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Carpooling and Drivers without Household Vehicles: Gender Disparity in Automobility among Hispanics in the U.S.*

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Abstract

Personal-level automobility is critical for accessing economic and social opportunities in an auto-oriented built environment such as the U.S. Household carpooling is the most popular alternative mode for solo-driving regardless of demographic group because it provides a certain degree of automobility, yet, carpool-dependent passengers often suffer from practical and other disadvantages. This paper explores the gender gap in personal-level automobility, particularly among Hispanics, with explicit consideration to drivers' access to household vehicles and non-drivers' access to household carpooling. The research finds that Hispanic females, especially immigrants, are low in automobility, both in the probability of being a driver and in access to household vehicles. The gender gap is specific to Hispanics, and not found for non-Hispanic Whites or Blacks. The gap decreases, but persists, as immigrant Hispanics stay longer in the U.S., gain or maintain employment, or become college-educated. Surprisingly, the gender gap in personal-level automobility exists even among U.S. native Hispanics.

Keywords: Mobility, Automobility, Hispanics, Gender, Immigrants, Carpool

Introduction

Personal-level automobility is critical for accessing economic and social opportunities in an auto-oriented place such as the U.S. When solo-driving is difficult, household carpooling is by far the most popular alternative mode regardless of demographic group (Blumenberg and Smart, 2010). Household carpooling is popular because carpooling provides a certain degree of automobility in terms of spatial reach and temporal flexibility, and because household carpooling is technically and emotionally easier than non-household carpooling. An increasing volume of research explores household and non-household carpooling and finds that carpooling is disproportionally used by females, and household vehicle availability strongly associates with the likelihood of carpooling (e.g., Buliung et al., 2012; Ferguson, 1997; Ferguson et al., 1994; Habib et al. 2011; Teal, 1987). Yet, little research has examined carpooling as a mode that constitutes personal automobility for non-drivers or drivers without primary access to household vehicle.

Hispanics in the U.S. are of interest because they constitute a large and growing demographic group in the U.S., and they use household and non-household carpooling, especially if they are immigrants, more than other demographic groups do (American Community Survey 1-year summary 2015; Riviera-Batiz, 2001; Smart, 2015). Although the travel behavior of native and immigrant Hispanics has important implications for transportation policy, Hispanics' travel issues are relatively invisible to public administration. Indeed, non-Hispanics often believe "there is no transportation problem" because "[Hispanic immigrants] are helping each other" (Bohon et al. 2008, p284).

Yet, many Hispanic immigrants report that carpooling provides a limited solution due to the scheduling requirement and unreliability, and this limitation often prevents access to education, employment, shopping, and socializing (Bohon et al., 2008; Hendricks, 2014; Maldonado et al. 2016). Previous research finds that immigrants of all race/ethnicity groups,

both documented and undocumented, gradually increase their automobility as they stay longer (Blumenberg and Smart, 2010; Chatman and Klein, 2013; Hu, 2017). However, some focus group interviews find that immobility issues persist for undocumented Hispanic immigrants even if they stay in the U.S. longer than 10 years (Lovejoy and Handy, 2008). Furthermore, anecdotes from those interviews, along with other research, indicate gender affects mobility, and immobility makes female Hispanic immigrants more likely to face challenges in job searches, job retention and wages (Bohon et al., 2008; Lovejoy and Handy, 2008; Maldonado et al. 2016). Yet, little research explores whether post-immigration mobility differs by gender over time.

This paper further explores the gender disparity in automobility among Hispanics, with explicit consideration to drivers' access to household vehicles and non-drivers' access to household carpooling. Self-driving and household carpooling remain the dominant modes of transportation in the U.S., even among immigrants (Blumenberg and Smart, 2010). This holds true despite four decades of a declining overall trend in household carpooling, two decades of increasing transit ridership, the emergence of commercial ridesharing services, and flourishing ethnic community carpooling (American Public Transportation Association, 2017; Chatman and Klein, 2013; Ferguson, 1997). Previous research on automobility often narrowly focuses on whether a person is a driver; however, availability of a household vehicle and/or household carpooling also can affect private (i.e. not used for commercial purposes) vehicle usage. First, drivers need a household vehicle to fully utilize their ability to drive. Immigrant households typically have fewer vehicles than the number of drivers, which suggests that multiple drivers with different priorities are sharing vehicles (Giuliano, 2000; Bohon et al. 2008). In addition, for both non-drivers and drivers without primary access to vehicles, household carpooling is an important transportation option. Thus, a nuanced

analysis of automobility should consider the different degrees of vehicle availability for drivers and the availability of household carpooling for non-drivers.

The analysis finds that Hispanic females, particularly Hispanic female immigrants, are not only less likely to be drivers but also are de-prioritized in their access to household vehicles. A source of this observed gender gap is differences in post-immigration mobility adjustment. Automobility of Hispanic female immigrants is low after they have just immigrated to the U.S., and it stagnates even after more than ten years in the U.S. In contrast, Hispanic male immigrants become drivers and secure access to household private vehicles soon after their immigration to the U.S. In addition, a smaller but considerable gender gap in automobility surprisingly exists among U.S. native Hispanics. Although literature documents that females prefer carpooling more than males do regardless of race/ethnicity, these large gender gaps among both native and immigrant populations are specific to Hispanics (Buliung et al. 2012; Neoh et al., 2017; Teal, 1987). A gender gap is not observed among U.S. native non-Hispanic Whites, and the gender gap for immigrant non-Hispanic Whites is relatively small. In addition, no sizeable gender gap is seen for non-Hispanic Blacks (hereafter, Blacks) regardless of their immigration status.

The gender gap in automobility of Hispanics is particularly large for those who immigrated to the U.S. as adults and lack bachelor's degrees. The gender gap narrows when Hispanic females, whether immigrant or native, are highly educated. This finding suggests that their higher wage potential (i.e., higher opportunity costs of immobility) and/or subsequent actual higher wages make them more likely to afford the initial cost of becoming a driver as well as able to secure and retain priority access to a household vehicle.

Automobility among Hispanics

Literature on automobility explains the "combination of greater and different trip-making supported by the car" (Rosenbloom, 2001, p376), and more broadly, how contemporary urban structure, life, and culture have been shaped by the popularity of private vehicle driving (Beckmann, 2001; Sheller and Urry, 2000; Stuesse and Coleman, 2014; Urry, 2004). Although some urban neighborhoods are transit-friendly, most of the U.S. is auto-oriented. As Urry (2004) discusses, automobility provides freedom for automobile users, yet, simultaneously, much of the built environment forces people to live in a spatially stretched and fragmented manner. In such an environment, people without personal cars and people who depend on transit can find it difficult to manage their work and life (Stuesse and Coleman, 2014). Thus, "automobility is a deeply contradictory mode of mobility and immobility insofar as it both 'frees' and 'fixes' populations." (Stuesse and Coleman, 2014, p56)

Most literature on automobility assumes auto-mobile people are autonomous drivers who can freely drive vehicles, while auto-immobile people are those who cannot. However, some literature acknowledges nuances to automobility. Stuesse and Colman (2014) describe "altermobility" as non-household ethnic community carpooling extensively used by undocumented Hispanic immigrants due to immigrant policing. Altermobility limits their automobility but reduces the risk of traffic stops that could result in detention or deportation. Maldonado et al. (2016) do not clearly define "altermobility" in a paper that uses the term in its title, but it seems to mean (non-household ethnic community) carpooling. Lovejoy and Handy (2008) find social networking allows recent Mexican immigrants without cars to gain practical access to private vehicle transportation but their needs are not fully met by friends and relatives within their limited community (in which immigrant policing is also cited as an issue)

Other research tries to account for vehicle availability by employing an index such as a vehicle-to-driver ratio or the number of household vehicles (Buliung, et al. 2012; Giuliano, 2003; Hu, 2017). However, such an index does not account for differences in vehicle availability, or accessibility, among household drivers. As several focus group interviews document, the priority in vehicle usage varies by household driver, and drivers with lower vehicle priority can be virtually autoless (Bohon et al. 2008; Lovejoy and Handy, 2008). Furthermore, private-vehicle transport is sometimes easily available for non-drivers, particularly from other household drivers (Lovejoy and Handy, 2008). Farber and Páez (2009) are among the few researchers who consider passengers of private vehicles as auto-mobile people.[1] But their research does not consider the different degrees of freedom experienced by drivers and passengers.

Hispanic immigrants, particularly recent immigrants are less likely to own a car and more likely to drive fewer miles than their U.S. native counterparts, and instead, carpool within and outside the household (Blumenberg and Smart, 2010; Blumenberg and Smart, 2014; Casas, Arce, and Frye, 2004; Chatman and Klein, 2009; Tal and Handy, 2010; among others). Automobility of immigrants can be low regardless of their origin due to three major difficulties: becoming a driver, owning a private vehicle, and driving on public roads (Chatman and Klein, 2013; Matsuo, 2016). Becoming a driver can be difficult for those not proficient in English, and is often illegal if a person is undocumented (Liu and Painter, 2012; Stuesse and Colman, 2014). Immigrants from low-to-middle income countries may be unable to purchase a vehicle because they send a significant portion of their earnings to family or creditors in their home country (Chatman and Klein, 2013). Limited access to auto loans or

[1] In their research, those who traveled 100% as drivers or passengers of a private vehicle are defined as auto-reliant.

credit makes it even more difficult for immigrants to purchase or lease vehicles (Blumenberg and Smart, 2011; Chatman and Klein, 2013; Cohen, 2006). Driving on public roads can be technically difficult for immigrants if the environment differs significantly from their home country (Chatman and Klein, 2013). It is also emotionally and practically difficult if their vehicles are mechanically unreliable or if they lack sufficient insurance coverage (Lovejoy and Handy, 2008). Furthermore, many immigrants report that they worry about policing and police harassment (Chatman and Klein, 2013; Garni and Miller, 2008; Maldonado et al. 2016; Stuesse and Colman, 2014). Under the U.S. Immigration and Customs Enforcement 287(g) Program and the Secure Communities Program, undocumented individuals held by state or local authority first on criminal grounds may be then held on civil immigration grounds (Stuesse and Colman, 2014). Traffic law enforcement is often used as a tool for capturing undocumented immigrants, and sometimes results in harassment even for documented immigrants (Maldonado et al. 2016; Stuesse and Colman, 2014).

Hispanic immigrants often bridge their mobility gap by using their social capital, namely, carpooling within the household (internal carpool) and with non-household members (external carpool) (Blumenberg and Smart, 2010; Charles and Kline, 2006; Liu and Painter, 2012; Maldonado et al. 2016; Smart, 2015; Shin 2017). Carpooling is frequently used by immigrants in general, and is particularly popular among females of all race/ethnicity groups (Blumenberg and Smart, 2010; Shin, 2017). Hispanic immigrants, both males and females, are very likely to form external carpools and the literature increasingly documents both the popularity and limitations of external carpooling (Blumenberg and Smart, 2010; Bohon et al. 2008; Chatman and Klein, 2009; Chatman and Klein, 2013; Liu and Painter, 2012; Lovejoy and Handy, 2011; Maldonado et al. 2016; Shin, 2017; Stuesse and Coleman, 2014; Valenzuela et al. 2005).

As a popular alternative to solo-driving, household (or internal) carpooling accounts for approximately one-third of daily trips made by immigrants of all race/ethnicity groups (Blumenberg and Smart, 2010).[2] Household carpooling is easier than external carpooling for several reasons. For one, carpooling requires personal interaction among members, and car-poolers need to trust each other in the driving skills and punctuality (Charles and Kline, 2006). Second, household carpooling is usually free of explicit charges. Yet, household carpooling still requires scheduling, which reduces convenience and flexibility for users.

Dependence on carpooling is likely to affect labor market outcomes, as evidenced by extensive literature on spatial mismatch and automobile mismatch. People who are transportation disadvantaged are much less likely to get jobs, especially better-paying ones, due to a smaller search radius, conversely, even if they get jobs, they may be burdened by long commutes (Kain 1968; Taylor and Ong, 1995; Teal, 1987; Smith and Zenou, 2003, among others). Bohon et al. (2008) report the exact transportation and labor market issues for Hispanic female immigrants.

Females disproportionally bear the disadvantages of carpooling-dependence. For example, Bohon et al. (2008) find that Hispanic female immigrants in Atlanta suburbs are disadvantaged in transportation in multiple ways, including negative employment consequences. In the ethnic labor market,[3] jobs for Hispanic male immigrants typically include employer-provided transportation, while jobs for Hispanic female immigrants do not. Wright and Ellis (2000) find a similar, strong gender-division in the Los Angeles labor

[2] Blumenberg and Smart (2010) do not limit the observation to Hispanics. Their data are taken from the National Household Travel Survey of 2001.

[3] Ethnic labor market is observed as a combination of specific types of employment that deliberately hire (a specific gender of) a specific ethnicity group, and involves people in a specific ethnic group who search for employment based on ethnic social network. Details are described by Wright and Ellis (2000).

market. [4] Moreover, local niching in ethnic employment is particularly strong for females (Ellis et al., 2007). Immigrants working in an ethnic niche are much more likely to carpool (Liu and Painter, 2012; Shin, 2017), which suggests the lack of solo-driving makes it hard for them to find better work opportunities elsewhere. In turn, without (better-paying) jobs, Hispanic female immigrants cannot purchase private vehicle for themselves (whether it is the first or second car for the household).

Even when a Hispanic immigrant household obtains a vehicle, males have priority use to commute to their (better-paying) jobs. (Bohon et al. 2008). Lovejoy and Handy (2008) report similar male-prioritization in vehicle access among Mexican immigrants in California, although they report cases of equal sharing as well. Maldonado et al. (2016) find carpooling-dependent female immigrants in a small rural town (Perry, Iowa) are almost immobile. Collectively, these three studies indicate that immobile Hispanic female immigrants are likely to be isolated at home, and even if they do travel, their destinations are limited within their ethnic community.

Using nationwide travel survey data, Matsuo (2016) confirms the gendered Hispanic mobility distribution, particularly among Hispanic immigrants. Hispanic female immigrants are much less likely to be drivers than Hispanic male immigrants or female immigrants of other race/ethnicity groups. Moreover, the probability of being a driver for Hispanic female immigrants stagnates for at least a decade. Hispanic natives in the U.S. show a much narrower, but persistent, gender gap in driver status, too. Yet this low-probability of being a driver is unlikely to mean that they are not auto-dependent. Hispanic immigrant households adopt auto-dependent lifestyle because Hispanic male immigrants generally become drivers soon after their arrival to the U.S., and drive as many miles as their non-Hispanic White

[4] Wright and Ellis (2000) find that gendered division of labor within the ethnic group is strongly observed for Guatemalans, Mexicans, and Salvadorans.

counterparts or U.S. native counterparts. Moreover, when Hispanic female immigrants become drivers, they drive as many miles as (or more than) female immigrants of other race/ethnicity groups.

One unanswered question is whether a gender gap is observed in more broadly defined automobility, namely, whether anecdotes of male-prioritization in vehicle usage can be confirmed by data. The high driving mileage of Hispanic female immigrant drivers found in Matsuo (2016) may mean that there is a gender difference only in the fixed cost in becoming a driver. If that is the case, vehicle access within the household should be relatively equal between genders. However, the high driving mileage of Hispanic female immigrants may be skewed by a small number of drivers who drive many miles as (semi-) occupational drivers. If so, most Hispanic female immigrant drivers may actually have much less access to vehicles.

Descriptive statistics of household- and personal-level mobility

The number of drivers and vehicles in the households

Data used for the analyses are obtained from the 2009 National Household Travel Survey. The data contain household characteristics, personal characteristics of the household members, and the characteristics of the vehicles owned by the households. Analyses focus on non-Hispanic White, Hispanic, or Black adults ages 22 to 69. Young adults ages 18 to 21 are excluded from the analyses because they are students or just starting jobs or careers, which makes their personal-level automobility choices differ significantly from the older cohort. Seniors, those age 70 and older, are also excluded because they are more likely to have physical concerns that limit automobility choice.

Table 1 summarizes the personal- and household-level characteristics of observations. Among the 176,461 US. Natives and immigrants included in the analysis, 86% (151,506) are non-Hispanic Whites, 8% (14,405) are Hispanics, and 6% (10,550) are Blacks. Among

Hispanics, 56% are in the households with at least one adult immigrant, and 24% are in the households where all adult members are immigrants. Most individuals in the dataset are drivers, but the probability of being a driver is lower for Hispanics and Blacks. In particular, 74% of Hispanic female immigrants are drivers, while more than 95% of non-Hispanic White males and females are drivers.

The average household size is 3.00 for Hispanic U.S. native households and 3.72 for Hispanic immigrant households, both of which are larger than their non-Hispanic White counterparts. However, the average number of drivers (two) per the household is approximately the same across all four groups. Hispanic immigrant households own slightly fewer active non-commercial vehicles than the number of drivers in the households (0.86 vehicles per driver), indicating drivers in these households share vehicles. Hispanic native households own almost one vehicle per driver (0.97 vehicles per driver) and have no signs of sharing, at least based on aggregated statistics. Non-Hispanic White native and immigrant households own more than one vehicle per driver.

Among Hispanic households, 2.64% of native households and 3.12% of immigrant households have no driver, and 6.09% of native households and 9.32% of immigrant households have no active non-commercial vehicle. These rates indicating auto-immobility are much higher than those of non-Hispanic White counterparts, but much lower than those of Black counterparts. Non-Hispanic White households with vehicles own and use approximately two non-commercial vehicles. The number of active non-commercial vehicles per household with vehicles is slightly lower (not significantly different) for Hispanics and Blacks than for non-Hispanic Whites regardless of immigration status, and for all-immigrant households than native households regardless of race/ethnicity groups.

Among non-Hispanic White native households, only 0.28 non-drivers are dependent on one household driver. The ratio doubles for Hispanic native households (0.55), and for

Hispanic immigrant households, it is slightly greater than one (1.03). Although the difference is not statistically significant due to large standard deviation, the data suggest that members of Hispanic (immigrant) households carpool more than other demographic groups.

Personal-level automobility and personal characteristics

Although driver status is an individual trait, driver access to vehicles is determined at the household level. This paper defines a range of personal-level automobility (*autochoice*) from zero to four, to fully account for different degrees of private auto access, including a household carpool.[5] The analyses consider only active drivers as drivers, and active non-commercial vehicles as household vehicles.[6]

The automobility level is the lowest (zero) if there is no vehicle and/or no driver in the household. The level is one if a person is not a driver but household carpooling is available; namely, his/her household has at least one driver and at least one vehicle. Research suggests that household (internal) carpooling is less costly and more flexible than external carpooling or taking transit. Thus, even if a person is not a driver, the person would enjoy better automobility than a person without any household carpooling option.

Levels two to four, each reflect that a person is a driver and the household has at least one vehicle, but the levels differ based on vehicle access. Level two means that the person is a driver and his/her household has at least one vehicle, but all the vehicles are accessed primarily by other drivers in the household. Automobility level three applies when a person lacks primary access to any vehicle but the household has at least one vehicle shared among

[5] Lovejoy and Handy (2008) report that drivers without any household vehicle occasionally borrow vehicles from neighbors but this borrowing is more difficult than carpooling or getting rides. As a result, the current analyses categorize drivers without any household vehicle as automobility zero.

[6] "Active drivers" in the National Household Travel Survey data are self-claimed drivers who do not have medical conditions that prevent them from driving and drove in the previous year (the record of annual driving mileage is positive). Active non-commercial vehicles are vehicles that were not commercially licensed and were used during the previous year.

drivers (i.e., no primary access assigned to that shared vehicle). For example, consider a household with three drivers (A, B, and C) and two vehicles (P and Q). If driver A has primary access to vehicle P and the two other drivers equally share vehicle Q, then drivers B and C have level three automobility. Drivers B and C are de-prioritized in vehicle access compared to driver A; however, equal access to another household vehicle affords them an automobility level higher than two. Automobility level four, the highest level, means that a person is a driver and has primary access to at least one vehicle in the household. In the previous scenario, driver A has level four automobility.

Table 2 shows descriptive statistics of the automobility level and worker status by gender for Hispanic and non-Hispanic White natives and immigrants. Notably, Hispanic immigrant females, even if they are workers, have lower mobility levels than their male counterparts or non-Hispanic White female counterparts.

The model

The personal automobility level is analyzed using the ordered Probit model. The probability of being at a specific automobility level (*autochoice*=0, 1, 2, 3, 4) is described as follows:

$$
\begin{aligned}
&\mathrm{P}(\text{autochoice} = 0|X) = P(autochoice^* \leq \alpha_1|X) \\
&\mathrm{P}(\text{autochoice} = 1|X) = P(\alpha_1 \leq autochoice^* \leq \alpha_2|X) \\
&\mathrm{P}(\text{autochoice} = 2|X) = P(\alpha_2 \leq autochoice^* \leq \alpha_3|X) \qquad \ldots(3) \\
&\mathrm{P}(\text{autochoice} = 3|X) = P(\alpha_3 \leq autochoice^* \leq \alpha_4|X) \\
&\mathrm{P}(\text{autochoice} = 4|X) = P(\alpha_4 \leq autochoice^*|X) \\
&\text{w.r.t.} \quad autochoice^* = \beta X + \varepsilon
\end{aligned}
$$

where β is a coefficient vector of X, which includes personal characteristics, household characteristics, and environmental characteristics. Standard errors are clustered at household-level.

Five personal characteristics employed are gender (female=1 if the person is female, and 0 otherwise), worker (worker=1 if the person is a worker, and 0 otherwise), four-year college degree (college=1 if the person has a bachelor's degree or higher, and 0 otherwise), immigrant or not (immigrant=1 if the person is an immigrant, and 0 otherwise), and the number of years since immigration to the U.S. Household characteristics employed include household family income (in natural log), race/ethnicity group of household respondent, immigration status, and household size by age/gender of members. Environmental characteristics are based on the respondent's residential location: the population density of the residing census block group (in natural log), the size of the urban area, and for urban areas with populations of 1 million or more, whether the area has any rail transportation service.[7]

The baseline analysis focuses on the gender differences among Hispanics (HSP-All model). The data of Hispanics are examined using the set of independent variables and their cross-terms with a female dummy variable. Namely, the $autochoice^*$ of Equation 3 is replaced by

$$autochoice^*_{HSP-All} = \beta_1 X + \beta_{1f} X * female + \varepsilon \qquad \ldots(4)$$

To supplement the baseline analysis, several other analyses are conducted. First, the same model is applied to Hispanic females to specify resultant coefficients for Hispanic

[7] Population and the presence (or lack) of rail service are used to categorized urban areas through the variable URBANSIZE in the National Household Travel Survey. URBANSIZE has six categories, 01 to 06, which correspond to urban areas with (01) 50,000 to 199,999 people, (02) 200,000 to 499,999 people, (03) 500,000 to 999,999 people, (04) 1 million or more without subway or rail, and (05)1 million or more with subway or rail, and (06) not in an urban area. I construct dummy variables for each category to control the effects of urban area size and rail.

females (HSP-Fem model). Second, the pooled data of three-race/ethnicity-groups are examined with double-cross-terms: cross-terms with a female dummy variable and race/ethnicity group dummy variables (WHB-All model; use Equation 5 to substitute $autochoice^*$ in Equation 3).

$$autochoice^*_{WHB-All} = \beta_2 X + \beta_{2H} X * Hispanic + \beta_{2B} X * Black + \beta_{2f} X * female + \beta_{2Hf} X * Hispanic * female + \beta_{2Bf} X * Black * female + \varepsilon \quad \ldots(5)$$

WHB-All model highlights the differences between Hispanic males and non-Hispanic White males, and the race-ethnicity group differences in the gender differences. The differences between Hispanics and Blacks are not discussed in depth due to the small sample size of Black immigrants. Third, female-only data of the three-race/ethnicity-groups are examined with race/ethnicity group dummy variables (WHB-Fem model; use Equation 6 to substitute $autochoice^*$ in Equation 3).

$$autochoice^*_{WHB-Fem} = \beta_{3f} X + \beta_{3H} X * Hispanic + \beta_{3B} X * Black + \varepsilon \quad \ldots(6)$$

WHB-Fem model assesses differences between Hispanic females and non-Hispanic White females.

Results

Gender differences and race/ethnicity group differences in the associations between factors and automobility

Tables 3 and 4 report signs and significance of the estimation results. Quantitative impacts are evaluated in the next subsection. Table 3 summarizes the results of automobility analysis for Hispanics. Model 1 is the baseline model (HSP-All). The left column in model 1 shows the signs and significance of the baseline coefficients, that is, those for Hispanic males. The right column in model 1 shows the signs and significance of the coefficients of

female cross-terms, namely, the gender differences in the coefficients among Hispanics. Model 2 shows the results of the Hispanic female-only model (HSP-Fem).

Table 4 summarizes selected results of the WHB-All and WHB-Fem models. Columns 1 and 2 show the signs and significance of coefficients for non-Hispanic White (NHW) males and females. Column 3 shows the gender differences for non-Hispanic Whites. Columns 4 and 5 show the signs and significance of race/ethnicity differences in the coefficients between Hispanic (HSP) males and non-Hispanic White males, and Hispanic females and non-Hispanic White females, respectively. Column 6 shows the race/ethnicity difference in gender difference between Hispanics and non-Hispanic Whites.

Hispanic male immigrants have higher automobility levels than their native counterparts, particularly if they immigrated to the U.S. before age 16 (Table 3 model 1). Among non-Hispanic Whites, immigrants do not show higher automobility compared to natives (Table 4 Column 1 and 3). After immigration, Hispanic males steadily increase automobility, and ten years post-immigration, their mobility level is not significantly different from those who have been in the U.S. for more than 15 years (Table 3 model 1).

In contrast, Hispanic female immigrants have significantly lower automobility than their native counterparts, even if they immigrated prior to age 16 and have stayed in the U.S. for more than 15 years (Table 3 model 2). Similar stagnation occurs for non-Hispanic White female immigrants compared to their native counterparts (Table 4 Column 2).[8] Although both male and female immigrants of Hispanics and non-Hispanic Whites increase their automobility as they stay longer in the U.S., the mobility levels of Hispanic and non-Hispanic

[8] Although both Hispanic female immigrants and non-Hispanic White female immigrants are significantly lower in the automobility than their native counterparts, these coefficients do not account directly for the magnitude of the difference. The next subsection discusses whether the difference is large in magnitude.

White female immigrants seem to stagnate compared to their male counterparts (Table 3 model 1 and 2, and Table 4 Columns 1 and 2).

Automobility level is higher if the person is a worker, has a bachelor's degree, or lives in a higher-income household, regardless of gender or race/ethnicity group (Table 3 models 1 and 2, and Table 4 Columns 1 and 2). The finding confirms what the theory of automobility suggests; namely, mobility level, worker status, and household income are inter-related and have positive associations. People with higher mobility are more likely to get (better-paying) jobs, thanks to a larger search radius and ability to commute. At the same time, people who are employed or have a high potential for earning high wage (i.e. well-educated) are more likely to become drivers and secure their own vehicle because their opportunity cost for travel time is much higher than for those who are unemployed and/or not well-educated. In addition to the personal value of time, household income is also important because a wealthier household may be able to afford an extra vehicle even for a person with low value-of-time.

Although the findings agree with the theory for all groups, associations with factors differ by gender and between Hispanics and non-Hispanic Whites. The associations with bachelor's degree and household income are slightly stronger for Hispanic females than for their male counterparts, suggesting that Hispanic females are de-prioritized in automobility unless they have high human capital or their household is sufficiently well-off (Table 3 model 1). The association with worker status is stronger for Hispanic males than for non-Hispanic White males, while it is weaker for Hispanic females than for non-Hispanic White females (Table 4 Columns 4 and 5). The gender difference in the coefficient of worker status is insignificant for Hispanics.

Regardless of race/ethnicity group or gender, an adult's automobility level decreases with each additional adult member of the same gender in the household (Table 3 models 1

and 2, and Table 4 Columns 1 to 3). Hispanic male adults are likely to share vehicles or become dependent on others' mobility when the household has another male adult (Table 3 model 1). However, the automobility of Hispanic males is barely lowered if the household has additional female adults. In contrast, Hispanic female adults are likely to share vehicles or become dependent on others' mobility when there is another adult member (either male or female) in the household, and they are particularly likely to have reduced automobility when that additional adult is female (Table 3 model 2). These negative associations with the number of adults of the same gender in the household are also observed for non-Hispanic White males and females (Table 4 Columns 1 and 2).

The number of children age 16 or 17 years is not associated with personal mobility level, regardless of the race/ethnicity group or gender (Table 3 models 1 and 2, and Table 4 Columns 1 and 2). In other words, children of driving age do not seem to be active drivers who equally share the vehicles or take a primary driving role in the household. The number of children younger than 16 years is significantly positive only for non-Hispanic White females, while it is insignificant for Hispanic males, Hispanic females, and non-Hispanic White males (Table 3 models 1 and 2, and Table 4 Columns 1 and 2). Since having more children under the driving age is likely to add demand for rides in a household, the finding suggests that non-Hispanic White females provide rides for children much more than their male counterparts or Hispanic female counterparts do.

Predicted automobility distribution by race/ethnicity group and by immigration status

The lists of coefficients from the ordered Probit model do not provide a full picture of the overall personal automobility distribution of each demographic group. Thus, I predict automobility levels as it relates to specific socioeconomic status, using the estimated coefficients in the WHB-All model. The predicted values are calculated mainly for working-class adults in a suburban neighborhood in a large metropolitan area, where access to

personal-vehicle transportation is critical. Specifically, the predictions are made for workers without bachelor's degrees with household income of $30,000. The households consist of one male adult, one female adult, and one child under 16 years old. The households are assumed to live in a metropolitan area in census region 2 (Midwest), where the population is one million or more and does not have rail service. Their residential census block group's population density is set at 3,000 people per square mile.

The top chart of Figure 1 shows the predicted automobility distribution for male and female U.S. natives of all three race/ethnicity groups. The predicted probabilities of being in each automobility level (zero to four) are shown from the bottom (the darkest gray, level zero) to the top (the lightest gray, level four). The bottom chart of Figure 1 shows the corresponding results for immigrants who immigrated to the U.S. 5 to 10 years ago, and who were 16 years or older when they immigrated.

Among natives, Hispanic males (86.2%) are as likely to be drivers with primary access to vehicle (level four) as non-Hispanic White males (84.7%) and females (88.9%) (Figure 1, top chart). Hispanic native females have significantly lower automobility than their male counterparts. These females are less likely to be drivers and less likely to enjoy the priority in accessing household vehicles, with only 69.5% at level four. Black native males and females do not show a significant gender difference in automobility, but both groups have lower probability of having level four automobility (72.4% and 73.8%, respectively) than their non-Hispanic White counterparts.

The gender gap in immigrant Hispanics is even more substantial than that for native Hispanics. Under the assumed conditions, only 41% of Hispanic female immigrants have automobility level four, compared to 75% of male counterparts (Figure 1, bottom chart). The low probability of a Hispanic female immigrant having level four automobility is also remarkable when compared with other female immigrants. Approximately 70% of non-

Hispanic White and Black female immigrants have automobility level four, which is 1.7 times of the corresponding probability for Hispanic female immigrants. Moreover, the probability of level four automobility for Non-Hispanic White female immigrants is only 4% lower than for their male counterparts, and for Black female immigrants it is 13% *higher* than for their male counterparts.

Figure 2 illustrates the predicted post-immigration adjustment that occurs for Hispanic immigrants, with comparisons to Hispanic U.S. natives. The top and bottom charts of Figure 2 show the predicted values for males and females, respectively. In each chart, the first four columns show the results of immigrants who immigrated at age 16 years or older, as based on length of stay in the U.S.: from the left to the right, the length of the stay in the U.S. is less than five years, 5 to 10 years, 10 to 15 years, and 15 years or longer, respectively. The fifth column shows the result for the immigrants who were younger than 16 years when they immigrated, and have stayed in the U.S. for 15 years or longer. The last column shows the result for Hispanic U.S. natives.

Within five years of immigration to the U.S., 83.1% of Hispanic males become drivers (automobility levels two through four), and three-quarters of these drivers secure their own vehicle (62.8% out of 83.1%) (Figure 2, the top chart). The automobility level increases steadily as immigrant Hispanic males stay longer in the U.S. Indeed, after 10 years of the stay in the U.S., more than 90% of Hispanic male immigrants are predicted to become drivers (levels two through four) and more than 85% of these drivers secure a vehicle (80.6% out of 93.3%). A Hispanic male immigrant who comes to the U.S. at age 16 years or younger has an even higher probability of being a driver and securing his own vehicle.

Hispanic female immigrants are much less likely to be drivers than their male counterparts, and even if they are drivers, they are much less likely than males to enjoy priority access to household vehicles (Figure 2, bottom chart). In addition, although Hispanic

female immigrants increase their automobility as they stay longer in the U.S., their automobility level remains much lower than their male counterparts. Within five years post-immigration, 55.5% of Hispanic female immigrants are predicted to become drivers, and 56% of these drivers (31% out of 55.5%) secure their own vehicle. Even after 10 years of stay in the U.S., less than 70% of Hispanic female immigrants are drivers, and less than two-thirds of the drivers have their own vehicle (44.7% out of 69.1%). Hispanic females who immigrated before age 16 have higher personal automobility than those who immigrated to the U.S. at age 16 or older, and more than 80% of them become drivers. However, even among those who immigrated at a younger age, the probability of a driver having her own vehicle is only about 75% (62.9% out of 83.2%).

This gender gap in automobility has a significant association with worker status and educational attainment. Figure 3 illustrates the predicted gender difference in automobility of Hispanics by worker status and educational attainment. The top chart shows predicted values for U.S. natives, and the bottom chart shows the values for immigrants who immigrated at age 16 years or older and have been in the U.S. for 5 to 10 years. Each chart has three sets of two columns. From left to right, the first set of columns shows results for *non-workers without bachelor's degrees*; the second set shows baseline results of *workers without bachelor's degrees*; and the third set shows *workers with bachelor's degrees*. In each set, values for males appear on the left and values for females on the right.

For all demographic groups, workers are higher in automobility than non-workers, and workers with bachelor's degrees are higher in automobility than workers without bachelor's degrees. Thus, as the theory suggests, having a faster and more flexible transportation option is likely to result in better labor market outcomes. Furthermore, being a worker and having higher human capital are likely to result in higher value of time, and higher value of time, in turn, adds incentives to increase automobility.

What is interesting in the findings is that the increase in automobility is particularly high for females, and the gender gap narrows for workers, especially for workers with bachelor's degrees (Figure 3). For example, among Hispanic immigrants who have been in the U.S. for 5 to 10 years (Figure 3, bottom chart), the gender gap in the probability of having the highest automobility level is 34.0% for non-workers, 34.4% for workers without bachelor's degrees, and 27.2% for workers with bachelor's degrees. Among the U.S. native Hispanics (Figure 3, top chart), the corresponding gender gap is 21.7% for non-workers, 16.7% for workers without bachelor's degrees, and 10.6% for workers with bachelor's degrees. This narrowing effect observed under the fully controlled condition may be even greater in practice because household income would increase as the number of (well-educated) household workers increases, and the income effect is stronger for females than males.

Although the gender gap in the automobility narrows, it persists even among workers with bachelor's degrees, and even among U.S. natives. The gender gap in automobility is observed both in the probability of being a driver and the probability of enjoying priority access to household vehicles. The probability of being a driver for Hispanic female immigrants is 46.8% for non-workers, 65.8% for workers without bachelor's degrees, and 74.3% for workers with bachelor's degrees, while corresponding values for males are 79.6%, 90.6%, and 92.0%, respectively. Even among U.S. natives, the probability of being a driver for Hispanic females is 74.4% for non-workers, 87.3% for workers without bachelor's degrees, and 91.8% for workers with bachelor's degrees, while corresponding values for males are 89.2%, 95.8%, and 96.5%. With regard to the probability of having a primarily-accessible vehicles for drivers (i.e. the proportion of people in automobility level four among drivers), the values for Hispanic female immigrants are predicted to be 50.8% for non-workers (23.8% out of 46.8%), 62.4% for workers without bachelor's degrees (41.0% out of

65.8%), and 68.4% for workers with bachelor's degrees (50.8% out of 74.3%), while corresponding values of male counterparts are 72.5%, 83.1%, and 84.8%, respectively. Even among U.S. natives, the probabilities of a Hispanic female driver having primary vehicle access are predicted to be 68.4% for non-workers, 79.6% for workers without bachelor's degrees, and 84.5% for workers with bachelor's degrees, while corresponding values for male counterparts are 81.5%, 90.0%, and 91.3%, respectively.

In sum, even when socioeconomic status is controlled and residential environment is not transit-friendly, Hispanic females, particularly Hispanic female immigrants, are predicted to be much lower in the automobility than their male counterparts or their female counterparts of other race/ethnicity groups. This lower automobility arises not only from the lower probability of being a driver but also from the lower priority in accessing household vehicles. Even when Hispanic immigrant females become drivers, they are less likely to enjoy full mobility of driving and may remain dependent on others' mobility. This large gender gap is specific to Hispanics, particularly for those who immigrated as adults, but is persistently observed even among U.S. natives. Non-Hispanic native and immigrant Whites are high in automobility, and the gender gaps within these groups are much smaller compared to their Hispanic counterparts. Blacks, whether native to the U.S. or immigrant, are lower in automobility than non-Hispanic Whites with comparable characteristics. However, Black females do not have lower automobility than Black males. The gender gap in automobility narrows, but does not disappear, when Hispanic females are working and have bachelor's degrees, and even if they are U.S. natives.

Conclusions and future directions

The analyses confirm the anecdotes from the focus group interviews conducted in the previous research. Namely, Hispanic female immigrants are low in personal automobility

both in the probability of being drivers and in drivers' priority access to household vehicles. This paper further finds that the gender gap in the automobility is specific to Hispanics, and persists even if immigrants stay long in the U.S., are a (well-educated) worker, or are U.S. natives.

The persistently low automobility among Hispanic female immigrants may have serious consequences in labor market outcomes. As Liu and Painter (2012) discuss, access to reliable private automobile transport is an effective way for low-income workers to overcome employment barriers and achieve economic objectives. Low automobility may contribute to Hispanic female immigrants' unemployment or to locally–concentrated gendered ethnic employment. As a result, Hispanic female immigrants may be trapped in a vicious cycle of low-labor market value and low-automobility: low-automobility deprives them of higher paying jobs or skill-building opportunities, and with lower (observed) labor market values, Hispanic female immigrants remain de-prioritized in increasing their automobility.

A question arising from this paper is why the gender gap in automobility persists among U.S. native Hispanics. Immigrants may keep their home country's culture in gender role and labor divisions, which can result in different automobility outcomes compared to U.S. natives. However, a person born and raised in the U.S. can generally easily become a driver, should have more work options than immigrants, and may be well exposed to the U.S culture of driving and gender roles. Thus, the factors that are likely to explain the gender gap in automobility among Hispanic immigrants may not be applicable to the Hispanic U.S. natives.

A limitation of this paper is not being able to detect causal relationships between labor market outcomes and personal automobility, or the reasons for the gender gap in automobility among Hispanics. The National Household Travel Survey data employed in the analyses are not panel data and lack narratives of the inter-personal relationships among household

members. Future research is anticipated to explore whether and how much Hispanic (immigrant) females are deprived of economic opportunities due to this de-prioritization in adding personal automobility, and why the gender gap in automobility is observed among Hispanics, even among U.S. natives.

Appendix

Following tables show full regression results of four models examined in the article. Table 5 shows full regression results of the HSP-All and HSP-Fem models. The left column of the HSP-All model shows the coefficients of the baseline explanatory variables, the coefficients for Hispanic males, and the right column of the HSP-All model shows the coefficients of the cross-terms with female dummy variable (i.e., gender differences in the coefficients). Table 6 shows the results of WHB-All model. The first column shows the coefficients of baseline explanatory variables (i.e., coefficients for non-Hispanic White males). The second and third columns of Table 6 show race/ethnicity difference among males. The second column shows the coefficients for cross-terms with a Hispanic dummy variable, and the third column shows those for cross-terms with a Black dummy variable. The fourth column shows gender differences in coefficients among non-Hispanic Whites, namely, the coefficients for female cross-terms. The fifth and sixth columns show the coefficients for double cross-terms. They show race/ethnicity differences in gender difference in coefficients for Hispanics compared with non-Hispanic Whites and for Blacks compared with non-Hispanic Whites, respectively. Table 7 shows the results of WHB-Fem model, which explains race/ethnicity differences in coefficients among females. The first column shows the coefficients for baseline explanatory variables (i.e., coefficients for non-Hispanic White females). The second and third columns show the coefficients for cross-terms with Hispanic and Black dummy variables, respectively.

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Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Authors' contribution

M Matsuo: Content planning, literature search and review, data construction and analysis, manuscript writing and editing.

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Tables

Table 1: Descriptive statistics of the data

	Three Groups Total	Whites			Hispanics			Blacks		
		Natives	Immigrants	(All-imm HHs [a])	Natives	Immigrants	(All-imm HHs)	Natives	Immigrants	(All-imm HHs)
Obs. Total (Age 22 to 69)	**176,461**	**139,504**	**12,002**	(2,451)	**6,297**	**8,108**	(3,425)	**9,517**	**1,033**	(429)
Male	79,674	63,628	5,611	(1,096)	2,790	3,608	(1,544)	3,596	441	(173)
Female	96,787	75,876	6,391	(1,355)	3,507	4,500	(1,881)	5,921	592	(256)
% Driver		**96.2%**	**95.9%**	94.9%	**91.4%**	**82.1%**	80.0%	**84.8%**	**88.3%**	85.1%
Male		96.5%	97.7%	97.4%	93.5%	92.0%	91.5%	86.3%	92.7%	90.2%
Female		95.9%	94.4%	92.8%	89.7%	74.2%	70.6%	83.9%	85.0%	81.6%
Num. of Households	**134,187**	**105,904**	**8,593**	(1,908)	**4,809**	**6,191**	(2,650)	**7,902**	**788**	(331)
Avg. Household Size		**2.56**	**2.86**	(2.31)	**3.00**	**3.72**	(3.40)	**2.52**	**3.16**	(2.77)
(Std. Dev.)		(1.20)	(1.30)	(1.23)	(1.47)	(1.58)	(1.58)	(1.33)	(1.50)	(1.54)
The Number of Adults (18+)		**2.04**	**2.20**	(1.78)	**2.15**	**2.44**	(2.08)	**1.97**	**2.18**	(1.81)
(Std. Dev.)		(0.66)	(0.69)	(0.63)	(0.81)	(0.90)	(0.74)	(0.80)	(0.84)	(0.75)
Num. of Drivers		**2.01**	**2.12**	(1.71)	**1.99**	**2.00**	(1.67)	**1.71**	**1.93**	(1.59)
(Std. Dev.)		(0.72)	(0.72)	(0.67)	(0.86)	(0.94)	(0.82)	(0.85)	(0.84)	(0.78)
%HHs without Driver		**0.93%**	**0.44%**	1.36%	**2.64%**	**3.12%**	5.28%	**5.85%**	**3.81%**	6.34%
Num. of Actv Non-Com Veh [b]		**2.19**	**2.20**	(1.68)	**1.94**	**1.73**	(1.50)	**1.69**	**1.74**	(1.36)
(Std. Dev.)		(1.06)	(0.69)	(0.86)	(1.10)	(1.08)	(0.92)	(1.20)	(1.11)	(0.93)
%HHs without Actv Non-Com Veh		**1.93%**	**1.52%**	3.93%	**6.09%**	**9.32%**	9.85%	**13.25%**	**10.79%**	15.71%
Active Non-Cm Veh per Dr		**1.10**	**2.16**	(1.00)	**0.97**	**0.86**	(0.89)	**0.94**	**0.88**	(0.81)
(Std. Dev.)		(0.46)	(1.01)	(0.46)	(0.48)	(0.48)	(0.49)	(0.59)	(0.52)	(0.52)
Non-Driver per Driver (if any)		**0.28**	**0.38**	(0.34)	**0.55**	**1.03**	(1.13)	**0.47**	**0.67**	(0.69)
(Std. Dev.)		(0.53)	(0.60)	(0.58)	(0.82)	(1.16)	(1.22)	(0.77)	(0.89)	(0.91)

Source: National Household Travel Survey 2009

a: If all adult members (18+ yrs old) are immigrants, the household is considered to be all-immigrant household

b: Active non-comm. vehicles are cars, vans, SVUs, and trucks without commercial license plates that are used in the previous year.

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Table 2 Distribution of personal automobility level by worker status

Non-Hispanic White Natives						
Mobility Level	Male			Mobility Level	Female	
	Non-Worker	Worker			Non-Worker	Worker
0	3.3%	0.8%		0	3.0%	0.7%
1	6.2%	1.0%		1	6.0%	1.0%
2	5.7%	5.6%		2	7.5%	3.2%
3	4.0%	2.8%		3	5.5%	2.7%
4	80.7%	89.7%		4	78.1%	92.3%
Total	17,649	45,987		Total	30,615	45,272

Non-Hispanic White Immigrants						
Mobility Level	Male			Mobility Level	Female	
	Non-Worker	Worker			Non-Worker	Worker
0	2.0%	0.9%		0	2.0%	0.9%
1	4.2%	0.9%		1	8.7%	2.0%
2	7.7%	6.1%		2	8.3%	4.4%
3	5.9%	3.8%		3	5.7%	3.5%
4	80.2%	88.3%		4	75.2%	89.2%
Total	1,286	4,326		Total	2,597	3,796

Hispanic Natives						
Mobility Level	Male			Mobility Level	Female	
	Non-Worker	Worker			Non-Worker	Worker
0	9.2%	1.7%		0	9.3%	3.0%
1	11.0%	1.5%		1	12.3%	2.3%
2	7.4%	6.7%		2	9.1%	4.7%
3	3.7%	3.1%		3	2.9%	3.2%
4	68.6%	87.0%		4	66.4%	86.7%
Total	725	2,065		Total	1,433	2,074

Hispanic Immigrants						
Mobility Level	Male			Mobility Level	Female	
	Non-Worker	Worker			Non-Worker	Worker
0	12.5%	4.3%		0	11.1%	6.1%
1	10.8%	2.8%		1	28.8%	9.7%
2	8.2%	7.8%		2	10.9%	9.5%
3	4.2%	3.6%		3	3.9%	3.8%
4	64.3%	81.6%		4	45.3%	71.0%
Total	784	2,824		Total	2,312	2,190

Black Natives						
Mobility Level	Male			Mobility Level	Female	
	Non-Worker	Worker			Non-Worker	Worker
0	17.2%	4.9%		0	21.6%	6.3%
1	13.4%	3.1%		1	11.5%	3.2%
2	8.3%	7.0%		2	6.3%	6.2%
3	4.1%	2.8%		3	3.0%	2.7%
4	57.0%	82.1%		4	57.6%	81.7%
Total	1,451	2,145		Total	2,617	3,304

Black Immigrants						
Mobility Level	Male			Mobility Level	Female	
	Non-Worker	Worker			Non-Worker	Worker
0	12.0%	4.9%		0	16.0%	9.9%
1	10.3%	1.5%		1	12.8%	5.2%
2	6.8%	7.7%		2	15.4%	7.9%
3	3.4%	3.4%		3	3.7%	2.5%
4	67.5%	82.4%		4	52.1%	74.5%
Total	117	324		Total	188	404

Source: National Household Travel Survey 2009

Table 3 Personal automobility level (0 to 4) of Hispanics

Ordered Probit y: autochoice (0-4)	(1) HSP-All		(2) HSP Fem
	BASE Male	FEM F-M Diff	
Immigrant	+ +	- -	- -
Imm. at 16yr old or older	-	ns	- -
Immigrant 10 to 15 yrs	ns	ns	- -
Immigrant 5 to 10 yrs	- -	ns	- -
Immigrant 0 to 5 yrs	- -	ns	- -
Worker	+ +	ns	+ +
College	+ +	+	+ +
Worker*College	-	ns	- -
ln(HH Income)	+ +	+ +	+ +
Num. of Male Adult in HH	- -	(+)	-
Num. of Female Adult in HH	ns	-	- -
Num. of Children 16-17 yr old	ns	ns	ns
Num. of Children U16	ns	ns	ns
Female Dummy	✓		
One-Adult HH Dummy	✓		✓
ln(Pop Density)	✓		✓
Urban Size	✓		✓
Census Region	✓		✓
Wald Chi2	2,950		1,949
Log Pseudo Likelihood	-11,030		-6,667
Pseudo R2	0.142		0.157
Observations	13,760		7,589

Source: National Household Travel Survey 2009
Errors are clustered by household
+ + / - - p<0.01, + / - p<0.05, (+) / (-) p<0.1

Table 4 Difference in coefficients among demographic groups

Ordered Probit y: autochoice (0-4)	(1) NHW M	(2) NHW F	(3) NHW F vs. NHW M	(4) HSP M vs. NHW M	(5) HSP F vs. NHW F	(6) HSP vs. NHW in Gender Diff
Immigrant	ns	− −	− −	+ +	ns	− −
Immigrate afte 16 yr old	ns	−	ns	ns	ns	ns
Immigrant 10 to 15 yrs	−	ns	ns	ns	ns	ns
Immigrant 5 to 10 yrs	− −	− −	ns	ns	ns	ns
Immigrant 0 to 5 yrs	− −	− −	ns	ns	ns	ns
Worker	+ +	+ +	+ +	+ +	− −	− −
College	+ +	+ +	ns	ns	+ +	(+)
Worker*College	− −	− −	− −	ns	ns	ns
ln(HH Income)	+ +	+ +	+ +	(+)	+	ns
Num. of Male Adult in HH	− −	− −	+ +	+ +	ns	−
Num. of Female Adult in HH	(−)	− −	− −	ns	+	ns
Num. of Children 16-17 yr old	ns	ns	ns	ns	ns	ns
Num. of Children U16	ns	+ +	+ +	ns	−	−
Model	WHB-All	WHB-Fem	WHB-All	WHB-All	WHB-Fem	WHB-All
Cross-terms with			Fem	HSP	HSP	HSP & Fem

Source: National Household Travel Survey 2009
Errors are clustered by household
+ + / − − p<0.01, + / − p<0.05, (+) / (−) p<0.1

Table 5 Full regression results for Hispanics (HSP-All and HSP-Fem models)

Ordered Probit y: autochoice (0-4)	(1) HSP-All		(2) HSP Fem
	BASE Male	FEM F-M Diff	
Female Dummy		-0.626*	
		(0.372)	
Immigrant	0.182***	-0.359***	-0.178***
	(0.0466)	(0.0585)	(0.0386)
Imm. at 16yr old or older	-0.305**	0.0528	-0.259***
	(0.128)	(0.154)	(0.0996)
Immigrant 10 to 15 yrs	-0.117	-0.0944	-0.217***
	(0.0931)	(0.104)	(0.0583)
Immigrant 5 to 10 yrs	-0.291***	-0.0101	-0.305***
	(0.0808)	(0.0928)	(0.0523)
Immigrant 0 to 5 yrs	-0.646***	0.0761	-0.581***
	(0.115)	(0.127)	(0.0716)
Worker	0.491***	-0.00524	0.494***
	(0.0472)	(0.0580)	(0.0355)
College	0.328***	0.243**	0.580***
	(0.0995)	(0.119)	(0.0701)
Worker*College	-0.241**	-0.0828	-0.332***
	(0.113)	(0.142)	(0.0886)
ln(HH Income)	0.390***	0.0723***	0.474***
	(0.0240)	(0.0275)	(0.0194)
Num. of Male Adult in HH	-0.136***	0.0725*	-0.0620**
	(0.0330)	(0.0396)	(0.0248)
Num. of Female Adult in HH	0.00938	-0.0957**	-0.0869***
	(0.0332)	(0.0414)	(0.0298)
Num. of Children 16-17 yr old	0.0864	0.0133	0.104
	(0.106)	(0.128)	(0.0878)
Num. of Children U16	0.0489	-0.163	-0.118
	(0.136)	(0.159)	(0.106)
One-Adult HH Dummy	-0.000515	0.0479	0.0292
	(0.0974)	(0.116)	(0.0659)
ln(Pop Density)	-0.0658***	-0.0272	-0.0962***
	(0.0176)	(0.0209)	(0.0142)
Urban Size 2	0.158	-0.0130	0.147*
	(0.0993)	(0.118)	(0.0819)
Urban Size 3	0.130	0.0328	0.169**
	(0.0864)	(0.0982)	(0.0684)
Urban Size 4	0.176**	-0.118	0.0619
	(0.0751)	(0.0870)	(0.0585)
Urban Size 5	-0.0219	-0.0205	-0.0442
	(0.0779)	(0.0908)	(0.0618)
Urban Size 6	0.0599	-0.0449	0.0160
	(0.0802)	(0.0949)	(0.0655)
Census Region 2	0.758***	-0.152	0.629***
	(0.144)	(0.156)	(0.109)
Census Region 3	0.737***	0.0621	0.823***
	(0.0799)	(0.0883)	(0.0673)
Census Region 4	0.565***	0.165*	0.753***
	(0.0801)	(0.0883)	(0.0677)
Constant cut1	2.430***		3.052***
	(0.324)		(0.256)
Constant cut2	3.141***		3.924***
	(0.322)		(0.257)
Constant cut3	3.536***		4.294***
	(0.321)		(0.258)
Constant cut4	3.677***		4.429***
	(0.321)		(0.258)
Wald Chi2	2,950		1,949
Log Pseudo Likelihood	-11,030		-6,667
Pseudo R2	0.142		0.157
Observations	13,760		7,589

Source: National Household Travel Survey 2009
Robust standard errors in parentheses
Errors are clustered by household
*** p<0.01, ** p<0.05, * p<0.1

Table 6 Full regression results for pooled data (WHB-All model)

Ordered Probit y: autochoice (0-4)	(1) WHB-All					
	BASE	HSP	BLK	FEM	HF	BF
	NHW Male	HSP M vs. NHW M	BLK M vs. NHW M	NHW F vs. NHW M	HSP vs. NHW in Gender Diff	BLK vs. NHW in Gender Diff
Race/ethnicity Dummy		-1.264***	-1.898***			
		(0.341)	(0.382)			
Female Dummy				-0.772***	0.123	0.693
				(0.140)	(0.397)	(0.450)
Immigrant	0.0129	0.169***	0.150	-0.122***	-0.240***	-0.0148
	(0.0346)	(0.0580)	(0.116)	(0.0441)	(0.0732)	(0.143)
Imm. at 16yr old or older	-0.00904	-0.289	-0.703*	-0.326	0.373	1.160**
	(0.219)	(0.253)	(0.365)	(0.250)	(0.293)	(0.520)
Immigrant 10 to 15 yrs	-0.218**	0.106	-0.0363	0.0919	-0.191	-0.247
	(0.0972)	(0.134)	(0.280)	(0.121)	(0.160)	(0.348)
Immigrant 5 to 10 yrs	-0.411***	0.121	0.577*	0.135	-0.150	-0.523
	(0.102)	(0.130)	(0.305)	(0.125)	(0.156)	(0.341)
Immigrant 0 to 5 yrs	-0.611***	-0.0367	0.349	-0.107	0.181	-0.434
	(0.101)	(0.153)	(0.386)	(0.128)	(0.180)	(0.421)
Worker	0.302***	0.186***	0.242***	0.303***	-0.303***	-0.276***
	(0.0167)	(0.0498)	(0.0567)	(0.0219)	(0.0617)	(0.0733)
College	0.249***	0.0758	0.0951	0.0293	0.218*	0.00915
	(0.0252)	(0.103)	(0.106)	(0.0310)	(0.123)	(0.128)
Worker*College	-0.137***	-0.0982	-0.106	-0.145***	0.0552	0.169
	(0.0290)	(0.117)	(0.128)	(0.0377)	(0.147)	(0.154)
ln(HH Income)	0.342***	0.0435*	0.194***	0.0671***	0.00630	-0.127***
	(0.00956)	(0.0259)	(0.0293)	(0.0118)	(0.0299)	(0.0338)
Num. of Male Adult in HH	-0.249***	0.108***	-0.0337	0.162***	-0.0878**	0.0660
	(0.0138)	(0.0357)	(0.0463)	(0.0176)	(0.0433)	(0.0574)
Num. of Female Adult in HH	-0.0261*	0.0338	0.00324	-0.126***	0.0313	-0.0212
	(0.0147)	(0.0363)	(0.0472)	(0.0188)	(0.0454)	(0.0571)
Num. of Children 16-17 yr old	0.0432	0.0411	-0.0104	-0.0465	0.0571	-0.0854
	(0.0368)	(0.113)	(0.123)	(0.0454)	(0.137)	(0.148)
Num. of Children U16	-0.0177	0.0685	-0.0454	0.186***	-0.347**	0.0871
	(0.0507)	(0.146)	(0.181)	(0.0640)	(0.172)	(0.212)
One-Adult HH Dummy	0.0556*	-0.0406	-0.158*	0.238***	-0.180	-0.249**
	(0.0295)	(0.101)	(0.0916)	(0.0383)	(0.121)	(0.108)
ln(Pop Density)	-0.0675***	0.00352	-0.0927***	-0.00327	-0.0239	0.0402
	(0.00548)	(0.0184)	(0.0242)	(0.00691)	(0.0221)	(0.0283)
Urban Size 2	0.0440	0.114	-0.0117	-0.0233	0.00893	0.115
	(0.0271)	(0.103)	(0.0940)	(0.0345)	(0.123)	(0.114)
Urban Size 3	0.0667**	0.0634	0.0176	-0.0346	0.0636	0.129
	(0.0285)	(0.0906)	(0.110)	(0.0364)	(0.105)	(0.130)
Urban Size 4	0.0624***	0.111	0.0220	-0.0472	-0.0725	0.0377
	(0.0238)	(0.0785)	(0.0869)	(0.0304)	(0.0923)	(0.106)
Urban Size 5	-0.0764***	0.0573	0.0521	-0.100***	0.0769	0.104
	(0.0268)	(0.0821)	(0.0997)	(0.0339)	(0.0970)	(0.118)
Urban Size 6	-0.0133	0.0699	-0.130	-0.0869***	0.0435	0.230**
	(0.0218)	(0.0829)	(0.0952)	(0.0278)	(0.0989)	(0.113)
Census Region 2	0.391***	0.355**	0.0615	-0.162***	0.00641	0.230
	(0.0241)	(0.145)	(0.142)	(0.0303)	(0.159)	(0.163)
Census Region 3	0.362***	0.359***	0.133	-0.0825***	0.148	0.401***
	(0.0172)	(0.0812)	(0.101)	(0.0220)	(0.0909)	(0.117)
Census Region 4	0.171***	0.375***	0.376***	0.0619**	0.108	0.205
	(0.0211)	(0.0821)	(0.119)	(0.0274)	(0.0923)	(0.137)
Constant cut1	1.189***					
	(0.113)					
Constant cut2	1.729***					
	(0.113)					
Constant cut3	2.175***					
	(0.113)					
Constant cut4	2.362***					
	(0.113)					
Wald Chi2	17,808					
Log Pseudo Likelihood	-93,048					
Pseudo R2	0.110					
Observations	166,440					

Source: National Household Travel Survey 2009
Robust standard errors in parentheses
Errors are clustered by household
*** p<0.01, ** p<0.05, * p<0.1

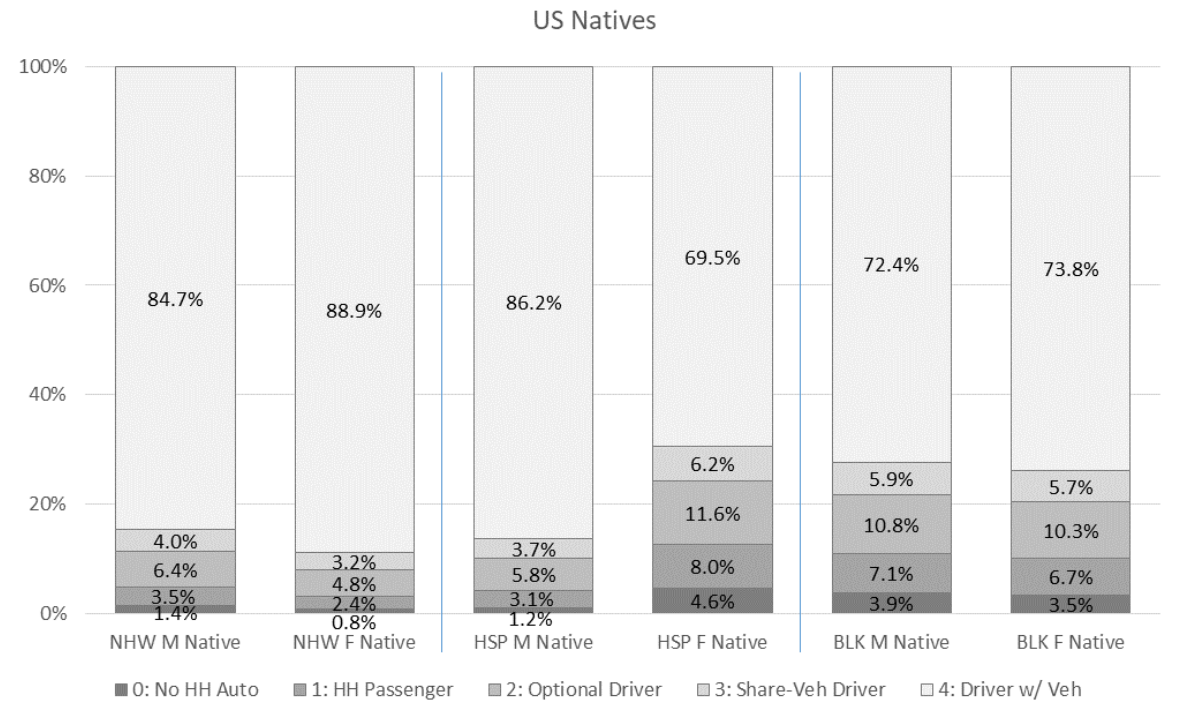
Table 7 Full regression results for female pooled data (WHB-Fem model)

Ordered Probit y: autochoice (0-4)	(1) WHB-Fem		
	BASE NHW F	HSP HSP F vs. NHW F	BLK BLK F vs. NHW F
Race/ethnicity Dummy		−1.145***	−1.220***
		(0.268)	(0.315)
Immigrant	−0.108***	−0.0703	0.135
	(0.0284)	(0.0472)	(0.0927)
Imm. at 16yr old or older	−0.334**	0.0833	0.455
	(0.140)	(0.169)	(0.378)
Immigrant 10 to 15 yrs	−0.125	−0.0859	−0.285
	(0.0822)	(0.0997)	(0.213)
Immigrant 5 to 10 yrs	−0.275***	−0.0293	0.0533
	(0.0787)	(0.0935)	(0.214)
Immigrant 0 to 5 yrs	−0.716***	0.144	−0.0852
	(0.0841)	(0.108)	(0.204)
Worker	0.604***	−0.117***	−0.0325
	(0.0146)	(0.0372)	(0.0471)
College	0.277***	0.293***	0.105
	(0.0188)	(0.0716)	(0.0751)
Worker*College	−0.282***	−0.0426	0.0630
	(0.0252)	(0.0908)	(0.0944)
ln(HH Income)	0.409***	0.0503**	0.0677***
	(0.00836)	(0.0205)	(0.0237)
Num. of Male Adult in HH	−0.0869***	0.0211	0.0332
	(0.0127)	(0.0272)	(0.0381)
Num. of Female Adult in HH	−0.151***	0.0645**	−0.0178
	(0.0136)	(0.0319)	(0.0374)
Num. of Children 16-17 yr old	−0.00324	0.0995	−0.0964
	(0.0351)	(0.0935)	(0.115)
Num. of Children U16	0.167***	−0.279**	0.0431
	(0.0501)	(0.116)	(0.163)
One-Adult HH Dummy	0.290***	−0.222***	−0.408***
	(0.0254)	(0.0689)	(0.0612)
ln(Pop Density)	−0.0709***	−0.0206	−0.0529***
	(0.00505)	(0.0148)	(0.0194)
Urban Size 2	0.0208	0.123	0.103
	(0.0250)	(0.0838)	(0.0786)
Urban Size 3	0.0322	0.127*	0.147
	(0.0267)	(0.0717)	(0.0913)
Urban Size 4	0.0152	0.0393	0.0600
	(0.0224)	(0.0613)	(0.0724)
Urban Size 5	−0.177***	0.134**	0.157*
	(0.0256)	(0.0655)	(0.0809)
Urban Size 6	−0.100***	0.114*	0.1000
	(0.0204)	(0.0670)	(0.0780)
Census Region 2	0.229***	0.365***	0.293***
	(0.0221)	(0.108)	(0.112)
Census Region 3	0.280***	0.509***	0.536***
	(0.0163)	(0.0669)	(0.0785)
Census Region 4	0.234***	0.485***	0.583***
	(0.0206)	(0.0684)	(0.0927)
Constant cut1	1.945***		
	(0.101)		
Constant cut2	2.530***		
	(0.101)		
Constant cut3	2.939***		
	(0.101)		
Constant cut4	3.136***		
	(0.101)		
Wald Chi2	12,908		
Log Pseudo Likelihood	−52,132		
Pseudo R2	0.127		
Observations	90,934		

Source: National Household Travel Survey 2009
Robust standard errors in parentheses
Errors are clustered by household
*** p<0.01, ** p<0.05, * p<0.1

Figures

Fig. 1: Distribution of predicted personal automobility by demographic group



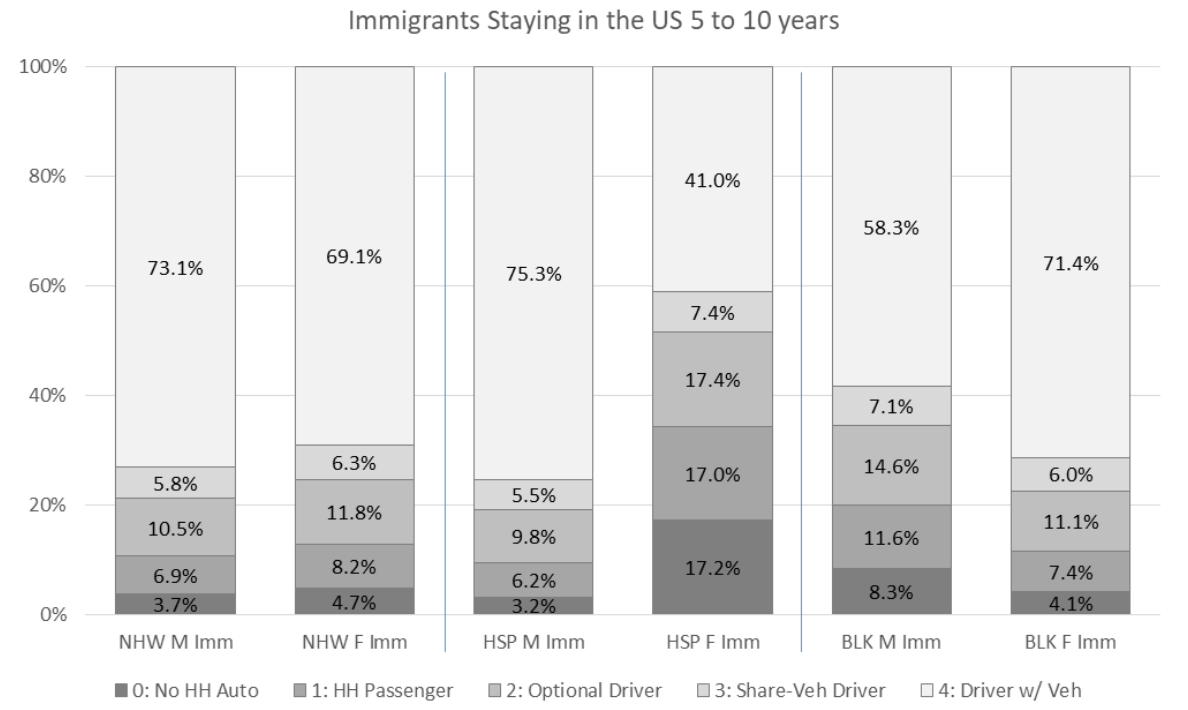
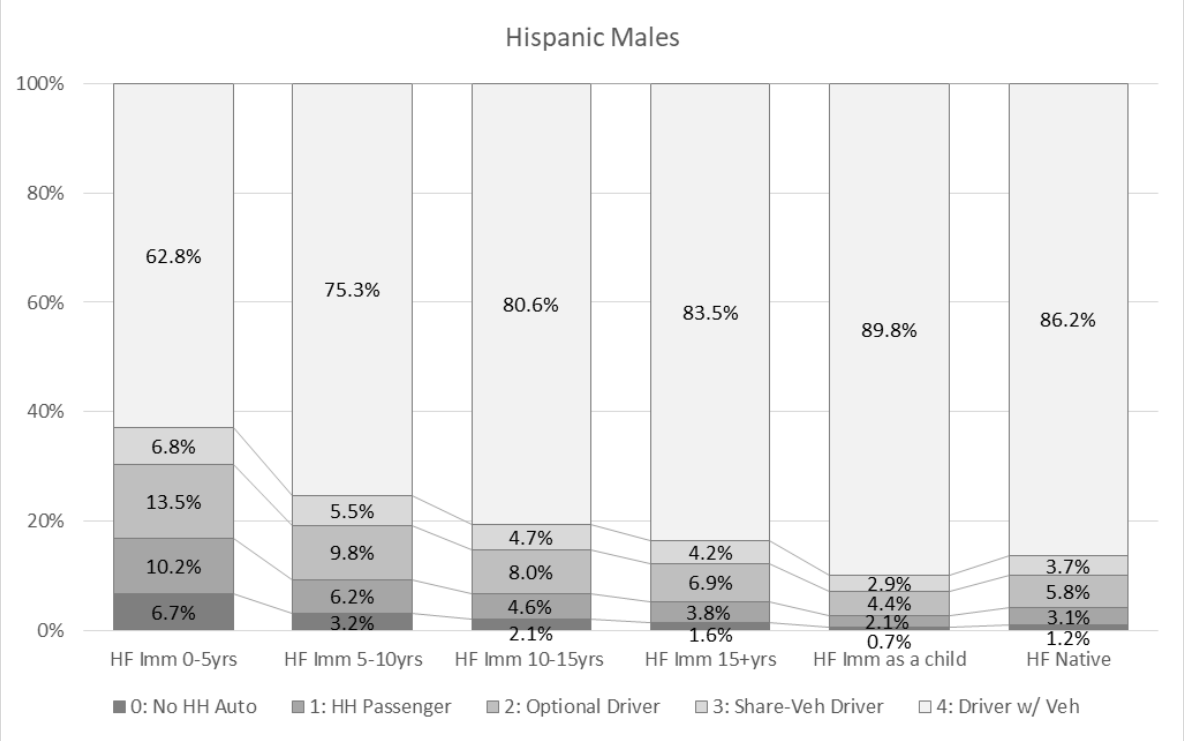


Fig. 2: Predicted change in personal automobility for Hispanics after the immigration



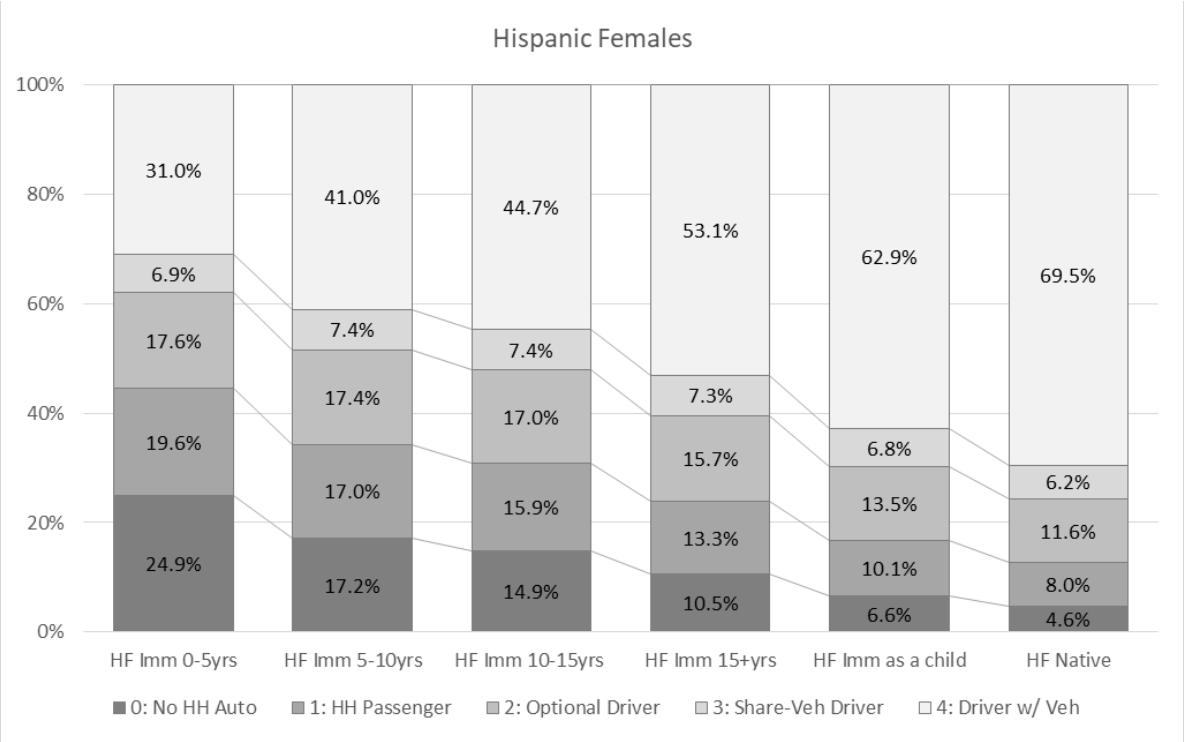


Fig. 3: Predicted gender difference in personal automobility for Hispanics by worker status and educational attainment level