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## Mobility and Accessibility of Hispanics in Small Towns and Rural Areas

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# **Mobility and Accessibility of Hispanics in Small Towns and Rural Areas**

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## List of Abbreviations

National Household Travel Survey (NHTS)

American Community Survey (ACS)

Ordinary least square (OLS)

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## Abstract

The Hispanic population has increased 43% (from 35.3 million to 50.5 million) in the 2000s in the U.S. Small towns and rural areas in the U.S. are among the areas that have experienced rapid growth in the Hispanic immigrant population in the last decade. This paper aims to understand whether Hispanics have the same transportation mobility as other race/ethnicity groups, particularly when they are immigrants and/or live in rural areas. In addition, the author examines the mobility experience of more recent Hispanic immigrants, as well as Hispanic females in general. Using the National Household Travel Survey (NHTS) data for 2009, this paper investigates the following aspects of transportation mobility for the study population: (1) vehicle availability, (2) driving mileage, and (3) native/immigrant and gender disparity in mobility. Compared to other populations, Hispanics generally face more mobility challenges, and the situation is severer for Hispanic immigrants and Hispanics in rural areas. In addition, recent immigrants and females are having more difficulties within the Hispanic immigrant population, whether in rural or urban areas. Despite the mobility limitation suggested by the data, public transit ridership by rural Hispanics is known to be lower than that of rural non-Hispanic minorities. A possible explanation for this disparity is that Hispanics may face language barriers in using public transit systems. The findings also suggest that rural Hispanics, especially immigrants, need more support to satisfy their accessibility needs.

## Chapter 1 Introduction

The transportation behavior of Hispanics, particularly for those who live in small town and rural areas, warrants research attention. Hispanics are now the largest minority group in the U.S. (16.4% in the 2010 census), and the socioeconomic status of Hispanics in small town and rural areas raise concerns about mobility and accessibility issues.

### 1.1 Hispanic Population Growth in Small Town and Rural Areas

Hispanics are the largest minority group in the U.S. and their population is rapidly growing with 43% growth between 2000 and 2010 (from 35.3 million to 50.5 million individuals), and the rapid growth of the Hispanic population raises the proportion of the Hispanic population from 12.6% to 16.3%. In particular, small towns and rural areas in the U.S., including those outside the southwest, have experienced rapid growth in Hispanic populations since the 1990s [1]. Comparing censuses 2000 and 2010, the rapid Hispanic population growth does not always take place in traditionally Hispanic-concentrated urban states, such as California, Texas, and Florida. Although these three states remain the top three in absolute growth, the growth rate of Hispanics is not so exponential, particularly compared to the general population growth. Other relatively rural states in the southeast and midwest (e.g., North and South Carolina, Tennessee, Oklahoma, and Iowa) experienced a high growth rate of Hispanics (Table 0.1). In 2000, the Hispanic population share was only 2 to 5% in the southeast and midwest states, but because of the relative growth of Hispanics, the share has doubled in these states.

**Table 0.1** Hispanic population growth between 2000 and 2010 by state

STATE	Hispanic Population		2010	Share	Net Growth	Growth Rate (%)
	2000	Share				
<b>Top 15 in growth rate</b>						
South Carolina	95,076	2.4%	235,682	5.1%	140,606	147.9%
Alabama	75,830	1.7%	185,602	3.9%	109,772	144.8%
Tennessee	123,838	2.2%	290,059	4.6%	166,221	134.2%
Kentucky	59,939	1.5%	132,836	3.1%	72,897	121.6%
Arkansas	86,866	3.2%	186,050	6.4%	99,184	114.2%
North Carolina	378,963	4.7%	800,120	8.4%	421,157	111.1%
Maryland	227,916	4.3%	470,632	8.2%	242,716	106.5%
Mississippi	39,569	1.4%	81,481	2.7%	41,912	105.9%
Delaware	37,277	4.8%	73,221	8.2%	35,944	96.4%
Georgia	435,227	5.3%	853,689	8.8%	418,462	96.1%
Virginia	329,540	4.7%	631,825	7.9%	302,285	91.7%
Oklahoma	179,304	5.2%	332,007	8.9%	152,703	85.2%
Iowa	82,473	2.8%	151,544	5.0%	69,071	83.7%
Pennsylvania	394,088	3.2%	719,660	5.7%	325,572	82.6%
Nevada	393,970	19.7%	716,501	26.5%	322,531	81.9%
<b>Top 5 in absolute growth</b>						
California	10,966,556	32.4%	14,013,719	37.6%	3,047,163	27.8%
Texas	6,669,666	32.0%	9,460,921	37.6%	2,791,255	41.8%
Florida	2,682,715	16.8%	4,223,806	22.5%	1,541,091	57.4%
Arizona	1,295,617	25.3%	1,895,149	29.6%	599,532	46.3%
New York	2,867,583	15.1%	3,416,922	17.6%	549,339	19.2%

Data: Census 2000 and 2010

The socioeconomic status of rural Hispanics raises concerns about their accessibility. People in rural areas usually suffer from low accessibility and high auto dependency [2, 3], particularly for access to healthcare services and healthy food [4-6]. Moreover, inaccessibility becomes even worse when people are in a low-mobility status because of low-income or socio-cultural barriers in receiving assistance. Table 0.2 illustrates income, educational attainment, and English proficiency of Hispanics based on the American Community Survey 2006–2010 (ACS 2006-2010) and the National Household Travel Survey data of year 2009 (NHTS 2009).

Compared to non-Hispanic whites, Hispanics are generally receive lower income and have lower educational attainment. Moreover, many foreign-born Hispanics are not fluent in English, which adds additional difficulties in earning higher income and obtaining information. Thus, they may have more difficulties in affording the costs of private autos and in utilizing publicly provided transportation services.

**Table 0.2** Income, educational attainment, and English skills of Hispanics

Median HH Income	U.S.		Non-Hisp White		Hispanic		
ACS 2006-2010	\$52,029		\$56,826		\$41,470		
NHTS 2009	\$50,000 - \$54,999		\$55,000-59,999		\$35,000-39,999		
Educ. Attainment	U.S.		Non-Hisp White		Hispanic		
(ACS 2006-2010)	Male	Female	Male	Female	Male	Female	
HS Grad	84.4%	85.6%	89.6%	90.3%	59.9%	63.2%	
Bachelor or higher	28.5%	27.3%	32.2%	29.7%	12.1%	14.0%	
English Level Less than Very Good						Hispanic	
(ACS 2006-2010)						Native	Foreign Born
						13.0%	69.5%

### 1.2 Mobility of Hispanics

As the difference in language skill shows, the mobility and accessibility concern may be different for native U.S. Hispanics and Hispanic immigrants. The travel behavior of immigrants in general is known to be different from that of U.S. born people, and differences also exist among immigrants of different origins [7, 8]. Chatman and Klein [7] and Tal and Handy [8] find that, compared to non-immigrants, immigrants are more likely to use public transit, particularly within the first few years of their residence in the U.S. Moreover, travel behavior differs among immigrants of different origins [8]. Hispanics are known to carpool more than other race/ethnicity groups, sometimes in the form of informal transit services [9, 10].

More detailed stories behind the difference is interesting and suggests potential issues that the Hispanic population may be facing. Bohon, Stamps, and Atilas [11] conducted focus group interviews of urban and rural Hispanic immigrants in Georgia and found that Hispanic immigrants do not find the commute of the households' primary workers to be a problem because of employer-provided commuter bus services. Yet, they suffer from schedule inflexibility and the financial costs of car sharing for non-work trips. More seriously, the non-primary workforce in the household, who are more likely to be females, face difficulty in reaching out for education, training, jobs, and public support because of transportation barriers. The difficulties in reaching for education opportunities and public support make it more difficult for Hispanic female immigrants to adapt to the life in the U.S., and add more difficulties to obtaining jobs and improving their quality of life.

The ACS data confirms the findings (Table 0.3). Despite the high foreign born share and low language proficiency, the unemployment rate of Hispanic males is non-Hispanic whites. However, the unemployment rate of Hispanic females is as high as another large minority group, African Americans (Black or African American single race, does not exclude Hispanic origin). The gap is large in southeast states and in some midwest states.

In sum, the lack of sufficient transportation is a barrier for Hispanic immigrants because it limits job choices, particularly for females, forces them to remain in residential locations that may not be satisfactory or meet their needs, and reduces access to welfare services, education, and training.

**Table 0.3** Unemployment rate by race/ethnicity groups by gender, particularly for states where unemployment rate for Hispanic females is higher than that of males by 2% or greater

State	Non-Hispanic Whites		Black/Afro Americans		Hispanics	
	Male	Female	Male	Female	Male	Female
Alabama	6.44%	6.78%	15.48%	13.92%	7.63%	11.13%
Arkansas	6.69%	6.17%	17.23%	13.58%	6.37%	9.58%
Georgia	6.64%	6.47%	14.77%	12.78%	6.70%	12.40%
Indiana	7.89%	6.86%	18.53%	15.21%	9.98%	12.67%
Kentucky	8.14%	6.99%	15.14%	13.78%	7.74%	13.48%
Louisiana	5.34%	5.12%	14.99%	12.01%	6.58%	8.73%
Maryland	5.09%	4.42%	11.87%	8.74%	6.74%	8.98%
Mississippi	6.18%	6.34%	17.23%	14.48%	6.84%	12.39%
Missouri	6.78%	5.69%	18.95%	14.02%	7.79%	10.48%
New Hampshire	5.98%	5.26%	8.97%	9.59%	8.72%	14.06%
North Carolina	7.25%	6.67%	15.54%	12.80%	8.24%	13.98%
North Dakota	3.23%	2.76%	14.06%	8.22%	6.33%	9.04%
Ohio	8.12%	6.66%	19.94%	15.02%	10.83%	12.86%
Oklahoma	5.42%	4.91%	11.91%	11.20%	5.53%	7.97%
South Carolina	6.87%	7.11%	16.60%	13.40%	8.57%	13.35%
Tennessee	7.51%	7.15%	16.38%	13.59%	6.84%	12.08%
Wyoming	3.97%	4.06%	14.96%	4.31%	5.09%	8.63%
US Average	6.94%	6.01%	15.51%	12.66%	8.97%	10.46%

Source: American Community Survey, 2010

### 1.3 Research Objectives and Design

Despite numerous previous studies on mobility and accessibility issues, the literature is not clear whether people in rural areas face different mobility and accessibility challenges from those in urban areas, and whether the recent rapid increase of Hispanic populations in rural areas raises unique concerns about their accessibility issues. Thus, it is important to know more about how recent Hispanics in rural areas are surviving their low-accessibility environment and whether the mobility limitation is more severe for immigrants or specific gender groups.

Using the NHTS 2009, this paper investigates mobility and accessibility challenges that Hispanics are facing. Specifically explored are the challenges of Hispanics, including

immigrants, females, and rural populations, in vehicle ownership and driver status, and the driving mileage of households and individual drivers are examined.

The analysis finds that mobility of Hispanics may be limited through owning vehicles and becoming a driver, which is found to be different from the potential mobility issues for Blacks. Hispanic households, particularly low-income or immigrant households, tend to own fewer vehicles than non-Hispanic/non-Black households. However, they seem to carpool and rely on driving because their household driving mileage is comparable to non-Hispanic/non-Black households. At an individual level, Hispanic females and immigrants may suffer from lower mobility because they appear to have barriers in becoming drivers. The gender gap in the probability of being a driver is particularly large for Hispanics, but when Hispanic females are drivers, the gender difference in personal driving mileage is not significantly different from other race/ethnicity groups. The trend is consistent for Hispanic females and Hispanic immigrants in rural areas, which raises a concern about their mobility. A low probability of being a driver and a smaller number of vehicles per household are less problematic when there are sufficient alternative modes of transportation; however, that is unlikely to be true for rural locales. Even if alternative modes of transportation exist, such as public transit, Hispanic immigrants are unlikely to maximize their use of these services because of the language barrier. The finding suggests that there may be serious mobility and accessibility concerns for Hispanics, particularly females and immigrants, in rural areas.

## Chapter 2 Data and Factors Examined

### 2.1 National Household Travel Survey Data

The NHTS data is constructed from randomized landline telephone surveys to civilian, non-institutionalized populations in the U.S. Cell phone numbers are reached as a trial in the NHTS 2009 but are not included in the dataset. This survey is conducted both in English and Spanish to gather data from the Hispanic population; however, the telephone landline-only survey method may bias the sample. It is well established that the population characteristics of people reached in phone surveys differ depending on whether the survey is conducted by landline or through cell phones [12]. Hispanics are more likely to use cell phones only, and thus, be reached through cell phone surveys [13, 14]. Moreover, immigrants are less likely to participate in general surveys because of language barriers, fears of revealing illegal immigration status if such status exists, and other factors. The under-representation of immigrants in the NHTS is already confirmed in the previous NHTS data collections [8].



**Table 2.1** Income distribution of the observations in the NHTS 2009 and ACS 2006-2010

	<i>Hispanics</i>				<i>Non-Hispanic Whites</i>			
	<i>NHTS 2009</i>		<i>ACS 2006-2010</i>		<i>NHTS 2009</i>		<i>ACS 2006-2010</i>	
	<i>Count</i>	<i>%</i>	<i>Count</i>	<i>%</i>	<i>Count</i>	<i>%</i>	<i>Count</i>	<i>%</i>
Less than \$10,000	1239	12.9%	1,092,351	8.5%	4847	4.3%	4,671,466	5.75%
\$10,000-\$14,999	852	8.9%	831,275	6.5%	5445	4.8%	4,023,557	4.95%
\$15,000-\$19,999	879	9.2%	887,278	6.9%	6151	5.4%	3,938,504	4.85%
\$20,000-\$24,999	576	6.0%	918,720	7.1%	5354	4.7%	4,074,667	5.02%
\$25,000-\$29,999	810	8.4%	864,071	6.7%	7744	6.8%	3,959,646	4.87%
\$30,000-\$34,999	422	4.4%	846,716	6.6%	4558	4.0%	4,097,478	5.04%
\$35,000-\$39,999	667	7.0%	760,502	5.9%	7517	6.6%	3,827,540	4.71%
\$40,000-\$44,999	265	2.8%	725,445	5.6%	3829	3.4%	3,912,159	4.82%
\$45,000-\$49,999	508	5.3%	626,437	4.9%	7420	6.5%	3,497,868	4.31%
\$50,000-\$59,999	616	6.4%	1,115,556	8.7%	10065	8.9%	6,795,305	8.36%
\$60,000-\$75,000	622	6.5%	1,275,406	9.9%	10879	9.6%	8,695,741	10.70%
\$75,000-\$99,999	922	9.6%	1,322,543	10.3%	16200	14.2%	10,742,677	13.22%
\$100,000 or More	1212	12.6%	1,605,309	12.5%	23705	20.8%	18,998,981	23.39%

Despite its potential weakness in data collection, the NHTS captures large numbers of low-income Hispanic households. Table 2.1 compares the household income distribution of Hispanics in the NHTS 2009 and the ACS 2006-2010. The NHTS appears to capture more low-income Hispanic households with an annual income of \$15,000 or less than the ACS does, while Hispanic households in the middle-income range of \$30,000 to \$75,000 are not well represented in the NHTS.

## 2.2 Groups of Interest and Their Definitions

The following analysis of the NHTS data considers three different groups: Hispanics, Blacks, and non-Hispanic/non-Blacks. The majority of the non-Hispanic/non-Black population are non-Hispanic Whites. Technically, people and households are categorized as Hispanics when they respond “yes” to Hispanic status of the household respondent, or “Hispanic/Mexican” to the race of the household respondent. Blacks are categorized as those who are not considered to be

Hispanic based on the previous criteria and respond that they are African American/Black. As Table 2.2 shows, 10,251 households out of 148,586 households (6.9%) and 18,310 adults out of 254,737 adults (7.2%, considers the population 18-years-old or older) are Hispanics. Blacks take the share of 6.1% of households and 5.5% of adults, and the remainder 87% of households and adults are non-Hispanic/non-Blacks.

The difference between urban and rural areas is another research interest in this paper. The author considers that a household is in a rural area if the NHTS variable of URBANSIZE is 6, that is, “not in an urbanized area”. Within the data of the NHTS, 57,440 households out of 148,586 households (38.7%) and 100,108 adults out of 254,737 adults (39.3%) are residing in rural areas.

**Table 2.2** The number of observations in the NHTS 2009 by race/ethnicity group, by gender, and by residential area

	Total	Non-Hisp Non-Blacks		Hispanics		Non-Hispanic Blacks	
<b>Total</b>							
Household	148,586	129,250	87.0%	10,251	6.9%	9,085	6.1%
Person	254,737	222,399	87.3%	18,310	7.2%	14,028	5.5%
Male	115,059	101,552	88.3%	8,160	7.1%	5,347	4.6%
Female	139,678	120,847	86.5%	10,150	7.3%	8,681	6.2%
<b>Urban</b>							
Household	91,146	76,348	83.8%	8,090	8.9%	6,708	7.4%
Person	154,719	129,941	84.0%	14,488	9.4%	10,290	6.7%
Male	69,164	58,834	85.1%	6,419	9.3%	3,911	5.7%
Female	85,555	71,107	83.1%	8,069	9.4%	6,379	7.5%
<b>Rural</b>							
Household	57,440	52,902	92.1%	2,161	3.8%	2,377	4.1%
Person	100,018	92,458	92.4%	3,822	3.8%	3,738	3.7%
Male	45,895	42,718	93.1%	1,741	3.8%	1,436	3.1%
Female	54,123	49,740	91.9%	2,081	3.8%	2,302	4.3%

Excluding commercial drivers is important in assessing the NHTS data. Although occupation data of the respondents are not available in the dataset, this paper tries to exclude commercial drivers by removing high-vehicle households or high-mileage drivers based on the following criteria. At the household level analysis, 28 households (0.00019%) that each own ten or more automobiles (excluding motorcycles and golf carts) are removed. All 28 of these households are households with four or fewer adults, which indicates that not all vehicles are owned or operated for daily use. Other households excluded are 926 households (0.62% of observation) that own at least one vehicle that is driven more than 80,000 miles per year. At the person-level analysis, the analysis excludes people who are younger than 18 years old or were out of town or out of the country on the date of the survey. In addition, 852 adult drivers who drive extremely long distances (annual driving mileage best estimate higher than 80,000 miles) are excluded.

In the analysis of vehicle ownership, the number of automobiles (cars, SUVs, vans, RVs, and trucks) is employed. Motorcycles and golf carts are removed from the count. While motorcycles and golf carts may be an important mode of transportation for some people, their role in daily life appears to be considerably different from the role of automobiles.

### 2.3 Socioeconomic Factors Examined

Various socioeconomic and demographic factors of households and individuals are examined in this research. Household level socioeconomic characteristics considered in the analyses are: household income, the number of adults in the household, life cycle of the household, and immigration status of the household. For household income, the mid-point value of the household family income category is used. For example, \$7,500 is the mid-point value if the household is in the annual income category of \$5,000 to \$9,999. The definition of adult

follows the definition in the NHTS dataset, namely, a person who is at least 18 years old. The lifecycle of the household is examined by whether the household is a single-adult household, whether the household has at least one child, or whether the household is a retired-adult household.

Immigration status is examined at the household level and individual level. Individual-level immigration status is straightforward: whether the person is an immigrant and if the person is an immigrant, how long has he/she stayed in the U.S. At the household-level analysis, household immigration status is controlled at two levels, depending on the number of immigrants per household: (1) an immigrant household dummy variable, which is one for households with at least one adult immigrant and zero otherwise and (2) an all-immigrant household dummy variable, which is one when all the adults in the household are immigrants and zero when there is at least one non-immigrant adult in the household. For all-immigrant households, the length of stay in the U.S. is also controlled. For the length of stay in the U.S. at a household-level, the length of stay in the U.S. of an adult member in the household who stays in the U.S. the longest within the household is employed. For example, if a household consists of two adult immigrants and one stays in the U.S. for 5 years and the other stays in the U.S. for 10 years, 10 years is employed as the length of stay in the U.S. at the household-level.

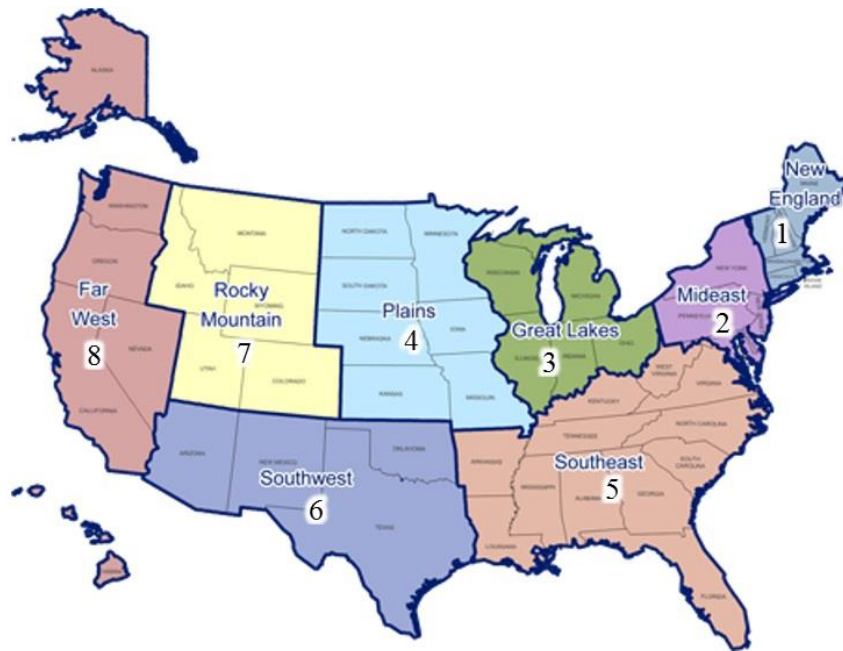
The race/ethnicity group is categorized based on the race/ethnicity group of the household respondent, following the NHTS data. The race/ethnicity data of individual members in the household is not available in the NHTS.

Besides socioeconomic characteristics, the population density of the household residential area and whether their metropolitan area has passenger rail services is considered. Population density of the household residential area is taken from the NHTS 2009 data of

population density per square mile at tract level (HTPPOPD). The data records the census tract level of population density around the respondents' residential area based on seven categories, and takes the mid-point of the range as the representative density of the category. The existence of rail service is recorded as the RAIL variable, which is 1 if the metropolitan statistical area in which the respondent resides has passenger rail service, and 0 otherwise.

At the individual level, gender (FEMALE, 1 if female and 0 if male) and age (AGE) are considered in addition to socioeconomic and environment characteristics considered in the household level analysis. The age of a person is assessed with a quadratic term of age to account for potential non-linear relationships. In the analysis, people under 18 year olds are excluded from the data because not all of the states allow people under 18 to obtain a driver's license.

Lastly, regional fixed effects are also controlled using the Bureau of Economic Analysis regions (BEA regions). BEA divides the U.S. states into eight regions based on geographic area (Figure 2.1). The regional fixed effects are expected to capture unobservable regional characteristics that affect travel behavior such as culture and climate.



**Figure 2.1** BEA Region

### Chapter 3 Mobility of Hispanic Households

This chapter explores the mobility status of Hispanics at the household level, specifically, the number of vehicles per household and the driving mileage per household. Table 3.1 illustrates the average number of vehicles per household, the average household vehicle mileage, and socioeconomic factors of each race/ethnicity group in urban and rural areas.

**Table 3.1** Summary statistics of household-level factors examined

	Non-Hisp/Non-Black		Hispanic		Non-Hisp Black	
	Urban	Rural	Urban	Rural	Urban	Rural
Avg. Number of Vehicles per Household	1.963	2.274	1.806	2.017	1.549	1.825
Avg. Household Vehicle Mile	20,530	24,843	21,866	23,644	18,917	22,455
Avg. HH Family Income	72,681	61,866	50,217	48,886	46,955	38,866
Avg. Number of Adults per Household	1.860	1.903	2.134	2.093	1.792	1.822
Avg. Population Density per Sq.Mile	4,368	633	7,925	1,230	6,297	707
Immigrant Household (%)	11.4%	5.2%	55.8%	41.2%	9.4%	4.2%
All Immigrant Household (%)	4.4%	1.4%	25.0%	16.6%	4.3%	1.6%

Basically, households in rural areas own more vehicles and drive more, which is intuitive considering the low density of development. The number of vehicles owned is largest for non-Hispanic/non-Black households and smallest for Blacks, and Hispanics are in-between. The same trend is observed for driving mileage, however, Hispanics in urban areas drive more than non-Hispanic/non-Blacks in urban areas.

With regard to socioeconomic factors, household income is higher in urban areas for all the race/ethnicity groups, the highest for non-Hispanic/non-Blacks, followed by Hispanics, and the lowest for Blacks. The average number of adults in a household is around two, and the number is slightly higher for Hispanic households. The average population density of the residential areas is very high for Hispanics in urban and rural areas, compared to other

race/ethnicity group counterparts. Lastly, the fraction of immigrants are substantially higher for Hispanic households than households of other race/ethnicity groups.

### 3.1 Household Vehicle Ownership

Household vehicle ownership is assessed using the socioeconomic factors. Two comparison analyses were conducted: an inter-race/ethnicity group comparison in urban and rural areas and an urban-rural comparison for each race/ethnicity group. For both analyses, the Poisson model (equation 3.1) is employed to assess the number of household vehicles. The dependent variable is a countable non-negative value including many zeros in observations, which is known to follow Poisson distribution.

$$y = \exp(\beta X + \varepsilon) \tag{3.1}$$

The first analysis completed is the assessment of inter-race/ethnicity group differences in urban and rural areas. The observations are divided by whether their residential areas are in urbanized areas, and the regression analysis is conducted for each group. Socioeconomic characteristics listed in section 2.3 and their cross-terms with race/ethnicity groups (Hispanics and Blacks) are examined.

The results are shown in Table 3.2. The table summarizes results of two regressions, one for an urban area and one for a rural area. The first column of each result shows coefficients of factors, and the second and third columns display coefficients of cross-terms between socioeconomic factors and Hispanic or Black dummy variables.

In an urban area, the coefficients of the base case (the first column of the table, which is for non-Hispanic/non-Black) show that the number of vehicles per household increases and



diminishes with an increase in income. The number of adults per household is also positively associated with the number of vehicle owned by a household, but the rate of increase is less than proportional. Immigrant households own a smaller number of vehicles per household, and the number is even smaller when all the adults of the household are immigrants. Within the all-immigrant households, the number of vehicles per household is smaller for more recent immigrant households. In other words, immigrants increase the number of vehicles per household as they stay longer in the U.S. The lifecycle of the household affects the number of vehicles owned by the household. Having at least one child is associated with a larger number of vehicles per household, while retired households tend to own a smaller number of vehicles. Population density and the existence of railroad within the metropolitan area also affects the number of vehicles per household. People tend to own fewer vehicles per household when the population density of the residential area is higher and when the metropolitan area they reside in has a railroad. Lastly, the vehicle ownership is different by BEA regions, and the lowest is in Region 2 where the New York metropolitan area exists.

The associations between socioeconomic characteristics and the number of vehicles per household are slightly different for Hispanics and Blacks. Hispanics and Blacks seem to carpool more than Non-Hispanic/Non-Blacks. The cross-terms of race/ethnicity groups and the number of adults per household are negative and significant, namely, the degree of increase in the number of vehicles associated with the number of adults is smaller than that of the non-Hispanic/non-Black population.

With regard to immigration status, cross-terms are mostly positive and insignificant with the exception of Hispanic immigrant households who stay in the U.S. 10 to 15 years. As non-Hispanic/non-Black households, immigrant households own fewer vehicles, and the number of

vehicles increases as they stay longer. However, for Hispanic households, the increase in the length of stay between 5 to 10 years to 10 to 15 years is slower than that of non-Hispanic/non-Blacks households.

**Table 3.2** Household vehicle ownership by race/ethnicity group for urban and rural areas

Dependent Variable: The Number of Vehicles per Household						
	Urban			Rural		
	Base	Hisp	Black	Base	Hisp	Black
Dummy		-0.379 (0.726)	-0.494 (0.871)		0.00704 (1.079)	0.351 (1.096)
ln(HH Family Income)	0.607*** (0.0522)	0.0255 (0.136)	0.0212 (0.164)	0.600*** (0.0540)	-0.0730 (0.207)	-0.144 (0.213)
ln(HH Family Income) <sup>2</sup>	-0.0209*** (0.00240)	0.00167 (0.00639)	0.00526 (0.00772)	-0.0210*** (0.00252)	0.00501 (0.00988)	0.0111 (0.0103)
ln(Num Adult)	0.716*** (0.00866)	-0.0517** (0.0230)	-0.205*** (0.0329)	0.657*** (0.0109)	0.00804 (0.0496)	-0.125** (0.0604)
Flag Immigrant HH	-0.0292*** (0.00585)	0.0125 (0.0141)	0.0213 (0.0277)	-0.0520*** (0.00975)	-0.0321 (0.0268)	-0.0971* (0.0506)
Flag All Immigrant HH	-0.0763*** (0.00898)	0.0133 (0.0180)	-0.0298 (0.0411)	-0.0481** (0.0192)	0.0293 (0.0355)	0.0353 (0.0701)
Immigrant 10 to 15	-0.0555*** (0.0159)	-0.0634** (0.0296)	0.0717 (0.0811)	-0.0865*** (0.0261)	-0.00969 (0.0488)	-0.228 (0.169)
Immigrant 5 to 10	-0.129*** (0.0200)	-0.00416 (0.0341)	0.110 (0.0728)	-0.0458 (0.0447)	-0.0992 (0.0670)	-0.0689 (0.122)
Immigrant 0 to 5	-0.221*** (0.0276)	0.0216 (0.0580)	0.118 (0.0996)	-0.131*** (0.0489)	0.0692 (0.106)	-0.791*** (0.0687)
One Adult Household	-0.0376*** (0.00798)	-0.0416 (0.0262)	-0.153*** (0.0300)	-0.0384*** (0.0104)	0.0623 (0.0513)	-0.132** (0.0547)
HH with Child	0.0221*** (0.00401)	-0.00138 (0.0136)	0.0288* (0.0173)	0.0109** (0.00505)	-0.0105 (0.0248)	-0.00967 (0.0280)
Retired Adult HH	-0.0978*** (0.00403)	-0.00734 (0.0167)	0.0911*** (0.0185)	-0.0967*** (0.00484)	0.0620** (0.0311)	-0.00427 (0.0291)
ln(Pop Density)	-0.0504*** (0.00162)	-0.00886* (0.00526)	-0.0349*** (0.00702)	-0.0470*** (0.00148)	0.0224*** (0.00645)	-5.69e-06 (0.00844)
Rail	-0.0238*** (0.00445)	-0.0408*** (0.0124)	-0.0435** (0.0174)	-0.00662 (0.00799)	-0.0651* (0.0344)	-0.148*** (0.0454)
BEA Region 2				-0.0111 (0.0114)		
BEA Region 3				0.0993*** (0.0126)		
BEA Region 4				0.139*** (0.0125)		
BEA Region 5				0.0952*** (0.0105)		
BEA Region 6				0.0388*** (0.0110)		
BEA Region 7				0.228*** (0.0221)		
BEA Region 8				0.120*** (0.0127)		
Constant	-3.521*** (0.284)			-3.397*** (0.290)		
Observations	83,420			53,135		
Log pseudolikelihood	-115772.03			-79316.381		
Pseudo R2	0.0913			0.076		

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Lifecycle effects on vehicle ownership for Hispanic households is not significantly different from that for non-Hispanic/non-Black households, while the effects for Black households are different from that for non-Hispanic/non-Black households. One-adult Black households tend to own much fewer vehicles than multi-adult counterparts, and the difference is significantly greater than the difference in non-Hispanic/non-Black households. In contrast, the coefficient of the cross-term of a retired adult household and a Black household cancel out the retired adult household coefficient, that is, retired Black households own a comparable number of vehicles to their working counterparts.

Hispanic and Black households appear to take advantage of a high-density urban environment and rail service than non-Hispanic/non-Blacks. These minority households, particularly Black households, tend to own fewer vehicles when they reside in high-density areas, and the rate of decrease is greater than non-Hispanic/non-Black counterparts. The same trend is observed when the metropolitan area has rail service. The rate of decrease in the number of vehicles per household when the metropolitan area has rail service is greater for these minority households.

In rural areas, essentially the same associations between socioeconomic factors and the number of vehicles per household are observed for non-Hispanic/non-Black households. The number of vehicles per household increases with the number of adults in the household, but less than proportionally. Immigrant households own fewer vehicles, and the number of vehicles is smaller for recent immigrants. One-adult households and retired adult households tend to own fewer vehicles, while households with children own more vehicles. Households in high-density areas own fewer vehicles.

Hispanic households in rural areas basically show similar characteristics as non-Hispanic/non-Black households in rural areas. An insignificant cross-term with the number of adults in a household suggests that the carpooling trend of rural Hispanic households is not significantly different from that of rural non-Hispanic/non-Black households. Immigrants tend to own fewer vehicles, and the differences from non-immigrant counterparts is not significantly different from those of non-Hispanic/non-Black households. A few differences observed from non-Hispanic/non-Black households are the effects of the household's lifecycle and residential environment. With regard to lifecycle effects on vehicle ownership, the number of vehicles owned by rural retired Hispanic households are not significantly different from that of working Hispanic household counterparts. Density effects on vehicle ownership is weaker for rural Hispanic households than rural non-Hispanic/non-Black households, which is the opposite of the finding for urban Hispanics.

In contrast to rural Hispanic households, rural Black households still show a stronger carpooling trend than non-Hispanic/non-Black counterparts. Moreover, rural Black immigrant households own significantly fewer vehicles per household than non-immigrant counterparts, and the difference is significantly greater than the difference for non-Hispanic/non-Black households. As observed in urban areas, rail effect is significantly stronger for Blacks in rural areas than non-Hispanic/non-Black counterparts. However, unlike in urban areas, the population density effect for Black households is similar to non-Hispanic/non-Black households.

**Table 3.3** The number of vehicles per household in urban and rural areas for three race/ethnicity groups

Dependent Variable: The Number of Vehicles per Household						
	Non-Hisp Non-Blk		Hispanic		Black	
	Base	Rural	Base	Rural	Base	Rural
Dummy		0.0622 (0.406)		0.470 (1.238)		0.894 (1.339)
ln(HH Family Income)	0.598*** (0.0523)	0.0125 (0.0752)	0.610*** (0.126)	-0.101 (0.236)	0.607*** (0.155)	-0.140 (0.258)
ln(HH Family Income) <sup>2</sup>	-0.0204*** (0.00240)	-0.00106 (0.00348)	-0.0181*** (0.00591)	0.00309 (0.0113)	-0.0145** (0.00732)	0.00417 (0.0124)
ln(Num Adult)	0.716*** (0.00865)	-0.0590*** (0.0139)	0.664*** (0.0213)	0.0108 (0.0531)	0.511*** (0.0316)	0.0180 (0.0673)
Flag Immigrant HH	-0.0276*** (0.00584)	-0.0263** (0.0113)	-0.0153 (0.0130)	-0.0682** (0.0282)	-0.00722 (0.0270)	-0.126** (0.0589)
Flag All Immigrant HH	-0.0757*** (0.00899)	0.0266 (0.0212)	-0.0637*** (0.0156)	0.0428 (0.0336)	-0.0986** (0.0401)	0.0691 (0.0800)
Immigrant 10 to 15	-0.0550*** (0.0159)	-0.0319 (0.0306)	-0.119*** (0.0248)	0.0266 (0.0477)	0.0219 (0.0783)	-0.289 (0.188)
Immigrant 5 to 10	-0.129*** (0.0200)	0.0819* (0.0490)	-0.133*** (0.0275)	-0.000960 (0.0562)	-0.0109 (0.0705)	-0.0847 (0.133)
Immigrant 0 to 5	-0.219*** (0.0275)	0.0884 (0.0560)	-0.194*** (0.0505)	0.130 (0.106)	-0.121 (0.0929)	-0.821*** (0.106)
One Adult Household	-0.0373*** (0.00798)	-0.00110 (0.0131)	-0.0738*** (0.0248)	0.111** (0.0559)	-0.188*** (0.0288)	0.0165 (0.0609)
HH with Child	0.0219*** (0.00401)	-0.0110* (0.00645)	0.0210 (0.0130)	-0.0251 (0.0275)	0.0497*** (0.0169)	-0.0482 (0.0323)
Retired Adult HH	-0.0974*** (0.00403)	-0.000166 (0.00629)	-0.105*** (0.0162)	0.0735** (0.0348)	-0.00690 (0.0180)	-0.0923*** (0.0339)
ln(Pop Density)	-0.0480*** (0.00160)	0.000475 (0.00217)	-0.0588*** (0.00514)	0.0346*** (0.00809)	-0.0735*** (0.00720)	0.0295*** (0.0109)
Rail	-0.0311*** (0.00431)	0.0279*** (0.00866)	-0.0419*** (0.0135)	0.0381 (0.0351)	-0.0384** (0.0190)	-0.0593 (0.0487)
BEA Region 2	-0.0215** (0.00876)		-0.253*** (0.0941)		-0.311*** (0.115)	
BEA Region 3	0.0889*** (0.00956)		0.0738 (0.0965)		-0.0390 (0.117)	
BEA Region 4	0.132*** (0.00955)		0.0798 (0.0995)		-0.183 (0.124)	
BEA Region 5	0.0897*** (0.00824)		0.0415 (0.0908)		-0.00854 (0.113)	
BEA Region 6	0.0566*** (0.00853)		0.0442 (0.0908)		-0.0538 (0.114)	
BEA Region 7	0.211*** (0.0165)		0.194* (0.115)		0.00883 (0.161)	
BEA Region 8	0.135*** (0.00885)		0.0983 (0.0908)		0.0145 (0.114)	
Constant	-3.503*** (0.284)		-3.764*** (0.671)		-3.902*** (0.827)	
Observations	118,669		9,530		8,356	
Log pseudolikelihood	-170652.5		-13252.707		-11169.606	
Pseudo R2	0.0824		0.1011		0.1288	

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The next analysis is the assessment of urban-rural differences for each race/ethnicity group. The observations are divided by race/ethnicity group, and the same regression analysis is conducted for each group. Since previous assessment has already covered inter-race/ethnicity group comparison within urban and rural areas, this analysis focuses on the interpretation of rural cross-terms.

In Table 3.3, rural dummy variables for three race/ethnicity groups are all insignificant; however, those of Hispanic and Black households are much larger in magnitude than those of non-Hispanic/non-Black households, and they are insignificant because of the large standard errors. Cross-terms with income are all insignificant, which suggests that income effects on the number of vehicles owned by a household are not significantly different within each race/ethnicity group, regardless of whether they live in urban or rural areas. The increase in the number of vehicles per household associated with the number of adults in a household is smaller in rural areas for non-Hispanic/non-Black households, while it is not significantly different between urban and rural areas for the other two groups.

Immigrant households, particularly all-immigrant households, tend to own fewer vehicles, and the difference between immigrants and non-immigrants is greater in rural areas than in urban areas. The urban-rural difference in the immigrant-non-immigrant difference is greater for Hispanics than non-Hispanic/non-Blacks, and the greatest for Blacks.

Urban-rural differences in the lifecycle effects are also different among race/ethnicity groups. One-adult households tend to own fewer vehicles per household than what is estimated by other terms, including the natural log of the number of adults in the household, and the effect is not different between urban and rural areas for non-Hispanic/non-Black households and Black households. For rural Hispanic households, the coefficient of the cross-term cancels out the

coefficient of one-adult households, suggesting that the one-adult household effect is not observed for rural Hispanic households. Urban households with children tend to own more vehicles than those without children, but the effect is weaker or insignificant in rural areas for all race/ethnicity groups. Retired households in urban areas tend to own fewer vehicles than working adult households, and the effect for rural non-Hispanic/non-Black households is not significantly different from that for urban counterparts. The urban-rural difference in the effect is greater for rural Black households than the difference for non-Hispanic/non-Black households. However, the difference between retired and working households are insignificant for rural Hispanic households.

The effects of a residential environment are also different between urban and rural areas, and the differences vary among race/ethnicity groups. A rural cross-term with population density is insignificant and very small in magnitude for non-Hispanic/non-Black households, suggesting that the density effect for rural non-Hispanic/non-Black households are not significantly different from that of urban counterparts. The density cross-terms with Hispanic and Black are positive and significant but smaller in magnitude than the density coefficient. That is, the density effect still exists, but it is weaker for rural Hispanic and rural Black households than urban counterparts. The rural cross-terms with rail service are positive and significant for non-Hispanic/non-Black households and positive but insignificant for Hispanic households. These cross-term coefficients are comparable in magnitude to the coefficients of rail dummy variables, suggesting that the rail effect becomes insignificant in rural areas.



### 3.2 Driving Mileage per Household

The driving mileage of households is assessed to capture travel behavior. In this case, the natural log of the household's best mile estimate is assessed with an ordinary least square (OLS) model, using socioeconomic and demographic factors examined earlier for household vehicles. The analysis is again done in two stages, first to compare among race/ethnicity groups in urban areas and those in rural areas, and then to compare urban-rural differences for each race/ethnicity group.

As observed in the household vehicle ownership analysis, socioeconomic factors affect household vehicle mileage (Table 3.4). For non-Hispanic/non-Black households in urban areas, the household driving mileage increases with the household family income. The driving mileage also increases with the number of adults in a household, but less than proportionally. Urban non-Hispanic/non-Black immigrant households tend to drive shorter than non-immigrant counterparts, and the driving mileage is even shorter when all the adult members of the household are immigrants. Among all-immigrant households, recent immigrant households drive much less than immigrant households who stay longer in the U.S. One-adult households tend to drive shorter than what is estimated based on other coefficients including the number of adults per household. The households with children tend to drive more than those without children, and retired households tend to drive less than working-adult households. Households in high population density areas and those in metropolitan areas with rail service tend to have a shorter driving mileage. Doubling population density is associated with 6.6% less driving mileage. Regional variation is also observed in driving mileage.

**Table 3.4** Household vehicle mileage by race/ethnicity groups in urban and rural areas

Dependent Variable: ln(HH Vehicle Mileage)						
	Urban			Rural		
	Base	Hisp	Black	Base	Hisp	Black
Dummy		1.215 (1.069)	2.999*** (1.100)		-1.436 (1.835)	5.669*** (1.642)
ln(HH Family Income)	-0.171** (0.0800)	-0.283 (0.204)	-0.642*** (0.212)	0.257*** (0.0877)	0.223 (0.353)	-1.146*** (0.319)
ln(HH Family Income) <sup>2</sup>	0.0207*** (0.00370)	0.0151 (0.00969)	0.0350*** (0.0103)	0.00183 (0.00409)	-0.0102 (0.0170)	0.0587*** (0.0155)
ln(Num Adult)	0.820*** (0.0151)	0.0166 (0.0421)	-0.261*** (0.0567)	0.791*** (0.0172)	-0.0924 (0.0782)	-0.196* (0.114)
Flag Immigrant HH	-0.0453*** (0.0108)	0.0257 (0.0271)	-0.0259 (0.0530)	-0.0199 (0.0150)	-0.0494 (0.0486)	-0.142* (0.0826)
Flag All Immigrant HH	-0.0408** (0.0182)	0.0751** (0.0353)	0.173** (0.0717)	-0.0792** (0.0340)	0.135* (0.0725)	0.237 (0.167)
Immigrant 10 to 15	-0.0651** (0.0324)	-0.0406 (0.0573)	0.102 (0.136)	-0.0869** (0.0432)	-0.0583 (0.106)	0.456** (0.204)
Immigrant 5 to 10	-0.165*** (0.0365)	0.0877 (0.0617)	0.105 (0.133)	-0.155*** (0.0542)	0.000935 (0.116)	0.234 (0.248)
Immigrant 0 to 5	-0.338*** (0.0479)	0.160 (0.144)	0.262* (0.139)	-0.289*** (0.0805)	0.327** (0.152)	1.147*** (0.114)
One Adult Household	-0.0992*** (0.0142)	0.174*** (0.0490)	-0.0292 (0.0511)	-0.0934*** (0.0169)	0.0766 (0.0873)	-0.0152 (0.100)
HH with Child	0.147*** (0.00677)	-0.0293 (0.0262)	0.0481 (0.0305)	0.138*** (0.00774)	-0.0207 (0.0448)	-0.0920* (0.0481)
Retired Adult HH	-0.371*** (0.00779)	0.0296 (0.0337)	0.164*** (0.0338)	-0.330*** (0.00848)	0.0813 (0.0588)	-0.0297 (0.0520)
ln(Pop Density)	-0.0665*** (0.00310)	0.00353 (0.0105)	-0.0108 (0.0130)	-0.0715*** (0.00272)	0.0331** (0.0131)	-0.00406 (0.0157)
Rail	-0.0255*** (0.00842)	-0.000332 (0.0236)	-0.0300 (0.0310)	-0.0276** (0.0139)	-0.0495 (0.0687)	-0.108 (0.0733)
BEA Region 2	-0.0543** (0.0245)			-0.0611*** (0.0192)		
BEA Region 3	0.0670** (0.0266)			0.0413** (0.0210)		
BEA Region 4	0.0565** (0.0264)			0.0452** (0.0208)		
BEA Region 5	0.0814*** (0.0236)			0.0631*** (0.0175)		
BEA Region 6	0.0638*** (0.0242)			0.0379** (0.0187)		
BEA Region 7	0.0157 (0.0409)			0.0412 (0.0324)		
BEA Region 8	0.0659*** (0.0240)			-0.0239 (0.0211)		
Constant	9.126*** (0.432)			6.860*** (0.471)		
Observations	78,125			51,229		
R-squared	0.345			0.359		

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

With regard to urban Hispanic households, the Hispanic dummy variable, cross-terms with family income factors, and the number of adults cross-term are insignificant. Considering that the cross-term of Hispanics and the number of adults is negative and significant for the number of vehicles per household (Table 3.2), urban Hispanic households with many adults drive as much as non-Hispanic/non-Black households with many adults, without increasing the number of vehicles at the same pace. Therefore, urban Hispanic households with many adults seem to do more carpooling than non-Hispanic/non-Black counterparts.

The driving mileage of urban Hispanic immigrant households does not seem to be significantly different from non-immigrant counterparts. Although cross-terms of immigration status and Hispanics are mostly insignificant, they are positive and have comparable magnitude as the coefficients of immigration status. Considering the cross-terms with the coefficients of immigration status together, the difference between immigrant and non-immigrant Hispanic households appears to be insignificant.

The number of vehicles owned by urban Hispanic households tends to decrease more rapidly with an increase in population density and with the existence of rail service than that of urban non-Hispanic/non-Black households, but the decrease in driving mileage per household does not seem to be significantly different from that of non-Hispanic/non-Black households. The cross-term coefficients of density and rail service are both insignificant and small in magnitude, while corresponding coefficients in the analysis of the number of vehicles per household are negative and significant (Table 3.2).

With regard to Black households, the dummy variable as well as the cross-terms with income factors and the number of adults are significant. Urban Black households tend to increase driving mileage more rapidly with income than non-Hispanic/non-Black counterparts. Unlike

urban Hispanic households, the increase in the household driving mileage associated with the number of adults in a household is smaller for urban Black households than non-Hispanic/non-Black counterparts.

The findings about Black immigrant households are similar to Hispanic immigrant households. Cross-terms with immigration status are mostly positive and comparable in magnitude as the base coefficients, but insignificant because of relatively large standard errors. That is, the driving mileage of Black immigrant households is not significantly shorter than non-immigrant counterparts, and the trend holds for recent immigrants as well.

The association between the household driving mileage and the socioeconomic factors are basically the same for rural non-Hispanic/non-Black households as urban ones. Some coefficients, such as that of the quadratic term of household family income and immigrant households are insignificant, but they are in the same sign and similar magnitude as those coefficients in urban areas.

Most cross-terms with Hispanics are insignificant because of the large standard errors. The Hispanic dummy variable is insignificant, but it is negative in rural areas, which is opposite to urban areas. The same findings apply to the cross-term with the number of adults in a household; although the cross-terms are both insignificant in urban and rural areas, they are in opposite signs. The effects of immigration status for rural Hispanic households are insignificant because some cross-terms are positive and significant and cancel out the baseline coefficients, and because others have large standard errors. Similar to urban areas, the difference in driving mileage between rural Hispanic immigrant households and that of non-immigrant counterparts is insignificant. Last, the density effect is weaker for rural Hispanics than rural non-Hispanic/non-Blacks.

The associations between socioeconomic factors and driving mileage for rural Black households seem to be significantly different from those of non-Hispanic/non-Black households. As found in urban areas, the Black dummy variable is positive and significant and large in magnitude. The cross-terms with income factors, the number of adults, and immigration status are significant as well. Income effects on driving mileage is more substantial to rural Black households than non-Hispanic/non-Black counterparts. Black households tend not to increase fewer driving mileage with the increase in the number of adults in a household than non-Hispanic/non-Black counterparts. Interestingly, cross-terms with immigrant status are mostly significant, negative for immigrant households, and positive for all others. Black immigrant households tend to drive less than non-immigrant counterparts. However, recent Black immigrants tend to drive more than Black immigrants who stay longer in the U.S.

The urban-rural differences for each race/ethnicity group is examined in Table 3.5. A very interesting and puzzling finding in the table is the negative and significant rural dummy variables for non-Hispanic/non-Black and Hispanic households. As Table 3.1 shows, the household vehicle mileage is greater in rural areas, which is likely to result in positive and significant coefficients for rural dummy variables. Table 3.6 explores a source of this negative and significant coefficient using calculated coefficients and average characteristics of households in each category.

**Table 3.5** Household vehicle mileage in urban and rural areas for each race/ethnicity group

Dependent Variable: ln(HH Vehicle Mileage)	Non-Hisp Non-Blk		Hispanic		Black	
	Base	Rural	Base	Rural	Base	Rural
	Dummy		-2.317*** (0.638)		-4.813** (2.023)	
ln(HH Family Income)	-0.178** (0.0799)	0.438*** (0.119)	-0.462** (0.187)	0.908** (0.389)	-0.807*** (0.196)	-0.0751 (0.364)
ln(HH Family Income) <sup>2</sup>	0.0211*** (0.00370)	-0.0194*** (0.00551)	0.0362*** (0.00896)	-0.0429** (0.0187)	0.0557*** (0.00956)	0.00461 (0.0178)
ln(Num Adult)	0.821*** (0.0151)	-0.0302 (0.0229)	0.837*** (0.0392)	-0.146* (0.0860)	0.558*** (0.0543)	0.0385 (0.125)
Flag Immigrant HH	-0.0434*** (0.0108)	0.0206 (0.0184)	-0.0204 (0.0250)	-0.0562 (0.0524)	-0.0752 (0.0512)	-0.0613 (0.0962)
Flag All Immigrant HH	-0.0406** (0.0182)	-0.0393 (0.0386)	0.0341 (0.0303)	0.0184 (0.0708)	0.142** (0.0685)	-0.00801 (0.177)
Immigrant 10 to 15	-0.0652** (0.0325)	-0.0197 (0.0541)	-0.105** (0.0471)	-0.0344 (0.107)	0.0265 (0.126)	0.356 (0.237)
Immigrant 5 to 10	-0.165*** (0.0365)	0.0121 (0.0653)	-0.0774 (0.0497)	-0.0717 (0.115)	-0.0618 (0.129)	0.160 (0.270)
Immigrant 0 to 5	-0.338*** (0.0479)	0.0512 (0.0937)	-0.179 (0.136)	0.224 (0.188)	-0.103 (0.131)	0.933*** (0.155)
One Adult Household	-0.0981*** (0.0142)	0.00354 (0.0221)	0.0760 (0.0467)	-0.0954 (0.0977)	-0.127*** (0.0489)	0.0202 (0.110)
HH with Child	0.147*** (0.00678)	-0.00926 (0.0103)	0.117*** (0.0254)	-0.00575 (0.0509)	0.193*** (0.0296)	-0.149*** (0.0559)
Retired Adult HH	-0.370*** (0.00778)	0.0401*** (0.0115)	-0.341*** (0.0327)	0.0933 (0.0670)	-0.206*** (0.0328)	-0.151** (0.0609)
ln(Pop Density)	-0.0644*** (0.00305)	-0.00756* (0.00407)	-0.0640*** (0.0103)	0.0246 (0.0164)	-0.0649*** (0.0133)	-0.00691 (0.0202)
Rail	-0.0231*** (0.00812)	-0.0105 (0.0153)	-0.0264 (0.0255)	-0.0454 (0.0711)	0.00363 (0.0331)	-0.0618 (0.0775)
BEA Region 2	-0.0519*** (0.0152)		-0.214 (0.132)		-0.386** (0.161)	
BEA Region 3	0.0568*** (0.0167)		0.0463 (0.142)		-0.212 (0.163)	
BEA Region 4	0.0516*** (0.0164)		-0.0717 (0.141)		-0.166 (0.169)	
BEA Region 5	0.0699*** (0.0142)		5.51e-05 (0.127)		-0.0369 (0.154)	
BEA Region 6	0.0496*** (0.0149)		-0.0242 (0.127)		-0.0543 (0.155)	
BEA Region 7	0.0357 (0.0257)		-0.191 (0.202)		-0.154 (0.261)	
BEA Region 8	0.0351** (0.0153)		-0.00681 (0.127)		-0.107 (0.157)	
Constant	9.159*** (0.432)		10.47*** (0.986)		12.12*** (1.020)	
Observations	113,950		8,491		6,913	
R-squared	0.369		0.269		0.295	

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 3.6** Comparison of household vehicle mileage and socioeconomic factors of households in urban and rural areas for each race/ethnicity group

	Non-Hisp/Non-Black		Hispanic		Non-Hisp Black	
	Urban	Rural	Urban	Rural	Urban	Rural
Avg. Household Vehicle Mile	20,530	24,843	21,866	23,644	18,917	22,455
Natural log of Avg. Household Vehicle Mile	9.930	10.120	9.993	10.071	9.848	10.019
Rural Dummy Variable Coefficient in Table 3.5		-2.317***		-4.813***		0.455
Avg. Population Density per Sq.Mile	4,368	633	7,925	1,230	6,297	707
Calculated Density Term Using Coefficients in Table 3.5 and Avg. Population Density	-0.540	-0.464	-0.575	-0.280	-0.568	-0.471
Avg. Number of Adults	1.860	1.903	2.134	2.093	1.792	1.822
Calculated HH Size Term Using Coefficients in Table 3.5 and Avg. Number of Adults	0.510	0.509	0.634	0.510	0.325	0.358
Avg. HH Family Income	72,681	61,866	50,217	48,886	46,955	38,866
Calculated Income Term Using Coefficients in Table 3.5 and Avg. HH Family Income	0.651	3.075	-0.759	4.034	-2.236	-2.587
Immigrant Household (%)	11.4%	5.2%	55.8%	41.2%	9.4%	4.2%
All Immigrant Household (%)	4.4%	1.4%	25.0%	16.6%	4.3%	1.6%

The first source of difference one might think of is the difference in population density between urban and rural areas. However, when the average density and the calculated coefficients are used to calculate the density term of the regression, the term is smaller in urban areas than in rural areas. Another potential source of difference one might think of is the difference in the average household size, but the calculation result suggests that this is not the source of the negative coefficient of the rural dummy variable, either.

The most likely source of the counter-intuitive coefficient of the rural dummy variable is the difference in income terms. As shown in table 3.6, the income term calculated using the coefficients and the average household income are substantially different. The quadratic function applied to urban and rural areas seems to request adjustment in a constant term, which results in the negative and significant coefficient in the rural dummy variable.

In addition to the differences in the income curve, the difference in proportion of immigrants seems to explain the shorter driving mileage in urban areas, despite the negative coefficient of the rural dummy variable. The fraction of immigrant households is higher in urban areas for all the race/ethnicity groups, and as Table 3.5 explains, the coefficients of immigrants tend to be negative, although some of them are insignificant because of relatively standard errors.

Other than the rural dummy variables and income cross-terms, most cross-term coefficients are significant in Table 3.5, particularly for non-Hispanic/non-Black and Hispanic households. Higher density population areas tend to be associated with an even further decline in driving mileage for rural non-Hispanic/non-Blacks than that of urban counterparts. Retired non-Hispanic/non-Black households in rural areas tend to drive as much as working adult households in rural areas, because the cross-term cancels out the coefficient of the retired household dummy variable.

For Hispanics, the increase in driving mileage of rural Hispanic households associated with the increase in the number of adults in the household is smaller than urban counterparts. Other cross-terms are mostly insignificant because of a large standard error. With regard to Blacks, one of the significant differences between households in urban and rural areas is the high driving mileage of recent immigrants in rural areas. As a previous analysis of Table 3.4 reveals, the rural Black cross-term with an immigrant household staying in the U.S. less than 5 years is positive and significant and very large in magnitude. Considering the magnitude of related coefficients, rural Black immigrant households staying in the U.S. less than 5 years surprisingly drive longer than those staying in the U.S. more than 15 years, and even longer than non-immigrant households. Lifecycle effects on household driving mileage is also different between urban and rural areas for Black households. In rural areas, the household driving mileage does



not significantly increase with having children in a household, and the driving mileage decreases substantially with retirement.

## Chapter 4 Mobility Challenges of Individual Hispanics

This chapter explores the individual level of mobility through driver status and personal driving mileage. Individual level mobility can be very different from household level characteristics, especially when there is age/gender differences in mobility. Particularly for immigrants, the first hurdle in extending personal mobility is becoming a driver. After becoming a driver, their physical, cultural, social, and financial circumstances influence their comfort level in driving and having a vehicle available for occasions.

**Table 4.1** Descriptive statistics of individual mobility

	Non-Hisp/Non-Black		Hispanic		Non-Hisp Black	
	Urban	Rural	Urban	Rural	Urban	Rural
Proportion of Drivers (%)						
Male	95.4%	96.0%	90.9%	91.9%	86.9%	85.9%
Female	91.8%	93.5%	76.6%	81.5%	79.7%	81.2%
Avg. Personal Vehicle Mile of Driving Drivers						
Male	13,203	15,686	12,573	14,552	12,035	13,879
Female	9,144	10,919	9,474	11,036	9,312	10,219
Avg. HH Family Income	77,456	65,312	59,675	56,118	58,786	46,904
Avg. Number of Adults per Household	2.090	2.106	2.434	2.320	2.073	2.079
Avg. Population Density per Sq.Mile	4,282	621	7,818	1,250	6,131	679
Females in Data (%)	54.7%	53.8%	55.7%	54.4%	62.0%	61.6%
Immigrants (%)	8.8%	3.5%	47.5%	35.5%	8.1%	3.5%

As **Table 4.1** illustrates, there is a gender gap in the probability of being a driver and driving mileage, particularly for Hispanics and Blacks. It is still unclear, however, whether this difference comes from a difference in the socioeconomic status of females from their male counterparts. In the remainder of Chapter 4, regression analysis is conducted to examine the probability of being a driver and personal driving mileage.

#### 4.1 Driver Status

This section explores whether driver status is different among race/ethnicity groups. A Logit regression is conducted to examine the driver status of individuals, using gender, age, and immigration statuses of individuals, as well as several socioeconomic and environmental factors examined earlier. As in Chapter 3, the first analysis is conducted to explore variation between race/ethnicity groups in urban and rural areas, and the second analysis compares differences between urban and rural areas for each race/ethnicity group. Again, the first column of each regression result shows the baseline coefficients, and the second and third columns shows a list of cross-term coefficients.

Table 4.2 explores the differences in the probability of being a driver among three race/ethnicity groups. The first finding about the urban non-Hispanic/non-Blacks is that there is a significant gender gap in being a driver. Female non-Hispanic/non-Blacks in urban areas are significantly less likely to be a driver than their male counterparts. The age of a person also affects the probability of being a driver; the probability is lower for younger and older generations and the highest around the late forties. With regard to personal immigration status in the probability of being a driver for urban non-Hispanic/non-Blacks, immigrants are significantly less likely to be a driver than non-immigrant counterparts, and more recent immigrants are significantly less likely to be a driver than those who stay in the U.S. longer.

**Table 4.2** Probability of being a driver for each race/ethnicity group in urban and rural areas

Dependent Variable: Driver (1 if a person is a driver, 0 otherwise)						
	Urban			Rural		
	Base	Hisp	Black	Base	Hisp	Black
Dummy		17.53*** (2.801)	7.616*** (2.749)		13.70** (5.444)	7.295 (4.637)
Female	-0.567*** (0.0286)	-0.658*** (0.0676)	0.162** (0.0747)	-0.506*** (0.0361)	-0.648*** (0.135)	0.352*** (0.114)
Age	0.177*** (0.00387)	-0.0496*** (0.00936)	-0.0404*** (0.0101)	0.188*** (0.00494)	-0.0388** (0.0184)	-0.0509*** (0.0171)
Age^2	-0.00182*** (3.38e-05)	0.000293*** (8.85e-05)	0.000401*** (9.29e-05)	-0.00192*** (4.33e-05)	0.000216 (0.000177)	0.000476*** (0.000150)
ln(HH Family Income)	0.211 (0.250)	-3.322*** (0.567)	-1.752*** (0.560)	-0.533* (0.318)	-2.606** (1.141)	-1.565 (0.967)
ln(HH Family Income)^2	0.0311** (0.0123)	0.164*** (0.0286)	0.0908*** (0.0287)	0.0718*** (0.0160)	0.129** (0.0592)	0.0782 (0.0509)
Num Adult in HH	-0.558*** (0.0263)	0.277*** (0.0424)	0.0440 (0.0520)	-0.692*** (0.0317)	0.175** (0.0851)	0.248** (0.0966)
Immigrant	-0.298*** (0.0480)	-0.141* (0.0838)	0.261* (0.143)	-0.576*** (0.0848)	-0.0510 (0.169)	0.769* (0.414)
Immigrant 10 to 15	-0.244 (0.176)	-0.0416 (0.206)	0.277 (0.475)	-0.227 (0.355)	0.346 (0.464)	-0.423 (0.892)
Immigrant 5 to 10	-0.765*** (0.145)	0.417** (0.178)	0.958** (0.453)	-0.890*** (0.298)	0.295 (0.366)	1.439 (0.938)
Immigrant 0 to 5	-1.262*** (0.181)	0.252 (0.229)	0.327 (0.394)	-1.138*** (0.357)	0.206 (0.467)	-0.0418 (1.076)
One Adult Household	0.120** (0.0493)	0.0726 (0.108)	-0.336*** (0.107)	-0.0240 (0.0632)	-0.138 (0.230)	-0.166 (0.186)
HH with Child	0.393*** (0.0508)	-0.308*** (0.0935)	0.0372 (0.109)	0.590*** (0.0688)	-0.379** (0.181)	-0.184 (0.180)
Retired Adult HH	-0.0513 (0.0410)	0.368*** (0.102)	0.0959 (0.0966)	0.0660 (0.0511)	0.304 (0.199)	-0.0404 (0.150)
ln(Pop Density)	-0.182*** (0.0147)	0.0207 (0.0345)	0.0607 (0.0384)	-0.0655*** (0.0132)	0.0455 (0.0398)	0.0266 (0.0436)
Rail	-0.00667 (0.0361)	0.00383 (0.0707)	0.125 (0.0915)	-0.136* (0.0722)	0.0232 (0.263)	-0.206 (0.229)
BEA Region 2				-0.00928 (0.100)		
BEA Region 3				0.327*** (0.113)		
BEA Region 4				0.490*** (0.116)		
BEA Region 5				0.158* (0.0928)		
BEA Region 6				0.349*** (0.0986)		
BEA Region 7				0.680*** (0.205)		
BEA Region 8				0.128 (0.109)		
Constant	-3.684*** (1.280)			-1.231 (1.591)		
Observations	143,150			93,333		
Log pseudolikelihood	-29959.57			-15984.106		
Pseudo R2	0.2471			0.2364		

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Household characteristics also affect the probability of being a driver for non-Hispanic/non-Black people in urban areas. Based on the signs of the coefficients, the probability increases with the increase in household family income and decreases with the number of adults in a household. The lifecycle of households also affects the probability of being a driver. Urban non-Hispanic/non-Blacks in one-adult households are more likely to be a driver than those who live in multi-adult households, and people in a household with children are more likely to be a driver than those who in a household without children.

The built environments of residential areas affect the probability of being a driver as well. Although the rail dummy variable is insignificant, non-Hispanic/non-Blacks in high-density residential areas are significantly less likely to be a driver. The probability of being a driver varies by region as well.

Urban Hispanics have some interesting differences from non-Hispanic/non-Blacks in the associations between demographic characteristics and the probability of being a driver. First and the most interestingly, the gender difference in the probability of being a driver is much greater for urban Hispanics than that for urban non-Hispanic/non-Blacks. The female cross-term coefficient is negative and significant, and it is even larger than the baseline female coefficient in magnitude. Other than that, as observed for urban non-Hispanic/non-Blacks, the probability of being a driver is high for mid-age and low for younger and older generations, but the variation by age is smaller (the age-driver inverse-U shape curve is flatter) than non-Hispanic/non-Blacks. Immigrant status of urban Hispanics reduces probability of being a driver even further than urban non-Hispanic/non-Blacks, and the probability increases with their stay in the U.S. more slowly than urban non-Hispanic/non-Blacks.

Interestingly, unlike the number of vehicles per household, the effect of the number of adults in a household is weaker for urban Hispanics than urban non-Hispanic/non-Blacks. Therefore, urban Hispanics in multi-adult households are not lower in the probability of being a driver, and they do not increase the number of vehicles at the same rate as non-Hispanic/non-Blacks. It seems that urban Hispanic drivers share vehicles more than urban non-Hispanic/non-Black drivers. In contrast, the effects of having children in a household on the probability of being a driver is similar to lifecycle effects on the number of vehicles per household: the probability of being an adult driver from an urban Hispanic household with children are not significantly different from those who live in a household without children.

The female cross-term for urban Blacks is positive and significant, which means that the gender difference in the probability of being a driver is narrower for Blacks than non-Hispanic/non-Blacks. As observed for Hispanics, the age curve is flatter (the magnitude of the quadratic term is significantly smaller) and the income curve is steeper (the magnitude of quadratic term is larger) than that of non-Hispanic/non-Blacks. In other words, the probability of being a driver is affected less by age and more by income for urban Blacks than urban non-Hispanic/non-Blacks.

Urban Black immigrants have different characteristics than those of immigrants from other race/ethnicity groups. Black immigrants who stay longer than 15 years are not less likely to be a driver (cross-term almost cancels out the immigrant coefficient) than Black non-immigrants. The category of immigrants who stay in the US less than 5 years is the only group who is less likely to be a driver than non-immigrants, and after that, their probability of being a driver is as high as Black non-immigrants.

In rural areas, the findings in urban areas basically hold for all three race/ethnicity groups. Relatively minor differences observed between rural non-Hispanic/non-Blacks and urban non-Hispanic/non-Blacks are: the difference in the probability of being a driver for immigrants and non-immigrants is greater in rural areas, the effects of population density on the probability of being a driver is weaker in rural areas, and the effects of having a rail in a metropolitan area is stronger in rural areas.

Rural Hispanics also hold similar characteristics with urban Hispanics; the Hispanic dummy variable is positive and significant, and the gender difference of the probability of being a driver is greater than non-Hispanic/non-Blacks. The difference between Hispanic immigrants and Hispanic non-immigrants is not significantly different from that of non-Hispanic/non-Blacks; however, the sign of the coefficient is still negative. The same can be said for Blacks. Although some cross-term coefficients are insignificant, they are essentially consistent in sign and similar in magnitude.

**Table 4.3** Probability of being a driver in urban and rural areas for each race/ethnicity group

Dependent Variable: Driver (1 if a person is a driver, 0 otherwise)						
	Non-Hisp Non-Blk		Hispanic		Black	
	Base	Rural	Base	Rural	Base	Rural
Dummy		2.259 (2.039)		-1.483 (5.705)		1.757 (5.007)
Female	-0.567*** (0.0286)	0.0598 (0.0461)	-1.234*** (0.0617)	0.0636 (0.145)	-0.396*** (0.0691)	0.243* (0.129)
Age	0.177*** (0.00386)	0.0100 (0.00627)	0.130*** (0.00862)	0.0208 (0.0199)	0.137*** (0.00938)	0.000244 (0.0189)
Age^2	-0.00182*** (3.38e-05)	-9.50e-05* (5.49e-05)	-0.00156*** (8.28e-05)	-0.000172 (0.000192)	-0.00142*** (8.68e-05)	-2.38e-05 (0.000168)
ln(HH Family Income)	0.195 (0.250)	-0.713* (0.404)	-3.080*** (0.507)	0.0504 (1.191)	-1.505*** (0.503)	-0.566 (1.046)
ln(HH Family Income)^2	0.0319*** (0.0123)	0.0393* (0.0202)	0.194*** (0.0257)	0.00147 (0.0616)	0.120*** (0.0260)	0.0290 (0.0550)
Num Adult in HH	-0.557*** (0.0262)	-0.139*** (0.0411)	-0.280*** (0.0331)	-0.241*** (0.0853)	-0.509*** (0.0450)	0.0679 (0.102)
Immigrant	-0.293*** (0.0479)	-0.286*** (0.0973)	-0.487*** (0.0699)	-0.157 (0.162)	0.00222 (0.138)	0.188 (0.426)
Immigrant 10 to 15	-0.243 (0.177)	0.0213 (0.395)	-0.298*** (0.107)	0.408 (0.326)	0.0505 (0.440)	-0.692 (0.949)
Immigrant 5 to 10	-0.757*** (0.146)	-0.135 (0.332)	-0.370*** (0.102)	-0.295 (0.239)	0.194 (0.429)	0.417 (0.996)
Immigrant 0 to 5	-1.256*** (0.183)	0.115 (0.405)	-1.040*** (0.140)	0.0648 (0.327)	-0.945*** (0.355)	-0.219 (1.060)
One Adult Household	0.118** (0.0492)	-0.138* (0.0801)	0.193** (0.0964)	-0.361 (0.240)	-0.226** (0.0954)	0.0386 (0.200)
HH with Child	0.391*** (0.0508)	0.202** (0.0856)	0.103 (0.0792)	0.106 (0.185)	0.421*** (0.0960)	-0.0134 (0.193)
Retired Adult HH	-0.0492 (0.0410)	0.113* (0.0655)	0.297*** (0.0936)	0.0807 (0.214)	0.0509 (0.0872)	-0.0253 (0.166)
ln(Pop Density)	-0.190*** (0.0148)	0.126*** (0.0197)	-0.124*** (0.0313)	0.115** (0.0489)	-0.163*** (0.0380)	0.127** (0.0557)
Rail	-0.0287 (0.0358)	-0.0981 (0.0778)	-0.0203 (0.0714)	-0.0441 (0.263)	0.0668 (0.0978)	-0.377 (0.234)
BEA Region 2	-0.0938 (0.0750)		-0.0586 (0.319)		-0.682 (0.479)	
BEA Region 3	0.216** (0.0843)		0.756** (0.379)		-0.197 (0.498)	
BEA Region 4	0.357*** (0.0848)		0.367 (0.361)		-0.654 (0.522)	
BEA Region 5	0.205*** (0.0719)		0.880*** (0.309)		-0.383 (0.471)	
BEA Region 6	0.284*** (0.0749)		0.589* (0.309)		-0.118 (0.475)	
BEA Region 7	0.541*** (0.141)		0.452 (0.528)		1.094 (1.146)	
BEA Region 8	0.187** (0.0761)		0.412 (0.306)		-0.0829 (0.482)	
Constant	-3.553*** (1.275)		13.06*** (2.504)		4.671* (2.488)	
Observations	206,114		17,289		13,080	
Log pseudolikelihood	-35711.627		-5562.7517		-4651.9666	
Pseudo R2	0.2251		0.2487		0.2041	

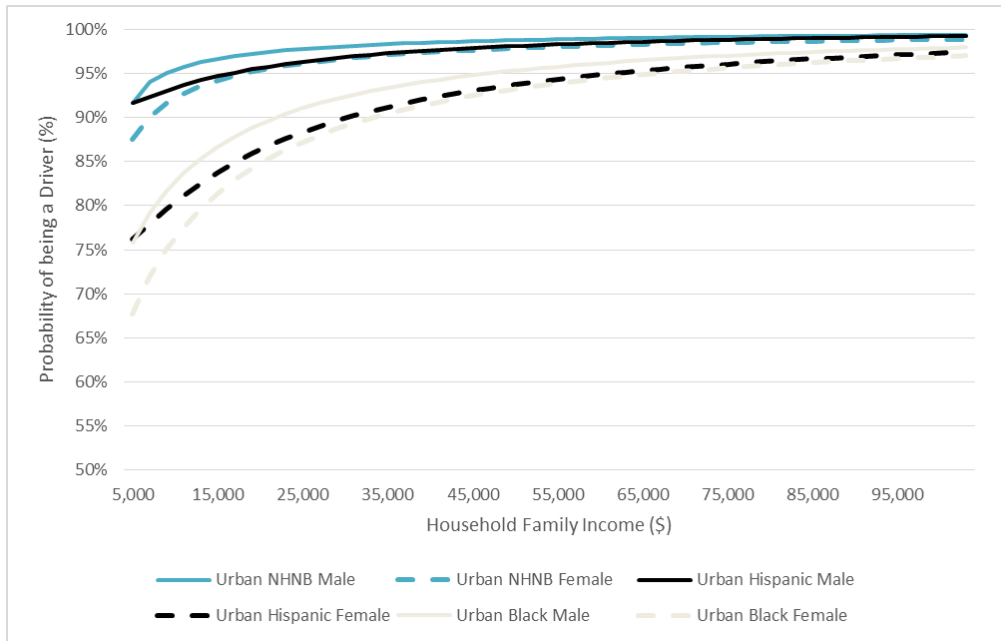
Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

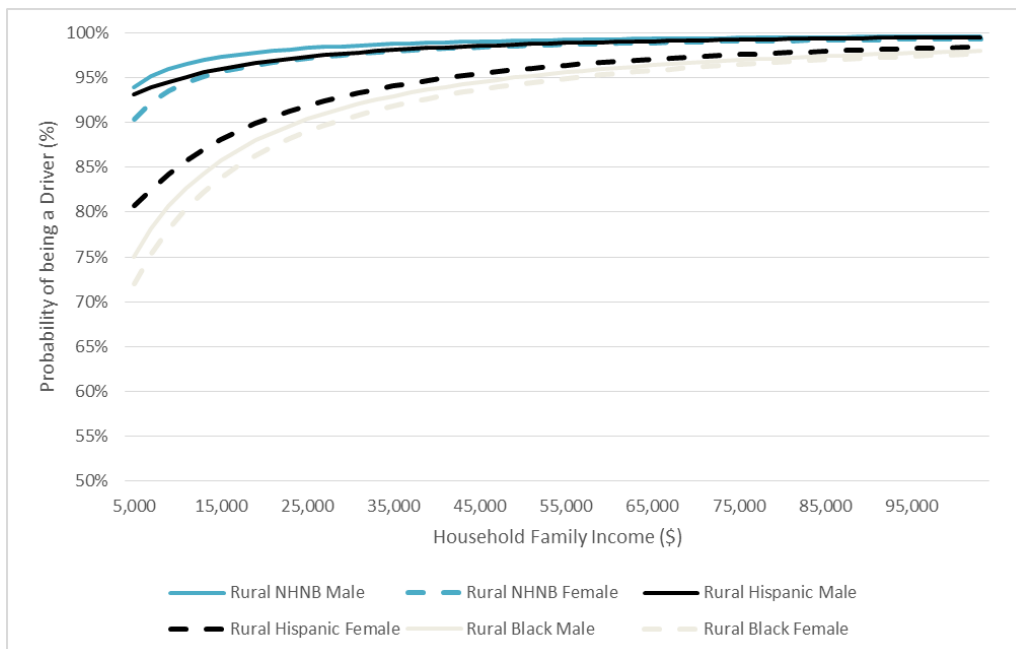


Table 4.3 summarizes the urban-rural differences for the probability of being a driver for each race/ethnicity group. For non-Hispanic/non-Blacks, rural people in a household with many adults are even less likely to be a driver than those who live in urban areas. This finding is consistent with the finding in the analysis of the number of vehicles per household (Table 3.3); in rural areas, people in a multi-adult household tend to share vehicles and drivers. Immigrant-non-immigrant differences in the probability of being a driver are also greater in rural areas than in urban areas. The effects of the household lifecycle is also significantly different between urban and rural areas as well. Urban non-Hispanic/non-Blacks adults in households with children are more likely to be a driver, and rural counterparts are even more likely to be a driver than urban non-Hispanic/non-Blacks. As noted earlier, the density effect is weaker (virtually insignificant) in rural areas than urban areas. That is, when the population density of residential areas is lower than a certain level, people have to drive anyways regardless of minor differences in population density.

All the findings regarding urban-rural differences for non-Hispanic/non-Blacks holds for Hispanics and Blacks. Although many cross-terms are insignificant for these minority groups because of large standard errors, their signs and magnitude of coefficients are similar to those of non-Hispanic/non-Blacks.



**Figure 4.1** Estimated association between a probability of being a driver and household family income in an urban area, using coefficients of table 4.3 (40 year old non-immigrant in a two-adult household with children)



**Figure 4.2** Estimated association between a probability of being a driver and household family income in a rural area using coefficients of table 4.3 (40 year old non-immigrant in a two-adult household with children)

Figure 4.1 and Figure 4.2 highlight the gender gap and differences according to each race/ethnicity group in the association between the probability of being a driver and household family income. The probability is estimated for a 40 year old non-immigrant in a two-adult household with children, using coefficients of Table 4.3. Figure 4.1 shows the result of urban areas and Figure 4.2 shows the result of rural areas. The blue lines show the graph of non-Hispanic/non-Blacks, the black lines show that of Hispanics, and light gray lines show that of Blacks. The solid lines are for males, and the dotted lines are for females.

Both in urban and rural areas, the probability of being a driver increases with income in the same race/ethnicity group, although the effect of income is slightly weaker in rural areas. Males are more likely to be a driver than females in a household with the same income level. Non-Hispanic/non-Blacks are the highest in the probability of being a driver, while Blacks are low in the probability even after controlling for the income level. With regard to Hispanics, the probability of being a driver for males is as high as that for non-Hispanic/non-Blacks, while the probability for females is as low as that for Blacks. The gender gap of Hispanics is slightly narrower in rural areas than in urban areas.

#### 4.2 Driving Mileage per Household and per Person

Driving mileage is assessed at both household and individual levels to capture travel behavior. In this case, the natural log of the household's best mile estimate is assessed with an OLS model, using socioeconomic and demographic factors.

**Table 4.4** Personal driving mileage by race/ethnicity group in urban and rural areas

Dependent Variable: ln(Personal Driving Mileage)						
	Urban			Rural		
	Base	Hisp	Black	Base	Hisp	Black
Dummy		0.427 (2.462)	-0.685 (2.720)		-7.211* (3.792)	2.751 (3.690)
Female	-0.525*** (0.00700)	0.0408 (0.0308)	-5.25e-05 (0.0391)	-0.565*** (0.00860)	0.0925 (0.0566)	0.0441 (0.0640)
Age	0.0596*** (0.00154)	0.0106 (0.00671)	0.00680 (0.00904)	0.0547*** (0.00194)	-0.0162 (0.0127)	0.0120 (0.0150)
Age^2	-0.000642*** (1.45e-05)	-0.000180*** (6.93e-05)	-0.000105 (8.74e-05)	-0.000620*** (1.87e-05)	0.000173 (0.000130)	-0.000121 (0.000143)
ln(HH Family Income)	1.222*** (0.141)	-0.246 (0.460)	-0.0491 (0.507)	1.209*** (0.148)	1.319* (0.708)	-0.680 (0.699)
ln(HH Family Income)^2	-0.0414*** (0.00642)	0.0145 (0.0214)	0.0113 (0.0238)	-0.0374*** (0.00681)	-0.0606* (0.0333)	0.0376 (0.0334)
Num Adult in HH	-0.0658*** (0.00828)	0.00979 (0.0236)	-0.0830** (0.0375)	-0.0904*** (0.0102)	0.0976** (0.0471)	-0.0733 (0.0759)
Immigrant	-0.127*** (0.0143)	0.137*** (0.0395)	0.182** (0.0814)	-0.135*** (0.0266)	0.153* (0.0787)	-0.383** (0.189)
Immigrant 10 to 15	-0.117*** (0.0444)	0.0645 (0.0985)	-0.0556 (0.235)	-0.0997 (0.0773)	-0.101 (0.185)	-0.274 (0.847)
Immigrant 5 to 10	-0.263*** (0.0587)	0.194* (0.106)	0.363* (0.217)	-0.292*** (0.0970)	-0.144 (0.278)	0.587 (0.767)
Immigrant 0 to 5	-0.608*** (0.0796)	0.618*** (0.163)	0.325 (0.378)	-0.562*** (0.157)	-0.367 (0.406)	2.509*** (0.274)
One Adult Household	0.144*** (0.0147)	-0.00539 (0.0651)	-0.0988 (0.0683)	0.207*** (0.0185)	-0.154 (0.141)	-0.284** (0.131)
HH with Child	0.0472*** (0.00927)	-0.0297 (0.0390)	0.0286 (0.0518)	0.0427*** (0.0116)	-0.118 (0.0800)	-0.110 (0.0895)
Retired Adult HH	-0.217*** (0.0110)	0.117** (0.0556)	0.0710 (0.0603)	-0.223*** (0.0130)	-0.104 (0.0940)	-0.0882 (0.0987)
ln(Pop Density)	-0.0888*** (0.00401)	0.0337* (0.0179)	-0.0285 (0.0216)	-0.0693*** (0.00353)	0.0201 (0.0202)	-0.0155 (0.0283)
Rail	-0.0257** (0.0100)	0.0789** (0.0356)	-0.0548 (0.0504)	0.0102 (0.0177)	-0.0257 (0.0952)	-0.112 (0.146)
BEA Region 2				-0.0429* (0.0258)		
BEA Region 3				-0.0226 (0.0287)		
BEA Region 4				-0.0514* (0.0282)		
BEA Region 5				0.0290 (0.0238)		
BEA Region 6				0.0474* (0.0252)		
BEA Region 7				-0.103** (0.0455)		
BEA Region 8				-0.0339 (0.0284)		
Constant	0.461 (0.774)			0.240 (0.809)		
Observations	104,096			69,358		
R2	0.201			0.217		

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The findings about the personal driving mileage of urban non-Hispanic/non-Blacks are basically the same as the findings in the probability of being a driver. Females drive significantly less than male counterparts, and both drive the most at the middle age. Personal driving mileage increases and diminishes with household income, and decreases with the number of adults in a household. Immigrants drive less than non-immigrants, particularly those who stay in the U.S. for a short time. Higher population density and the existence of rail service are also negatively associated with personal driving mileage.

Most cross-term coefficients for urban Hispanics are insignificant, suggesting that the findings for urban non-Hispanic/non-Blacks holds for urban Hispanics. One interesting finding about urban Hispanics is that the female cross-term is positive and insignificant. In the previous section, the driver status analysis finds that a Hispanic female is significantly less likely to be a driver than a Hispanic male, and the gender difference is significantly greater than that of non-Hispanic/non-Blacks. However, this result suggests that if a Hispanic female is a driver, the gender-difference in driving mileage is not significantly different from that of non-Hispanic/non-Blacks. Another interesting difference regarding non-Hispanic/non-Blacks is the driving mileage distinction between immigrants and non-immigrants. The cross-term coefficients cancel out the baseline coefficients, which suggests that urban Hispanic immigrants drive as much as urban Hispanic non-immigrants do regardless of the length of stay in the U.S.

With regard to urban Blacks, the findings are basically similar to those about urban Hispanics. The only noticeable difference from the difference between Hispanics and Blacks is the effect of the number of adults in the household. Black adult drivers in a household with many adults drive significantly less than those living in a household with fewer adults, and the rate of decrease is greater than that of non-Hispanic/non-Blacks.

In rural areas, findings for non-Hispanic/non-Blacks are very similar to the findings in urban areas. However, there are some interesting findings about Hispanics and Blacks. In rural areas, the Hispanic dummy variable is surprisingly large, negative, and significant. The reason of the sign and magnitude of this coefficient will be discussed afterwards with the income effect differences between urban Hispanics and rural Hispanics. For rural Hispanics, differences in the number of adults in a household does not associate with a significant difference in personal driving mileage. Rural Hispanic immigrants drive as much as rural Hispanic non-immigrants, as found for urban Hispanics, but unlike urban Hispanic immigrants, recent rural Hispanic immigrants drive less than rural Hispanic immigrants who stay longer in the U.S. The findings about rural Black immigrants are also interesting. They drive much less than Black non-immigrants, and the difference is greater than the difference between non-Hispanic/non-Black immigrants and non-immigrants. However, recent Black immigrants drive substantially more than Black non-immigrants. Although rural Black immigrants who stay in the U.S. less than 5 years are less likely to be a driver than rural Black immigrants who stay in the U.S. more than 15 years, if those recent rural Black immigrants are drivers, they drive substantially more than those who stay in the U.S. more than 15 years.

**Table 4.5** Personal driving mileage in urban and rural areas by race/ethnicity group

Dependent Variable: ln(Personal Driving Mileage)						
	Non-Hisp Non-Blk		Hispanic		Black	
	Base	Rural	Base	Rural	Base	Rural
Dummy		-0.251 (1.118)		-7.421* (4.354)		3.084 (4.439)
Female	-0.525*** (0.00700)	-0.0396*** (0.0111)	-0.486*** (0.0300)	0.0195 (0.0635)	-0.528*** (0.0385)	0.00811 (0.0742)
Age	0.0595*** (0.00154)	-0.00470* (0.00248)	0.0718*** (0.00652)	-0.0311** (0.0141)	0.0665*** (0.00889)	0.00141 (0.0173)
Age^2	-0.000641*** (1.45e-05)	2.04e-05 (2.37e-05)	-0.000838*** (6.76e-05)	0.000370** (0.000145)	-0.000748*** (8.61e-05)	-2.25e-06 (0.000166)
ln(HH Family Income)	1.217*** (0.141)	-0.00281 (0.204)	0.986** (0.434)	1.463* (0.814)	1.166** (0.484)	-0.620 (0.838)
ln(HH Family Income)^2	-0.0411*** (0.00642)	0.00346 (0.00935)	-0.0275 (0.0202)	-0.0666* (0.0382)	-0.0298 (0.0227)	0.0291 (0.0399)
Num Adult in HH	-0.0657*** (0.00828)	-0.0243* (0.0131)	-0.0533** (0.0221)	0.0552 (0.0511)	-0.150*** (0.0367)	-0.0113 (0.0836)
Immigrant	-0.125*** (0.0143)	-0.0121 (0.0301)	-0.0161 (0.0372)	0.0160 (0.0827)	0.0672 (0.0801)	-0.587*** (0.204)
Immigrant 10 to 15	-0.117*** (0.0445)	0.0184 (0.0893)	-0.0567 (0.0876)	-0.132 (0.187)	-0.180 (0.232)	-0.162 (0.849)
Immigrant 5 to 10	-0.264*** (0.0587)	-0.0267 (0.113)	-0.0761 (0.0882)	-0.366 (0.276)	0.101 (0.205)	0.194 (0.776)
Immigrant 0 to 5	-0.609*** (0.0796)	0.0473 (0.176)	-0.00463 (0.142)	-0.911** (0.401)	-0.305 (0.372)	2.220*** (0.437)
One Adult Household	0.144*** (0.0147)	0.0631*** (0.0236)	0.138** (0.0633)	-0.0881 (0.154)	0.0414 (0.0665)	-0.116 (0.146)
HH with Child	0.0473*** (0.00927)	-0.00465 (0.0148)	0.0231 (0.0379)	-0.0919 (0.0873)	0.0740 (0.0509)	-0.138 (0.102)
Retired Adult HH	-0.217*** (0.0110)	-0.00586 (0.0170)	-0.0997* (0.0544)	-0.215** (0.108)	-0.145** (0.0594)	-0.164 (0.115)
ln(Pop Density)	-0.0874*** (0.00393)	0.0180*** (0.00525)	-0.0477*** (0.0180)	0.00459 (0.0265)	-0.116*** (0.0222)	0.0324 (0.0354)
Rail	-0.0261*** (0.00970)	0.0380** (0.0192)	0.00531 (0.0393)	-0.0365 (0.0981)	-0.0535 (0.0551)	0.0125 (0.154)
BEA Region 2	-0.0671*** (0.0202)		-0.0829 (0.193)		-0.450** (0.224)	
BEA Region 3	-0.0190 (0.0222)		0.0908 (0.224)		-0.271 (0.242)	
BEA Region 4	-0.0455** (0.0215)		0.152 (0.215)		-0.575** (0.276)	
BEA Region 5	0.0205 (0.0190)		0.248 (0.184)		-0.186 (0.214)	
BEA Region 6	0.0459** (0.0197)		0.0794 (0.183)		-0.126 (0.218)	
BEA Region 7	-0.0992*** (0.0351)		-0.234 (0.275)		0.147 (0.366)	
BEA Region 8	0.00975 (0.0202)		0.140 (0.184)		-0.136 (0.220)	
Constant	0.466 (0.774)		0.662 (2.326)		-0.00204 (2.595)	
Observations	156,601		9,618		7,235	
R2	0.212		0.169		0.196	

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 4.5 compares the urban-rural differences in personal driving mileage for each race/ethnicity group. Again, the following analysis will focus on inter-race/ethnicity group differences in rural cross terms because the regressions conducted are basically the same as the previous one (Table 4.4).

As discussed earlier, the dummy variable of rural Hispanics is negative, significant, and considerably large in magnitude. If the coefficient is directly interpreted, rural Hispanics drive substantially less than urban Hispanics, which is not true as shown in descriptive statistics (Table 4.1). As completed for household driving mileage in Chapter 3, Table 4.6 explores potential reasons for this negative dummy variable using coefficients in Table 4.5 and average data for each factor.

**Table 4.6** Comparison of household vehicle mileage and socioeconomic factors of households in urban and rural areas for each race/ethnicity group

	Non-Hisp/Non-Black		Hispanic		Non-Hisp Black	
	Urban	Rural	Urban	Rural	Urban	Rural
Avg. Personal Vehicle Mile	11,185	13,355	11,156	12,954	10,539	11,919
Rural Dummy Variable Coefficient in Table 4.4		-0.251		-7.421*		3.084
Avg. Population Density per Sq.Mile	4,118	604	6,939	1,161	5,365	635
Calculated Density Term Using Coefficients in Table 4.4 and Avg. Population Density	-0.727	0.115	-0.422	0.032	-0.996	0.209
Avg. Number of Adults	2.085	2.099	2.434	2.320	2.073	2.079
Calculated HH Size Term Using Coefficients in Table 4.4 and Avg. Number of Adults	-0.048	-0.018	-0.047	0.046	-0.109	-0.008
Avg. HH Family Income	80,334	67,258	59,675	56,118	58,786	46,904
Calculated Income Term Using Coefficients in Table 4.4 and Avg. HH Family Income	8.502	8.846	7.517	15.528	9.211	5.792
Immigrant Driving Drivers (%)	8.5%	3.4%	43.6%	32.8%	8.0%	3.8%



As previous analysis about household driving mileage found that the difference in income-mileage relationships, not residential density or differences in household size, appears to explain the observed negative and significant coefficient for the rural dummy variable for Hispanics. Although the estimated average density term and the household size term are larger for rural Hispanics than urban Hispanics, the magnitude is not large enough to explain the rural dummy variable. The urban-rural difference in the income term is, however, large enough to account for the counter-intuitive rural dummy variable. The rural dummy variable seems to cancel out the large difference in the family income term.

Other than the rural dummy variable for Hispanics, there are several noticeable differences in rural-cross term coefficients among race/ethnicity groups. One of them is the gender difference in driving mileage. The gender difference in driving mileage is significantly greater for rural non-Hispanic/non-Blacks than urban counterparts, while the urban-rural difference in the gender difference is insignificant for Hispanics and Blacks. A similar thing is found for the effects of the number of adults in a household. The effect of the number of adults in a household on personal driving mileage is stronger in rural areas for non-Hispanic/non-Blacks, while the effect is insignificant for Hispanics and Blacks. The insignificance of the coefficient of the number of adults for Hispanics is, however, caused by the large standard error, and the magnitude of the cross-term is large enough to cancel out the baseline coefficient.

Additional noticeable differences in rural-cross term coefficients regard immigration status. Rural Hispanic immigrants staying in the U.S. less than 5 years drive less than those who stay in the U.S. more than 15 years; however, recent Hispanic immigrants in urban areas drive as much as those who stay in the U.S. more than 15 years. In contrast, rural Black immigrants drive significantly less than urban counterparts, while rural Black immigrants who stay in the U.S. less

than 5 years drive significantly more than rural Black immigrants who stay in the U.S. more than 15 years.

The urban-rural differences in the effects of residential density are different among three race/ethnicity groups. For non-Hispanic/non-Blacks, the effects of population density and the existence of rail service on personal driving mileage are weaker in rural areas than in urban areas, while urban-rural differences are insignificant for Hispanics and Blacks.

## Chapter 5 Conclusion and Future Directions

The analysis finds that Hispanics have different mobility characteristics from other race/ethnicity groups, even after controlling for their socioeconomic status. Hispanic households appear to rely on private vehicles, while owning vehicles appear to be more difficult for them than for non-Hispanic/non-Blacks; Hispanic households drive as much as non-Hispanic/non-Black households do, but they share vehicles more even after controlling for household family income. The trend is different from another large minority group of Blacks who tend to own fewer vehicles and do not drive much, which suggests that they use alternative modes of transportation. Sharing vehicles becomes slightly less common for rural Hispanic households than urban Hispanic households, potentially because rural environments require more individual mobility to fulfil daily needs.

Hispanic immigrants also rely on shared-private vehicles even if they have come to the U.S. within a relatively recent time frame. Recent Hispanic immigrant households tend to drive more than recent immigrants of other race/ethnicity groups with a comparable number of vehicles. Although non-Hispanic/non-Black immigrants steadily increase the number of vehicles owned with the length of stay in the U.S., the increase is smaller for Hispanic immigrant households.

At an individual level, Hispanic females are much less likely to be a driver than male Hispanics, and the difference is greater than the gender difference of other race/ethnicity groups. Considering that Hispanic females drive as much as females of other race/ethnicity groups do, Hispanic females seem to be relatively limited in mobility, and the hurdle exists in becoming a driver. Hispanic immigrants also seem to face a hurdle in becoming drivers. They are less likely

to be drivers than non-immigrant counterparts, but when they are drivers, they drive as much as Hispanic non-immigrants do.

In summary, Hispanics rely on private transportation, but Hispanic females and immigrants are further limited in mobility because there seems to be a hurdle in becoming drivers. The finding is consistent with the widely-known fact of carpooling among Hispanics and the limited mobility of the non-primary workforce found by Bohon, Stamps, and Atilas (11). The mobility issue of Hispanics is significantly different from that of Blacks, who tend to switch to alternative modes of transportation or reduce activity rather than doing extensive carpooling. Future study is anticipated to explore why Hispanics do not own many vehicles despite their high dependency in driving, and why Hispanic females and immigrants have difficulties in becoming drivers.

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