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Trends in Commuting

# TRAVEL INDICATORS AND TRENDS IN WASHINGTON STATE

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16. ABSTRACT

This review of travel indicators in Washington State aims to understand similarities and differences between the state and the nation and to detect changes or special conditions that need to be considered in the future. The work is intended to support general transportation policies and future state-level transportation plans.

None of the travel indicators reviewed strongly suggests that travel conditions in the state stand out in the national context. Two factors are prime in their association with travel demand: household income and development density. Stagnant income explains why the demand for car travel has slowed over the recent past, yet future demand for car travel may increase if the economy improves. On the other hand, demand could remain stable if development density continues to increase.

Residential and population densities are positively associated with demand for modes other than single-occupancy vehicle (SOV) travel. Living in more compact residential areas and in alternative housing types, and renting versus owning a home, also relate to lower demand for SOV travel.

Even at the aggregate level of national data, the Puget Sound region's transportation context differs from that of rural or other urbanized regions in the state. State policies need to recognize at least three different markets for transportation, which are found in rural, small town, and metropolitan areas.

Overall, Washington State needs to stay tuned to national projections about the likely impacts on travel demand and transportation of general economic trends, the slow down in household formation, growth in car ownership among new immigrants, an aging population with changing driving patterns, and population growth in densely populated areas --where transportation systems investments and land-use policies can affect future travel behavior.

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## SUMMARY POWERPOINT PRESENTATION

A PowerPoint presentation titled *Washington State Travel Trends 1980-2001* highlights important findings. It is available electronically.

# BACKGROUND

## Purpose

The goal of this project was to better understand how Washington State travel indicators fare in relation to those from other states in the nation. The question is how similar or different is Washington State from others? A second goal was to review the state's travel indicators over time to detect changes or special conditions that need to be considered in the future. This work was intended to support the development of general transportation policies, as well as that of future state-level transportation plans.

Main travel indicators for the State of Washington were analyzed in relation to demographic and land use factors affecting travel behavior. Also addressed were trends in commuting and non-work travel over the past three decades (1980, 1990, 2000). The trends were investigated for Washington State as a whole, as well as for the urbanized areas of the state, including the Puget Sound and Spokane regions. They were compared to trends of the nation as a whole, as well as to those of selected metropolitan areas in the country.

The work was modeled on Alan Pisarski's "Commuting in America" (Pisarski 1996) and his more recent work on travel trends (Pisarski 2005). Pisarski has tracked changes in mode choice, length of travel, trip purpose, and other factors and has looked at future travel demand on the basis of socio-demographic factors, communication technology, work opportunities, and life style. He has also examined changes in metropolitan development patterns in the nation. Pisarski has speculated about the effects on transportation of future population growth, which will take place primarily in metropolitan areas. He has shown that while household formation is slowing down, growth in car ownership among new immigrants and the working poor will continue to exert pressure on transportation demand (Pisarski 2002a and 2002b).

This work also used recent analyses of national travel trends based on the Census 2000 and the National Household Travel Survey (Litman 2005).

## Structure of Report

This report begins with an Introduction that summarizes principal differences in travel indicators among Washington State, the nation as a whole, and specific states in the

nation. It is then divided into two parts. Part 1 summarizes 2001 travel indicators for Washington State relative to demographic and land use factors affecting travel; this is based on data from the National Household Transportation Survey (NHTS 2001). Part 2 reviews trends in travel behavior over the past two decades; it is based on data from the Neighborhood Change Database (NCDB) 1980-2000.

Analyses for parts I and II are organized according to the grids shown in tables 1 and 2.

**Table 1: Grid of analysis used in Part 1 (NHTS 2001)**

| TRAVEL INDICATORS AND MEASURES | CORRELATES OF TRAVEL | | | | | |
|---|---|---|---|---|---|---|
| Household VMT* | DEMOGRAPHIC FACTORS | | | | | |
| Household Vehicle Count | HH Income | Home Ownership | Life Cycle | Race | Place of Birth | Education |
| Personal Distance to Work | | | | | | |
| P Number of Walking trips | | | | | | |
| P Number of Biking trips | LAND USE FACTORS | | | | | |
| P Public Transit Use | Housing Unit Density | Population Density | Home Type | Urban/ Rural | Size of MSA* | |
| D Travel Mode (POV** Use) | | | | | | |
| *VMT = vehicle miles traveled | ** POV = Personal Vehicle<br>* **MSA = Metropolitan statistical area | | | | | |

**Table 2: Grid of analysis used in Part 2 (NCDB 1980-2000)**

| TRAVEL INDICATORS | MEASURES |
|---|---|
| Travel Time to Work | Nationwide travel time to work<br>MSAs with a greater and lower than average increase in travel time to work |
| Commuting Mode Choice | Percentage of commuters using public transportation<br>Mean morning commute time in Puget Sound by mode |
| Labor Force | Percentage of employed female civilians<br>Percentage of workers 16+ years old working within their metro area of residence |
| Socio-Demographic Factors | Distribution of population by race<br>Distribution of population by age<br>Distribution of foreign-born population<br>Average family income<br>Average household income |
| Access to Private Automobiles | Occupied housing units by number of cars<br>Percentage of occupied housing units with at least one car<br>Distribution of households with no car by race<br>Proportion of households with no car by race |

Parts I and II each comprise a summary, a review of data and methods, and a presentation of findings. The report concludes with a discussion of likely changes in travel behavior in the future.

## INTRODUCTION: HOW DIFFERENT ARE WE? WASHINGTON STATE VERSUS THE NATION

Table 3, based on the National Household Travel Survey (2001), features the principal differences in travel between Washington State and the nation. For better or worse, Washington State is not an outlier among the nation's 50 states.

**Table 3: Summary comparison between Washington State travel indicators and those of the nation**

| Travel Indicators | Washington State Versus Nation |
|---|---|
| Household Vehicle Miles Traveled | Below average |
| Household Vehicle Count | Above average |
| Person Distance to Work | Slightly below average |
| Person Public Transit Use | Average |
| Person Number of Walking trips | Slightly above average |
| Person Number of Biking trips | Below average |

Figure 1 shows in greater detail differences between Washington State and the nation, indicating states that have minimum and maximum values for the travel indicators used.

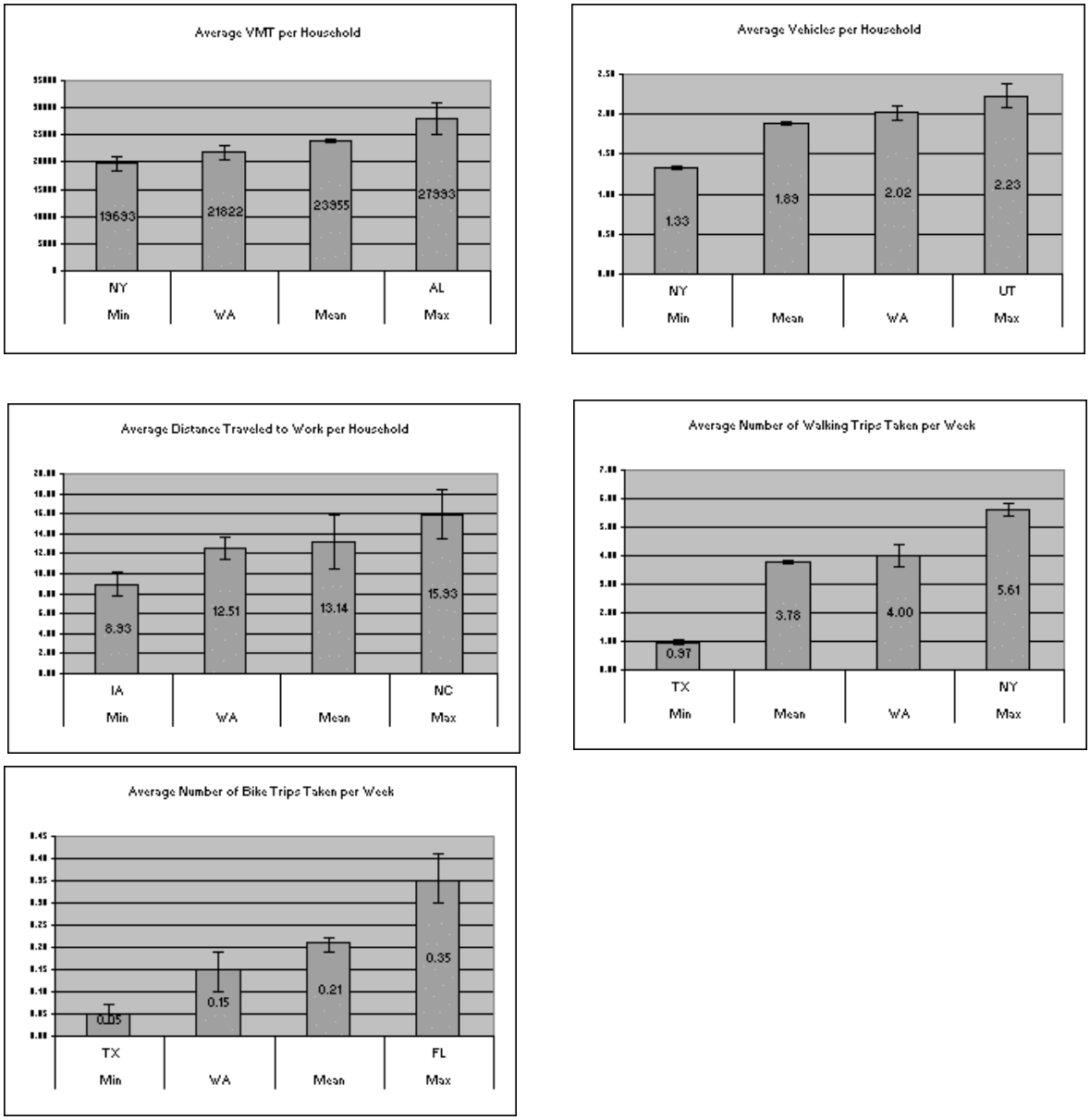



**Figure 1: Travel behavior comparisons between Washington State and the nation.**

# PART 1: WASHINGTON STATE 2001 TRAVEL INDICATORS RELATED TO DEMOGRAPHIC AND LAND-USE FACTORS

## Summary

Tables 4 and 5 summarize Washington State travel indicators as related to demographic and land-use factors, respectively (NHTS 2001).

## Data and Methods

### *Data Sources*

To derive estimates for Part 1 of this report, data from the 2001 National Household Travel Survey (NHTS 2001) were downloaded from the NHTS website: http://nhts.ornl.gov/2001/html_files/download_directory.shtml. Measures of housing and population densities were taken at the US Census block group level.

The National Household Travel Survey provides the only authoritative source of information at the national level on the relationships between the characteristics of personal travel and the demographics of the traveler. However, the sample data in the NHTS are not adequate to provide robust statewide or area-specific estimates. Estimates of travel behavior for Washington State summarized in this report are, therefore, less certain because large standard errors exist as a result of small sample sizes. If Washington State or a local jurisdiction wants to develop robust travel estimates for a specific area, it can purchase additional households in its jurisdiction to be interviewed and included in the NHTS.

Approximately 66,000 households are in the final 2001 NHTS dataset. About 26,000 households are in the national sample, while the remaining 40,000 households are from nine add-on areas. Of these households, 705 were located in Washington State.

**Table 4: Travel indicators and demographic characteristics**

| Travel Variables | Correlates | | | | | |
|---|---|---|---|---|---|---|
| | HH Income | Home Ownership | Life Cycle | Race | Place of Birth | Education |
| Household Vehicle Miles Traveled (VMT) | VMT appears higher for households with higher incomes.* | VMT appears higher for households that own their home than for households that rent. | VMT generally increases with the number of adults and with the presence of older children. Only couples with small children have lower VMT than couples without children. | Non-white households appear to have lower VMT than white households. | na | There appears to be no correlation between education and vehicle miles traveled. |
| $R^2$ | 0.97 | | | | | -0.032 |
| Household Vehicle Count | The number of vehicles per household appears higher for households with higher income. | Households that own their home appear to have a greater number of vehicles than households that rent. | The number of vehicles per household appears higher in households with a greater number of adults and a greater number of children over the age of 5. | Non-white households appear to have fewer vehicles per household than white households. | na | There appears to be no correlation between education and household vehicle counts. |
| $R^2$ | 0.952 | | | | | 0.016 |
| Pearson | | 0.000 | 0.000 | 0.425 | na | 0.423 |
| RS2 | | 0.000 | 0.000 | 0.520 | na | 0.457 |
| P Distance to work | The distance traveled to work per household appears higher for households with higher income. | Households that own their home appear to travel greater distances to work than households that rent. | The distance traveled to work appears higher in households with a greater number of adults and a lower number of children, except for households of couples with children between the ages of 16-21. | Non-white and white households appear to travel similar distances to work. | It appears that foreign-born households travel shorter distances to work, but the standard error is large, making these differences statistically insignificant. | There appears to be no correlation between education and distance traveled to work. |
| $R^2$ | 0.764 | | | | | -0.084 |
| Pearson | | 0.333 | 0.002 | 0.343 | 0.173 | |
| RS2 | | 0.387 | 0.681 | 0.219 | 0.118 | |

**Table 4: Travel indicators and demographic characteristics (continued page 2)**

| Travel Variables | Correlates | | | | | |
|---|---|---|---|---|---|---|
| | HH Income | Home Ownership | Life Cycle | Race | Place of Birth | Education |
| P Number of Walking trips | The number of walking trips taken per household appears higher for households with higher income. However, small differences and large standard errors make these differences statistically insignificant. | Households that own their home appear to take fewer walk trips per week than households that rent. However, small differences and large standard errors make these differences statistically insignificant. | Standard errors are high and differences are small, yet it appears that households with children under the age of 5 take fewer walk trips per week than other households. | White households appear to make more walk trips than non-white households. However, small differences and large standard errors make these differences statistically insignificant. | Households born in the US appear to make more walk trips than foreign-born households. However, small differences and large standard errors make these differences statistically insignificant. | Households with high levels of education appear to make more walk trips than households with lower levels. However, households with the lowest levels of education appear to make more walk trips than households with moderate levels of education. |
| $R^2$ | 0.856 | | | | | 0.504 |
| Pearson | | 0.356 | 0.000 | 0.223 | 0.670 | |
| RS2 | | 0.150 | 0.124 | 0.593 | 0.071 | |
| P Number of Biking trips | Large standard errors prevent statistically significant conclusions from being drawn. However, it appears that fewer biking trips are made by households with low incomes than households with median and high incomes. | Large standard errors prevent statistically significant conclusions from being drawn. However, it appears that fewer biking trips are made by households that rent than by households that own their home. | Large standard errors prevent statistically significant conclusions from being drawn. However, unlike any other variable the number of biking trips made per week appears to be higher for households with only one adult than for households with two adults except when children in the household are between 0 and 5. | Non-white and white households appear to take a similar number of bike trips a week. However, large standard errors prevent statistically significant conclusions from being drawn. | Households born in the U.S. appear to make more bike trips than foreign-born households. However, small differences and large standard errors make these differences statistically insignificant. | There appears to be no correlation between education levels and the number of bike trips taken per week. |
| $R^2$ | 0.419 | | | | | 0.061 |
| Pearson | | 0.993 | 0.002 | 0.297 | 0.999 | |
| RS2 | | 0.779 | 0.592 | 0.048 | 0.931 | |

**Table 4: Travel indicators and demographic characteristics (continued page 3)**

| Travel Variables | Correlates | | | | | |
|---|---|---|---|---|---|---|
| | HH Income | Home Ownership | Life Cycle | Race | Place of Birth | Education |
| P Public Transpor-tation Use | Public transportation use appears higher in households with lower incomes. Howeve,r the highest income bracket appears to have a high percentage of regular public transportation users as well. | Public transportation use appears higher in households that rent than in households that own their homes. | Public transportation use appears higher in one-adult households than in two-adult households, except when children are very young. Households with older children appear to use public transportation the most, especially if there is only one adult. | Public transportation use appears similar in both white and non-white households. | Public transportation use appears similar in households born in the U.S. and born abroad. | Public transportation use appears highest in households with high education levels. |
| Pearson | 0.002 | 0.001 | 0.000 | 0.004 | 0.000 | 0.000 |
| RS2 | 0.546 | 0.039 | 0.000 | 0.009 | 0.000 | 0.000 |
| D Travel Mode Breakdown | Private automobile use appears to be similar for households in all income categories. | Private automobile use appears to be slightly lower for households that rent than for households that own their home. | Private automobile use appears to be lower for households that have one adult than for households with two adults, regardless of the number of children, except for retirees. Interestingly however, private automobile use appears to be higher for households without children than for households with children, except when the children are between the ages of 16 to 21. | Private automobile use appears to be lower for non-white households than for white households. | na | na |
| Pearson | 0.000 | 0.000 | 0.000 | 0.000 | na | na |
| RS2 | 0.791 | 0.289 | 0.226 | 0.863 | na | na |

**Table 5: Travel indicators and land-use characteristics**

| Travel Variables | Correlates | | | | |
|---|---|---|---|---|---|
| | Housing Unit Density | Population Density | Home Type | Urban / Rural | Size of MSA |
| Household Vehicle Miles Traveled (VMT) | Households living in areas with high housing unit (HU) densities appear to have lower VMT than households living in areas with low housing unit densities. The one discrepancy shown is where densities exceed 5000 HU/square mile. However this may be due to the large standard error for this category because of its small sample size. | Households living in areas with high population densities appear to have lower VMT than households living in areas with low population densities. The sample size for the highest density category was 1.0, making this estimate meaningless. | Households living in mobile and single family (SF) homes appear to have the highest VMT; households living in town-homes or row houses appear to have lower VMT; and households living in apartments and condominiums appear to have the lowest VMT. | Households living in rural areas appear to have higher VMT than households living in urban areas. | Not much difference in VMT exists between households living in different sized metropolitan statistical areas (MSAs). However VMT is greater for households living outside of MSAs |
| $R^2$ | -0.7158 | -0.0006 | | | -0.1346 |
| Household Vehicle Count | The number of vehicles per household appears lower for households living in areas with higher housing unit densities. | The number of vehicles per household appears lower for households living in areas with higher population densities. | Households living in SF and mobile homes appear to have a greater number of vehicles than households living in apartments and condominiums. Households living in row houses and townhomes also appear to have fewer vehicles, but the standard error for this category is too high to make the estimate meaningful. | Households living in rural areas appear to have a greater number of vehicles than households living in urban areas. | Not much difference in vehicle ownership appears to exist between households living in different sized MSAs, nor does there appear to be a difference in vehicle ownership between households living inside and outside of an MSA. |
| $R^2$ | -0.9364 | -0.8942 | | | -0.0243 |
| Pearson | | | 0.000 | 0.000 | |
| RS2 | | | 0.000 | 0.001 | |

**Table 5: Travel indicators and land-use characteristics (continued page 2)**

| Travel Variables | Correlates | | | | |
|---|---|---|---|---|---|
| | Housing Unit Density | Population Density | Home Type | Urban / Rural | Size of MSA |
| P Distance to work | Households living in areas with higher housing unit densities appear to travel shorter distances to work than households living in areas with lower housing unit densities. However, the large standard errors make these differences statistically insignificant. | Households living in areas with higher population densities appear to travel shorter distances to work than households living in areas with lower population densities. However, the large standard errors make these differences statistically insignificant. | Households living in rowhouses and townhomes appear to travel the shortest distances to work, and households living in mobile homes appear to travel the longest distance to work. | na | Households living in larger MSA appear to travel longer distances to work than households living in smaller MSAs and outside of MSAs. However, standard errors are large making differences statistically insignificant. |
| $R^2$ | -0.4658 | -0.4994 | | | 0.1361 |
| Pearson | | | 0.021 | na | |
| RS2 | | | 0.122 | na | |
| P Number of Walking trips | Households living in areas with lower housing unit densities appear to take slightly more than or similar numbers of walking trips per week as households living in areas with higher housing unit densities. However, the small differences and large standard errors make these differences statistically insignificant. | Households living in areas with lower population densities appear to take slightly more than or similar numbers of walking trips per week as households living in areas with higher housing unit densities. However, the small differences and large standard errors make these differences statistically insignificant. | Large standard errors and small differences prevent statistically significant conclusions to be drawn. However, it appears that a slightly greater number of walking trips are made by households living in rowhouses, townhouses and apartments than by households living in SF and mobile homes. | Urban Rural Not Available. Instead Presence of Sidewalks: Households living in areas where sidewalks are a problem take almost as many walking trips per week as households where sidewalks are not a problem. Large standard errors and small differences make any differences statistically insignificant. | The size of the MSA appears to have no consistent relationship with the number of walking trips taken by households living within or without them. |
| $R^2$ | 0.3251 | 0.3709 | | | -0.0065 |
| Pearson | | | 0.000 | na | |
| RS2 | | | 0.641 | na | |

**Table 5: Travel indicators and land-use characteristics (continued page 3)**

| Travel Variables | Correlates | | | | |
|---|---|---|---|---|---|
| | Housing Unit Density | Population Density | Home Type | Urban / Rural | Size of MSA |
| P Number of Biking Ttrips | Households living in areas with 1000 - 3000 housing units per mile appear to take more biking trips per week, and households living in areas with 3000-10,000 housing units per mile take fewer biking trips per week than other households. However, the small differences and large standard errors make these differences statistically insignificant. | The number of biking trips taken per week appears to peak for households living in areas with population densities between 500 and 1000 people per square mile and then again for households living in areas with densities greater than 4000 people per square mile. However, small differences and large standard errors make these statistically insignificant. | Large standard errors and small differences prevent statistically significant conclusions to be drawn. However, it appears that fewer biking trips are made by households living in apartments and duplexes than by households living in other types of homes. | na | Large standard errors and small differences make results statistically insignificant. |
| $R^2$ | .228 | 0.0077 | | | 0.134 |
| Pearson | | | 0.085 | na | |
| RS2 | | | 0.026 | na | |
| P Public Transportation Use | Public transportation use appears higher in areas with high housing unit densities than in areas with low housing unit densities. | Public transportation use appears higher in areas with high population densities than in areas with low population densities. | Public transportation use appears highest for households living in apartments and duplexes and lowest for households living in mobile homes. | na | Public transportation use appears highest for households living in MSAs of 2 million to 2 million people. |
| Pearson | 0.000 | 0.000 | 0.002 | na | 0.000 |
| RS2 | 0.000 | 0.003 | 0.113 | na | 0.001 |

**Table 5: Travel indicators and land-use characteristics (continued page 4)**

| Travel Variables | Correlates | | | | |
|---|---|---|---|---|---|
| | Housing Unit Density | Population Density | Home Type | Urban / Rural | Size of MSA |
| D Travel Mode Breakdown | Private automobile use appears to be lowest for households living in areas of high housing unit density. | Private automobile use appears to be lowest for households living in areas of high population density. | Private automobile use appears to be lowest for households living in rowhouses, townhouses, and apartments. | Private automobile use appears to be highest for households living in areas surrounded by urban areas. | Private automobile use appears to be similar for households living in different sized MSAs. |
| Pearson | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| RS2 | 0.015 | 0.186 | 0.292 | 0.180 | 0.317 |

The sample sizes for Washington State in each survey data file category were as follows:

- Household: 705 (sample size); 2,612,077 (weighted sum)
- Vehicle: 1517 (sample size); 5,266,558(weighted sum)
- Person: 1715 (sample size); 7,092,654 (weighted sum)
- Travel day person trips: 6724 (sample size); 10,063,700,232 (weighted sum)

The travel behaviors considered in this report were taken from each of the above files. Household vehicle count was taken from the household file; vehicle miles traveled (VMT) was taken from the vehicle file and aggregated into households; distance to work, walk trips, bike trips and public transportation use were all taken from the person file; and transportation mode breakdowns were taken from the day trip file.

### *Samples, Weighs, and Sampling Errors*

'The full sample of 'usable households' was used in this analysis. 'Useable households' were those in which interviews were completed with at least 50 percent of the adults in the household.

To obtain estimates that were minimally biased, full sample weights were used. Weights reflect the selection probabilities and adjustments to account for nonresponse, undercoverage, and multiple telephones in a household.

To calculate sampling errors, replicate weights were used. Sampling errors illustrate the variability in the estimated statistics. For this analysis, sampling errors were calculated by using the WesVar statistical software. WesVar software computes estimates and replication variance estimates by properly reflecting complex sampling and estimation procedures (Choudhry and Vallian 2002).

### *Correlations and Tests for Independence*

Simple linear regressions were run for the dependent travel variables that were ratio in scale to determine whether, and how much, changes in travel behavior were correlated with changes in demographic or land-use factors. Chi-square tests were run for dependent travel variables that were ordinal in scale and for nominal independent variables to test hypotheses of independence. Pearson and RS2 chi-square statistics were calculated. The RS2 statistic is a modified chi-square statistic that reflects the complex

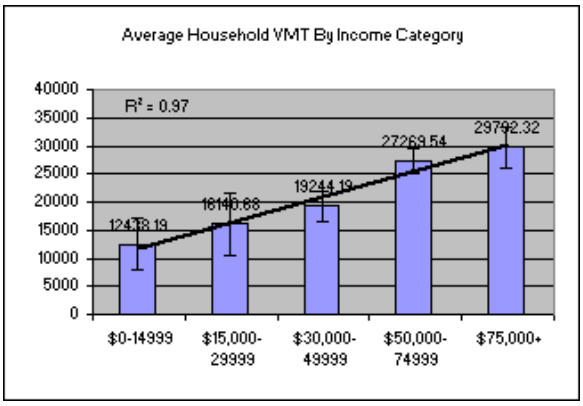
sample design. The Pearson chi-square statistic was adjusted by using the estimated "design effect,t" as suggested by Rao and Scott (1981).

**Demographic Factors**

Figures 2 through 8 explain the findings of relationships between travel indicators and demographic factors.

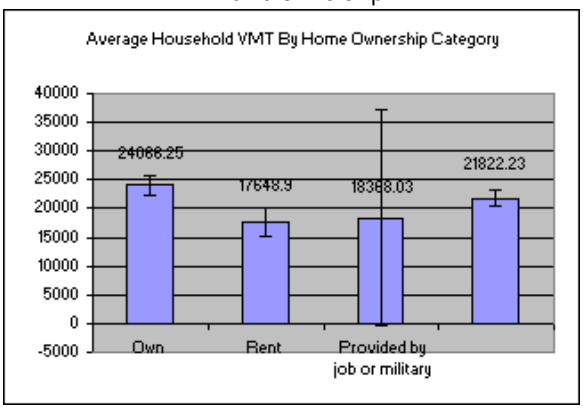
### *Annual Vehicle Miles Traveled (VMT) per Household in Relation to Different Demographic Characteristics*

Income



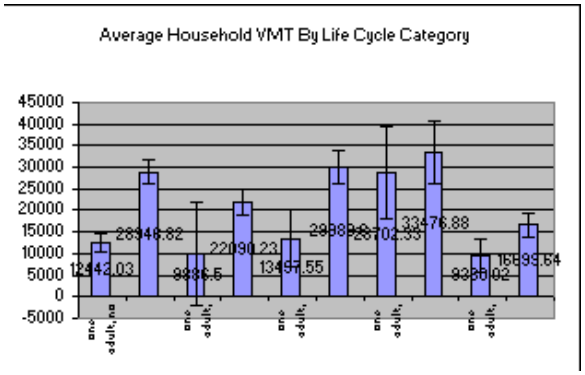

VMT appears higher for households with higher incomes.

Home Ownership



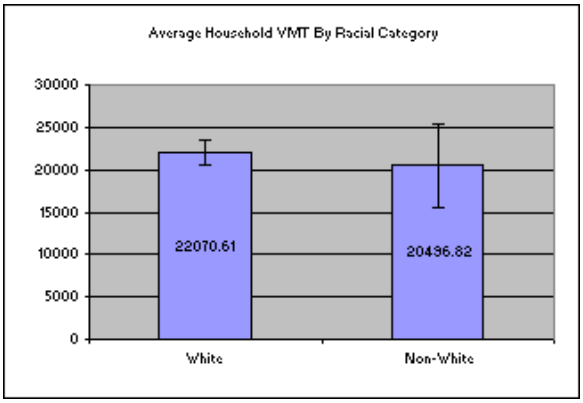

VMT appears higher for households that own their home than for households that rent. The standard error for households in the military is so large that the estimate is meaningless.

Life Cycle



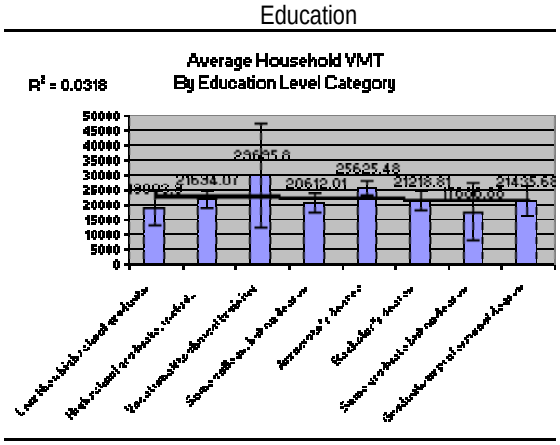

VMT appears higher in households with a greater number of adults and older children. Only couples with small children appear to have lower VMT than couples without children.

Race




Non-white households appear to have lower VMT than white households. However, the standard error for non-white households is large and therefore, no statistically significant difference can be assumed.

Education

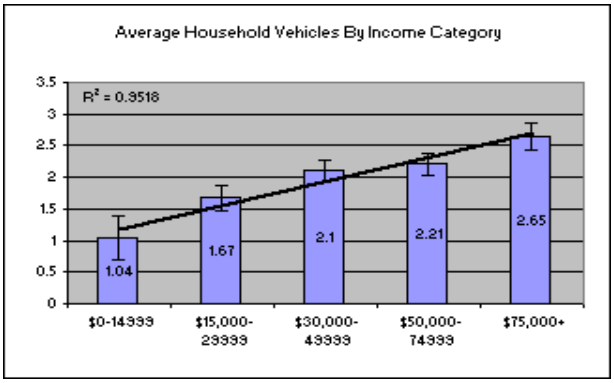



Not much difference in VMT exists between households with different levels of education.

**Figure 2: Vehicle miles traveled (VMT) and demographic factors**

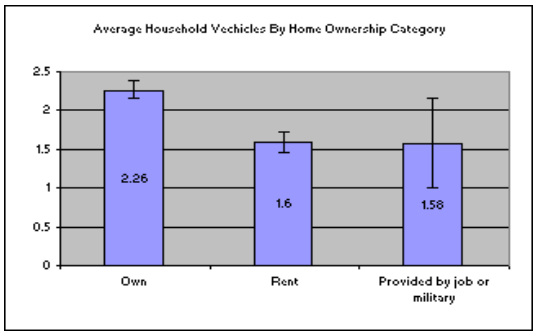
## *Number of Vehicles Owned per Household in Relation to Demographic Characteristics*

Income



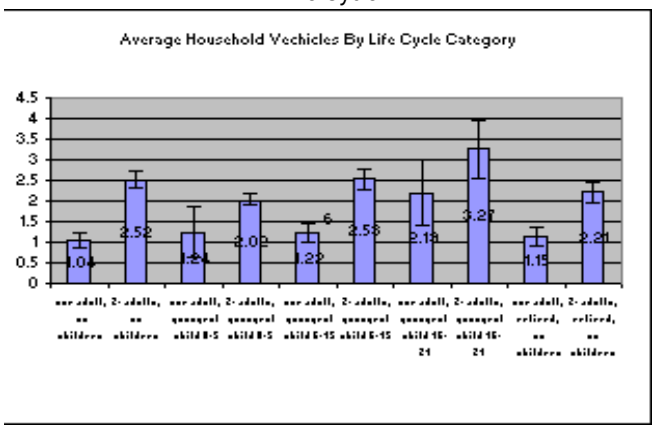

The number of vehicles per household appears higher for households with higher income.

Home ownership



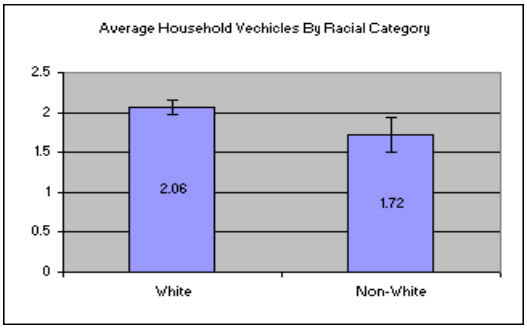

Households that own their own home appear to have a greater number of vehicles than households that rent.

Life Cycle



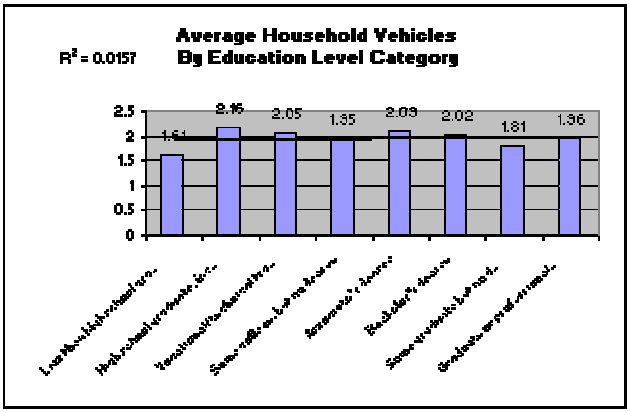

The number of vehicles per household appears higher in households with a greater number of adults and a greater number of children over the age of 5.

Race




Non-white households appear to have fewer vehicles per household than white households.

Education

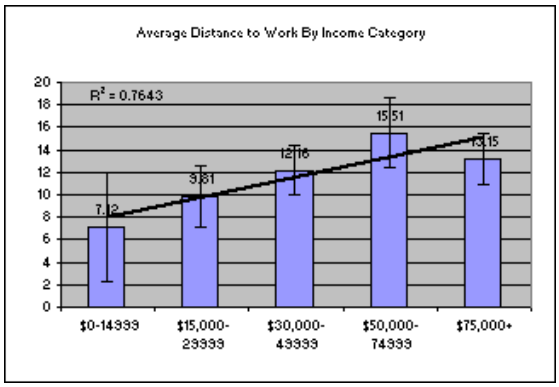



Not much difference in vehicle ownership appears to exist between households with different education levels.

**Figure 3: Number of vehicles owned and demographic factors**

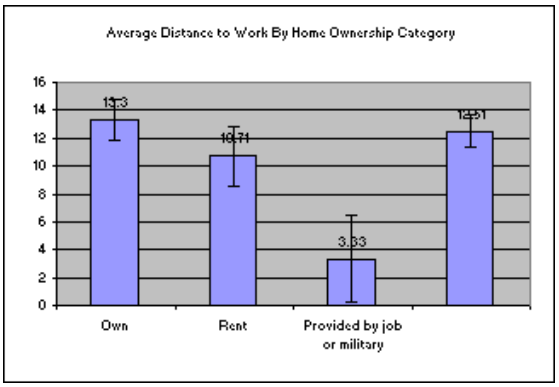
## *Distance Traveled to Work per Person in Relation to Demographic Characteristics*

Income



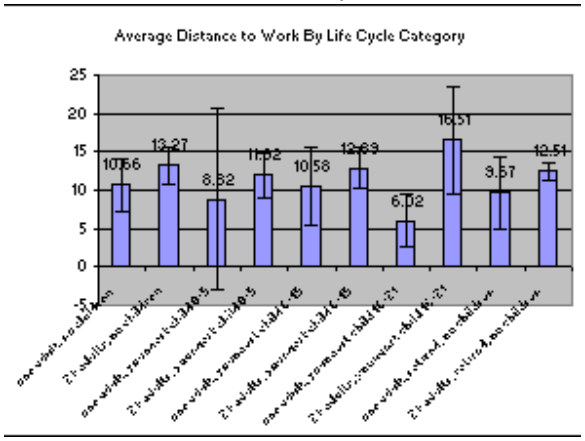

The distance traveled to work per household appears higher for households with higher income.

Home Ownership



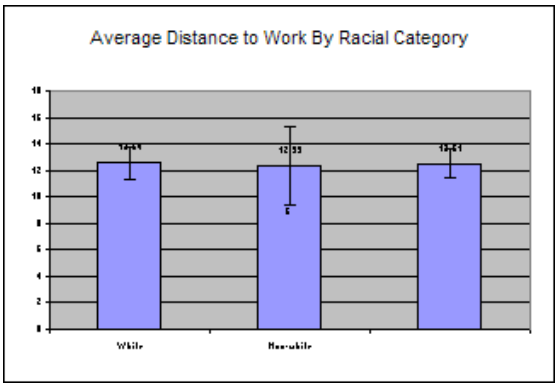

Households that own their own home appear to travel greater distances to work than households that rent.

Life Cycle



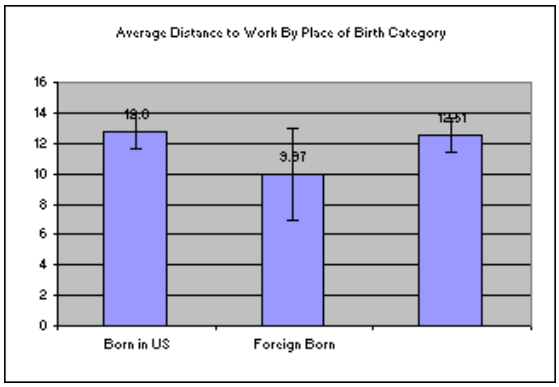

The distance traveled to work appears higher in households with a greater number of adults and a lower number of children, except for households of couples with children between the ages of 16-21.

Race




Non-white and white households appear to travel similar distances to work.

Place of birth

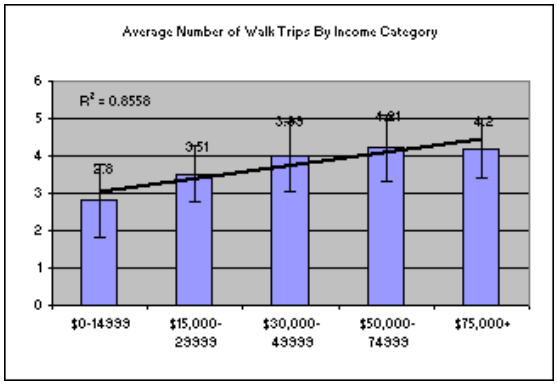



It appears that foreign-born household respondents travel shorter distances to work, but the standard error is large, making these differences statistically insignificant.

**Figure 4: Distance to work and demographic factors**

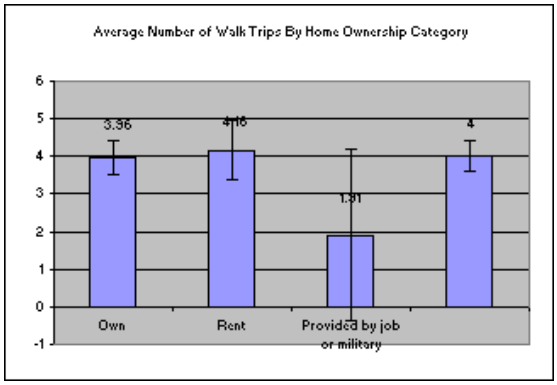
## *Number of Walking Trips Made per Person on a Weekly Basis in Relation to Demographic Characteristics*

Income



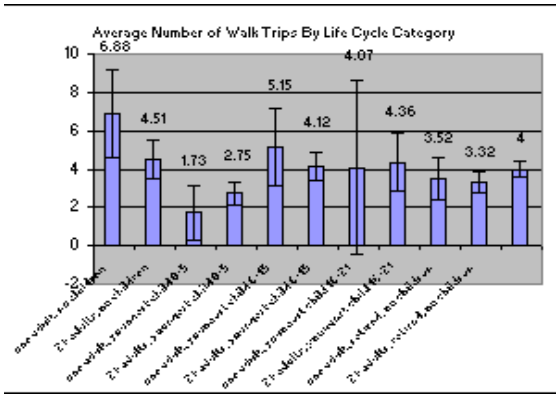

The number of walking trips taken per household appears higher for households with higher income. However, small differences and large standard errors make these differences statistically insignificant.

Home Ownership



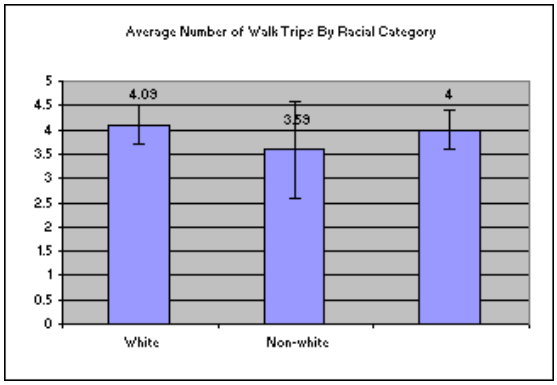

Households that own their own home appear to take fewer walk trips per week than households that rent. However, small differences and large standard errors make these differences statistically insignificant.

Life Cycle



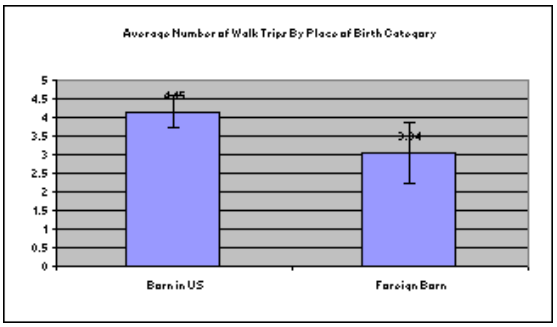

Standard errors are high and differences are small, yet it appears that households with children under the age of 5 take fewer walk trips per week than other households.

Race



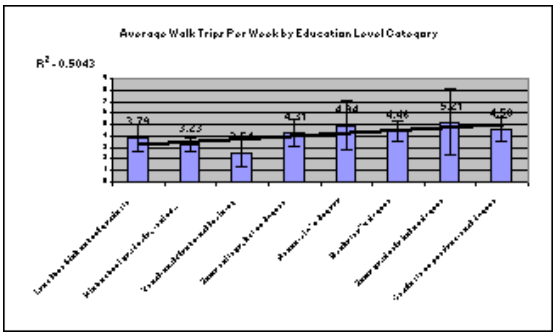

White households appear to make more walk trips than non-white households. However, small differences and large standard errors make these differences statistically insignificant

Place of Birth




Born in U.S. households appear to make more walk trips than foreign-born households. However, small differences and large standard errors make these differences statistically insignificant.

Education

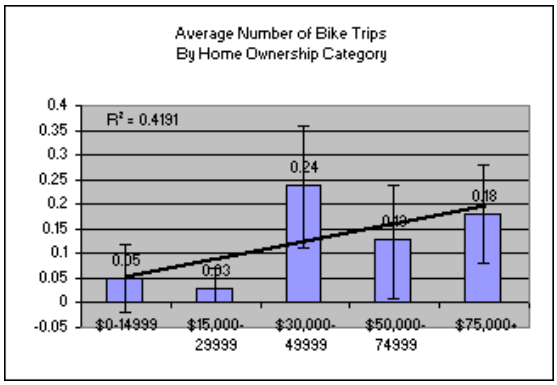



Households with moderate levels of education appear to make the least number of walk trips in comparison to households with higher and lower levels of education.

**Figure 5: Walking trips and demographic factors**

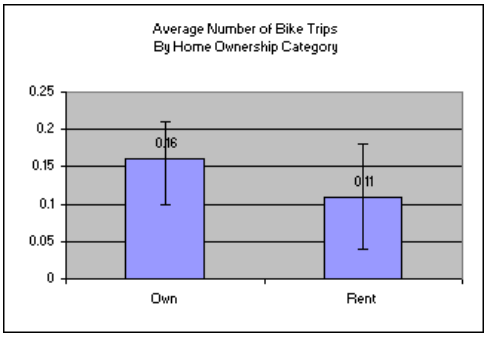
## *Number of Biking Trips Made per Person on a Weekly Basis in Relation to Demographic Characteristics*

Income



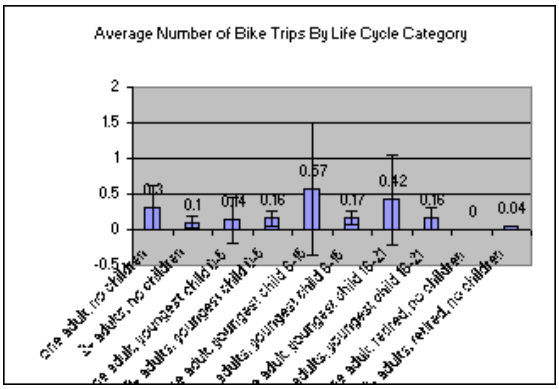

Large standard errors prevent statistically significant conclusions from being drawn. However, it appears that fewer biking trips are made by households with low incomes than households with median and high incomes.

Home Ownership



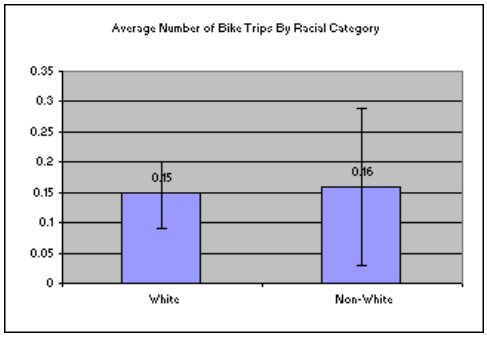

Large standard errors prevent statistically significant conclusions from being drawn. However, it appears that fewer biking trips are made by households that rent than by households that own their home.

Life Cycle



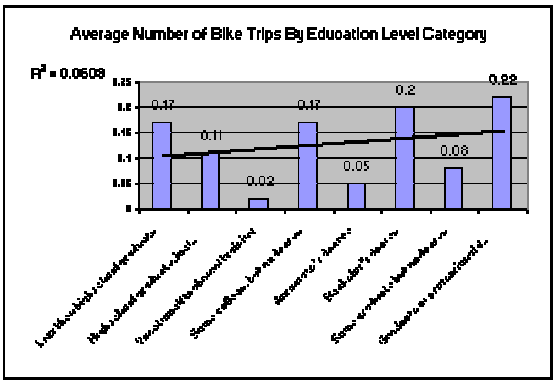

Standard errors are too large to draw conclusions. However, unlike any other variable, the number of biking trips made per week appears to be higher for households with only one adult than for those with two adults, except when children in the household are between 0 and 5

Race



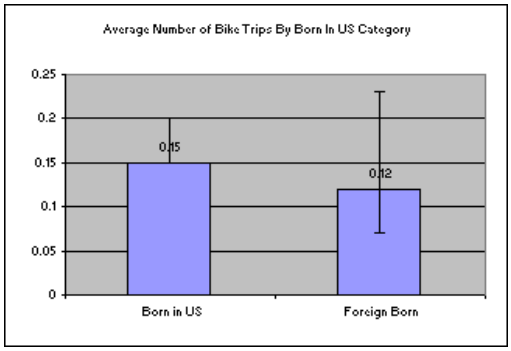

Non-white and white households appear to take a similar number of bike trips a week. However, large standard errors prevent statistically significant conclusions from being drawn.

Education




The average number of bicycle trips taken a week varies between households with different education levels.

Place of Birth

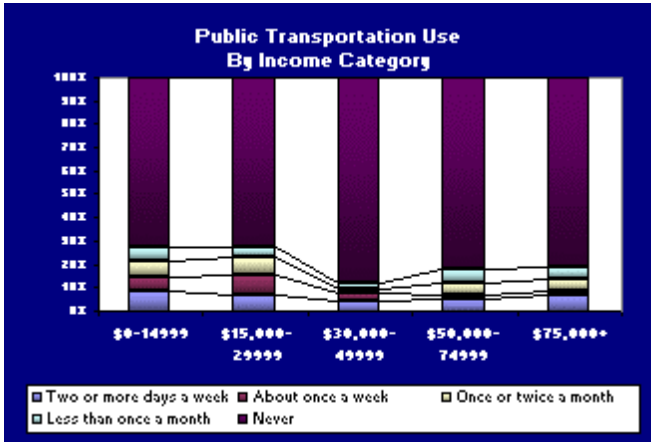



Households born in the U.S. appear to make more bike trips than foreign-born households. However, small differences and large standard errors make these differences statistically insignificant.

**Figure 6: Biking trips and demographic factors**

## *Public Transportation Use in Relation to Demographic Characteristics*

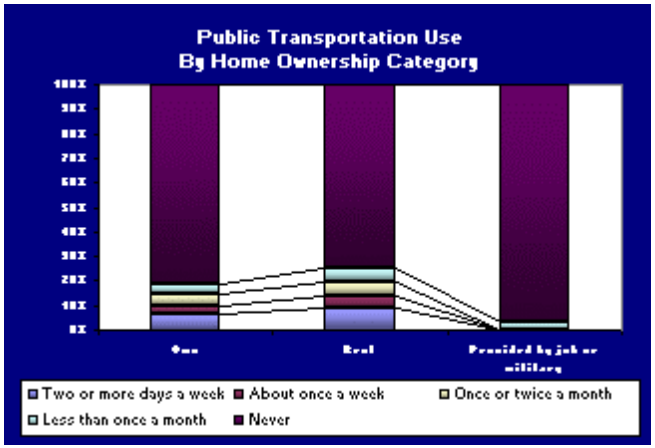
Income




| Household Income | Public Transportation Use in the Last Two Months | | | | |
|---|---|---|---|---|---|
| | Two or more days a week | About once a week | Once or twice a month | Less than once a month | Never |
| $0-14999 | 8.5% | 6.3% | 6.8% | 5.7% | 72.7% |
| $15,000-29999 | 6.4% | 9.1% | 7.3% | 4.5% | 72.8% |
| $30,000-49999 | 4.4% | 3.4% | 1.7% | 2.2% | 88.3% |
| $50,000-74999 | 5.0% | 2.2% | 4.6% | 5.9% | 82.3% |
| $75,000+ | 6.8% | 2.0% | 5.1% | 4.5% | 81.6% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 20 | 43.727 | 0.002 |
| RS2 | 20 | 20.196 | 0.446 |
| RS3 | 11.89 | 11.928 | 0.442 |

Home Ownership

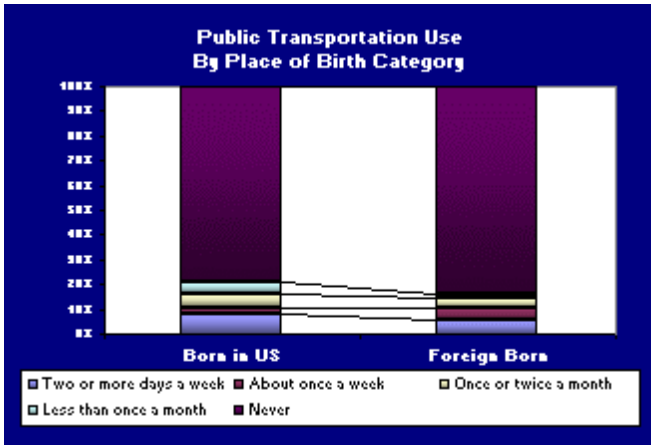



| Home Ownership | Public Transportation Use in the Last Two Months | | | | |
|---|---|---|---|---|---|
| | Two or more days a week | About once a week | Once or twice a month | Less than once a month | Never |
| Own | 6.8% | 2.7% | 4.9% | 4.4% | 81.2% |
| Rent | 9.0% | 4.8% | 5.8% | 5.6% | 74.7% |
| Military | 0.0% | 0.0% | 0.0% | 3.4% | 96.6% |

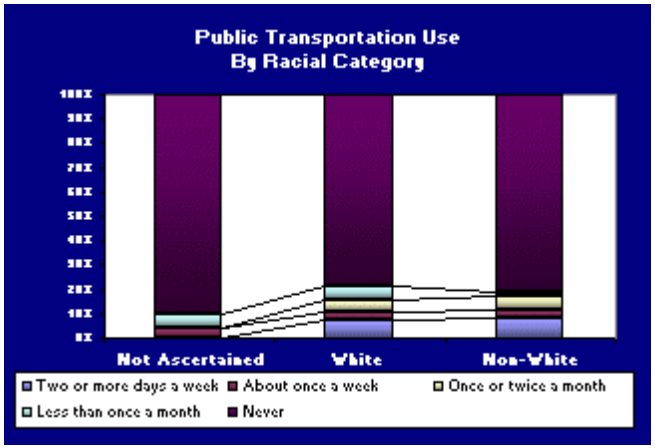
| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 8 | 8.972 | 0.345 |
| RS2 | 8 | 6.115 | 0.634 |
| | | | |

**Figure 7: Public transportation and demographic factors**

Place of Birth




Race




| Place of Birth | Public Transportation Use in the Last Two Months | | | | |
|---|---|---|---|---|---|
| | Two or more days a week | About once a week | Once or twice a month | Less than once a month | Never |
| Born in US | 7.7% | 3.0% | 5.2% | 5.3% | 78.8% |
| Foreign Born | 5.3% | 5.3% | 4.3% | 1.0% | 84.1% |

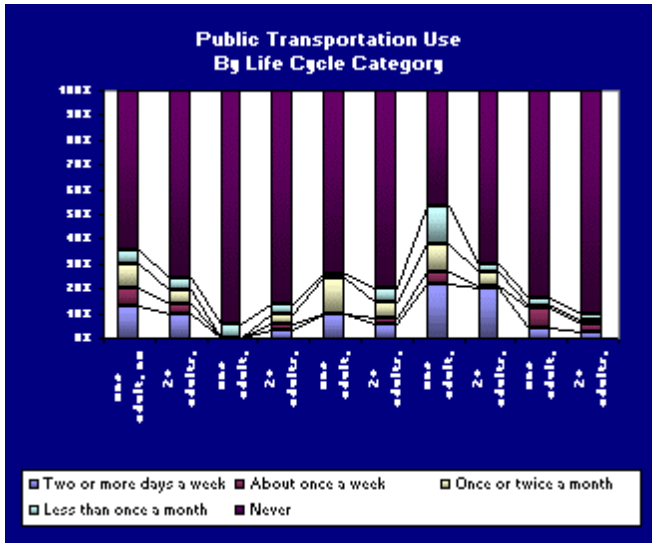
| Race | Public Transportation Use in the Last Two Months | | | | |
|---|---|---|---|---|---|
| | Two or more days a week | About once a week | Once or twice a month | Less than once a month | Never |
| Not Ascertained | 0.0% | 3.8% | 0.0% | 5.8% | 90.3% |
| White | 7.3% | 3.3% | 4.9% | 5.4% | 79.0% |
| Non-White | 8.4% | 2.8% | 6.4% | 1.5% | 80.9% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 8 | 9.92 | 0.271 |
| RS2 | 8 | 11.77 | 0.162 |

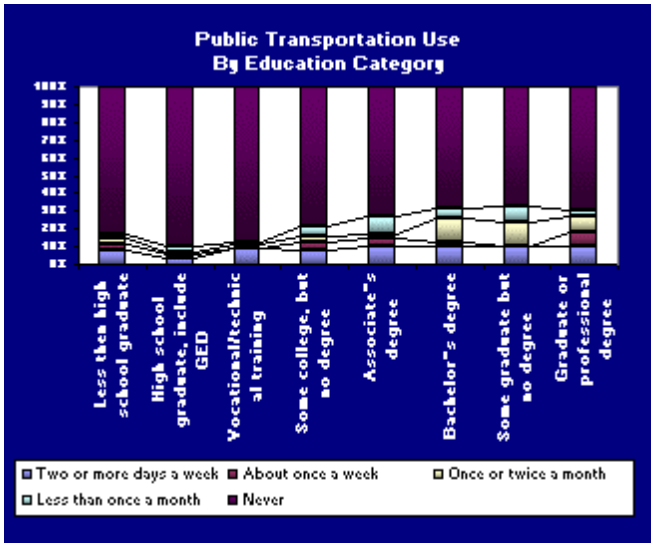
| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 56 | 108.278 | 0 |
| RS2 | 56 | 54.407 | 0.535 |

**Figure 7: Public transportation and demographic factors (continued page 2)**

Life Cycle




Education Level




| Life Cycle | Public Transportation Use (Last Two Months) | | | | |
|---|---|---|---|---|---|
| | Two or more days a week | About once a week | Once or twice a month | < once a month | Never |
| one adult, no children | 12.6% | 7.5% | 9.8% | 5.3% | 64.8% |
| 2+ adults, no children | 10.0% | 3.9% | 5.6% | 5.0% | 75.5% |
| one adult, youngest child 0-5 | 0.0% | 0.0% | 0.0% | 5.8% | 94.2% |
| 2+ adults, youngest child 0-5 | 3.2% | 2.4% | 3.7% | 4.4% | 86.3% |
| one adult, youngest child 6-15 | 9.4% | 0.0% | 14.8% | 1.4% | 74.3% |
| 2+ adults, youngest child 6-15 | 5.6% | 2.4% | 6.2% | 6.0% | 79.8% |
| one adult, youngest child 16-21 | 22.0% | 4.7% | 11.4% | 15.0% | 47.0% |
| 2+ adults, youngest child 16-21 | 19.9% | 1.0% | 5.4% | 3.7% | 70.0% |
| one adult, retired, no children | 4.3% | 7.6% | 1.3% | 3.0% | 83.8% |
| 2+ adults, retired, no children | 2.8% | 2.9% | 1.7% | 2.6% | 90.0% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 36 | 84.757 | 0 |
| RS2 | 36 | 46.522 | 0.113 |

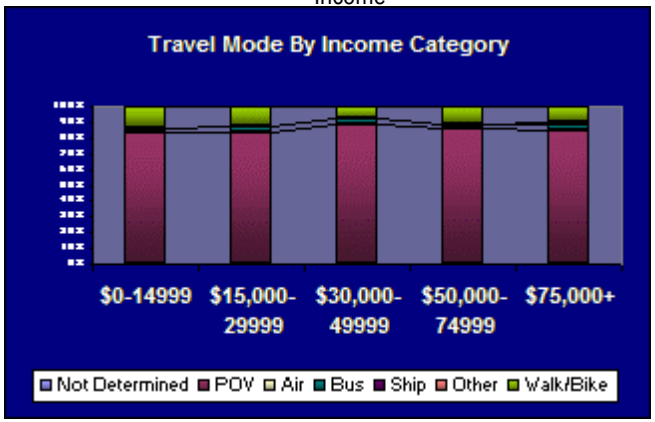
| Education | Public Transportation Use in the Last Two Months | | | | |
|---|---|---|---|---|---|
| | Two or more days a week | About once a week | Once or twice a month | < once a month | Never |
| < HS graduate | 7.3% | 3.7% | 3.1% | 2.6% | 83.2% |
| HS grad., incl. GED | 3.4% | 2.3% | 1.4% | 3.3% | 89.6% |
| Vocational/techn. training | 8.5% | 0.5% | 2.3% | 1.5% | 87.2% |
| Some college, but no degree | 7.7% | 4.2% | 3.3% | 6.1% | 78.7% |
| Associate"s degree | 9.7% | 4.8% | 2.1% | 10.3% | 73.0% |
| Bachelor"s degree | 10.6% | 1.7% | 13.4% | 5.4% | 69.0% |
| Some graduate but no degree | 9.8% | 0.0% | 13.4% | 9.0% | 67.8% |
| Graduate or professional degree | 10.1% | 8.2% | 9.1% | 2.8% | 69.8% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 36 | 102.187 | 0 |
| RS2 | 36 | 68.527 | 0.001 |

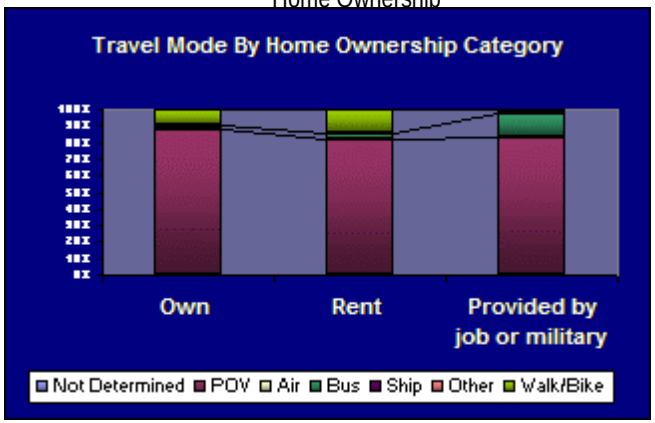
**Figure 7: Public transportation and demographic factors (continued page 3)**

### *Travel Mode Breakdown in Relation to Demographic Characteristics*

Income




Home Ownership




| Household Income | Travel Mode Breakdown | | | | | | |
|---|---|---|---|---|---|---|---|
| | NA | POV* | Air | Bus | Ship | Other | Walk/ Bike |
| $0-14999 | 0.0% | 83.1% | 0.0% | 2.7% | 0.0% | 0.4% | 13.7% |
| $15,000-29999 | 0.0% | 83.0% | 0.2% | 4.0% | 0.4% | 0.0% | 12.4% |
| $30,000-49999 | 0.0% | 89.0% | 0.0% | 3.0% | 0.0% | 0.2% | 7.8% |
| $50,000-74999 | 0.0% | 85.9% | 0.0% | 2.5% | 0.2% | 0.0% | 11.4% |
| $75,000+ | 0.1% | 84.7% | 0.2% | 3.6% | 0.1% | 1.0% | 10.3% |

| Home Ownership | Travel Mode Breakdown | | | | | | |
|---|---|---|---|---|---|---|---|
| | NA | POV | Air | Bus | Ship | Other | Walk/ Bike |
| Own | 0.1% | 87.4% | 0.1% | 2.8% | 0.1% | 0.4% | 9.2% |
| Rent | 0.1% | 81.5% | 0.1% | 3.9% | 0.2% | 0.3% | 13.9% |
| Military | 0.0% | 83.7% | 0.0% | 14.0% | 0.0% | 0.0% | 2.3% |

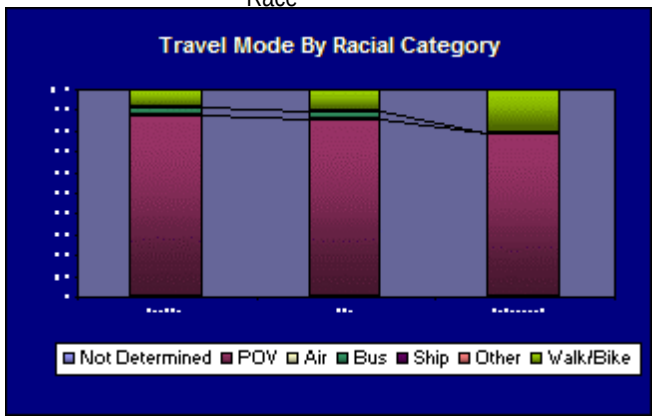
| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 30.00 | 87.37 | 0.00 |
| RS2 | 30.00 | 23.57 | 0.79 |

*POV= Personal Vehicle

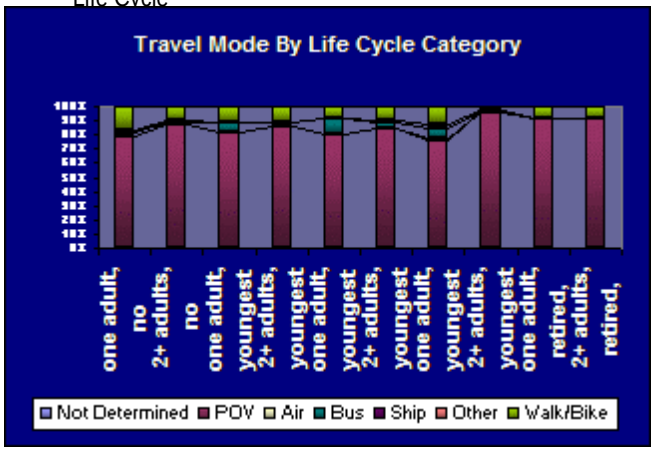
| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 12.00 | 68.19 | 0.00 |
| RS2 | 12.00 | 14.18 | 0.29 |

**Figure 8: Travel modes and demographic factors**

Race




Life Cycle




| | Travel Mode Breakdown | | | | | | |
|---|---|---|---|---|---|---|---|
| Race | NA | POV | Air | Bus | Ship | Other | Walk/ Bike |
| Not Ascertained | 0.0% | 87.3% | 0.1% | 3.8% | 0.0% | 0.0% | 8.8% |
| White | 0.1% | 85.7% | 0.1% | 3.1% | 0.2% | 0.4% | 10.4% |
| Non-White | 0.0% | 78.9% | 0.0% | 0.0% | 0.0% | 0.0% | 21.1% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 12.00 | 41.82 | 0.00 |
| RS2 | 2.00 | 26 | .86 |

| | Travel Mode Breakdown | | | | | | |
|---|---|---|---|---|---|---|---|
| Life Cycle | NA | POV | Air | Bus | Ship | Other | Walk/ Bike |
| one adult, no children | 0.0% | 78.5% | 0.4% | 2.6% | 0.5% | 0.5% | 17.5% |
| 2+ adults, no children | 0.0% | 87.0% | 0.2% | 2.1% | 0.4% | 0.6% | 9.7% |
| one adult, youngest child 0-5 | 0.0% | 82.3% | 0.0% | 5.9% | 0.0% | 0.0% | 11.8% |
| 2+ adults, youngest child 0-5 | 0.0% | 86.0% | 0.0% | 2.6% | 0.0% | 0.0% | 11.4% |
| one adult, youngest child 6-15 | 0.7% | 79.7% | 0.0% | 11.2% | 0.5% | 0.0% | 7.9% |
| 2+ adults, youngest child 6-15 | 0.1% | 83.9% | 0.1% | 4.8% | 0.0% | 0.6% | 10.5% |
| one adult, youngest child 16-21 | 0.0% | 76.2% | 1.7% | 6.5% | 0.0% | 3.2% | 12.4% |
| 2+ adults, youngest child 16-21 | 0.0% | 95.5% | 0.0% | 0.4% | 0.3% | 0.3% | 3.4% |
| one adult, retired, no children | 0.0% | 91.2% | 0.0% | 1.1% | 0.0% | 0.0% | 7.8% |
| 2+ adults, retired, no children | 0.0% | 91.0% | 0.0% | 0.5% | 0.0% | 0.0% | 8.4% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 54.00 | 230.88 | 0.00 |
| RS2 | 54.00 | 61.46 | 0.23 |

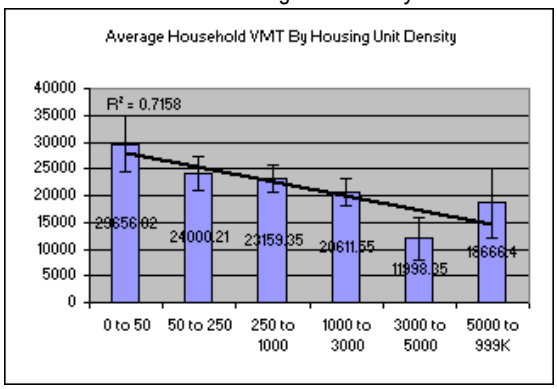
**Figure 8: Travel modes and demographic factors (continued page 2)**

**Land-Use Factors**

Figures 9 through 15 explain the findings of relationships between travel indicators and demographic factors.

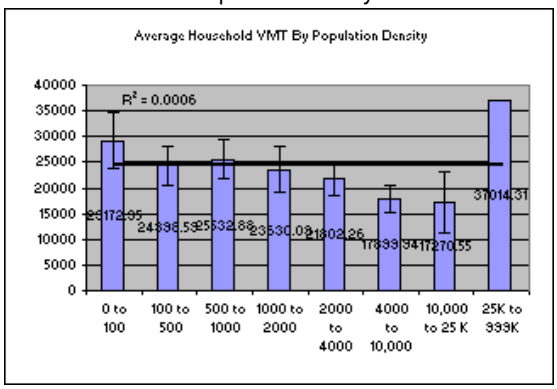
## *Annual Vehicle Miles Traveled (VMT) per Household in Relation to Different Land-Use Characteristics*

Housing Unit Density



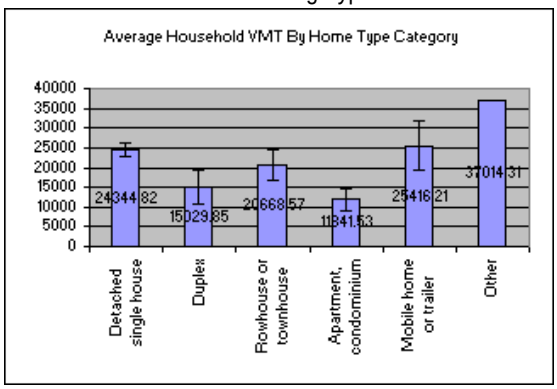

Households living in areas with high housing unit densities appear to have lower VMT than households living in areas with low housing unit densities. The one discrepancy shown is where densities exceed 5000 HU/square mile. However, this may be due to the large standard error for this category because of its small sample size.

Population Density



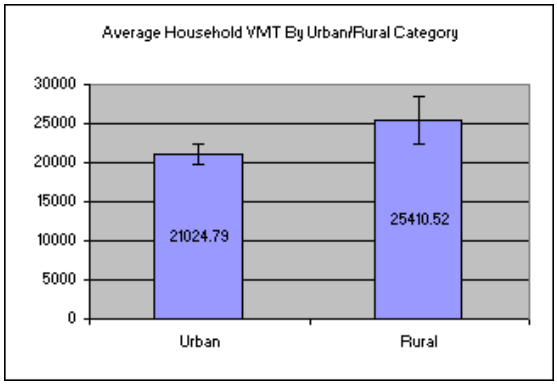

Households living in areas with high population densities appear to have lower VMT than households living in areas with low population densities. The sample size for the highest density category was 1.0, making this estimate meaningless.

Housing Type



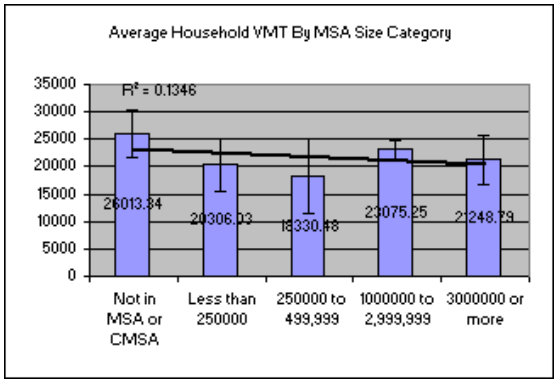

Households living in mobile and SF homes appear to have the highest VMT; households living in town-homes or row houses appear to have lower VMT; and households living in apartments and condominiums appear to have the lowest VMT.

Urban / Rural




Households living in rural areas appear to have higher VMT than households living in urban areas.

MSA Size

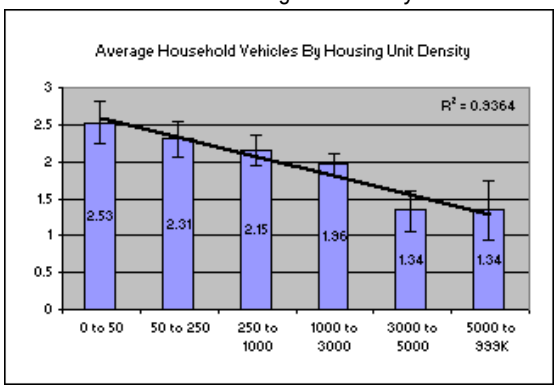



Not much difference in VMT exists between households living in different sized MSAs. However, VMT appears greater for households living outside of an MSA

**Figure 9: Vehicle miles traveled (VMT) and land-use factors**

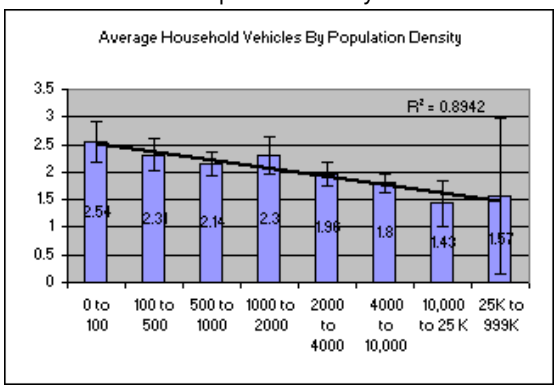
## *Number of Vehicles Owned per Household in Relation to Land-Use Characteristics*

Housing Unit Density



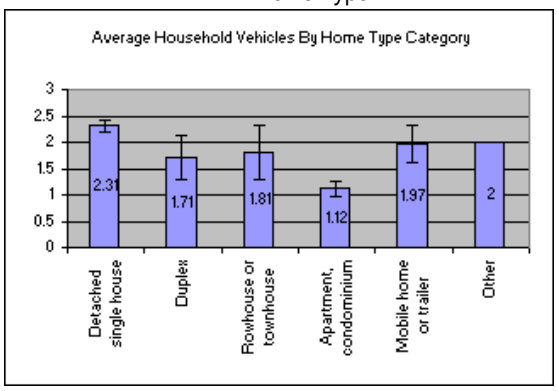

The number of vehicles per household appears lower for households living in areas with higher housing unit densities.

Population Density



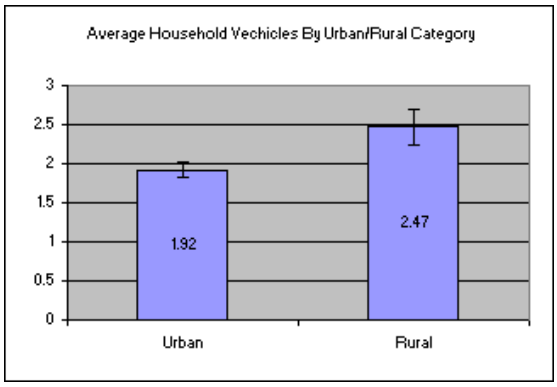

The number of vehicles per household appears lower for households living in areas with higher population densities.

Home Type



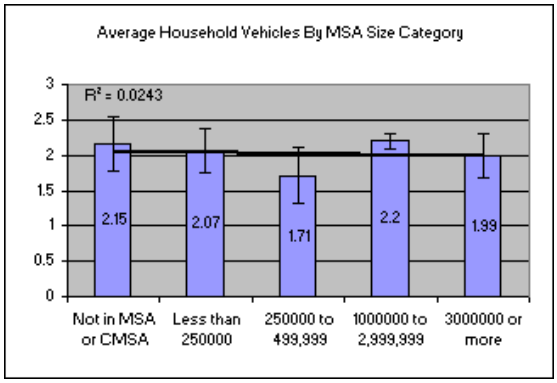

Households living in SF and mobile homes appear to have a greater number of vehicles than households living in apartments and condominiums. Households living in row houses and townhomes also appear to have fewer vehicles, but the standard error for this category is too high to make the estimate meaningful.

Urban / Rural




Households living in rural areas appear to have a greater number of vehicles than households living in urban areas.

MSA Size

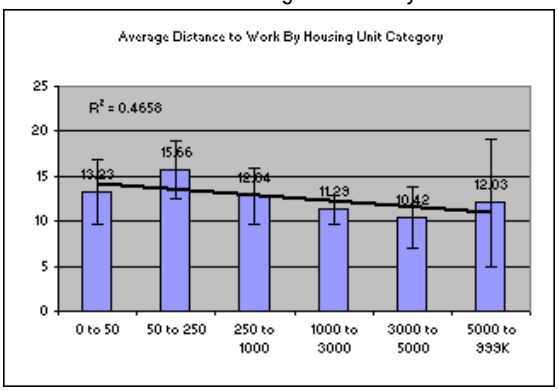



Not much difference in vehicle ownership appears to exist between households living in different sized MSAs, nor does there appear to be a difference in vehicle ownership between households living inside and outside of an MSA.

**Figure 10: Number of vehicles owned and land-use factors**

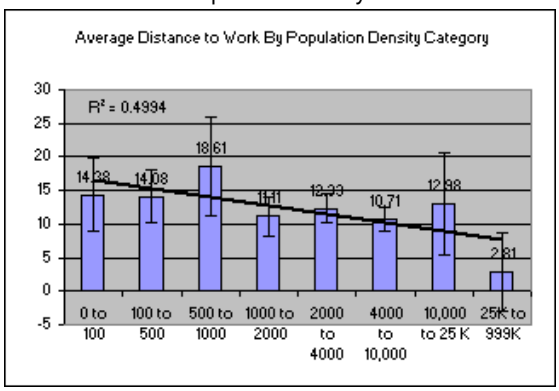
## *Distance Traveled to Work per Person in Relation to Land Use Characteristics*

Housing Unit Density



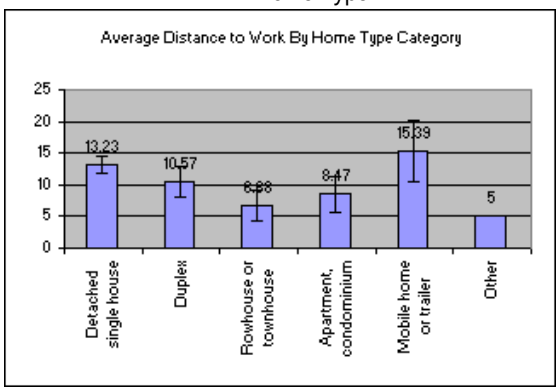

Households living in areas with higher housing unit densities appear to travel shorter distances to work. However, the large standard errors make these differences statistically insignificant.

Population Density



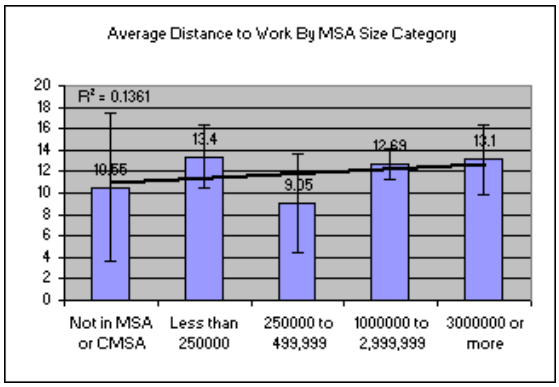

Households living in areas with higher population densities appear to travel shorter distances to work than households living in areas with lower population densities. However, the large standard errors make these differences statistically insignificant.

Home Type




Households living in rowhouses and townhomes appear to travel the shortest distances to work, and households living in mobile homes appear to travel the longest distance to work.

MSA Size

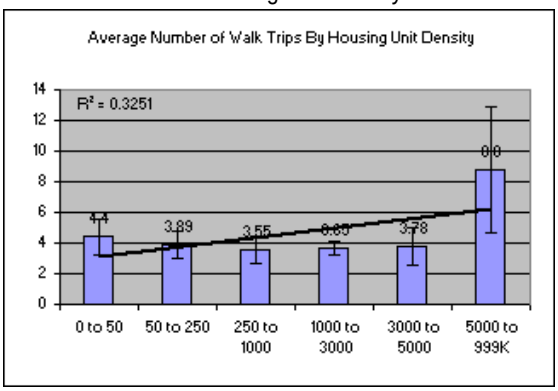



Households living in larger MSAs appear to travel longer distances to work than households living in smaller MSAs and outside of MSAs. However, standard errors are large making differences statistically insignificant.

**Figure 11: Distance to work and land-use factors**

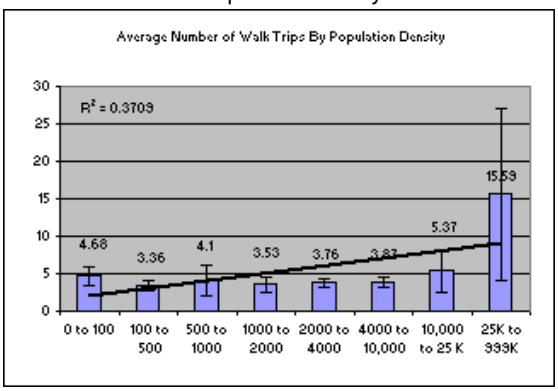
## *Number of Walking Trips Made per Person on a Weekly Basis in Relation to Land-Use Characteristics*

Housing Unit Density



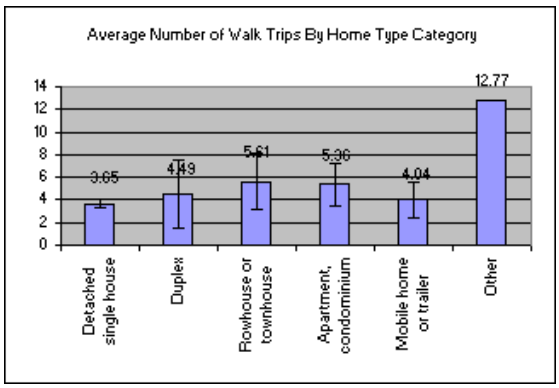

Households living in areas with lower housing unit densities appear to take slightly more walking trips per week than households living in areas with higher housing unit densities. Results are statistically insignificant because of small differences and large standard errors.

Population Density



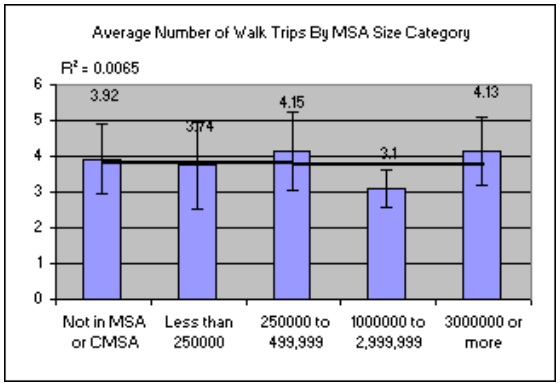

Households living in areas with lower population densities appear to take slightly more walking trips per week than households living in areas with higher housing unit densities. Results are statistically insignificant because of small differences and large standard errors.

Home Type



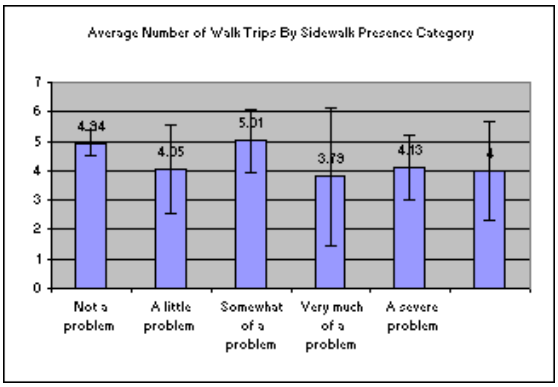

Results are statistically insignificant because of small differences and large standard errors. However, it appears that a slightly greater number of walking trips are made by households living in rowhouses, townhouses, and apartments than by those living in single family and mobile homes.

MSA Size




The size of the MSA appears to have no consistent relationship with the number of walking trips taken by households living within or without them.

Sidewalk Presence

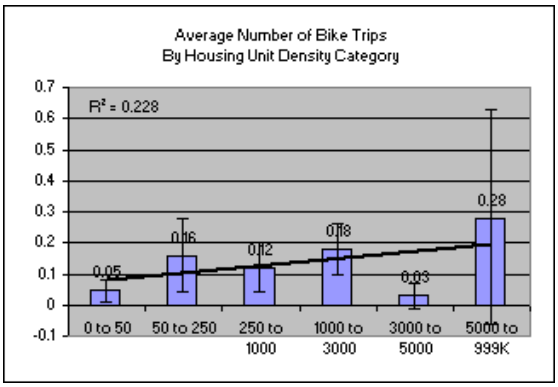



Households living in areas where sidewalks are a problem take almost as many walking trips per week as households where sidewalks are not a problem. Large standard errors and small differences make any differences statistically insignificant.

**Figure 12: Walking trips and land-use factors**

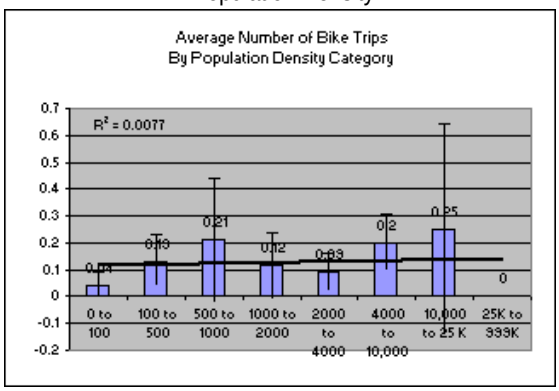
### *Number of Biking Trips Made per Person on a Weekly Basis in Relation to Land Use Characteristics*

Housing Unit Density



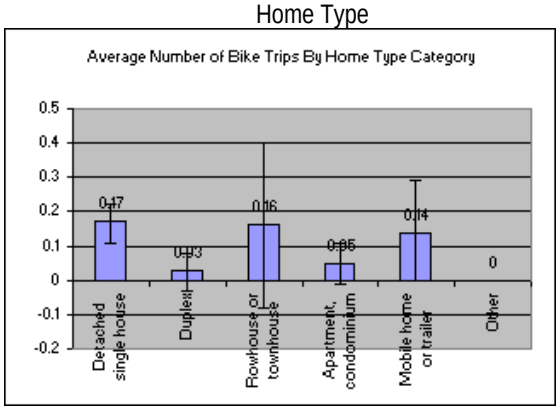

Households living in areas with 1000 - 3000 housing units per square mile appear to take more biking trips per week, and households living in areas with 3000-10,000 housing units per mile make fewer biking trips per week than other households. However, the small differences and large standard errors make these differences statistically insignificant.

Population Density



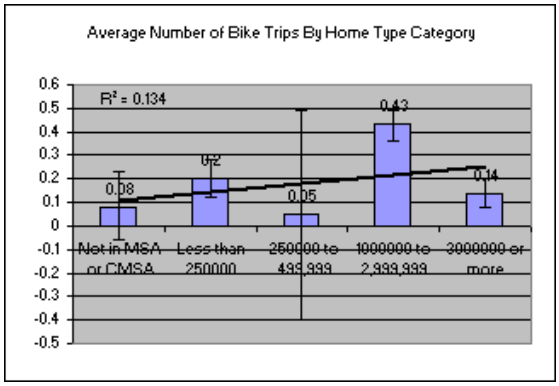

The number of biking trips taken per week appears to peak for households living in areas with population densities between 500 and 1000 people per square mile and then again for households living in areas with densities greater than 4000 people per square mile. However, the small differences and large standard errors make these differences statistically insignificant.

Home Type




Large standard errors and small differences prevent statistically significant conclusions to be drawn. However, it appears that fewer biking trips are made by households living in apartments and duplexes than by households living in other types of homes.

MSA Size

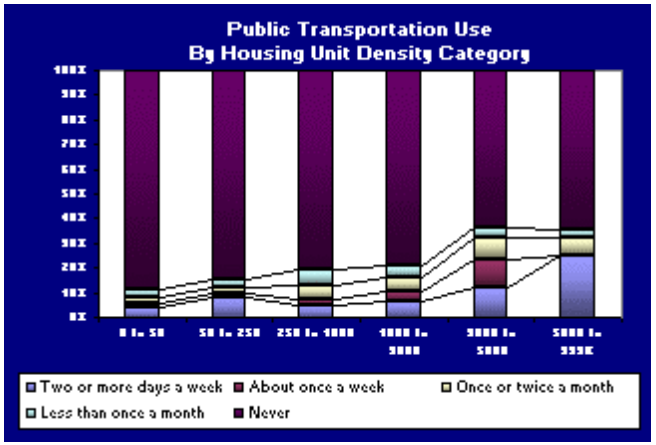



Large standard errors and small differences make results statistically insignificant.

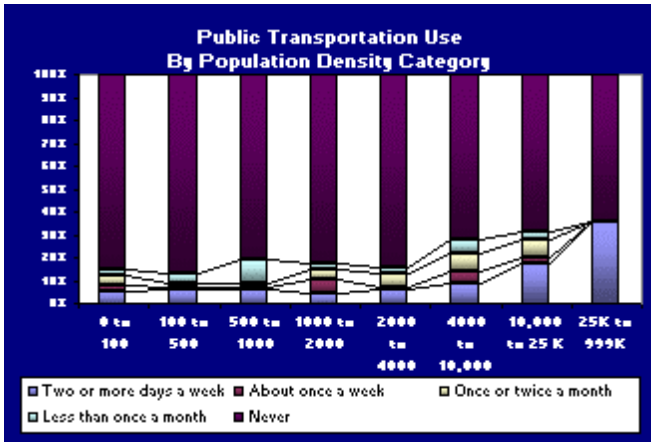
**Figure 13: Biking trips and land-use factors**

## *Public Transportation Use in Relation to Land-Use Characteristics*

Housing Unit Density




Population Density




| Housing Units per Sq. Miile | Public Transportation Use in the Last Two Months | | | | |
|---|---|---|---|---|---|
| | Two or more days a week | About once a week | Once or twice a month | < once a month | Never |
| 0 to 50 | 3.9% | 1.8% | 2.3% | 3.6% | 88.4% |
| 50 to 250 | 8.4% | 0.9% | 2.8% | 3.2% | 84.7% |
| 250 to 1000 | 4.7% | 2.7% | 5.3% | 6.3% | 81.0% |
| 1000 to 3000 | 6.5% | 3.9% | 5.7% | 5.2% | 78.7% |
| 3000 to 5000 | 12.2% | 11.3% | 9.0% | 3.7% | 63.9% |
| 5000 to 999K | 25.4% | 0.0% | 7.1% | 2.8% | 64.8% |

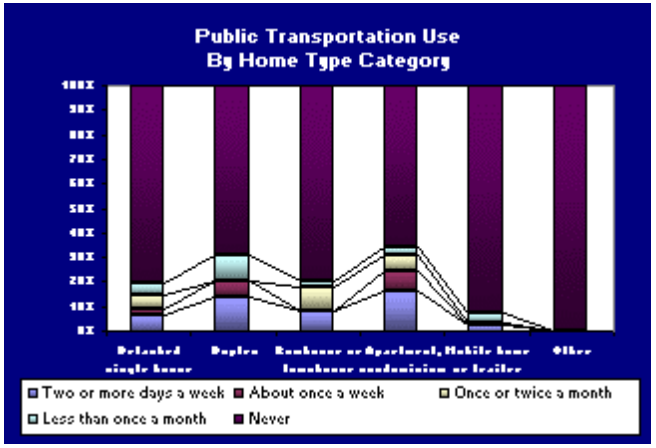
| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 20 | 72.106 | 0 |
| RS2 | 20 | 33.291 | 0.031 |

| Population per Sq.Mile | Public Transportation Use in the Last Two Months | | | | |
|---|---|---|---|---|---|
| | Two or more days a week | About once a week | Once or twice a month | < once a month | Never |
| 0 to 100 | 5.4% | 2.0% | 4.4% | 2.7% | 85.5% |
| 100 to 500 | 6.1% | 1.0% | 1.2% | 4.4% | 87.3% |
| 500 to 1000 | 6.4% | 0.5% | 1.4% | 11.1% | 80.7% |
| 1000 to 2000 | 4.2% | 6.2% | 4.0% | 2.8% | 82.8% |
| 2000 to 4000 | 6.1% | 1.0% | 6.2% | 2.3% | 84.4% |
| 4000 to 10,000 | 8.4% | 5.9% | 7.2% | 6.5% | 72.0% |
| 10,000 to 25 K | 17.8% | 2.5% | 7.9% | 3.1% | 68.8% |
| 25K to 999K | 35.6% | 0.0% | 0.0% | 0.0% | 64.4% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 28 | 81.782 | 0 |
| RS2 | 28 | 33.366 | 0.223 |

**Figure 14: Public transportation and land-use factors**

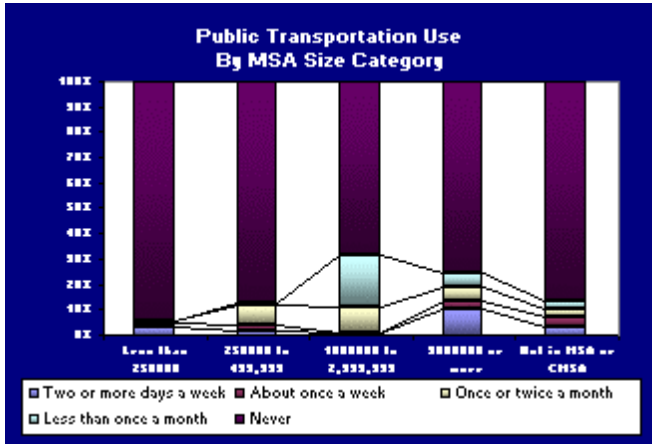
Home Type




| Home Type | Public Transportation Use in the Last Two Months | | | | |
|---|---|---|---|---|---|
| | Two or more days a week | About once a week | Once or twice a month | < once a month | Never |
| Detached single house | 6.2% | 2.8% | 5.4% | 5.0% | 80.6% |
| Duplex | 14.1% | 6.1% | 0.0% | 10.8% | 69.1% |
| Rowhouse or townhouse | 8.0% | 0.0% | 10.1% | 2.3% | 79.6% |
| Apartment, condominium | 16.6% | 8.0% | 6.7% | 2.8% | 66.0% |
| Mobile home or trailer | 2.1% | 0.8% | 0.7% | 3.6% | 92.8% |
| Other | 0.0% | 0.0% | 0.0% | 0.0% | 100.0% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 20 | 60.275 | 0 |
| RS2 | 20 | 29.561 | 0.077 |

MSA Size



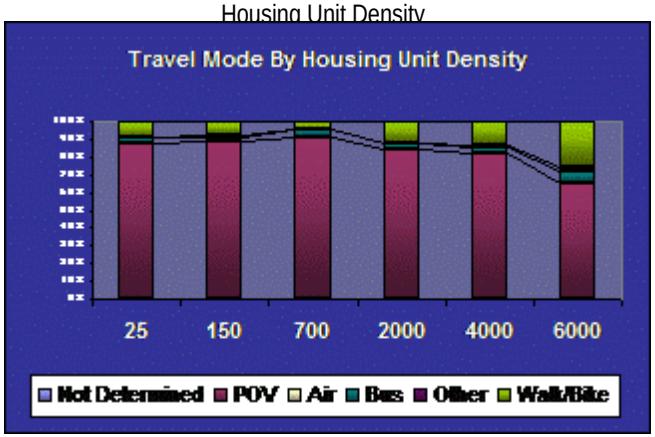

| MSA Size | Public Transportation Use in the Last Two Months | | | | |
|---|---|---|---|---|---|
| | Two or more days a week | About once a week | Once or twice a month | < once a month | Never |
| Less than 250000 | 3.3% | 1.7% | 0.8% | 0.0% | 94.2% |
| 250000 to 499,999 | 1.8% | 2.1% | 7.8% | 0.6% | 87.7% |
| 1000000 to 2,999,999 | 1.0% | 0.0% | 10.4% | 20.3% | 68.3% |
| 3000000 or more | 10.0% | 3.8% | 5.4% | 5.0% | 75.9% |
| Not in MSA or CMSA | 3.5% | 3.8% | 3.4% | 2.7% | 86.7% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 16 | 87.806 | 0 |
| RS2 | 16 | 36.25 | 0.003 |

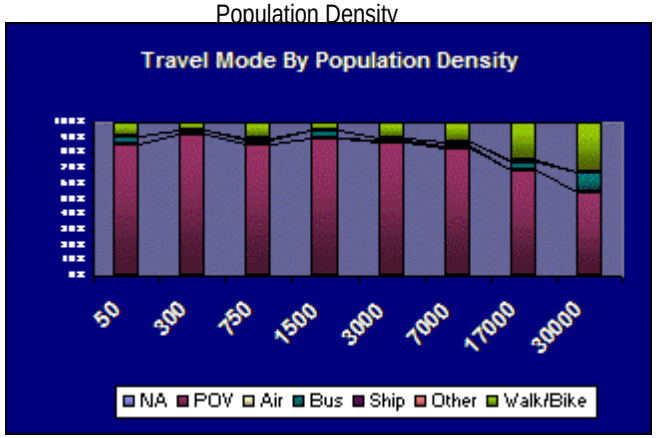
**Figure 14: Public transportation and land-use factors (continued page 2)**

### *Travel Mode Breakdown in Relation to Land-Use Characteristics*

Housing Unit Density




Population Density




| Housing Denity/sq. mi. | Travel Mode Breakdown | | | | | | |
|---|---|---|---|---|---|---|---|
| | NA | POV | Air | Bus | Ship | Other | Walk/ Bike |
| 0 to 50 | 0.0% | 87.3% | 0.0% | 3.8% | 0.3% | 0.1% | 8.6% |
| 50 to 250 | 0.0% | 88.4% | 0.1% | 2.2% | 0.3% | 0.8% | 8.2% |
| 250 to 1000 | 0.1% | 90.9% | 0.1% | 3.7% | 0.3% | 0.1% | 4.9% |
| 1000 to 3000 | 0.1% | 84.5% | 0.0% | 2.7% | 0.0% | 0.2% | 12.5% |
| 3000 to 5000 | 0.0% | 82.0% | 0.4% | 3.1% | 0.0% | 0.7% | 13.8% |
| 5000 to 999K | 0.0% | 64.6% | 0.4% | 6.8% | 0.0% | 2.0% | 26.2% |

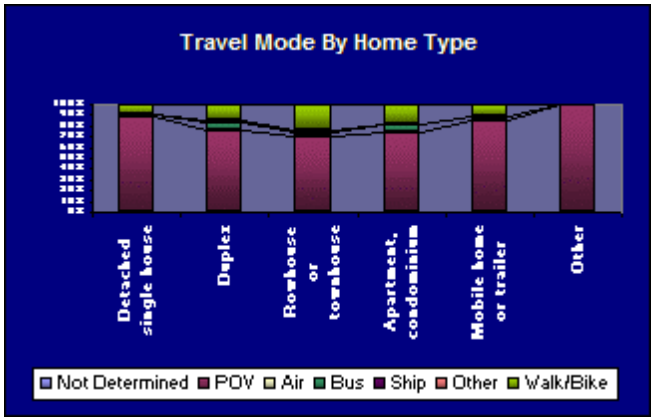
| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 30.00 | 232.04 | 0.00 |
| RS2 | 30.00 | 49.24 | 0.02 |

| Population Density/sq. mi. | Travel Mode Breakdown | | | | | | |
|---|---|---|---|---|---|---|---|
| | NA | POV | Air | Bus | Ship | Other | Walk/ Bike |
| 0 to 100 | 0.0% | 86.2% | 0.0% | 4.2% | 0.3% | 0.0% | 9.4% |
| 100 to 500 | 0.0% | 91.8% | 0.2% | 2.3% | 0.7% | 0.1% | 4.9% |
| 500 to 1000 | 0.0% | 85.9% | 0.0% | 2.7% | 0.1% | 1.4% | 9.8% |
| 1000 to 2000 | 0.2% | 90.0% | 0.0% | 4.4% | 0.0% | 0.0% | 5.3% |
| 2000 to 4000 | 0.2% | 87.4% | 0.1% | 2.1% | 0.0% | 0.1% | 10.2% |
| 4000 to 10,000 | 0.0% | 83.7% | 0.1% | 3.2% | 0.0% | 0.4% | 12.6% |
| 10,000 to 25 K | 0.0% | 68.3% | 0.4% | 4.9% | 0.0% | 2.0% | 24.3% |
| 25K to 999K | 0.0% | 54.1% | 0.0% | 13.1% | 0.0% | 0.0% | 32.8% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 42.00 | 272.78 | 0.00 |
| RS2 | 42.00 | 50.00 | 0.19 |

**Figure 15: Travel modes and land-use factors**

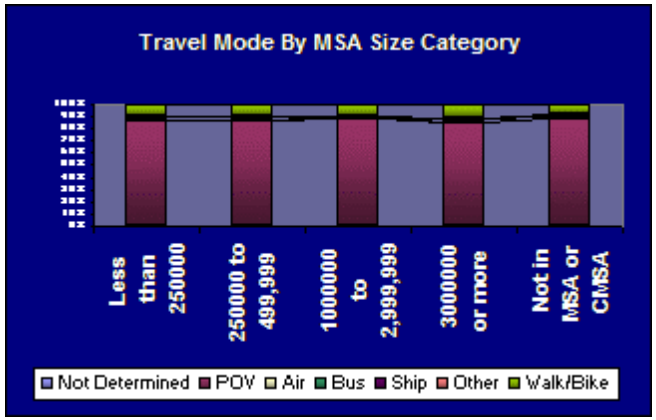
Home Type




| Travel Mode Breakdown | | | | | | | |
|---|---|---|---|---|---|---|---|
| Home Type | NA | POV | Air | Bus | Ship | Other | Walk/ Bike |
| Detached single house | 0.1% | 88.4% | 0.1% | 2.4% | 0.1% | 0.3% | 8.6% |
| Duplex | 0.0% | 75.5% | 0.0% | 7.8% | 0.0% | 2.2% | 14.5% |
| Rowhouse or townhouse | 0.0% | 70.1% | 0.0% | 3.1% | 2.2% | 0.0% | 24.6% |
| Apartment, condominium | 0.0% | 73.5% | 0.3% | 7.3% | 0.0% | 0.7% | 18.2% |
| Mobile home or trailer | 0.0% | 85.9% | 0.0% | 3.3% | 0.0% | 0.0% | 10.8% |
| Other | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 30.00 | 288.06 | 0.00 |
| RS2 | 30.00 | 33.71 | 0.29 |

MSA Size

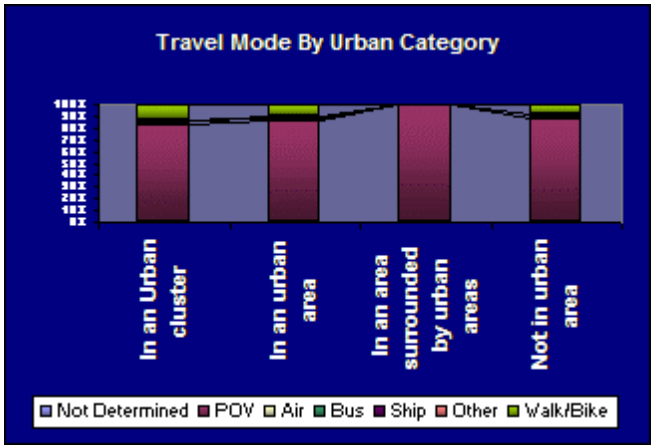



| Travel Mode Breakdown | | | | | | | |
|---|---|---|---|---|---|---|---|
| MSA SIze | NA | POV | Air | Bus | Ship | Other | Walk/ Bike |
| Less than 250000 | 0.4% | 87.3% | 0.0% | 1.9% | 0.0% | 0.0% | 10.4% |
| 250000 to 499,999 | 0.0% | 86.6% | 0.0% | 3.0% | 0.0% | 0.5% | 9.9% |
| 1000000 to 2,999,999 | 0.0% | 89.0% | 0.3% | 0.3% | 0.0% | 0.3% | 10.1% |
| 3000000 or more | 0.0% | 84.5% | 0.1% | 3.9% | 0.1% | 0.5% | 10.9% |
| Not in MSA or CMSA | 0.0% | 88.6% | 0.0% | 2.2% | 0.6% | 0.0% | 8.7% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 24.00 | 80.24 | 0.00 |
| RS2 | 24.00 | 26.74 | 0.32 |

**Figure 15: Travel modes and land-use factors (continued page 2)**

Urban Category




| Travel Mode Breakdown | | | | | | | |
|---|---|---|---|---|---|---|---|
| Urban Category | NA | POV | Air | Bus | Ship | Other | Walk/ Bike |
| In an Urban cluster | 0.0% | 83.6% | 0.0% | 3.6% | 0.0% | 0.0% | 12.9% |
| In an urban area | 0.1% | 85.6% | 0.1% | 3.1% | 0.0% | 0.5% | 10.7% |
| In an area surrounded by urban areas | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Not in urban area | 0.0% | 87.6% | 0.1% | 3.4% | 0.6% | 0.1% | 8.3% |

| CHI-SQUARE | D.F. | VALUE | PROB |
|---|---|---|---|
| PEARSON | 18.00 | 47.84 | 0.00 |
| RS2 | 18.00 | 23.28 | 0.18 |

**Figure 15: Travel modes and land-use factors (continued page 3)**

## PART 2: TRENDS 1980-2000

**Summary**

The following is a summary of the analyses of trends based on the Neighborhood Change Database (NCDB) 1980-2000. Detailed data are provided for three study areas within Washington State: the state as a whole, the Puget Sound region, and the Spokane region.

**1. Commute time to work: commute trip is getting longer. The use of private vehicles is lower in the state and the Puget Sound than the national average, but higher in Spokane.**

- The proportion of workers commuting "more than 45 minutes" has increased over time in all study areas.
- The proportion of workers working at home has increased over time in all study areas.
- The average commute trip in the Puget Sound has increased by 3.6 minutes from 1990 to 2000 (this is higher than the 3.1minute national average increase).

**2. Increases in transit use from 1990 to 2000 in Puget Sound raised the Washington State average to the same level as the national average, marking an increase in the use of transit in the state while the nation experienced a decrease.**

- The proportion of workers using public transportation in the Puget Sound is higher than the national average, while Spokane and statewide averages are lower.
- The proportion of commute trips by public transportation in Washington State and the Puget Sound reached their lowest point in 1990 and increased slightly in 2000.
- Nationwide, the proportion of those who commute to work by public transportation has decreased over the last two decades.

**3. Labor force: results are incomplete and inconclusive.**

- The number of employed female civilians has steadily increased during the two decades.

- The proportion of employed female civilians in Spokane has been slightly higher than that of Washington State, the Puget Sound, and the national average.

**4. Demographics: increases in working age and the Asian and Hispanic population in Washington State and the Puget Sound may affect future travel.**

- The 18-64 age group shows the largest increase in Puget the Sound (from 61.3 percent in 1980 to 65.2 percent in 2000).
- Spokane has the highest proportion of those 65 years and older in the state.
- The proportion of the foreign-born population has been stable between 1980 and 1990 but increased substantially between 1990 and 2000

**5. Income: trends are similar in Washington State to those of the nation, but the gap between the Puget Sound and Spokane is getting wider.**

- The average income per family has more than doubled over the two decades.
- The average family income of Washington State is similar to the national average.
- The average family income in the Puget Sound is higher than the national average, but lower in Spokane.
- The gap in average income per household has widened between the Puget Sound and the Spokane regions over the last decade.

**6. Access to private automobiles: on average, the population in Washington State has greater access to cars than that of the nation.**

- The proportion of occupied housing units with no car available is smaller in Washington, the Puget Sound, and Spokane than the nationwide average.
- The proportion of occupied housing units with two vehicles available has increased over time for all study areas.
- The proportion of occupied housing units with two vehicles is higher in Washington, Puget Sound, and Spokane than the national average.
- The proportion of occupied housing units with three and more vehicles is higher in Washington, Puget Sound, and Spokane than the national average. It has slightly decreased over time, while the nationwide average has increased slightly.

- In Washington State and the Puget Sound, the proportion of people of color with no car is higher relative to that of the population; it is similar in Spokane.

## Data and Methods

This trend analysis was based on data extracted from Neighborhood Change Database (NCDB) 1980-2000. The NCDB contains 1970, 1980, 1990, and 2000 Long Form data, with detailed data such as population, household, and housing characteristics, income, poverty status, education level, employment, housing costs, immigration, and other variables (U.S. Census1970-2000). The Neighborhood Change Database, however, is not as exhaustive as the full census and includes only a subset of the complete variable list for each decade.

The NCDB database indicates no boundary change at the county level during the two decades.

## Trends

### *Travel Time to Work*

- The proportion of workers commuting "more than 45 minutes" increased over time in all study areas.
- The proportion of workers commuting "less than 25 minutes" increased during the 1980s and then slightly decreased between 1990 and 2000.
- Because categories used in this analysis were aggregated from the 1990 and 2000 original data, which had 12 categories, it is not appropriate to conclude that travel time is getting shorter or longer. For example, use of the original 12 categories for comparing commute travel time between 1990 and 2000 indicates that, nationwide, the proportion of trips in all categories below 20 minutes declined, while the proportion in the category of 5 minutes or more increased.

**Table 6. Percentage of workers 16+ years old by travel time to work**

| | 1980 | | | | 1990 | | | | 2000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U.S. | WA | Puget Sound | Spokane | U.S. | WA | Puget Sound | Spokane | U.S. | WA | Puget Sound | Spokane |
| Workers 16+ years old with travel time to work less than 25 minutes or work at home | 49% | 49% | 44% | 58% | 65% | 66% | 59% | 76% | 61% | 61% | 54% | 71% |
| Workers 16+ years old with travel time to work 25 to 44 minutes | 39% | 41% | 45% | 38% | 23% | 23% | 28% | 19% | 24% | 24% | 28% | 22% |
| Workers 16+ years old with travel time to work more than 45 minutes | 12% | 10% | 11% | 5% | 12% | 11% | 13% | 5% | 15% | 14% | 17% | 7% |

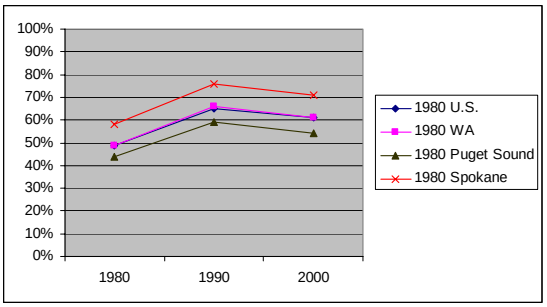



**Figure 16. Proportion of workers with travel time less than 25 minutes**

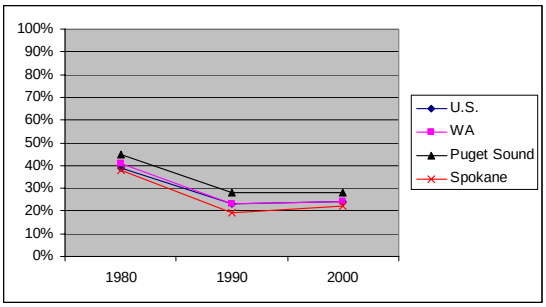



**Figure 17. Proportion of workers with travel travel time 25 to 44 minutes**

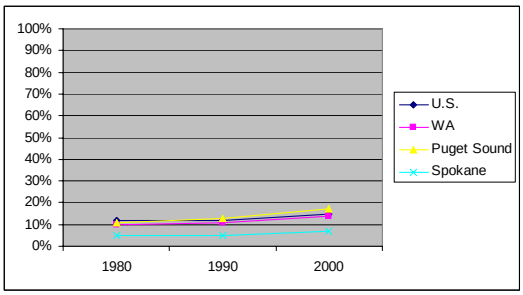



**Figure 18. Proportion of workers with travel time more than 45 minutes**

Nationwide Travel Time to Work

- Nationwide, travel time to work increased by 3.2 percent (0.7 minutes) between 1980 and 1990, and by 13.8 percent between 1990 and 2000 (3.1 minutes).

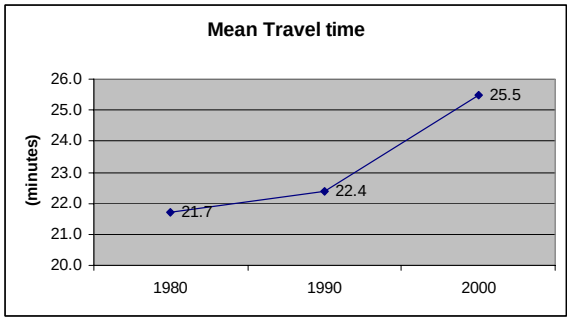



**Figure 19. Mean travel time to work in the U.S. (minutes)**

(Source: U.S. Census Bureau: http://www.census.gov/population/www/socdemo/journey.html) (2000)

MSAs with a Greater and Lower Than Average Increase in Travel Time to Work

- The Seattle metropolitan statistical area (MSA) had a greater increase in commute trip length than the national average.

**Table 7. Metropolitan statistical areas with a greater than average increase in travel time (>3.1 min.) 1990-2000**

| MSA Name | 1990 Average Travel Time | 2000 Average Travel Time | Change in Travel Time |
|---|---|---|---|
| National Total | 22.4 | 25.5 | 3.1 |
| Atlanta | 26 | 31.2 | 5.2 |
| Miami | 24.1 | 28.9 | 4.8 |
| West Palm Beach | 20.9 | 25.7 | 4.8 |
| Raleigh | 20.2 | 24.9 | 4.7 |
| Charlotte | 21.6 | 26.1 | 4.5 |
| Boston | 23.6 | 27.8 | 4.2 |
| Orlando | 22.8 | 27 | 4.2 |
| New York | 30 | 34 | 4.1 |
| Jacksonville | 22.6 | 26.6 | 4 |
| Philadelphia | 24 | 27.9 | 3.9 |
| Austin | 21.7 | 25.5 | 3.8 |
| Tampa | 21.8 | 25.6 | 3.8 |
| Sacramento | 21.8 | 25.6 | 3.8 |
| Las Vegas | 20.3 | 24.1 | 3.8 |
| San Francisco | 25.6 | 29.3 | 3.7 |
| Denver | 22.2 | 25.9 | 3.7 |
| Providence | 19.6 | 23.2 | 3.6 |
| Seattle | 24.1 | 27.7 | 3.6 |
| Greensboro | 18.8 | 22.4 | 3.6 |
| Washington, DC | 28.2 | 31.7 | 3.5 |
| Dallas | 24.1 | 27.5 | 3.4 |

(Source: Journey to Work Trends - http://www.fhwa.dot.gov/ctpp/jtw/jtw3.htm#tra) (FHWA 2000)

**Table 8. Metropolitan statistical areas with a lower than average increase in travel time (<3.1 min.) 1990-2000**

| MSA Name | 1990 Average Travel Time | 2000 Average Travel Time | Change in Travel Time |
|---|---|---|---|
| National Total | 22.4 | 25.5 | 3.1 |
| Los Angeles | 26.4 | 29.1 | 2.7 |
| Louisville | 21.3 | 22 | 0.7 |
| Rochester | 19.8 | 21.1 | 1.3 |
| Kansas City | 21.5 | 22.9 | 1.4 |
| Buffalo | 19.4 | 21.1 | 1.7 |
| Oklahoma City | 20.3 | 22 | 1.7 |
| Cincinnati | 22.4 | 24.3 | 1.9 |
| Indianapolis | 21.8 | 23.8 | 2.0 |
| Columbus | 21.2 | 23.2 | 2.0 |
| Cleveland | 21.9 | 24 | 2.1 |
| Milwaukee | 20 | 22.1 | 2.1 |
| Hartford | 20.7 | 22.9 | 2.2 |
| St. Louis | 23.2 | 25.5 | 2.3 |
| Norfolk | 21.8 | 24.1 | 2.3 |
| New Orleans | 24.3 | 26.7 | 2.4 |
| Grand Rapids | 18.3 | 20.7 | 2.4 |
| Minneapolis | 21.2 | 23.7 | 2.5 |
| San Antonio | 22 | 24.5 | 2.5 |
| Salt Lake City | 19.8 | 22.4 | 2.6 |
| Houston | 26.1 | 28.8 | 2.7 |
| Pittsburgh | 22.5 | 25.3 | 2.8 |
| Memphis | 21.8 | 24.6 | 2.8 |
| Portland | 21.5 | 24.4 | 2.9 |
| Detroit | 23.1 | 26.1 | 3.0 |
| Chicago | 27.9 | 31 | 3.1 |
| Phoenix | 23 | 26.1 | 3.1 |
| San Diego | 22.2 | 25.3 | 3.1 |
| Nashville | 22.7 | 25.8 | 3.1 |

### *Commuting Mode Choice*

- Private vehicles are the most prevalent means of commuting travel.
- The proportion of workers working at home increased over time in all study areas.
- The proportion of workers using public transportation in Puget Sound is higher than the national average, while Spokane and statewide averages are lower.
- The proportion of commute trips by public transportation in Washington State and the Puget Sound reached their lowest point in 1990 and increased slightly in 2000.
- Nationwide, the proportion of commute to work by public transportation has decreased over the two decades.

**Table 9. Commuting mode choice**

| | 1980 | | | | 1990 | | | | 2000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | U.S. | WA | Puget Sound | Spokane | U.S. | WA | Puget Sound | Spokane | U.S. | WA | Puget Sound | Spokane |
| Public Transportation | 7.7% | 6.0% | 7.8% | 4.2% | 5.3% | 4.4% | 6.2% | 2.8% | 4.7% | 4.7% | 6.8% | 2.8% |
| Private Vehicles | 84.1% | 82.5% | 81.1% | 86.5% | 86.5% | 83.0% | 82.0% | 88.8% | 87.9% | 82.5% | 80.7% | 89.0% |
| Walk or other means | 6.6% | 9.2% | 9.1% | 6.9% | 5.2% | 9.0% | 8.4% | 5.1% | 4.1% | 8.6% | 8.5% | 4.1% |
| Working at home | 1.7% | 2.3% | 2.0% | 2.5% | 3.0% | 3.6% | 3.4% | 3.4% | 3.3% | 4.2% | 4.0% | 4.1% |

Percentage of Commuters Using Public Transportation

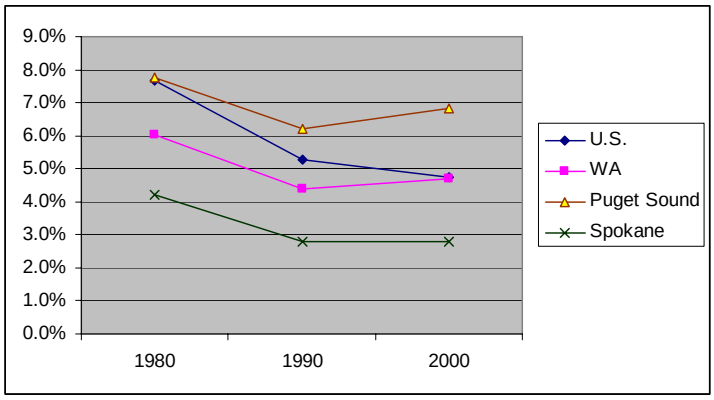



**Figure 20: Percentage of commuters using public transportation**

Mean Morning Commute Time in the Puget Sound by Mode

- Travel times remained fairly constant throughout the 1990s. Only in 1997, the most recent year of the survey, did travel times to work show a tendency to increase.
- Travel time by transit is 60 percent longer than by automobile or combined automobile and transit
- Travel time by non-motorized modes is about 15 minutes.

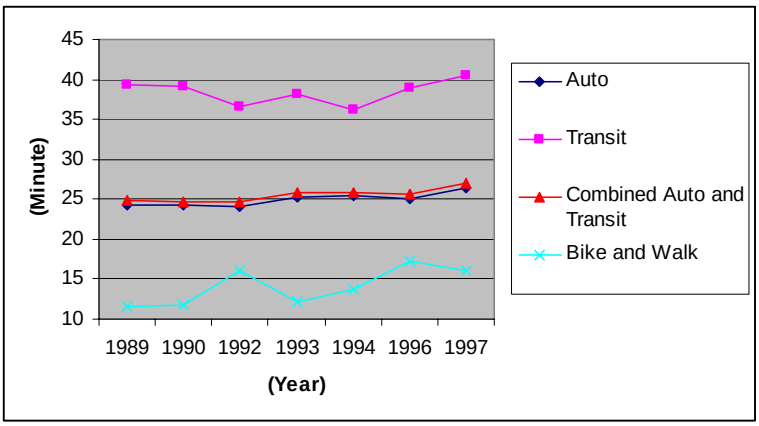



**Figure 21. Mean morning commute time in Puget Sound by mode**

* Data Source: PSRC, 1999, Puget Sound Transportation Panel (PSTP), a survey of approximately 1,700 households

- Evidence in the Puget Sound suggests that as employment grows faster in centers other than the central cities, workers select jobs and/or residential locations in a way to maintain an acceptable commute. People who have made the same commute over the past decade have noticed increased congestion as new employment and residential locations result in new trip patterns. Also, with the increased use of flex-time and the higher proportion of part-time jobs, more commute trips are being made during hours other than the traditional "rush" hours, stretching the time span of peak congestion (PSRC 1999).

### *Labor Force*

Percentage of Employed Female Civilians

- The number of employed female civilians steadily increased during the two decades.
- The proportion of employed female civilians in Spokane has been slightly higher than that of Washington State, the Puget Sound, and the national average.

**Table 10. Percentage of employed female civilians**

| | 1980 | 1990 | 2000 |
|---|---|---|---|
| U.S. | 43% | 46% | 47% |
| WA | 42% | 45% | 46% |
| Puget Sound | 42% | 45% | 46% |
| Spokane | 43% | 46% | 48% |

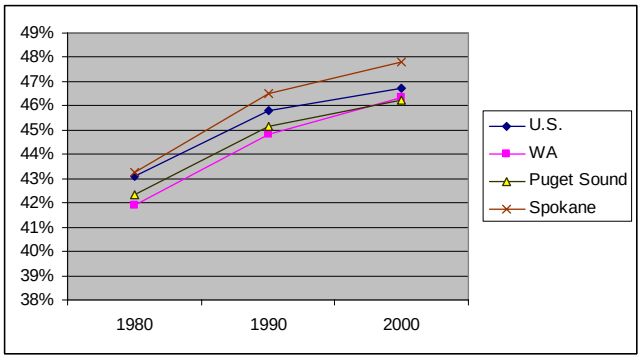



**Figure 22. Percentage of employed female civilians**

Percentage of Workers 16+ Years Old Working within Their Metro Area of Residence

**Table 11. Percentage of workers 16+ years old working within their metro area of residence**

| | 1980 | 1990 | 2000 |
|---|---|---|---|
| U.S. | 94% | 75% | 76% |
| WA | 93% | 79% | 80% |
| Puget Sound | 98% | 93% | 91% |
| Spokane | 99% | 99% | 99% |

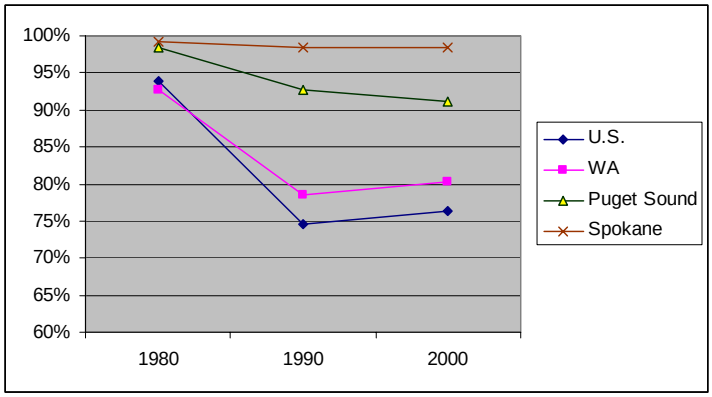



**Figure 23. Percentage of workers 16+ years old working within their metro area of residence***

* Formula: Percentage of workers 16+ years old working within their metro area of residence

$$= \frac{\text{Number of Workers 16+ years old working within their metro area of residence}}{\text{Number of Workers 16+ years old working within their state of residence}}$$

## *Socio-Demographic Factors*

Distribution of Population by Race

- The proportion of the white population in the U.S. and Washington decreased over time.
- On average, Washington State has a lower proportion of African Americans and Hispanics, and a higher proportion of American Indians and Asians, than the U.S.
- The proportion of the white population in the Puget Sound decreased over the past decades, reaching 80.1 percent in 2000.
- The ethnic composition of Spokane was relatively stable during the two decades.

**Table 12. Percentage of population distribution by race**

| | | White | Black | Am.Indian | Asian | Other | Hispanic |
|---|---|---|---|---|---|---|---|
| 1980 | U.S | 82.2% | 12.4% | 0.5% | 2.0% | 2.9% | 7.3% |
| | WA | 91.2% | 3.0% | 1.4% | 3.1% | 1.4% | 2.9% |
| | Puget Sound | 90.0% | 4.0% | 1.2% | 4.0% | 0.8% | 2.2% |
| | Spokane | 95.6% | 1.3% | 1.2% | 1.3% | 0.6% | 1.5% |
| 1990 | U.S | 80.3% | 12.0% | 0.8% | 2.9% | 3.9% | 8.8% |
| | WA | 88.6% | 3.0% | 1.7% | 4.3% | 2.3% | 4.2% |
| | Puget Sound | 86.8% | 4.6% | 1.3% | 6.3% | 1.0% | 2.8% |
| | Spokane | 94.8% | 1.4% | 1.5% | 1.8% | 0.5% | 1.6% |
| 2000 | U.S | 76.4% | 12.9% | 0.9% | 4.2% | 5.5% | 12.5% |
| | WA | 83.3% | 4.0% | 1.6% | 7.2% | 3.9% | 7.5% |
| | Puget Sound | 80.1% | 6.0% | 1.1% | 10.5% | 2.3% | 5.2% |
| | Spokane | 92.7% | 2.2% | 1.4% | 2.8% | 0.8% | 2.7% |

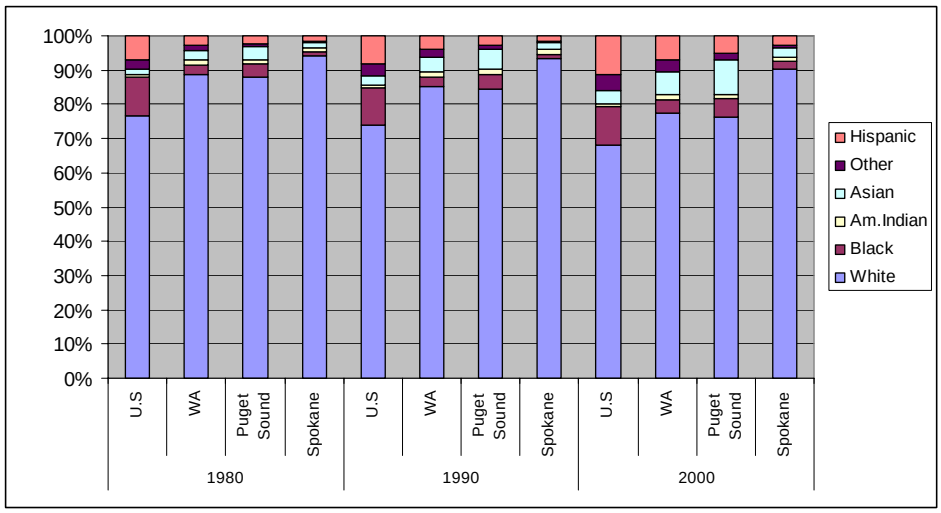



**Figure 24. Percentage of population distribution by race**

Distribution of Population by Age

- Overall, the proportion of the group 65 years and older increased slightly over the past decades.
- The 18-64 age group shows the largest increase in Puget the Sound (from 61.3 percent in 1980 to 65.2 percent in 2000).
- Spokane has the highest proportion of those 65 years and older in the state.
- The proportion of the 5-17 age group has been relatively stable over time (approximately 19 percent).

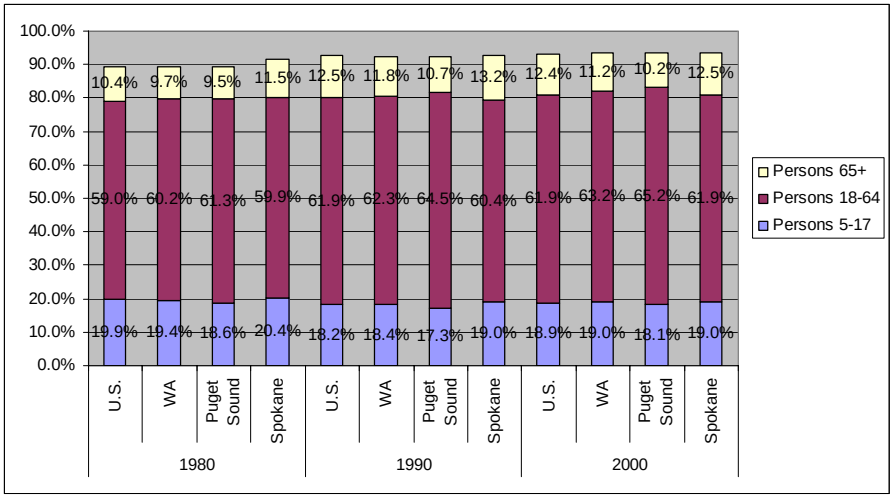



**Figure 25: Percentage of population distribution by age**

Distribution of Foreign-Born Population

- The proportion of the foreign-born population was stable between 1980 and 1990 but increased substantially between 1990 and 2000
- Washington State and Spokane have a smaller proportion of foreign-born population than the U.S.
- The foreign-born population in Puget Sound increased substantially over the last decade and was proportionally larger than that of the U.S. in 2000.

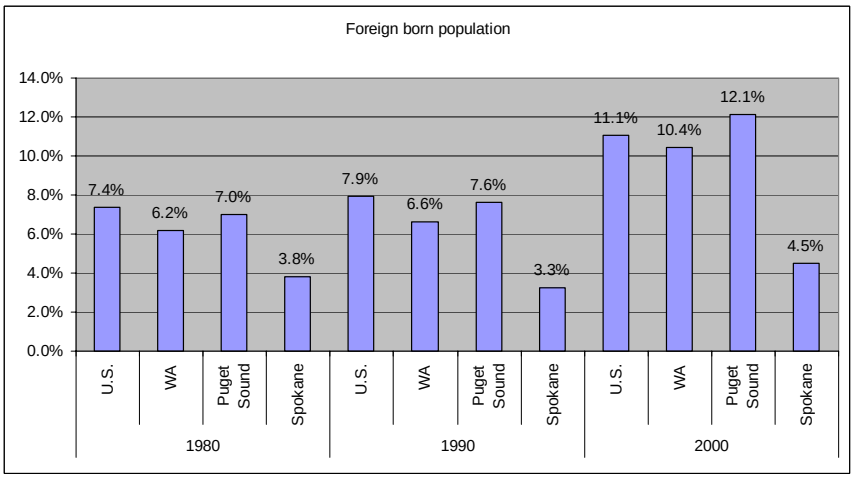



**Figure 26: Percentage of foreign-born population**

Average Family Income

- The unadjusted average income per family more than doubled over the two decades. Adjusted for inflation, family income remained similar over the same time period (see household income below).
- The average family income of Washington State is slightly higher than the national average.
- The average family income in the Puget Sound is higher than the national average.
- The average income per family in Spokane is lower than the national average.

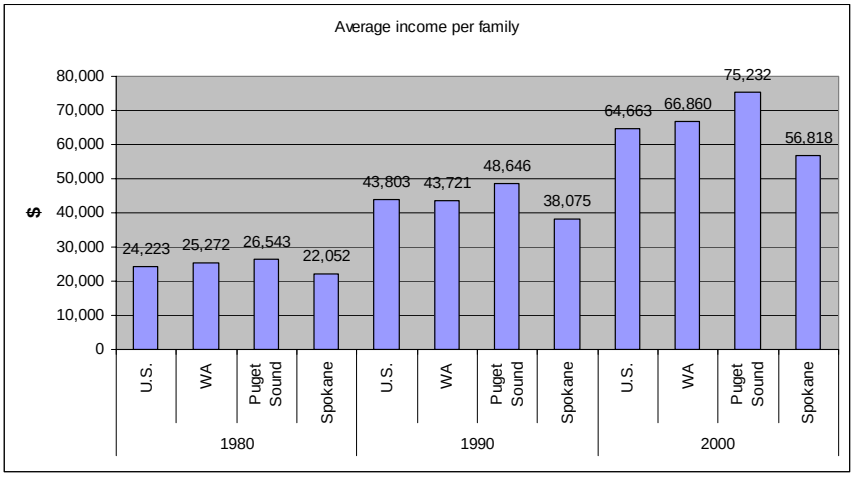
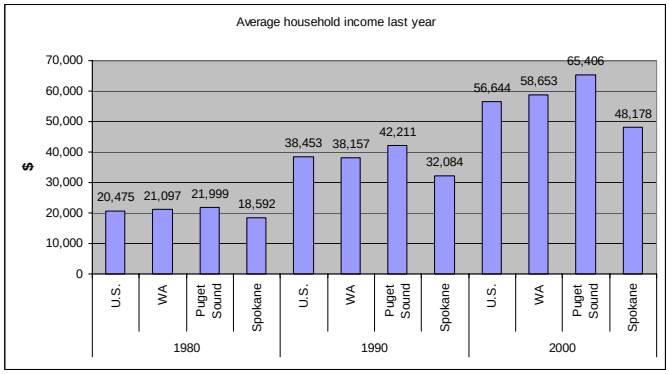



**Figure 27: Average income per family ($) (last year of decade, not adjusted)**

Average Household Income

- Trends in average household income are similar to those of average income per family.
- The average household income in Puget Sound is higher than the national average, while the average of Spokane is lower.
- The gap in average income per household widened between Puget Sound and Spokane over the last decade.



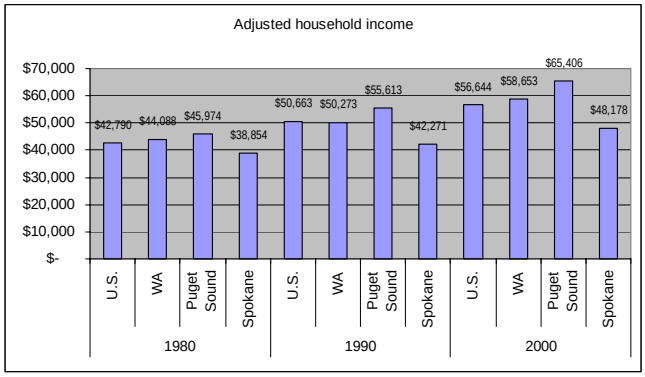




**Figure 28: Average household income ($) (last year of decade, not adjusted and adjusted to 2000 dollars based on the Consumer Price Index)**

### *Access to Private Automobiles*

Occupied Housing Units by Number of Cars

- The proportion of occupied housing units with no car available is smaller in Washington, the Puget Sound, and Spokane than the nationwide average.
- The proportion of occupied housing units with two vehicles available increased over time for all study areas. A larger proportion of people 16 years and older may have contributed to the growth in vehicles per household (PSRC, Puget Sound Trends, 1999 (The proportion of the population age 16 and older increased from 67.8 percent to 77.5 percent from 1960 to 1990 (and to 78.0 percent in 2000) as "baby boomers" ages 0-14 years in 1960 grew to 26-44 years old in 1990, and to 36-54 years old in 2000).

- The proportion of occupied housing units with two vehicles is higher in Washington, Puget Sound, and Spokane than the national average.
- The proportion of occupied housing units with three and more vehicles is higher in Washington, Puget Sound, and Spokane than the national average. It slightly decreased over time, while the nationwide average increased slightly.

**Table 13. Percentage of occupied housing units by number of cars**

| | | Occupied housing units with no car available | Occupied housing units with one vehicle available | Occupied housing units with two vehicle available | Occupied housing units with three vehicle available |
|---|---|---|---|---|---|
| 1980 | U.S | 13.6% | 36.2% | 33.5% | 16.6% |
| | WA | 9.0% | 32.7% | 34.6% | 23.8% |
| | Puget Sound | 9.6% | 33.1% | 34.3% | 23.0% |
| | Spokane | 9.8% | 33.8% | 33.8% | 22.6% |
| 1990 | U.S | 11.5% | 33.8% | 37.4% | 17.3% |
| | WA | 7.5% | 31.1% | 39.0% | 22.3% |
| | Puget Sound | 7.8% | 31.4% | 38.9% | 21.9% |
| | Spokane | 9.4% | 32.6% | 37.6% | 20.4% |
| 2000 | U.S | 10.3% | 34.2% | 38.4% | 17.1% |
| | WA | 7.4% | 31.7% | 39.4% | 21.5% |
| | Puget Sound | 7.9% | 33.0% | 39.0% | 20.1% |
| | Spokane | 8.8% | 32.7% | 38.6% | 19.9% |

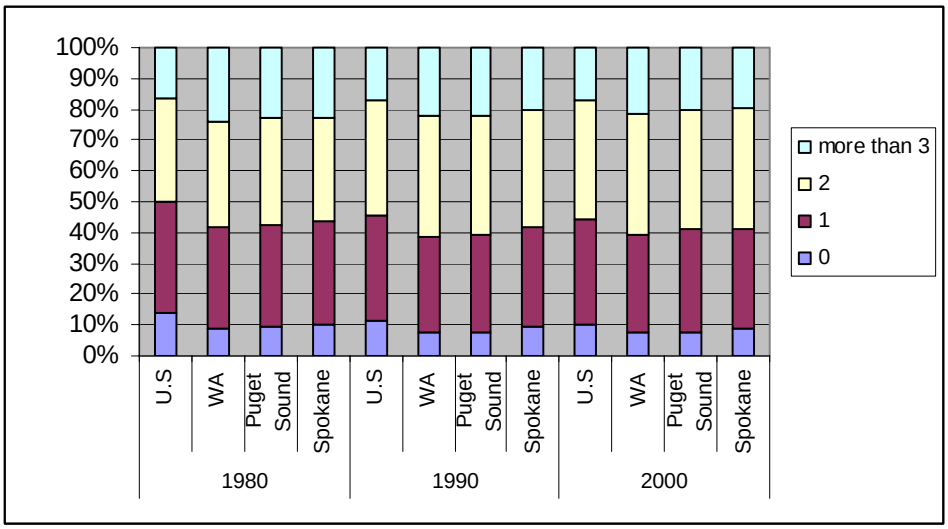



**Figure 29: Percentage of occupied housing units by number of cars**

Percentage of Occupied Housing Units with at Least One Car

- The percentage of housing units with at least one car is higher in Washington, Puget Sound, and Spokane than the national average.
- The percentage of housing units with at least one car increased over time in all study areas.

**Table 14. Percentage of occupied housing units with at least one car**

| | 1980 | 1990 | 2000 |
|---|---|---|---|
| U.S | 86% | 88% | 90% |
| WA | 91% | 92% | 93% |
| Puget Sound | 90% | 92% | 92% |
| Spokane | 90% | 91% | 91% |

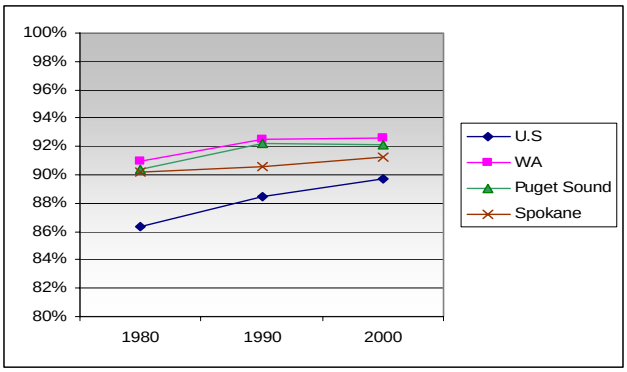



**Figure 30: Percentage of occupied housing units with at least one car**

Distribution of Households with No Car by Race

- In Washington State and the Puget Sound, the proportion of people of color with no car is higher relative to that of the population nationwide; it is similar in Spokane
- The proportion of people of color with no car increased slightly over time in Washington State
- In the Puget Sound and in Spokane, the proportion of people of color with no car decreased between 1980 and 1990 (likely an income effect) but increased between 1990 and 2000 (likely a population effect).

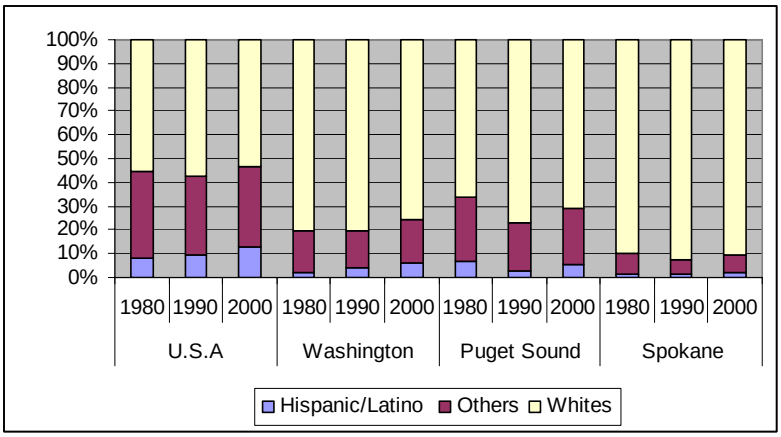



**Figure 31: Hispanic, white, and other households with no car available**

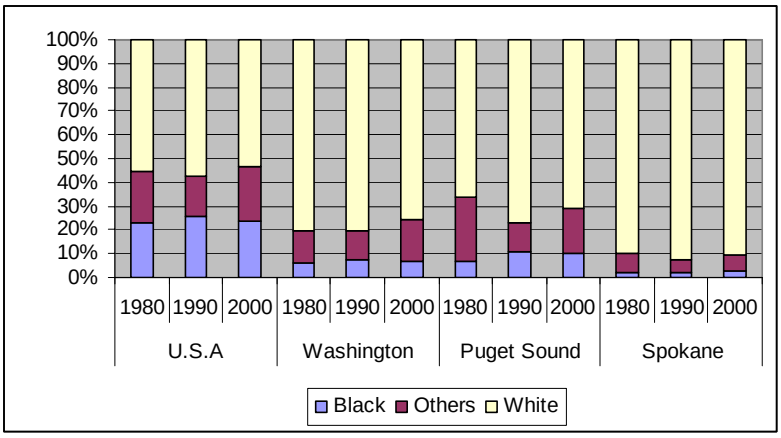



**Figure 32: Black, white, and other households with no car available**

Proportion of Households with No Car by Race

- Access to a private vehicle for African American and Hispanic households appear to be lower than that of other ethnic groups.[1] The proportion of African American and Hispanic households with no car available is disproportionately higher than that population in the entire population.
- The proportion of households with no vehicle available for other ethnic groups appears to correspond to that of the population.

[1] The lack of data makes it difficult to compare the proportion of household by ethnic groups with the proportion of households with no vehicle by race because data for the number of households by race are not available.

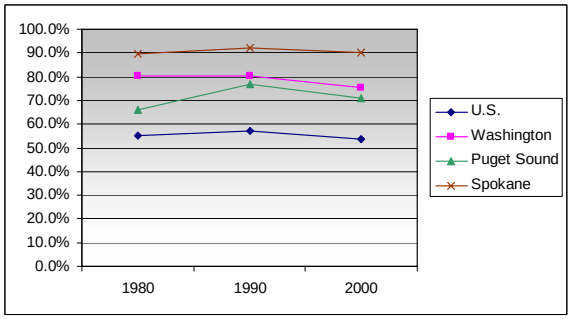



**Figure 33: Proportion of white households among the households with no car available (%)**

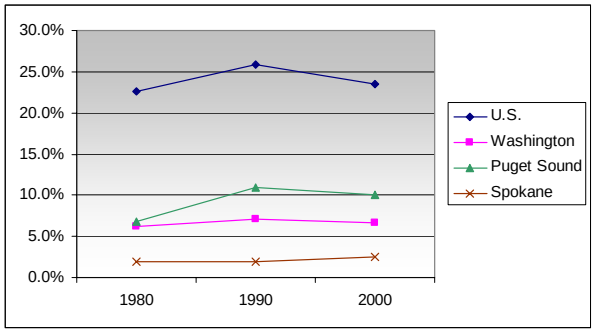



**Figure 34: Proportion of black households among households with no car available (%)**

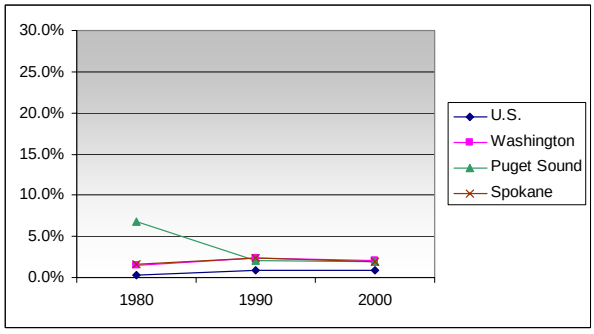



**Figure 35: Proportion of American Indian households among households with no car available (%)**

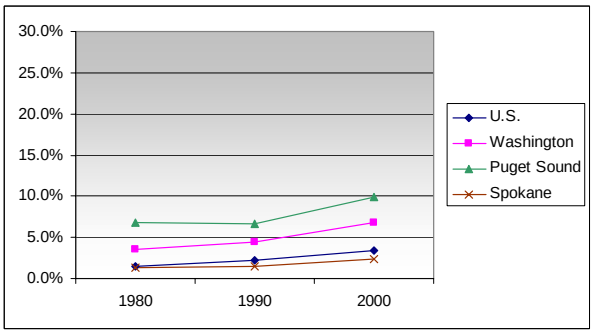



**Figure 36: Proportion of Asian, Native Hawaiian and other Pacific Islander households among households with no car available (%)**

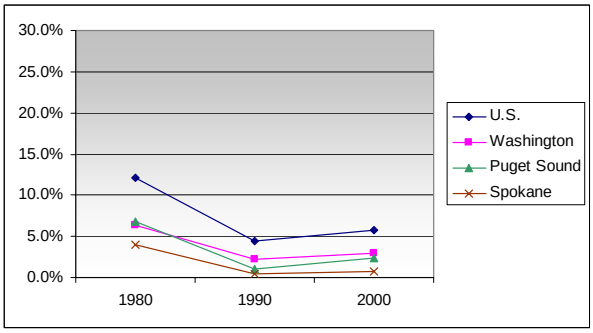



**Figure 37: Proportion of other race households among households with no car available**

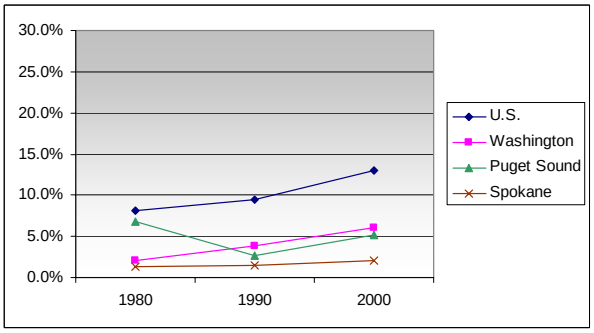



**Figure 38: Proportion of Hispanic/Latino households among households with no car available**

## CONCLUSIONS

In comparison to those of the nation, travel indictors for Washington State do not generally raise "red" flags that are specific to the state. No indicator strongly suggests conditions in the state, whether socio-demographic or related to urban development, that are extreme enough to make the state stand out in the national context. For example, even though car ownership remains comparatively high in the state, it does not seem to translate into higher statewide VMT. One the other hand, the state does show a modest increase in the use of public transit, which is at odds with the nation's drop in public transit ridership between 1990 and 2000. The increase in public transit use comes primarily from the Puget Sound region. This and other statistics point to the different transportation "markets" in the state.

Two factors prime in their association with travel demand: household income and development density. This consistently strong association between income, residential density, and travel (VMT and car ownership) may explain the leveling of demand for car travel reported by Todd Litman (2005). Litman argues that in the early part of the 21st century, the slowing of the economy has dampened travel demand, as has continued increases in populations living in denser metropolitan areas. Future demand for travel will likely increase if the economy improves, but it could remain stable if development density continues to increase.

Socio-demographic factors continue to show that income and wealth are associated with higher demand for automobile transportation. As a result, monitoring increases in income and wealth should be an important tool for identifying growth in future demand for transportation.

Land-use factors also reflect demand for transportation. Residential and population densities matter, as they are positively associated with demand for modes other than single-occupancy vehicle travel. Living in more compact residential areas and in housing types such as row and town houses, and renting versus owning a home, also relate to lower demand for single-occupancy vehicle travel. As a result, continuing to work with growth management laws and programs in the state will be important for keeping track of, and attempting to stay ahead of, travel demand in the state.

The data used in this project were limited in that, being at the national level, they aggregated and eventually averaged out what are reasonably different situations not only within the country but within each state. In Washington State, differences in travel demand even between the Puget Sound and other parts of Western Washington remain wide ranging. Yet the study shows that, even at the aggregate level of national data, the Spokane region's transportation context has differed, and likely will continue to differ, from that of the Puget Sound. The more rural communities of the state have yet again different conditions, created by specific socio-demographic and land-use factors. Hence, state policies should recognize at least three different markets for transportation, which are found in rural, small town, and metropolitan areas.

Overall, Washington State should keep abreast of transportation issues raised at the national level: Pisarski (2002b) showed that while household formation is slowing down, growth in car ownership among new immigrants and the working poor will continue to exert pressure on transportation demand. Washington State will not be immune to these trends, as its immigrant population is growing, albeit at a slower pace than in other states of the nation. Pisarski also pointed to the effects of metropolitan development on transportation, as 80 percent of the population now lives in metropolitan regions. Land-use policies and transportation systems investments in densely populated areas will affect future travel behavior.

Both Pisarski and Litman suggested that the beginning of the 21st century is a turning point in transportation. In his analysis of travel and demographic changes between 2000 and 2004, Litman (2005) pointed to the fact that the aging population will drive less (those 65 years old and above drove 6000 miles per year in 2003, versus more than 12,000 miles for those between the ages of 25 and 54). He also indicated that the proportion of 17-year-olds licensed to drive has declined from 52 percent in 1992 to 43 percent in 2002.

In conclusion, the state needs to stay tuned to national projections about the possible impacts of population and immigration changes, as well as the impacts of economic trends. It must also rethink its policies in terms of how they might affect local situations because in transportation, "one size" often does *not* "fit all."

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