Metropolitan Policy Program at BROOKINGS

Making Transportation Sustainable: Insights from Germany

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TECHNICAL APPENDIX

A. Data Sources

Two national travel surveys, the U.S. *National Household Travel Survey 2001 (NHTS)* and the *Mobility in Germany 2002 (MiD)*, are the main data sources for the multivariate analyses. The data for both surveys were collected in successive years: in 2001 for the U.S. and in 2002 in Germany. Given that the German survey was influenced by the American model, both surveys use the same data collection methods and contain comparable variables. Similarities and differences of the two surveys are summarized in Table A-1. These two surveys are the most comparable national travel surveys that currently exist. Some variables were readily available for comparison in both datasets and just had to be transformed to make them fully comparable for multivariate analyses. Some variables had to be added to the datasets, and others had to be generated for the purpose of the analyses. Data added include residential and workplace density, costs of car use (for Germany only), and distance of household location to a transit stop (United States only). Variables transformed are household income, household life cycle, age, mix of land uses, and relative speed of travel by different modes.

B. Modeling Strategy

Some of the variables that explain the variability in travel behavior within and across countries are: socioeconomic and demographic variables, spatial development patterns, transportation policies, and cultural preferences. These explanatory factors have a different impact in each country, contributing to a unique transportation system. Model 1 summarizes these factors in a general model for comparing similarities and differences in travel behavior (see Equation 1):

Model (1): TB=f (TP, SD, SE, CP) Eq. (1)

Where:
TB=travel behavior
TP= transportation policies
SD=spatial development patterns
SE=socioeconomics and demographics
CP=cultural preferences

Travel behavior is approximated by
(1) Average daily travel distance per inhabitant,
(2) Average daily kilometers of car travel per inhabitant, and
(3) Individual choice of transportation mode.
Therefore, Model 1 has three specifications, given the three different proxies of travel behavior.

All models were based on a pooled sample, which included information from the MiD and NHTS surveys. For example, models for average travel distance and average car travel distance were based on a pooled sample of 122,000 individuals from Germany and the United States. The analytical strategy chosen
(1) Explored differences and similarities in travel behavior within and between the countries,
(2) Evaluated the contribution of explanatory factors to explained variability and
(3) Tried to capture the importance of explanatory factors for differences between the countries through simulations.

Differences in magnitude, sign, and significance of coefficients between the countries were captured through *interaction effects*. This meant that for every independent variable one additional interaction variable for Germany was included in the analysis. Cultural preferences do not have an interaction variable, as cultural preferences were captured with a dummy variable (Germany=1, United States=0). Model 2 displays a general model for explaining international similarities and differences in travel behavior with interaction effects (see Equation 2):

Model (2): TB=f (TP, TP(G), SD, SD(G), SE, SE(G), CP) Eq. (2)

Where:
TB=travel behavior
TP= transportation policies
SD=spatial development patterns
SE=socioeconomics and demographics
CP=cultural preferences
(G)=interaction effect for Germany

Model 2 is Model 1 augmented with interaction effects. Therefore, Model 2 has three specifications for each proxy for travel behavior, the dependent variable.

The model is created as a set of nested equations—where independent variables are entered one after the other. For example, all variables measuring transportation policies are included in the first model. Variables capturing spatial development patterns are added in the next model. The basic logic of the set-up of the models is presented in Equations 3-6. Each subsequent model includes the explanatory variables of the previous model(s) and adds a new set of independent variables. This allowed controlling for changes in total variance explained (R^2) for different groups of independent variables. It also identifies omitted variables bias through observing changing signs and magnitudes of coefficients across different models.

$$\textit{Model (3): } TB = f\,(TP) \qquad \text{Eq. (3)}$$

$$\textit{Model (4): } TB = f\,(TP, SD) \qquad \text{Eq. (4)}$$

$$\textit{Model (5): } TB = f\,(TP, SD, SE) \qquad \text{Eq. (5)}$$

$$\textit{Model (6): } TB = f\,(TP, SD, SE, CP) \qquad \text{Eq. (6)}$$

The sequence of entering the variable groups is based on theoretical background. Four separate models are estimated with each group of independent variables. The purpose of these additional individual models is to identify the unique contribution of each group of independent variables, by comparing the R^2 for the four models.

In Model 2, the coefficients of the independent variables are evaluated according to three criteria:
(1) The sign of the coefficient,
(2) Its magnitude, and
(3) Its statistical significance.

The signs of the coefficients show if the independent variables have the same direction in their impact on travel behavior in both countries. The magnitude of the coefficients is expected to vary between the countries. The statistical significance of coefficients shows whether a certain independent variable has a significant impact on travel behavior, given everything else constant. This is especially important for the interaction effects for Germany. If an interaction effect is not statistically significant, it shows that the sign and magnitude of the effect of a specific variable are not significantly different in both countries.

C. Analyses
Table A-2 describes the proxies for the independent variables, with data sources. The table also indicates in which analyses the variables are used. Modeling requirements and data availability made it impossible to include all variables in each analysis. Tables

A-3 through A-5 summarize descriptive statistics of the independent and dependent variables employed in each analysis. The last column indicates statistically significant linear bivariate (Pearson) correlations between dependent and independent variables, if applicable. Due to space constraints we will only highlight the main results of the analyses. Details on the rest of the analyses can be obtained from the authors.

Ordinary Least Squares (OLS) is employed to estimate the first two specifications of Model 2. Daily travel distance and daily car travel distance are regressed on proxies for transportation policies, spatial development patterns, socioeconomic and demographic variables, and cultural differences. The unit of analysis for the first specification is an individual who made a trip on the travel day—excluding individuals who stayed at home. The second specification uses as unit of analysis an individual who made a trip by car—excluding those who did not drive during a day.

The groups of independent variables are added sequentially in each of the first two specifications of Model 2. The sequential approach has to be carefully interpreted as the variance explained depends on the order in which variables are entered. The F-statistics for these regressions are significant, indicating that the effect of at least one of the variables is statistically different from zero and the independent variables have joint statistical significance in explaining the dependent variable. The standard tests for multicolinearity (Variance Inflation Factor, Tolerance and Condition Index) yielded satisfactory results. We also corrected for spatial autocorrelation.

The linear multivariate analyses reveal differences in the travel behavior of similar individuals and differences in the impact of spatial development patterns and policies on travel behavior. Socioeconomic and demographic variables explain between six and 14 percent of total variability in travel behavior. Transportation policies explain between four and nine percent of the variability in the data and spatial development patterns account for four to 10 percent. Decomposing the total variability explained across all models into the different components yields the following results: roughly 25 percent explained by the policy and the dummy variable, roughly 25 percent for spatial development variables, roughly 50 percent for socioeconomic and demographic variables.[1]

Multinomial (MNLM) and conditional logit estimation techniques are used for the analysis of daily choice of transportation modes. The unit of analysis for the third specification is a trip made on that specific day. The travel choice is between car and each of the following modes:
(1) public transportation,
(2) bicycle, and
(3) walking.

This specification of Model 2 predicts mode share well.[2] Both Hausmann and Small-Hisao tests of the MNLM show that the assumption of independence of irrelevant alternatives (IIA) holds true. The R^2 ranged from 19 to 32 percent.

Daily travel distance: Table A-6 gives the OLS results for travel behavior expressed as total daily travel distance. On average, Germans travel 14.78 miles per day less than Americans. Living in close range to a transit stop has a larger impact in the United States than Germany. Being located within 0.24 miles of a transit stop compared to more than 0.62 miles away reduces daily travel distance by 4.4 miles in the United States and only 1.73 miles in Germany.

Higher population density and greater mix of land use lead to shorter daily travel distance in both countries. The population density effect is significantly weaker in Germany than in the United States. While a density higher by 1,000 people per square kilometer results in daily travel distance shorter by 1.61 miles in the United States, the effect for Germany is only 0.74 miles.

Daily travel distance by car: Table A-6 gives the OLS results for travel behavior expressed as daily travel distance by car. The results for daily car travel distance are similar to those of total daily travel distance, at large. Living within 0.24 miles of a transit stop reduces daily car travel distance by 4 miles in the U.S., but only by 2 miles in Germany. An additional 1,000 people per square kilometer leads to a 1.67 miles shorter daily car travel distance in the United States, the reduction was only one mile in Germany.

The car travel costs have a lower effect on daily travel distance in Germany than in the United States. A one cent increase in the operating cost of a car leads to 0.24 miles reduction in vehicle miles traveled in Germany versus a 1.5 miles reduction in the United States. The magnitude of difference between these coefficients is unexpected. Theory suggests a more elastic demand in Germany given higher gasoline prices, better accessibility without a car, and greater availability of other modes of transportation. A closer look at these results shows that the differences are not as pronounced as they might seem at first sight.

Based on these coefficients, price elasticities of the demand for passenger miles of car travel are |0.20| for the United States and |0.16| for Germany (measured at the mean). Therefore, a 10 percent increase in operating costs of car reduced passenger miles of car travel by 2 percent in the United States and by 1.6 percent in Germany. The 95 percent confidence intervals for the two elasticity estimates overlap. Thus it could not be determined that the two estimates are statistically significantly different.[3]

Mode choice: Table A-7 presents the results of the analysis of travel behavior expressed by travel mode choice. Multinomial logit (MNLM) and conditional logit estimation techniques are often used in choice analysis. Interpreting coefficients from a MNLM is not as straight forward as for OLS regressions, given that they are interpreted as chances of taking a decision over another.

Being located within 0.24 miles of a transit stop compared to more than 0.62 miles away a transit stop increases the odds of using public transportation by 4.5 percent ($e^{0.044}$) in the United States. The likelihood of using public transportation in Germany is 1.67 times the odds in the United States ($e^{0.514}$) in the same situation.   If the population density in an area would increase by 1000 people per km^2 the odds of making the trip by transit over the car increases by 16 percent ($e^{0.149}$) in the United States. The odds of riding transit in Germany are 1.28 times the odds for the United States. Households living closer to a transit stop and in areas with greater land use mix are more likely to walk in both countries.

The influence of different independent variables can also be interpreted as *marginal changes* in predicted probabilities. A small change in the level of mix of land uses in Germany reduces the probability of driving by 7.9 percent and increases the probabilities for walking (4.1 percent), cycling (3.2 percent), and transit use (0.2 percent). For the United States**,** a small change in the level of mix of land uses reduces the probability of driving by 1.6 percent and increases the chance of walking by 1.7 percent.

Conditional logit models extend the MNLM analysis. The main variables of interest in this analysis are the speed variables. As expected, in both countries speed has a positive influence on the likelihood of choosing a mode. One mile/hour increase in travel speed of any given mode compared to other modes increases the likelihood of choosing that mode by 7.6 percent (= $e^{0.073}$) in Germany and by 7.3 percent (= $e^{0.069}$) in the U.S.

D. Limitations

International comparisons of travel behavior are hampered traditionally by problems with the comparability of data or survey methods. Most studies rely on country or city averages, which mask wide variability in individual travel behavior. The unique comparability of the German MiD and the U.S. NHTS surveys constitutes an unprecedented opportunity for individual level international comparisons.

Sample selection bias is a problem for all travel surveys, but for comparative analysis in particular. Response rates for national and regional travel surveys generally range from 10 to 40 percent. Limited non-response studies were carried out for both surveys and found the potential for selection bias. Both surveys included weights to adjust for the distributions of certain characteristics in the samples and the populations. Higher weights were assigned to the travel behavior of respondents with certain characteristics.

The two surveys are only representative for the countries as a whole and certain regions and states of each country. They are not representative for specific cities and metropolitan areas. The aggregate nature of the two surveys masks variability within specific metropolitan areas and cities within the two countries. Dummy variables for states are used to help account for spatial variation, but these variables are still at a relatively aggregate level.

Spatial development and policy variables rely on rough proxies or aggregate indicators. For example, neither survey included information about the supply of transportation and local accessibility. Household distance to major highways, and bike networks, and the frequency of transit service could greatly enhance the analysis of mode choice decisions. Furthermore, one or two variables capturing local accessibility, such as distance to the closest supermarket and other facilities could be very helpful in describing spatial development patterns.

Beyond any improvements that can be added to future surveys in the two countries, we acknowledge that our study has a number of limitations. The study relies on cross-sectional data, as no time series data are available to compare travel behavior over time in the two countries. Cross-sectional data are useful in providing a glimpse into differences in travel in both countries at one point in time. However, to capture the impacts of variables like gasoline prices, transit access, or population density, observations would have to be measured over time. A time series study, ideally a panel study, would show how changes in policies or spatial development patterns effect changes in travel behavior over time.

Most of the hypotheses are exploratory in nature and are tested in an international comparative context for the first time. It can be argued that some explanatory variables in specifications 1 and 2 of Model 2 influence the fundamentals of daily travel distance or car travel distance: the decision to make a trip or to make a trip by car on a given day. For example, having a driver's license or living in a household with car availability may increase the likelihood of making a trip or making a trip by car. If this were true, just estimating a regression for daily travel distance or car travel distance could lead to inefficient and biased estimators, due to sample selection bias. Two-stage Heckman Selection Models (HSM) are estimated for both specifications. The decision to make a trip or to make a car trip is modeled in the first stage and the distance traveled in the second stage. This represents more accurately the travel decision making process. In addition, it serves as a control case for the OLS estimation affected by possible sample selection bias. The OLS results are almost identical to the results of the second stage HSM equations. Therefore, we presented only the OLS results. The HSM results are available from the authors.

The sequence of entering the variable groups in the OLS specifications 1 and 2 of Model 2 is based on theoretical background. This approach influences the changes in R^2. In addition, endogeneity and self-selection bias are always problems for analyses of travel behavior. Endogeneity bias can occur
(1) if independent variables are also a function of the dependent variable or
(2) if independent variables are correlated with omitted variables.[4]
In both cases estimators will be biased and inconsistent. These two conditions are often encountered in transportation and land-use research. The built environment influences travel behavior, but at the same time, travel behavior impacts spatial development patterns over time. In this case, not accounting for the simultaneity of the influence might bias estimators.

Furthermore, some researchers argue that the choice of household location and car ownership is associated with travel preferences and attitudes. Individuals who wish to travel less by car might own fewer cars and locate closer to transit stops or in areas with higher population densities and a more diverse mix of land uses. Not including specific variables about attitudes and travel preferences could lead to biased coefficients. Several solutions exist to address these problems, such as statistical control, instrumental variable models, sample selection models, joint models, and longitudinal designs.[5] All of these approaches come with stringent requirements for comparability of variables and measurements in both countries and are hard to implement with just two cross-sectional surveys.

Table A-1 Potential Sources of Divergence in National Travel Surveys and Comparability of MID and NHTS

	Range of NTS*	MiD (Germany) 2002	NHTS (United States) 2001
Survey Period	*10 weeks to 14 months*	14 months (11/01 - 12/02)	14 months (03/01 - 04/02)
Collection Rhythm	*annually to irregularly*	KONTIV: '76, '82, '89; MiD: '02	NPTS: '69, '77, '83, '90, '95; NHTS: '01
Sample Size	*3,000 to 63,000 households*	25,848 households	26,082 households
		61,729 individuals	60,228 individuals
		167,851 trips	248,512 trips
Survey Method	*phone, person, mail*	CATI (95%)	CATI (100%)
Target Population	*civilian population*	civilian	civilian
Eligibility of HH Members	*adults, children, age cap*	adults and children	adults and children
Sampling Technique	*RDD to pop. register*	stratified random sample	list assisted random digit dialing
Survey Period	*1 to 7 days*	1 day travel diary	1 day travel diary
Response Rates	*often below 40% of households*	42% of households	41% of households
Inclusion Criteria		households where at least 50% of household members responded	households where at least 50% of household members over 18 years old responded
Nonresponse Treatment		collection of household data	collection of household data
Weights		selection reciprocal, non-response, household size, weekday, month, regional characteristics	selection reciprocal, non-response, household size, weekday, month, regional characteristics
Data Level	*household, person, trip, or car*	household, person, trip, car	household, person, trip, car
Representative	*country, subsections*	Germany, States	United States, Census Regions
Add-ons		Yes	Yes
*based on 9 recent national travel surveys			

Note: Cells shaded in grey indicate comparability between the two surveys; cells in white display remaining differences.
Acronyms: MiD=Mobility in Germany 2002, NHTS=U.S. National Household Travel Survey 2001, HH= household.

Table A-2. Independent Variables in the Regressions: Measurement, Explanation, and Data Sources

Variable	Measurement	Explanation	Source	Included in Analysis #
Household distance to a transit stop	two nominal variables indicating if a household is located (1) within 400 meters (1/4 mile) or (2) between 400 (1/4 mile) and 1000 meters (0.62 miles) from transit	United States: distance of a household from a rail station or bus corridor	ORNL	all
		Germany: distance of a household from a bus stop or a rail station	MiD	
Automobile operating cost	United States cents per mile	United States: operating cost based on type and fuel economy of vehicle (assuming 55 percent urban) and average state gasoline prices	EPA	(3) and (4)
		Germany: operating cost based on type and fuel economy of vehicle (assuming 55 percent urban) and average gasoline and diesel prices	ADAC	
Relative speed	ratio	United States: ratio of speed of average car trip to other modes by trip distance category	NHTS	(4)
		Germany: ratio of speed of average car trip to other modes by trip distance category	MiD	
Travel speed	miles per hour	United States: "door to door" travel speed, including wait time for transit	NHTS	(5) and (6)
		Germany: "door to door" travel speed, including wait time for transit	MiD	
Population density	population per square mile	United States: population per land area on census tract	NHTS	all
		Germany: population per settled land area per municipality	DESTATIS	
Mix of land uses	index ranging from 0 (no mix) to 1 (great mix)	United States: index based on ratio of workplaces and residents	CTPP, Gazetteer	all
		Germany: index based on ratio of workplaces and residents	DESTATIS, BAA	
Household income	United States dollars	United States: annual income before taxes	NHTS	all
		Germany: annual income before taxes	MiD	

Driver's License	nominal variable	United States: value of 1 indicates individual with driver's license	NHTS	(1), (2), and (3)
		Germany: value of 1 indicates individual with driver's license	MiD	
Car access	ratio	United States: ratio of vehicles per household to household members with a driver's license	NHTS	all
		Germany: ratio of vehicles per household to household members with a driver's license	MiD	
Teenager/child	nominal variable	United States: value of 1 for individuals younger than driving age	NHTS	all
		Germany: value of 1 for individuals younger than driving age	MiD	
Gender	nominal variable	United States: value of 1 for male respondents	NHTS	all
		Germany: value of 1 for male respondents	MiD	
Household lifecycle and employment	series of nominal variables indicating household life cycle and respondents employment status including: employed in single HH; unemployed in single HH; employed in adult only HH; unemployed in adult only HH; employed in HH with small children; unemployed in HH with small children; employed in HH with older children; unemployed in HH with older children; retired in HH of retired individuals	United States: employed individual in hh with older children as reference category	NHTS	all
		Germany: employed individual in hh with older children as reference category	MiD	
Trip purpose	series of nominal variables indicating if a trip was (1) a work or (2) a shopping trip	United States: series of nominal variables indicating if a trip was (1) a work or (2) a shopping trip	NHTS	(5) and (6)
		Germany: series of nominal variables indicating if a trip was (1) a work or (2) a shopping trip	MiD	
Germany - USA dummy	nominal variable	value of 1 if respondent is from German sample	NHTS	all
			MiD	

Note: Code for Column (5):
(1) Total daily travel distance
(2) Heckman Selection Model (HSM) of total daily travel distance, controlling for decision to stay at home

(3) Total daily car travel distance
(4) Heckman Selection Model (HSM) of total daily car travel distance, controlling for decision to make a car trip
(5) Multinomial Logit Model for the choice to make a trip by car/light truck, transit, bike, or on foot
(6) Conditional Logit Model for the choice to make a trip by car/light truck, transit, bike, or on foot.

Table A-3. Dependent and Independent Variables in the Daily Travel Distance Regressions

		Level of Measurement	Mean	Min	Max	N	Correlation with Dependent Variable
Dependent variable							
	Travel distance	interval ratio	40	0	200	93,347	*n.a*
Independent variables							
Policy	Transit access <1/4 mile	nominal/dummy (1= hh within 1/4 mile of transit stop)	*n.a.*	0	1	93,109	-0.14
	Transit access 0.25-0.62 miles	nominal/dummy (1= hh within 0.25-0.62 miles of transit stop)	*n.a.*	0	1	93,109	-0.07
Spatial development patterns	Population density	interval ratio	4,605	0.1	25,892	91,836	-0.21
	Mix of use	interval ratio	0.33	0	1	91,836	-0.08
Socioeconomic and demographic variables	Household income	interval ratio	53,200	2,500	115,000	89,638	0.14
	Car access/availability	interval ratio	0.89	0	4	93,109	0.21
	Driver's license	nominal/dummy (1=respondent has driver's license)	*n.a.*	0	1	93,300	0.21
	Younger than 16/18	nominal/dummy (1=respondent younger than driving age)	*n.a.*	0	1	92,484	-0.15
	Employed in single HH	nominal/dummy (1=respondent with job in single HH)	*n.a.*	0	1	93,287	0.03
	Unemployed in single HH	nominal/dummy (1=respondent without job in single HH)	*n.a.*	0	1	93,287	-0.02
	Employed in adult only HH	nominal/dummy (1=respondent with job in 2 pers. HH)	*n.a.*	0	1	93,287	0.10

	Unemployed in adult only HH	nominal/dummy (1=respondent without job in 2 pers. HH)	*n.a.*	0	1	93,287	-0.05
	Employed in HH with small children	nominal/dummy (1=respondent with job in HH with child 0-5)	*n.a.*	0	1	93,287	0.09
	Unemployed in HH with small children	nominal/dummy (1=respondent without job in HH with child 0-5)	*n.a.*	0	1	93,287	-0.01
	Unemployed in HH with school children	nominal/dummy (1=respondent without job in HH with child 6-16/18)	*n.a.*	0	1	93,287	-0.01
	Retired HH	nominal/dummy (1=respondent retired in retired HH)	*n.a.*	0	1	93,287	-0.05
	Sex (Male=1)	nominal/dummy (1=male)	*n.a.*	0	1	93,347	0.06
	Germany(1/0)	nominal/dummy (1=respondent from Germany)	*n.a.*	0	1	93,109	-0.24

Note: All correlations significant at 1% level

Table A-4. Dependent and Independent Variables in the Car Travel Distance Regressions

		Level of Measurement	Mean	Min	Max	N	Correlation with Dependent Variable
Dependent variable							
	Car travel distance	interval ratio	30.4	0	200	109,640	*n.a*
Independent variables							
Policy	Transit access <1/4 mile	nominal/dummy (1= hh within 1/4 mile of transit stop)	*n.a.*	0	1	109,349	-0.10
Policy	Transit access 0.25-0.62 miles	nominal/dummy (1= hh within 0.25-0.62 miles of transit stop)	*n.a.*	0	1	109,350	-0.06
Policy	Operating cost per mile in cent	interval ratio	*10.90*	2.1	30.6	87,635	-0.18
Policy	Relative generalized cost of other modes vs. car	interval ratio	*3.50*	1.4	6.4	94,171	0.47
Spatial development patterns	Population density (population per square mile)	interval ratio	4,649	0.1	25,892	108,063	-0.15
Spatial development patterns	Mix of use	interval ratio	0.33	0.01	9.99	108,561	-0.04
Socioeconomic and demographic variables	Household Income	interval ratio	52,087	2,500	115,000	105,191	0.08
Socioeconomic and demographic variables	Car access/availability	interval ratio	0.88	0	4	109,600	0.15
Socioeconomic and demographic variables	Driver's license	nominal/dummy (1=respondent has driver's license)	*n.a.*	0	1	109,578	0.14
Socioeconomic and demographic variables	Younger than 16/18	nominal/dummy (1=respondent younger than driving age)	*n.a.*	0	1	109,640	-0.12
Socioeconomic and demographic variables	Employed in single HH	nominal/dummy (1=respondent with job in single HH)	*n.a.*	0	1	109,556	0.02

	Unemployed in single HH	nominal/dummy (1=respondent without job in single HH)	*n.a.*	0	1	109,557	-0.01
	Employed in adult only HH	nominal/dummy (1=respondent with job in 2 pers. HH)	*n.a.*	0	1	109,558	0.08
	Unemployed in adult only HH	nominal/dummy (1=respondent without job in 2 pers. HH)	*n.a.*	0	1	109,559	-0.04
	Employed in HH with small children	nominal/dummy (1=respondent with job in HH with child 0-5)	*n.a.*	0	1	109,560	0.06
	Unemployed in HH with small children	nominal/dummy (1=respondent without job in HH with child 0-5)	*n.a.*	0	1	109,561	-0.04
	Unemployed in HH with school children	nominal/dummy (1=respondent without job in HH with child 6-16/18)	*n.a.*	0	1	109,562	-0.08
	Retired HH	nominal/dummy (1=respondent retired in retired HH)	*n.a.*	0	1	109,563	-0.02
	Sex (Male=1)	nominal/dummy (1=male)	*n.a.*	0	1	109,640	0.05
	Germany(1/0)	nominal/dummy (1=respondent from Germany)	*n.a.*	0	1	109,640	-0.20

Note: All correlations significant at 1% level

Table A-5. Dependent and Independent Variables in the Mode Choice Regressions

		Level of Measurement	Mean	Min	Max	N
Dependent variable						
	Mode Choice	nominal	*n.a.*	1	4	410,991
Independent variables						
Policy	Transit access <1/4 mile	nominal/dummy (1= hh within 1/4 mile of transit stop)	*n.a.*	0	1	415,166
	Transit access 0.25-0.62 miles	nominal/dummy (1= hh within 0.25-0.62 miles of transit stop)	*n.a.*	0	1	415,167
	Speed (all)	interval ratio	32	0.2	105	402,498
Spatial development patterns	Population density	interval ratio	4,323	0	25,845	409,889
	Mix of use	interval ratio	0.33	0.01	0.99	411,260
Trip Purpose	Work trip	nominal/dummy (1=work trip)	*n.a.*	0	1	415,166
	Shopping trip	nominal/dummy (1=shopping trip)	*n.a.*	0	1	415,166
Socioeconomic and demographic variables	Car access/availability	nominal/dummy (1=respondent with job in single HH)	*0.95*	0	4	415,032
	Household income	nominal/dummy (1=respondent without job in single HH)	*55,389*	2,500	115,000	399,544
	Sex (Male=1)	nominal/dummy (1=respondent with job in 2 pers. HH)	*n.a.*	0	1	415,166
	Single HH with job	nominal/dummy (1=respondent is male)	*n.a.*	0	1	414,904
	Single HH without job	nominal/dummy (1=respondent without job in 2 pers. HH)	*n.a.*	0	1	414,905
	Couple HH with job	nominal/dummy (1=respondent with job in HH with child 0-5)	*n.a.*	0	1	414,906

	Couple HH without job	nominal/dummy (1=respondent without job in HH with child 0-5)	*n.a.*	0	1	414,907
	HH, children without job	nominal/dummy (1=respondent without job in HH with child 6-16/18)	*n.a.*	0	1	414,908
	Retired HH	nominal/dummy (1=respondent retired in retired HH)	*n.a.*	0	1	414,909
	Younger than 16/18	nominal/dummy (1=respondent is younger than 16/18)	*n.a.*	0	1	412,027
	Germany(1/0)	nominal/dummy (1=respondent from Germany)	*n.a.*	0	1	417,074

Table A-6. OLS Regression Results for Dependent Variables: Total Daily Travel Distance and Total Daily Car Travel Distance

		Daily Travel Distance		Daily Car Travel Distance	
		United States	Germany	United States	Germany
Policy	Transit access <1/4 mile	--	-	--	-
	Transit access 0.25-0.62 miles	--	-	--	-
	Operating cost per mile driven	*n.a.*		--	-
	Relative speed of cars vs. other modes*	*n.a.*		+	++
Spatial development patterns	Population density (population per square mile)	--	-	--	-
	Mix of use	-		-	
Socioeconomic and demographic variables	Household Income	+	++	+	++
	Car access/availability	+	++	+	++
	Driver's license	+		+	
	Younger than 16/18	--	-	--	-
	Employed in single HH	-	+	-	+
	Unemployed in single HH	-	0	-	+
	Employed in adult only HH	-	+	-	+
	Unemployed in adult only HH	-		-	
	Employed in HH with small children	-		-	
	Unemployed in HH with small children	-		-	
	Unemployed in HH with school children	--	-	--	-
	Retired HH	--	-	--	-
	Sex (Male=1)	+	++	+	
	Germany(1/0)	-		-	
	Types of Models Employed	OLS and HSM		OLS and HSM	

Note: If not indicated differently: all coefficients significant at 5% level;
*Relative speed was used in a Heckman Selection Model for the choice of car vs. other modes of transportation.

Legend and Key			
Sign	**Interpretation**	**Sign**	**Interpretation**
+	positive relationship	One sign for both countries combined	relationship not statistically significantly different
-	negative relationship	Double sign for one country; single sign for the other	relationship is stronger in country with double sign
0	no relationship	Signs in different directions	different direction of relationships between the countries

Table A-7. MNLM and CL Regression Results for Dependent Variable Mode Choice

<table>
<tr><th colspan="2" rowspan="3"></th><th colspan="6">Mode Choice</th></tr>
<tr><th colspan="2">Transit vs. Car</th><th colspan="2">Bike vs. Car</th><th colspan="2">Walk vs. Car</th></tr>
<tr><th>United States</th><th>Germany</th><th>United States</th><th>Germany</th><th>United States</th><th>Germany</th></tr>
<tr><td rowspan="3">Policy</td><td>Transit access <1/4 mile</td><td>+</td><td>++</td><td colspan="2">+</td><td>+</td><td>++</td></tr>
<tr><td>Transit access 0.25-0.62 miles</td><td>-</td><td>+</td><td>-</td><td>+</td><td colspan="2">+</td></tr>
<tr><td>Travel speed other modes vs. car</td><td>+</td><td>++</td><td>+</td><td>++</td><td>+</td><td>++</td></tr>
<tr><td rowspan="2">Spatial development patterns</td><td>Population density (pop. per square mile)</td><td>+</td><td>++</td><td>+</td><td>0</td><td colspan="2">+</td></tr>
<tr><td>Mix of use</td><td colspan="2">+</td><td colspan="2">+</td><td colspan="2">+</td></tr>
<tr><td rowspan="7">Socioeconomic and demographic variables</td><td>Household Income</td><td>--</td><td>-</td><td>-</td><td>0</td><td colspan="2">-</td></tr>
<tr><td>Car access/availability</td><td>-</td><td>--</td><td>-</td><td>--</td><td>-</td><td>--</td></tr>
<tr><td>Younger than 16/18</td><td>+</td><td>-</td><td colspan="2">+</td><td>+</td><td>++</td></tr>
<tr><td>Employed in single HH</td><td colspan="2">+</td><td colspan="2">0</td><td colspan="2">+</td></tr>
<tr><td>Unemployed in single HH</td><td colspan="2">+</td><td colspan="2">+</td><td>++</td><td>+</td></tr>
<tr><td>Employed in adult only HH</td><td>+</td><td>-</td><td>+</td><td>-</td><td>++</td><td>+</td></tr>
<tr><td>Unemployed in adult only HH</td><td colspan="2">+</td><td colspan="2">0</td><td colspan="2">+</td></tr>
</table>

	Unemployed in HH with children	+		-	+	+	-
	Retired HH	-	+	-	+	+	++
	Sex (Male=1)	+	-	+	0	-	--
Trip purpose	Work trip (=1)	+	++	-	0	--	-
	Shopping trip (=1)	--	-	--	-	--	-
	Germany(1/0)	+		+		+	
	Types of Models Employed	MNLM and CL					

Note: If not indicated differently: all coefficients significant at 5% level;

Legend and Key			
Sign	**Interpretation**	**Sign**	**Interpretation**
+	positive relationship	One sign for both countries combined	relationship not statistically significantly different
-	negative relationship	Double sign for one country; single sign for the other	relationship is stronger in country with double sign
0	no relationship	Signs in different directions	different direction of relationships between the countries

NOTES

[1] These R^2s might seem low, but they are in line with other multivariate analysis performed with NHTS and MiD data. The relatively low R^2 is most likely related to the disaggregate nature and the degree of variability of the individual level data of the national travel surveys.

[2] For the choice car vs. transit: 90 percent of car use is predicted correctly (sensitivity), 50 percent of transit use is predicted correctly (specificity). For the choice car vs. bike: 97 percent of car use is predicted correctly (sensitivity), 15 percent of bike use is correctly (specificity). For the choice car vs. walk: 70 percent of car use is predicted correctly (sensitivity), 50 percent of walking is predicted correctly (specificity).

[3] A more inelastic demand for driving in Germany compared to the United States is in line with findings from Litman (2008) and de Jong (2001). It is possible that Germans might already have minimized driving over the years, in reaction to historically high gasoline prices. In addition, they drive more fuel efficient cars. Additional increases in the price of gasoline result in marginal reductions in driving, as the car trips currently made are necessary and hard to substitute or forego. In the United States, gasoline prices have traditionally been low and most trips are made by car. If gas prices increase, individuals can more easily forego unnecessary car trips, thus leading to a reduction in driving. Todd Littman," Transportation Elasticities" (Victoria, Canada: Victoria Transport Policy Institute, 2008), available at http://www.vtpi.org/elasticities.pdf. Gerard de Jong and Hugh Gunn, "Recent Evidence on Car Cost and Time Elasticities of Travel Demand in Europe," *Journal of Transport Economics and Policy,* 35(2) (2001): 137-160.

[4] Xinyou Cao, Patricia L. Mokhtarian, and Susan L. Handy, "Examining the Impacts of Residential Self- Selection on Travel Behavior: Methodologies and Empirical Findings," Working Paper 06-18, (Institute of Transportation Studies, University of California- Davis, 2006).

[5] Ibid.