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Hidden Costs of Carpooling in Family Life: Travel Behavior of Hispanic Families with Children in the US*

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HIDDEN COSTS OF CARPOOLING IN FAMILY LIFE: TRAVEL BEHAVIOR OF HISPANIC FAMILIES WITH CHILDREN IN THE US

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ABSTRACT

In the U.S., Hispanic immigrant households who have low access to private vehicles typically depend on carpooling rather than taking transit, the tendency that is not observed for immigrants of other race/ethnicity groups. Moreover, my previous paper reveals that females of Hispanic immigrants are heavily dependent on others' mobility and delay becoming drivers, even though they seem to choose auto-dependent lifestyle at household level. These findings leave a question how much time is wasted by dependence on carpooling when many household members are transportation disadvantaged, such as children under driving age. This paper explores travel characteristics of Hispanic immigrant households with children in the following points; (1) whether they are lower mobility at household level, (2) whether adult members' time is wasted for transporting children, and (3) whether children's total travel time and active non-commuting trip frequency are different by the number of drivers and/or vehicles in the household, using the National Household Travel Survey data of 2009.

Keywords: Mobility, Immigrants, Hispanics, Children, National Household Travel Survey

1. INTRODUCTION

Travel behavior of Hispanic immigrant families deserves research attention because they are large and growing population in the U.S. and because their travel behavior is different from that of non-Hispanic Whites or other minority groups. Hispanic population is the largest minority group in the U.S., and it is growing due to legal and illegal immigration and their high fertility rate (American Community Survey 1-year summary 2015; Riviera-Batiz, 2001). Hispanic immigrants are known to have different mobility characteristics compared to U.S. natives or immigrants of other race/ethnicity groups. They carpool more when they face limited access to private vehicles, and dependence on carpooling are known to have some negative impacts on their employment status and efficiency in the use of time (Blumenberg and Smart, 2010; Blumenberg and Smart, 2014; Bohon, Stamps, and Atiles, 2008; Chatman and Klein, 2009; Chatman and Klein, 2013; Cline, Sparks, and Eschbach, 2009; Lovejoy and Handy, 2008; Lovejoy and Handy, 2011; Tal and Handy, 2010; Valenzuela, Schweitzer, and Robles, 2005).

Matsuo (2016) poses a further question about the costs of carpooling for life of Hispanic families, particularly for Hispanic immigrant families. Her paper finds that Hispanic immigrant females are remarkably less likely to be drivers compared to Hispanic immigrant males and females of other race/ethnicity groups, while Hispanic immigrant households seem to choose auto-dependent lifestyle. The finding leaves a question how Hispanic immigrant family manage their travel needs with limited number of drivers, particularly for fulfilling travel needs of children.

This paper explores travel characteristics of Hispanic immigrant households with children in the following points; (1) whether they are lower mobility at household level, (2) whether adult members' time is wasted for transporting children, and (3) whether children's total travel time and active non-commuting trip frequency are different by the number of

drivers and/or vehicles in the household. The analyses find that Hispanic immigrant families have two gendered characteristics in travel behavior: Hispanic immigrant females dependent on other's mobility, yet, they are expected to take primary role in transporting children. This gendered characteristics is stronger for Hispanic immigrants than that is observed for Hispanic natives and immigrants of other race/ethnicity groups. The number of vehicles and drivers in the household appears not to limit the frequency of children's active non-commuting trip, but their total time spent for transportation is longer for carpooling-dependent families.

2. TRAVEL VEHAVIOR OF HISPANIC IMMIGRANT FAMILIES

Hispanic immigrants, particularly recent arrivals, are less likely to own a car, more likely to drive fewer miles, and more likely to carpool than their U.S. native counterparts (Blumenberg and Smart, 2010; Blumenberg and Smart, 2014; Casas, Arce, and Frye, 2004; Chatman and Klein, 2009; Tal and Handy, 2010; among others). Mobility of immigrants may be low because they have difficulties in becoming a driver and in owning their own private vehicle. Becoming drivers is difficult if they are not proficient in English, and is impossible if they are undocumented. Purchasing vehicles is also difficult for many immigrants because of their financial capacity. Immigrants from low-to-middle income countries send a significant portion of their earnings to family or creditors in their home country, and they face limited opportunities and even discrimination in obtaining automobile loans or credit. (Blumenburg and Smart, 2011; Chatman and Klein, 2013; Cohen, 2006).

Autoless Hispanic immigrants often fill their mobility gap by carpooling both inside and outside the household (Blumenberg and Smart, 2010; Shin 2017). Hispanic immigrants in their ethnic communities share a ride with friends and neighbors, and such carpooling with non-household members can be either with or without explicit compensation (Lovejoy and

Handy, 2011). Carpooling may save monetary costs of owning private vehicles (as well as environmental costs and congestion externalities), but it accompanies with other costs. Generally, carpooling associates with higher time cost: longer travel time and needs for schedule adjustments with accompanying members. In addition, if they do not have other transportation options, dependence on other mobility associates with opportunity costs in labor market. Job search is more difficult without personal mobility, and regular and reliable commuting may not be possible if they have to ask for a ride every time. It may also accompany monetary cost if they ask for a ride to non-household member with compensation. Research finds that those who asking for a ride suffers from overpayment because of low negotiation power. Even if they can get a ride without monetary compensation, those who asking for a ride tend to be burdened by guilt of free ride (Lovejoy and Handy, 2011).

The costs of high carpooling-dependence unevenly distributed to females. Bohon, Stamps, and Atiles (2008) find that Hispanic female immigrants in Hispanic immigrant communities in Georgia have limited transportation options, which prevents access to training and employment opportunities. More specifically, their study finds that for primary workers (typically males) in the Hispanic immigrant households, employers often provide commuter bus services. However, there are few transportation options for other members or their other travel needs. Bohon et al (2008) also found that the residential locations of Hispanic immigrants often lack public transit service, and those immigrants must rely on very inconvenient carpooling. As a result, the households' non-primary workers, who are more likely to be females, are often isolated in the ethnic community and experience low wages and unemployment.

Matsuo (2016) confirms the gendered mobility characteristics among Hispanic immigrants using nation-wide travel survey data. Namely, Hispanic female immigrants are much less likely to be drivers than Hispanic male immigrants or female immigrants of other

race/ethnicity groups, and their probability of being a driver stagnates at least for a decade. Yet, Hispanic immigrant households seem to choose auto-dependent lifestyle. Hispanic male immigrants become drivers soon after their arrival to the U.S., and drive as much mile as their non-Hispanic White counterparts or U.S. native counterparts. Moreover, when Hispanic female immigrants become a driver, she drives as much as (or more than) female immigrants of other race/ethnicity group. The findings pose a question how Hispanic immigrant households manage their household travel needs with a limited number of drivers, particularly when they have children under the driving age.

3. RESEARCH DESIGN AND DATA

Three analyses are conducted to explore how Hispanic family with children manage their travel needs. First, I examine the household choice of the mobility level: the driver status of adults and vehicle ownership in households with children under 16 years old. The driver status is examined by Logit model (Equation 1), and the probability of being a driver is described as a function of personal characteristics (X), household characteristics (A_h), and environmental characteristics (A_e),

$$\mathrm{L}(\mathrm{DRIVER} = 1) = \frac{\exp(F(X,A_h,A_e))}{1+\exp(F(X,A_h,A_e))} \qquad \ldots(1)$$

$$\text{s.t., } F(X, A_h, A_e) = \beta_X X + \beta_h A_h + \beta_e A_e$$

where β_X, β_h, β_e are coefficients of personal characteristics, household characteristics, and environmental characteristics, respectively. This analysis of driver status replicates Matsuo (2016) to confirm whether greater gender difference in the driver status is observed for Hispanics (particularly Hispanic immigrants) even after limiting observations to adults in the households with children. The differences between genders, between native and immigrant households, and differences among different race/ethnicity groups are examined using regression with cross-terms.

The number of vehicles in a household with children under 16 years old is assessed using Poisson model (Equation 2). The natural log of the number of vehicles in the household (*vehcnt*) is described as a function of household characteristics (A_h) and environmental characteristics (A_e).

$$\ln(vehcnt) = \gamma_h A_h + \gamma_e A_e \quad \ldots(2)$$

, where γ_h and γ_e are the coefficients of household characteristics and environmental characteristics, respectively. Poisson model is employed because such countable observation with zero truncation is known to follow Poisson distribution. The differences between native and immigrant households as well as differences among race/ethnicity groups are examined by employing cross-terms.

The second analysis explores how much time adult members of the household transport their children using Tobit model. Tobit model is employed because the observation is limited to only who made such trips (Equation 3). For this analysis, time spent for transporting children is defined as an adult trips made solely for pick up, take and wait, or dropping off children who are traveling for active non-commuting purpose (e.g., shopping or social/recreational)[1]. Figure 1 illustrates the examples of trips considered in the analysis. Home-based transport children trip includes five types of trips: (a) a trip by adult for picking up children, (b) a home trip with children after the pick-up, (c) a trip to drop-off children who is travelling for active non-commuting purpose, (d) a home trip of the adult after the drop off (d), and (e) recurring take and wait trip. The adult's time spent for transporting children are travel times of (a) , (b), (c), and (d), and dwell time comes after (a) and (c). With regard to take and wait trip (e), as long as children's trip purpose is non-active commuting and the

[1] Active non-commuting trip is defined as the trip purpose is none of the followings "home", "work", "school", "transport someone", or "other". "Other" is not considered as active because it appears to include being a passenger of transporting someone trips. Examples of active purpose trip includes shopping, social/recreational, personal business, and meal.

adult's trip purpose is take and wait, the adult time spent for transportation and dwell time are considered to be the time spent for children trips.

More generally, trips for transporting children may be a part of multi-trip tour. Extra time spent for transporting children within the multi-trip tour should be examined as the difference in travel time from counter-factual tour (i.e., the tour that would have made if there is no trip for transporting children). Due to the difficulty in estimating travel time of such a counter-factual tour, this research considers home-based trips for transporting children and non-home-based "transport someone" trip. Namely, only trip type (f) is considered to be a not-home-based transport children trip.[2]

The time spent for transporting children (*trpChldMin*) is described as a function of personal characteristics of individual (*driver* and X), household characteristics (A_h) and environmental characteristics (A_e),

$$trpChldMin = \begin{cases} y^* & \text{if } y^* > 0 \\ 0 & \text{if } y^* \leq 0 \end{cases} \quad \ldots(3)$$

where $y^* = \delta_{drv} * driver + \delta_X X + \delta_h A_h + \delta_e A_e$

where δ_{drv}, δ_X, δ_h and δ_e are their coefficients, respectively. Tobit model is employed because the dependent variable left-truncated at zero and is recorded only for those who made such a trip. Difference between genders and race/ethnicity groups are particularly explored through the model with cross-terms.

The third analysis examines whether the children's active trip frequency and total travel time are affected by the household-level mobility choice. Children may reduce active trip if their transportation option is limited, and if they refrain from taking unnecessary trips total daily travel time would be shorter. If they do not give up trips despite low personal

[2] For precise analysis, extra time spent for transporting children would be the travel time difference between current travel time and the counter factual tour that does not include transporting children. However, this counter-factual analysis is not possible due to data availability.

vehicle availability, their total travel time would be longer. They have to make a multi-stop tour to reach destination because they carpool with others, or if they take transit instead of using private car because transit is usually slower than auto.

Children's trip frequency of active non-commuting trip (*activecnt*) is examined using Poisson model to address whether active trip frequency is different between race/ethnicity groups or by socioeconomic characteristics (Equation 4).

$$\ln(activecnt) = \theta_{drvcnt} drvrcnt + \theta_{vehcnt} vehcnt + \theta_X X + \theta_h A_h + \theta_e A_e \quad \ldots(4)$$

Then, children's total travel time (*CTotTrvlTime*) is examined using Tobit model (Equation 5).

$$CTotTrvlTime = \begin{cases} y^{**} & \text{if } y^{**} > 0 \\ 0 & \text{if } y^{**} \leq 0 \end{cases} \quad \ldots(5)$$

where $y^{**} = \varphi_{drvcnt} * drvrcnt + \varphi_{vehcnt} * vehcnt + \varphi_X X + \varphi_h A_h + \varphi_e A_e$

In both analyses, the associations with the number of drivers in the household (*drvrcnt*) and the number of vehicles in the household (*vehcnt*) are explicitly examined together with personal, household, and environmental characteristics (X, A_h, A_e). In the equations, θ_{drvcnt}, θ_{vehcnt}, θ_X, θ_h, θ_e, φ_{drvcnt}, φ_{vehcnt}, φ_X, φ_h, φ_e are the estimated coefficients, respectively.

Throughout the analyses, I employ gender, age, and age squared as personal characteristics. Household family income (in natural log), race/ethnicity group of household respondent, and immigration status of the household are examined as household characteristics[3]. In addition, residential density and residing regions are controlled as

[3] Immigration status of the household is categorized as follows. First, a household is categorized as immigrant household if at least one of the adult members is immigrant. Among immigrant households, the household is considered to be an all-immigrant household if all adult members are immigrants. All-immigrant households are categorized by the length of their stay in the U.S. of the longest-staying adult member. For example, suppose a household consists of two immigrant adult members (one is staying in the U.S. for eight years and the other staying in the U.S. for three years) and a U.S.-born children. That family is categorized as an all-immigrant household staying five to ten years.

environmental characteristics. The existence of rail service in the metropolitan area is dropped from the analysis because it does not have significant association in any assessment.

In the assessment of data, travel groups are identified by (1) the combination of household members who were on the trip and (2) travel start time and end time. For example, if a trip record of person 1 in household X says that person 2 and 3 of the same household were on the trip and the trip started at 8:30AM and ended at 9AM, the same trip should be recorded for the person 2 and 3 of the household X. Thus, a single group trip ID number is given to these three records. One group trip may include multiple purposes. For example, a group trip of one adult and two children may have three trip purposes: one child is traveling for social/recreational purpose, an adult member transporting the child, and the other child is in the vehicle simply because he/she is not expected to be left home alone.

Data used for the analyses are obtained from National Household Travel Survey (NHTS) of 2009. The NHTS data contains household characteristics, person characteristics of the household members, and the trip record of the members. Analysis focuses on households with at least one child whose age is 15 years old or younger[4]. Although this paper considers 18 years old or older as adults following the definition in the dataset, children whose age are 16 years old or older are not treated as children because they are more likely to be drivers by themselves. To assess regular pattern of transporting children, the analysis considers the households that (1) everyone in the household completed the daily trip survey, and (2) all the children were in town.

Table 1 summarizes descriptive statistics of three demographic groups considered in the analysis, non-Hispanic Whites, Hispanics, and non-Hispanic Black/Afro Americans (hereafter, Blacks). The data contains 331,300 trip records of 82,211 individuals in 23,454

[4] NHTS data does not include travel data of household members who were younger than 5 years old. Individuals who were out of town entire observation day were excluded from the analysis.

households. Among them, 70,160 trips are made by 30,123 children whose age between 5 and 15.[5] Non-Hispanic Whites share 83% of trip records, Hispanics share 11% of trip records, and Blacks 5.5% of trip records, respectively. Approximately 10% of the non-Hispanic Whites' trip records, 64% of the Hispanics' trip records, and 16% of Blacks' trip records are from people in immigrant household.[6]

Most households own at least one vehicle and at least one driver adult but the share is lower for Hispanic immigrant households. Among Hispanic all-immigrant households, 8% of them have no vehicle, and their vehicle per adult is as low as 0.82. In combination of lower probability of being a driver and higher probability of one-adult household, only 66.3% of Hispanic all-immigrant households have multiple drivers in the household. In contrast, Hispanic natives are likely to own vehicles, and become drivers (96.6% of household own at least one vehicle and 96.6% of adults are drivers). With regard to non-Hispanic Whites, more than 98% of households own at least one vehicle, and more than 97% of non-Hispanic White adults are drivers, even if they are immigrants. The number of vehicles owned and the probability of being a driver is lower for Black natives, and Black immigrants.

Female adults make more trips than male adults, and natives make slightly more trips than immigrants. Male adults make more commuting trips than female adults, while female adults make more transport someone trips than male adults. The difference in trip frequency is not large among race/ethnicity group, but Hispanics seem to make slightly more trips than people in other race/ethnicity groups.

[5] Data of children under four years old are not included in the database.
[6] Households are considered to be immigrant households if there is at least one adult member who is immigrant. The households are considered to be all-immigrant households if all the adult members of the household are immigrant.

4. RESULTS

4.1. Driver status

Table 2 shows logistic regression results of driver status for three demographic groups: the first one for non-Hispanic Whites, the second one for Hispanics, and the third one for Blacks. The left columns of each model summarizes the baseline coefficients (i.e., coefficients for males), and the right column of each model summarizes the coefficients for female-cross-terms with explanatory variables (i.e., gender difference in coefficients). The models in Table 3 help us to interpret Table 2 by showing inter-race/ethnicity group differences in coefficients and inter-race/ethnicity group differences in gender difference of coefficients. The first model of Table 3 examines pooled data of three demographic groups using double-cross terms. In this model, the baseline explanatory variables are examined together with their cross-terms with race/ethnicity group dummy variables and with female dummy variable. The base column shows the baseline coefficients (i.e., coefficients for non-Hispanic White males). The Hispanic and Black columns show the coefficients of cross-terms with Hispanic and Black dummy variables respectively, which explain the race/ethnicity group difference in explanatory variable coefficients among males. The female column shows the coefficients of cross-terms with female dummy variables, which explain the gender differences in coefficients among non-Hispanic Whites. Last, the Hispanic female and Black female columns show the coefficients of cross-terms with Hispanic and female dummy variables as well as Black and female dummy variables, respectively. The results in the Hispanic female and Black female columns explain the race/ethnicity group differences in the gender differences. The second model of Table 3 shows the regression results of female-only data with race/ethnicity cross-terms, which explain the race/ethnicity group differences in coefficients among females.

As found by Matsuo (2016), Hispanic males are not significantly different from non-Hispanic White males in many ways, while Hispanic females have different characteristics

from non-Hispanic White females (Hispanic cross-terms in Table 3 Models 1 are mostly insignificant, while those in Table 3 Model 2 are significant). Hispanic male immigrants are as much likely to be drivers as U.S. native counterparts, while Hispanic females are less likely to be drivers than their U.S. native counterparts. The tendency is also seen to non-Hispanic whites. The joint-significance tests of immigration status-related coefficients in Table 1 Models 1 and 2 are insignificant for baseline coefficients (i.e., for males) but their female cross-terms are jointly significant. The difference between natives and immigrants is not significantly different between non-Hispanic Whites and Hispanics, for both males and females (Hispanic cross-terms in Table 2 Model 1 for males and Hispanic cross-terms in Table 2 Model 2 for females). Blacks seem to have different native-immigrant difference in the probability of being a driver, possibly because of small sample size.

When people reside in a household with multiple adults, Hispanics show strong gender divide in taking driver role. Based on the significance and magnitude of the coefficients for the number of adults and a single adult dummy variable, Hispanic males are more likely (not less likely) to be drivers when they live in multiple-adult households, while Hispanics females are significantly less likely to be drivers. In other words, Hispanic females are more likely to be dependent on other's mobility when they live with other adults. This gendered driver-role is not observed for non-Hispanic White households, and only weakly observed for Black households.

One noticeable race/ethnicity group difference common to males and females are the sensitivity to household income; the driver status of Hispanic males are less sensitives to household income than non-Hispanic White males, which is also true for Hispanic females compared to non-Hispanic White females.

Table 4 shows the results of Poisson regression with immigrant household cross-terms for each demographic group, the first one for non-Hispanic Whites, the second one for

Hispanics, and the third one for Blacks. The right columns of the models in Table 4 show the baseline coefficients (i.e., coefficients for U.S. native households), and the left columns show the coefficients of cross-terms with immigrant household dummy variables (i.e., the native-immigrant difference in coefficients). As in the previous analysis, the first model of Table 5 shows the regression results of pooled data of three demographic groups with double-cross terms; cross-terms with race/ethnicity group dummy and cross-terms with immigrant household dummy. The second model of Table 5 shows the regression results of immigrant household-only with race/ethnicity cross-terms.

Immigrants own fewer vehicles than U.S. natives when they first arrive to the U.S. As they stay longer, non-Hispanic White immigrants increase their vehicle ownership, while Hispanics seem to find the way to manage their life with fewer vehicles and stick with it instead. Immigration status variables in the Table 4 Models 1 and 2 are negative and significant, and the magnitude is smaller for those who stay in the U.S. longer. In contrast, the association with immigration status is more persistent with Hispanic immigrants. The negative coefficients of the dummy variables for immigrants staying in the U.S. 5 to 10 years and 10 to 15 years are significantly stronger for Hispanics than that for non-Hispanic Whites (Table 5 Model 1, Hispanic immigrant column). The coefficients for Black immigrants are not significantly different from that for non-Hispanic Whites.

Households with many adult members and/or higher income own more vehicles. However, Hispanic and Black U.S. native households add fewer vehicles than non-Hispanic White U.S. native households when they have more adults in their household (Table 5 Model 1). The association with the number of adults in the household is not significantly different among immigrant households of different race/ethnicity groups. However, the difference between one- and two-adult households are greater for Hispanic immigrant households (Table 5 Model 2). The association with income is not significantly different between U.S.

natives and immigrants, while it is significantly stronger for minorities. The stronger association for minority may be because there is discrimination against minorities in obtaining auto loans as Cohen (2006) explains.

Higher population density is associated with fewer auto ownership, but the association is weaker for Hispanic households than that for non-Hispanic White households. The association with density is particularly weaker for Hispanic immigrants when compared with non-Hispanic White immigrants. Hispanic immigrants appears to be reluctant to use transit even if they live in high-density neighborhood with more transit option.

To visualize the differences between demographic groups, Figure 2 illustrates the association between the household family income and the projected number of vehicles using the coefficients estimated in Table 4. The top graph shows the association for two-adult households and the bottom graph shows the association for one-adult households. In both graphs, the color of lines describes the race/ethnicity group and the line type describes the immigration status. Blue lines are for non-Hispanic Whites and black lines are for Hispanics, and the solid lines are for U.S. native households and the dotted lines are for immigrant households.

Both graphs show that households tend to own vehicle even if their income is low, and the tendency is particularly stronger for non-Hispanic Whites and the U.S. natives. In two-adult households, people seem to obtain the first vehicle as soon as they are possible, regardless of their demographic status. However, when they consider about purchasing second vehicle, Hispanic immigrants seem to hesitate to purchase one if their income is not high. When it comes to one-adult households, Hispanic households (both natives and immigrants) do not seem to own a vehicle when their income is low.

4.2. Transporting children

The next question would be how they manage their travel needs with or without cars, particularly for those who need transportation supports like children. Three models in Table 6 examines the gender difference in travel time spent for transporting children for adults of each race/ethnicity group. The baseline coefficients are shown to the left, and their cross-terms with a female dummy variable are shown to the right. As previous analysis, Table 7 follows up Table 6. Model 1 assesses pooled data of three demographic groups with double-cross-terms, and Model 2 assesses female-only data with race/ethnicity cross-terms.

The analysis finds that drivers spend significantly longer time for transporting children than their non-driver counterparts, and the difference is particularly greater for Hispanic females. Regardless of the race/ethnicity group, the difference between drivers and non-drivers is greater for females than males (Table 7 Model 1 for non-Hispanic Whites and Table 6 Models 2 and 3 for Hispanics and Blacks). And regardless of their gender, the difference is greater for Hispanics and Blacks than for non-Hispanic Whites (Table 7 Models 1 and 2). As a result, Hispanic females faces the greatest increase in the time spent for transporting children if non-drivers become drivers.

Interestingly, higher income is associated with longer time spent for transporting children for all demographic groups (Table 6 Models 1 to 3). The income effect is stronger for males than females if they are Hispanics, while it is stronger for females than for males if they are non-Hispanic Whites or Blacks (Table 6 Model 1 to 3 and Table 7 Model 1). People in a household with higher income spend longer time for transporting children, possibly because they can afford more after-school activity for children. The gender differences in the association with household income can be explained at least one of the following three reasons. The first one is that households with higher income are more likely to own vehicles for secondary drivers, which enables secondary drivers to make more frequent and flexible trips for transporting children. The second is that if they hesitate to add vehicles the income

effect might be small. The third is that if one of the gender group already take major role in transporting children, there may be little room for household income to affect transportation behavior. The first one is consistent with the stronger income effects for non-Hispanic White females and Black females, and the second and third ones explain the weaker income effects for Hispanic females.

People in households with many adults spend less time for transporting children because they can share the role with other adult members. The difference in time spent for transporting children by Hispanic males in one-adult household and two-adult household is smaller than the difference those who in two-adult households and three-adult households. Hispanic males may have to take transporting role because their adult partner (who is likely to be females) are less likely to be drivers or less likely to be primary drivers. In contrast, non-Hispanic White males spend dramatically shorter time for transporting children if live in two-adult households than those who live in one-adult households, while non-Hispanic White females are not exempted the role much even if they live with another adult. In one-adult household, non-Hispanic White males seem to spend their time for transporting children, but when they live with another adult (in many cases, with female adult), they let the other do the job.

The difference between immigrants and natives are relatively small for Hispanics than non-Hispanic Whites, regardless of their gender. Non-Hispanic White male immigrants spend significantly longer time for transporting children than U.S. native counterparts, while the difference is much smaller for non-Hispanic White females (Table 7 Model 1). When they are immigrated to the U.S., first, males seem to become drivers and take dominant role in transporting children. As they stay longer in the U.S., females also become drivers (or become more active drivers) and take more parts in transporting children. With regard to Hispanic males, the immigrant-native difference is much smaller than non-Hispanic White

males, and it is large only when they stay in the U.S. more than 10 years. The gender difference in immigrant-native difference for time spent for transporting children is smaller for Hispanics (Table 7 Model 1). Hispanic female immigrants spend significantly less time for transporting children when they are just immigrated to the U.S., but as they stay longer than 5 years, they spend as much time as U.S. native counterparts (Table 6 Model 2). Although Hispanic immigrant females are substantially less likely to be drivers than male counterparts and persistently less likely to be drivers even years after the immigration, they seem to take the role of transporting children a few years after the immigration.

4.3. Children's travel behavior

Table 8 explains the travel behavior of children in terms of the number of trips made for active non-commuting trip purpose (Model 1) and total time spent for travelling (Model 2). Children's active non-commuting trip frequencies are almost solely explained by the household income and race/ethnicity differences are not observed (Table 8 Model 1). Children in higher-income household make more active non-commuting trip, while the number of adults in the household is negatively associated with the trip frequency. The strong positive association with income suggests that children's non-school activities is luxury goods. The negative association with the number of adults in the household may adjusting the household income effect caused by increase in the number of workers in the household. Other factors, such as the number of vehicles, the number of drivers in the household, the immigration status, and the race/ethnicity group do not have significant associations with the active trip frequency.

Total travel time is unaffected by the number of drivers, but for Hispanics, it has significant association with household vehicles (Table 8 Model 2). Hispanic children in a household with many vehicles spend shorter time for transportation, which is consistent with the hypothesis of wasting time because of carpooling. Children in immigrant households,

particularly in recently-immigrated households spend less time for travel, which appears to reflect their unfamiliarity with the region. Household income is not significantly associated with total travel time. It suggests that children in lower household income makes fewer trips but spend longer travel time per trip because they have to take slower transportation mode such as transit or carpooling.

5. CONCLUSION AND FUTURE DIRECTIONS

Overall, the analyses find that two gendered expectations in Hispanic immigrant households; one is deprioritized mobility of females and the other is the high expectation for females in taking transporting children. Hispanic immigrant households own fewer vehicles even after a decade of stay in the U.S., and male adults take dominant role in driving in the household. The stagnation of females becoming drivers and the low-number of vehicles owned by households is specific to Hispanic immigrants, and not observed for non-Hispanic White or Black immigrant counterparts. Hispanic immigrant households also tend not to increase the number of vehicles much even when they are in a household with many adults. They seem to carpool and delay the purchase of second or third vehicle, compared to non-Hispanic White households in a comparable situation. One-adult Hispanic immigrant households are also less likely to purchase a vehicle and rely on other's mobility.

Hispanic females appears to face particularly strong expectation to take the role of transporting children. Due to low probability of being a driver, Hispanic males still take the role of transporting children even if they live in a two-adult household. But when Hispanic females become drivers, they seem to take a large proportion of duty and spend long time for transporting children. Hispanic female immigrants spend shorter time for transporting children soon after their immigration to the U.S. But they start transporting children after five

year from their immigration, although they are reluctant to become drivers even after years of immigration.

Last, children's active trip frequency seems to be unaffected by the numbers of vehicles or drivers in the household. However, carpooling appears to make children's total travel time longer because they have to detour for making multiple stops.

The findings suggest that high dependence on carpooling often seen in Hispanic immigrant families add costs of extra time spent for transportation. The cost is unevenly distributed to females and children because they are more likely to face take role of transporting others and spend longer multi-stop trips due to carpooling. Further research is anticipated to explore whether the access to transit reduce the costs associated with carpooling.

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TABLES

Table 1: Descriptive Statistics of the Data

	Three Groups Total	NH Whites			Hispanics			Blacks		
Num. of HH with Children U16	29,151	22,982			4,093			2,076		
100% members completed survey	23,454	19,234			2,751			1,469		
HHs with children under 16yr old (everyone completed travel survey)										
		Natives	Immigrants		Natives	Immigrants		Natives	Immigrants	
				All-immigrant households (*)			All-immigrant households			All-immigrant households
One adult HH (smallest 0-5yr old)	496	246	13	13	49	61	56(**)	122	5	4
Two adult HH (smallest 0-5yr old)	8,921	6,407	799	158	443	831	561	346	95	47
One adult HH (smallest 6-12yr old)	1,750	1,188	45	43	96	114	99	284	23	22
Two adult HH (smallest 6-12 yr old)	12,287	9,408	1,128	219	426	731	425	493	101	55
%HH by num of vehicles										
0	1.8%	0.8%	0.9%	1.8%	3.4%	6.3%	8.1%	10.1%	6.3%	7.8%
1	12.1%	9.4%	9.0%	19.4%	16.1%	27.7%	35.2%	28.6%	19.2%	29.5%
2+	86.0%	89.9%	90.1%	78.8%	80.6%	66.0%	56.7%	61.3%	74.6%	62.8%
Avg. vehicle per adult		1.22	1.11	1.07	1.09	0.86	0.82	1.02	0.96	0.91
%HH by num of drivers										
0	0.7%	0.3%	0.3%	0.7%	1.3%	2.9%	3.9%	3.7%	1.3%	2.3%
1	10.5%	8.1%	4.9%	14.1%	15.3%	21.8%	29.7%	32.8%	17.0%	26.4%
2+	88.8%	91.6%	94.8%	85.2%	83.4%	75.2%	66.3%	63.5%	81.7%	71.3%
% adults being a driver		98.3%	97.2%	97.2%	96.6%	87.2%	85.2%	93.4%	93.6%	93.4%
People in HHs with children under 16yr old (everyone completed travel survey)										
		Natives	Immigrants		Natives	Immigrants		Natives	Immigrants	
				All-immigrant households (*)			All-immigrant households			All-immigrant households
People in a HH with children U16	82,211	60,409	7,109		3,440	6,515		3,970	768	
Adult members (age 18+) observed	49,072	35,929	4,334	852	2,094	3,903	2,378	2,332	480	255
Children age 16 or 17yr old	3,016	2,214	243	53	110	266	178	153	30	16
Children age 13-15yr old	8,955	6,737	701	156	339	620	402	491	67	38
Children age 5-12yr old	21,168	15,529	1,831	397	897	1,726	1,206	994	191	123
Num. of trips recorded	331,300	247,237	28,788	5,909	13,400	23,927	14,847	15,144	2,804	1,447
Trips made by children 13-15 yr old	28,493	21,754	2,223	529	1,054	1,797	1,138	1,495	170	92
Trips made by children 5-12 yr old	70,160	52,260	5,956	1,224	2,859	5,489	3,736	3,076	520	301
Avg. num. of trips										
Male adults	4.78	4.74	4.68	4.55	5.09	4.89	3.85	5.22	4.96	3.99
Female adults	5.60	5.58	5.09	4.76	6.19	5.86	4.09	5.91	5.17	3.91
Children 13-15	3.63	3.62	3.44	3.39	3.91	3.71	2.83	3.83	3.07	2.42
Children 5-12	3.82	3.80	3.47	3.08	4.12	4.14	3.10	3.98	3.47	2.45
Avg. num. of commuting/school/daycare trips										
Male adults	1.04	1.06	0.99	0.86	1.05	1.02	0.79	0.89	0.98	0.87
Female adults	0.70	0.70	0.58	0.50	0.77	0.67	0.46	0.87	0.86	0.72
Children 13-15	0.75	0.74	0.67	0.65	0.82	0.81	0.58	0.85	0.82	0.74
Children 5-12	0.75	0.74	0.68	0.68	0.80	0.84	0.59	0.89	0.86	0.71
Avg. num. of trips to transport someone (70)										
Male adults	0.40	0.38	0.41	0.52	0.46	0.46	0.36	0.46	0.61	0.54
Female adults	0.82	0.81	0.74	0.77	0.91	0.93	0.61	0.82	0.75	0.59

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

**: The number of adults are two or more for 7 HHs whose lifecycle is "one adult with youngest child age 0-5" because the household have grown-up children (18+ years old)

Table 2: Probability of Being a Driver of Adults in a Households with Children

Logistic Regression y: Prob. of being a Driver	(1) NHW Base	Female	(2) Hispanic Base	Female	(3) Black Base	Female
Female		NS		NS		NS
Age	0.247*** (0.0165)	NS	0.237*** (0.0280)	-0.0691** (0.0341)	0.152*** (0.0341)	NS
Age^2	-0.00256*** (0.000179)	NS	-0.00268*** (0.000297)	NS	-0.00162*** (0.000358)	NS
Immigrant (*)	NS	-1.032*** (0.347)	NS	-0.820*** (0.268)	NS	NS
Imm 10 to 15 yrs (*)	NS	NS	NS	-0.666* (0.363)	13.50*** (0.543)	-14.44*** (0.877)
Imm 5 to 10 yrs (*)	NS	NS	NS	NS	-1.469** (0.744)	2.137** (0.934)
Imm 0 to 5 yrs (*)	NS	NS	-0.811** (0.380)	NS	NS	-1.322* (0.781)
ln(HH Family Income)	1.057*** (0.0639)	NS	0.661*** (0.0882)	NS	0.648*** (0.0992)	NS
Number of Adults	-0.541*** (0.0667)	NS	-0.452*** (0.0757)	0.257*** (0.0827)	-0.587*** (0.141)	NS
Single Adult Dummy	NS	NS	-1.068*** (0.405)	1.567*** (0.454)	-1.339*** (0.408)	0.822* (0.462)
ln(Population Density)	-0.0623* (0.0373)	-0.0941** (0.0463)	NS	-0.109* (0.0605)	NS	NS
BEA Regions	Included		Included		Included	
Constant	-10.89*** (0.908)		-7.463*** (1.543)		9.769 (6.427)	
Joint significance tests (5% level)						
Immigrantion status (*)	NS	significant	NS	significant	significant	significant
Observations	43,120		7,533		3,508	
Log Pseudo Likelihood	-3790.5829		-2182.9528		-938.72793	
Pseudo R2	0.2866		0.2715		0.2434	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Significance Tests for Race/Ethnicity Differences in Coefficients of Table 1

Logistic Regression y: Prob. of being a Driver	(1) All Base	Hispanic	Black	Female	Hisp Fem	Blk Fem	(2) Female Base	Hispanic	Black
Race/ethnicity		+	+ + +					+ + +	+ + +
Female				NS	NS	NS			
Age	+ + +	NS	- -	NS	- -	NS	+ + +	- - -	- - -
Age^2	- - -	NS	+ +	NS	+	NS	- - -	+ + +	+ + +
Immigrant (*)	NS	NS	NS	- - -	NS	NS	- - -	NS	+ + +
Imm 10 to 15 yrs (*)	NS	NS	+ + +	NS	NS	- - -	NS	NS	NS
Imm 5 to 10 yrs (*)	NS	NS	NS	NS	NS	+ +	- - -	NS	+
Imm 0 to 5 yrs (*)	NS	NS	NS	NS	NS	NS	- - -	NS	NS
ln(HH Family Income)	+ + +	- - -	- - -	NS	NS	NS	+ + +	- - -	- - -
Number of Adults	- - -	NS	NS	NS	+ +	NS	- - -	+ + +	NS
Single Adult Dummy	NS	-	- -	NS	+ +	NS	NS	NS	- -
ln(Population Density)	-	NS	NS	- -	NS	NS	- - -	+	NS
BEA Regions	Included						Included		
Joint significance tests (5% level)									
Immigrantion status (*)	NS	NS	significant	significant	NS	significant	significant	NS	significant
Observations	54,161						29,607		
Log Pseudo Likelihood	-6912.264						-4509.393		
Pseudo R2	0.3328						0.3471		

+ + +/- - - p<0.01, + + / - - p<0.05, +/- p<0.1, NS insignificant

Table 4: The Number of Vehicles in a Household with Children

Poisson Regression y: HH Vehicle Count	(1) NHW Base	Immigrant	(2) Hispanic Base	Immigrant	(3) Black Base	Immigrant
Race/ethnicity						
Immigrant HH (*)		NS		NS		NS
All Immigrant HH (*)		-0.0823*** (0.0191)		-0.0552*** (0.0185)		NS
Imm 10 to 15 yrs (*)		NS		-0.172*** (0.0251)		NS
Imm 5 to 10 yrs (*)		-0.0860*** (0.0326)		-0.169*** (0.0293)		NS
Imm 0 to 5 yrs (*)		-0.111*** (0.0421)		-0.156*** (0.0497)		NS
ln(HH Family Income)	0.132*** (0.00461)	NS	0.213*** (0.0158)	NS	0.253*** (0.0150)	NS
Number of Adults	0.239*** (0.00590)	NS	0.207*** (0.0187)	NS	0.196*** (0.0208)	NS
Single Adult HH	-0.236*** (0.0157)	0.178*** (0.0677)	-0.233*** (0.0543)	NS	-0.324*** (0.0442)	NS
ln(Population Density)	-0.0491*** (0.00173)	NS	-0.0358*** (0.00745)	NS	-0.0638*** (0.00795)	NS
BEA Regions	included		included		included	
Joint significance tests (5% level) Immigrantion status (*)		significant		significant		NS
Observations	22,743		4,027		2,056	
Log pseudo likelihood	-34645.894		-5754.2254		-2917.7281	
Pseudo R2	0.0377		0.0674		0.0965	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5 Significance Tests for Race/Ethnicity Differences in Coefficients of Table 4

Poisson Regression y: HH Vehicle Count	(1) All Base	Hispanic	Black	Immigrant	Hisp Imm	Blk Imm	(2) Immigrant Base	Hispanic	Black
Race/ethnicity		- - -	- - -					- - -	- - -
Immigrant HH (*)				NS	NS	NS			
All Immigrant HH (*)				- - -	NS	NS	- - -	NS	NS
Imm 10 to 15 yrs (*)				NS	- - -	NS	NS	- - -	NS
Imm 5 to 10 yrs (*)				- - -	-	NS	- - -	-	NS
Imm 0 to 5 yrs (*)				- - -	NS	NS	- - -	NS	NS
ln(HH Family Income)	+ + +	+ + +	+ + +	NS	NS	NS	+ + +	+ + +	+ + +
Number of Adults	+ + +	-	- -	NS	NS	NS	+ + +	NS	NS
Single Adult HH	- - -	NS	-	+ + +	-	NS	NS	- -	NS
ln(Population Density)	- - -	+	-	NS	NS	NS	- - -	+ + +	NS
BEA Region	Included						Included		
Joint significance tests (5% level)									
Immigrantion status (*)				significant	significant	NS	significant	significant	NS
Observations	28,826						4,976		
Log pseudo likelihood	-43316.157						-7165.7987		
Pseudo R2	0.0513						0.0614		

+ + +/- - - p<0.01, + + / - - p<0.05, +/- p<0.1, NS insignificant

Table 6 Travel Time Spent for Transporting Children

Tobit Model y: time spent for transporting children (min)	(1) NHW Base	 Female	Sig. of F Coeff	(2) Hisp Base	 Female	Sig. of F Coeff	(3) Blk Base	 Female	Sig. of F Coeff
Female		NS			-69.75*** (1.700)			88.13*** (1.777)	
Driver	NS	NS	***	31.63*** (1.358)	18.68*** (1.611)	***	18.78*** (1.484)	7.680*** (1.729)	***
Immigrant (*)	NS	NS	NS	NS	NS	NS	11.90*** (1.645)	NS	***
Immigrant10to15 (*)	NS	NS	NS	6.895*** (2.024)	NS	***	NS	-48.36*** (3.770)	***
Immigrant5to10 (*)	NS	NS	NS	-8.521*** (1.890)	NS	***	-7.319** (3.043)	-8.649** (3.739)	***
Immigrant0to5 (*)	NS	NS	NS	NS	-9.083** (4.301)	***	NS	NS	-
ln(HH Family Income)	5.955*** (1.537)	NS	***	5.923*** (0.130)	-2.007*** (0.155)	***	7.217*** (0.139)	2.109*** (0.164)	***
# of Adlts	-12.19*** (2.091)	NS	***	-19.82*** (0.560)	6.548*** (0.648)	***	-1.817*** (0.640)	-5.636*** (0.759)	***
One-adult HH	20.67*** (5.367)	-23.02*** (6.201)	NS	-9.910*** (2.466)	9.605*** (2.571)	NS	10.83*** (1.559)	-3.989** (1.675)	***
ln(Pop Density)	2.504*** (0.596)	-1.814** (0.730)	NS	-0.412** (0.171)	0.523** (0.203)	NS	1.139*** (0.191)	-2.323*** (0.223)	NS
Age and age squared	included			included			included		
BEA Region Dummies	included			included			included		
Joint significance test (5% level) Immigration status (*)	NS	NS		significant	significant		significant	significant	
Pseudo R2	0.0217			0.0296			0.0291		
Log Pseudo Likelihood	-38,453.5			-4,814.6			-2,079.4		
Observations	35,214			5,202			2,408		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7 Significance Tests for Race/Ethnicity Differences in Coefficients of Table 6

	(1) Three Groups Pooled						(2) Females of Three Groups		
VARIABLES	Base	Hisp	Blk	Female	Hisp Fem	Blk Fem	Base	Hisp	Blk
Race/ethnicity		- - -	- - -					- - -	- - -
Female				+ + +	- - -	+ + +			
Driver	+ + +	+ + +	+ +	+ + +	+ + +	NS	+ + +	+ + +	+ + +
Immigrant (*)	+ + +	- - -	+ + +	NS	NS	NS	+ + +	-	+ + +
Immigrant10to15 (*)	+ + +	- -	- - -	- -	+ +	- - -	+ + +	NS	- - -
Immigrant5to10 (*)	+ + +	- - -	- - -	- - -	+ + +	NS	- - -	+ + +	- -
Immigrant0to5 (*)	+ + +	- - -	NS	- - -	NS	NS	NS	- - -	NS
ln(HH Family Income)	+ + +	- - -	+ + +	+ + +	- - -	+ + +	+ + +	- - -	+ + +
# of Adlts	- - -	- - -	+ + +	- - -	+ + +	- - -	- - -	+ +	+ + +
One-adult HH	+ + +	- - -	- - -	- - -	+ + +	+ + +	- - -	+ +	+ + +
ln(Pop Density)	+ + +	- - -	- - -	- - -	+ + +	- - -	+ + +	- - -	- - -
Age and age squared			included					included	
BEA Region Dummies			included					included	
Joint significance test (5% level)									
Immigration status (*)	significant	significant	significant	significant	significant	significant	significant	significant	significant
Pseudo R2	0.0233						0.0154		
Log Pseudo Likelihood	-45,357.6						-30,177.8		
Observations	42,824						22,646		

+ + +/- - - p<0.01, + + / - - p<0.05, +/- p<0.1, NS insignificant

Table 8 Children's Frequency of Active Non-Commuting Trip and Total Travel Time

	Poisson regression y: # of active trip			Tobit regression y: Total travel time		
	(1)			(2)		
	Base	Hisp	Blk	Base	Hisp	Blk
Race/ethnicity		NS	NS		NS	NS
# of HH drivers (#)	NS	NS	NS	NS	NS	NS
# of HH vehicles(#)	NS	NS	NS	NS	-4.579***	-4.001*
					(1.766)	(2.331)
Immigrant (+)	NS	NS	-13.49***	NS	35.36*	64.36***
			(1.022)		(18.34)	(15.47)
Immigrant10to15 (+)	NS	NS	-	NS	NS	-
Immigrant5to10 (+)	-1.267**	1.263*	-	NS	NS	-
	(0.587)	(0.730)				
Immigrant0to5 (+)	NS	NS	14.41***	NS	NS	-53.72**
			(1.142)			(21.60)
ln(HH Family Income)	0.0615***	NS	NS	NS	NS	NS
	(0.0153)					
# of Adlts	-0.0539**	NS	NS	NS	NS	NS
	(0.0262)					
One-adult HH	0.0886**	NS	NS	NS	NS	-11.56*
	(0.0436)					(6.122)
ln(Pop Density)	NS	NS	NS	-2.717***	NS	NS
				(0.369)		
Age and age squared	included			included		
BEA Region Dummies	included			included		
Joint test						
Driver and vehicle (#)	NS	NS	NS	NS	**	NS
Immigrant (+)	NS	*	***	***	NS	***
All the cross-terms listed in the column		***	***		***	***
Pseudo R2	0.0045			0.0011		
Log Pseudo Likelihood	-43,237.9			-149,926.9		
Sigma				63.24***		
				(1.471)		
Observations	26,937			26,937		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 1 Transporting Children

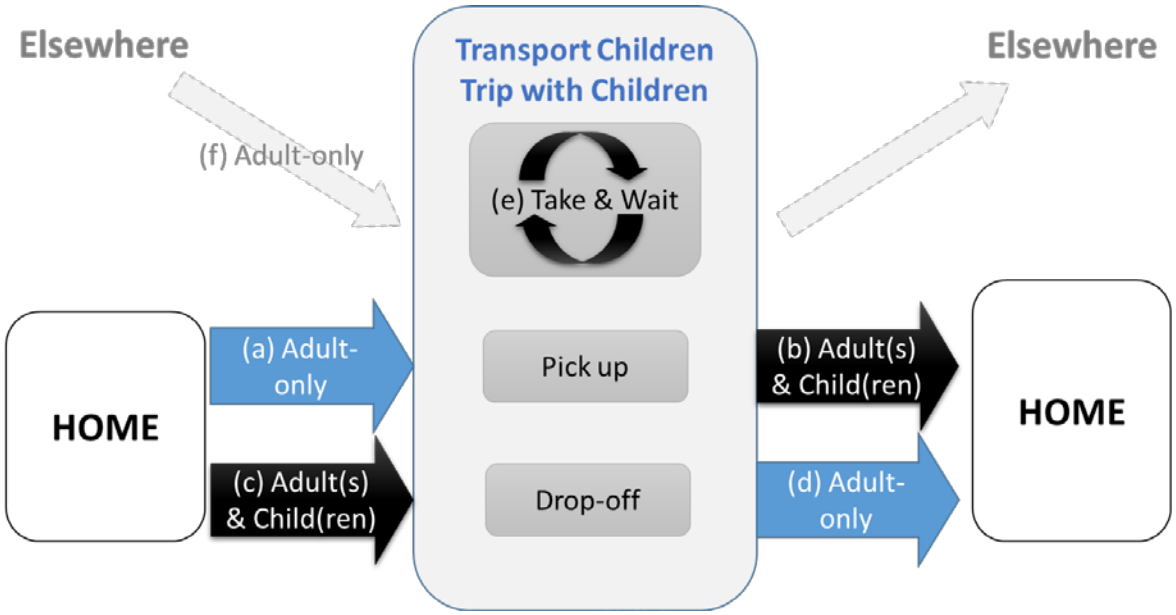

Figure 2 Estimated Number of Vehicles per Household Based on Table 4