken a day off for some other reason, so we would not expect anymore than 60 percent to have made a work trip on the travel day. Of those who did make a trip to work, about 2/3 had access to transit. Finally, missing data on the work location variable eliminated about 1/4 of the remaining sample. The resulting sample includes a 4.7 percent share of transit trips. Logistic models do not perform as well when one share is very dominant. In addition, the validity of the sample is greatly reduced because of the large reduction in the number of observations. Therefore results of the analysis must be interpreted with caution.

Table 4-6: Variable Description

Variables	Description
Dependant Variable	
HW_TRAN	1 = home to work trip by transit (bus or rail)
Demographic	
WORKER_O	1 = older worker, age > = 50 years old
WORKER_Y	1 = younger worker, age < = 25 years old
AD1_KIDS	1 = single adult household, with kids
AD2_KIDS	1 = two or more adult household, with kids
R_SEX2	1 = male
BLACKDUM	1 = non-Hispanic black
HISPDUM	1 = Hispanic
Economic	
LOW_INC	1 = low income household
CARAV_0	1 = household has no cars
CARAV_L1	1 = household drivers > cars
Geography	
MSASZ5	1 = person residing in a MSA > 3M
HIGH_DEN	1 = person residing in a high-density area (> 10K/square mile)
WORKCCTY	1 = work in central city
Transit Access	
S_DIST	1 = distance from transit station/bus stop =< 0.5 mile
Travel	
FT_WORK	1 = full-time worker
AM_PEAK	1 = start time of home-work trip in AM peak (6-9am)
ALLSTOP	total number of home-to-work and work-to-home stops

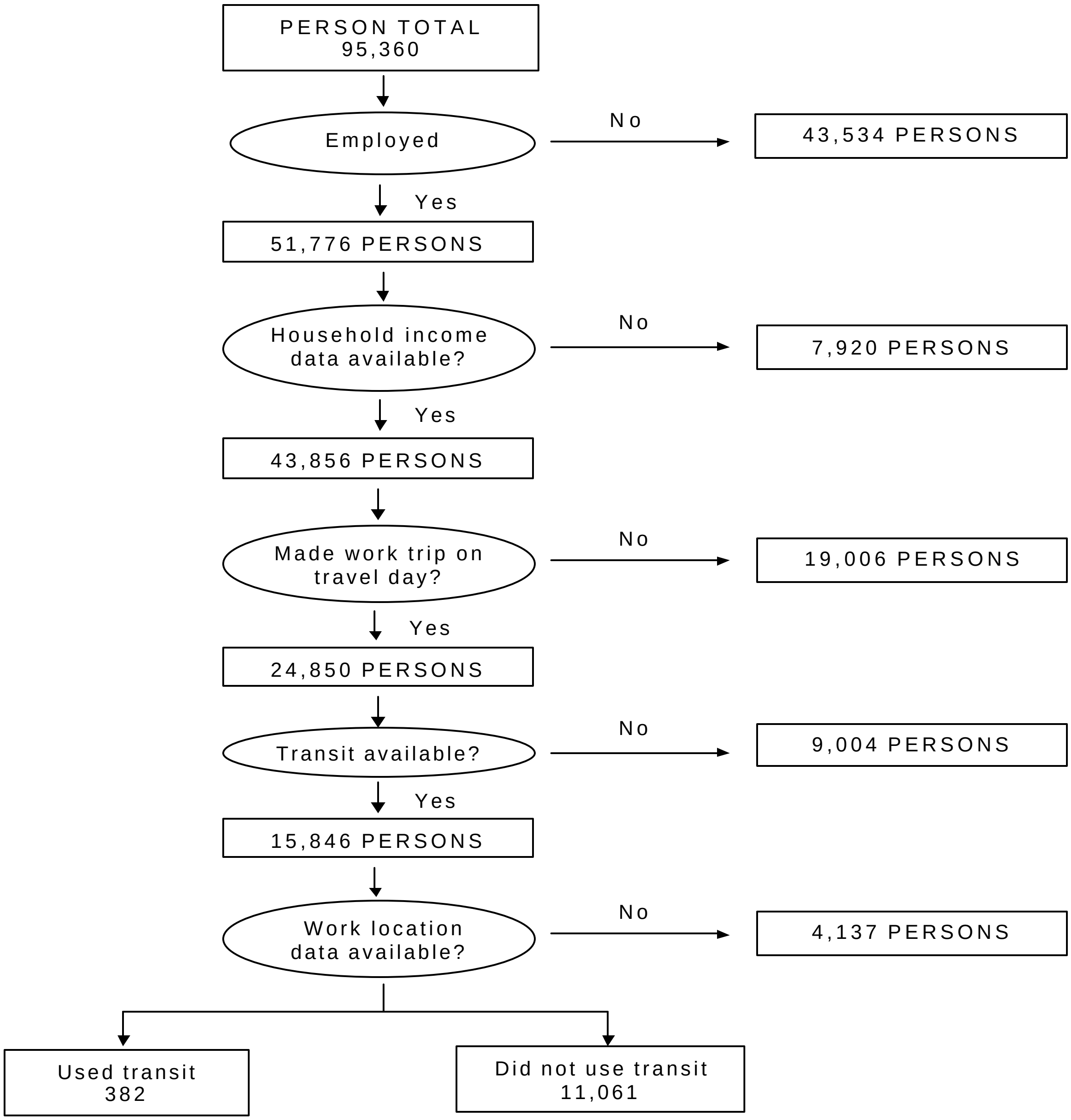


Figure 4-2: Development of Sample for Work Trip Analysis

Results

Because the poor constitute just 7 percent of all workers, we conduct our analysis using low income and not low income as our income groups. About 27 percent of all workers in our work trip sample are in the low income group. Within these income groups, 6.1 percent of low income workers used transit, and 4.2 percent of not-low income workers used transit. To give some indication of differences in the commutes of these two groups, Table 4-7 gives descriptive statistics for the home to work trip by mode and income group. Transit users within both income groups have slightly shorter distance commutes than those who do not use transit, but transit commutes are much longer in terms of time. Transit trips are slower for the low income group, which is consistent with their greater use of bus transit. Commutes are longer in distance for the not low income group. Transit users in both groups are also less likely to make stops along the way to work.

Table 4-7: Descriptive Statistics for Home to Work Trip

	Low income		Not- low income	
	Transit	Not transit	Transit	Not transit
Average distance	9.78	10.99	12.86	13.32
Average time	37.97	20.17	42.81	23.24
Average number of stops	1.13	1.26	1.16	1.24

Results for the full binary model are shown in Table 4-8. As before, coefficients significant at $p < .05$ are in bold. Most of the coefficients of demographic variables are not significant. The coefficient for multiple adult households with children is significant and of the expected sign, as is the coefficient for Blacks.

The low income dummy coefficient is not significant, indicating that household income does not affect the probability of using transit for the work trip, once all other factors are taken into account (note that car ownership is related to income; perhaps the lack of income effect is explained by the stronger influence of car ownership). As in the previous analysis, having no car

Table 4-8: Binary Full Model

Variable	B[a]	S.E.
Constant	**-5.424**	.305
Demographic		
Older worker	-.079	.141
Younger worker	-.196	.155
1 adult + kids	-.231	.243
≥ 2 adult + kids 2	-.295	.120
Male	-.131	.109
Black	**1.136**	.142
Hispanic	.250	.188
Economic		
Low income	-.064	.133
No cars	**2.259**	.131
Cars > drivers	**-.507**	.240
Geography		
Large MSA	**1.278**	.138
High density	**1.243**	.122
Work central city	**.768**	.109
Transit access		
Stop within .5 mi	**.685**	.167
Travel		
Full-time worker	.030	.159
Peak commuter	**.536**	.131
Stops	**-.167**	.052
N	11507	
- 2 Log Likelihood	2854.81	
C&S R^2	.121	
Percent correct	95.8	

[a] bold = sig. at $p < .05$

is the most powerful predictor of commuting by transit. When there are more cars than drivers in the household, the likelihood of commuting by transit declines. As before, we expect some degree of interdependency between car ownership and transit use.

All of the geography variable coefficients are highly significant and of the expected sign. Using transit for the work trip is more likely in the largest MSAs, in high-density areas, and when the job is located in the central city. The coefficient for living within 1/2 mile of a transit stop is also positive and significant.

Our attempt to capture schedule and travel complexity was more successful for the work trip. Although working full-time has no relationship with transit use, making the commute trip during the traditional peak (in this case traveling from home to work between 6 and 9 AM) is associated with greater probability of using transit. Low income commuters are less likely to travel to work during the AM peak (61 percent of low income vs. 71 percent of not low income), so the lack of frequent transit service may be a greater problem for low income commuters. Conversely, making stops along the way to or from work reduces the likelihood of using transit.

Although the lack of significance of the low income dummy suggests that income does not have an independent effect on the probability of using transit for commuting, the full model does not account for possible joint effects between income and the other independent variables. Table 4-9 gives results for the joint effects model. Just three of the interactive variable coefficients are significant. They do not add much to the model, as indicated by the small change in –2LL, not shown in the table. As noted above, the coefficients for the independent variables are equivalent to those for the "not low income" group alone. The interaction variable coefficients test whether the effect of low income is different for a given independent variable. In all but three cases, we cannot reject the null hypothesis that there is no difference between the groups.

The three cases where there are differences are no cars in households, living in the largest MSA, and working in the central city. The effect for the low income group is the sum of the two coefficients. Having no car increases the likelihood of commuting by transit for low income workers significantly more than for not-low income workers. The net effect of the two coefficients for living in the largest MSA indicates less effect for the low income group, as does

Table 4-9: Binary Model with Joint Effects

Base = Not low income

	Independent effects		Low income	
Variable	B[a]	S.E.	B[a]	S.E.
Constant	**-5.916**	.381		
Low Income	.895	.675		
Demographic				
Older worker	-.069	.159	.018	.347
Younger worker	.376	.194	-.444	.324
1 adult + kids	-.251	.385	-.098	.513
≥ 2 adults + kids 2	-.254	.141	-.043	.276
Male	-.101	.125	-.151	.258
Black	**.989**	.183	.381	.301
Hispanic	.182	.233	.267	.402
Economic				
No cars	**1.939**	.169	**.746**	.273
Cars > drivers	**-.602**	.269	.720	.598
Geography				
Large MSA	**1.710**	.183	**-1.176**	.302
High density	**1.318**	.143	-.127	.277
Work central city	**.955**	.128	**-.646**	.246
Transit access				
Stop within .5 mi	**.611**	.191	.020	.118
Travel				
Full-time worker	.181	.228	-.299	.323
Peak commuter	**.495**	.160	.086	.277
Stops	**-.171**	.061	.020	.118
N	11507			
- 2 Log Likelihood	2819.035			
C&S R^2	0.115			
Percent correct	95.8			

[a] bold = sig. at $p < .05$

the effect for working in the central city. These differences are consistent with the greater likelihood of choice riders within the not-low income group.

Conclusions on Transit Use for Commuting

Our results are largely consistent with the literature. The least consistency is found with the demographic variables, including age and sex. The role of car ownership is as expected, and is also consistent with the analysis in the previous section. Car ownership is a powerful predictor of transit use for all purposes. Clearly geography plays a major role in commute mode choice. As previous studies have shown, commuting by transit is more likely in the largest MSAs, and for those who live in high-density neighborhoods, or who work in the central city. Living near a transit stop is important for the work trip, as it was for regular transit use. What about differences between the income groups? We found few differences between groups for the work trip, but more differences between groups for transit use in general. Some possible explanations for these findings include: 1) there is limited comparability between data on usual behavior and data on actual behavior, 2) because so few poor persons are employed, the work trip analysis compared income groups that were more similar to one another than the previous analysis, 3) low income status has a greater effect on discretionary trip making.

Why People Don't Use Transit

We have noted that attitudes play an important role in travel behavior, yet the NPTS data do not allow us to include measures of attitudes in our models. For the work trip the NPTS does provide some information on why people do not use transit. Although we can provide only descriptive information, it may help us to understand our results and their policy implications. The NPTS asked respondents about their usual mode of travel for the journey to work. For those who do not use transit for work, respondents were asked why not. They were given a series of choices and were asked if each were a reason s/he did not use transit. Again, rotating blocks of questions were used, so the number of respondents who answered each question is relatively small. Results for the closed-end responses by income group are given in Figure 4-3.

Responses are quite interesting. The reason most often given for not using transit is, "I don't like to use transit." Slightly more low income respondents gave this reason. This makes sense; given the economic attraction of using transit for low income persons, they are more likely to use transit even if they don't like it very much. Low income persons who do not use transit likely have strong feelings of dislike. Lack of availability and inconvenient schedule are the second and third ranked reasons for not using transit, with the not-low income group identifying these reasons slightly more than the low income group. Surprisingly, "using transit takes too much time" ranks at the bottom, with needing a car for other things ranked second to last. Obviously perceptions of transit play a significant role in discouraging people from using transit.

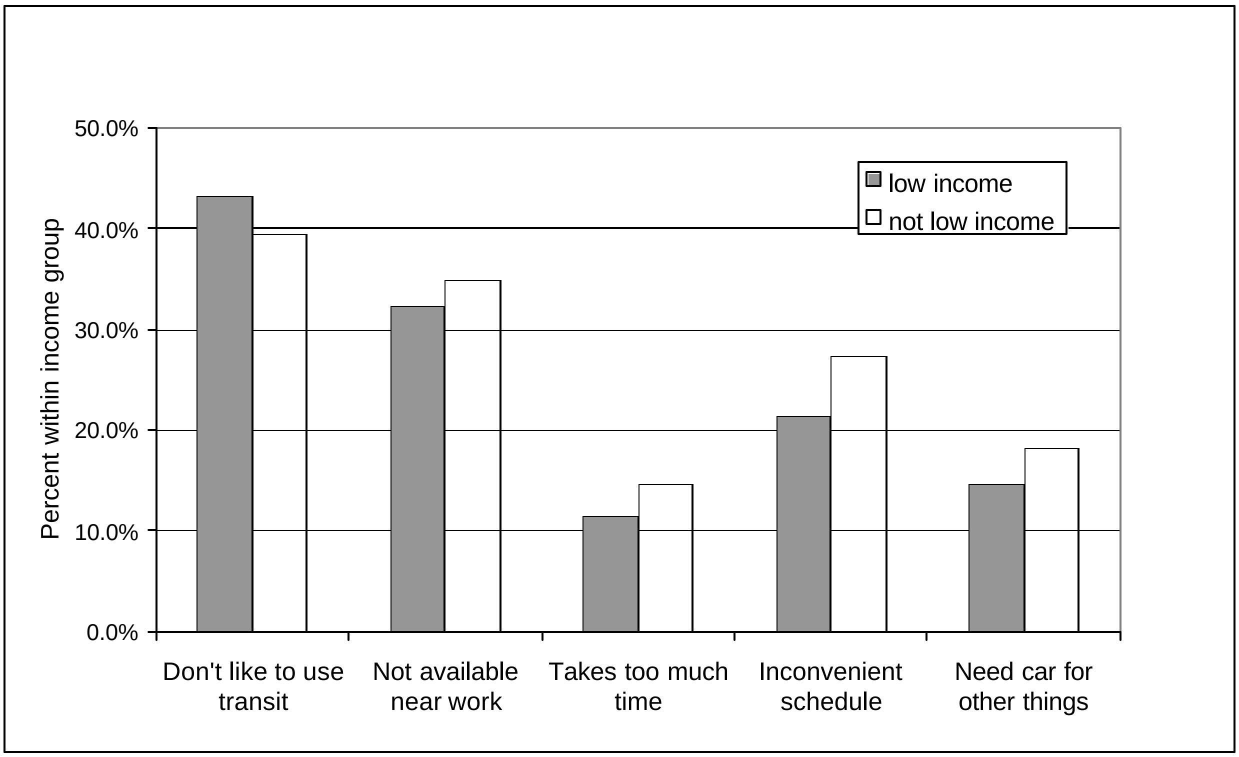


Figure 4-3: Why Not Use Transit for Work Trip

SUMMARY FROM DATA ANALYSIS

Our data analysis has shown that there are some differences in the demand for transit across income groups. Most of our results are consistent with the literature. By incorporating measures of schedule constraints and complex travel, we were able to show that transit use for the work trip is more likely when the trip takes place during the peak period, and when the individual is not inclined to make stops along the way. Differences between income groups are greater for our analysis of regular transit use. Our comparisons of regular transit use showed that the combination of poverty and minority status led to higher probability of transit use. Car ownership, as expected, is the single largest predictor of transit use, regardless of how transit use is measured. Geographic factors are also important, as is living close to a transit stop.

CHAPTER FIVE
CONCLUSIONS AND POLICY IMPLICATIONS

The last task of this research is to evaluate the market for transit among low income and minority households. This chapter summarizes our results and discusses their policy implications.

TRANSIT AND MOBILITY

1. *The poor have lower mobility than the non-poor, no matter how measured.* We used measures of total daily distance traveled, total daily time spent traveling, and total daily trips to compare mobility. The poor are more likely not to travel at all on a given day. The poor make fewer trips and travel fewer miles than the non-poor. They travel at lower speeds due to more use of transit and non-motorized modes.

2. *The poor use transit more than the non-poor, but still use it for just 5 percent of all trips.* Transit plays a limited role in the mobility of the poor; about 3/4 of all person-trips are made in private vehicles, and of these, about 40 percent are made as a passenger. The poor respond to limited transportation resources by traveling less as well as making more use of non-POV modes.

3. *The poor who are regular transit users have the lowest mobility of all population segments.* Regular transit users spend more time traveling over the course of the day, but travel fewer miles than those who do not use transit. Average daily travel distance for the poor regular transit user is 14 miles, compared to 24 miles for all poor, 24 miles for non-poor regular transit users, and 36 miles for all non-poor.

Policy Implications

The poor travel less not because their preferences are different than the non-poor, but because of limited resources. The poor spend a greater share of income on transportation than the non-poor, and only the very poor are unlikely to own at least one car. Transit and non-motorized modes are not close substitutes for the private vehicle. Hence the activity sphere of the poor is smaller than that of the non-poor.

One of the most difficult policy issues this research generates is what transit policy can do to improve mobility and accessibility for the poor. In view of congestion and environmental and energy concerns, it is easy to prescribe more investment in public transit, not only to improve mobility for the poor, but to achieve other policy objectives. However, it seems clear that those who use transit are disadvantaged. If this were not the case, we would not observe such large differences in transit use between the poorest households and everyone else. If we were most interested in increasing the mobility of the poor, we would subsidize car ownership. In a few metropolitan areas car subsidies are offered to job seeking welfare recipients in order to increase their accessibility to the job market. Car ownership not only increases access to jobs, but to all sorts of activities and services. A second-best approach is to improve transit service quality, or to promote land-use policies that bring more opportunities to mobility constrained populations, or allow such populations to locate in more accessible areas. These options are further discussed below.

TRANSIT ACCESS

1. *The poor are as likely to not have transit available as the non-poor.* It is often presumed that since the poor are concentrated in the central cities of the largest MSAs, they have higher-than-average access to transit. The NPTS data show this not to be the case. A significant proportion of the poor live in rural areas where transit is virtually non-existent. Many poor also live in smaller MSAs, where transit access is limited.
2. *The poor on average live closer to a transit stop than the non-poor.* Those who are dependent upon transit are more likely to live near a transit stop than those who are not. By income group, poor or low income persons live closer to a transit stop than non-poor or non-low income persons. Evidence indicates that those who must use transit, or who prefer to use transit, choose residential locations with high transit access.
3. *Average reported distance to a transit stop is a function of MSA size.* The extent and density of transit service is a function of metropolitan size. Average and median distance to a transit stop decreases with increases in metropolitan size.
4. *Access to a transit stop within 1/2 mile from home is a significant predictor of regular transit use, and of using transit for the journey to work.* Our model estimations showed that

having a transit stop nearby increased the probability of being a regular transit user and the probability of using transit for the work trip. The effect was more pronounced for low income travelers.

Policy Implications

While the data suggest that people self-select in order to take advantage of public transit when they either prefer or are dependent on it, the data also show that significant numbers of people do not live within 1/2 mile of a transit stop. Access to a transit stop is a rough surrogate for the density and coverage of the transit system. Those who live more than 1/2 mile from the nearest bus stop have very limited access to transit. This does not suggest that the solution is a vast increase in transit service levels. Because traditional fixed route transit cannot efficiently serve dispersed land-use patterns, such a policy would be both financially prohibitive and ineffective. Rather, the implication is that fixed route transit should be concentrated in high-density areas where it can be effective, especially in high-poverty/high-density areas. Numerous surveys indicate that more frequent service and lower fares would significantly expand the market for transit.

For those living outside the central parts of the largest MSAs, the implication is that other forms of mass transportation more suited to low-density environments should be explored. This is an old idea; demand-responsive systems have been in operation since the 1970s. However, these systems have proved to have very high cost per passenger and very low levels of services. More cost-effective would be jitney type services, or various types of car sharing arrangements. Our previous Los Angeles case study indicated that informal carpooling is common: perhaps financial incentives to drivers would promote such arrangements. In addition, new technology applications may improve the productivity and efficiency of paratransit. More research is indicated to develop more flexible forms of transit (shared-ride taxis, car sharing) and to explore the possibilities for using information technology to increase the efficiency of such services.

TRANSIT AND CAR OWNERSHIP

1. *Car ownership is the single most important factor in predicting transit use.* Those who live in households without cars are most likely to be a regular transit user, and to use transit for the work trip, for those who work. The effect of car ownership is the same across income groups.

2. *The poorest households are most likely to be no-car households, and these households have the least mobility.* Those who live in no-car households also have very low mobility levels — the availability of transit does not compensate for the lack of a personal vehicle.

Policy Implications

Concerns regarding congestion, air pollution, and other environmental problems have caused policy-makers to search for ways to reduce use of the car. Thus it is difficult to argue that car use should be encouraged or subsidized. On the other hand, there are clear social justice implications of policies to make car ownership and use more difficult or costly, since low income households, who already own fewer cars and use them less, would be most affected by such policies.

TRANSIT AND DEMOGRAPHICS

1. *Blacks are more likely to be regular transit users and commute by transit.* We controlled for income and geography. Blacks are more likely to be regular transit users even when residential location characteristics, household characteristics, and income are taken into account.

2. *Sex has no consistent relationship with transit use.* Travel patterns of women and men have become more similar as more women have entered the workforce. Consistent with recent prior studies, we surmise that extensive household responsibilities and related schedule constraints have increased women's preferences for private vehicle travel.

Policy Implications

Our modeling results show that race/ethnicity is a significant factor in travel behavior. In previous work on this topic, we found that Asians have equally different travel patterns. Small sample size precluded us from considering race/ethnicity more extensively in our models. Our findings on race/ethnicity support the idea that travel behavior is a function of many factors, including cultural and social differences. The challenge for policy-makers is to develop a better understanding of these factors and how they affect transit demand, and to consider such market segments in developing more attractive transit options.

GEOGRAPHY AND TRANSIT

1. *Living in MSAs of over 3 million population is positively associated with regular transit use and transit use for the work trip for everyone.* Our model estimations showed that living in the largest MSAs is positively associated with the probability of being a regular transit user and the probability of using transit for the work trip. The effect is more pronounced for the not-low income group, suggesting that the higher quality of transit service available in the largest MSAs attracts more choice riders.

2. *Living in high-density residential neighborhoods is positively associated with regular transit use and transit use for the work trip for everyone.* The effect of high residential density is the same for all income groups. We surmise that high density is a surrogate for "transit-friendly" environments and for relatively high-quality transit service available. Conversely, living in low-density neighborhoods reduces the probability of being a regular transit user, and the effect is somewhat more pronounced for the low income group.

3. *Working in the central city is positively associated with using transit for the work trip among not-low income commuters, but not for low income commuters.* Commuters who work in the central city are more likely to use transit if they are not living in low income households. This could mean that low income commuters are less likely to have long commutes into the central city, or that low income commuters are more likely to take transit whether or not they work in the central city. The latter is another indication that there are fewer choice riders within the low income segment.

Policy Implications

We noted earlier that promoting land-use policies to create environments more amenable to effective transit service has become a major "second best" option for dealing with mobility problems. The idea is that high-density, mixed-use development increases accessibility, and under such conditions mobility demand declines. Our research shows that transit use is more likely in the largest MSAs and in high-density areas for both income groups. This is a function of both land use (spatial form more amenable to concentrated travel flows) and transit supply (demand in such areas is sufficient to support relatively frequent and dense service). In the areas where "transit works," transit service clearly should be preserved and improved.

Does it then follow that land-use policy will be effective in increasing the number and extent of such areas, and, in particular, that land-use policy will be effective in increasing accessibility for the poor? The potential effectiveness of land-use policy to promote higher-density development and therefore more transit use is a subject of extensive debate. While the relationship between transit use and density is well documented, whether land-use policy can produce more high density in an era when all the trends are in the opposite direction is another question.

The issue more relevant to this research is whether such policies might improve access for the poor. First, land-use policy to promote higher density is relevant only to larger metropolitan areas, and probably only within the central cities of such areas, where average densities are already moderate. For the poor living outside MSAs or in the smaller MSAs, it is hard to imagine how promoting higher densities could possibly be an effective strategy, since the level of density that might be achieved in such areas would not be sufficient to support extensive transit service. Second, many poor, inner-city areas are already very dense. Our previous Los Angeles research showed that high-poverty neighborhoods (30 percent or more of all households are poor) had densities ranging from 17 to 84 persons per acre, with most in the range of 30 to 40 persons per acre. It is not necessarily density that counts, but rather access to jobs, goods, and services. Promoting economic development in such areas has proved to be a major challenge. Recent experiences with efforts to bring banks and major chain grocery stores into inner-city neighborhoods are illustrative. Third, while local economic development policy might improve access to jobs and basic services in high-poverty neighborhoods, there remains the issue of access to jobs and other metropolitan scale opportunities. An alternative, related strategy is to encourage provision of more low income housing in areas of high job accessibility. The scarcity of affordable housing in California's metropolitan areas continues to increase, however. Effective affordable housing strategies would require major policy changes and financial incentives, and political consensus for such changes has not yet materialized.

TRANSIT AND COMPLEX TRAVEL

1. *There is no difference in the propensity of low income persons to chain trips.* We found no evidence that low income travelers are less likely to economize on travel by combining incidental trips with the work trip, or by making multi-stop tours.

2. *Those who use transit for the work trip are less likely to make stops along the way, independent of income status.* Differences in making stops on the way to or from work are between those who use transit and those who do not. The probability of using transit for the work trip is negatively associated with trip chaining. Whether those using transit for the work trip have less desire or demand to trip chain, or whether using transit forces incidental trips to be made in other ways is an open question.

3. *Those who use transit for the work trip are more likely to commute during peak period, regardless of income.* Those who work traditional schedules and travel to work during the AM peak are more likely to use transit. However, fewer low income commuters than not-low income commuters make their trip to work during the AM peak (61 percent and 71 percent, respectively). Therefore low income commuters are more likely to be commuting at times when transit service is less frequent and available.

Policy Implications

Our results provide some limited support for the hypothesis that complex travel behavior is not complementary to transit use. Making stops along the way to or from work, a form of economizing on trip making, is less convenient via transit than via car. Only in areas where stops can be made between home or work and the transit stop is such behavior convenient when using transit, and there are few such areas. While every effort should be made to preserve and expand such areas, we conclude that such policies will not substantially improve mobility of the poor.

Our results also provide some support for the problem of mismatch between work schedules and transit availability. Off-peak commutes are more likely for low income workers, reducing their access to high quality (e.g., frequent service) transit service. Expanded and improved transit for off-peak and off-direction commuting would benefit low income workers.

A NOTE ON ATTITUDES AND TRANSIT QUALITY

Our research provided substantial indirect and anecdotal evidence that attitudes and perceptions of transit affect transit use. When workers who do not use transit for the work trip were asked why, the most frequent answer was "I don't like to use transit." When transit users were asked what problems they had with transit, the poor viewed more problems as "large problems" than the non-poor. Of particular concern (after cost) for the poor are the cleanliness of vehicles and stations and fear of crime.

We noted that since the NPTS did not ask people why they did not use transit at all (as opposed to not using transit for the work trip), we have no information on what prevents people from using transit. We suspect the reasons are a combination of 1) convenience factors, since transit is such a poor substitute for the car under most circumstances, 2) quality factors (clean vehicles, safety, friendly and capable drivers, etc.), and 3) attitudinal factors (dislike of crowding, being in vehicle with people of other race/ethnic groups, etc.). Transit agencies are constrained by their budgets, and therefore service expansions are often not an option. The challenge is to use resources as efficiently as possible to serve poor and low income travelers. However, a clean and safe transit system is fully under the control of transit management, and should be viewed as a necessary condition for all public transit.

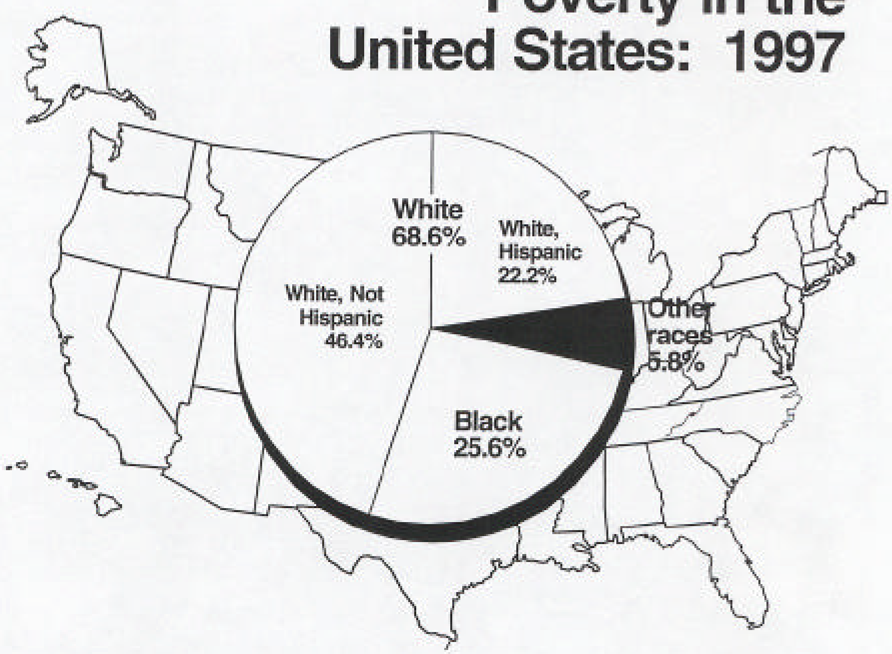
APPENDIX A

CURRENT POPULATION REPORTS

Consumer Income

P60-201

Poverty in the United States: 1997



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Appendix A.
Definitions and Explanations

Family. The term "family" refers to a group of two or more persons related by birth, marriage, or adoption who reside together; all such persons are considered as members of one family. For example, if the son of the person who maintains the household and the son's wife are members of the household, they are treated as members of the parent's family. Every family must include a reference person (see definition of householder for primary families). Two or more people living in the same household who are related to one another, but are not related to the householder, form an "unrelated subfamily." Beginning with the 1980 Current Population Survey (CPS), unrelated subfamilies were excluded from the count of families and unrelated subfamily members were excluded from the count of family members.

Family households. Family households are households maintained by a family (as defined above). Members of family households include any unrelated persons (unrelated subfamily members and/or secondary individuals) who may be residing there. The number of family households will not equal the number of families since families living in group quarters are included in the count of families. In addition, the count of family household members differs from the count of family members in that the family household members include all persons living in the household; whereas, family members include only householders and their relatives. (See the definition of family.)

Householder. A householder is the person (or one of the persons) in whose name the home is owned or rented. If the house is owned jointly by a married couple, either the husband or the wife may be listed first, thereby becoming the reference person, or householder, to whom the relationship of the other household members is recorded. One person in each household is designated as the "householder." The number of householders, therefore, is equal to the number of households.

Households. Households consist of all persons who occupy a housing unit. A house, an apartment or other group of rooms, or a single room is regarded as a housing unit when it is occupied or intended for occupancy as separate living quarters: the occupants do not live and eat with any other persons in the structure and there is direct access from the outside or through a common hall.

A household includes the related family members and all the unrelated persons, if any, such as lodgers, foster children, wards, or employees who share the housing unit. A person living alone in a housing unit or a group of unrelated persons sharing a housing unit as partners is also counted as a household. The count of households excludes group quarters.

Income. For each person in the CPS sample 15 years old and over, questions were asked on the amount of money income received in the preceding calendar year from each of the following sources:

1. Earnings from longest job (or self-employment)
2. Earnings from jobs other than longest job
3. Unemployment compensation
4. Workers' compensation
5. Social security
6. Supplemental security income
7. Public assistance
8. Veterans' payments
9. Survivor benefits
10. Disability benefits
11. Pension or retirement income
12. Interest
13. Dividends
14. Rents, royalties, and estates and trusts
15. Educational assistance
16. Alimony
17. Child support
18. Financial assistance from outside of the household, and other periodic income

Capital gains and lump-sum or one-time payments are excluded. For definitions of alternative measures of income (definitions 1 through 15 shown in tables 5 and 6), see Appendix B.

It should be noted that although the income statistics refer to receipts during the preceding calendar year, the demographic characteristics such as age, labor force status, and family or household composition are as of the survey date. The income of the family/household does not include amounts received by persons who were members during all or part of the income year if these persons no longer resided in the family/household at the time of interview. However, income data are collected for persons who are current residents but did not reside in the household during the income year.

Data on consumer income collected in the CPS by the Census Bureau cover money income received (exclusive of certain money receipts such as capital gains) before payments for personal income taxes, Social Security, union dues, medicare deductions, etc. Therefore, money income does not reflect the fact that some families receive part of their income in the form of noncash benefits such as food stamps, health benefits, noncash benefits in the form of rent-free housing and goods produced and consumed on the farm. In addition, money income does not reflect the fact that noncash benefits are also received by some nonfarm residents which often take the form of the use of business transportation and facilities, full or partial payments by business for retirement programs, medical and educational expenses, etc. These elements should be considered when comparing income levels. Moreover, readers should be aware that for many different reasons there is a tendency in household surveys for respondents to underreport their income. From an analysis of independently derived income estimates, it has been determined that income earned from wages or salaries is much better reported than other sources of income and is nearly equal to independent estimates of aggregate income.

Income deficit. Income deficit is the difference between the total income of families and unrelated individuals below the poverty level and their respective poverty thresholds. In computing the income deficit, families reporting a net income loss are assigned zero dollars, and for such cases, the deficit is equal to the poverty threshold. The income deficit is a measure of the degree of impoverishment of a family or unrelated individual.

Periods of Recession

Peak month	Year	Trough month	Year
November	1948	October	1949
July	1953	May	1954
August	1957	April	1958
April	1960	February	1961
December	1969	November	1970
November	1973	March	1975
January	1980	July	1980
July	1981	November	1982
July	1990	March	1991

Source: National Bureau of Economic Research, Inc., 1050 Massachusetts Avenue, Cambridge, MA 02138.

Population coverage. This report includes the civilian noninstitutional population of the United States and members of the Armed Forces in the United States living off post or with their families on post, but excludes all other members of the Armed Forces. The poverty data also exclude unrelated individuals under 15 years of age.

The information on the Hispanic population shown in this report was collected in the 50 States and the District of Columbia and, therefore, does not include residents of outlying areas or U.S. territories such as Guam, Puerto Rico, and the Virgin Islands.

Poverty definition. Poverty statistics presented in this report are based on a definition developed by Mollie Orshansky of the Social Security Administration (SSA) in 1963-1964[1] and revised in 1969 and 1981 by interagency committees. This definition was established as the official definition of poverty for statistical use in all Executive departments by the Bureau of the Budget (BoB) in 1969 (in Circular No. A-46); after BoB became Office of Management and Budget, this was reconfirmed in Statistical Policy Directive No. 14.

The original poverty definition provided a range of income cutoffs or thresholds adjusted by such factors as family size, sex of the family head, number of children under 18 years old, and farm-nonfarm residence. At the core of this definition of poverty was the economy food plan, the least costly of four nutritionally adequate food plans designed by the Department of Agriculture. It was determined from the Department of Agriculture's 1955 Household Food Consumption Survey that families of three or more persons spent approximately one-third of their after-tax money income on food; accordingly, poverty thresholds for families of three or more persons were set at three times the cost of the economy food plan. Different procedures were used to calculate poverty thresholds for two-person families and persons living alone in order to compensate for the relatively larger fixed expenses of these smaller units. For two-person families, the cost of the economy food plan was multiplied by a factor of 3.7 (also derived from the 1955 survey). For unrelated individuals (one-person units), no multiplier was used; poverty thresholds were instead calculated as a fixed proportion of the corresponding thresholds for two-person units. Annual updates of these SSA poverty thresholds were based on price changes of the items in the economy food plan.

[1]For a detailed discussion of the original SSA poverty thresholds, see Mollie Orshansky, *Counting the Poor: Another Look at the Poverty Profile*, Social Security Bulletin, vol. 28, no. 1, January 1965, pp. 3-29 (reprinted in Social Security Bulletin, vol. 51, no. 10, October 1988, pp. 25-51); and *Who's Who Among the Poor: A Demographic View of Poverty*, Social Security Bulletin, vol. 28, no. 7, July 1965, pp. 3-32.

As a result of deliberations of a Federal interagency committee in 1969, the following two modifications to the original SSA definition of poverty were adopted:[2]

1. The SSA thresholds for nonfarm families were retained for the base year 1963, but annual adjustments in the levels were based on changes in the Consumer Price Index (CPI) rather than on changes in the cost of foods in the economy food plan.

2. The farm thresholds were raised from 70 to 85 percent of the corresponding nonfarm levels. The combined impact of these two modifications resulted in an increase in the tabulated totals for 1967 of 360,000 poor families and 1.6 million poor persons.

In 1981, three additional modifications in the poverty definition recommended by another interagency committee were adopted for implementation in the March 1982 CPS as well as the 1980 census:

1. Elimination of separate thresholds for farm families

2. Elimination (by averaging) of separate thresholds for female-householder families and "all other" families (earlier termed "male-headed" families)

3. Extension of the detailed poverty threshold matrix to make the largest family size category "nine persons or more"

For further details, see the section, "Changes in the Definition of Poverty," in Current Population Reports, Series P-60, No. 133.

The poverty thresholds are increased each year by the same percentage as the annual average Consumer Price Index (CPI). Table A-1 shows the CPI and the corresponding thresholds for a family of four for the 1959-97 period. The poverty thresholds are currently adjusted using the annual average CPI-U (1982-84 = 100). This base year has been used since 1988. From 1980 through 1987, the thresholds were adjusted using the CPI-U (1967 = 100). The CPI (1963 = 100) was used to adjust thresholds prior to 1980. Table A-2 shows the full poverty threshold matrix for 1997.

For further information on how the poverty thresholds were developed and subsequent changes in them, see Gordon M. Fisher, "The Development and History of the Poverty Thresholds," Social Security Bulletin, vol. 55, no. 4, Winter 1992, pp. 3-14.

[2]Poverty thresholds for 1959-1967 were recalculated on this basis, and revised poverty population figures for those years were tabulated using the revised thresholds. These revised 1959-1967 poverty population figures have been published in Census Bureau reports issued since August 1969 (including the present report). Because of this revision, poverty statistics from documents dated before August 1969 are not comparable with current poverty statistics.

Table A-1. **Average Poverty Threshold for a Family of Four and the Consumer Price Indexes (CPI-U and CPI-U-X1): 1947 Through 1997**

(1982-84=100)

Year	Average threshold for a family of four people[1] (dollars)	CPI-U	CPI-U-X1[2]
1997	16,400	160.5	160.5
1996	16,036	156.9	156.9
1995	15,569	152.4	152.4
1994	15,141	148.2	148.2
1993	14,763	144.5	144.5
1992	14,335	140.3	140.3
1991	13,924	136.2	136.2
1990	13,359	130.7	130.7
1989	12,674	124.0	124.0
1988	12,092	118.3	118.3
1987	11,611	113.6	113.6
1986	11,203	109.6	109.6
1985	10,989	107.6	107.6
1984	10,609	103.9	103.9
1983	10,178	99.6	99.6
1982	9,862	96.5	95.6
1981	9,287	90.9	90.1
1980	8,414	82.4	82.3
1979	7,412	72.6	74.0
1978	6,662	65.2	67.5
1977	6,191	60.6	63.2
1976	5,815	56.9	59.4
1975	5,500	53.8	56.2
1974	5,038	49.3	51.9
1973	4,540	44.4	47.2
1972	4,275	41.8	44.4
1971	4,137	40.5	43.1
1970	3,968	38.8	41.3
1969	3,743	36.7	39.4
1968	3,553	34.8	37.7
1967	3,410	33.4	36.3
1966	3,317	32.4	35.2
1965	3,223	31.5	34.2
1964	3,169	31.0	33.7
1963	3,128	30.6	33.3
1962	3,089	30.2	32.8
1961	3,054	29.9	32.5
1960	3,022	29.6	32.2
1959	2,973	29.1	31.6
1958	(NA)	28.9	31.4
1957	(NA)	28.1	30.5
1956	(NA)	27.2	29.6
1955	(NA)	26.8	29.1
1954	(NA)	26.9	29.2
1953	(NA)	26.7	29.0
1952	(NA)	26.5	28.8
1951	(NA)	26.0	28.3
1950	(NA)	24.1	26.2
1949	(NA)	23.8	25.9
1948	(NA)	24.1	26.2
1947	(NA)	22.3	24.2

[1]For years prior to 1981, average threshold for a nonfarm family of four is shown.
[2]Factors prior to 1967 are extrapolated.
NA Not available.

Table A-2. **Poverty Thresholds in 1997, by Size of Family and Number of Related Children Under 18 Years**
[Dollars]

Size of family unit	Weighted average thresholds	Related children under 18 years								
		None	One	Two	Three	Four	Five	Six	Seven	Eight or more
One person (unrelated individual)	8,183									
Under 65 years	8,350	8,350								
65 years and over	7,698	7,698								
Two people	10,473									
Householder under 65 years	10,805	10,748	11,063							
Householder 65 years and over	9,712	9,701	11,021							
Three people	12,802	12,554	12,919	12,931						
Four people	16,400	16,555	16,825	16,276	16,333					
Five people	19,380	19,964	20,255	19,634	19,154	18,861				
Six people	21,886	22,962	23,053	22,578	22,123	21,446	21,045			
Seven people	24,802	26,421	26,586	26,017	25,621	24,882	24,021	23,076		
Eight people	27,593	29,550	29,811	29,274	28,804	28,137	27,290	26,409	26,185	
Nine people or more	32,566	35,546	35,719	35,244	34,845	34,190	33,289	32,474	32,272	31,029

Ratio of income to poverty level. Because the poverty definition does not meet all the needs of the analysts of the data, a few of the tables in the report present variations of the poverty level expressed as a ratio of income to the family's (or unrelated individual's) appropriate poverty threshold. Ratios below 1.00 are below the official definition while a ratio of 1.00 or greater indicates income above the poverty level. A ratio between 1.00 and 1.25 indicates, for example, that a family's income was above their poverty threshold but below 125 percent of their poverty threshold. If a family's poverty threshold was $10,000 a ratio of 1.00 to 1.25 would mean their income was between $10,000 and $12,500.

Rounding. Percentages are rounded to the nearest tenth of a percent; therefore, the percentages in a distribution do not always add to exactly 100.0 percent.

Symbols. The following abbreviations and symbols are used in this publication:

-	represents zero or rounds to zero.
B	The base for the derived figure is less than 75,000.
NA	Not available.
r	Revised.

Unrelated individuals. The term "unrelated individuals" refers to persons 15 years and over (other than inmates of institutions) who are not living with any relatives. An unrelated individual may either:

- Constitute a one-person household
- Be part of a household including one or more other families or unrelated individuals

  or
- Reside in group quarters, such as a rooming house

Thus, a widow living by herself or with one or more other persons not related to her, a lodger not related to the householder or to anyone else in the household, and a servant living in an employer's household with no relatives are examples of unrelated individuals. The poverty status of unrelated individuals is determined independently of other household members' income.

Work experience. A person with work experience is one who, during the preceding calendar year, did any work for pay or profit or worked without pay on a family-operated farm or business at any time during the year, on a part-time or full-time basis. A year-round worker is one who worked for 50 weeks or more during the preceding calendar year. A persons is classified as having worked full time if he or she worked 35 hours or more per week during a majority of the weeks worked. A year-round, full-time worker is a person who worked full time, 35 or more hours per week and 50 or more weeks during the previous calendar year.

APPENDIX B

MULTINOMIAL LOGISTIC MODEL WITH DUMMY VARIABLES

Case Processing Summary

		N
transit use	regular user	4323.53
	occasional user	3299.28
	never	26028.91
age old	65 or over	4081.26
	under 65	29570.46
black male	black male	1937.40
	else	31714.31
black female	black female	2609.35
	else	31042.36
hispanic male	hispanic male	2011.34
	else	31640.38
hispanic female	hispanic female	1957.42
	else	31694.30
household size	household member=1	5136.13
	else	28515.59
MSA size	pop msa >3m	16208.92
	not in msa or pop< 3m	17442.79
employment status	not employed	9381.79
	employed	24269.93
low population density	pop density =0-500	3921.62
	else	29730.09
high population density	pop density= 10k-999k	5009.45
	else	28642.27
access to transit	acess transit within 0.5 mile	23222.70
	else	10429.02
low income	low income	10904.64
	not low income	22747.08
no cars and no drivers	.00	2278.62
	1.00	31373.09
more cars than drivers	.00	4322.71
	1.00	29329.01
Valid		33651.72
Missing		49938.28
Total		83590.00

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	23599.343			
Final	15527.956	8071.387	30	.000

Pseudo R-Square

Cox and Snell	.213
Nagelkerke	.285
McFadden	.174

Likelihood Ratio Tests

Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	15527.956	.000	0	.
FRQ	15588.043	60.087	2	.000
IN_AGO	15653.975	126.019	2	.000
IN_BLACM	15600.036	72.079	2	.000
IN_BLACF	15663.370	135.414	2	.000
IN_HISPM	15542.684	14.728	2	.001
IN_HISPF	15552.634	24.677	2	.000
IN_HHSI1	15547.457	19.501	2	.000
IN_LRMSA	16074.507	546.551	2	.000
IN_NOEMP	15534.869	6.913	2	.032
IN_LODEN	15589.760	61.804	2	.000
IN_HIDEN	16300.103	772.146	2	.000
IN_S_DIS	15765.953	237.997	2	.000
IN_LOW	15538.879	10.923	2	.004
INNOCARD	17478.074	1950.118	2	.000
INMORCA	15600.896	72.940	2	.000

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
regular user	Intercept	-3.405	0.072	2220.602	1	0.000			
	FRQ	-1.01E-02	0.007	2.048	1	0.152	0.990	0.976	1.004
	[IN_AGO=.00]	-0.823	0.077	113.007	1	0.000	0.439	0.377	0.511
	[IN_BLACM=.00]	0.618	0.071	75.553	1	0.000	1.855	1.614	2.132
	[IN_BLACF=.00]	0.727	0.061	141.919	1	0.000	2.069	1.836	2.332
	[IN_HISPM=.00]	-1.40E-02	0.078	0.033	1	0.857	0.986	0.847	1.148
	[IN_HISPF=.00]	0.374	0.074	25.587	1	0.000	1.453	1.257	1.680
	[IN_HHSI1=.00]	-0.138	0.056	6.200	1	0.013	0.871	0.781	0.971
	[IN_LRMSA=.00]	0.770	0.045	295.039	1	0.000	2.159	1.978	2.358
	[IN_NOEMP=.00]	3.68E-02	0.050	0.551	1	0.458	1.037	0.941	1.143
	[IN_LODEN=.00]	-0.475	0.097	24.213	1	0.000	0.622	0.515	0.751
	[IN_HIDEN=.00]	1.306	0.047	780.761	1	0.000	3.690	3.367	4.044
	[IN_S_DIS=.00]	0.771	0.058	179.220	1	0.000	2.162	1.931	2.421
	[IN_LOW=.00]	-8.30E-04	0.044	0.000	1	0.985	0.999	0.916	1.090
	[INNOCARD=.00]	2.766	0.068	1658.725	1	0.000	15.888	13.908	18.149
	[INMORCA=.00]	-0.597	0.077	59.672	1	0.000	0.550	0.473	0.640

		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
occasional user	Intercept	-2.992	0.062	2364.548	1	0.000			
	FRQ	4.64E-02	0.006	54.556	1	0.000	1.047	1.035	1.060
	[IN_AGO=.00]	-0.265	0.068	15.416	1	0.000	0.767	0.672	0.876
	[IN_BLACM=.00]	0.219	0.078	7.898	1	0.005	1.245	1.069	1.451
	[IN_BLACF=.00]	0.178	0.071	6.281	1	0.012	1.195	1.040	1.374
	[IN_HISPM=.00]	-0.319	0.087	13.521	1	0.000	0.727	0.613	0.861
	[IN_HISPF=.00]	8.59E-02	0.079	1.169	1	0.280	1.090	0.933	1.273
	[IN_HHSI1=.00]	0.159	0.052	9.292	1	0.002	1.172	1.058	1.298
	[IN_LRMSA=.00]	0.720	0.041	310.660	1	0.000	2.055	1.897	2.226
	[IN_NOEMP=.00]	0.127	0.048	6.936	1	0.008	1.135	1.033	1.247
	[IN_LODEN=.00]	-0.477	0.079	36.101	1	0.000	0.621	0.531	0.725
	[IN_HIDEN=.00]	0.520	0.053	95.285	1	0.000	1.681	1.515	1.866
	[IN_S_DIS=.00]	0.350	0.046	57.235	1	0.000	1.419	1.296	1.554
	[IN_LOW=.00]	-0.143	0.044	10.459	1	0.001	0.866	0.794	0.945
	[INNOCARD=.00]	1.206	0.088	189.523	1	0.000	3.341	2.814	3.966
	[INMORCA=.00]	-0.188	0.060	9.933	1	0.002	0.829	0.737	0.931

MULTINOMIAL LOGISTIC MODEL WITH CATEGORICAL VARIABLES

Case Processing Summary

		N
transit use	regular user	4456.99
	occasional user	3366.28
	never	26657.42
SEX	female	17438.51
	male	17042.18
the elderly	under 65	30282.69
	65 or over	4198.00
race	non-hispanic white	24138.20
	hispanic	3968.76
	non-hispanic black	4546.76
	non-hispanic asian	998.00
	non-hispanic other	828.98
household size	1-2	15481.98
	3-4	14042.92
	>5	4955.79
household income	less than 15k	4312.96
	15k-44.9k	15963.20
	45k-99.9k	12096.08
	100k or more	2108.46
employment status	full time	19960.84
	part time	4850.09
	not emp	5943.42
	retired	3726.35
driver/car ratio	no cars and/or no drivers	2337.52
	cars < drivers	5980.28
	cars = drivers	21737.30
	cars > drivers	4425.59
msasize	not in msa	2172.35
	pop < 250k	2574.20
	pop 250k - 500k	2540.44
	pop 500k - 1m	3109.65
	pop 1m - 3m	7405.98
	pop > 3m	16678.07
population density	0-500	4040.50
	500-2k	6662.37
	2k-10k	18576.19
	10k-999k	5201.64
Access to transit (bus, rail)	else	10630.70
	acess transit within 0.5 miles	23850.00
Valid		34480.70
Missing		49109.30
Total		83590.00

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	41240.890			
Final	32362.801	8878.090	54	.000

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	50435.504	43282	.000
Deviance	29570.751	43282	1.000

Pseudo R-Square

Cox and Snell	.227
Nagelkerke	.303
McFadden	.186

Likelihood Ratio Tests

Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	32362.801	.000	0	.
FRQ	32426.095	63.294	2	.000
SEX	32365.007	2.206	2	.332
AGO	32406.661	43.860	2	.000
RACE2N	32555.249	192.448	8	.000
R_HHSIZE	32404.249	41.448	4	.000
R_HHINC	32474.709	111.909	6	.000
JOB3	32482.431	119.630	6	.000
DRTCAR3	34626.175	2263.374	6	.000
MSASIZE2	32910.757	547.956	10	.000
REPODEN	33217.376	854.575	6	.000
S_DIST	32554.970	192.169	2	.000

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Parameter Estimates

		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
regular user	Intercept	-1.640	0.186	77.736	1	0.000			
	FRQ	-1.414E-02	0.007	3.969	1	0.046	0.986	0.972	1.000
	[SEX=.00]	-2.161E-02	0.040	0.291	1	0.590	0.979	0.905	1.059
	[AGO=.00]	0.580	0.094	37.894	1	0.000	1.785	1.485	2.147
	[RACE2N=1.00]	-0.144	0.117	1.506	1	0.220	0.866	0.689	1.090
	[RACE2N=2.00]	5.420E-02	0.124	0.002	1	0.965	1.005	0.788	1.283
	[RACE2N=3.00]	0.548	0.122	20.294	1	0.000	1.729	1.362	2.194
	[RACE2N=4.00]	-0.301	0.155	3.767	1	0.052	0.740	0.546	1.003
	[R_HHSIZE=1.00]	0.146	0.062	5.588	1	0.018	1.158	1.025	1.307
	[R_HHSIZE=2.00]	5.216E-02	0.058	0.798	1	0.372	1.054	0.940	1.181
	[R_HHINC=1.00]	-0.326	0.096	11.418	1	0.001	0.722	0.598	0.872
	[R_HHINC=2.00]	-0.648	0.082	61.771	1	0.000	0.523	0.445	0.615
	[R_HHINC=3.00]	-0.514	0.082	39.425	1	0.000	0.598	0.509	0.702
	[JOB3=1.00]	0.424	0.104	16.524	1	0.000	1.528	1.245	1.874
	[JOB3=2.00]	0.801	0.110	53.346	1	0.000	2.229	1.798	2.764
	[JOB3=3.00]	0.623	0.105	34.976	1	0.000	1.864	1.516	2.291
	[DRTCAR3=1.00]	3.226	0.098	1088.717	1	0.000	25.167	20.779	30.482
	[DRTCAR3=2.00]	1.207	0.083	213.342	1	0.000	3.345	2.844	3.933
	[DRTCAR3=3.00]	0.338	0.077	19.134	1	0.000	1.402	1.205	1.632
	[MSASIZE2=.00]	-0.932	0.132	49.710	1	0.000	0.394	0.304	0.510
	[MSASIZE2=1.00]	-0.688	0.098	49.666	1	0.000	0.503	0.415	0.609
	[MSASIZE2=2.00]	-0.895	0.100	79.492	1	0.000	0.408	0.335	0.497
	[MSASIZE2=3.00]	-0.830	0.087	90.401	1	0.000	0.436	0.368	0.518
	[MSASIZE2=4.00]	-0.615	0.056	121.523	1	0.000	0.541	0.485	0.603
	[REPODEN=1.00]	-1.656	0.104	255.821	1	0.000	0.191	0.156	0.234
	[REPODEN=2.00]	-1.573	0.074	448.665	1	0.000	0.207	0.179	0.240
	[REPODEN=3.00]	-1.259	0.047	706.829	1	0.000	0.284	0.259	0.311
	[S_DIST=.00]	-0.705	0.058	147.912	1	0.000	0.494	0.441	0.554

		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
occasional user	Intercept	-2.021	0.186	117.468	1	0.000			
	FRQ	4.621E-02	0.006	53.888	1	0.000	1.047	1.034	1.060
	[SEX=.00]	-5.642E-02	0.039	2.131	1	0.144	0.945	0.876	1.020
	[AGO=.00]	0.263	0.082	10.150	1	0.001	1.301	1.106	1.529
	[RACE2N=1.00]	0.255	0.133	3.653	1	0.056	1.291	0.994	1.676
	[RACE2N=2.00]	0.163	0.143	1.313	1	0.252	1.178	0.890	1.558
	[RACE2N=3.00]	0.477	0.140	11.525	1	0.001	1.611	1.223	2.122
	[RACE2N=4.00]	0.146	0.168	0.755	1	0.385	1.157	0.832	1.609
	[R_HHSIZE=1.00]	0.349	0.063	30.837	1	0.000	1.417	1.253	1.603
	[R_HHSIZE=2.00]	0.138	0.060	5.206	1	0.023	1.148	1.020	1.292
	[R_HHINC=1.00]	-0.327	0.094	12.008	1	0.001	0.721	0.599	0.868
	[R_HHINC=2.00]	-0.442	0.076	33.721	1	0.000	0.643	0.554	0.746
	[R_HHINC=3.00]	-0.214	0.075	8.227	1	0.004	0.807	0.697	0.934
	[JOB3=1.00]	-6.977E+00	0.088	1.075	1	0.300	0.913	0.768	1.085
	[JOB3=2.00]	0.291	0.094	9.584	1	0.002	1.338	1.113	1.609
	[JOB3=3.00]	0.173	0.092	3.543	1	0.060	1.189	0.993	1.423
	[DRTCAR3=1.00]	1.385	0.103	181.217	1	0.000	3.994	3.264	4.886
	[DRTCAR3=2.00]	0.437	0.071	37.679	1	0.000	1.549	1.347	1.781
	[DRTCAR3=3.00]	0.137	0.060	5.130	1	0.024	1.147	1.019	1.291
	[MSASIZE2=.00]	-1.097	0.121	82.720	1	0.000	0.334	0.264	0.423
	[MSASIZE2=1.00]	-0.778	0.089	76.453	1	0.000	0.459	0.386	0.547
	[MSASIZE2=2.00]	-0.870	0.090	93.575	1	0.000	0.419	0.351	0.500
	[MSASIZE2=3.00]	-1.023	0.086	140.810	1	0.000	0.360	0.304	0.426
	[MSASIZE2=4.00]	-0.466	0.049	89.651	1	0.000	0.627	0.570	0.691
	[REPODEN=1.00]	-0.881	0.095	86.419	1	0.000	0.415	0.344	0.499
	[REPODEN=2.00]	-0.661	0.071	87.836	1	0.000	0.516	0.450	0.593
	[REPODEN=3.00]	-0.475	0.053	79.555	1	0.000	0.622	0.560	0.690
	[S_DIST=.00]	-0.323	0.047	47.000	1	0.000	0.724	0.660	0.794

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