

Portland State University

PDXScholar

---

Center for Urban Studies Publications and Reports

Center for Urban Studies

---

7-1998

# Household Travel/Activity Decisions: Who wants to Travel?

Catherine T. Lawson  
*Portland State University*

Follow this and additional works at: [https://pdxscholar.library.pdx.edu/cus\\_pubs](https://pdxscholar.library.pdx.edu/cus_pubs)



Part of the [Tourism and Travel Commons](#), [Transportation Commons](#), and the [Urban Studies and Planning Commons](#)

Let us know how access to this document benefits you.

---

## Citation Details

Lawson, Catherine T., "Household Travel/Activity Decisions: Who wants to Travel?" (1998). *Center for Urban Studies Publications and Reports*. 27.

[https://pdxscholar.library.pdx.edu/cus\\_pubs/27](https://pdxscholar.library.pdx.edu/cus_pubs/27)

This Working Paper is brought to you for free and open access. It has been accepted for inclusion in Center for Urban Studies Publications and Reports by an authorized administrator of PDXScholar. Please contact us if we can make this document more accessible: [pdxscholar@pdx.edu](mailto:pdxscholar@pdx.edu).

# **Household Travel/Activity Decisions: Who wants to Travel?**

**Catherine T. Lawson**  
ctl@pp.pdx.edu

**July 1998**

**Discussion Paper 98-4**

Submitted for Presentation  
at the 1999 Annual Meeting of the  
Transportation Research Board

Center for Urban Studies  
College of Urban and Public Affairs  
Portland State University  
Portland, OR 97207-0751  
(503) 725-4020 • (503) 725-8480 FAX  
<http://www.upa.pdx.edu/CUS/>

## **INTRODUCTION**

Researchers are using activity-based survey data to better understand the nature of the derived demand for travel. However, a strong theoretical construct for derived demand has yet to be developed. In order to understand the ramifications of considering travel as a derived demand, it is necessary to review some of the basic tenets of economics.

Some activities require travel (i.e. shopping or picking up children from daycare), while others are conducted entirely within the confines of the home. There is a set of activities that can be conducted either in or out of the home. A need to travel arises out of the choice to conduct one of these activities out of the home. This study uses a microeconomic framework to examine the decision to travel, using “new home economics” and related home production approaches.

## AN ECONOMIC PERSPECTIVE

Economics is a broad-ranging discipline that offers theoretical models representing logical structures and abstractions of the real world. The decisions made within a conventional microeconomic context are based on an optimizing process. Firms focus on maximizing profits from the production of goods, while the consumers maximize utility from purchases of the firms' outputs, using wages earned while “selling” their labor to firms (Berk 1980).

The concept of derived demand stems from the production process employed by firms. The production process can be illustrated using a production function, based on premise that output (Y) can be produced with ‘n’ homogenous factors of production, with the quantities  $v_1..v_n$ . A production function can be expressed as:

$$(1) \quad Y = f(v_1, \dots, v_n)$$

where f indicates the form of the production function.

For a firm, the inputs are considered factors of production:

$$(2) \quad Y = f(X_K, X_L, X_M, X_{Ld}, X_T)$$

where  $X_K, X_L, X_M, X_{Ld}, X_T$  are the quantity of capital, labor, materials, land and transport, respectively (see Isard, 1956). (Y) denotes the level of aggregate output. There is a derived demand for each factor through the demand for (Y).

Boulding (1966) states that the demand for a factor, like any other demand, is a function that indicates the amount of the factor used at each price. This function has two parameters: the magnitude of the demand (large or small); and the elasticity of the demand (responsiveness in the quantity demanded to a price change). The magnitude of a derived demand (based on the demand for the final product) will be larger, the larger the proportion of the total cost of the product accounted for by that factor. The elasticity of demand for a factor will be greater, the more substitutes are available for that factor.

Further, Baumol and Blinder (1985) point out that the demand curve for any input is the downward-sloping portion of its marginal revenue product curve. A producer will only use an additional unit of a factor if such use results in additional revenue being generated.

### **DERIVED DEMAND FOR TRANSPORT**

If activities are considered, in a sense, a “final product”, then there is a derived demand for transport as an input. In this case, the same general principles described with respect to the derived demand for factors of production would apply. For example, an increase in the amount of travel used to participate in an activity would have to be offset by the additional benefit a person expects to gain as a result of that travel. Under this notion, when a choice is made to conduct an activity out of the home, it can be assumed that this activity and its associated travel, generates more benefits than either foregoing the activity, or conducting it in the home, given the resource constraints of that household.

Transport can also be classified as representing a fixed cost or a variable cost. In terms of transport for employment activities, the commute represents a fixed cost. Trips that are “chained” to this fixed cost trip, such as out-of-home substitutes for home production activities or out-of-home leisure activities, can be considered variable cost trips. In a sense, the additional destinations or stops, increase the return on the use of transport by spreading it over more activities.

### **CONSUMER THEORY**

Utility theory is based on the notion that individuals obey certain basic behavioral postulates in their preferences among goods. All commodity bundles are ranked and can be represented by a utility function. In making choices, individuals will behave as if they were maximizing this function (Nicholson 1995). This ranking process per se is

unobservable. The revealed preferences are demonstrated by the observed behaviors of people responding to prices and other factors.

Consumer theory is based on the levels of utility that an individual can achieve, given a set of constraints (i.e. budget constraints). Traditional economics describes consumer behavior in the context of a set of utility functions that represent trade-offs. The slope of a utility curve illustrates a trade-off relationship, such as perfect substitutes or complements. Utility maximization can be thought of as occurring at the individual or household level. For example, an individual in a single-person household may wish to go to the movies and proceeds to attend. An individual member of a household may also wish to go to the movies, however, due to obligations related to another household member, instead chooses to stay home and watch television.

Traditional microeconomic theory as it relates to consumer behavior is illustrated in Figure 1. There exists a set of linkages involving an exchange of income for goods and an exchange of labor for wages (Berk 1980). In this system, time in the market (employment) produces income and the ability to purchase goods (buying). The use of the purchases (consumption) results in utility for the household.

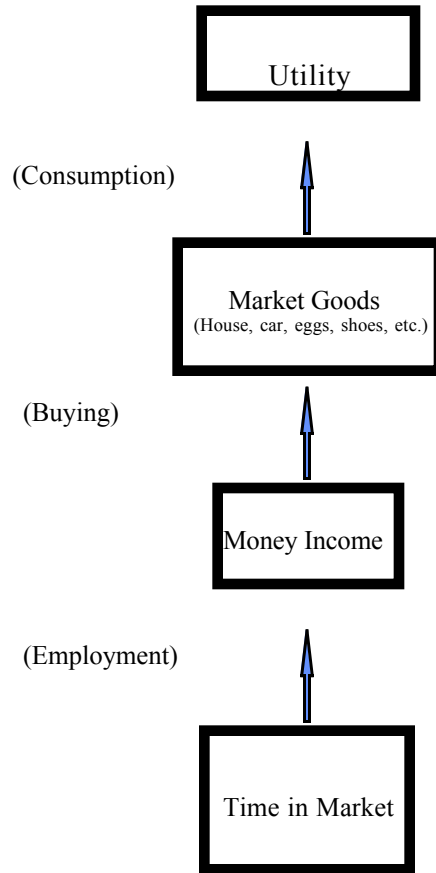


Figure 1 Traditional Microeconomic Approach

Source: Richard A. Berk, "The New Home Economics: An Agenda for Sociological Research," in Sarah Fenstermaker Berk, ed., *Women and Household Labor*, (Beverly Hills, CA: Sage Publications, 1980, p. 116)

## “NEW HOME ECONOMICS”

Becker (1965) challenged the notion that households only consume, claiming that the "household is truly a small factory: It combines capital goods, raw materials and labor to clean, feed, procreate and otherwise produce useful commodities". In the “new home economics” framework, market goods are inputs used in the production process of the household commodities that actually produce some level of utility. Figure 2 illustrates the "new home economics” concept. A consumer's demand for market goods is a derived demand, in the same manner that firms have a derived demand for the factors of production (Becker 1965).

In this approach, time is spent either in the market (employment) or at home. The time in the market produces income which is used to purchase goods (buying). These goods are used at home to produce household commodities (consumption). It is the process of combining goods and time at home that results in utility, rather than the goods producing utility in their “raw” state. Utility is a function of household commodities produced in the home.

Becker’s (1965) formulation yields a marginal product of market goods relative to a marginal product of time, which declines as the ratio of goods to time rises. Thus, as money incomes rise, the relative decline in its marginal utility (or marginal product) induces households to conserve time and use money relatively intensively. In other words, households will be willing to spend more money on products or services that produce a time savings, or make activity choices that produce a time savings (such as trip chaining).

Becker’s contribution to the understanding of how households make decisions uses the construct of production theory, as he relates the activities within a household to a firm. If transport is viewed as a factor that has become less expensive (time reduction in travel due to increased supply of roadways), then more of this factor (transport) will be used in the production process for a household. If a quantity of transport is used (the commute), and the resource “price” (both in terms of time and money) remains constant, the increase in productivity of the use of transport (more stops made between work and home) would result in an increase in the use of transport. This additional use spreads the overall cost of travel over more activities, thus, more is gained by using transport. The resulting increase in productivity relates to an increase in full real income, which in turn could lead to the purchase of more goods and services.



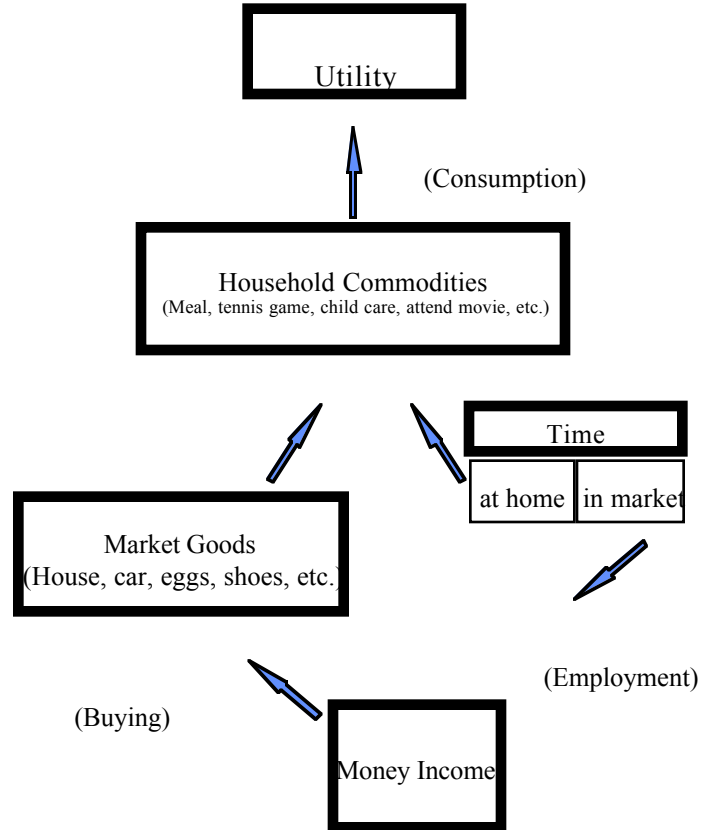


Figure 2 "New Home Economics" Approach

Source: Richard A. Berk, "The New Home Economics: An Agenda for Sociological Research," in Sarah Fenstermaker Berk, ed., *Women and Household Labor*, (Beverly Hills, CA: Sage Publications, 1980, p. 116,

## THE THEORY OF HOUSEHOLD TRAVEL/ACTIVITY DECISIONS

"New home economics" addressed activities that were previously ignored (i.e. home production), but did not include the ability to find substitutes for home production activities out in the market place. In addition, it did not explicitly incorporate the use of transport as an input into the home production function.

The theory of household travel/activity decisions is based on the notion that time can be divided into the portion spent in the market (employment) and out of the market. As illustrated in the "new home economics" approach, employment generates income which is used to obtain goods (buying). These goods are used at home to produce

household commodities (consumption). It is the process of combining goods and time at home that results in utility, rather than the goods producing utility in their “raw” state.

It is also possible to obtain these “household commodities” in the market place, using transport as an input and the income earned from market work. In other words, a person can obtain utility (consumption) by traveling out of the home and obtaining household commodities produced in the market place. The decision to satisfy the needs of obtaining household commodities in either of these conditions depends on which activity location creates the greater utility. Transport is also associated with most employment and shopping activities. The key question with respect to travel behavior is “when is transport chosen as an input?” This represents the derived demand for travel as it relates to the production of an activity. Understanding the underlying factors that increase or decrease the use of transport within a household sets the stage for a better understanding of travel behavior (see Figure 3).

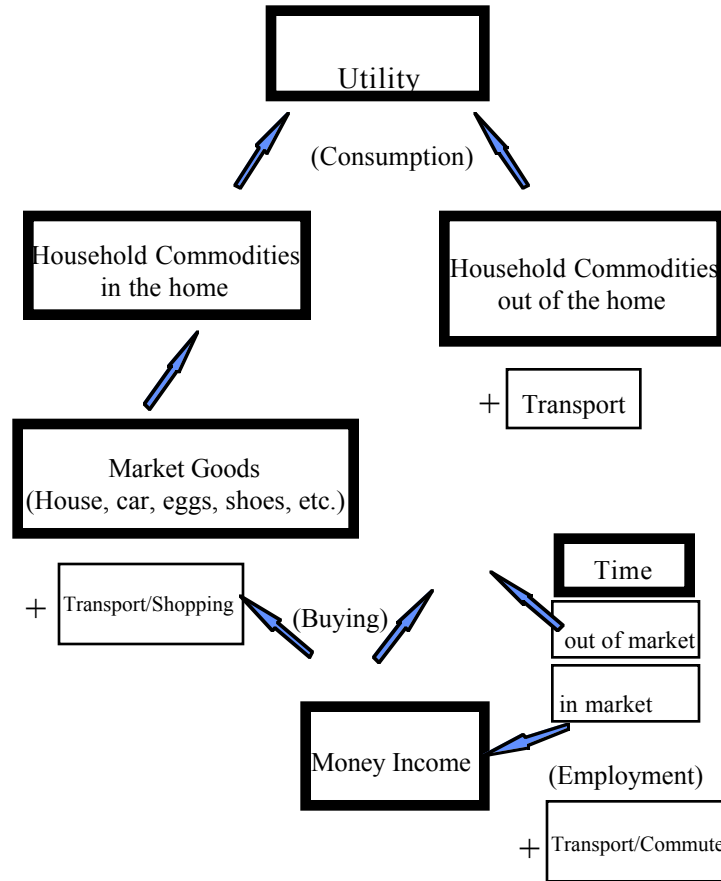


Figure 3 Household Production Approach

### Factors that Influence Travel

The decision to conduct an activity out of the home results in transport being included in the “production function” for that activity. There are a number of factors that have been associated with travel in previous travel behavior studies. These factors include monetary resources, temporal influences and socio-demographic characteristics.

#### Monetary Influences

Total household income determines the monetary resources available to a household for the purchase of goods and services. Generally, the number of workers in a household determines total household income. In addition, the decision to work impacts the available time for other activities, the roles assigned within a household, and potential access to activity locations to and from work.

Gronau (1977) examined the relationship between time and money (using wages and time in specific activities of individual members in a household) to explain labor force participation of household members. His model was based on the notion that there is a distinction between work at home (home production) and leisure (home consumption). Home production is something that one would rather have somebody else do (if the price is right), while it would be impossible for someone else to enjoy your leisure. This presumes that home production generates services which have a close substitute in the market. The travel induced by a decision to work includes the commute and the subsequent travel associated with purchasing home production substitutes out of the home.

The influence of income levels on home production activities has been examined regarding the purchase of prepared foods and meals prepared at home. According to Redman (1980), a household's expenditure on ready-prepared foods and meals away from home is inversely related to the amount of time allocated to household production. She found that family income had a positive effect on meals consumed away from home.

Lamm (1982) found that the share of purchased meals of a consumer's budget has increased relative to the share of consumer' at-home food expenditures. Using a translog approximation, he estimated the elasticities for food consumed at home and for purchased meals to be highly inelastic, both with respect to price and to total food expenditures. On the other hand, he found that non-food items were both elastic for price and expenditures. However, the demand for purchased meals is more elastic with respect to price and to total expenditures than is the demand for food consumed at home.

### Temporal Influences

Time of day impacts the set of activities that can or must be conducted. The more time one activity consumes, the less time is available for other activities. In the same sense, ordering or scheduling activities efficiently allows for participation in more activities or longer durations of chosen activities. Trip chaining increases the number of

activities that can be participated in by reducing the amount of transport used between activities (chained trips versus single destination trips).

Downs (1992) points out that many non-work trips are concentrated in the peak commuting periods as people take children to school or run errands before and after work. In 1983, weekday non-work trips made up 49.7% of all morning peak-hour trips and 68.9% of all evening peak-hour trips (Downs 1992).

Gordon et al (1988) found that between 1977 and 1983, non-work trips grew faster than commute trips and grew during peak periods. Richardson and Gordon (1989) found that the overall growth in non-work travel accounted for 70 to 75% of all week-day trips. They found that in all size SMSAs, nonwork travel grew three to four times faster than work trips. They were unable to explain this growth with traditional theories of travel. However, they made the assertion that many of these non-work trips could be diverted to non-peak travel times.

Strathman, Dueker, and Davis (1993) used the concept of trip chaining to examine the propensity of households to add non-work trips to the work commute and the allocation of non-work trips through chaining. They found that certain household types contributed the largest amounts of peak period chaining behavior: single adults; dual income couples; dual income families with preschoolers; and multi-worker households. These types of households were also the faster growing type of household formations. However, a general congestion indicator had no effect on the allocation of non-work trips among alternative chains. Trip chaining analysis lead to the puzzling conclusion that even with the increase of congestion during peak periods, people continued to trip chain. This could indicate an inelastic demand for the activities/locations, regardless of the price to be paid in congestion, both in time or money.

Davidson (1991) examined the exact nature of trip chains in a study of employees. The data defined a full work trip, including stops for meals, shopping and daycare. The study found that the employees were twice as likely to make stops on their way home

from work as they were during the morning. Their chains had the following compositions: morning chain - (45.2% ) gas, (22.7%) bank, (19.4) dry cleaners, (16.4%) to eat; evening chain - gas (63%), shop (55.8%), bank (49.6%) and dry cleaners (31.5%).

Hamed and Mannering (1993) found that travelers who depart from work between 2:00 p.m. and 6:00 p.m. are less likely to be involved in a chain of activities. Adler and Ben-Akiva (1979) included scheduling convenience in a utility function for travel patterns. Small (1982) found that scheduling of trips was affected by congestion. Noland and Small (1994) further determined that uncertainty from unexpected, non-recurrent events contributed to the departure time decision. Wilson (1989) found estimates of scheduling costs are higher than the estimates for the value of travel time.

#### Socio-demographic Influences

There have been numerous studies indicating differences in travel behaviors by gender. However, there have been no systematic studies looking at activities conducted in the home or out of the home with respect to gender. Studies have looked at gender differences in the length of trips, mode choice, trip purpose and miles traveled. For example, Wachs (1987) found women made shorter work trips, used transit more than men, made more trips for the purpose of providing travel services for others, and drove fewer miles than men.

Madden (1981) found that sex differences in household "roles" was the most important factor in influencing women to work "closer to home" (make shorter commute trips). McLafferty and Preston (1991) found that white women had significantly shorter commuting times than white men. Among minorities, there was no gender difference. Hanson and Hanson (1981) report that Swedish women who worked, made more shopping and domestic trips, fewer social and leisure trips, and used transit more than their spouses. Rosenbloom (1987) found women accepted more responsibility for the travel needs of children. Bernard et al (1996) found women who worked made more trips than non-working women. Gordon, Kumar, and Richardson (1989), using the Nationwide

Personal Travel Survey (NPTS) data report that the growth of non-work trips-making is greater for women than men. Hamed and Mannering (1993) found that males are more likely to go directly home after work than females.

There is a general assumption that mobility declines with age. Bhat (1997) found that older people were more likely to participate in in-home activity than out of home. Abu-Eisheh and Mannering (1989) found that young commuters tend to drive faster than older ones. This changes the amount of time spent on the system by each group. Older individuals were less likely to participate in recreational activity than in social or shopping activities (Damm 1980, Hamed and Mannering 1993). It should be noted that the behavior patterns of the elderly may represent a “cohort effect”. In other words, the mobility preferences or constraints facing the elderly today may not be the same for future elderly. Therefore, current behaviors may or may not be expected to occur.

The structure of a household has direct bearing on the decision to conduct a “substitutable” activity in or out of the home. A proxy for household structure is the number of children and their ages. Gronau (1977) looked at the effects of an increase in the number of children and the age cohorts of the children. In his model, as the number of children in a household increase, the additional time devoted to children will be spent on work at home and leisure.

Redman (1980) found that family size had a negative effect on meals being eaten outside of the home. Households with preschool children spent significantly less on meals out of the home than other households. As the children aged, more money was spent on meals out of the home.

Another important element of household structure is the marital status of the adults. Gronau (1977) found differences in behavior based on marital status. Single men performed less market work than married men. Married women, in his study, spent more time than unmarried women in work at home.

Koppelman and Townsend (1987) examined the construct that travel/activity behavior of individuals is not only related to his/her own needs and desires, but to the needs and desires of the household. They looked at the theoretical tradeoffs between components of time spent in working at home (home production). They found that increasing the relative power of one person in a household decreased that persons time in home and market work and increased their time in leisure, while having the opposite consequences for the other person in the household. There was no direct relationship between time spent in home-related work and market work.

Blau and Ferber (1992) developed a model to examine the role of specialization and exchange for a married couple. They concluded that the gains from specialization are greater, the more the two individuals differ in their comparative advantages. If each individual produces the same set of goods, their combined per capita production equals their individual production. In other words, there appears to be no gains realized. However, there may still be some gains available as the two people can use many goods and services more efficiently than single individuals.

Blau and Ferber (1992) suggest that the couples tastes play a role in how they will ultimately determine how to allocate their time and income between home goods and market goods. Using the theory of comparative advantage, one individual can be said to have a comparative advantage over another in the production of a particular good relative to other goods they can produce, if they produce that good least inefficiently as compared with the other person. In other words, if the wife produces the home goods, all market work being equal, she also has the comparative advantage, if she produces them “least inefficiently” compared to the husband. In addition, the greater the difference between the two in their comparative advantage, the greater the gains from specialization and exchange.

Roles and household decision-making for married couples regarding the allocation of resources has been addressed with several models, including a bargaining model



(Manser and Brown 1993) and a separate spheres bargaining and marriage markets model (Lundberg and Pollak 1993). There appears to be little research on household decision-making among nontraditional couples. In addition, as Pisarski (1996) points out, the fastest growing household type is the non-family household, increasing by 30% between 1980 and 1990. It is unclear how the adults within these households interact with regards to activities, if at all. Individuals in new household types, such as co-housing residents, may have expectations of joint participation for some activities.

It can be hypothesized that participation in some activities (i.e. home maintenance) would increase within the home, the longer a person lived in the same house. It is unclear whether the length of time at a particular residence should be associated with a desire to conduct substitutable activities in the home. It may also be the case that new residents find more activities of interest in the early years within their home, preferring more activities out of the home, over time.

There have been a number of studies looking at the influence of vehicle availability on travel patterns. Meurs (1993) found that the purchase of a second vehicle was more elastic than the purchase of the first vehicle. Bhat and Koppelman (1993) reported that the propensity for auto ownership was reduced with the presence of children and by living in a large metropolitan area. Pisarski (1996) indicates that the number of vehicles now exceeds the number of licensed drivers. The ability to afford additional vehicles may be highly correlated with total household income, acting as a proxy for wealth.

Kitamura (1988) points out that in-home/out-of-home activity substitution does not uniquely determine travel demand because in-home activities also generate trips. He also notes that activity data is cross-sectional time use data and only reflects differences in time use across individuals. It does not provide information on substitution between in-home and out-of-home activities for a given individual.

In summary, previous studies have indicated that travel and the location of “substitutable activities” (i.e. home production activities conducted in or out of the home)

can be associated with various individual and household characteristics. These factors include total household income, time of day, gender, age, household structure, years spent in a home, employment status, and number of vehicles.

## RANDOM UTILITY MODELS

The choice of whether to conduct an activity in or out of the home can be characterized using random utility theory (RUT). RUT uses the notion that behavior can be explained by recognizing a systematic and a random component in the decision making process. Thus,

$$(3) \quad U_i = V_i + \varepsilon_i,$$

where  $U_i$  is the unobservable, yet true utility of alternative  $i$ ;  $V_i$  is the observable or systematic component of utility; and  $\varepsilon_i$  is the random component. In other words,  $V_i$  is the portion of the variance in a choice that can be explained and  $\varepsilon_i$  is the portion that can not be explained. Although it can be assumed that there will always be some portion of the variation that can not be explained, it is possible to model or predict the probability that an individual will choose an alternative as follows:

$$(4) \quad P(i|C) = P[(V_i + \varepsilon_i) > (V_j + \varepsilon_j)]$$

where  $P(i|C)$  is the probability of choosing  $i$  from a set of competing alternatives, defined as  $C$ . A random utility model can be used for an activity conducted out of the home where  $V_O$  and  $V_H$  are the systematic components of utility for conducting an activity out of the home and in the home, respectively:

$$(5) \quad P(i|C) = P[(V_O + \varepsilon_O) > (V_H + \varepsilon_H)]$$

## DATA

In 1994, the Metropolitan Service District (Metro), located in Portland, Oregon, undertook a comprehensive and innovative data collection program (Cambridge Systematics 1996). The data was collected from 4,451 households, using a region-wide, two day activity survey. The survey instrument, the Oregon and Southwestern Washington 1994 Activity and Travel Behavior Survey, was a detailed diary that recorded what each member in a household did (activity choice), where (location choice), for how long (activity duration), and with whom (activity participation). In the survey data, 9,471 persons reported 122,348 activities and 67,891 trips (Cambridge Systematics 1996).

The individual descriptions of activities were categorized into 27 activities. For this study, only activities that could be performed either in the home or out of the home were used. An activity must occur both in and out of the home to be considered “substitutable”. Table 1 indicates the major categories and the individual activities that met this criteria.

*Table 1 Classification of “Substitutable” Activities that Occur Both In and Out of the Home*

<b>Activity Type</b>	<b>Activity</b>
<b>Work</b>	Work
<b>Maintenance</b>	Meals
	Household Business
	Household Maintenance
	Household Obligation
<b>Discretionary</b>	Exercise
	Rest and Relaxation
	Amusement

## LOGIT MODEL

A logit model is used to estimate the influence of variables on the decision to conduct a substitutable activity out of the home. According to Demaris (1992), the probability,  $P_i$  can be expressed as:

$$(6) \quad P_i = \frac{\exp[\alpha + \beta_1(X_1) + \beta_2(X_2) + \dots + \beta_n(X_n)]}{1 + \exp[\alpha + \beta_1(X_1) + \beta_2(X_2) + \dots + \beta_n(X_n)]}$$

The Model 1 was specified as follows:

$$(7) \quad \log(P/1-P) = f(\text{MALE, AGE, HHS, YRSH, EMPLOYD, HHINC, VEH});$$

Table 2 indicates the results of the factors thought to influence the decision to conduct a “substitutable” activity out of the home. All of the factors are statistically significant. Being a male, being employed, having an income greater than \$60,000 and the number of vehicles in the household all have a positive influence. Age, household size and the number of years that a household has lived in the same house have a negative influence. These findings are consistent with previous studies.

The amount of available time for activities is constrained for individuals that work outside of the home. In this case, the subset includes the morning peak (AM PEAK) and the evening peak (PM PEAK). Another model was specified to determine if time of day influences the decision to conduct an activity out of the home. Model 2 includes these new variables:

$$(8) \quad \log(P/1-P) = f(\text{MALE, AGE, HHS, YRSH, EMPLOYD, HHINC, VEH, AM PEAK, PM PEAK});$$

Table 2 indicates the results when the peaks are disaggregated into the morning and evening peaks.

	<i>Model 1</i>		<i>Model 2</i>		
<i>Variable</i>	<i>Coefficient</i>	<i>t-statistics</i>	<i>Coefficient</i>	<i>t-statistics</i>	<i>Odds Ratio</i>
Constant	<b>-1.1612</b>	(-25.207)	<b>-1.1972</b>	(-25.431)	
MALE	<b>.16673</b>	(9.995)	<b>.17643</b>	(10.381)	1.19
AGE	<b>-.00871</b>	(-13.724)	<b>-.0094348</b>	(-14.563)	–
HHS	<b>-.12491</b>	(-16.421)	<b>-.13008</b>	(-16.778)	–
YRSR	<b>-.02416</b>	(-3.546)	<b>-.024469</b>	(-3.522)	–
EMPLYED	<b>1.1396</b>	(49.250)	<b>1.1533</b>	(49.001)	3.16
HHINC (> \$60,000)	<b>.17319</b>	(8.533)	<b>.17223</b>	(7.762)	1.18
VEH	<b>.07448</b>	(7.875)	<b>.076462</b>	(7.935)	–
AM PEAK		–	<b>1.0315</b>	(41.452)	2.80
PM PEAK		–	<b>-.60785</b>	(-20.714)	-1.83
log likelihood		-43140.02	-41908.88		
restricted log likelihood		-45904.88	-45904.88		
N		75766	75766		
significance level		.00000	.00000		

A log likelihood ratio test for the two models ( $\chi^2 = -2\ln(L_R/L_U)$ ) with two degrees of freedom, indicates that the null hypothesis is rejected ( $\chi^2 = 2462.24$ ). The odds ratios were calculated for the dummy variables. Odds ratios represent the ratio of the probabilities of the outcome occurring for sample members who have a value of one for the dummy variable versus those in the reference group. For example, the probability of a man conducting a substitutable activity out of the home is 1.19 times higher than for women. Employed individuals have a probability 3.18 times higher than unemployed individuals of conducting a substitutable activity out of the home. Individuals in households with incomes greater than \$60,000 have a probability 1.18 times higher than those from lower income households of conducting substitutable activities out of the home.

In addition, the results of this model clearly indicate that the morning peak has a positive influence on choosing out-of-home substitutes, while the evening peak has a negative influence. The probability of an individual conducting a substitutable activity

out of the home in the morning is 2.80 times higher than other times during the day. In the same vein, the probability is 1.83 times lower during the evening peak.

It can be hypothesized that the activity chains in the morning peak contain substitutable activities, whereas the evening peak chains are less likely to contain substitutable activities. Bianco and Lawson (1996) found that women were more likely to be shopping and picking up children in the evening peak. Thus, evening peak trip chains are more likely to contain activities that can only occur out of the home and where travel is complementary to the activity.

## **DISCUSSION AND CONCLUSIONS**

From a policy perspective, the attraction of Transportation Demand Management (TDM) programs as solutions for congestion and air quality concerns come into question. These programs attempt to change the mode preferences of individuals (i.e. single occupant vehicle to carpool or transit) and can be assumed to restrict mobility and flexibility with respect to transport. Using a household production framework to evaluate these policies, clearly households that are able to obtain a higher level of utility from using transport, are worse off. Further research is needed to determine the magnitude of this loss of utility to various household types.

Previous questions regarding the growth of non-work trips in peak periods (Richardson and Gordon 1989; Strathman, Dueker, and Davis 1993), can be further examined by disaggregating the peaks to determine the nature of these trips. The expectation that peak trips could be diverted suggests that households would lower their utility by reducing their use of transport. Households that increase chained trips, even in the face of congestion, could actually increase household utility.

Attempts to reduce congestion and air quality concerns are also being pursued through changes in urban form. Further research may be able to examine peak periods in smaller intervals of time, or use geocoded data (see McNally 1998), to determine where

individuals are conducting their out-of-home substitute activities. For example, if an activity occurs within the first five minutes of the morning peak, then it can be assumed that the activity occurred just after leaving home (residential pre-commute activity). However, if the activity occurs near the workplace (employment post-commute activity), or somewhere in the middle, it may be possible to test some of the urban design issues revolving around appropriate land uses.

Using a household production framework to better understand travel behavior appears to be a productive approach. Further research to examine the equity impacts of transportation policies and practices may be possible. In addition, disaggregating activities into subgroups (i.e. home production and leisure activities) will help transportation planners better understand the use of transport within the context of a household production function.



## REFERENCES

- Abu-Eisheh and Fred Mannering. (1987). "Discrete/Continuous Analysis of Commuters' Route and Departure Time Choices." Transportation Research Record 1138.
- Adler, Thomas and Moshe Ben-Akiva. (1979). "A Theoretical and Empirical Model of Trip Chaining Behavior." Transpn. Res. - B. 13B:243-257.
- Baumol, William and Alan S. Blinder. (1985). Economics: Principles and Policy. San Diego, CA: Harbourt Brace Jovanovich, Inc.
- Becker, G. S. (1965). "A Theory of the Allocation of Time." The Economic Journal. 75:493-517.
- Berk, Richard A. (1980). "The New Home Economics: An Agenda for Sociological Research." In Women and Household Labor, (ed.), Sarah Fenstermaker Berk, Beverly Hills, Ca: Sage Publications.
- Bernard, Anne, et al. (1996). "Household Structure and Mobility Patterns of Women in O-D Surveys: Methods and Results Based on the Case Studies of Montreal and Paris." A paper presented at the Second National Conference on Women's Travel Issues, in Baltimore, Maryland, on October 24-26, 1996.
- Bhat, Chandra. (1998). "Joint Model of Work Mode Choice, Evening Commute Stops, and Post-Home-Arrival Stops." A paper presented at the 77th Annual Meeting of the Transportation Research Board in Washington, D. C. on January 11 - 15, 1998.
- Bhat, Chandra and Frank S. Koppelman. (1993). "An Endogenous Switching Simultaneous Equation System of Employment, Income and Car Ownership." Transpn. Res.-A, 27A(6): 447-459.
- Bianco, Martha and Catherine Lawson. (1996). "Trip-Chaining, Childcare, and Personal Safety: Critical Issues in Women's Travel Behavior". A paper presented at the Second National Conference on Women's Travel Issues in Baltimore, Maryland on October 24 - 26, 1996.
- Blau, Francine D. and Marianne A. Ferber. (1992). The Economics of Women, Men, and Work. Englewood Cliffs, NJ: Prentice-Hall.

- Boulding, Kenneth E. (1966). Economic Analysis. New York, NY: Harper & Row.
- Cambridge Systematics, Inc. (1996). Data Collection in the Portland, Oregon Metropolitan Area. U.S. Department of Transportation.
- Damm, David. (1980). "Interdependencies in Activity Behavior." In Transportation Research Record 750, TRB, National Research Council, Washington, D. C., pp. 33-40.
- Davidson, D. (1991). "Impact of Suburban Employee Trip Chaining on Transportation Demand Management." In Transportation Research Record 1321, TRB, National Research Council, Washington, D. C.
- Demaris, Alfred. (1992). Logit Modeling Practical Applications. Newbury Park, CA: Sage Publications.
- Downs, Anthony. (1992). Stuck in Traffic: Coping with Peak-Hour Traffic Congestion. Washington, D.C.: The Brookings Institution.
- Gordon, Peter, Ajay Kumar and Harry W. Richardson. (1988). "Beyond the Journey to Work." Transpn. Res. - A. 22A:416-426.
- Gordon, Peter, Ajay Kumar, and Harry W. Richardson. (1989). "Gender Differences in Metropolitan Travel Behavior." Regional Studies. 23(6):499-510.
- Gronau, Reuben. (1977). "Leisure, Home Production, and Work - the Theory of the Allocation of Time Revisited." Journal of Political Economy. 85(6):1099-1123.
- Hamed, Mohammad M. and Fred L. Mannering. (1993). "Modeling Travelers' Postwork Activity Involvement: Toward A New Methodology." Transportation Science. 27(4): 381-394.
- Hanson, Susan and Perry Hanson. (1981). "The Impact of Married Women's Employment on Household Travel Patterns; A Swedish Example." Transportation. 10: 165-183.
- Isard, Walter. (1956). Location and Space-Economy. Cambridge, Massachusetts: The M. I. T. Press.
- Kitamura, Ryuichi. (1988). "An Evaluation of Activity-based Travel Analysis." Transportation 15: 9-34.

- Koppelman, F. S. and T. A. Townsend. (1987). "Task Allocation among Household Members: Theory and Analysis. Paper presented at the 5th International Conference on Travel Behavior, Aixen-Provence, France.
- Lamm, R. McFall, Jr. (1982). "The Demand for Food Consumed at Home and Away from Home." Agricultural Economics Research. 34(3): 15-20.
- Lundberg, Shelly and Robert A. Pollak. (1993). "Separate Spheres Bargaining and the Marriage Market." Journal of Political Economy. 101(6): 988-1010.
- Madden, Janice Fanning. (1981). "Why Women Work Closer to Home." Urban Studies. 8:181-194.
- Manser, Marilyn and Murray Brown. "Marriage and Household Decision-Making: A Bargaining Analysis." International Economic Review. 21(1):31-44.
- McLafferty, Sara and Valerie Preston. (1991). "Gender, Race, and Commuting Among Service Sector Workers." Professional Geographer. 43(1): 1-15.
- McNally, Michael. (1998). "Analyzing Portland Household Travel Data." A paper presented at Portland State University, Portland, Oregon, on May 1, 1998.
- Meurs, Henk. (1993). "A Panel Data Switching Regression Model of Mobility and Car Ownership." Transpn. Res.-A. 27A(6) :461-476.
- Nicholson, Walter. (1995). Microeconomic Theory: Basic Principles and Extensions. Fort Worth, Texas: The Dryden Press.
- Noland, Robert B. and Kenneth A. Small. (1994). "Travel-time Uncertainty, Departure Time Choice, and the Cost of the Morning Commute." Presented at the Annual Meeting of the Transportation Research Board, Washington, D. C., January 1995.
- Pisarski, Alan E. (1996). Commuting in America II. Lansdowne, Virginia: ENO Foundation.
- Redman, Barbara J. (1980). "The Impact of Women's Time Allocation on Expenditure for Meals Away from Home and Prepared Foods." Am. J. Agr. Econ. 62(2): 234-237.
- Richardson, Harry W. and Peter Gordon. (1989). "Counting Nonwork Trips." Urban Land. 48(9):6-12.

- Rosenbloom, S. (1987). "The Impact of Growing Children on Their Parents' Travel Behavior: A Comparative Analysis." In Transportation Research Record 1135, TRB, National Research Council, Washington, D. C., pp. 17-25.
- Small, Kenneth A. (1982). "The Scheduling of Consumer Activities: Work Trips." American Economic Review. 72(3):467-479.
- Strathman, James G., Kenneth J. Dueker and Judy S. Davis. (1993). Congestion Management: Travel Behavior and the Use of Impact Fees, Volume I: Effects of Household Structure and Selected Travel Characteristics on Trip Chaining. Seattle, WA: Transportation Northwest (Transnow).
- Wachs, M. (1987). "Men, Women, and Wheels: The Historical Basis of Sex Differences in Travel Patterns. In Transportation Research Record 1135, TRB, National Research Council, Washington, D. C., pp. 10-16.
- Wilson, Paul W. (1989). "Scheduling Costs and the Value of Travel Time." Urban Studies. 26:356-366.