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COMPARING THE INFLUENCE OF LAND USE ON NONWORK TRIP GENERATION AND VEHICLE DISTANCE TRAVELED: AN ANALYSIS USING TRAVEL DIARY DATA

by

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ABSTRACT
This study uses two-day travel diary data to examine whether land use matters more for an individual's trip generation or for an individual's total vehicle miles traveled (VMT). More specifically, sociodemographic, land use, and street connectivity variables are used to estimate nonwork trip frequency and nonwork vehicle miles traveled via ordered probit and ordinary least-squares regression models. We compare standardized coefficients of the models and conclude that: (1) the influence of land use variables is similar in both the trip generation and VMT regressions; and (2) income is the primary determinant of both trip frequency and VMT, but that land use exerts an influence that is on par with other sociodemographic characteristics after the primary role of income is considered.

BACKGROUND

The modern literature on the influence of land-use on nonwork travel behavior is now a decade old, and includes scores of studies, yet the results are still murky. Recent literature reviews illustrate this point. Crane (*7*) and Pickrell (*17*) come to generally skeptical conclusions about the influence of land use on travel behavior, while, for example, Ewing and Cervero (*8*), after reviewing much the same literature, are somewhat more supportive of the link between land use and travel. More narrow studies reach similarly diverse conclusions. See, for example, the differing conclusions in Boarnet and Sarmiento (*4*), Frank, Stone and Bachman (*9*), and Handy and Clifton (*12*). As various authors have discussed, comparing the studies in this literature requires choosing between research that employs diverse methods, using different data sets, with variation in both the dependent and independent variables. Here we move the literature forward by testing one emerging hypothesis using a regression technique, sets of independent variables, and data that have been used in the past to study this topic. In particular, we hypothesize that land use influences vehicle miles of travel more than it influences trip generation. This hypothesis is due in part to Ewing and Cervero (*8*), who concluded, based on their literature review, that individual trip generation is primarily influenced by sociodemographic characteristics, while trip distances are primarily influenced by land use patterns, with sociodemographics a secondary factor. While Ewing and Cervero (*8*) came to that conclusion by comparing the results of a large number of studies, here we analytically test that proposition, providing additional evidence on the nature of the land use-travel behavior link.

Our method is similar to recent research on this topic. We use travel diary data that allows us to identify travel for individuals, and then regression measures of travel behavior on the individual's sociodemographic characteristics and land use patterns near the person's residence. We reformulate Ewing and Cervero's (*8*) hypothesis slightly, examining whether land use matters more for an individuals total nonwork vehicle travel distance during the diary period than for an individual's nonwork vehicle trip generation. This is not the same as comparing trip generation and trip distance, because vehicle miles traveled is the sum of individual trip distances. If land use changes induce persons to change their trip generation rates, the net impact on both trip generation and vehicle miles of travel can be ambiguous, even if particular land use changes unambiguously shorten individual trips (*6*).

We examine total nonwork vehicle miles of travel (for an individual) because that variable is more clearly linked to policy than individual trip distances. For example, total driving VMT can be linked to greenhouse gas emissions. Trip generation can be linked to ozone concentration in the lower atmosphere because modern emission control devices are less efficient in the first few minutes of engine operation – the cold start phenomenon. More generally, different land use-travel behavior linkages have different policy ramifications. If land use influences vehicle miles of travel but not trip generation, that suggests that land use policies might be less effective in bringing air basins into compliance with, for example, Clean Air Act regulations but possibly more important in reducing the emission of greenhouse gasses. More generally, we believe that the land use-travel behavior literature should focus on links to policy, giving attention to the possibility that the interaction between travel and land use might imply that some policy goals are more amenable to land use solutions than others. We contribute to that agenda by examining the relative role of land use in individual trip generation and trip distances.

In studying that hypothesis, we follow Ewing and Cervero (*8*) in asking how land use variables compare to sociodemographic characteristics for both trip generation and vehicle miles of travel. This approach echoes an older debate about the relative influence of sociodemographic and land use variables in individual travel behavior. Kulkarni and McNally (*16*) found that street grid pattern explained travel patterns in Orange County neighborhoods, but that when the income of residents was added to the model, income became influential and street grid pattern was not significant. Kitamura et al. (*14*) found a similar result, namely that individual attitudes appeared to be more influential than land use patterns in explaining personal vehicle travel. Yet Kockelman (*15*) found, in a mode choice model, that density has more explanatory power than income. By using a consistent set of independent variables to explain individual travel behavior (both number of nonwork vehicle trips and total two-day nonwork vehicle distance traveled), we are able to provide a more consistent comparison of the relative influence of sociodemographic and land use characteristics than has been possible in the past.

MODEL

This research follows the approach used by Boarnet and Crane (*1,2*) in their study of land use and travel behavior in Southern California and the similar studies by Boarnet and Greenwald (*3*) and Greenwald and Boarnet (*10*) of Portland, Oregon. Earlier examples of similar approaches can be found in Vickerman (*18*) and Hanson and Hanson (*13*). Here, we model both the frequency and total distance traveled for individual nonwork vehicle trips using variables that measure the individual's (or individual's household) sociodemographic characteristics and land use, urban design, and transportation network in the neighborhood surrounding the person's residence.

The basic model involves regressing the dependent variable on sets of independent variables that include both sociodemographics and land use. Boarnet and Crane (*1,2*) propose the below model

$$N = f(S, y, p, L)$$

Where N = number of nonwork vehicle trips
S = a vector of individual or household sociodemographic characteristics
y = income (in this study, measured for the individual's household)
p = trip costs, measured in Boarnet and Crane (*1*) by median trip speeds and median trip distances (medians are calculated for each individual)
L = a vector of land use variables

Here we use two regressions, inspired by the above approach.

$$N = a_0 + a_1 S + a_2 L \qquad (1)$$

and

$$VMT = a_0 + a_1 S + a_2 L \qquad (2)$$

Where N = number of nonwork vehicle trips made by the individual during the two-day travel diary period
VMT = the total nonwork vehicle distance traveled by an individual during the two-day diary period
S = a vector of sociodemographic characteristics

L = a vector of land use characteristics

We include household income in the sociodemographic characteristics, and follow other authors (e.g. Boarnet and Sarmiento, (4)) in including both income and income squared as independent variables. Given that, we depart from the modeling approach used in Boarnet and Crane (*1*) in two ways. First, we do not include median speed and median distance as measures of trip costs. We exclude those variables from the regression because median nonwork trip speeds and distances are correlated by construction with the dependent variable in Equation 2. Because we felt that argued for including median speed and median distance from Equation 2, we also exclude those variables from Equation 1 to allow consistent comparisons. We did test versions of both Equation 1 and 2 with median speeds and distances, and found that those variables typically obscured the influence of land use variables. Because our interest here is the land use variables, we also thought that was a reason to exclude median speed and median distance from the regressions.

The second departure from Boarnet and Crane (*1*) relates to the first. Boarnet and Crane (*1*) tested a two-step procedure that first regressed the median speed and median distance variables on land use characteristics, and then inserted predicted median speed and median distance into a regression like Equation 1, above. That provides a consistent specification for handling the correlation between median speed, median distance, and land use characteristics, while retaining the median speed and median distance variables in the regression. The disadvantage is that interpreting the influence of land use variables is difficult, and because our focus here is interpreting the relative influence of land use variables (an exercise that requires an examination of both statistical significance and the magnitude of coefficients), we choose here the more easily interpretable regressions in Equations 1 and 2.

Equation 1 is estimated by ordered probit. Equation 2 is estimated by ordinary least squares regression, because the dependent variable is continuous.

DATA

This study utilizes data from three sources. First, the 1994 Portland Travel Diary provides sociodemographic and travel characteristics of individuals in a three-county area surrounding Portland. The area comprises Clackamas, Multnomah and Washington counties. The dataset comprises ethnicity, income and employment characteristics of individual respondents and spatially explicit information concerning their travel activities over a two-day period. The dataset also includes a pedestrian environment factor (PEF), a composite generated on four criteria: ease of street crossing, sidewalk continuity, street connectivity (grid versus cul-de-sac), and topography.

Second, individual respondents were associated with a vector of population, housing and employment characteristics made available by the 1990 U.S. Census. These data, extracted from Summary Tape File 3A and the Census Transportation Planning Package (CTPP), reflect neighborhood land use patterns throughout the study area.

Lastly, a transportation network provided by Portland's Regional Land Information System was used in a geographic information system (GIS) to compute spatially explicit variables relating to street connectivity. The PCTGRID variable, for example, represents the proportion of a quarter-mile buffer (0.40 km) that is covered by a grid street pattern. Table 1 lists and defines the variables used in the following ordered probit and ordinary least-squares regression models.

The variables used in this study are similar to those employed in Boarnet and Crane (*1,2*), Boarnet and Sarmiento (*4*), and Boarnet and Greenwald (*3*). In addition, the following three variables were developed using a GIS and incorporated in the following specifications:

- The DISTTOCBD variable represents the Euclidian distance from each household to Portland's central business district (measured as distance from home to Portland City Hall).
- The INT_TOTAL variable represents the total number of street intersections within a one-mile (1.61 km) buffer of each household. A GIS was used to identify and count the number of intersections represented in the Portland transportation network.
- The INT_PCT4WAY variable represents the total number of four-way street intersections within a one-mile (1.61 km) buffer of each household. Intersections along limited access highways and highway ramps were removed from the INT_TOTAL and INT_PCT4WAY variable counts.

RESULTS

We describe the results of regressions for two different dependent variables – the number of nonwork vehicle trips made by an individual (Table 2) and the total nonwork vehicle miles traveled by an individual during the two-day diary period (Table 3). In each table, we use the same set of independent variables, to test whether land use variables, in particular, have different influences on trip generation and trip distance (or vehicle miles traveled). The sets of independent variables in Tables 2 and 3 are described below, referring to columns in both Tables 2 and 3. For each column below, we list the variables that are added to the previous columns. Independent variables are not deleted unless that is explicitly mentioned, below, so that moving from Column A to Column E in Tables 2 and 3 involves adding successive sets of independent variables to the regression specification.

Column A: Individual or household sociodemographic variables
Column B: Add initial four neighborhood land use variables
Column C: Delete percent grid variable and add variables that measure percentage of four-way intersections and number of four-way intersections within a mile (1.61 km) of individual's residence
Column D: Add distance from residence to central business district
Column E: Add measures of housing density

Our hypothesis requires an examination of both magnitudes and statistical significance of coefficients. We care not only about which variables affect nonwork vehicle travel, but also about which variables matter more. In particular, one hypothesis that we examine here is that land-use variables have a larger influence on nonwork vehicle distance traveled that on nonwork vehicle trip generation.

In Table 4, we show the standardized regression coefficients from Tables 2 and 3. The standardized coefficients allow a consistent comparison of magnitudes across independent variables that are measured in different units. Standardized regression coefficients are the regression coefficient from Table 2 or 3 multiplied by the sample standard deviation of the independent variable and divided by the sample standard deviation of the dependent variable. The standardized coefficient shows the amount that the dependent variable changes, in fractions or multiples of the standard deviation of the dependent variable, for a one-standard deviation change in the independent variable. If one-standard deviation changes of all independent variables are equally likely or equally difficult to attain, the standardized regression coefficient gives a consistent measure of the magnitude of the impact of each independent variable. We interpret independent variables with larger standardized regression coefficients as having a larger magnitude of impact on the dependent variable. In Table 4, we only show standardized regression coefficients for independent variables that were significant using a 90 percent two-tailed test in Tables 2 or 3.

First, we discuss the pattern of significant variables in the regressions in Tables 2 and 3. In Table 2, Column A, females take more nonwork vehicle trips, and increasing age is related to more nonwork vehicle trips. Income has a quadratic effect, with trip-making first increasing with income, then decreasing. This is expected, since persons with more income can "consume" more travel, but that at higher income levels the higher value of time should become a deterrent to increased travel. The coefficients in Column A imply a very high income level as a turning point in the quadratic relationship – at income levels higher than \$85,670, on average, increases in income lead to reductions in the number of nonwork vehicle trips. Persons living in households with more children took more nonwork vehicle trips, persons took fewer nonwork trips if the two-day diary period included at least one work day, persons took more nonwork vehicle trips is they lived in households with more cars per driver, and persons took more nonwork vehicle trips if they lived in households with more employed persons (the measure of employed persons in the household excludes the respondent). All of these results corresponded to intuitive hypotheses about sociodemographic characteristics and nonwork vehicle travel, with the possible exception of the relationship between the number of employed persons in the household and number of nonwork vehicle trips. Note that the dummy variable for race (equal to one if the respondent is non-white) is the only variable that is not significant in Column A.

In Column B, we add four land use variables to the specification in Column A. These are the same four land use variables used in the Boarnet and Greenwald (*3*) and Greenwald and Boarnet (*10*) studies of individual travel behavior in the Portland metropolitan area. The variables are intended to measure what Cervero and Kockelman (*5*) called the "three D's" of land use variables – density, diversity, and design. Density is measured by population density in the census tract that contains the travel diary respondent's residence, land use diversity (or land use mix) is proxied by two variables – employment density in the census tract of residence and retail employment density in the census tract of residence, and design (in this case, street grid pattern) is measured by the percentage of the street grid within a quarter-mile of the survey respondent's home that is characterized by four-way intersections. The street grid variable in Column B is the percent of land in the quarter-mile radius characterized by four-way intersections, to correspond to previous research Boarnet and Greenwald, (*3*); Greenwald and Boarnet, (*10*). In subsequent columns in Tables 2 and 3, we use an alternative measure of the street grid.

The results in Column B show that persons who live in tracts with higher employment density take more nonwork vehicle trips (controlling for other variables in the regression), while persons living in tracts with higher retail employment densities take, ceteris paribus, fewer nonwork vehicle trips. The coefficients on some of the sociodemographic variables change when the land use variables are added to the model, although the results in Columns C through E suggest that those changes could be due more to the reduction in the number of observations (6,432 in Column A versus 3,625 in Column B) rather than competing influences of the land use and sociodemographic variables in Column B. The income variables, the number of children in the household, and cars per driver are all insignificant in Column B. For simplicity, we will not discuss changes in sociodemographic variables in each successive column as new variables are added, although in Columns C through E the pattern of sign and significance on the sociodemographic variables is the same same as in Column A.

The loss of observations in going from Column A to Column B is mostly due to the percent grid variable, which is available for many observations. The percent grid variable was calculated by Boarnet and Greenwald (*3*) based on the fraction of land area in a quarter mile of a residence that is characterized by gridded street patterns. The previous spatial analysis of the street network did not yield percent grid scores for many residences. In Column D, we measure street grid patterns using different variables that are likely more accurate than percent grid and that are available for most observations in the data set. Column C shows those results, with street connectivity measured by two variables – the percentage of intersections within a mile of the residence that are four-way, and the total intersections within a mile of the travel diary respondent's residence. The number of observations in Column C, 6,242, is closer to the number of observations in Column A.

The two variables that measure street pattern in Column C can give more detailed information about the street pattern than the single percent grid variable in Column B. The total number of intersections within a mile of the person's residence is a measure of block size, and the percentage of intersections within a mile that are four-way is a measure of gridded versus more curvilinear street patterns. We experimented with other "catchment areas" around respondents' residences, ranging from quarter-mile to five-mile radii. Based on the results, we concluded that the one-mile radius was the best distance to measure neighborhood scale (as opposed to more regional scale) land use patterns that influence driving. On the distinction between neighborhood and regional scale land use patterns, see Handy (*11*).

In Column C, the total number of intersections is correlated with more nonwork vehicle trips (a result that some might consider counter to expectations), and the coefficient on the percentage of four-way intersections, while negative, is insignificant. Other land use variables are insignificant in Column C.

In Column D, we add the distance from the person's residence to the central business distance to the regression. The coefficient on population density in census tracts becomes negative (at the ten percent two-tailed level) and the coefficient on the percentage of intersections within a mile of residence that are four-way becomes negative – both consistent with hypotheses about how land use might influence travel behavior. Less expected is the significantly negative sign of the coefficient on distance from the central business district.

In Column E, we add three measures of housing stock density that can proxy for land use characteristics – the density of single family detached, single family attached, and multi-family housing units in the census tract where the individual lives. All three are significantly negative, suggesting that persons living in more dense tracts (as measured by the three housing stock variables) take fewer nonwork vehicle trips. The percentage of four-way intersections and distance from the central business district remain negative, but the population density variable is now insignificant.

Many of the land use variables in Column E are collinear, and as would be expected the addition of some land use variables to the regression causes other measures to become insignificant. (Notice that the coefficient on population density, significantly negative in Column D, becomes insignificant when the measures of housing density are added to the regression in Column E.) Yet a consistent trend emerges that measures of density and the grid nature of the street pattern are correlated with nonwork vehicle travel in ways that would be expected based on recent theories of land use-travel behavior links. A remaining question, discussed later, is how the magnitude of those land use-travel behavior links compare to the influence of sociodemographics. Before we turn our attention to that, consider the results for nonwork vehicle distance traveled in Table 2.

In Column A of Table 3, the sociodemographic variables show a similar pattern in relation to nonwork vehicle travel distance as in relation to nonwork vehicle trips (from Column A of Table 2), although fewer sociodemographic variables are significant in Table 2. Older persons drive more nonwork vehicle miles, the relationship between income and nonwork vehicle travel distance is quadratic (with a turning point at $69,494), persons with more children drive more (significant at the ten percent level), and persons drive less nonwork vehicle miles when the two-day diary period includes at least one work day. Note that the sociodemographic variables have a similar pattern in the other columns in Table 3, with the exception that the sign on the number of children in the household is negative in the other columns.

In Column B we add four land use variables. Of those, only population density is statistically significant in Column B, with a negative coefficient.

In Column C, we delete percent grid and add the total number of street intersections within a mile of the travel diary respondent's residence, and the percentage of those intersections that are four-way. Of the land use variables in Column C, census tract population density, the total number of intersections within a mile, and the percentage of intersections within a mile that are four-way all have significantly negative coefficients. In other words, the results in Column C suggest that persons living in census tracts with higher population density and in areas with smaller blocks and more grid-oriented street patterns drive less, where driving is measured in nonwork vehicle miles of travel.

In Column D we add the distance from the person's residence to the central business district. As expected, the coefficient on distance from the central business district is significantly positive. The coefficient on the percentage of intersections that are four-way is not statistically significant in Column D.

In Column E we add the three measures of housing density. Persons living in tracts with higher densities of single family detached and multi-family dwelling drove less distance; the coefficient on single family detached housing density is statistically significant at the ten percent level (two-tailed test) and the coefficient on multi-family housing density is statistically significant at the five percent two-tailed level. As was the case in Table 1, the coefficient on census tract population density becomes insignificant when the housing density variables are added to the regression.

Table 4 shows the standardized regression coefficients for the variables in Tables 2 and 3. Variables with larger standardized coefficients are more important in terms of magnitude. Only variables that are statistically significant at the ten percent (two-tailed) level are shown in Table 4. Several trends are evident from the standardized coefficients in Table 4.

- The sociodemographic variables have similar patterns of significance and magnitude in all of the trip generation regressions (excluding the regression in Column B, which is estimated on far fewer observations than the other regressions). The pattern of the sociodemographic variables – both significance and magnitude – is not changed when land use measures are added to the regression. If anything, the link between land use and trip generation appears to be independent of sociodemographic influences, at least in the specification tested here.
- The standardized coefficients in Table 4 give little support for the hypothesis that land use variables matter more for nonwork vehicle travel distance than for trip generation. The

magnitudes of the standardized coefficients, compared to the standardized coefficients for sociodemographic variables, appear similar in both the trip generation and distance traveled regressions.

- For both trip generation and distance traveled, household income is the dominant explanatory variable, in terms of the magnitude of the standardized coefficient. When income is ignored, the magnitudes of the land use variables are similar to the other sociodemographic characteristics. Hence we conclude that income is the primary determinant of both individual trip generation and individual distance traveled, but that land use exerts an influence that is on par with other sociodemographic characteristics after the primary role of income is taken into account.

Overall, our hypotheses that land use variables matter more for individual nonwork distance traveled than for individual trip generation is not well supported. Instead, we conclude that land use variables have roughly similar impacts on both trip generation and vehicle distance traveled. The role of land use patterns is not as strong as individual sociodemographics, but also not trivially small in the context of sociodemographic characteristics other than income. Earlier conclusions that individual travel might be determined by sociodemographics, with land use playing little role, might have been too quick to dismiss land use variables.

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TABLE 1 Variables and Definitions

Dependent Variables	
NWTRIPS[a]	Number of nonwork vehicle trips
NWTRIPDIST[a]	Total distance of nonwork vehicle trips
Sociodemographic Variables	
AGE[a]	Age of individual
CARSPRDR[a]	Licensed cars per driver in household
GENDER[a]	Gender of individual dummy variable (0 = Male; 1 = Female)
INCOME[a]	Annual household income
INCOMESQ[a]	Annual household income squared
KIDS[a]	Number of children under the age of 16 per household
RACE[a]	Ethnicity of individual respondent (0 = white; 1 = non-white)
TOTEMP[a]	Number of employed workers per household
WORKDAY[a]	Variable for whether or not diary covered at least one work day (0 = No; 1 = Yes)
Neighborhood Land Use Variables	
MFDEN_TR[b]	Proportion of multi-family dwelling units per census tract, 1990
PEFSCORE[a]	Pedestrian Environment Factor score for home traffic analysis zone
POP_SQ[b]	Population density (persons per square mile) in census tract
RETEMP_SQ[c]	Retail employment density (retail jobs per square mile) in census tract
SFADEN_TR[b]	Proportion of single family attached dwelling units per census tract, 1990
SFDDEN_TR[b]	Proportion of single family detached dwelling units per census tract, 1990
TOTEMP_SQ[c]	Employment density (total jobs per square mile) in census tract
Transportation Network/Urban Design Variables	
DISTTOCBD[d]	Distance to central business district in miles
INT_PCT4WAY[d]	Proportion of four-way intersections within one-mile (1.61 km) buffer of household
INT_TOTAL[d]	Number of total intersections within one-mile buffer (1.61 km) of household
MLRC[a]	Home is within half-mile (0.81 km) of Multnomah Light Rail Corridor (0 = No; 1 = Yes)
PCTGRID[d]	Percentage of area in quarter-mile (0.40 km) buffer covered by grid format

Data Sources: [a] Portland Travel Diary, 1994; [b]U.S. Census of Population and Housing STF3A, 1990; [c]U.S. Bureau of the Census Transportation Planning Package (CTPP), 1990; and [d]Variables derived by authors from above sources

TABLE 2 Ordered Probit Model of Sociodemographic, Landuse and Housing Characteristics on Nonwork Vehicle Trip Frequencies

	Column A		**Column B**		**Column C**		**Column D**		**Column E**	
	Socio Demographic		**Sociodemographic & Landuse**		**Sociodemographic, Landuse & Street Pattern**		**Sociodemographic, Landuse, Street Pattern & Distance to CBD**		**Socio Demographic, Landuse, Street Pattern, Distance to CBD & Housing Characteristics**	
	Coefficient	**Z statistic**	**Coefficient**	**Z statistic**	**Coefficient**	**Z statistic**	**Coefficient**	**Z statistic**	**Coefficient**	**Z statistic**
GENDER	**0.1938285**	**7.64**	**0.206273**	**6.10**	**0.188996**	**7.33**	**0.190283**	**7.37**	**0.190347**	**7.32**
AGE	**0.0037483**	**5.03**	**0.002843**	**2.87**	**0.003419**	**4.50**	**0.003390**	**4.46**	**0.003326**	**4.33**
RACE	-0.0277307	-0.51	0.016287	0.23	-0.017830	-0.32	-0.018760	-0.34	-0.001170	-0.02
INCOME	**8.33E-06**	**3.27**	3.27E-06	0.95	**7.83E-06**	**3.01**	**7.69E-06**	**2.96**	**8.45E-06**	**3.21**
INCOMESQ	**-4.86E-11**	**-2.20**	-9.76E-12	-0.33	**-4.78E-11**	**-2.12**	**-5.10E-11**	**-2.26**	**-5.61E-11**	**-2.47**
KIDS	**0.0682826**	**5.14**	0.020643	1.13	**0.055518**	**4.04**	**0.057612**	**4.19**	**0.051991**	**3.73**
WORKDAY	**-0.3753933**	**-6.88**	**-0.406640**	**-5.75**	**-0.371880**	**-6.71**	**-0.379190**	**-6.84**	**-0.366840**	**-6.57**
CARSPRDR	**0.1434085**	**4.41**	-0.009600	-0.21	**0.115277**	**3.48**	**0.110377**	**3.33**	**0.108596**	**3.24**
TOTEMP	**-0.0814258**	**-4.92**	**-0.082200**	**-3.91**	**-0.093170**	**-5.55**	**-0.084570**	**-5.02**	**-0.089720**	**-5.25**
POP_SQ			-1.83E-07	-0.03	-7.15E-07	-0.13	**-9.39E-06**	**-1.70**	-6.70E-06	-1.17
TOTEMP_SQ			**3.91E-05**	**1.8**	-1.7E-05	-1.24	-1.9E-05	-1.36	-1.5E-05	-1.06
RETEMP_SQ			**-0.000120**	**-1.96**	8.99E-06	0.23	1.15E-05	0.30	1.16E-05	0.30
PCTGRID			0.081404	0.7						
INT_PCT4WAY					-0.001	-1.3	**-0.001800**	**-2.31**	**-0.002720**	**-2.96**
INT_TOTAL					**0.001206**	**2**	-6.1E-05	-0.10	0.000392	0.59
DISTTOCBD							**-0.006100**	**-6.31**	**-0.006490**	**-5.54**
PEFSCORE									0.000529	0.06
MLRC									0.085011	1.47
SFDDEN_TR									**-0.003670**	**-2.12**
SFADEN_TR									**-0.016970**	**-2.79**
MFDEN_TR									**-0.686340**	**-3.22**
N		6432		3625		6242		6242		6153
Log (L)		-15892.731		-8969.14		-15410.1		-15390.2		-15176.2

Note: Coefficients in bold are significant at the ten percent level or greater

TABLE 3 Ordinary Least-Squares Model of Sociodemographic, Landuse and Housing Characteristics on Total Nonwork Vehicle Travel Distance

	Column A Socio Demographic		**Column B Sociodemographic & Landuse**		**Column C Sociodemographic, Landuse & Street Pattern**		**Column D Sociodemographic, Landuse, Street Pattern & Distance to CBD**		**Column E Socio Demographic, Landuse, Street Pattern, Distance to CBD & Housing Characteristics**	
	Coefficient	**t statistic**	**Coefficient**	**t statistic**	**Coefficient**	**t statistic**	**Coefficient**	**t statistic**	**Coefficient**	**t statistic**
GENDER	0.6666286	1.22	0.7474472	1.14	0.376891	0.70	0.3606648	0.67	0.4347605	0.83
AGE	**0.0658150**	**4.08**	**0.0591732**	**3.07**	**0.033008**	**2.07**	**0.0340423**	**2.15**	**0.0397472**	**2.58**
RACE	-0.1394055	-0.12	1.1370390	0.83	1.057975	0.91	1.0730480	0.93	0.4010346	0.36
INCOME	**0.0002474**	**4.50**	**0.0001723**	**2.57**	**0.000158**	**2.92**	**0.0001635**	**3.03**	**0.0001802**	**3.42**
INCOMESQ	**-1.78E-09**	**-3.74**	**-1.18E-09**	**-2.04**	**-1.18E-09**	**-2.51**	**-1.10E-09**	**-2.34**	**-1.19E-09**	**-2.61**
KIDS	**0.5114558**	**1.78**	**-0.59501**	**-1.68**	-0.464490	-1.61	**-0.5239165**	**-1.83**	**-0.4699337**	**-1.67**
WORKDAY	**-7.6014980**	**-6.42**	**-8.5809020**	**-6.24**	**-7.264170**	**-6.24**	**-7.0725000**	**-6.11**	**-6.740257**	**-5.98**
CARSPRDR	0.1417413	0.20	-0.3640478	-0.42	0.309045	0.45	0.4609729	0.67	0.5354734	0.80
TOTEMP	-0.3286923	-0.92	**-0.6919861**	**-1.70**	-0.510900	-1.46	**-0.7748054**	**-2.22**	**-1.0188980**	**-2.98**
CONSTANT	**20.0514600**	**10.02**	**28.5321000**	**11.16**	**35.856760**	**17.01**	**27.1557900**	**11.74**	**30.4623300**	**7.23**
POP_SQ			**-0.0007485**	**-5.68**	**-0.000470**	**-4.27**	**-0.0002243**	**-1.97**	-0.0001741	-1.53
TOTEMP_SQ			0.0000838	0.20	0.000120	0.43	0.0001760	0.63	0.0001668	0.61
RETEMP_SQ			-0.0006030	-0.49	-0.000550	-0.72	-0.0006681	-0.87	-0.0005655	-0.76
PCTGRID			-1.5055770	-0.67						
INT_PCT4WAY					**-0.050360**	**-3.14**	-0.0265272	-1.64	**-0.0461843**	**-2.51**
INT_TOTAL					**-0.124240**	**-9.86**	**-0.0869309**	**-6.58**	**-0.0693505**	**-5.22**
DISTTOCBD							**0.1781716**	**8.87**	**0.1741140**	**7.40**
PEFSCORE									0.1545367	0.89
MLRC									-0.0263876	-0.02
SFDDEN_TR									**-0.0651096**	**-1.87**
SFADEN_TR									-0.0400414	-0.33
MFDEN_TR									**-9.0200550**	**-2.13**
N		6432		3625		6242		6242		6153
F-Test (Prob>F)		10.72 (0.00)		10.83 (0.00)		38.37 (0.00)		41.5 (0.00)		28.8 (0.00)
R^2		0.015		0.0375		0.0794		0.0909		0.0859
Adj. R^2		0.0134		0.0341		0.0773		0.0887		0.0829

Note: Coefficients in bold are significant at the ten percent level or greater

TABLE 4 Comparison of Standardized Coefficients for Nonwork Trip Frequencies and Total Nonwork Vehicle Travel Distance

	Column A		Column B		Column C		Column D		Column E	
	Nonwork Vehicle Trips	Nonwork Vehicle Distance	Nonwork Vehicle Trips	Nonwork Vehicle Distance	Nonwork Vehicle Trips	Nonwork Vehicle Distance	Nonwork Vehicle Trips	Nonwork Vehicle Distance	Nonwork Vehicle Trips	Nonwork Vehicle Distance
GENDER	0.0952		0.1015		0.0919		0.0922		0.0922	
AGE	0.0762	0.0618	0.0586	0.0621	0.0691	0.0310	0.0683	0.0320	0.0669	0.0388
INCOME	0.2185	0.2994		0.2281	0.2037	0.1918	0.1994	0.1979	0.2193	0.2271
INCOMESQ	-0.1447	-0.2446		-0.1780	-0.1410	-0.1623	-0.1499	-0.1504	-0.1653	-0.1701
KIDS	0.0754	0.0260		-0.0331	0.0603		0.0624	-0.0265	0.0564	-0.0247
WORKDAY	-0.0853	-0.0797	-0.0960	-0.1026	-0.0838	-0.0762	-0.0852	-0.0742	-0.0823	-0.0734
CARSPRDR	0.0551				0.0440		0.0420		0.0412	
TOTEMP	-0.0690		-0.0730	-0.0310	-0.0784		-0.0709	-0.0303	-0.0748	-0.0412
POP_SQ				-0.1052		-0.0744	-0.0316	-0.0352		
TOTEMP_SQ			0.2137							
RETEMP_SQ			-0.2300							
MDSPD										
MDDIST										
INT_PCT4WAY						-0.0563	-0.0431		-0.0651	-0.0536
INT_TOTAL					0.0325	-0.1560		-0.1091		-0.0884
DISTTOCBD							-0.1078	0.1471	-0.1056	0.1375
SFDDEN_TR									-0.0829	-0.0714
SFADEN_TR									-0.0392	
MFDEN_TR									-0.1369	-0.0873

Note: All coefficients are significant at the ten percent level or greater