HOUSEHOLD DEMOGRAPHIC COMPOSITION, COMMUNITY DESIGN AND TRAVEL BEHAVIOR

An Analysis of Motor Vehicle Use in Germany

(3,541 Words, 3 Figures, 2 Tables)

COLIN VANCE

German Aerospace Center (DLR)
in the Helmholtz Association
Institute of Transport Research (IVF)
Rutherfordstrasse 2
12489 Berlin
GERMANY

Tel 0049-30-67055 147
Fax 0049-30-67055 202
colin.vance@dlr.de

SABINE BUCHHEIM

German Aerospace Center (DLR)
in the Helmholtz Association
Institute of Transport Research (IVF)
Rutherfordstrasse 2
12489 Berlin
GERMANY

Tel 0049-30-67055 291
Fax 0049-30-67055 202
sabine.buchheim@dlr.de

September 2004

Prepared for presentation at the Research on Women's Issues in Transportation Conference, November 2004, Chicago.

ABSTRACT

This study explores the determinants of car use in Germany by analyzing a panel of travel-diary data collected between the years 1994 and 2001. The analysis is conducted against the backdrop of two questions: Do women have more constrained access to the car than men, and if so, how is this constrained access mitigated or exacerbated by other determinants of car use such as urban form, socioeconomic circumstance, and the demographic composition of the household? A cross-cutting issue is whether the existence of gender discrepancies in car use reflects the outcome of objective reasoning or patriarchal constraints. We pursue these questions by estimating a discrete choice model of the determinants of car utilization on weekdays.

While we find that women are characterized by a lower likelihood of car use than men, the magnitude of the discrepancy is not as great as has been suggested elsewhere in the literature. The presence of children is found to play the strongest role in reducing disparities between men and women with respect to car use, while urban form variables are generally play an insignificant role. We conclude that although car use decisions may be made on the basis of objective reasoning, this reasoning often emerges from patriarchal constraints that dictate traditional gender roles.

1 INTRODUCTION

The determinants of motor vehicle use are significant to a range of themes that have relevance for the study of mobility behavior. Private cars not only contribute to air and noise pollution, but are also major sources of congestion, injuries, and fatalities on the public roadways. The behaviors that give rise to these negative external effects emerge largely from decision-making undertaken at the household level, including choices pertaining to the allocation of both household resources and responsibilities among individual members. These choices, in turn, give rise to in-home and out-of-home activity patterns, from which the demand for travel by various modes is derived. In Germany, as elsewhere in the industrialized world, the demand for motor vehicle travel is of particular interest because of its strong growth in recent years, with the number of newly registered vehicles increasing by 15.2 % between 1995 and 2003 (Kraftfahrt-Bundesamt, 2004). Understanding the preferences and constraints underlying such trends can be useful to several policy applications, including assessments of the provision of public transport infrastructure, forecasting of trends in air pollution, and the evaluation of zoning and other land use measures.

One important area of research has focused on the role of gender in car use decisions. An oft cited observation emerging from this work is that while women tend to have more complicated activity patterns and make more serve-passenger trips than men, they have unequal access to the car and conduct more of their travel by public transportation or by foot (Manning, 1978; Giuliano, 1979; Hanson and Hanson, 1980,1981; Hanson and Johnston, 1985; Bernard, Seguin, and Bussiere, 1996, Preißner, Hunecke, Sander and Backhaus, 2000, Heine, Mautz and Rosenbaum, 2001). Consensus on female subordination in car access, however, is far from universal, and empirical evidence varies widely over both time and geography. For example, while Hanson and Johnston (1985) point to evidence from a survey in Baltimore showing that women are far more reliant on public transportation for getting to work, Gordon, Kumar and Richardson (1989) find little difference between men and women in private automobile and public transport use. They point to statistics from the 1983 Nationwide Personal Transportation Survey (NPTS) showing that the proportion of women who drive to work (62.2%) in the U.S. is actually slightly higher than that of men (61.7%). Likewise, Rosenbloom (1996) presents statistics from the 1990 Public Use Micro Sample (PUMS) indicating that 89.5% of all female trips is by car compared with 89.1% for men, with both groups having increased car usage substantially over the previous decade. A more recent survey from the U.K. notes that despite a strong growth in license holding among women, only two thirds of female license holders are the main driver of the household car compared with four-fifths of male license holders. In another study from the U.K., Dargay and Hanly (2004) find no significant effect of gender in a probit model of the likelihood of using the car as a commute mode.

Regarding German mobility behavior, Preißner, Hunecke, Sander and Backhaus (2000) analyze data from 1991 to suggest that women are more often “captive riders” of the public transport as men, because only 55.6% of them are licensed drivers compared with 84.1% of men. Nevertheless, the authors concur with Buhr (1999), who stresses the role of the car in helping women to manage both household and family duties, that female motorization will catch up in the future. Heine, Mautz and Rosenbaum (2001) found in their qualitative study of German families that children are the most important factor in increasing female car use. In addition to women using the car for shopping and accompaniment duties, the necessity of car access is explained by security aspects of caring for the child in the case of emergencies

On the whole, the literature presents a mixed picture of the nature and sources of disparities in car use between women and men. Moreover, the existing body of evidence provides little insight into whether differences in car reliance are primarily a function of access or other factors such as preferences. While it is true that the question of access has been addressed at the household level in analyses of car ownership, there have been few studies addressing the issue of access at the intra-household level among households that own cars. In such situations, Pickup (1985: 63) suggests that car use decisions are generally not made on the basis of "objective reasoning", but rather that the "general pattern is for husbands to have first choice of car-use, usually for commuting, and for wives to rely on public transport or receiving lifts to meet travel needs." Gordon, Kumar and Richardson (1989: 504) take a contrary view, rejecting the notion that patriarchal constraints determine car access and suggesting that the "diffusion of automobile ownership has been a strong equalizing force in the United States." A strong empirical case for either argument, however, is difficult to produce given the complex confluence of individual preferences, household power relations, and external socioeconomic and geographical factors that jointly determine mode choice decisions.

The present paper attempts to address this issue by employing an econometric analysis of car use on a panel of travel-diary data collected in Germany between the years 1994 and 2001. The analysis is conducted against the backdrop of the following two questions: Do women have more constrained access to the car than men, and if so, how is this constrained access mitigated or exacerbated by other determinants of car use such as urban form, socioeconomic circumstance, and the demographic composition of the household? We pursue this question by estimating a discrete choice model of the determinants of car utilization on weekdays. The remainder of the paper is structured as follows. The next section describes the data sources and their assembly for the quantitative analysis. Section three describes the model specification, and section four presents the results. In section five we offer concluding remarks.

2 DATA

The primary data source used in this research is drawn from the German Mobility Panel (MOP), a representative multiyear travel survey financed by the German Federal Ministry of Transport, Building and Housing. The survey was initiated in 1994 and includes a total of roughly 7000 households. In its initial years from 1994 – 1998, the MOP focused exclusively on the former West German states, but in 1999 its scope was broadened to include the new Federal states.

The panel is organized in waves, each comprising a group of households surveyed for a period of one week over each of three years. Households that participate in the survey are requested to fill out a questionnaire eliciting general household information and person-related characteristics. In addition, all relevant aspects of everyday travel behavior are recorded, including distances traveled, modes used, activities undertaken, and activity durations. Despite the high demands made on the survey respondents, the average attrition rate is relatively low, about 30%. As a consequence, the sample size for a given year comprises about 750 households (Dargay, Hanly, Madre, Hivert, Chlond (2003: 4)). The data used in this paper are from the first six waves of the panel, spanning 1994 to 2001.

Our analysis focuses exclusively on those households that owned at least one car, comprising roughly 85% of the sample. The analysis is further limited to household members who are at least 18 years old and who possess a driver's license (the minimum age for possession of a license in Germany is 18). Finally, as one of the explanatory variables of interest in the study is employment status, we exclude week-ends from the sample. The resulting sample size comprises 2624 individuals from 1516 households. Overall, 28888 individual person-day observations are included in the sample on which the model is estimated.

With the exception of a few neighborhood descriptors obtained from the respondents themselves, the MOP lacks sufficiently detailed geospatial information to derive measures of urban form. As an alternative, we augmented the data with additional information obtained from infas GEOdaten GmbH, a commercial data provider. This data is drawn from the year 2002 and is measured at the zip code level (the median size of a zip code is roughly 27 square kilometers). Three variables are used in the present analysis from this data set: the kilometers of main streets per 1000 residents, the kilometers of pedestrian zones per 1000 residents, and the average income of households in the zip code.

3 THE MODEL

In our data, roughly 28% of the individuals who possess a license and live in a car-owing household do not use the car on a given day. 59% of such individuals are women. To assess the determinants of this pattern, we specify a structural model describing the probability of car use:

(1) $$y_i^* = \beta' x_i + \varepsilon_i$$

where x is a vector of explanatory variables, ε is an error term, ß is a vector of estimated coefficients, and the subscript i denotes the observation. The variable y_i^* measures the utility associated with car use, and is therefore unobservable. We do, however, observe the outcome of whether the car is used. This outcome can be denoted by the dichotomous variable y_i, whereby:

(2) $$y_i = 1 \text{ if } y_i^* > 0, \text{ 0 otherwise}$$

In the present analysis, y_i equals one for individuals who use the car as a driver and zero for non-users or passengers. Returning to equation (1), if the error term is assumed to have a normal distribution, then the parameters ß can be estimated using the probit maximum likelihood method. This is expressed as:

(3) $$P(y_i = 1) = \Phi(\beta' x)$$

where Φ is the standard normal distribution (Green, 1997).

The explanatory variables *x* selected for inclusion in the model can be conceptually grouped into four broad categories: individual attributes, household socioeconomic characteristics, urban form variables/neighborhood characteristics, and activity pattern indicators. Descriptive statistics and definitions for these and the dependent variables are presented in Table 1. In addition to the variables listed in the table, the model includes interaction terms for select variables to capture differential effects of gender according to age, employment status, the presence of children, and opportunities for non-motorized travel. The model also includes binary variables indicating the year to control for autonomous shifts in macroeconomic conditions that could affect the sample as a whole. We explored including dummy variables for each day of the week, but found that they were statistically insignificant and did not contribute to the overall fit of the model.

Table 1: Descriptive statistics.

Variable Name	Definition	Mean	Standard Deviation
female	1 if female, 0 otherwise	0.482	0.496
education	education of respondent (1-4, 1=gradeschool; 4=college degree)	2.877	0.919
age	age of respondent	47.1	15.7
parttime	1 if parttime employed, 0 otherwise	0.152	0.331
fulltime	1 if fulltime employed, 0 otherwise	0.424	0.475
servstop	number of stops for shopping, accompaniment etc.	1.05	0.76
recstop	number of stops for recreation	0.60	0.48
maintain	daily expenditure of time for maintenance in hours	0.71	33.69
subsis	daily expenditure of time for work in hours	3.95	208.60
leisure	daily expenditure of time for leisure in hours	1.03	55.97
adults	number of adults in the household	2.0	0.7
kids	number of children in the household	0.5	0.8
numempl	number of employed people in the household	1.0	0.8
numlic	number of licensed drivers in the household	1.7	0.6
carhh	number of cars belonging to the household	1.4	0.6
prkstr	1 if parking on the street possible, 0 otherwise	0.105	0.273
citycenter	1 if household located in city with 100,000 inhabitants or more, 0 otherwise	0.289	0.452
public	1 if > 20 minutes to walk to public transport means, 0 otherwise	0.055	0.199
popdens	population density in 1000s per km²	1.485	2.379
income	average income of zip code in thousands of Euros	16.620	4.050
strdens	km of main roads per 1000 residents	33.75	24.80
peddens	km of pedestrian zones per 1000 residents	1.54	3.44

4 Results

Table 2 catalogues the results from the model. Column one contains the coefficient estimates, column two the associated marginal effects evaluated at the mean values of the independent variables, and column three the Z-statistics. In discussing the results we focus on the marginal effects of column 2, which can be interpreted as the change in probability given a one-unit increase in the explanatory variable. These effects are generally included in the standard output of most statistical software packages, though some care must be taken in their interpretation when interaction terms are involved. As Ai and Norton (2003) show, the interaction effect for two variables in non-linear models such as the probit requires computing the cross derivative $\frac{\partial^2 \Phi(\beta' x)}{\partial x_1 \partial x_2}$, whereas the general practice is to compute the marginal effect, equal to $\frac{\partial \Phi(\beta' x)}{\partial (x_1 x_2)}$. Computation of the marginal effect is shown to often result in false inferences with respect to both the sign and significance of the interaction term. The authors have written a program for calculating the cross derivative, adapted in the present paper, that makes use of the Delta method (Ai and Norton, 2003; Norton, Wang and Ai, 2004). The program command, called *inteff*, is implemented using the Stata software package. The program only works for the interaction between two variables that do not have higher order terms. Hence, we wrote a separate program for calculating the interaction of the variable age, which is specified as a quadratic, and the female indicator variable. This program makes use of Stata's *nlcom* command and is available from the authors upon request. To further facilitate interpretation of the interaction effects, we plot predicted probabilities and associated 95% confidence intervals over a range of values for particular variables of interest. The predicted values are generated on the basis of statistical simulations using a method and programming code developed by King, Tomz and Wittenberg (2000) and Tomz, Wittenberg and King (2003).

With respect to the model estimates, the majority of the variables have signs that are consistent with intuition, though not all are statistically significant. The probability of a female using the car is roughly 0.062 lower than that of males when holding all other variables fixed at their mean values. While the coefficient estimate on the female indicator variable is individually insignificant, a joint chi square test of the indicator and associated interaction terms reveals gender to be a highly significant determinant. Likewise, education has a negative and highly significant effect on the probability of car use, a possible reflection of more pronounced environmental consciousness among the more highly educated. The indicators for part-time and fulltime employment status both increase the probability of car use by eleven and six percent, respectively, but the insignificance of the interaction term suggests no differences of employment status by gender. Viewed from another angle, the model uncovers no differences in the likelihood of car use between employed and unemployed women. Age, which is specified as a quadratic, has a significant and nonlinear effect on the probability of car use, with the probability initially increasing until an age of about 52 and then tapering downward into retirement years. Moreover, the significance of the interaction term suggests that the effect of age is mitigated by gender. Further insight into this effect can be gleaned from Figure 1, which shows the simulated probabilities of car use over a range of ages for men and women. Women have lower predicted probabilities of car use over the entire range. At the extremes of age, however, the uncertainty of the estimates results in overlapping 95% confidence intervals, thereby precluding the identification of statistically significant differences between men and women among the young and old.

With respect to the household socio-demographic characteristics, the model results confirm the importance of children as a determinant of car use. While the coefficient estimate on the variable kids is negative and statistically significant for men, given by the estimate individually, it is positive and significant for women, a possible reflection of the greater number of serve-passenger trips associated with child care. As indicated by the plots of the predicted probabilities in Figure 2, the influence of children is actually seen to decrease the gender disparities with respect to the probability of car use. In households having two or more children, statistically significant differences between men and women cannot be discerned.

Consistent with intuition, the other demographic variables measuring the number of adults over 18 years of age in the household and the number of license holders have negative and statistically significant effects. Specifically, an additional adult in the household reduces the probability of car use by 0.06, while each additional license holder reduces the probability by 0.09. This effect likely reflects both increased competition for the car but also greater sharing of responsibilities, such as shopping, that require car use. In a similar vein, the number of cars in the household has a positive effect on the probability of car use. This can again be interpreted as a reflection of the degree of competition – in this case attenuated – among household members.

Among the neighborhood characteristics included in the model, only population density and income are statistically significant, and both have negative coefficients. To the extent that higher population density is associated with a higher incidence of road congestion, it is expected to deter car use. The negative coefficient on the average income in the postal zone, however, is counterintuitive, and contradicts the emphasis placed by traditional analyses on income as a positive determinant of car use (Rosenbloom, 1996; Ingram and Liu, 2000). One possible explanation is that the result is akin to an environmental Kuznet's curve effect, whereby wealthier individuals place a higher premium on environmentally benign travel modes and hence are less likely to use the car. In this regard, it is recalled that the sample was limited to car-owning households. A different effect may be uncovered by expanding the analysis to include car ownership decisions. Given that the very poor may often not own cars, a non-linear result could be expected as increases in wealth initially increase the probability of car ownership and hence car use, followed by decreases as wealth increases further.

Most of the variables measuring urban form are found to be statistically insignificant. Residence in a large city has no apparent effect on the probability of car use, either on its own or interacted with the female indicator, nor does road density. By contrast, the variables measuring the kilometers of pedestrian zones per 1000 residents have a negative effect on the probability of car use, as indicated by their joint significance and the significance of the interaction term. Figure 3 displays how this effect differs between men and women. The approximately parallel trajectory of the two curves suggests that the marginal effect of the variable is roughly the same for both groups, with women having a lower probability of car use over the entire range. This discrepancy becomes statistically insignificant at a value of 13, at which point the confidence intervals for the two curves overlap. On the whole, the result suggests some limited scope for city planners to influence mobility decisions through the provision of public infrastructure, though it must be interpreted with caution. To the extent that individuals with a preference for non-motorized mobility settle in neighbors that make such behavior attractive, the result may merely reflect correlation rather than causation.

Finally, all four of the activity indicators were found to be positive and highly significant. In terms of the magnitude of the coefficients, the variable measuring recreational stops has the strongest effect, while the remaining variables have roughly equal effects. Taken together, these results suggest that more complex and time-consuming mobility patterns encourage greater reliance on the automobile.

Table 2: Probit model results: Determinants of car use.

Variables	Estimated Coefficient	Marginal Effect	P-value
female	-0.197	-0.062	0.237
education	-0.038	-0.012	0.051
age	0.025	0.008	0.002
agesq	-0.0002	-0.00008	0.003
female*age	-0.007	-0.002	0.001
parttime	0.397	0.112	0.012
female*parttime	-0.003	-0.013	0.638
fulltime	0.218	0.067	0.007
female*fulltime	0.109	0.034	0.238
adults	-0.189	-0.059	0.000
kids	-0.043	-0.014	0.019
femal*kids	0.117	0.044	0.006
numempl	-0.062	-0.019	0.131
numlic	-0.286	-0.089	0.000
carhh	0.751	0.235	0.000
prkstr	-0.076	-0.024	0.213
citycenter	-0.005	-0.001	0.944
female*citycenter	-0.079	-0.025	0.330
strdens	0.0004	0.0001	0.648
peddens	-0.009	-0.003	0.198
female*peddens	-0.020	-0.006	0.035
public	0.106	0.032	0.187
popdens	-0.053	-0.017	0.000
income	-0.014	-0.004	0.017
servstop	0.317	0.099	0.000
recstop	0.092	0.029	0.000
maintain	0.062	0.019	0.000
subsis	0.069	0.021	0.000
leisure	0.077	0.024	0.000
Joint $\chi 2$ tests interacted terms		**$\chi 2$**	
female		179.79	0.000
age		13.13	0.004
parttime		30.92	0.000
fulltime		16.54	0.000
kids		6.56	0.037
center		1.57	0.455
year dummies		13.29	0.038
Summary statistics			
Number of obs.	28888		
Log-likelihood	-14230		
Wald $\chi 2$	1721.23		0.000

P-values are calculated on the basis of robust standard errors.

Figure1: The simulated probabilities of car use over a range of ages for men and women.

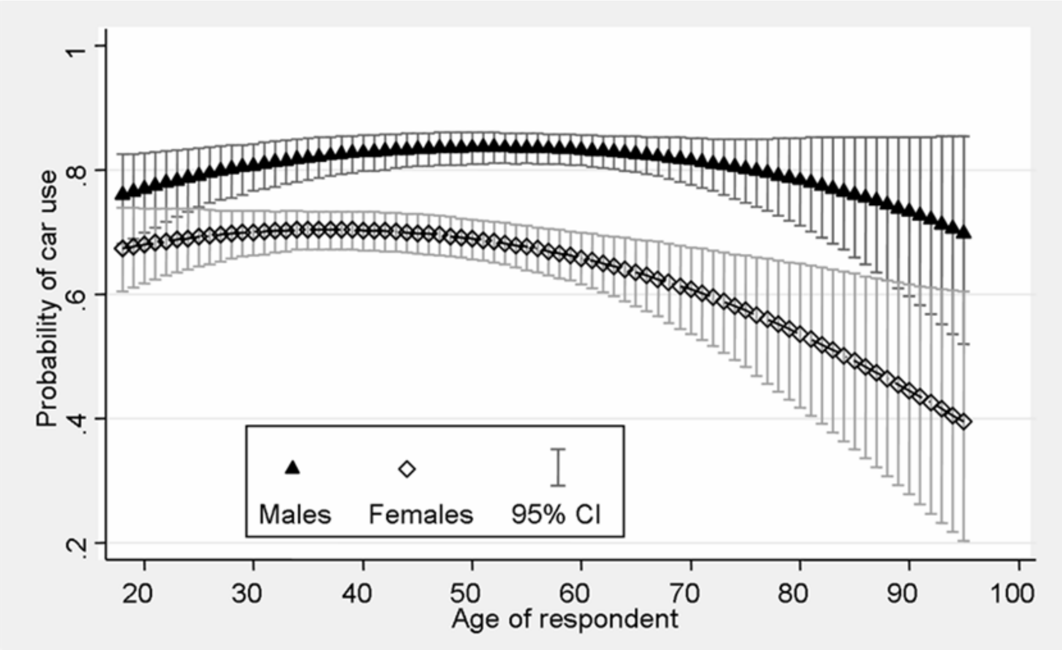


Figure 2: The influence of children on the probability of car use for men and women.

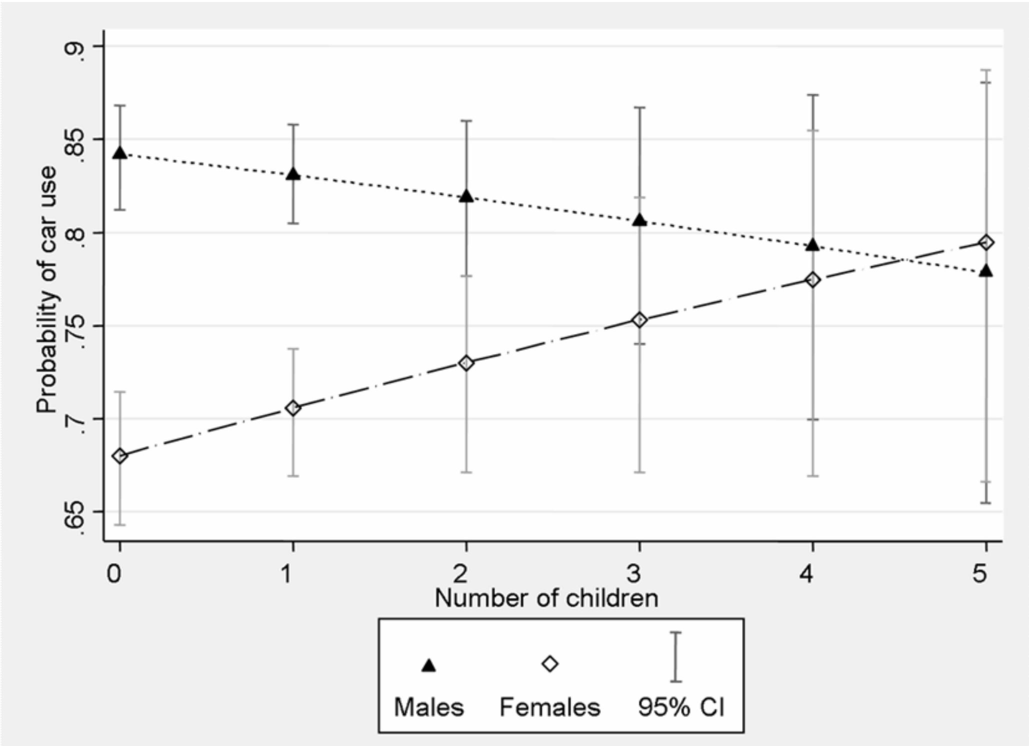
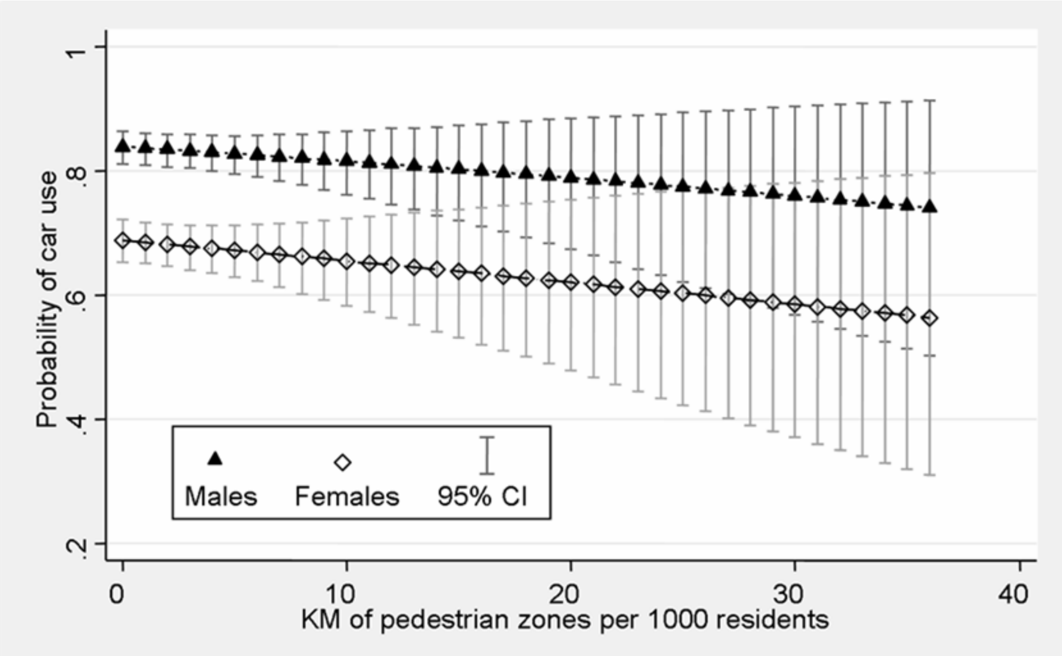


Figure 3: The influence of pedestrian zones on the probability of car use for men and women.



5 DISCUSSION AND CONCLUSION

The most fundamental result emerging from the foregoing analysis is that women are characterized by a lower likelihood of car use than men, though the magnitude of the discrepancy – roughly 0.06 points lower on the probability scale holding other determinants fixed at their mean values – was perhaps not as great as has been suggested elsewhere in the literature. In this regard, the analysis of simulated probabilities generated from the model suggested differences between men and women that were for a wide range of values difficult to distinguish statistically. This was especially true for the variables *kids* and *peddens*, though more clear distinctions emerged with respect to age.

Drawing inferences as to whether the identified gender discrepancies reflect the outcome of objective reasoning or patriarchal constraints is tricky, but a few tentative observations can be offered. The first of these relates to the role of children. The presence of children often figures as a critical factor in research on male-female mobility disparities. Women are said to bear a greater share of the responsibility for child care, a burden which is often used to explain other observed aspects of their mobility behavior such as shorter commute distances relative to males. The results presented here suggest that children reduce disparities between men and women with respect to car use, but whether children thereby represent an equalizing force in men and women's mobility behavior is more questionable. It is unlikely, for example, that car access for child care, pick-up services and maintenance activities would substantially relax whatever other constraints underlie women's shorter commute distances. Hence, while car access decisions may – given the presence of children – be made on the basis of objective reasoning, this reasoning emerges from patriarchal constraints that dictate a preeminent role of women in child care. With respect to employment status, the results from the model give some support to the notion that patriarchal constraints play a more direct role in determining car access. While employment status was found to be a very important determinant of car use for men, it was found to have no significant effect in increasing the probability of car use for women. Nevertheless, to the extent that women do on average have shorter commute distances than men, objective reasoning may figure as part of the explanation for this result. Further exploration of this issue would require including controls for workplace proximity.

A direct extension to the model estimated in this paper would involve an analysis of the determinants of distance traveled among car users. One advantage to be drawn from the estimation of the probit model is the ability to calculate the inverse Mills ratio. Inclusion of this ratio in a model of distance traveled would serve to control for sample selection biases that could otherwise arise from the existence of unobservable variables that determine both the discrete and continuous choices pertaining to car use. Such biases may emerge from the possibility that the determinants of car use are not random: those individuals who would travel short distances are the same individuals who are less likely to use the car.

6 ACKNOWLEDGEMENTS

The authors wish to thank May Boggess of Stata Corporation's Technical Support for her assistance with the program code used for the calculation of marginal effects.

7 REFERENCES

Ai, C., Norton, E.C. (2003): Interaction terms in logit and probit models. Economic Letters 80 (2003): 123-129.

Bernard, A., Seguin, A.-M., Bussiere, Y. (1996): Household structure and Mobility patterns of women in O-D surveys: methods and results based on the case studies of Montreal and Paris. Proceedings of the Second National Conference of Women's Travel Issues, 13.

Buhr, Regina (1999): "Neue Nutzungskonzepte – Zur Bedeutung des Autos im Alltag von Frauen", in: Regina Buhr, Weert Canzler, Andreas Knie, Stephan Rammler (Hg.), Bewegende Moderne – Fahrzeugverkehr als soziale Praxis, Berlin: edition sigma: 105-131

Dargay, J. Hanly, M. (2004): Volatility of car ownership, commuting mode and time in the UK. Paper for presentation at the World Conference on Transport Research, Istanbul, Turkey, July 2004, http://www.cts.ucl.ac.uk/tsu/papers/BHPSWCTR04Final.pdf (August 2004)

Dargay, J.; Hanly, M.; Madre, J.-L.; Hivert, L.; Chlond, B. (2003): Demotorisation seen through panel surveys. A Comparison of France, Britain and Germany. Conference paper. The 10th

International Conference on Travel Behavior Research, Lucerne, 2003.

Gordon, P, Kumar, A., Richardson, H.W. (1989): Gender differences in metropolitan travel behavior. Regional Studies, Vol. 23.6: 499-510.

Greene, WH (1995): Econometric anlaysis. Upper Saddle River (NY): Prentice Hall.

Guilano, G. (1979): Public transport and the travel needs of women. Traffic Quarterly, Vol.6: 72-83.

Hanson, S., Johnston, I. (1985). "Gender differences in work-trip length: explanations and implications.", Urban Geography, 3: 193-219.

Hanson,S., Hanson, P. (1980): Gender and urban activity patterns in Uppsala, sweden. Geographical Review, Vol. 70: 291-299.

Hanson,S., Hanson, P. (1981): The travel activity patterns of urban residents: dimensions and relationships to sociodemographic characteristics. Economic Geography, Vol. 57: 332-347

Heine, H., Mautz, R., Rosenbaum, W. (2001),: Mobilität im Alltag. Warum wir nicht vom Auto lassen. Frankfurt/New York

Ingram, G.K., Liu, Z. (2000): Determinants of motorization and road provision. The Brookings Iinstitution.

King, G., Tomz, M., Wittenberg, J., (2000): „Making the most of statistical analyses: Improving Interpretation and presentation." American Journal of Political Science 44, No. 2 (April 2000): 347-61.

Kraftfahrt-Bundesamt (2004): Bestand an Personenkraftwagen am 1. Januar 2004 nach Zulassungsjahren und Antriebsarten. http://www.kba.de/Abt3_neu/KraftfahrzeugStatistiken/bestand_u_bestandsveraend/B/b_zul_antr.htm (August 2004)

Manning, I. (1978): The journey to work. Boston: George Allen and Unwin.

Norton, E.C., Wang, H., Ai, C. (2004): Computing interaction effects and standard errors in logit and probit models. The Stata journal, 2004, 4(2):103-116.

Pickup, L. (1985): Women's gender-role and its influence on travel behavior. Built Environment Vol. 10, No. 1.

Preißner, C. L.; Hunecke, M.; Sander, C.; Backhaus, W. (2000): Mobilitätsbedürfnisse und Mobilitätsverhalten in der Alltagsgestaltung von Frauen. In: Hunecke, M (2000).: Gestaltungsoptionen für eine zukunftsfähige Mobilität – Eine empirische Studie zum Zusammenwirken von Raumstruktur und Lebensstil im Mobilitätsverhalten von Frauen und Männern in vier ausgewählten Kölner Stadtquartieren. WerkstattBericht 27, Gelsenkirchen.

Rosenbloom, S. (1996): Trends in women's travel patterns. Proceedings of the Second National

Conference of Women's Travel Issues, 2.

Tomz, M., Wittenberg, J., King, G., (2003): CLARIFY: Software for interpreting and pretesting statistical results. Version 2.1. Stanford University, University of wisconsin and Harvard University. http://gking.harvard.edu/ (August 2004)