Rethinking the Future of Alternative Transportation to Work in Light of Millennial Usage

July 2015

By Dr. Robert B. Case and Seth T. Schipinski
HRTPO
723 Woodlake Dr., Chesapeake, VA 23320
757-420-8300
rcase@hrtpo.org

ABSTRACT
It has been written that Millennials (born 1982-2000) use cars less often and alternative modes (bike, walk, public transit) more often than those of previous generations. Most travel mode data covers work trips. Therefore, this analysis seeks to determine—in light of current higher Millennial usage of alternative transportation to work—*whether we should plan for a quantum leap in demand for alternative transportation to work in the future in the U.S*. To answer this question, HRTPO staff isolated the effects on usage of alt-trans-to-work of seven (7) factors (generation, age, era, income, gender, MSA status, Urbanized Area status) by compiling and regressing a dataset of National Household Travel Survey (NHTS) records from three different years: 1983, 1995, and 2008/2009. The analysis revealed highly significant relationships between alternative mode usage for commuting and nearly all of the independent variables selected, allowing the authors to provide an answer to the forecast question.

ACKNOWLEDGMENTS
Using funds from Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), this document was prepared by the staff of the Hampton Roads Transportation Planning Organization (HRTPO) in cooperation with local jurisdictions and transit agencies of Hampton Roads, FHWA, FTA, Virginia Department of Transportation (VDOT), Virginia Department of Rail and Public Transportation (DRPT), and Virginia Port Authority (VPA). This document does not constitute a standard, specification, or regulation. The contents do not necessarily reflect the official views or policies of the HRTPO, FHWA, FTA, VDOT or DRPT.

Staffers James Clary and David Pritchard added valuable research to this paper.

INTRODUCTION

Motivation and Purpose

The literature suggests that Millennials (considered by some to be born 1982 through 2000) are more likely to use alternative modes (walk, bike, transit) than members of previous generations. Most travel mode data covers the work trip. Therefore, the resulting research question is:

> "Given recent Millennial reports, should we plan for a quantum leap in demand for alternative transportation to work in the future?"

To the degree that Millennials' preference for alternative modes is a function of their age and the current economy (both of which will change)—as opposed to an inherent generational trait (which will not change)—the usage of alternative modes by all generations in the future will be similar to that of today. Therefore, in order to forecast the usage of alternative transportation to work, we must consider income, age, generation, era, etc.

Understanding (and forecasting) the individual factors contributing to a phenomenon allows one to forecast that phenomenon more effectively than simply looking one-dimensionally at the changes in that phenomenon over recent years. Therefore, before we forecasted the future of alternative transportation to work, we conducted a multi-variate analysis to determine on which factors to base that forecast.

EXPLAINING ALT-TRANS-TO-WORK USING MULTI-VARIATE REGRESSION

In preparation for conducting a multi-variate regression for forecasting usage of alternative transportation to work, we reviewed the literature to a) see the forecasts of others, and b) see their analytical methodology.

Literature Review

Mode Choice in the Future
Dutzik and Baxandall have suggested three possible scenarios for the future of vehicle-miles traveled (VMT) (*7*, pp. 29-30), VMT theoretically being related negatively to the usage of alternative transportation. The three scenarios are listed below:

1. *Back to the Future* Under this scenario, the U.S. decline in driving since 2004 is assumed to be the effect of temporary conditions: poor economic conditions and higher gas prices. As these conditions reverse, the travel preferences of Millennials will increasingly mimic those of previous generations.

2. *Enduring Shift* In this scenario, the shift in travel behavior that has occurred over the last decade is assumed to be lasting, consistent with the view that the preferences of Millennials will be embraced by future generations.

3. *Ongoing Decline* This scenario assumes that the decline in driving over the last decade is the beginning of a broader change that makes driving less necessary. The outcome of this scenario is that driving will stabilize at a much lower level per capita.

In her analysis of Millennial travel mentioned above, after she found that Millennials in 2009 drove less than Gen Xers in 1995, Noreen McDonald measured the degree to which three factors explain the decrease in driving in order to determine how much of current Millennial behavior will endure as they age. She found 1) that decreased employment and other lifestyle shifts explain 10-25% of the decrease in driving, 2) that general dampening of travel demand across all age groups explains 40% of the decrease, and 3) that different attitudes and online shopping/media (i.e. the factor inherent to the Millennial generation) explains the remaining 35-50% of the decrease. Millennials would be expected to carry this different attitude into the future.

In her dissertation "Stalled on the Road to Adulthood?" (*22*), Kelcie Ralph looked for factors to explain why people fall into four mode-based categories: 1) "Drivers", 2) "Long-distance Trekkers", 3) "Multimodals", and 4) "Car-less". Her conclusion:

> "I find that economic constraints, role deferment, and racial/ethnic compositional changes in the population primarily explain the travel trends during this period. The evidence in support of preferences and residential location explanations was substantially more limited." (*22*, p. iii)

This finding indicates that much of the decrease in auto travel associated with Millennials is expected to reverse itself as the generation ages and economics change.

Wanting to conduct its own forecast, HRTPO staff also reviewed the literature for help in designing a multi-variate analysis on which to base that forecast.

Conceptual Framework
For generational research, the literature identifies the following types of effects on travel behavior (*3*, p. 9), (*4*, p. 3):

1. *Period (or Era) Effect* The effect of a situation that impacts an entire population for a period of time.
   - Example: WWII

2. *Age Effect* An effect associated with a particular person age.
   - Examples: Being of high school age, being of working age, being of retirement age

3. *Generational Effect* The effect of events whose consequences follow a group of people, born at a specific time, throughout their lifetimes.
   - Example: The Great Depression's effect on the Silent Generation

Based on the literature, staff designed its multi-variate analysis to include each of these three effects (era, age, and generation) on mode choice.

Methodology
In her analysis of Millennial travel mentioned above, McDonald used a linear regression model to explain auto mileage, and a negative binomial model to explain auto trips. In order to identify to what extent differences between Millennials and Gen-Xers (at the same age) reflect preferences (as opposed to demographic—including economic—and era effects), she used the regression coefficients from her 1995 model to forecast 2009 mileage, comparing that forecast to the actual. (*21*, p. 12)

Dr. Ralph, on the other hand (in her dissertation mentioned above), used "multinomial logistic regression to identify the independent relationship between traveler type and economic resources, adult roles, residential location, and race/ethnicity." (*22*, p. iii)

As in these two papers, staff's multi-variate analysis includes demographic, economic, and location variables. Like Dr. Ralph, staff's analysis used logistic regression.

Multi-variate Regression

Source of Data
In order to conduct an original analysis that considers each of the above effects on mode choice from the literature—age, era, and generation—HRTPO staff chose the National Household Travel Survey (NHTS), a comprehensive travel survey conducted by FHWA approximately every 7 years since 1969.

Variables for Regression
Dependent Variable The research question being related to mode choice, HRTPO staff chose usage of alternative transportation to work (i.e. for commuting) as the dependent variable.

Independent Variables In order to identify and measure those factors related to alt-trans-to-work, we included seven (7) groups of factors as independent variables as guided by the literature:

1) era
2) age
3) generation
4) gender
5) income
6) MSA status
7) Urbanized Area status.

Data Preparation
The raw 1983 NHTS dataset (national) contains 17,383 observations. The 1995 and 2008/2009 sets contain 95,361 and 308,902 observations, respectively. Due to computational limitations, HRTPO staff reduced the sizes of the later two sets to approximately that of the first set using random selection. Then, HRTPO staff combined all three sets into one database of 22,483 records for the analysis.

All variables (dependent and independent) in this analysis were entered into the regression in binary form. For the discrete variables in the NHTS dataset (era, generation, gender, MSA population category, and Urbanized Area status), a set of sub-variables was created for each. For example, HRTPO staff created an "era" set containing three sub-variables: "Reagan Era (1983)," "Clinton Era (1995)," and "Bush/Obama Era (2008/2009)." For the continuous NHTS variables—age and income—HRTPO staff transformed each into a categorical variable set.

The dependent variable—mode to work—was categorical in the NHTS data set. Given our focus on alternative transportation, HRTPO staff converted the NHTS mode data into a binary variable: alternative vs. conventional. Records that had missing or unknown responses to the mode question were excluded from the analysis. Records with missing data on income (an independent variable), however, were given the average income of respondents reporting such data.

Description of Data Set
Descriptive statistics for the variables used in this analysis are shown in Table 1 on the following page.

As shown at the bottom of the table, in our dataset of 22,483 NHTS person records from the 1983, 1995, and 2008/2009 surveys, 8% of the (working) persons used alternative means to get to work (0.5% biked, 3.0% walked, and 4.6% used public transportation).

TABLE 1 Descriptive Statistics (unweighted), HRTPO Model

Binary Variables		Observations	Share (%)	Min	Max
Era					
Reagan Era (1983)		7,560	34	0	1
Clinton Era (1995)		8,352	37	0	1
Bush/Obama Era (2008/2009)		6,571	29	0	1
		22,483	100		
Age					
16-17		508	2	0	1
18-34		7,288	32	0	1
35-54		10,369	46	0	1
55-74		4,164	19	0	1
75+		154	1	0	1
		22,483	100		
Generation	Years born				
Lost Generation	1883-1900	5	0	0	1
G.I. Generation	1901-1924	696	3	0	1
Silent Generation	1925-1945	5,065	23	0	1
Baby Boomer Generation	1946-1964	11,830	53	0	1
Generation X	1965-1981	4,266	19	0	1
Millennial Generation	1982-2000	621	3	0	1
		22,483	100		
Gender					
Male		11,707	52	0	1
Female		10,776	48	0	1
		22,483	100		
Total Annual Household Income					
<$20,000		1,573	7	0	1
$20,000-$39,999		4,168	19	0	1
$40,000-$59,999		4,582	20	0	1
$60,000-$99,999		7,649	34	0	1
$100,000+		4,511	20	0	1
		22,483	100		
MSA Population					
<1 million		6,489	29	0	1
1 million-3 million		4,744	21	0	1
>3 million		6,605	29	0	1
Household not in MSA		4,237	19	0	1
MSA size not identified		408	2	0	1
		22,483	100		
Urbanized Area Status					
Household in Urbanized Area		14,704	65	0	1
Household not in Urbanized Area		7,733	34	0	1
Urbanized Area status unknown		46	0	0	1
		22,483	100		
Mode to work					
Alternative modes (public transit, walk, bike)		1,837	8	0	1
Conventional modes (privately-owned vehicle, other)		20,646	92	0	1
		22,483	100		

Regression

Given the binary nature of the dependent variable (alternative mode to work), binary logistic regression was performed (using SPSS). Coming from a logistic regression, the model estimates the odds of the subject person using alternative transportation to work, as follows:

$$Odds_i = e \wedge (\beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots + \beta_n X_n)$$

where $Odds_i$ is the odds of using an alternative mode, X_1 through X_n are the regressors, β_1 through β_n are the coefficients of those regressors, and β_0 is the "Constant" at the end of the regression results. In addition, for ease of interpretation, "Odds Factors" have been calculated for the coefficients of the (binary) independent variables (Table 6, following page). Each "Odds Factor" indicates the impact of the subject regressor/variable being 1 (or true) on the odds of using an alternative mode, vs. the basis. For example, if an odds factor for a "male" variable (vs. basis variable "female") is 0.9 and the odds of Betty using alternative transportation is 0.50:1 (for:against, i.e. a 33% chance), then the odds of Betty's twin brother Bill using alternative transportation—all other modeled factors being equal—would be 0.45:1 (0.50*0.9=0.45; 0.45:1 odds is a 31% chance).

The regression results are summarized in Table 2 on the following page.

TABLE 2 Regression Results, HRTPO Model

Logistic regression **Number of observations** **22,483**

DV: Alternative Mode to Work		Signif.	Coeff.	Std. Error	Odds Factor	95% Conf. Interval Lower	Upper
Independent Variables-Regressors							
Era							
Reagan Era (1983) (basis)					1.000		
Clinton Era (1995)		0.000++	-.321	.073	.726	.629	.838
Bush/Obama Era (2008/2009)		0.000++	-.934	.116	.393	.313	.494
Age							
16-17 (basis)					1.000		
18-34		0.000++	-.509	.144	.601	.453	.797
35-54		0.000++	-.703	.169	.495	.355	.690
55-74		0.005++	-.591	.210	.554	.367	.836
75+		0.121	-.630	.406	.533	.240	1.181
Generation	Years born						
Lost Generation	1883-1900	0.144	1.619	1.107	5.050	.576	44.243
G.I. Generation	1901-1924	0.545	-.118	.194	.889	.607	1.301
Silent Generation	1925-1945	0.147	-.132	.091	.876	.732	1.048
Baby Boomer (basis)	1946-1964				1.000		
Generation X	1965-1981	0.022++	.198	.086	1.219	1.029	1.443
Millennial Generation	1982-2000	0.015++	.467	.192	1.596	1.095	2.326
Gender							
Male		0.006++	-.139	.051	.870	.787	.961
Female (basis)					1.000		
Total Annual Household Income							
<$20,000		0.000++	1.211	.090	3.357	2.813	4.006
$20,000-$39,999		0.000++	.356	.080	1.428	1.220	1.672
$40,000-$59,999 (basis)					1.000		
$60,000-$99,999		0.062+	-.142	.076	.867	.747	1.007
$100,000+		0.001++	-.290	.088	.748	.630	.889
Metro Area Population							
<1 million		0.000++	-.492	.104	.612	.499	.750
1 million-3 million		0.002++	-.331	.109	.718	.580	.889
>3 million		0.000++	.886	.098	2.425	2.001	2.939
Household not in MSA (basis)					1.000		
MSA size not identified		0.025++	-.470	.210	.625	.414	.943
Urbanized Area Status							
Household in Urbanized Area		0.000++	1.082	.081	2.950	2.515	3.460
Household not in Urbanized Area (basis)					1.000		
Urbanized area status unknown		0.030++	1.002	.462	2.723	1.101	6.738
Constant		0.000++	-2.537	0.174	0.079	N.A.	N.A.

+Significant at the 0.10 level, ++Significant at the 0.05 level

Statistically, the model has great explanatory power (to be interpreted carefully given the inherent causation issues of regression). The -2 Log Likelihood was 11,269, the Nagelkerke R-Square was 0.145, and 24 of the 29 independent variables are statistically significant at the 95% level.

The alt-trans-to-work odds factor results are represented in Figure 1, organized by the seven (7) independent variable groups. Each group includes the odds factor of the basis variable (1.000), to which all other variables in the group are compared.

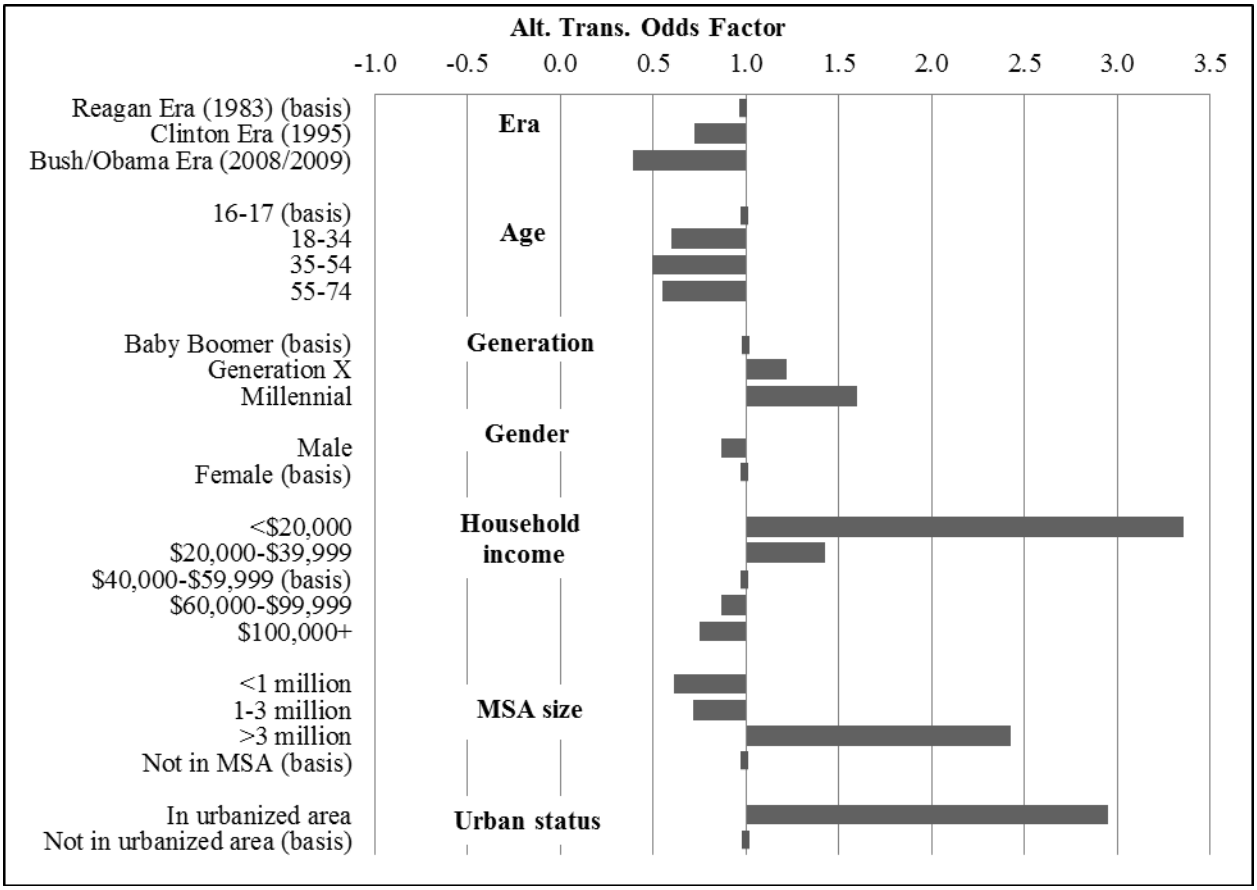

FIGURE 1 Alternative mode to work, odds factors, U.S., NHTS, HRTPO model.

Discussion of Regression Results

The results for each of the seven (7) factor groups are discussed below.

1. Age

All of the *age* variables (except 75+) were significantly related to mode choice. With the youngest age group (16-17) as basis, the alt-trans-to-work odds factors of the other age groups (18-34, 35-54, and 55-74) all being roughly 0.55 indicates that, all other modeled factors being equal, 1) teenagers have a bent toward alternative transportation to work, and 2) excluding teenagers, the bent of American workers toward such modes doesn't vary with age. The regression having controlled for income, the teenage bent toward alternative transportation to

work cannot be explained by being unable to afford a car, but may perhaps be explained by lack of a driver's license.

2. Gender

All other modeled things being equal, the gender odds factors show that the predisposition to use alt-trans-to-work is slightly lower for males (odds factor 0.9 vs. females) than for females.

3. Household Income

All of the *income* variables being significantly related to mode choice, the regression indicates that, all other modeled factors being equal, the bent of American workers toward alternative modes drops with increasing income. In particular, those with the lowest income (<$20k/year) have a large bent toward alternative transportation to work (alt-trans-to-work odds factor approx. 3.5 vs. middle income [$40-60k]). This bent is likely explained by the longer travel times and greater exposure to the elements associated with alternative transportation, and the typical proximity of transit infrastructure to the residences of low-income households.

4. MSA Status

Not surprisingly, concerning *MSA status and size*, all other modeled factors being equal, persons in MSAs with more than 3m population (alt-trans-to-work odds factor approx. 2.5 vs. not being in an MSA) are much more inclined than all others to use alternative modes to work. This can be explained by the higher densities and greater alternative mode infrastructure of large metros.

5. Urbanized Area Status

Similarly, all other modeled factors being equal, persons in *Urbanized Areas* (alt-trans-to-work odds factor approx. 3.0) are much more inclined than those in non-Urbanized Areas to use alternative modes to work. This too can be explained by higher densities and greater alternative mode infrastructure.

6. Generation

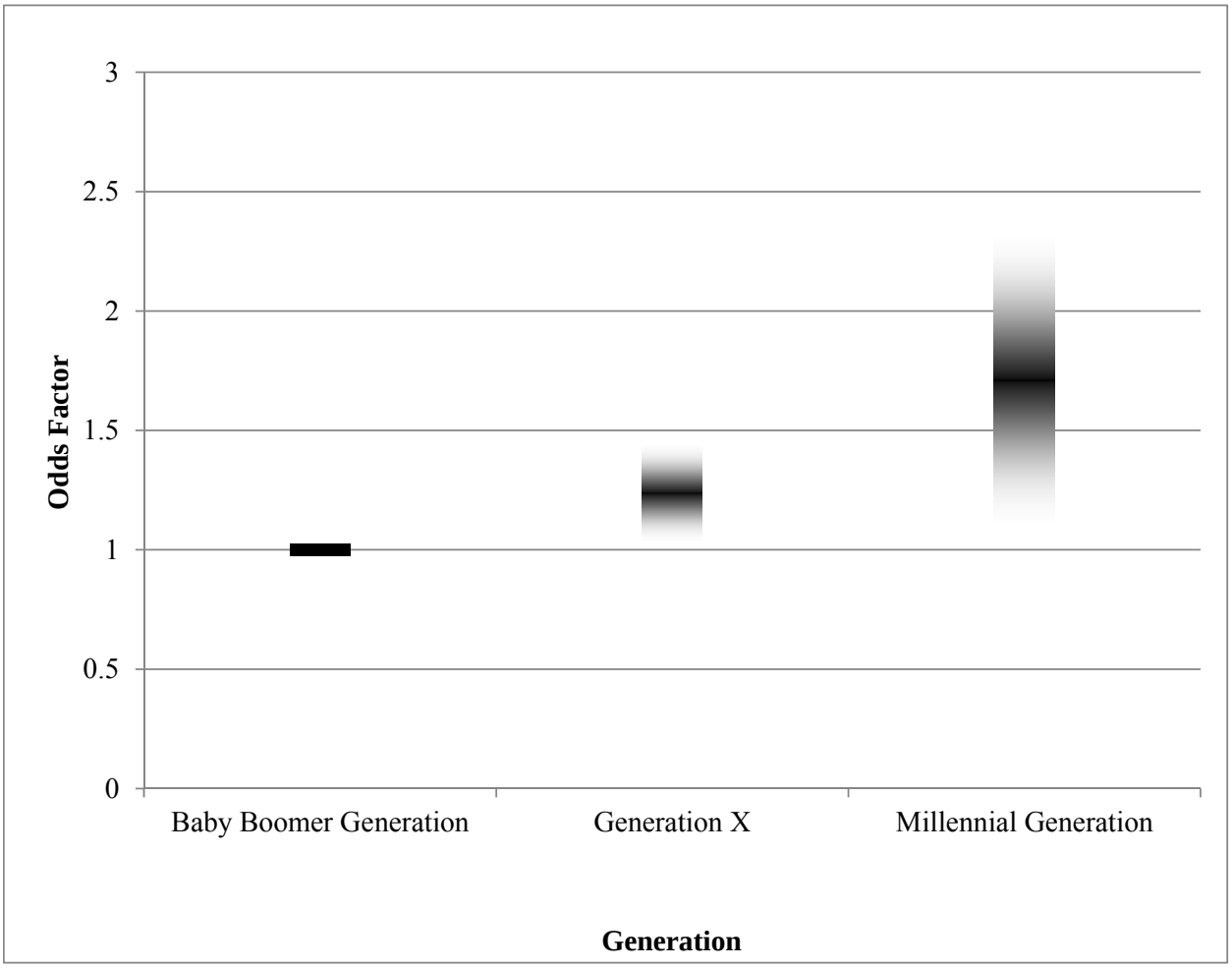

FIGURE 2 Alternative mode to work, by generation, odds factor (vs. Boomers), U.S., NHTS.
Note: Bars represent 95% confidence interval.

Figure 2 shows the regression results for the *generation* factor group. The model coefficients for the Lost Generation, the G.I. Generation, and the Silent Generation being statistically insignificant, odds factor estimates for those generations are not shown on the above figure.

The regression shows that, all other modeled factors being equal, Millennials (and, to a lesser extent, Gen Xers) *do have an inherent bent toward alternative transportation to work* (vs. Baby Boomers: Gen X alt-trans-to-work odds factor 1.2, Millennial alt-trans-to-work odds factor 1.6).

7. Era

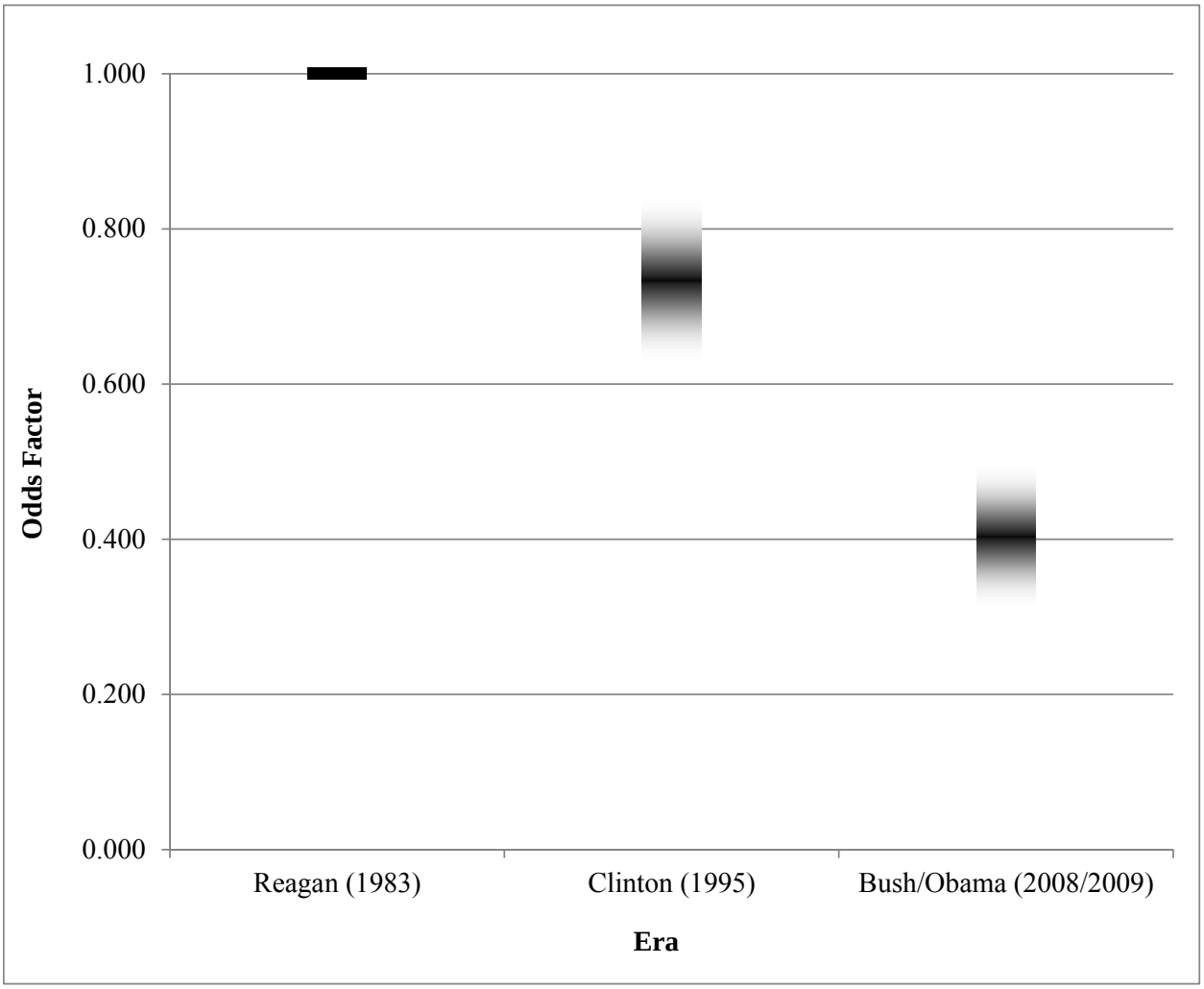

FIGURE 3 Alternative mode to work, by era, odds factor (vs. Reagan Era), U.S., NHTS.
Note: Bars represent 95% confidence interval.

Figure 3 shows the regression results for the *era* factor group. The model revealed an era trend of increasingly lower inclination toward alt-trans-to-work over time. With the Reagan Era as basis (odds factor 1.0), the odds factors of the Clinton Era (0.7) and the Bush/Obama Era (0.4) indicate that, all other modeled factors being equal, the bent of American workers toward alternative modes for work has decreased greatly over recent decades.

This era trend not being explained by age, income, generation, or location—all of which were controlled for—theories explaining why the bent toward alternative transportation to work has declined over this 26-year period are presented below.

Our first theory explaining the era effect is that the "suburbanization of work" over that time period has made jobs harder to reach by bicycling, walking, and riding transit. This theory is based on the accommodations for bicycling (e.g. slower vehicle speeds), walking (e.g.

sidewalks), and transit (e.g. bus hours) being typically more scarce in suburbs than central cities. As shown on Figure 4, over recent years the suburbs contain a higher and higher portion of jobs.

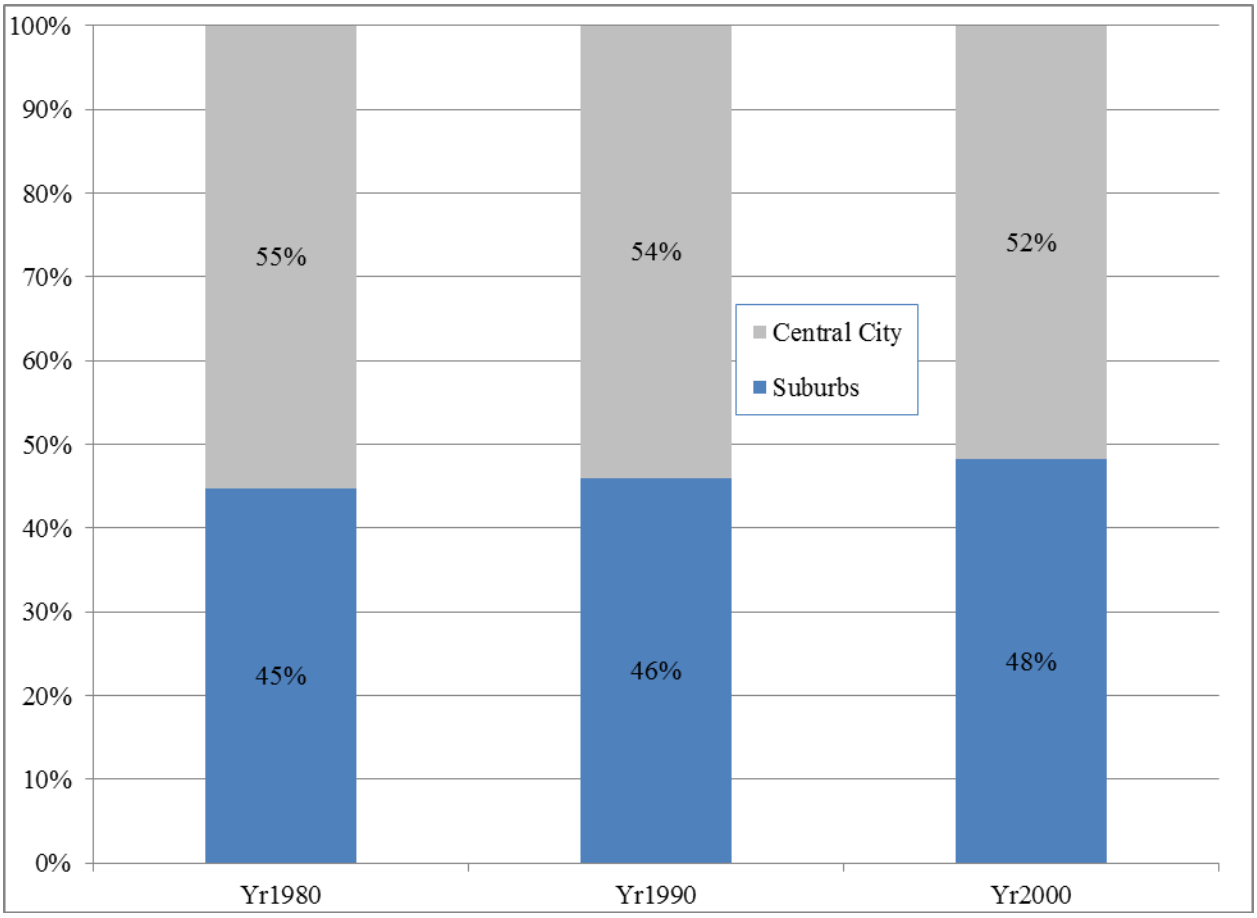

FIGURE 4 Suburbanization of work in U.S., portion of workers.
Source: HRTPO analysis of census data, SOCDS (*23*)

Our second theory explaining the era effect, perhaps related to the above suburbanization-of-work theory, is the increase in work trip length over that time, longer trips favoring the more-rapid automobile mode. According to *Commuting in America 2013* (*20*), work trip lengths increased almost 40% over the subject time period (8.5 miles in 1983, 11.8 miles in 2009).

Our third theory explaining the era effect is a possible increase in the stigma of alternative transportation. Over the study period (NHTS survey years 1983 thru 2008/9), the prevalence of zero-vehicle households declined from 13% (1980 Census) to 9% (2010 Census) (*30*). Considering this decline in "carless-ness", it is possible that the socio-economic stigma of alternative travel has increased as carless-ness has become more nonstandard. This hypothetical stigma trend would explain why the regression shows that a person with a given household income in 2009 (say $30k/year in 2009$'s) was less likely to use alternative transportation to work than a similar person (also having HH income $30k/year in 2009$'s) in 1983.

Our fourth theory explaining the era trend away from alternative transportation to work is the increasing affordability of automobiles. As shown in Figure 5, autos become more affordable over the study period, 1983-2009.

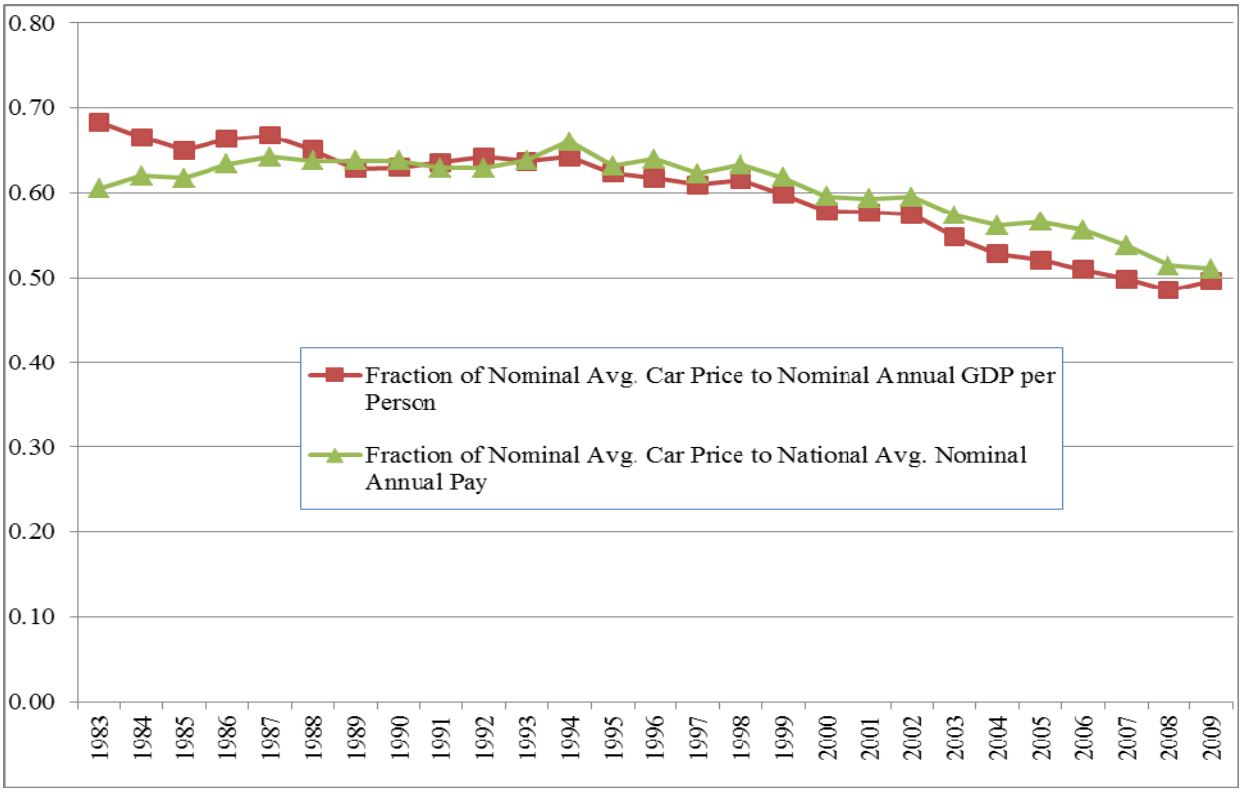

FIGURE 5 Auto cost.
Source: HRTPO Staff analysis of ORNL (*24*), World Bank (*25*), BEA (*26*), and BLS (*27*) data

Each of these four theories—1) suburbanization of work, 2) lengthening work trip distances, 3) growing stigma, and 4) increasing auto affordability—being logically sound and supported by data, it appears that the observed era effect results from some combination of the four, plus likely other unknown factors.

FORECAST OF USAGE OF ALTERNATIVE TRANSPORTATION TO WORK IN U.S.

Understanding How Alt. Trans. Person Factors Affect a Nation of Workers

The above regression having been conducted on *person* records (one record for each person surveyed), the alternative transportation odds factors measured by that regression show how the seven (7) factors are related to the odds of an *individual person* choosing alt-trans-to-work. The forecast of alt-trans-to-work below, however, requires forecasting the behavior of a *whole nation of persons*. The behavior of a nation being the sum of the behavior of individual persons, applying the person factors to the national forecast is appropriate. However, in order to understand any differences between *individual* and *national* behavior (before forecasting national behavior), we used the seven (7) *person* factors to explain the *national* decline of usage of alt-trans-to-work over the recent 30-year census period (1980-2010).

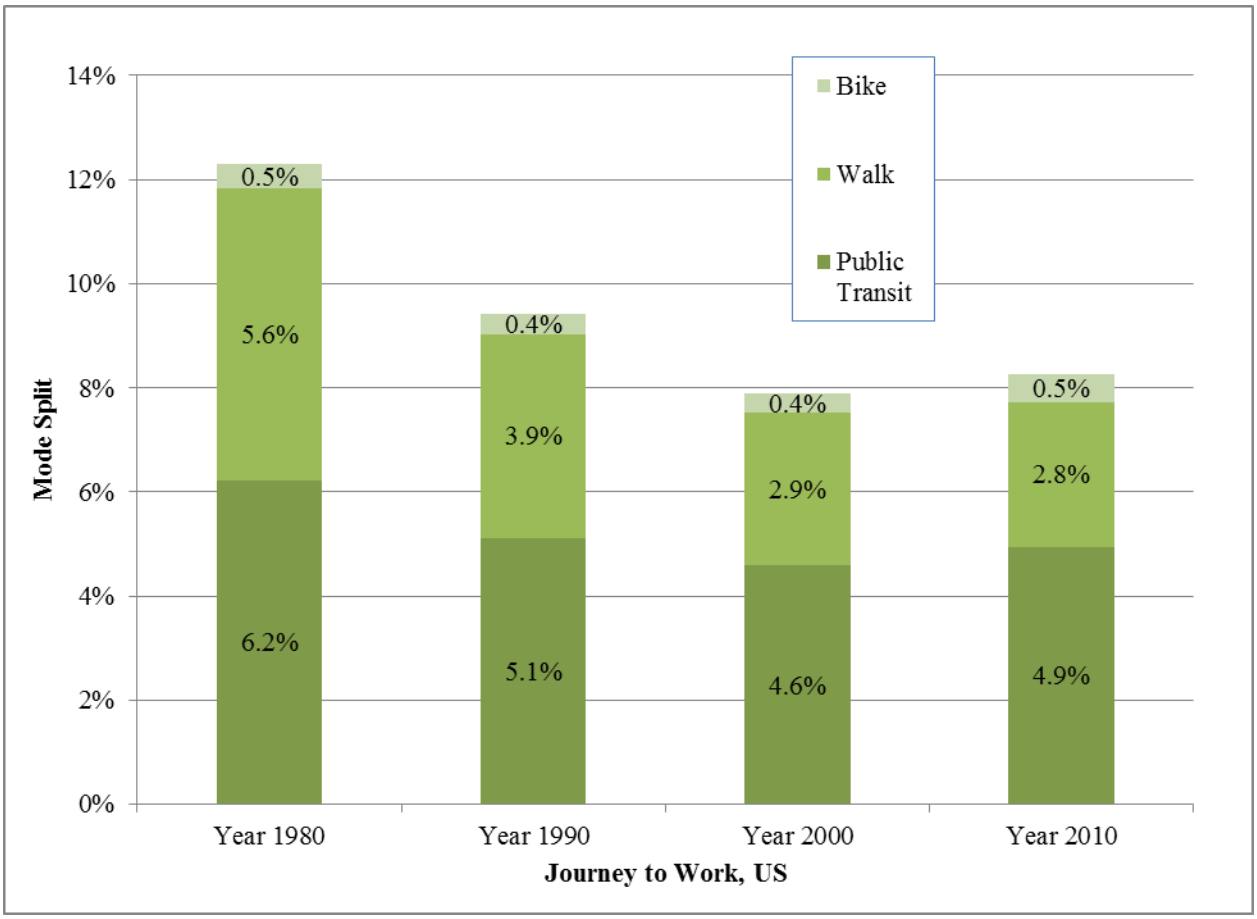

FIGURE 6 Usage of alternative modes to work, U.S.
Sources: "Commuting in America III" (*28*) and HRTPO processing of US Census ACS data (*29*)

As shown in Figure 6, usage of alternative transportation to work declined significantly over the 30-year period, from 12.3% in 1980 to 7.9% in 2000, with a 0.3% increase from 2000 to 2010 (8.2%). (From 2010 to 2013 [8.6%, not shown], usage increased another 0.4%.)

We prepared for the national forecast by using the seven (7) person factors to explain the national decline of usage of alt-trans-to-work over the recent 30-year census period (1980-2010), as follows:

1. Gender

   Gender remaining constant over the study period (1980-2010), gender does *not explain* the 1980 to 2010 decline in alt-trans-to-work.

2. MSA Size

   Although mega-metros (MSAs with population > 3 million) may have captured a higher portion of the population in 2010 than 1980, because living in a mega-region is associated with higher usage of alt-trans-to-work (odds factor 2.4), this change in location would *not explain* the declining usage of alt-trans-to-work over that period (1980-2010).

3. Urban Status

   Likewise, although we assume that Urbanized Areas captured a higher portion of the population in 2010 vs. 1980, because living in an Urbanized Area is associated with higher usage of alt-trans-to-work (odds factor 3.0), this change in location would *not explain* the declining usage of alt-trans-to-work over that period (1980-2010).

4. Age

   Although America aged during the study period, the alt-trans-to-work odds factors being similar for all persons age 18+, it appears that this aging did *not affect* the usage of alternative transportation over the subject period (1980-2010).

5. Household Income

   Household income (adjusted for inflation) having been fairly flat in recent decades, this factor does *not explain* the decline in alt-trans-to-work from 1980 to 2010.

6. Generation

   Given a) that Baby Boomers (age 16-34 in 1980) and Gen Xers (age 0-15 in 1980) represented a growing portion of the workforce over the period 1980-2010, the GI and Silent generations declining, and b) that Baby Boomers (odds factor 1.0) and Gen Xers (odds factor 1.2) likely have *no lesser* bent toward alt-trans-to-work than the GI and Silent generations (odds factors 0.9

and 0.9, respectively, not significant at the 0.10 level), the generation trend does *not explain* the actual decline in alt-trans-to-work 1980-2010.

7. Era

   Given that the era odds factor declined in value over time (1983 odds factor: 1.0; 1995 odds factor: 0.7; and 2008/9 odds factor: 0.4) paralleling the decline in alt-trans-to-work over the 1980-2010 period (from 12% to 8%), it appears that the era factor explains that decline. In fact, given that the trends of all six of the factors above had either *zero or positive* impact on the usage of alt-trans-to-work over the subject period, the last of the seven factors—the era factor—*must* have had a *strongly negative* effect on the usage of alt-trans-to-work from 1980 to 2010 in order for the actual usage of alt-trans-to-work to decline as it did.

From the above national analysis, we learned that the era person-factor can overpower the person-factors that otherwise would increase alt-trans-to-work (MSA size and Urban status). Given a) the size of the era effect (Reagan Era odds factor 1.0 vs. Bush/Obama odds factor 0.4), and b) the fact that era affects the *whole population*, whereas the other factors only affect a *subset of the population* (e.g. the MSA > 3million factor only affects persons in mega-metros), the overpoweringly negative impact of era on the nation seems reasonable.

Forecasting the Usage of Alternative Transportation to Work in the U.S.
Having:

a) measured (via regression) seven (7) factors that explain usage of alternative transportation to work (era, age, generation, gender, income, and location), and

b) discovered (in the previous section) how to apply the seven (7) person factors to national statistics,

we forecasted these seven (7) factors to forecast alt-trans-to-work for the U.S. over the next 15-years and thus answer the research question—"Given recent Millennial reports, should we plan for a quantum leap in demand for alternative transportation to work in the future?", as follows.

(Balancing the desire to forecast a) far enough in the future for infrastructure planning purposes, and b) near enough in the future to limit potential error, we chose to forecast 15 years in the future, i.e. a forecast year of 2030.)

1. Gender

   Given that gender distribution has only changed in the past due to major wars, we assume that gender distribution will remain constant and therefore have *no effect* on alt-trans-to-work in 2030.

2. MSA Size

   We assume that the mega-metros (MSAs with population > 3 million) will capture a slightly higher portion of the population in the near future, and therefore have a *slightly positive* effect on alt-trans-to-work in 2030.

3. Urban Status

   Given the centuries-long urbanization process in the U.S., we assume that Urbanized Areas will capture a moderately higher portion of the population in the near future, and therefore have a *moderately positive* effect on alt-trans-to-work in 2030.

4. Age

   Although we expect the aging of America to continue, the alt-trans-to-work odds factors being similar for all persons age 18+, we expect this aging to have *no effect* on the usage of alternative transportation to work in 2030.

5. Household Income

   Although *personal* incomes may continue their recent gentle rise, we expect *household* size (i.e. persons per household) to continue to decline, rendering a flat forecast for *household* income in 2030, and therefore *no effect* on alt-trans-to-work.

6. Generation

   In 2030, Baby Boomers (age 66-84) will have largely retired, leaving the workforce mostly to Gen Xers (age 49-65) and Millennials (age 30-48). The latter two generations having a slight-to-moderate bent toward alt-trans-to-work (odds factors 1.2 and 1.6 respectively, as compared to Baby Boomers), this "changing of the guard" will have a *slight-to-moderate* positive effect on alt-trans-to-work in 2030.

7. Era

   The era factor having been shown above to be a surrogate for four (4) sub-factors—1) location of work (central vs. suburban), 2) work trip length, 3) association with alternative transportation (pride vs. stigma), and 4) auto affordability—we must forecast these four sub-factors.

   Concerning the first, we see no sign of the "suburbanization of work" ending. The continued suburbanization of work will have a *negative* effect on alt-trans-to-work in 2030.

Concerning the second sub-factor, the population growth expected in the U.S. will likely increase the physical size of metro areas, increasing the "average work trip length", giving this sub-factor a *negative* effect on alt-trans-to-work in 2030.

Concerning the third, in order to forecast a change in "stigma" associated with alternative modes, one would have to forecast usage of alt-trans-to-work, i.e. the ultimate purpose of this whole analysis. Therefore this sub-factor is a feedback mechanism, thus having *no initial effect* on alt-trans-to-work.

Concerning the fourth sub-factor, we expect no significant change in "auto affordability" in the near future, giving this sub-factor *no effect* on alt-trans-to-work in 2030.

Given the sub-factor forecast above, we expect the era group of factors to have an overall *negative effect* on alt-trans-to-work in 2030. However, given the lack of effect expected from the last two sub-factors (association and auto affordability), we expect the era factor to be overall *less negative* in the near future than in the near past.

Therefore, given:

a) the *overpoweringly negative* impact of era on U.S. usage of alternative transportation to work in the past,

b) the *mixed forecast* of the seven (7) factors (three positive, three with no impact, and one—the era factor—negative),

c) the fact that "era" impacts the *whole population,* whereas the other six factors only affect a *subset of the population*, and

d) the expectation that the era factor will have a *less negative* impact in the near future than in the near past,

we forecast no large change—neither a large decrease nor a quantum leap—in the portion of persons using alternative transportation (walk, bike, transit) to work in the year 2030, e.g. no near-term return to the 12% level of 1980.

REFERENCES

1. U.S. Department of Transportation, Federal Highway Administration. 2009 National Household Travel Survey. http://nhts.ornl.gov.
2. Fry, R. *This year, Millennials will overtake Baby Boomers.* Pew Research Center, Washington. http://www.pewresearch.org/fact-tank/2015/01/16/this-year-millennials-will-overtake-baby-boomers/. Accessed June 22, 2015.
3. Blumenberg, E., B. D. Taylor, M. Smart, K. Ralph, M. Wander and S. Brumbaugh. *What's Youth Got to Do with It? Exploring the Travel Behavior of Teens and Young Adults*, University of California Transportation Center, Los Angeles. http://www.uctc.net/papers/UCTC-FR-2012-14.pdf. 2012. Accessed June 17, 2015.
4. Iacono, M. and D. Levinson. *Travel Behavior Over Time, Task 6: Cohort Analysis of Travel Behavior*, University of Minnesota, Minneapolis, 2014.
5. RSG. *Who's on Board 2014: Mobility Attitudes Survey*, TransitCenter, New York. http://transitcenter.org/wp-content/uploads/2014/08/WhosOnBoard2014-ForWeb.pdf. 2014. Accessed June 17, 2015.
6. Polzin, S. E., C. Xuehao and J. Godfrey. *The impact of millennials' travel behavior on future personal vehicle travel*, Energy Strategy Reviews, Center for Urban Transportation Research, University of South Florida, vol. 5, pp. 59-65, Tampa, 2014.
7. Dutzik, T., and P. Baxandall. *A New Direction: Our Changing Relationship with Driving and the Implications for America's Future*, U.S. PIRG, Boston. http://www.uspirg.org/sites/pirg/files/reports/A%20New%20Direction%20vUS.pdf. 2013. Accessed June 17, 2015.
8. St. Louis Federal Reserve, *Moving 12-Month Total Vehicle Miles Traveled*. https://research.stlouisfed.org/fred2/series/M12MTVUSM227NFWA. 2015. Accessed June 17, 2015.
9. Hill, C. *U.S. drivers reach record mileage through April*, Equipment World's Better Roads. http://www.equipmentworld.com/u-s-drivers-reaching-record-mileage-through-april-2015-previous-year/. 2015. Accessed July 7, 2015.
10. American Fact Finder. *Means of Transportation to Work for Workers 16 Years and Over*, U.S. Census Bureau. http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none. 2015. Accessed June 17, 2015.
11. American Fact Finder. *Means of Transportation to Work by Age*, U.S. Census Bureau. http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_B08101&prodType=table. 2015. Accessed June 17, 2015.
12. The League of American Bicyclists. *The Growth of Bike Commuting*. http://www.bikeleague.org/sites/default/files/League-info-BikeCommuting.pdf. 2014. Accessed June 17, 2015.
13. The League of American Bicyclists. *Where we Ride: Analysis of bicycle commuting in American cities*. http://bikeleague.org/sites/default/files/ACS_report_2014_forweb_edit.pdf. 2013. Accessed June 17, 2015.
14. Global Strategy Group. *Rockefeller Millennials Survey.* http://t4america.org/wp-content/uploads/2014/04/RF-Millennials-Survey-Topline.pdf. 2014. Accessed June 18, 2015.

15. Miller, V. *Record 10.7 Billion Trips Taken on U.S. Public Transportation in 2013: The Highest Transit Ridership in 57 Years*, American Public Transportation Association, Washington. http://www.apta.com/mediacenter/pressreleases/2014/Pages/140310_Ridership.aspx. 2014. Accessed June 18, 2015.
16. Dutzik, T., J. Inglis and P. Baxandall. Millennials in Motion: Changing Travel Habits of Young Americans and the Implications for Public Policy, U.S. PIRG, Boston. http://uspirg.org/sites/pirg/files/reports/Millennials%20in%20Motion%20USPIRG.pdf. 2014. Accessed June 18, 2015.
17. Sakaria, N. Serving the Mobility Preferences of Generation Y. In *Transit Cooperative Research Program, Project J-11/Task 17, Web Only Document 61*, Transportation Research Board of the National Academies, Washington, D.C., 2013.
18. Davis, B., T. Dutzik and P. Baxandall. *Transportation and the New Generation: Why Young People Are Driving Less and What It Means for Transportation Policy*, U.S. PIRG, Boston. http://www.uspirg.org/sites/pirg/files/reports/Transportation%20%26%20the%20New%20Generation%20vUS_0.pdf. 2012. Accessed June 18, 2015.
19. Rappaport, J. *The Demographic Shift From Single-Family to Multifamily Housing*, Kansas City Federal Reserve Economic Review, Fourth Quarter. https://www.kansascityfed.org/publicat/econrev/pdf/13q4Rappaport.pdf. 2013. Accessed June 18, 2015.
20. *Commuting in America 2013*. Brief 15. AASHTO, U.S. Department of Transportation, Jan. 2015, p. 4.
21. McDonald, Noreen C. "Are Millennials Really the 'Go-Nowhere' Generation?", in *Journal of the American Planning Association*, published online 9 July 2015.
22. Ralph, Kelcie Mechelle. *Stalled on the Road to Adulthood: Analyzing the Nature of Recent Trvel Changes for Young Adults in America, 1995 to 2009.* ProQuest LLC UMI 3706272.
23. State of the Cities Data Systems (SOCDS), Housing and Urban Development (HUD), http://socds.huduser.org/Census/totaljobs.odb?msacitylist=000*000*1.0&metro=cbsa.
24. Davis, Stacy C., Susan W. Diegel, and Robert G. Boundy, "Transportation Energy Data Book", Chapter 8, Oak Ridge National Laboratory. July 31, 2014. http://cta.ornl.gov/data/chapter8.shtml
25. World DataBank, World Bank, http://databank.worldbank.org/data/reports.aspx?Code=NY.GDP.MKTP.CD&id=af3ce82b&report_name=Popular_indicators&type=series&ispopular=y#
26. Bureau of Economic Analysis http://www.bea.gov/iTable/iTable.cfm?ReqID=12&step=1#reqid=12&step=3&isuri=1&1203=55
27. Quarterly Census of Employment and Wages, Bureau of Labor Statistics, June 17, 2014. http://www.bls.gov/cew/datatoc.htm
28. Pisarski, Alan E. *Commuting in America III*, TRB, 2006.
29. American Community Survey (ACS), US Census.
30. Pisarski, Alan E., et al, *Commuting in America 2013*, Brief 7, TRB, Sept. 2013, p. 8.