



Travel behavior of immigrants: An analysis of the 2001 National Household Transportation Survey

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ABSTRACT

The purpose of this paper is to examine the relationships between travel behavior and immigrant status. The National Household Travel Survey (NHTS) allows us to explore the relationships between travel behavior and characteristics that are usually hard to discern in surveys with smaller samples. The correlation between travel behavior and immigrant characteristics such as place of birth and year of immigration in the US was tested while controlling for spatial and socio-demographic variables. The effects of place of birth and year of arriving to the US were found to be significant for some places of birth and for immigrants who entered the US in recent years. Understanding the differences in travel behavior and the possible explanations for these differences can help in modeling travel demand, finding policies best suited to meeting the travel needs of foreign-born communities, and addressing environmental justice concerns.

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1. Introduction

Approximately 33.5 million foreign-born individuals live in the United States—11.7% of the US population (US Census Bureau, 2005). Immigrants are expected to be a major source of population growth in many parts of the nation. In California, for example, the total population is expected to almost double between the years 1990 and 2040 mainly as a result of new immigrants (California Department of Finance, 2004).

Previous research suggests that the travel behavior of immigrants is different from the travel behavior of US-born residents for the first 5–10 years from arrival to the US and that in some cases immigrants are more likely than others to use public transportation regardless of their year of arrival to the United States (Myers, 1996; Rosenbloom and Fielding, 1998; Deakin et al., 2002; Purvis, 2003; Casas et al., 2004; Chatman and Klein, 2009; Tal and Handy, 2005). The differences in travel behavior are usually associated with the socio-demographic and locational characteristics of immigrants. In many cases, the travel patterns of immigrants mirror those of racial and ethnic minorities in the US; although these similarities decline the longer immigrants have lived in the US. However, questions on immigration status and place of birth are seldom asked in travel and activity surveys, so that data on the travel behavior of immigrants are limited.

It is important to understand the travel behavior of minority groups in general and immigrant groups specifically for various reasons. First, understanding travel behavior and travel needs of specific groups in society enables the adoption of targeted policies and a more effective distribution of transportation resources; research on the travel behavior of these groups is thus important for addressing environmental justice concerns. Second, understanding the travel behavior of immigrants may help to improve travel demand forecasting, particularly for public transportation and intelligent transportation systems (ITS) policies. Third, immigrants who are not yet captives of American norms and attitudes may play an important role as agents of change, for example, by using new transit services.

The purpose of this paper is to examine relationships between travel behavior and immigrant status focusing on the distinctive travel patterns of immigrants that are not associated with socio-demographic and locational characteristics. We use the 2001 National Household Travel Survey (NHTS), one of the few travel diary surveys in the US to record immigrant status, to test the effect of place of birth and year of immigration to the US on travel behavior for commute mode and for general travel variables such as yearly miles driven (as reported by the respondent), number of weekly walk trips, and number of daily trips by all modes. Full models that include spatial and socio-demographic variables were estimated for each of the dependent variables. The effects of place of birth and year of arriving to the US were found to be significant in the full models that control for socio-demographic and locational variables.

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2. Prior research on immigrants and travel

Travel patterns are the outcome of the needs and constraints of individuals and households and the location-specific set of opportunities provided by the distribution of activities and the structure of the transportation system. In this section we review previous research on immigrants' residential location decisions and travel patterns. The residential location patterns of immigrants are different in many ways from those of long-term residents of the US and may have a strong effect on travel behavior by affecting both the availability of activities and transportation options.

2.1. Residential location

Most immigrants to the US live in one of the largest 25 metropolitan areas within the US, compared to only 50% of the native-born population (Bartel, 1989). The residential location patterns of immigrants are often described as one of two patterns. The first pattern of "ethnic enclaves" or ethnic segregation suggests that immigrants tend to locate together, both on arriving in the US and over time (Massey, 1985). The second pattern, "spatial assimilation," suggests that new immigrants first live in transitional ethnic neighborhoods, but then relocate to higher-income neighborhoods, perhaps located in the suburbs (Alba, 1999; Logan et al., 2002). Pamuk (2004) explores two theories to explain these patterns. The human ecology approach suggests that immigrants are willing to live in congested conditions as a transition phase before improving their socio-economic conditions and moving to middle-class neighborhoods, in a process of spatial assimilation. The second theory maintains that ethnic clusters provide immigrants with socio-economic and cultural networks, or agglomeration benefits, and therefore immigrants are not likely to move out when their socio-economic conditions improve. Both theories suggest a clustering pattern of new immigrants that may affect their cultural and behavioral experience and therefore their travel behavior.

However, spatial assimilation as well as agglomeration vary by ethnicity and location (Allen and Turner, 1996; White and Sassler, 2000). In San Francisco, Pamuk (2004) found three different types of immigrant clustering among Chinese, Mexican, and Filipino immigrants: (1) low-income ethnic clusters, (2) more wide spread middle-income ethnic communities, and (3) a high-income Chinese cluster. In a national study, Bartel (1989) concluded that more immigrants who first locate outside of major metropolitan areas eventually move inside these areas than immigrants who first locate inside these areas move out, perhaps in part because of the desire to locate in or at least near immigrant clusters. These studies suggest that immigrant groups will not necessarily blend with the general population when their economic situations improve.

According to the theories outlined above, immigrant segregation depends on time of arrival and socio-demographic factors such as education, income, household size, and others. Pendall (2001) explored the connection between density, sprawl, and segregation by race and income in US Metropolitan Areas and found that high density development does not reduce economic segregation and ethnic segregation. Economic segregation in this case is highly correlated with ethnic segregation, but new Hispanic immigrants tend to be more segregated regardless of their economic situation.

2.2. Travel patterns

The few studies that have examined the travel patterns of immigrants have focused on changes in behavior over time. Myers

(1996) showed that after 10 years in the US, the travel behavior of immigrants becomes similar to that of the US-born population. In their first years in the US, immigrants behave differently, for example by using more transit than the US-born population. The extensive use of public transportation in the first years from arrival compared to the general population was also reported by Casas et al. (2004), who used 2001 NHTS data to evaluate travel behavior of "newcomer Hispanic" versus "settled" and native-born residents.

Vehicle ownership is highly correlated with mode choice as households that cannot afford a car are more likely to use public transportation or other travel modes and because households that live in areas with high density and with good public transportation services have less need to purchase vehicles (Myers, 1996; Blumenberg and Shiki, 2007). McGuckin and Srinivasan (2003) found that 20.7% of the new immigrants live in households without vehicles versus only 8% of the immigrants who have lived in the US for 10 years or more and only 3.9% of the US-born population. Rosenbloom and Fielding (1998) found that new immigrants are more likely to live in higher density areas that can be served by public transit and, not surprisingly, use transit more than less recent immigrants. However, she also found that immigrants are more likely to use public transportation than on average for the population, regardless of the number of years they have lived in the US. Indeed, Purvis (2003) found that immigrants generate about one-third of the public transportation commuting trips in San Francisco.

Culture also influences travel behavior in different ways. Douma (2004) held focus groups with homogeneous groups of Latino, Somali, and Hmong immigrants in both urban and rural areas of Minnesota to identify ways of better meeting their travel needs. The focus groups showed that Latino immigrants are open to transit and more "social" types of travel, while privacy was an important consideration for the Hmong. All groups were found to prefer to drive themselves rather than use public transit. Similarly, Blumenberg (2008) found that Southeast Asian welfare recipients in California tend to use private vehicles more than other racial and ethnic groups. On the other hand, Lovejoy and Handy (2008), who conducted focus groups with recent Mexican immigrants in California, found high dependency on private vehicles among this group, including use of vehicles other than those owned by the household. Similarly, carpools provide an important alternative to either owning one's own car for immigrants, or to using public transit (Myers, 1996). Language can be a barrier to using public transit (Sanchez et al., 2004). In response to this barrier and probably to compensate for other deficiencies in regular public transit service, minivans privately operated as jitney services, called *Camionetas*, have appeared in Latino communities throughout the US (see for example: Valenzuela et al., 2005).

The evidence reviewed here suggests that the travel patterns of immigrants derive from both socio-demographic characteristics (in ways similar to the US-born population) and unique requirements and needs related to cultural and attitudinal differences. The travel behavior of immigrants may be different from the travel behavior of US-born residents with the same socio-demographic characteristics for a variety of reasons: (1) *activity patterns*: immigrants may have different needs such as shopping in special ethnic food shops, or they may have different social and recreational habits (Wang, 1999); (2) *cognitive maps*: immigrants may have different levels of knowledge about their area that may be reflected in their activity patterns and in their route choices (Mondschein et al., 2006); (3) *attitudes and beliefs*: immigrants may have a different set of attitudes and beliefs about transportation; attitudes and beliefs have a direct impact on travel behavior (Beirão and Cabral, 2008; Salomon and

Mokhtarian, 1997). In the work that follows, we examine relationships between immigrant status and travel behavior, recognizing that immigrant status itself does not have a causal effect but rather serves as an indicator of underlying mechanisms such as these.

3. Research approach and methodology

Travel behavior is usually modeled using socio-demographic variables that relate to the demand for activities and therefore for travel, and using spatial and network variables that reflect the availability of potential activities and the travel cost associated with reaching them. In this research we ask two questions about the travel behavior of immigrants. First, do immigrant travel characteristics differ from US-born travel characteristics, even after controlling for socio-demographic and spatial variables? If so, are there differences in the effects of socio-demographic and spatial variables among immigrants from different origin countries and the US-born population?

To characterize travel, we used three variables that reflect the relative importance of the auto in satisfying travel needs: auto ownership, yearly miles driven, and use of driving and public transit. We present models for each of these characteristics as dependent variables. We also estimated models for total number of trips and for non-motorized trips, but immigrant status was insignificant in these models and we do not present them here. To answer the first question, we used multivariate models with dummy variables for place of birth (continent or subcontinent as defined in Table 4) and year of immigration, in addition to socio-demographic characteristics and spatial variables. In addressing the second question, we added to the models interaction terms to test for interactions between the place-of-birth dummy variables and the socio-demographic and spatial variables. The final models presented thus address both questions.

3.1. The sample

The National Household Travel Survey (NHTS) is a national survey comprising a questionnaire and a travel diary survey that is conducted every 5–6 years. There are approximately 66,000 households in the final 2001 NHTS dataset, including about 160,658 individuals; we used a smaller sample of 97,694 individuals after taking out all cases where travel data were not complete. All of the cases where travel was a part of the individual's job requirement, e.g. truck drivers or delivery persons, were excluded from the analysis because they may have extremely high VMT that has nothing to do with their personal or locational characteristics. We also excluded all cases where physical or other conditions limited the individual from traveling in any transportation mode. The characteristics of the reduced sample are somewhat different from the overall sample; for example, the reduced sample was 53.7% female in contrast to

51.9% female in the original sample. The sample used in the analysis includes 5396 foreign-born individuals.

3.2. Limitations of the national household travel survey

The NHTS has notable limitations that impact the analysis presented here. Immigrants, due to language barriers, fear of revealing illegal immigration status, and other factors, are less likely to participate in travel behavior or similar surveys (Sharp and Murakami, 2004). Recent immigrants, large families, households with no vehicles, and other unique groups are more likely to be underrepresented in the NHTS, as illustrated by Casas et al. (2004) for Hispanic immigrants.

According to the 2000 Census, 11.1% of Americans were foreign born and 42% of those entered the US between 1990 and 2000. The NHTS full sample includes 5.8% foreign-born respondents, and the reduced sample we use in this paper includes 5.4%. Only 25.6% of the immigrants in our sample arrived in the US between 1991 and 2001. Based on the difference between the sample characteristics and the census, we assume that the results presented in this paper under represent newer immigrants and therefore under represent the full magnitude of differences in travel behavior for immigrants.

3.3. Immigrants' characteristics

The sample used in the analysis includes 5396 foreign-born individuals, about a quarter of whom arrived in the US in the 10 years prior to the survey, with 724 having arrived in the last 5 years. The gender break down for foreign-born respondents is 42.5% male and 57.5% female, higher than for the overall sample. The new arrivals to the US are distributed across all ages, though the largest share is in their 30s. Despite the fact that immigrants arrive in the US at all ages, there is a clear trend in life cycle: a few years after arriving in the US the number of individuals in the household increases and respondents have more children. Around 45% of households that include individuals who arrived in the US in the last 5 years contain one or two adults with no children; for households with individuals who arrived 5–10 years before the survey, this share is around 30%; and for individuals who arrived 10–20 years ago, less than 25% live in households without children.

The income of recent arrivals (defined here as immigrants who arrived in the US in the last 5 years) appears to increase over time, as shown in Table 1: individuals who arrived in the US recently are generally poorer than individuals who arrived before them. It is also interesting that the biggest differences are in the very low-income and very high-income categories. In the first 5 years from arrival, 30% of respondents make less than \$30,000 per year; only about 20% of individuals who arrived 5–10 years before the survey and around 10% of the individuals who arrived more than 20 years before the survey are included in this income group. The share of households with income over \$100,000 per year is twice

Table 1
Socio-demographic variables by year of arriving to the US.

Year of arriving to the US	Respondent age (years)			HH size (individuals)			Yearly HH income		
	Mean	Std. dev.	t-Test vs. US born ^a	Mean	Std. dev.	t-Test vs. US born ^a	Mean	Std. dev.	t-Test vs. US born ^a
US born	37.17	23.13	–	3.23	1.50	–	54,046	30,467	–
Pre-1981	52.92	15.34	< 0.0001	2.92	1.50	< 0.0001	52,791	32,466	0.0567
1981–1991	37.61	12.08	0.2208	3.85	1.73	< 0.0001	50,868	32,188	0.0007
1991–1996	35.49	11.59	0.0001	3.64	1.69	< 0.0001	44,625	30,759	< 0.0001
1996–2001	32.00	10.22	< 0.0001	3.32	1.55	0.1203	40,109	30,635	< 0.0001

^a Probability that mean for this group is not different than the mean for the US-born group.

that for individuals who arrived more than 10 years ago compared to individuals who arrived in the last 5 years. Immigrants have, on average, lower incomes than the US-born population.

Between 1980 and 2001, the geographic areas that contributed most to immigration shifted between Europe, Central and South America and Asia. The NHTS data did not include a question about the place of origin (i.e. the country where the respondent was living immediately before immigrating) but it included a question about the place of birth that can be used as a proxy for place of origin. Another possible proxy for immigrants' place of origin and relevant cultural group is the race/ethnicity variable. The correlation between place of birth and race/ethnicity is high for immigrants from Asia and Central/South America. However, white respondents have emigrated from many different regions. We assume place of birth is a more accurate indicator of the previous environment in which a respondent lived and use this measure rather than race/ethnicity in our models.

Table 2 compares age, household size and income for immigrants by place of birth in comparison to US-born respondents. The table also describes the average number of years in the US for each immigrant group based on place of birth. Notice that Western European immigrants are the oldest population, averaging 31 years in the US with an average age of

more than 50; they also have smaller households and relatively high incomes. Immigrants from India and Central/South America have lived in the US on average less than half that time, and they are younger than the US-born population. Immigrants from Central and South America have the largest households and the lowest incomes. In contrast, immigrants from India, with shorter average time in the US, have the highest household income—higher than US-born respondents and the long established Western European group.

4. Bivariate analysis of travel behavior by year of immigration

In this section we focus on the travel behavior of foreign-born respondents differentiated by year of arrival in the US (Table 3). Households of recent immigrants have an average of 0.45 vehicles per person compared to 0.58 vehicles per person for respondents who arrived 10–15 years before the survey. The households of immigrants who arrived more than 20 years ago have a much higher level of automobile ownership, with almost 0.8 vehicles per person on average. Lack of a vehicle may be one reason that respondents who arrived in the US in the 5 years before the survey make somewhat fewer trips per day on average than other

Table 2
Socio-demographic variables by region of birth.

Region of birth	N	Years in the US		Respondent age (years)			HH size (individuals)			Yearly HH income		
		Mean	Std. dev.	Mean	Std. dev.	t-Test vs. US born ^a	Mean	Std. dev.	t-Test vs. US born ^a	Mean	Std. dev.	t-Test vs. US born ^a
US	86,008	–	–	40.60	20.41	–	3.14	1.44	–	58,388	27,429	–
Canada	432	26.15	16.74	48.99	16.44	< 0.0001	2.79	1.41	> 0.0001	57,525	29,878	0.5494
Central and South America	1125	16.71	13.24	37.32	12.70	< 0.0001	3.93	1.65	> 0.0001	38,426	25,632	< 0.0001
Europe and Scandinavia/Polar Regions	1074	31.57	14.96	50.28	16.39	< 0.0001	2.76	1.30	> 0.0001	61,783	28,879	0.0001
Eastern Europe and Russia/USSR	333	19.31	16.31	46.02	16.44	< 0.0001	2.89	1.27	0.0004	55,734	27,022	0.0746
East Asia	1327	20.29	13.98	42.22	14.60	0.0001	3.28	1.62	0.0018	58,249	28,019	0.8577
Indian Subcontinent	279	12.03	10.74	38.94	12.99	0.0344	3.19	1.37	0.5433	63,689	28,469	0.0021
Caribbean/Atlantic Islands	306	21.90	14.56	42.33	14.96	0.0446	3.46	1.55	0.0004	48,078	29,860	< 0.0001

^a Probability that mean for this group is not different than the mean for the US-born group.

Table 3
Travel indicators by year of arriving to the US.

Variable name	Year of arriving to the US	Mean	Std. dev.	t-Test vs. US born ^a
Daily trips per person	US born	4.36	2.76	–
	Pre-1981	4.37	2.75	0.8654
	1981–1991	4.41	2.64	0.5328
	1991–1996	4.09	2.49	0.0065
	1996–2001	3.99	2.50	0.0002
Yearly miles driven (drivers only)	US born	11716	8821	–
	Pre-1981	10383	8437	0.0001
	1981–1991	10321	9084	< 0.0001
	1991–1996	9536	8769	< 0.0001
	1996–2001	7394	7518	< 0.0001
HH vehicle ownership per person	US born	0.81	0.47	–
	Pre-1981	0.79	0.42	0.0218
	1981–1991	0.58	0.34	< 0.0001
	1991–1996	0.55	0.35	< 0.0001
	1996–2001	0.45	0.34	< 0.0001
Number of walk trips per week	US born	3.01	5.26	–
	Pre-1981	2.90	4.84	0.5112
	1981–1991	2.91	4.87	0.4749
	1991–1996	3.20	6.26	0.4321
	1996–2001	3.58	6.26	0.0162

^a Probability that the mean for this group is not different than the mean for the US-born group.

respondents. Given the large standard deviation, the differences are very small. However, given the large sample size, the differences are statistically significant: respondents who arrived in the last 10 years generate statistically fewer trips than US-born respondents.

The average number of walk trips per week is highest for respondents who arrived in the last 5 year at 3.6 trips per week. US-born respondents make three trips per week on average—significantly lower than new arrivals. Similarly, recent immigrants make about 0.4 bicycle trips per week on average versus 0.26 per week on average for immigrants who have lived in the US for 5–10 years and 0.2 trips per week on average for the entire sample (not shown in table). For the entire sample, 93% of respondents commute by motor vehicle, 4% by public transportation, and 3% by walking.

Miles driven per year also differs significantly between immigrants and US-born respondents, though the differences decline as the length of time in the US increases. Recent immigrants to the US (within the 5 years before the survey) drive just 63% of the miles that US-born respondents drive on average. In contrast, immigrants who arrived before 1981 drive 89% of the miles that US-born respondents drive on average. Recent arrivals may be driving less than others because of more limited availability of a car.

Among the 2866 foreign-born commuters, the distribution across modes is significantly different depending on year of arrival in the US. About 12% of the commuters who arrived in the US in the 5 years before the survey walk as their commute mode, though only about 3% of respondents who arrived 10 years before the survey walk. Differences for public transportation are also significant, with just fewer than 20% of recent arrivals commuting by public transportation but only 10% of immigrants who have been in the US for more than 20 years using public transportation. However, the share using public transportation for the immigrants who have been in the US for the longest is still higher than for US-born respondents.

5. Multivariate analysis of travel behavior by year of immigration and place of birth

In order to understand the relationship of travel behavior with immigration status and place of birth while controlling for socio-demographic characteristics such as income as well as location, we estimated a series of multivariate models for three key indicators of travel behavior: number of vehicles per adult, miles driven per year, and the mix of public and private transportation use (Table 4). These variables give an indication of the role that

Table 4
Variables names and definitions.

Variable name	Description
Dependent variables	
Number of vehicles per adult in the HH	Number of vehicles per adult (over 18) in the HH
Miles driven per year	Miles respondent reported driving in the last 12 months
Motorized transportation mode mix	Transportation mode reported on the NHTS diary (1) uses only private vehicle; (2) uses a mix of private vehicle and public transportation; (3) uses only public transportation
Independent variables	
Immigration status	
Central and South America	Region of birth: Central and South America; <i>N</i> =1130; 23.2% of the foreign-born population
Europe and Scandinavia	Region of birth: Europe and Scandinavia; <i>N</i> =1408; 28.9% of the foreign-born population
East Asia	Region of birth: East Asia; <i>N</i> =1349; 27.7% of the foreign-born population
Omitted category	Local born population and foreign-born from all other places (20%)
In the US for 0–5 years	Arrived to the US between 2001 and 1997
In the US for 5–10 years	Arrived to the US between 1996 and 1991
In the US for 10–15 years	Arrived to the US between 1990 and 1985
Omitted category	Local born and immigrants that arrived to the US prior to 1985
Individual characteristics	
Respondent age	Age in year between 5 and 80
Sex	Male (1), female (0)
Household (HH) size	Between 1 and 9
Income	Household income divided by HH size
Life cycle: adults no child	HH with one or more adults that are not retired and no kids under 21
Life cycle: 1 adults and child	HH with one adult that are not retired and with no kids under 21
Life cycle: 2 or more adults and child	HH with one or more adults that are not retired and no kids under 21
Life cycle: adults retired	Adults retired no child in HH
Omitted category	One-adult household with kids under 21
Spatial characteristics	
Population per sq mile	Population per sq mile based on census block level data
Workers per sq mile	Workers per sq mile based on census tract level data
MSA with heavy transit	Metropolitan statistical area of 1 million or more, with heavy transit
MSA without heavy transit	Metropolitan statistical area of 1 million or more, without heavy transit
MSA less than 1 million	Metropolitan statistical area less than 1 million
Omitted category	Not in MSA
Rural area	Rural area: urban/rural indicator—tract level
Suburban area	Suburban area: urban/rural indicator—tract level
Urban area	Urban area: urban/rural indicator—tract level
Omitted category	Town and second city: urban/rural indicator—tract level
New York City	MSA code 5602 includes: New York—Northern New Jersey—Long Island, NY–NJ–CT–PA

immigration status, years in the US, and place of birth plays for the travel behavior of immigrants and the degree to which immigrant travel matches the auto-dependent patterns of US-born residents.

We tested three sets of explanatory variables in the models. Immigration status variables (Table 4) include place of birth for the three largest groups of immigrants (Central and South America, Europe and Scandinavia, and East Asia); the omitted category in the model includes US-born respondents. We tested models with four and five groups of immigrants, dividing the European immigrants into east and west and adding an India-born group, which did not produce a higher explanatory power or an important difference in the variables shown to be significant. A second set of dummy variables was based on the question “year of arriving in the US” with three variables created: (1) arrived to the US between 2001 and 1997, (2) arrived to the US between 1996 and 1991, (3) arrived to the US between 1990 and 1985; the omitted category in the model combines US-born respondents and immigrants that arrived in the US prior to 1985. We chose not to include a category for immigrants in the US for more than 20 years to avoid correlations with the age variable.

The third set of variables comprises individual and household socio-demographic characteristics, including age, sex, household size, household income, and household life-cycle dummy variables (Table 4). We collapsed the 10 life-cycle categories into three groups: (1) households with no children and with no retired adults, (2) households with two or more adults and children under 21, (3) households with one or more adults retired and no children under 21; the omitted category in the models is one-adult households with children under 21.

The final set of variables includes the spatial characteristics selected to reflect access to activities (Table 4). The NHTS spatial data are based on census data and do not include any network characteristics. In the absence of data about the network or travel times, we include spatial variables that reflect the character of the residential area and the region. We used population per square mile (for the census block) and number of workers per square mile (for the census tract) to reflect accessibility of the residential area. To characterize the region, we used the rural/urban indicator

that is based on the population density of the surrounding area and is not directly correlated with block or tract population density level. We created dummy variables for urban, rural, and suburban categories using second cities and towns as the omitted category in the model. The MSA dummy variables capture unmeasured features of specific locations, including mass transit availability in the metropolitan area. We were particularly concerned about capturing differences for New York City (NYC), which has higher densities, more public transit options, and more immigrants than other cities in the US. With respect to mode choice, New York is a clear outlier, accounting for about 40% of public transit riders in the US in 2000 (American Public Transportation Association, 2001).

5.1. Number of vehicles per adult

The results for the model for the number of vehicles per adult are shown in Table 5. The “All” column shows the coefficients and their statistical significance for each explanatory variable, while the next three columns present the coefficients and significance for the interactions of place of birth with each of the explanatory variables. Note that the total effect of a variable for one of the three immigrant groups depends on the sum of the “all” coefficient and the coefficient for the interaction term. The overall explanatory power of the model is not high, at $R^2=0.16$, in part because of the limitations noted before.

As expected, income, household size, and life cycle have the largest effects for the overall sample. The interaction variables reveal that socio-demographic variables have different effects on car ownership for some of the immigrant groups: household size, households with no children, and retired households have negative effects on auto ownership for immigrants from Central and South America and from East Asia. All three effects may relate to lower need for a car relative to others in the same immigrant group but also suggest greater constraints on car ownership than for respondents with the same demographic characteristics in other immigrant groups. Income has a greater positive effect on car ownership for immigrants from Central and South America

Table 5
Model for number of vehicles per adult in the HH.

Variable name	Estimate			
	All	Central and South America	Europe and Scandinavia	East Asia
Adjust $R^2=0.157$; $N=79,564$				
Constant	NS			
Dummy				
In the US for 0–5 years	–0.23**	NS	NS	–0.33**
In the US for 5–10 years	–0.11**	NS	–0.12**	NS
In the US for 10–15 years	–0.15**	NS	–0.14**	NS
Respondent age	0.14**	NS	NS	NS
Sex male	NS	NS	–0.17**	–0.16**
Household size	0.38**	NS	NS	NS
Income	0.78**	–0.19**	NS	–0.19**
Life cycle: adults no child	0.34**	0.44**	NS	NS
Life cycle: 2 adults and child	NS	–0.13**	NS	–0.12**
Life cycle: adults retired	0.33**	NS	NS	NS
Population per sq mile	0.17**	–0.14**	NS	–0.11**
Workers per sq mile	NS	NS	NS	NS
MSA with heavy transit	–0.13**	–0.21**	NS	0.4**
MSA without heavy transit	–0.15**	NS	–0.04*	–0.03**
MSA less than 1 million	–0.05*	NS	NS	–0.07**
Rural area	–0.14**	NS	NS	NS
Suburban area	NS	–0.15**	NS	NS
Urban area	0.16**	–0.17**	NS	NS
New York City	–0.13**	0.12**	NS	0.14**

** P -value < 0.05; * P -value < 0.1.

than for the general population, which may reflect greater need for mobility for this group and/or a greater cultural preference for auto ownership.

Not surprisingly, living in an MSA, regardless of size or rail availability, is negatively associated with vehicle ownership for the overall sample, as in living in New York City. On the other hand, living in an urban area is associated with greater auto ownership, relative to living in a town or small city. However, the effects of urban area and NYC are essentially neutralized for immigrants from Central and South America, while living in a suburban area has a negative effect on auto ownership for these immigrants but not for others. These differences may reflect both differences in the specific communities in which Central and South American immigrants reside (e.g. disproportionately California) as well as differences in cultural attitudes towards auto ownership. Similarly, living in an MSA with heavy transit reduces auto ownership more for immigrants from Europe and Scandinavia and East Asia than those from Central and South America. Interestingly, living in a rural area is also associated with lower auto ownership, relative to living in a town or small city for the overall sample. After controlling for these effects, time since arrival in the US and place of birth have significant effects on auto ownership. As expected, recent immigrants own fewer vehicles per adult than immigrants who have been in the US for longer periods of the time, with 5 years apparently the key inflection point. The significance of the dummy variable for East Asia as place of birth shows that these immigrants have fewer vehicles per adult for reasons that are not captured by the explanatory variables in the model, such as previous experience and cultural preferences.

5.2. Miles driven per year

The model for miles driven per year, presented in Table 6, is based on 48,591 respondents who report driving, excluding professional drivers and individuals who have to drive as part of their job. Consistent with prior research, men drive more than women and higher incomes are associated with more driving for

the overall sample; higher population density and living in an urban area are associated with less driving.

Immigrant status seems to have less of an impact on driving than on auto ownership. Few of the interaction terms for place-of-birth are significant for immigrants from Central and South America and from East Asia. However, the significance of the dummy variables for these groups suggests that they drive less than the overall sample for reasons other than those captured by the explanatory variables in the model. Possible explanations include differences in previous experience with driving or with other aspects of lifestyle for immigrants. Immigrants from Europe, on the other hand, are affected by many of the explanatory variables differently than is the overall sample, usually with the effect of more miles driven, again potentially the result of differences in experience and lifestyle. As with auto ownership, arrival in the US within the last 5 years has a negative effect on miles driven, suggesting that 5 years is the point at which immigrants have largely assimilated to US driving habits.

5.3. Travel mode

In analyzing travel mode, we focused on trips of all types. We created three groups of vehicle users: (1) individuals who use private vehicles only; (2) individuals who use public transit and private vehicles and; (3) individuals who use public transit only. A total of 73,847 individuals reported at least one motorized trip (by private vehicle or public transit) in their travel diary and are included in the sample for this model. We estimated a logistic regression model to demonstrate the association between immigrant status and the likelihood of using private vehicles only rather than a mix of modes and of using public transit only rather than a mix of modes (Table 7).

This model has interesting and some non-intuitive results partially because of the interaction variables and the use of mixed mode vs. private or public modes as the dependent variable. The model shows that recent immigrants overall are more likely to use only private vehicles rather than a mix of modes. This result suggests that if recent immigrants have a private vehicle they are more likely than others to not use public transit at all, whether

Table 6
Model for miles driven last 12 months.

Variable name	Estimate			
	All	Central and South America	Europe and Scandinavia	East Asia
Adjust $R^2=0.105$; $N=48,591$				
Constant	NS			
Dummy		-945.78**	NS	-1053.59*
In the US for 0–5 years	-0.24*	NS	NS	NS
In the US for 5–10 years	NS	NS	NS	NS
In the US for 10–15 years	-0.16*	NS	-0.10*	NS
Respondent age	NS	NS	0.16*	NS
Sex male	0.27*	NS	NS	NS
Household size	NS	0.17**	NS	NS
Income	0.54*	NS	NS	NS
Life cycle: adults no child	NS	NS	0.20*	NS
Life cycle: 2 adults and child	NS	NS	0.18*	NS
Life cycle: adults retired	-0.37*	NS	0.19*	NS
Population per sq mile	NS	-0.08**	NS	-0.09*
Workers per sq mile	-0.80**	NS	NS	NS
MSA with heavy transit	0.14**	NS	NS	NS
MSA without heavy transit	NS	NS	0.11*	NS
MSA less than 1 million	NS	NS	NS	NS
Rural area	NS	NS	NS	NS
Suburban area	NS	NS	NS	NS
Urban area	-0.24*	NS	0.10*	NS
New York City	NS	NS	NS	NS

Ln(yearly miles driven) for drivers only, not including those with 0 miles.

*P-value < 0.05; **P-value < 0.1.

Table 7

Model for modes used: private vehicle only and public transportation only versus mix of private vehicle and public transportation.

Variable name	Estimate			
	All	Central and South America	Europe and Scandinavia	East Asia
Adjust $R^2 = 0.199$; $N = 73,847$				
<i>Private/mix</i>				
Constant	NS			
Dummy		NS	NS	NS
In the US for 0–5 years	0.54*	NS	NS	–0.36**
In the US for 5–10 years	NS	NS	NS	–0.32*
Respondent age (5, 80)	NS	1.13**	NS	1.64**
Household size (1, 9)	NS	NS	NS	–0.82*
Income (\$61, \$100,000)	NS	NS	NS	–1.53**
Workers per sq mile	–2.41*	NS	NS	NS
Urban area	–0.63**	NS	NS	NS
New York City	–0.70**	NS	0.31*	NS
<i>Public/mix</i>				
Constant	NS			
Dummy		2.77*	NS	NS
Respondent age (5, 80)	1.90**	NS	–1.66*	NS
Population per sq mile	NS	0.25*	NS	NS
Workers per sq mile	NS	0.68*	NS	NS
Suburban area	NS	NS	NS	–0.53**
New York City	NS	–0.25*	NS	NS

** P -value < 0.05; * P -value < 0.1.

they acquire a vehicle immediately upon arrival in the US or after some time. The significant coefficients for the interaction of East Asian immigrants and time of arrival to the US, both recent immigrants and those who immigrated 5–10 years before the survey, suggest that the tendency to not use public transit is less strong among this group. While the full explanation for these differences lie beyond the scope of the available data, this result may suggest that East Asian immigrants have different mode preferences than other groups particularly with respect to private vehicle use. For this group, most of the interaction variables (except for age) are significant and have a negative effect on use of private vehicles only relative to mixed modes, suggesting that they are more likely to use public transit relative to other immigrants and the general population with similar income and household size. The unique patterns for East Asian immigrants may be explained by differences in cultural preferences or by differences in residential location patterns, particularly relatively high-income ethnic enclaves in urban areas.

The public transit versus mixed modes part of the model suggests that Central and South Americans are more likely to use public transit over a mix of modes. The sizable coefficient for the dummy variable for this group in the model for public transit use suggests that these immigrants are much more likely than others to rely solely on public transit, for reasons not captured by the other variables in the model. As with other findings, this effect could be due to the specific communities in which these immigrants live, differences in their activity patterns and preferences, or other factors. Spatial variables have differential effects on this group that lead to a higher probability of using public transit rather than a mix of modes, except in NYC where these immigrants are less likely to use public transit only. Living in a suburban area is significant only for East Asian immigrants, who are less likely to use public transit only rather than a mix of modes. Note that several spatial variables are significant in explaining private vehicle use only, while no socio-demographic variables are; higher densities, urban area, and NYC all reduce the likelihood of relying solely on private vehicles.

6. Conclusions

The analysis presented here shows that recent immigrants have different patterns of travel than individuals born in the US and than immigrants who have lived in the US for longer periods of time, and that patterns of travel vary with place of birth. The models show that immigrants largely assimilate to typical US patterns of travel after 5 years, consistent with prior studies (Blumenberg and Shiki, 2007; McGuckin and Srinivasan, 2003; Purvis, 2003; Rosenbloom and Fielding, 1998). The descriptive analysis revealed significant differences in income level, household lifecycle stage, and age for immigrant groups from different places of birth living in the US for different periods of time. These socio-demographic variables may in part explain differences in travel behavior. However, multivariate analyses show that immigrant status and place of birth are associated with certain aspects of travel behavior even after accounting for these socio-demographic factors.

Although the evidence for associations between travel behavior and immigrant status as well as place of birth is strong, the evidence for a causal relationship is not. These variables are likely associated with factors such as needs, limitations, preferences, attitudes, culture, and prior experiences that influence travel behavior but are not measured in the NHTS or in most large-scale travel surveys. These factors may affect both activity patterns and travel behavior (Beirão and Cabral, 2008; Salomon and Mokhtarian, 1997). We believe that mode preferences as revealed in this study stem partially from attitudes that are based on previous experience in the country of origin. Moreover, the unique travel behavior of immigrants may reflect location and activity preferences that are not captured by the spatial variables and stem from social segregation of these immigrants.

Understanding the factors that explain the observed differences in travel behavior requires further research, and both qualitative and quantitative methods may be helpful. Comparisons of the experience of immigrants to the US to the experience of immigrants in European countries would help to identify patterns that are more universally characteristic of the immigrant

experience. The understanding that further research on the travel behavior of immigrants would produce could help in modeling travel demand, finding policies best suited to meeting the travel needs of foreign-born communities, and addressing environmental justice concerns.

Uncited references

Chatman and Klein (2009); Tal and Handy (2005); Valenzuela et al. (2005)

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