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An Analysis Of Journey To Work Characteristics In Florida Using Census 2000 Public Use Microdata Sample Data Files

Liren Zhou

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An Analysis Of Journey To Work Characteristics In Florida
Using Census 2000 Public Use Microdata Sample Data Files

by

Liren Zhou

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science in Civil Engineering
Department of Civil and Environmental Engineering
College of Engineering
University of South Florida

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AN ANALYSIS OF JOURNEY TO WORK CHARACTERISTICS IN FLORIDA
USING CENSUS 2000 PUBLIC USE MICRODATA SAMPLE DATA FILES

Liren Zhou

ABSTRACT

This thesis presents an overall picture of demographic and socio-economic characteristics as well as journey to work travel behavior characteristics in Florida. In addition, detailed comparisons of journey to work private vehicle occupancy distribution, travel time distribution, mode choice and departure time distribution by household and individual characteristics are also provided based on three data files: American Community Survey Public Use Microdata Samples data file, Summary File 3 Public Use Microdata Samples 1% and Public Use Microdata Samples 5% data files. Utilizing the three data files, this thesis not only investigates current commuting patterns but also provides more reliable information on current journey to work characteristics and helps to gain knowledge that is useful to identify problems and provide creative solutions on related transportation issues in the state of Florida.

In analyzing the data, several socio-economic and journey to work travel behavior characteristics were identified. Interesting findings include the lower
utilization of transit, the lower private vehicle occupancies for individuals in Florida, and different journey to work departure time distribution by gender, by young people and by senior citizens from other adult categories. The data analysis shows that the three data files reflect acknowledged demographic trends and capture known changes such as aging of population, smaller household size, and increasing car ownership. The comparison analysis shows that in most cases, ACS PUMS data files approximate SF3 PUMS 1% and 5% data files very well.

The detailed comparison of the three data files regarding journey to work travel behavior characteristics in Florida is important to decision makers who will make informed choices when evaluating alternative transportation programs and related policy issues. The knowledge of reliability of data regarding journey to work travel behavior will also help transportation professionals for travel demand modeling, transportation and land use planning and related studies.
CHAPTER 1
INTRODUCTION

Substantial changes in travel behavior and urban development have taken place over the past few decades. Accelerated urban expansion, increased participation of women in labor force, and increased car ownership are not only contributors of altered commuting patterns, but also adding more demands on the nation’s metropolitan roadway systems. In order to have a better understanding of commuting patterns, reliable and up-to-date information and knowledge of journey to work are indispensable because decision makers rely heavily on knowledge of travel behavior and commuting patterns to make informed choice when evaluating alternative transportation services and investment and land use plans. A comprehensive data analysis of journey to work will also help to forecast future transportation needs and develop accurate travel demand models.

The focus of this thesis is the analysis of journey to work travel behavior with respect to demographic and household characteristics in Florida using American Community Survey Public Use Microdata Samples (ACS PUMS) data file and Summary File 3 Public Use Microdata Samples (SF3 PUMS) 1% and 5% data files. This thesis presents an overall picture of demographic and socio-
economic characteristics as well as journey to work travel behavior characteristics in Florida. In addition, detailed comparisons of journey to work private vehicle occupancy distribution, travel time distribution, mode choice and departure time distribution by household and individual characteristics are also provided based on three data files. The primary purpose is to gain a better understanding of journey to work travel behavior characteristics.

Three data files are used to analyze the journey to work characteristics. The first one is The American Community Survey Public Use Microdata Samples data file (ACS data file hereafter) and the other two are Summary file 3 Public Use Microdata Samples 1% and 5% files (PUMS 1% and PUMS 5% hereafter). The American Community Survey (ACS) is a nationwide survey designed to provide communities up-to-date information on a variety of statistics. Unlike most other long form data, American Community Survey can identify changes in an area’s population and give an up-to-date statistical picture when data users need it, every year, not just once every ten years. Different from summary data, ACS Microdata’s basic unit of analysis is an individual housing unit and the people who live in it, rather than a specific geographic entity, thus enabling us to analyze the data at a disaggregate level, which is extremely helpful when our focus is on individual decisions. The advantage of PUMS is that data users can tabulate data according to characteristics they need to know about. It also helps users to look at the relationship among variables not shown in the standard products offered by the Census Bureau.
PUMS 1% and PUMS 5% data files are Summary File 3 Public Use Microdata Sample data file released by Census Bureau. Summary File 3 presents data for the United States, the 50 states, the District of Columbia and Puerto Rico in a hierarchical sequence down to the block group. Public Use Microdata Sample (PUMS) files contain records representing 5-percent or 1-percent samples of the occupied and vacant housing units in the U.S. and the people in the occupied units. For 1-percent files, the minimum geographic population threshold is above 100,000. For 5-percent files, the minimum geographic threshold is 10,000. Analyses of data using three different data files provide more reliable information on current journey to work characteristics and help to gain knowledge that are useful in identifying problems and providing creative solutions on related transportation issues in the state of Florida.

The detailed comparison of the three data files regarding journey to work behavior characteristics was conducted using the SPSS statistical software. Syntax in the SPSS are utilized to process basic demographic and journey to work travel behavior characteristics and cross tabulations between related variables such as car ownership by household income and journey to work travel time by household characteristics.

Given the size of the data files, it was not possible to analyze all the variables included in the data files. Demographic and socio-economic variables that are examined include age, gender, race, household income, household size, number of workers in each family, and household car ownership. Journey to work characteristics include mode choice, private vehicle occupancy, journey to
work travel time and journey to work departure time. It should be noted that some of the demographic variables were only analyzed in the context of other related variables.

The first analysis presents overall demographic and journey to work related characteristics in Florida considering Florida’s distinctive population makeup. The second analysis involves the comparisons of journey to work travel behavior variables by household and individual characteristics including detailed comparison of journey to work private vehicle occupancy, travel time, mode choice, and departure time distribution using the three data files.

The rest of this thesis is organized as follows: chapter 2 includes a literature review concerning studies and findings in journey to work travel behavior. Chapter 3 provides a detailed introduction of data files used in this thesis. Chapter 4 presents an overall analysis of demographic, socio-economic and journey to work travel behavior characteristics using three different data files. Chapter 5 provides a detailed presentation of comparison of journey to work private vehicle occupancy, journey to work travel time, journey to work mode choice and journey to work departure time by household and individual characteristics using the three data files. Chapter 6 presents a brief summary of the findings and discussions for further research in this field.
CHAPTER 2
LITERATURE REVIEW

2.1 Background

Throughout the country, in both large and small communities, traffic congestion is getting worse. Employees are spending more time stuck in traffic while commuting to and from work. As shown by the data provided by United States Census Bureau (U.S. Census 2000 Journey to Work), the average commute time has increased to 25 minutes and 30 seconds in 2000, which is an increase of over two minutes compared to 1990. Additionally, the increase in commute time from 1990 to 2000 is four times the increase from 1980 to 1990.

The journey to work is one of most commonly experienced forms of everyday travel, encompassing almost all transport modes, and making a substantial contribution to urban traffic congestion. For most people, journey to work is undertaken to a regular rhythm on an unchanging route. In theory, therefore, it is easier to contemplate the provision of alternative forms of transport for commuters than for other individuals with unpredicted journeys for leisure and other purposes. An in-depth of understanding of journey to work travel behavior characteristics will help policy makers to make appropriate decisions regarding transportation land use and transportation management.
As a matter of fact, commuters’ journey to work is described by many factors including mode choice, departure time choice, location choice and route choice. Mode choice deals with how to commute. The choices faced by commuters include driving alone, carpooling, transit, walk and so on. Time choice deals with when employees get to work, which is determined by both mode and schedule. Route choice is generally the result of necessity, experience, and information available. Commuters take routes that are time saving based on their experience, condition of route and information through media sources.

Mode choice refers to way in which commuters travel. The most popular mode, used by 80 percent of commuters in the United States, is driving alone in one’s own car. There are other options the commuters may have to travel to work such as transit, carpooling, vanpooling, walk or bicycling. Transit is feasible in areas where bus, train, or ferry services are available and convenient for commuting. It also requires that commuters understand how to use the system and that schedules are coordinated to coincide with work hours. Carpooling can be simple as two or more commuters who live close share the ride to work. If six or more commuters share a ride to work, that is called vanpooling. Most vanpools in the United States have seven to fifteen riders, with one or two agreeing to drive everyday. And it tends to work best for commuters of at least 25 miles or more each day. Vanpooling also requires commitment to a regular schedule and often involves extra time to pick up or drop off riders. For a very limited number of workers, walk or bicycling is a choice, but most of them choose this mode for health reasons.
For most commuters, time choice is determined by mode choice and schedules. Many commuters experiment with the time that they leave home or the hours they work to avoid the worst traffic congestion. If flexible-time or alternative work schedules are offered to commuters, commuters are in a position to choose starting and ending times that better fit their personal schedule and avoid rush hour traffic. Flexible-time could be all forms that allow employees to choose the schedule they work with certain boundaries. Alternative work schedules are generally including longer days with more time off.

Commuters usually travel to work at the same time, with the same mode to the same place and via the same route. However, as traffic congestion is worsening, they often wonder if there are other routes to take to avoid the congestion. The congestion could be caused by increased traffic on highways, car accidents, bad weather, or road constructions. Nowadays, advances in information technology make up-to-date advice available to commuters so that they can find alternatives to their current route. Additionally, most information is provided directly from the information source to commuters. Since most researchers focused on the study of mode choice, this literature review will concentrate on the mode choice as well as travel time.

2.2 Mode choice

According to census in 2000, 75.7 percent of commuters drove alone to work, followed by carpooling of 12.2 percent, transit of 4.7 percent and walk of 2.9 percent. There are many factors affecting commuters’ mode choice for
journey to work. Variables to be considered include but not limit to income, car ownership, the relative location of home and worksites, cost of different modes, accessibility, personal preference, routing and convenience. Recent research on travel behavior and mode choice generally uses quantitative analyses for modeling travel behavior and predicting future trends. Some studies focused on the impact of job decentralization on the generation of journey to work. Other studies focused on the relative attractiveness of transport modes and factors influencing commuters' decision about mode choice.

Pooley and Turnbull (2001) examined changing attitudes to different modes based on a survey of 1834 individuals. They demonstrate that in general, the reasons why men and women chose one mode of transport have been consistent over time. To the policy makers, their paper suggests that once a particular mode of transport becomes established, people are often reluctant to change.

Adidjaja et. al (1999) analyze changes in journey to work patterns in the tri-state metropolitan regions (New York, New Jersey and Connecticut) between 1980 and 1990. Journey to work in this region increased by 13 percent from 1980 to 1990. Their report indicates that trips by drive-alone mode increased 28 percent between 1980 and 1990, while nationally, trips by drive-alone increased by 35 percent. They believe that possible reason is due to a combination of factors including an increase in the number of dual income families, increased participation of women in labor force and decentralized development patterns. In the same area, carpooling dropped significantly by 22 percent during the same
period. The possible reasons include increase in car ownership, the inconvenience of matching time and locations for commuters and lack of autonomy during carpooling. Mass transit increased by 7 percent to 26 percent of total mode choice, much higher than the national level of 5.2 percent, while nationwide, mass transit decreased by 2 percent. It is clear that mass transit has a larger share of mode choice because in this region, there exists extensive network of bus, rail and subway.

Kingham et. al. (2001) examined commuters' perception of their mode choice during the journey to work based on surveys administered at two large companies in U.K. The results of survey indicate that 97% and 88% of staff at the respective companies travel to work by car, while only 2% and 7% of respondents cycled to work. Although only 0% and 3% currently use public transport for the journey to work, they express their willingness to shift to public transport if services are improved. Overall, there seems to be genuine willingness to move out of car for the journey to work, with one of the main barriers being a perception that alternatives are not viable. They conclude that it is clear people are aware of both pollution and congestion because of excess use of car and that people are willing to act to improve the situation. There is also potential for an increase in public transit if there is substantial improvement in providing quality services. But the main barrier to see a mode shift for commuters’ journey to work is the fact that people live far from their worksites. This severely reduces the possibility of cycling to work. It also hampers the likelihood to use public transit such as bus because if people live too far away,
the transit trip could be time consuming. Their research also shows that there is a scope for growth in a number of alternatives to driving alone by car. Cycling, public transit, carpooling and home working all have potential to take the burden off the roads.

Hjorthol (2000) analyzes the work trips of married couple in Oslo and shows that married men and women adjust their working hours and journey to work in different ways with the same urban context. A common adjustment is that women arrange their working hours and their travel to work to fit in with the family’s phase in life cycle because men generally have a higher income and the family is more dependent on the husband’s income than on wife’s. Their results also indicate that allocation of the family cars follow the traditional gender patterns. If the family has only one car, the husband generally is the dominant user. Women travel by public transport and walk and cycle more than men do. The author suggests that given the fact the women have less access to car and fewer fringe benefits related to car use than men have, urban development based on car use will have different impact for men than for women. Since urban sprawl is a common phenomenon in most western countries, urban development based on car use will be less favorable to women, while concentrated urban development will favor both women and environment.

De Palma and Rochat (2000) investigate the mode choice for trips to work in the city of Geneva by means of a nested logit approach. They focus on the joint nature of the decision of how many cars to own in the household and the decision to use the car for the trip to work. Their findings suggest that travel time
and travel cost play a key role in mode split choice between car and transit. Their results also highlight the effect of the perceived level of comfort and accessibility of modes on the mode choice. They also indicate that car ownership decision is related primarily to the income level of the household but also to contextual household constraints such as number of workers in the household, and locations of home. They conclude that any land-use policy aimed to influence travel behavior should be accompanied by a strong improvement in public transit system.

Kim et. al.,(2003) estimate a multinomial probit model of work trip mode choice in Seoul, Korea, using a simulation-based method: Bayesian approach using Gibbs sampling. They estimate direct and cross elasticity with respect to travel cost and the value of time. Their findings suggest that whereas travel demands are insensitive to cost, travel demands are sensitive to travel time change. The cross-elasticity results indicate that the bus has a greater substitute relation to the subway than autos and that an increase in the cost of an auto will increase the demand for bus transport more than that of subway.

2.3 Travel time

The pressure of time is a major factor in travel choice people make. In 2000, 14 percent of workers traveled more than 45 minutes and 29 percent of commuters traveled less than 15 minutes. In 1990, those numbers were 12 percent and 31 percent respectively. Furthermore, 40 percent of workers in large cities travel over 30 minutes to work one way on a daily base. Travel time is
widely studied by researchers during last half a century. Research conducted in late 1970s and early 1980s find that travel time length per traveler is stable over time. But a reverse result is showed in mid 1990s. Most researchers agree that the length of travel time is actually influenced by many social and economic factors including age, auto ownership, gender, household size, location of home, income, employment status and time of day.

2.3.1 Age

Studies on the relationship between travel time and age indicate that people at different age spend varying travel time in their trips. Kitamura (1992) found that people between 18 and 50 spend longer travel time than people of other ages. It is logical because people between 18 and 50 are portion of working age population and actively involved in variety of activities. However, Purvis (1994) found mixed results on the relationship between the age and travel time.

2.3.2 Auto ownership

Most researchers believe there is a clear relationship between auto ownership and travel time, however, they disagree on whether they are positively or negatively related. Some studies show that auto ownership enables people to spend more time on travel because of both accessibility and freedom a car will bring to the owner (Lu and Pas 1999). Others found negative relationship between auto ownership and travel time with possible reason that owning a car would make a person to save time during travel (Zahavi and Talvitie 1981). In
cities with transit service, transit travel time, on average, far exceeds auto travel
time because of walking to and from stops, waits at stops and for transfers, and
frequent vehicle stops along the way (Blumenberg and Waller 2003). However,
there are some studies showing that there is no significant relationship between
auto ownership and travel time (Purvis 1994).

Another possible linkage between travel time and auto ownership could
that increased travel time induce an auto ownership in the future given the
income constraint. As a person spend more and more time on travel, the
likelihood that he shifts from lower speed mode to higher speed mode increases
considering the benefit a car could bring to a person.

2.3.3 Gender

There is no agreement on the relationship between gender and travel
time. A number of studies show that women have significantly different travel
patterns than men. Women, tend to have shorter average trip lengths (Giuliano
1979; Gordon et. al 1989; Hanson and Johnston 1985; Hanson and Pratt 1990)
but make more trips than men (Rosenbloom 1988). Taylor and Mauch (2000)
showed that the average trip made by women is 21.8 minutes and the average
length made by men is 24.8 minutes, a 12.9 percent of difference. Some studies
show that men spend more time on travel than women while other studies show
that women spend more time traveling than men (Lu and Pas 1999). Hanson and
Johnston argued that women’ shorter commutes are due primarily to spatial and
economic factors such as lower income, low paid labor intensive occupations
located in central cities. Additionally, others believe there is insignificant relationship between gender and travel time because the relationship between gender and travel time is influenced by other factors such as employment status, family structure and income.

2.3.4 Household size and structure

Studies show that with the increase in household size, the average travel time per person decreases (Purvis 1994). A larger household size generally means more kids at home, which may increase the total travel time per household, but the average travel time per person will not increase with the increase in household size. Research also shows that married mothers’ trip making pattern and travel time are very different from those of comparable men, and single parents’ travel patterns and travel time are quite different from their married counterparts (Johnston-Anumono 1989; Rosenbloom and Burns 1993). Some other studies, however, show that there is no clear linkage between household size and travel time (Zahavi and Talvitie 1981).

Households are categorized into four groups: single adult without children, single adult with children, two-or-more adults without children and two-or-more adult with children, which are generally referred as household structure. The findings from the commute time analyses for the journey-to-work with respect to household types indicate that difference in commute times between women who live alone and men who live alone barely existed when compared to two-or-more adults households and households with children. The difference between male
and female single adult household without children was about 0.6 minutes, compared to a 3.8 to 4.5 minute difference for other household types (Taylor and Mauch 2000).

2.3.5 Race and ethnicity

McLafferty and Preston (1991) argue that analyses of gender differences in journey to work length have largely ignored intervening effects of race and ethnicity. Their study of service sector workers in metropolitan New York finds little gender difference in commute times of Hispanic and black men and women. Taylor and Mauch find that male/female commute time differences are lower among non-whites and not statistically significant. The difference in journey to work travel time is higher among whites (4.5 minutes) than non-whites, and the lowest among Hispanics (1.8 minutes). But they believe that data on this issue are far from clear and thus further research is necessary.

2.3.6 Location of home

The effect of location of home on travel time is widely studied. If a person’s home is located in rural areas rather than urban areas, it is expected that the travel time he spends will be different from those living in urban areas if other conditions are equal. Some studies show that people living in large cities spend more time on travel than those in small cities (Adidjaja et. al, 1999). The possible explanation could be that large cities with a higher population have more traffic congestions.
According to U.S. decennial census, ten million workers nationwide now travel 60 minutes or more to their jobs, and 6.7 million of them are workers in large cities. And workers in large cities have longer commutes than workers in nationwide.

2.3.7 Household income

The studies on the relationship between income and travel time indicate inconclusive results. Some studies show that income positively influence travel time. When income is higher, more travel time is spent with other conditions remaining the same (Pas and Lu 1999). Some studies show, however, income and travel time are negatively related using data in developing countries in Latin America and Asia. Other studies show there is no clear linkage between income and travel time (Zahavi and Talvite 1981).

2.2.8 Employment status

There is agreement on the relationship between employment and travel time. Studies show that employees spend more time on travel than those people who do not work (Lu and Pas 1999). If a person is employed, daily journey to work is required and therefore more travel time is spent.

2.2.9 Time of day

The relationship between time of day and travel time is clear. If a person travel at off-peak hours, the travel time tends to be shorter. Researchers found
that travel time tends to be longer if departing from work than departing from home. The possible explanation is that people tend to leave office at rush hours, which increase the travel time because of increased traffic.

From the above literature review concerning travel time and its related factors, it is clearly shown that commuters’ decisions in mode choice and travel time are not determined by any single factor. Any decision is actually a result of combination of many factors interacting with each other. It also suggests that a better understanding of commuters’ travel choices be obtained through analysis at the disaggregate level.
CHAPTER 3
DATA DESCRIPTION

Three data files are used to analyze the journey to work travel behavior characteristics. The first one is the American Community Survey Public Use Microdata Sample files and the other two are Summary File 3 Public Use Microdata Sample 1% and 5% files.

3.1 ACS PUMS data files

The American Community Survey (ACS) is a nationwide survey designed to provide communities up-to-date information on a variety of statistics. The ACS is also a critical element in the Census Bureau’s reengineered 2010 census. The decennial census has two parts: the short form and the long form. The short form counts the population, while the long form obtains demographic, housing, social and economic information from a 1-in-6 sample of households. However, because long form census is conducted every ten years, long form information becomes out of date soon after they are published, about two years after the census is taken. Their usefulness declines every year thereafter. Planners and other data users are reluctant to rely on it for decisions that are expensive and affect the quality of life of thousands of people. The American Community Survey
can identify changes in an area’s population and give an up-to-date statistical picture when data users need it, every year, not just once every ten years.

The American Community Survey is conducted using the best mail self-response techniques of the decennial census combined with follow-up techniques that produce high quality data. For households that do not respond by mail, the quality of data is improved by using well-trained permanent interviewer staff using computerized interviewing, which incorporate edits into the collection process. Using a permanent coding, staff provides additional improvements in data quality. Furthermore, as an ongoing survey, the American Community Survey is also flexible, capable of adapting to changing needs.

The American Community Survey can screen for households with specific characteristics. These households could be identified through the basic survey, or through the use of supplementary questions. The targeted households can then be candidates for follow-up interviews, thus providing a more robust sampling frame for other surveys. The American Community Survey provides more reliable detailed data than national household survey whose samples are too small to provide reliable estimates for states or localities.

The American Community Survey uses three modes of data collection---mail, telephone and personal visits. The sample has a three-month data collection period; the first month is by mail and the second month by telephone. Those who have not responded by mail and by telephone two months after the initial mailout are identified and sampled at a rate of 1-in-3. The households selected in 1-in-3 sample are then enumerated by personal visit during the third
month of the data collection period. By doing this, ACS is able to reduce the amount of non-sampling error introduced through nonresponse for sampling housing units.

Public Use Microdata Sample files are from the Census 2000 Supplementary Survey that shows the full range of responses made on individual questionnaires. The questionnaires include questions on age, gender, tenure, income, education, language spoken at home, journey to work, occupation, shelter costs, vehicle available and other subjects. Actually, the full range of population and housing information collected in the Census Supplementary Survey is available in the PUMS.

Different from summary data, microdata’s basic unit of analysis is an individual housing unit and the people who live in it, rather than a specific geographic entity, which enables us to analyze the data at a disaggregate level, which is extremely helpful when our focus is on personal decisions such as mode choice and time choice. The advantage of PUMS is that data users can tabulate data according to characteristics they need to know about. It also helps users to look at the relationship among variables not shown in the standard products offered by the Census Bureau.

There are two basic record types: the housing unit record and the person record. Each has a unique identifier. Each record contains a serial number that links the person in the housing unit to the proper housing unit record. The file is sorted to maintain the relationship between both record types.
The Census Bureau releases the PUMS in this format because of tremendous amount of data contained in one record. Although these records are extremely large, they can be handled by most statistical software. Each record has an individual weight. That is, there are two sets of weights assigned to individual and housing unit. Estimates of person characteristics were based on person weight and estimates of family, household or housing unit characteristics were based on the housing unit weight. And each sample person or housing unit record was assigned exactly one weight to be used to produce estimates of all characteristics.

PUMS data files are available across 50 states in the United States. This paper focuses on the analyses of data obtained in the state of Florida.

3.2 SF3 PUMS 1% and 5% data files

PUMS 1% and PUMS 5% data files are Summary File 3 Public Used Microdata Sample data released by Census Bureau. Summary File 3 presents data for the United States, the 50 states, the District of Columbia and Puerto Rico in a hierarchical sequence down to the block group for many tabulations, but only to the census tract levels for others. Summaries are included for other geographic areas such as Zip Code Tabulation Areas (ZCTAs™) and Congressional districts.

Public Use Microdata Sample (PUMS) files contain records representing 5-percent or 1-percent samples of the occupied and vacant housing units in the U.S. and the people in the occupied units. Group quarters people also are
The file contains individual weights for each person and housing unit, which when applied to the individual records, expand the sample to the relevant total.

The Public Use Microdata Sample (PUMS) files contain geographic units known as super-Public Use Microdata Areas (super-PUMAs) and Public Use Microdata Areas (PUMAs). To maintain the confidentiality of the PUMS data, minimum population thresholds are set for PUMAs and super-PUMAs. For the 1-percent state-level files, the super-PUMAs contain a minimum population of 400,000 and are composed of a PUMA or a group of contiguous PUMAs delineated on the 5-percent state-level PUMS files. Super-PUMAs are a new geographic entity for Census 2000. The 5-percent state-level files contain PUMAs, each having a minimum population of 100,000; the 5-percent files also will show corresponding super-PUMAs codes. Each state is separately identified and may be comprised of one or more super-PUMAs or PUMAs. Large metropolitan areas may be subdivided into super-PUMAs and PUMAs. PUMAs and super-PUMAs do not cross state lines. Super-PUMAs and PUMAs also are defined for place of residence on April 1, 1995 and place of work.

The SF3 PUMS 1-percent files give users the maximum amount of socio-economic and housing information. There is no national minimum threshold for the identification of variable categories, with the exceptions of a national minimum population of 8,000 for race and Hispanic origin. The goal of these files is to provide a similar level of detail as was available in the 1990 PUMS files (and, in some cases, more detail). In order to provide the level of characteristic
detail for the 1-percent files described above, the minimum geographic population threshold needed to be raised above 100,000 (the PUMA minimum). A new geographic entity was created—the super-PUMA. Super-PUMAs have a minimum population of 400,000 and are composed of a PUMA or PUMAs delineated on the 5-percent PUMS files. Each state will be identified, and any state with a population of 800,000 or greater can be subdivided into two or more super-PUMAs.

To maintain confidentiality, while retaining as much characteristic detail as possible, a minimum threshold of 10,000 nationally is set for the identification of variable categories within categorical variables in the 5-percent PUMS files. Each PUMA in the 5-percent files must meet a minimum population threshold of 100,000. The minimum PUMA threshold was held at 100,000 by increasing the degree of variable collapsing as described above.

PUMS data files are used in this thesis because PUMS files essentially allow “do-it-yourself” special tabulations. The Census 2000 files furnish nearly all of the detail recorded on long-form questionnaires in the census, subject to the limitations of sample size, geographic identification, and confidentiality protection. Therefore, we can construct a wide variety of tabulations interrelating any desired set of variables. We have almost the same freedom to manipulate the data that we would have if we had collected the data in our own sample survey, yet these files offer the precision of census data collection techniques and sample sizes larger than would be feasible in most independent sample surveys. Since we focus on the characteristics of journey-to-work rather than identifying specific
small geographic areas or detailed crosstabulations for small populations, PUMS data is suitable to concentrate on the study of relationships among journey-to-work related variables.

According to Census Bureau, each microdata file is a stratified sample of the population which was created by subsampling the full census sample (approximately 15.8 percent of all housing units) that received census long form questionnaires. Initial sampling was done address-by-address in order to allow the study of family relationships and housing unit characteristics for occupied and vacant units. Sampling of people in institutions and other group quarters was done on a person-by-person basis. PUMS 5% and PUMS 1% are two independently drawn samples, designated “5 percent” and “1 percent,” each featuring a different geographic scheme. Nationwide, the Census 2000 5-percent sample provides the user records for over 14 million people and over 5 million housing units. For the 1-percent sample, there are records for over 2.8 million people and over 1 million housing units.

The main reason for analyzing the above mentioned data files lies in the fact that the data files can be very helpful when establishing or updating regional travel models because socio-economic variables from the data files could be inputs for various transportation models. They can also be used in gaining understanding of the geographic distribution of travel in the region, along with travel mode choice and travel duration by mode. This knowledge of travel behavior and commuting patterns, the distribution of origins and destination, the distribution of departure time to and from work can lead to potential
transportation demand management techniques that are aimed at reducing traffic congestion or improving environmental conditions. Decision makers will also benefit since they are able to make informed decisions regarding land use and other related public policy based on the knowledge of travel behavior and travel needs.

Given the purpose of this thesis is to analyze the journey to work related variables, the unrelated data were deleted and the results are presented in the following chapters.
CHAPTER 4
OVERALL ANALYSIS OF DEMOGRAPHIC, SOCIO-ECONOMIC AND
JOURNEY TO WORK TRAVEL BEHAVIOR CHARACTERISTICS IN FLORIDA

This chapter contains an overall statistic analysis of demographic, socio-economic and journey to work travel behavior characteristics in Florida using the three data files: ACS PUMS data file, SF3 PUMS 1% and PUMS 5% data files. The demographic and socio-economic variables include age, race, household size, household car ownership, and household income. The journey-to-work related variables include private vehicle occupancy, departure time, travel time, and mode choice.

4.1 Demographic and socio-economic characteristics

According to the Bureau of the Census, Florida's population has increased more than 24 percent from 1990 (12.9 million) to 2000 (15.98 million). During the same period, the gender distribution in Florida has remained stable with approximately 48.8 percent of the population being male and 51.2 percent being female. The following statistic analysis on age, race, household size, income and car ownership analysis are presented based on the three data files.
Age is divided into seven categories. For categories between 20 and 29, between 30 and 39, and between 60 and 64, there is no significant difference among the results reported by the three data files. As shown by the Figure 4.1.1, people under 16 accounts for 21.17% in the ACS data, a little higher than that of 20.30% and 20.26% in PUMS 1% and PUMS 5% respectively. On the other hand, people aged 65 and over account for a lower percentage (17.07%) in ACS data, compared to that in PUMS 1% and PUMS 5% (17.53% and 17.56%). Census data reports that in 2000, people under 16 accounts for 20 percent of population in Florida and people over 65 account for 18 percent. Comparing the results of the three data files with those provided by the Census, most of the results are very close, indicating that the three data files are accurately reflecting the age distribution in Florida.

Race is divided into three categories: white, African-American and other. ACS data contains a lower percentage (6.72%) of non-African American minorities than that in PUMS 1% (7.62%) and PUMS 5% (7.61%). The Census reports that in 2000, white constitutes 80 percent of population in Florida, African American 15 percent and non African American 5 percent.

Household size is divided into five categories: single family, family with two members, family with three members, family with four members and family with five or more members. As shown by the Figure 4.1.3, ACS data contains a higher percent of single family than that in PUMS 1% and PUMS 5%. On the contrary, ACS data contains a lower percent of household with five or more family members than the other two data files. The average household size is a
little bit different: 2.39 reported by ACS data and 2.45 by PUMS 1% and 5% data files, while the Census reports that the average household size in Florida is 2.5.

Household is divided into 11 categories by income with the lowest income category of less than $10,000 and highest income category of more than $100,000. ACS data shows that the richest household in Florida accounts for 9.95%, while the PUMS 1% and PUMS 5% data files report a higher percentage: 11.27 percent and 11.22 percent respectively. The average household income in Florida is $51,464 reported by ACS data, $53,386 by PUMS 1% and $53,467 by PUMS 5%.

Private vehicle occupancy presents the distribution of number of passengers in each vehicle in the journey-to-work trip. For the drive-to-work mode, over 85 percent of commuters chose to drive alone. The most likely reasons include the increase in employment in the suburbs, the availability of relatively cheap gas. Results also indicate that carpooling accounts for 2.37% of total drive-to-work mode in ACS data, and 3.16% and 3.07% in PUMS 1% and PUMS 5% respectively. The possible reasons may include increase in car ownership, difficulty in matching time and locations for commuters, lack of autonomy during carpooling and decentralization of employment.

Household car ownership presents the distribution of number of cars a household owns. Figure 4.1.5 indicates that over 90 percent of households own at least one car, and over 50 percent of households own two or more cars. The average number of cars owned by each household is 1.59.
Figure 4.1.1 Florida Population Distribution by Age (%)  
ACS, PUMS 1% and PUMS 5%  
(Number of Samples: ACS=57,745, PUMS 1%=159,704, PUMS 5%=796,421)

Figure 4.1.2 Florida Population Distribution by Race (%)  
ACS, PUMS 1% and PUMS 5%  
(Number of Samples: ACS=57,745, PUMS 1%=159,704, PUMS 5%=796,421)
Figure 4.1.3 Florida Household Distribution by Household Size (%)  
ACS, PUMS 1% and PUMS 5%  
(NumberOf Samples: ACS=26,957, PUMS 1%=67,270, PUMS 5%=336,349)

Florida Average Household Size:  
ACS=2.39, PUMS 1%=2.45, PUMS 5%=2.45

Figure 4.1.4 Florida Household Distribution by Income (%)  
ACS, PUMS 1% and PUMS 5%  
(NumberOf Samples: ACS=26,957, PUMS 1%=67,270, PUMS 5%=336,349)

Florida Average Household Income:  
ACS=$51464, PUMS 1%=$53385, PUMS 5%=$53467

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Figure 4.1.5 Florid Household Distribution by Car Ownership (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=24,772, PUMS 1%=63,379, PUMS 5%=316,897)

Florida Average Household Car Ownership:
ACS=1.59, PUMS 1%=1.59, PUMS 5%=1.58
4.2 Journey to work travel behavior characteristics

Departure time to work presents when commuters go to work. It is grouped into 10 categories. The results indicate that most people work during regular office hours, therefore their departure time concentrates on the period from 6 am to 9 am. For those people who work during non-regular office hours, the three data files have very close results.

Journey-to-work travel time is divided into six categories. ACS data shows that 12.76% of commuters’ travel time is less than 10 minutes, around 1.5 percent higher than that reported by PUMS 1% and PUMS 5%. ACS data shows 7.39 percent of commuters travel longer than 50 minutes, one percent lower than that reported by PUMS 1% and PUMS 5%.

Private vehicle occupancy presents the distribution of number of passengers in each vehicle in the journey-to-work trip. It is related with drive-to-work mode only. In Florida, journey to work average private vehicle occupancy is 1.17 reported by ACS data, 1.19 reported by PUMS 1% and 5%. For the drive-to-work mode, over 85 percent of commuters chose to drive alone, which indicates that drive-to-work is the dominant choice for commuters. Results also indicate that carpooling accounts for 2.37% of total drive-to-work mode in ACS data, and 3.16% and 3.07% in PUMS 1% and PUMS 5% respectively.
Figure 4.2.1 Florida Journey to Work Departure Time Distribution (%)  
ACS, PUMS 1% and PUMS 5%  
(Number of Samples: ACS=23,975 PUMS 1%=159,704 PUMS 5%=796,421)

Figure 4.2.2 Florida Journey to Work Average Travel Time Distribution (%)  
ACS, PUMS 1% and PUMS 5%  
(Number of Samples: ACS=23,975, PUMS 1%=65,739, PUMS 5%=328,270)
Figure 4.2.3 Florida Journey to Work Mode Choice Distribution (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=24,805, PUMS 1%=67,874, PUMS 5%=338,467)

Figure 4.2.4 Florida Journey to Work
Private Car Occupancy Distribution (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=22,711, PUMS1%=62,162, PUMS 5%=310,910)
CHAPTER 5
ANALYSIS OF JOURNEY TO WORK TRAVEL BEHAVIOR BY HOUSEHOLD AND INDIVIDUAL CHARACTERISTICS IN FLORIDA

5.1 Journey to work private vehicle occupancy analysis

This section contains an analysis of journey-to-work private vehicle occupancy by number of workers, household size, household income, household car ownership, age, race, and gender.

Figure 5.1.1 depicts the journey to work private vehicle occupancy distribution by household size. All the three data files indicate that under the category of single family, drive-alone is the dominant choice: more than 93 percent of commuters chose to drive alone, around 5 percent of commuters chose to carpooling. When the household size increase from one member to two members and three members, the choice of drive alone falls by around 5%, while the choice of carpooling increase more than 6%. There is no significant difference in all categories of private vehicle occupancy when the household size is two-member, three- member and four or more members. All three data files show that with the increase in household size, the choice of drive-alone falls, while the carpooling increased.
Figure 5.1.2 depicts private vehicle occupancy distribution by household income. When household income is less than $15,000, drive-alone is still the dominant choice, however, ACS data reports more than 85 percent of people under this income category chose to drive alone, while PUMS 1% and PUMS 5% data reports more than 79 percent chose to drive alone. Under the same income category, ACS reports more than 11 percent of people chose to carpool around 3 percent lower than that reported by the other two data files. The Figure clearly indicates that with the increase in household income, the percentage of drive-alone increases, while percentage of carpooling falls.

Figure 5.1.3 depicts private vehicle occupancy distribution by household car ownership. When a household does not own a car, ACS reports that 57.09 percent of people chose to drive alone, 11 percent lower than that reported by PUMS 1% and 12.14 percent lower than that reported by PUMS 5%. The point here is that how those people drive alone without owning a car. Under the same category of car ownership, ACS reports two-person carpooling of 27.87 percent and three-person carpooling of 7.74%, much higher than those reported by PUMS 1% and PUMS 5%. For all other categories of car ownership, there is no significant difference among the results reported by the three data files. The results indicate that with the increase in the number of cars owned by household, the choice of drive-alone increases, and the choice of carpooling decrease substantially.

Figure 5.1.4 depicts private vehicle occupancy distribution by age. ACS data reports more than 80 percent of people under 19 chose to drive alone,
around 8 percent higher than that reported by PUMS 1% and PUMS 5%. For the same age category, ACS data reports more than 16 percent of people chose to carpool, around 7 percent lower than that reported by other two data files. For all other categories, there is no significant difference in the choice of private vehicle occupancy. The Figure suggests that with the increase in age, more people tend to drive alone and fewer and fewer people tend to use carpooling.

Figure 5.1.5 depicts the Journey-to-work private vehicle occupancy distribution by race. Results indicate that for white persons, there is no significant difference among three data files. All of them show that around 88 percent of white chose to drive alone, and around 12 percent white chose to carpool. However, for African-American, ACS data shows that around 85 percent of people chose to drive alone, around 5 percent more than that reported in PUMS 1% and PUMS 5%, while 11.68 percent of them chose to carpool, around 3 percent lower than that reported in PUMS 1% and PUMS 5%. The similar difference exists for category of non-African-American minorities. The data files also clearly indicate that compared to white, more African-American and non African-American minorities chose carpooling.

Figure 5.1.6 depicts private vehicle occupancy distribution by gender. The results from all three data files suggest that gender does not play a significant role in the choice of private vehicle occupancy as the percentage of drive-alone, carpooling reported by all three data files is indifferent between male and female. However, PUMS data suggests that female has a little higher likelihood to choose carpooling.
Figure 5.1.1 Florida Journey to Work Private Car Occupancy Distribution by Household Size (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=22,771, PUMS 1%=62,162, PUMS 5%=310,190)
Figure 5.1.2 Florida Journey to Work Private Car Occupancy Distribution by Household Income (%)

ACS, PUMS 1% and PUMS 5%

(Number of Samples: ACS=22,771, PUMS 1%=62,162, PUMS 5%=310,190)
Figure 5.1.3 Florida Journey to Work Private Car Occupancy Distribution by Car Ownership (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=22,771, PUMS 1%=62,162, PUMS 5%=310,190)
Figure 5.1.4 Florida Journey to Work Private Car Occupancy Distribution by Age (%)  
ACS, PUMS 1% and PUMS 5%  
(Number of Samples: ACS=22,771, PUMS 1%=62,162, PUMS 5%=310,190)
**Figure 5.1.5** Florida Journey to Work Private Car Occupancy Distribution by Race (%)  
ACS, PUMS 1% and PUMS 5%  
(Number of Samples: ACS=22,771, PUMS 1%=62,162, PUMS 5%=310,190)

**Figure 5.1.6** Florida Journey to Work Private Car Occupancy Distribution by Gender (%)  
ACS, PUMS 1% and PUMS 5%  
(Number of Samples: ACS=22,771, PUMS 1%=62,162, PUMS 5%=310,190)
5.2 Journey to work travel time analysis

This section presents the analysis of journey to work travel time by household characteristics such as household income, number of household workers, household size, car ownership, and other individual characteristics including age, gender and race.

Figure 5.2.1 depicts the average journey to work travel time by household income. As shown by the figure, journey to work travel time is sensitive to household income level. Worth to mention is that except under income category of between $70,000 and $79,999, ACS data reports a shorter travel time than that reported by PUMS 1% and PUMS 5%. The difference between the results reported by ACS and PUMS 1% and PUMS 5% ranges from 0.57 minutes to 2.38 minutes. PUMS 1% and PUMS 5% report very close results regarding travel time under most income categories except the categories between $60,000 and $69,000, $70,000 and $79,999 and between $80,000 and $89,999 with difference ranging from 0.43 to 1.12 minutes.

Figure 5.2.2 depicts journey to work travel time by number of household workers. For household with one worker, ACS reports an average journey to work travel time of 24.98 minutes, while PUMS 1 % reports 27.33 minutes and PUMS 5% reports 27.41 minutes. For household with two workers or so-called dual income family, all three data files report an increase in average journey to work travel time. When the household worker increased from two to three, reported average journey to work time decreased. Under the two workers category, 25.02 minutes of average travel time reported by ACS data file, 2.35
minutes and 2.31 minutes less than the counterparts reported by PUMS 1% AND 5% respectively. Under the category of three or more workers, the difference reported by ACS and PUMS 1% and 5% is even widened to 2.75 minutes.

Figure 5.2.3 depicts average journey to work travel time by household size. PUMS 5% data files report that with the increase in household size, the average travel time also increases. ACS reports the same trend except when the household increases from 3-member to 4-member, the average travel time decreased 0.4 minutes. PUMS 1% reports that when the household size increases from 4-member to 5 or more members, the average travel to work time decreases. Besides, the differences reported by the three data files are significant in all categories ranging from 0.5 minutes to 2.75 minutes.

Figure 5.2.4 depicts the average journey to work travel time by household car ownership. When a household does not own any cars, the average travel time is 27.75 minutes reported by ACS, compared to 28.55 minutes and 30.17 minutes reported by PUMS 1% and 5% respectively. All three data files report that once a household owns at least one car, average travel time decreases. This could be explained that if without car, people are more likely to either take transit or other modes, which is time consuming compared to drive. All three data files report that when the number of cars owned by household increases from one to two, the average journey to work travel time increases, while the number of cars owned increases from three to four or more, the average travel time decreases. Again, the differences on the results reported by ACS and PUMS 1% and 5% do exist.
Figure 5.2.5 depicts average journey to work travel time by age. It shows that for the category under 19, people have shortest journey to work travel time, with a mean of 17.19 minutes reported by ACS, compared to 19.42 minutes and 19.62 minutes reported by PUMS 1% and 5% respectively. All three data files report that people between 35 and 49 have longest journey to work travel time, followed by those between 20 and 34, those between 50 and 64. Under all age categories, ACS reports a shorter travel time than that reported by PUMS 1% and 5% data files.

Figure 5.2.6 depicts average journey to work travel time by gender. All three data files report that the male has longer journey to work travel time. ACS reports that the male spends 25.88 minutes on trip to work on average, three minutes longer than the female. PUMS 1% and 5% report similar results. ACS reports shorter journey to work travel time than PUMS data files on both gender.

Figure 5.2.7 depicts average journey to work travel time by race. ACS data reports that there is no significant difference in average travel time among race. PUMS 5% data file reports that African-American spend more time on journey to work than white and other non-African-American minorities, while PUMS 1% data file reports that non-African-American spend more time on journey to work than white and African-American. For the African-American, ACS reports an average travel time of 24.89 minutes, 2.33 minutes less than that reported by PUMS 1%, and 2.60 minutes less than that reported by PUMS 5%. For the non-African-American, the difference is even wider.
Figure 5.2.1 Florida Journey to Work Average Travel Time by Household Income
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=23,975 PUMS 1%=159,704 PUMS 5%=796,421)

Florida Average Journey to Work Travel Time (minutes):
ACS=24.46, PUMS 1%=26.12, PUMS 5%=26.21
Figure 5.2.2 Florida Journey to Work Average Travel Time by Number of Workers
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=23,975 PUMS 1%=159,704 PUMS 5%=796,421)

Figure 5.2.3 Florida Journey to Work Average Travel Time by Household Size
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=23,975 PUMS 1%=159,704 PUMS 5%=796,421)
Figure 5.2.4 Florida Journey to Work Average Travel Time by Household Car Ownership
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=23,975 PUMS 1%=159,704 PUMS 5%=796,421)

Figure 5.2.5 Florida Journey to Work Average Travel Time by Age
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=23,975 PUMS 1%=159,704 PUMS 5%=796,421)
Figure 5.2.6 Florida Journey to Work Average Travel Time by Gender
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=23,975 PUMS 1%=159,704 PUMS 5%=796,421)

Figure 5.2.7 Florida Journey to Work Average Travel Time by Race
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=23,975 PUMS 1%=159,704 PUMS 5%=796,421)
5.3 Journey to work mode choice analysis

This section presents journey to work mode choice analyses by household characteristics including household income, household car ownership, household size, number of workers, and other individual characteristics including gender, race and age.

Figure 5.3.1 depicts journey to work mode choice by household car ownership. All three data files report that the mode choice is significantly different with and without owning a car. When a household does not own any car, ACS reports only 43.90 percent of individuals choose to go to work by driving, more than 30 percent by public transportation, more than 12 percent by walk and 11 percent by other means. However, under the same car ownership category, PUMS data files report a much higher percent of individuals choose to drive and a much lower percent by public transportation compared to those reported by the ACS. When the household own at least one car, all three data files report very close results.

Figure 5.3.2 depicts journey to work mode choice by household size. The three data files all report very close results regarding mode choice. It seems that when the household size increases from one member to four-member, the likelihood of choosing driving to work also increase. However, when the household is five-or-more-member, the likelihood of driving to work decrease but the likelihood of public transportation increases. The results also indicate that for single families, ACS reports a lower percent of walk than that reported by PUMS data files.
Figure 5.3.3 depicts the journey to work mode choice given five income categories. For the individuals whose household income is less than $15,000, ACS reports that 83.14 percent of households in Florida choose to drive to work, while PUMS 1% and 5% report 79.68 percent and 78.98 percent respectively. ACS reports that 7.78 percent of individuals under this income category choose public transportation to go to work, 1.5 percent higher than those reported by PUMS 1% and 5%. Except the mode of driving to work, all other mode choices, ACS reports a lower percent. For the income category of between $15,000 and 39,000, the results on all mode choices reported by the three data files are very close with ignorable differences. For the income categories of between $40,000 and $69,999, $70,000 and $99,999 and more than $100,000, ACS reports a lower percentage of individuals choose to drive to work, a higher percentage of individuals choose public transportation compared to those reported by PUMS data files. It is evident that with the increase in household income, more and more households choose to drive to work, and fewer and fewer individuals select public transportation and walk. Work at home is the only mode that is not sensitive to the household income as it is determined by many other factors besides employee income and preference.

Figure 5.3.4 depicts journey to work mode choice by age. It is evident that for all age categories, driving to work is the dominant mode choice. For people below 19, more people choose to go to work by walk or other means than any other age categories. Worth to mention is the mode of work at home. Results
indicate the people over 65 more like to work at home than any other age categories.

Figure 5.3.5 depicts journey to work mode choice by number of workers. For household with two or more workers, the results reported by three data files are very close. For single families, however, ACS reports a more than 91 percent of individuals choose to drive to work, around 9 percent higher than that reported by PUMS 1% and 5%. For all other mode choices, ACS results are lower than those reported by PUMS data files. It is also evident that once there is at least one worker in household, the dominant mode choice is driving.

Figure 5.3.6 depicts journey to work mode choice by gender. It is evident that driving is dominant mode choice for both male and female. It does show some slight difference on the mode choice between female and male. For example, more females go to work by public transportation than males but more males go to work by other means than females. All three data files report very close results.

Figure 5.3.7 depicts journey to work mode choice by race. Although driving to work is still dominant mode choice. The results indicate that African-American are more likely to go to work by public transportation than white and non-African-American minorities. White, compared with the African American and others, are more likely to choose to work at home.
Figure 5.3.1 Florida Journey to Work Mode Choice Distribution by Household Car Ownership (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=24,805, PUMS 1%=67,874, PUMS 5%=338,467)
Figure 5.3.2 Florida Journey to Work Mode Choice Distribution by Household Size (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=24,805, PUMS 1%=67,874, PUMS 5%=338,467)
Figure 5.3.3 Florida Journey to Work Mode Choice Distribution by Household Income (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=24,805, PUMS 1%=67,874, PUMS 5%=338,467)
Figure 5.3.4 Florida Journey to Work Mode Choice Distribution by Age (%)

ACS, PUMS 1% and PUMS 5%

(Number of Samples: ACS=24,805, PUMS 1%=67,874, PUMS 5%=338,467)
Figure 5.3.5 Florida Journey to Work Mode Choice Distribution by Number of Workers (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=24,805, PUMS 1%=67,874, PUMS 5%=338,467)

Figure 5.3.6 Florida Journey to Work Mode Choice Distribution by Gender (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=24,805, PUMS 1%=67,874, PUMS 5%=338,467)
Figure 5.3.7 Florida Journey to Work Mode Choice Distribution by Race (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=24,805, PUMS 1%=67,874, PUMS 5%=338,467)
5.4 Journey to work departure time analysis

This section presents analysis of departure time to work by household size, number of household workers, household income, household car ownership and individual characteristics such as gender, age and race.

Table 5.4.1 presents the distribution of departure time to work by household size. All three data files report very close results regarding the distribution of departure time to work by household size. However, there are a few points worth to mention. Firstly, ACS reports with the increase in the household size, fewer and fewer people depart to work during 9:00 am to 9:59 am. Secondly, for the household with 5 or more members, more than 7 percent and around 8 percent of people depart to work between 12:00pm and 3:59pm and between 4:00pm and 11:59pm respectively, higher than any other household size.

Table 5.4.2 depicts the distribution of departure time to work by number of workers. For families with only one worker, ACS reports 5.55 percent of people depart to work between 9:00am and 9:59am, while PUMS 1% reports 8.24 percent and PUMS 5% reports 6.99 percent. When the number of workers increases from two to three or more, ACS report that the percentage of people departing between 6:00am and 8:59am decreases slightly from 69 percent to 62 percent, while PUMS data files report the percentage remains unchanged.

Table 5.4.3 depicts the distribution of departure time to work by household income. As shown by the table, with the increase in household income, the percentage of people depart to work between 12:00am and 4:59 am, between
5:00 am and 5:59 am, between 12:00 pm and 3:59 pm, between 4:00 pm and 11:59 pm decrease substantially. It is also evident that with the increase in household income, more and more people choose to depart to work during 7:00 am to 7:59am. There is no significant difference among the results reported by the three data files for the income categories exceeding $40,000. However, for household income less than $15,000, ACS results are different from those reported by PUMS data files. For example, for the departure time period between 7:00 am and 7:59 am, ACS reports that 21.56 percent individuals depart between 7:00 am and 7:59 am, while PUMS 1% reports 23.93 percent and PUMS 5% reports 25.22 percent.

Table 5.4.4 depicts the distribution of departure time to work by car ownership. It seems that departure time to work is not sensitive to car ownership as the results reported by each data file are relatively stable with regard to the increase in household car ownership. Additionally, three data files report very close results except for the category of zero car ownership as ACS reports a higher percent of people depart during the period between 12:00pm and 3:39pm as well as between 4:00pm and 11:59pm than those reported by PUMS 1% and 5% data files.

Table 5.4.5 depicts the distribution of departure time to work by gender. It is evident that the male and the female have different departure time distribution as shown by the table that for the categories of departure time period between 12:00 am to 4:59 am, between 5:00 am to 5:59 am, between 6:00 am and 6:59 am, a much higher percent of the male choose to depart during those periods of
time than the female. For the departure time categories between 7:00 am and 7:59 am, between 8:00 am and 8:59 am, between 9:00 am and 9:59 am, a higher percent of the female choose to depart to work than the male. All other departure time period, the male and the female have no significant difference.

Table 5.4.6 depicts the distribution of departure time to work by race. The results show that the distribution of departure time between the white and minorities are different. For the departure time periods between 12:00 am and 4:59 am, between 5:00 am and 5:59 am, between 12:00 pm and 3:59 pm, between 4:00 pm and 11:59 pm, a higher percent of African-American and Non African American minorities depart to work. For the period between 10:00 am and 10:59 am, between 11:00 am and 11:59 am, there is no significant difference exists between white and minorities. For all other time periods categories, a higher percent of white depart than the minorities.

Table 5.4.7 depicts the distribution of departure time to work by age. It is evident from the table that the distribution of departure time to work for people under 19 is totally different from that for adults. For people under 19, almost 60 percent of people choose to depart to work during the periods of between 12:00 pm and 3:59 pm, between 4:00 pm and 11:59 pm. The possible reason is that most of people in this age category work part time and generally after school hours. For the adults, people over 65 years old have a different distribution of departure time. A higher percent of senior workers choose to depart to work during the periods between 9:00 am and 9:59 am, between 10:00 am and 10:59 am, between 12:00 pm and 3:59 pm than any other age category.
Table 5.4.1  Journey to Work Departure Time Distribution by Household Size (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=22,771, PUMS 1%=62,162, PUMS 5%=310,190)

<table>
<thead>
<tr>
<th>Departure Time</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ACS PUMS 1%</td>
<td>PUMS 5%</td>
<td>ACS PUMS 1%</td>
<td>PUMS 5%</td>
<td>ACS PUMS 1%</td>
</tr>
<tr>
<td>12:00 to 4:59 a.m.</td>
<td>2.84% 2.65% 2.53%</td>
<td>2.72% 2.67% 2.57%</td>
<td>2.41% 3.09% 2.90%</td>
<td>3.62% 2.98% 3.05%</td>
<td>3.21% 3.62% 3.56%</td>
</tr>
<tr>
<td>5:00 to 5:59 a.m.</td>
<td>6.00% 5.82% 5.88%</td>
<td>6.35% 5.81% 5.82%</td>
<td>6.41% 6.49% 6.03%</td>
<td>6.17% 6.56% 5.93%</td>
<td>5.99% 7.15% 6.97%</td>
</tr>
<tr>
<td>6:00 to 6:59 a.m.</td>
<td>17.19% 17.90% 17.36%</td>
<td>18.22% 18.80% 18.87%</td>
<td>19.78% 19.45% 19.31%</td>
<td>18.02% 19.73% 19.65%</td>
<td>21.10% 20.54% 20.97%</td>
</tr>
<tr>
<td>7:00 to 7:59 a.m.</td>
<td>29.53% 29.69% 30.79%</td>
<td>29.28% 32.16% 32.19%</td>
<td>30.64% 32.05% 32.21%</td>
<td>31.78% 32.06% 32.57%</td>
<td>27.91% 27.88% 29.02%</td>
</tr>
<tr>
<td>8:00 to 8:59 a.m.</td>
<td>19.84% 19.91% 19.68%</td>
<td>21.19% 19.41% 19.20%</td>
<td>17.59% 16.94% 17.55%</td>
<td>17.65% 17.67% 17.10%</td>
<td>16.62% 16.10% 15.29%</td>
</tr>
<tr>
<td>9:00 to 9:59 a.m.</td>
<td>8.07% 6.82% 7.38%</td>
<td>7.05% 7.14% 7.15%</td>
<td>6.36% 5.76% 5.84%</td>
<td>5.56% 5.00% 5.52%</td>
<td>5.85% 5.48% 5.45%</td>
</tr>
<tr>
<td>10:00 to 10:59 a.m.</td>
<td>2.17% 2.77% 2.83%</td>
<td>2.64% 2.81% 2.73%</td>
<td>2.49% 2.53% 2.46%</td>
<td>2.25% 2.01% 2.03%</td>
<td>2.81% 2.15% 2.24%</td>
</tr>
<tr>
<td>11:00 to 11:59 a.m.</td>
<td>1.22% 1.31% 1.27%</td>
<td>1.32% 1.22% 1.18%</td>
<td>1.31% 1.15% 1.07%</td>
<td>1.13% 1.05% 1.00%</td>
<td>1.23% 1.18% 1.11%</td>
</tr>
<tr>
<td>12:00 to 1:59 p.m.</td>
<td>6.64% 6.70% 6.28%</td>
<td>5.95% 5.35% 5.43%</td>
<td>6.61% 6.09% 6.26%</td>
<td>6.12% 6.04% 6.13%</td>
<td>7.46% 7.79% 7.37%</td>
</tr>
<tr>
<td>2:00 to 3:59 p.m.</td>
<td>6.50% 6.42% 5.99%</td>
<td>5.27% 4.64% 4.86%</td>
<td>6.39% 6.45% 6.39%</td>
<td>7.70% 6.89% 7.02%</td>
<td>7.82% 8.11% 8.02%</td>
</tr>
<tr>
<td>Departure Time</td>
<td>1</td>
<td>2</td>
<td>3+</td>
<td></td>
<td></td>
</tr>
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<td></td>
</tr>
<tr>
<td></td>
<td>ACS</td>
<td>PUMS 1%</td>
<td>PUMS 5%</td>
<td>ACS</td>
<td>PUMS 1%</td>
</tr>
<tr>
<td>12:00 to 4:59 a.m.</td>
<td>3.34%</td>
<td>2.01%</td>
<td>3.07%</td>
<td>2.97%</td>
<td>3.20%</td>
</tr>
<tr>
<td>5:00 to 5:59 a.m.</td>
<td>7.14%</td>
<td>9.57%</td>
<td>8.10%</td>
<td>6.46%</td>
<td>7.03%</td>
</tr>
<tr>
<td>6:00 to 6:59 a.m.</td>
<td>19.66%</td>
<td>15.19%</td>
<td>19.73%</td>
<td>19.39%</td>
<td>20.22%</td>
</tr>
<tr>
<td>7:00 to 7:59 a.m.</td>
<td>30.59%</td>
<td>28.90%</td>
<td>28.81%</td>
<td>31.43%</td>
<td>31.52%</td>
</tr>
<tr>
<td>8:00 to 8:59 a.m.</td>
<td>19.67%</td>
<td>17.89%</td>
<td>15.79%</td>
<td>19.28%</td>
<td>17.77%</td>
</tr>
<tr>
<td>9:00 to 9:59 a.m.</td>
<td>5.55%</td>
<td>8.24%</td>
<td>6.99%</td>
<td>6.48%</td>
<td>6.23%</td>
</tr>
<tr>
<td>10:00 to 10:59 a.m.</td>
<td>2.62%</td>
<td>4.06%</td>
<td>2.48%</td>
<td>2.30%</td>
<td>2.24%</td>
</tr>
<tr>
<td>11:00 to 11:59 a.m.</td>
<td>1.19%</td>
<td>1.41%</td>
<td>1.00%</td>
<td>1.06%</td>
<td>1.19%</td>
</tr>
<tr>
<td>12:00 to 3:59 p.m.</td>
<td>5.12%</td>
<td>5.84%</td>
<td>7.42%</td>
<td>5.09%</td>
<td>5.29%</td>
</tr>
<tr>
<td>4:00 to 11:59 p.m.</td>
<td>5.11%</td>
<td>6.88%</td>
<td>6.61%</td>
<td>5.54%</td>
<td>5.33%</td>
</tr>
<tr>
<td>Departure Time</td>
<td>Household Income</td>
<td>ACS</td>
<td>PUMS 1%</td>
<td>PUMS 5%</td>
<td>ACS</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------</td>
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<td>-----</td>
</tr>
<tr>
<td>12:00 to 4:59 a.m.</td>
<td>Less than $15,000</td>
<td>3.36%</td>
<td>2.55%</td>
<td>3.00%</td>
<td>3.39%</td>
</tr>
<tr>
<td>5:00 to 5:59 a.m.</td>
<td>$15,000 to $39,999</td>
<td>6.08%</td>
<td>6.68%</td>
<td>6.88%</td>
<td>7.09%</td>
</tr>
<tr>
<td>6:00 to 6:59 a.m.</td>
<td>$40,000 to $69,999</td>
<td>16.62%</td>
<td>17.35%</td>
<td>16.50%</td>
<td>19.53%</td>
</tr>
<tr>
<td>7:00 to 7:59 a.m.</td>
<td>$70,000 to $99,999</td>
<td>21.56%</td>
<td>23.93%</td>
<td>25.22%</td>
<td>26.84%</td>
</tr>
<tr>
<td>8:00 to 8:59 a.m.</td>
<td>More than $100,000</td>
<td>16.72%</td>
<td>16.94%</td>
<td>16.18%</td>
<td>16.87%</td>
</tr>
<tr>
<td>9:00 to 9:59 a.m.</td>
<td></td>
<td>8.44%</td>
<td>7.32%</td>
<td>7.64%</td>
<td>6.14%</td>
</tr>
<tr>
<td>10:00 to 10:59 a.m.</td>
<td></td>
<td>3.92%</td>
<td>4.16%</td>
<td>3.80%</td>
<td>2.86%</td>
</tr>
<tr>
<td>11:00 to 11:59 a.m.</td>
<td></td>
<td>2.29%</td>
<td>1.78%</td>
<td>1.83%</td>
<td>1.44%</td>
</tr>
<tr>
<td>12:00 to 3:59 p.m.</td>
<td></td>
<td>10.11%</td>
<td>9.46%</td>
<td>9.70%</td>
<td>7.93%</td>
</tr>
<tr>
<td>4:00 to 11:59 p.m.</td>
<td></td>
<td>10.91%</td>
<td>9.83%</td>
<td>9.26%</td>
<td>7.91%</td>
</tr>
</tbody>
</table>
Table 5.4.4  Florida Journey to Work Departure Time Distribution by Car Ownership (%)
ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=22,771, PUMS 1%=62,162, PUMS 5%=310,190)

<table>
<thead>
<tr>
<th>Departure Time</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4+</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS PUMS 1% PUMS 5%</td>
<td>ACS PUMS 1% PUMS 5%</td>
<td>ACS PUMS 1% PUMS 5%</td>
<td>ACS PUMS 1% PUMS 5%</td>
<td>ACS PUMS 1% PUMS 5%</td>
<td></td>
</tr>
<tr>
<td>12:00 to 4:59 a.m.</td>
<td>2.98% 3.57% 3.40% 2.49% 2.89% 2.78% 2.96% 2.83% 2.86% 3.28% 3.33% 2.78% 3.28% 3.02% 3.38%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5:00 to 5:59 a.m.</td>
<td>7.37% 8.59% 7.28% 5.94% 6.39% 6.04% 6.45% 6.26% 5.87% 6.14% 6.15% 6.14% 5.54% 5.20% 6.23%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6:00 to 6:59 a.m.</td>
<td>18.48% 21.05% 21.23% 19.29% 18.50% 18.54% 18.60% 18.43% 19.39% 18.67% 19.10% 19.58% 18.81% 20.68% 19.03%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7:00 to 7:59 a.m.</td>
<td>27.00% 27.37% 27.72% 28.49% 30.06% 30.62% 30.43% 32.71% 33.13% 31.47% 30.53% 31.07% 28.79% 29.18% 29.32%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:00 to 8:59 a.m.</td>
<td>17.15% 14.65% 14.41% 19.02% 18.17% 18.24% 20.07% 18.98% 18.66% 16.63% 17.03% 16.86% 16.67% 16.01% 15.87%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:00 to 9:59 a.m.</td>
<td>3.50% 5.54% 5.74% 6.78% 6.37% 6.76% 6.59% 6.02% 6.30% 6.61% 6.24% 5.91% 6.68% 6.09% 6.24%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00 to 10:59 a.m.</td>
<td>2.67% 2.57% 3.17% 2.93% 2.77% 2.64% 2.30% 2.34% 2.35% 2.57% 2.48% 2.37% 2.07% 2.31% 2.60%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:00 to 11:59 a.m.</td>
<td>2.08% 1.82% 1.46% 1.16% 1.31% 1.21% 1.18% 1.05% 0.98% 1.38% 1.15% 1.20% 1.49% 1.06% 1.35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:00 to 3:59 p.m.</td>
<td>9.14% 6.85% 7.72% 7.00% 6.74% 6.52% 5.53% 5.15% 5.18% 6.82% 6.93% 7.07% 8.47% 8.76% 8.04%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4:00 to 11:59 p.m.</td>
<td>9.62% 7.99% 7.86% 6.91% 6.80% 6.66% 5.90% 5.22% 5.30% 6.43% 7.05% 7.02% 8.20% 7.69% 7.95%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 5.4.5  Florida Journey to Work Departure Time Distribution by Gender (%)

ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=22,771, PUMS 1%=62,162, PUMS 5%=310,190)

<table>
<thead>
<tr>
<th>Departure Time</th>
<th>Gender</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>ACS</td>
<td>PUMS 1%</td>
<td>PUMS 5%</td>
<td>ACS</td>
<td>PUMS 1%</td>
<td>PUMS 5%</td>
<td>ACS</td>
<td>PUMS 1%</td>
</tr>
<tr>
<td>12:00 to 4:59 a.m.</td>
<td>3.97%</td>
<td>3.94%</td>
<td>3.82%</td>
<td>1.70%</td>
<td>1.84%</td>
<td>1.80%</td>
<td>3.55%</td>
<td>4.16%</td>
</tr>
<tr>
<td>5:00 to 5:59 a.m.</td>
<td>7.99%</td>
<td>8.40%</td>
<td>8.05%</td>
<td>4.19%</td>
<td>3.90%</td>
<td>3.78%</td>
<td>7.70%</td>
<td>6.88%</td>
</tr>
<tr>
<td>6:00 to 6:59 a.m.</td>
<td>21.94%</td>
<td>22.87%</td>
<td>22.83%</td>
<td>15.14%</td>
<td>15.15%</td>
<td>15.13%</td>
<td>19.51%</td>
<td>20.99%</td>
</tr>
<tr>
<td>7:00 to 7:59 a.m.</td>
<td>28.19%</td>
<td>29.14%</td>
<td>29.29%</td>
<td>31.92%</td>
<td>33.46%</td>
<td>34.28%</td>
<td>27.84%</td>
<td>29.78%</td>
</tr>
<tr>
<td>8:00 to 8:59 a.m.</td>
<td>16.55%</td>
<td>15.06%</td>
<td>15.20%</td>
<td>21.62%</td>
<td>21.55%</td>
<td>20.99%</td>
<td>24.24%</td>
<td>27.38%</td>
</tr>
<tr>
<td>9:00 to 9:59 a.m.</td>
<td>5.74%</td>
<td>5.36%</td>
<td>5.51%</td>
<td>7.52%</td>
<td>7.00%</td>
<td>7.24%</td>
<td>6.63%</td>
<td>7.16%</td>
</tr>
<tr>
<td>10:00 to 10:59 a.m.</td>
<td>2.08%</td>
<td>2.19%</td>
<td>2.12%</td>
<td>2.98%</td>
<td>2.82%</td>
<td>2.88%</td>
<td>2.25%</td>
<td>2.10%</td>
</tr>
<tr>
<td>11:00 to 11:59 a.m.</td>
<td>1.03%</td>
<td>1.07%</td>
<td>1.00%</td>
<td>1.51%</td>
<td>1.30%</td>
<td>1.27%</td>
<td>1.30%</td>
<td>1.27%</td>
</tr>
<tr>
<td>12:00 to 3:59 p.m.</td>
<td>5.96%</td>
<td>5.87%</td>
<td>5.91%</td>
<td>6.96%</td>
<td>6.58%</td>
<td>6.43%</td>
<td>6.58%</td>
<td>6.43%</td>
</tr>
<tr>
<td>4:00 to 11:59 p.m.</td>
<td>6.55%</td>
<td>6.10%</td>
<td>6.28%</td>
<td>6.45%</td>
<td>6.39%</td>
<td>6.19%</td>
<td>6.45%</td>
<td>6.39%</td>
</tr>
</tbody>
</table>

### Table 5.4.6 Florida Journey to Work Departure Time Distribution by Race (%)

ACS, PUMS 1% and PUMS 5%
(Number of Samples: ACS=22,771, PUMS 1%=62,162, PUMS 5%=310,190)

<table>
<thead>
<tr>
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<th></th>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
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CHAPTER 6

SUMMARY

The analysis of journey to work using ACS data file, PUMS 1% and 5% data files was undertaken in an effort to gain insight into and a better understanding of the commuting patterns in Florida. Current transportation data has always been important to transportation planners, forecasters, and decision makers, which makes the Public Use Microdata findings valuable source of information. The presence of comparative data files such as American Community Survey and PUMS data files have made the demand for microdata results even greater. This research effort, therefore, sought to capitalize on the availability of these detailed comprehensive data files to analyze present journey to work characteristics and develop an overall picture of work related travel behavior in Florida.

This thesis presents an overall picture of demographic and social and economic characteristics as well as journey to work patterns in Florida. In addition, detailed comparison of journey to work private vehicle occupancy distribution, mode choice, travel time, departure time based on household and individual characteristics are also provided using three different data files.
In analyzing the data, several socio-economic and journey to work characteristics were identified. Interesting findings include the lower utilization of transit, the lower private vehicle occupancies for household in Florida, and different journey to work departure time distribution by gender and different journey to work departure time by young people and by senior citizens from other adult categories. The analysis showed that the three data files reflected acknowledged demographic trends and captured known changes such as aging of population, smaller household size, increasing car ownership and increased women participation rate in labor force. The comparison analysis showed that for most part, ACS data files approximated PUMS data files.

The detailed comparison of journey to work characteristics in Florida is useful and helpful in providing more reliable information on current journey to work travel behavior. The knowledge is important to decision makers who will make informed choices when evaluating alternative transportation programs and related policy issues. The knowledge of journey to work travel behavior will also help transportation professionals for travel demand modeling, transportation and land use planning and related studies.

The first opportunity for additional research exists in the tremendous volume of information offered by these three data files. Given the size of the data files, it is not possible to analyze all of the available variables in this research effort. The variables that were not analyzed include specific travel characteristics for travel period trips, vehicle related data, family life cycle data including number of adults, number of children, their age, and the education level of individuals.
Other items for future research include the effect of household location on journey to work, the effect of urban size on household characteristics and travel behavior, and the effect of congestion on journey to work.

All three data files could be used to conduct more detailed analysis of specific population categories. Journey to work characteristics for the senior citizens, for example, could be analyzed both in current day terms and over time since the most microdata are collected annually. Changes in average journey to work travel time and mode choices may have had an impact on total travel or the traffic congestion that many other commuters are now experiencing because in Florida senior citizens comprise a larger percent share of total population than they do in other states. Similarly, additional research on journey to work made by teenager workers could also be conducted given the increased car ownership per household.
REFERENCES


Hanson, Susan, and Geraldine Pratt (1990). “Geographic perspectives on the occupational segregation of women”, National Geographic Research, 6(4) 376-399


