TOPIC 15
TRAVEL CHOICE AND
DEMAND MODELLING

DEMAND FOR TELECOMMUTING—MODELING THE ADOPTION PROCESS

ADRIANA BERNARDINO
Mercer Management Consulting
33 Hayden Avenue
Lexington, MA 02173, US

MOSHE BEN-AKIVA
Massachusetts Institute of Technology
77 Massachusetts Avenue, Room 1-181
Cambridge, MA 02139, US

Abstract

A comprehensive model system of the telecommuting adoption process is estimated. The employer's decision to offer telecommuting is significantly influenced by the potential impacts on productivity and production costs. The employee's decision to adopt telecommuting is influenced by the expected impacts on life style, working costs, income and commuting.

INTRODUCTION

Information technology (IT) provides individuals with electronic-based non-travel access to various types of activities, such as work, shopping and leisure. Therefore, we need travel demand models that are sensitive to changes in both transportation and information technologies, incorporating new travel and non-travel related options, to capture the behavioral adaptation of individuals and households to the changing environment.

From this perspective, we analyze the impacts of new IT on the labor markets. IT facilitates various forms of remote work arrangements, providing organizations with a wide range of alternatives to address issues such as availability of skilled labor, cost of office and parking space, and traffic congestion.

Among these new alternatives, telecommuting appears to be a powerful tool to address, through the reduction of work trips, a host of transportation issues such as traffic congestion, pollution and energy consumption. However, this potential is limited by several factors, and in particular by the extent to which organizations are willing to adopt telecommuting.

Research on the process of adoption of telecommuting by organizations has been limited, focusing largely on the employee's perspective. See, for example, Bernardino et al. (1993), Mokhtarian and Salomon (1994a, 1994b, 1994c and 1995) and Sullivan et al. (1993). However, in order to achieve any meaningful conclusion about the potential of telecommuting to reduce work trips, a broader framework of analysis of the adoption process must be used, one which encompasses the perspectives of both the employer and the employee. Our objective is to develop and demonstrate this framework. A framework and model of the adoption process involving both the employer's and the employee's perspectives has also been developed by Yen and Mahmassani (1994).

In order to accomplish our objective we specify and estimate a model system that explains the telecommuting adoption process. We model the employer's decision to implement telecommuting as a function of the expected impacts of the telecommuting program on productivity and costs, and the employee's decision to adopt telecommuting as a function of the potential impacts of the program on her/his lifestyle, work related costs and income. Finally, we combine the results of the employer's and the employee's models to assess the expected reduction in the number of work trips due to telecommuting.

ANALYTICAL FRAMEWORK

A schematic view of the telecommuting adoption process is presented in Figure 1. The employer identifies objectives and constraints to the implementation of a telecommuting program and evaluates alternative program designs that satisfy these objectives and constraints. Those programs which yield positive net benefit to the organization may be made available to the employees.

Given the option, the employee can choose whether to adopt telecommuting, based on her/his attitudes towards telecommuting and on the assessment of the net benefits s/he may attain from the program offered by the employer. After some experience with telecommuting, the employer decides whether to maintain, withdraw, or change the characteristics of the program, and the employee decides whether to maintain or withdraw participation.

The employer's decision process

The employer's decision process is further detailed in Figure 2. The basic assumption underlying this process is that the employer's objective is to maximize profitability. The working arrangements offered to the employees s/he supervises are designed to attain this objective.

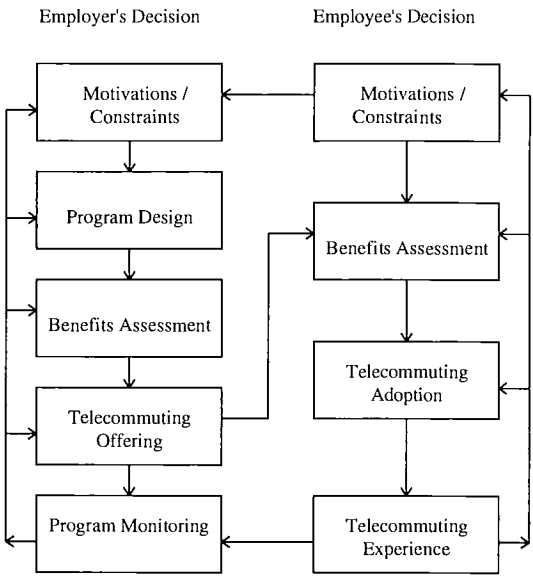

Figure 1 The process of adoption of telecommuting

Within this context, the employer generates telecommuting arrangements which could effectively address her/his motivations to implement a telecommuting program, while satisfying the existing constraints, and decides whether or not to offer some or all of the generated arrangements to the employees, based on the assessment of the impacts of the program on the organization 's profit.

If we define a telecommuting program as a set of attributes, each of which can assume various values, the employer's task when designing a program is to choose the combination of attribute values that best addresses her/his motivations, given the existing constraints.

The attributes of a telecommuting program are listed in Table 1. Each combination of values of these attributes will constitute a telecommuting arrangement. Once a telecommuting program has been selected, the employer will compare it to the prevailing arrangement to decide whether to offer it to her/his employees. This decision is based on the employer's assessment of the program's impacts on revenues and on production costs.

Assuming that the total number of employees in the organization remains constant, and that there is no change in prices due to the adoption of telecommuting, changes in revenue occur as a consequence of changes in productivity. Changes in costs include the program start-up costs and variations in direct costs per employee, employee turnover costs and overhead costs.

Start-up costs are the initial expenditures involved in the implementation of the telecommuting program. Direct costs refer to the wage and benefits awarded to the employee, as well as to expenditures with telecommunications and equipment. Changes in employee turnover costs occur if telecommuting reduces annual training and recruiting costs by reducing the employee turnover rate. Overhead costs include primarily expenditures associated with the use of office space.

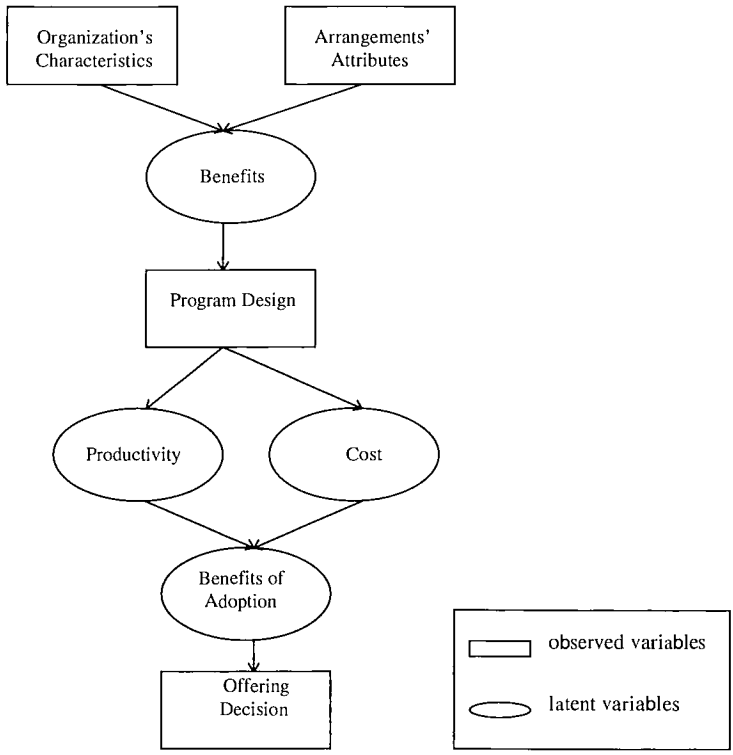

Figure 2 The employer's decision process—analytical framework

Table 1 Attributes of a telecommuting program

Attributes Description
Minimum number of telecommuting days required
Maximum number of telecommuting days allowed
Flexibility of telecommuting schedule
Office space for commuting days
Telecommuter 's income
Telecommuting site
Equipment required
Equipment provider
Phone bills responsibility
Health and equipment liability

The employer evaluates the benefits and costs of the telecommuting program, compares them to those yielded by the conventional commuting arrangement and chooses the arrangement which yields greater profit.

The employee's decision process

The employee's decision process is presented in greater detail in Figure 3. The underlying assumption in this framework is that the employee maximizes utility. Therefore, s/he selects,

among all the alternatives s/he is presented by the employer, the telecommuting arrangement which could best address her/his motivations to adopt telecommuting, while satisfying the existing constraints. S/he decides whether to adopt the chosen arrangement based on the assessment of the program 's impact on her/his lifestyle, work related costs and income.

Changes in lifestyle may occur as a consequence of a shift in the amount of time the employee spends in the office and at home and in the amount of time s/he has available to spend in activities other than work. Work related costs may change due to variations in expenditures with equipment, phone bills, transportation, home utilities, insurance, and child and elder care. Changes in income are due to differences between the wages paid to telecommuters and commuting employees.

The employee evaluates the benefits and costs of the telecommuting program, compares them to those yielded by the conventional commuting arrangement and chooses the arrangement which yields higher utility.

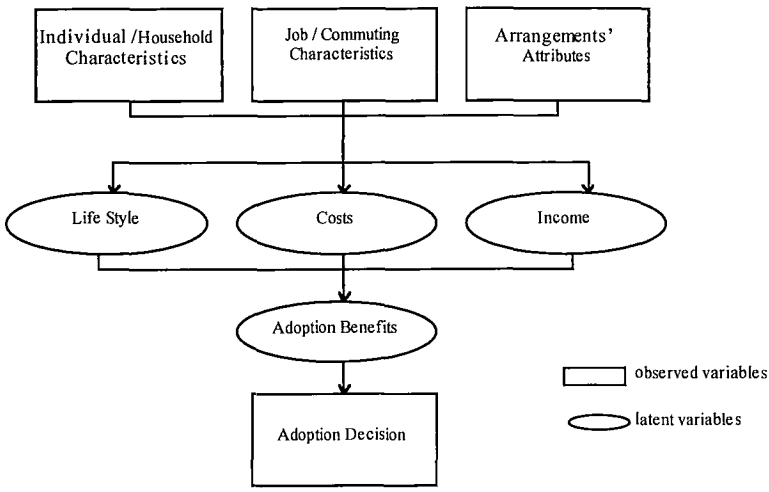

Figure 3 The employee's decision process—analytical framework

THE TELECOMMUTING SURVEY

Taking the above framework as a basis, a survey instrument was designed to collect data on the employer's and the employee's perceptions, attitudes and behavior regarding telecommuting. These data were used in the estimation of the model system that represents the telecommuting adoption process.

The survey was distributed to a convenience sample of 120 organizations across the US selected from industries whose characteristics favor the implementation of telecommuting. For an organization to participate in the study, we required that telecommuting be feasible for at least some of its employees. It was not required that a program be in place when the survey was administered. The employer's survey was distributed to individuals in managerial positions supervising employees whose jobs could be performed under telecommuting. The employee's survey was distributed to individuals whose job could be performed at least partially under telecommuting.

The employer's survey asks questions about the employer's awareness of and experience with telecommuting arrangements, about possible motivations s/he would have to implement a

program, about the working structure of the group supervised by the respondent, and about other characteristics of the organization which may have an impact on the decision to adopt telecommuting.

It also guides the respondent through the design and evaluation of a telecommuting program which would best suit the group s/he supervises. In this task, we use a menu approach, in which the employer is presented with a list of all attributes that constitute a telecommuting program and asked to select the combination of attribute levels that best addresses her/his needs. Then, s/he is questioned about the expected impacts of the designed arrangement on various aspects of costs and productivity, and asked if s/he would actually offer it to her/his employees.

The employee's survey collects revealed preference data about telecommuting programs currently available to the respondent and asks questions about commuting patterns, job, individual and household characteristics. It also contains a stated preference experiment to identify the respondent's preferences for various telecommuting arrangements.

Initially, the respondent is presented with three pairs of telecommuting arrangements created from a fractional factorial design, and asked to choose her/his preferred arrangement in each pair, to evaluate the potential impacts of the chosen arrangement on her/his lifestyle and work related costs, and to decide whether or not to adopt it, if offered.

Then, the respondent is proposed an additional task, using a menu approach. In this task, the employee is presented with a list of all attributes that constitute a telecommuting program and asked to select the combination of attribute values that best addresses her/his needs. Then s/he is asked about the expected impacts of this program on her/his lifestyle and work related costs. Finally, s/he is asked if s/he would actually adopt the designed program, if it was offered by her/his employer.

Eighty managers from 28 different organizations responded the employer's survey. One hundred and seventy six employees from 21 different organizations responded to the employee's survey. About 54% of the managers were offering a telecommuting program to their employees, and about 32% of the employees were telecommuters at the time they answered the survey.

MODEL ESTIMATION RESULTS

Using the survey data, we estimated a model system that represents the process of adoption of telecommuting. We discuss the results of the employer's and the employee's decision process models in order. See Bernardino (1995) for a detailed discussion of the estimation process.

The employer's decision process

The model that predicts the employer's decision to offer a telecommuting program to her/his employees was estimated in two parts: the program design and the decision to offer telecommuting. When designing a telecommuting program, the employer is searching for the combination of attribute levels that maximizes the organization's profitability. Since the organization's profit function is unknown, we define profit as a random variable and estimate a multinomial logit (MNL) model for the probability that a program has the maximum profit potential among all possible telecommuting programs. The estimated coefficients of the systematic profit function are presented in Table 2.

The estimation results indicate that small organizations, with 50 employees or less, are unlikely to require a minimum number of telecommuting days per week. A similar behavior is expected from large organizations, if its employees work primarily in teams. However, a minimum frequency for telecommuting is likely to be established by large organizations, if its employees work primarily on individual tasks. The attractiveness of the telecommuting program for the employer decreases as the maximum number of telecommuting days increases. Large organizations prefer fixed schedules, while small organizations prefer flexible schedule.

Table 2 The employer's program design model

Variable Description	estimate	t-statistic
minimum telecommuting required, team structure	-0.934	-27.48
minimum telecommuting required, individual structure, large organization	1.036	33.13
minimum telecommuting required, individual structure, small organization	-0.462	-41.05
maximum telecommuting allowed	-0.184	-21.58
flexible telecommuting schedule, large organizations	-0.582	-8.96
flexible telecommuting schedule, small organizations	1.069	43.30
shared desk to work on commuting days	-1.712	-50.48
lower salary paid to telecommuters	-2.366	-51.57
telework center based telecommuting	-1.212	-49.50
fax machine available	0.517	23.52
dedicated phone line available	0.593	27.02
access to computer network available, large organizations	-0.892	-12.80
access to computer network available, small organizations	2.022	61.75
equipment provided by employer	1.143	47.66
phone bills paid by employer	1.908	64.63
employer is liable for work-related insurance at home	0.315	14.25
Number of observations	104	
Number of Cases	6136	
Log-likelihood at zero	-425.8	
Log-likelihood at convergence	-249.1	
Adjusted rho-squared	0.38	

An employer is unlikely to offer lower salaries to telecommuters than s/he would offer to regular office workers. S/he is likely to provide all the equipment required for telecommuting, pay for telecommuting related phone bills and hold liability for property and employee health and safety in home based telecommuting.

As far as the equipment is concerned, virtually all respondents required that a computer be available, and therefore this variable was not included in the model. Available access to a computer network significantly increases the attractiveness of a program for small organizations. This is not a valuable resource for large organizations, which are more likely to have their own network. A fax machine and a dedicated phone line increase the attractiveness of a program to both organizations.

The employer decides whether to offer telecommuting to her/his employees based on the expected impacts of the designed program on productivity and costs, as well as on the employees' demand for telecommuting, the employer's level of experience with these arrangements and the alternatives to telecommuting available to the organization. We hypothesize that the employer would expect the decisions associated with telecommuting schedule and direct income to have an impact on employee productivity, and decisions associated with provision of equipment and office space, payment of phone bills, liabilities and salary to impact production cost. Based on these hypotheses, we estimated a binary logit model with two latent variables, productivity impacts and cost impacts, for the probability of an employer offering telecommuting to her/his employees. The estimated model is presented in Table 3.

The estimation results show that the requirement of a minimum weekly telecommuting frequency is expected to have a negative impact on productivity. This may indicate that establishing a minimum number of days in which telecommuting is required reduces the employee's flexibility and therefore generates less satisfaction than if no minimum frequency is required. Moreover, as the minimum number of telecommuting days per week required increases, a decrease in group productivity and monitoring capabilities may be expected, since the prolonged absence of telecommuters from the office reduces the frequency of their face-to-face interactions with coworkers and supervisors.

An increase in the maximum number of telecommuting days per week is expected to have an overall positive impact on productivity. The flexibility telecommuters have to tailor their telecommuting program to their needs increases as the maximum number of days in which

telecommuting is allowed increases. An increase in job satisfaction, and therefore in individual productivity, is then expected.

Table 3 The employer's offering decision model

Variable Description	estimate	t-statistic
LATENT VARIABLES		
Productivity Impact		
minimum telecommuting required	-0.113	-3.49
maximum telecommuting allowed	0.098	2.94
lower salary paid to telecommuters	-0.288	-2.67
telework center telecommuting	-0.111	-2.03
Cost Impact		
shared desk to work on commuting days	-2.458	-4.58
lower salary paid to telecommuters	-0.445	-0.82
phone bills paid by employer	0.685	1.84
employer is liable for work-related insurance at home	0.754	2.73
organization located in heavily congested area	-0.758	-2.05
PROFIT FUNCTION		
telecommuting constant	1.167	1.25
productivity impact (latent variable)	1.836	1.67
cost impact (latent variable)	-0.498	-1.28
employees demonstrated interest	2.213	3.10
no experience with telecommuting in the organization	-1.085	-1.26
some experience with telecommuting in the organization	1.794	2.26
organization is relocating office	-1.784	-1.93
Number of observations	100	
Complete log-likelihood at convergence	-1401.1	
Log-likelihood of choice model at zero	-69.3	
Log-likelihood of choice model at convergence	-36.9	
Adjusted rho-squared	0.57	

Paying telecommuters a lower salary than that paid to regular commuters is expected to have a negative impact on productivity, since telecommuters are likely to be dissatisfied. Telework center-based programs are perceived to have a negative impact on productivity. The other attributes that constitute a telecommuting arrangement did not have a significant impact on productivity, and were therefore removed from the model.

The only variables that have a significant impact on the production costs of the organization are those related to office space and liability in home-based programs. Offering telecommuters a shared desk in the office to work on commuting days allows for office space savings. Offering telecommuters a lower salary, however, has a low potential for cost reductions.

If the employer pays for the phone bills, production costs increase, as expected. Similarly, when the employer is liable under a home-based telecommuting arrangement, some additional expenses are expected, since new types of insurance may be required. Organizations located in heavily congested areas expect higher cost reductions due to telecommuting than their counterparts located in non-congested areas. The cost of equipment, which in this case refers primarily to a computer, did not have a significant impact on production costs and the sign of the corresponding variable was opposite to what was expected. Thus, this variable was removed from the model.

Overall, employers expect telecommuting to have a positive impact on the organization's profit, everything else being equal. An expected increase in productivity induces a profit increase, and therefore increases the probability of the program being offered. An expected increase in costs induces a profit loss and reduces the probability of the program being offered. The probability of an employer offering a program increases as the employees' demand increases, and as the

employer's level of experience with these arrangements increases. It decreases if the organization is changing its office location, indicating relocation as a potential substitute for telecommuting.

The employee's decision process

The employee's decision process is modelled in two stages: the program choice and the adoption decision. The program choice consists of the selection by the employee, among the options made available by the employer, of the telecommuting program that maximizes her/his utility. Since the utility function cannot be observed, it is treated as a random variable, and an MNL model is estimated for the probability of a program yielding the maximum utility among all those offered by the employer.

Two models were developed to represent the employee's selection of a telecommuting program. The first, based on the menu data, represents the employee's preferences, given the set of arrangements s/he considers. The second, based on the fractional factorial data, represents the employee's choice, given her/his preferences and the alternatives made available by the employer. It seems that most employees did not consider arrangements offering a higher salary when defining their preferences. As such, this variable was included only in the second model. The estimation results are presented in Table 4.

Table 4 The employee's program choice model

PREFERENCE MODEL		
Variable Description	**estimate**	**t-statistic**
minimum telecommuting required	-0.687	-57.9
maximum telecommuting allowed	0.128	13.1
flexible telecommuting schedule	2.095	60.5
shared office to work on commuting days	-0.409	-15.5
shared desk to work on commuting days	-2.543	-48.5
lower salary offered to telecommuters	-3.488	-37.5
telework center based telecommuting	-2.106	-64.4
computer available	3.716	64.3
fax machine available	0.471	18.9
dedicated phone line available	1.066	38.8
access to computer network available	2.225	61.1
equipment provided by employee	1.948	58.9
phone bills paid by employee	2.248	60.2
employee is liable for work-related insurance at home	0.676	26.5
Number of observations	123	
Number of cases	7257	
Log-likelihood at zero	-503.6	
Log-likelihood at convergence	-129.1	
Adjusted rho-squared	0.71	

CHOICE MODEL		
Variable Description		
higher salary paid to telecommuter	0.324	2.08
fitted value of preference model	0.218	14.01
Number of observations	491	
Number of cases	491	
Log-likelihood at zero	-340.3	
Log-likelihood at convergence	-298.8	
Adjusted rho-squared	0.12	

The results indicate that an employee is likely to prefer programs with a flexible telecommuting schedule in which no minimum telecommuting frequency is required. The preference also increases as the maximum number of telecommuting days allowed increases. These results demonstrate the employee's search for flexibility to adjust her/his working schedule to her/his personal and professional needs.

Concerning the space available for work on regular commuting days, an employee prefers working in an individual office to sharing an office or a desk. S/he is unlikely to select a program which offers a lower salary to telecommuters than that paid to regular commuters. On the other hand, the probability of her/him choosing a program increases if a higher salary is offered.

The desirability of a program increases when access to a computer and a computer network is granted. The availability of a dedicated phone line and a fax machine also increase the attractiveness of a program, but not as significantly. The employee prefers that the employer provides the required equipment, pays for the work-related phone bills and be liable for property and employee health in home based telecommuting. S/he is unlikely to select a telework center based program.

Once a program is selected, the employee compares it with the current situation, evaluating the expected changes in lifestyle, work related costs and income due to the adoption of telecommuting. Some of these changes, however, cannot be measured directly. Thus, we define two latent variables, to capture the expected changes in the quality or attractiveness of lifestyle and work related costs.

We hypothesize the expected impacts of telecommuting on the quality of lifestyle to be a function of the employee's personal and household characteristics, as well as of the time the employee is allowed to telecommute, the flexibility s/he is given to decide about her/his telecommuting schedule and the telecommuting site. Telecommuting is expected to affect the employee's work related costs through changes in expenditure with equipment, telecommunications, insurance, transportation, home utilities, and child and elder care.

Given these data and hypotheses, we specify and estimate a binary logit model with latent variables to explain the employee's decision to adopt telecommuting. The estimated model is presented in Table 5.

The results indicate that employees perceive programs in which a minimum telecommuting frequency is required to have a negative impact on lifestyle quality, since it increases the constraints placed on the employee's schedule. While employees working under a team structure perceive lifestyle quality improvements as the maximum telecommuting frequency increases, employees working primarily on individual tasks perceive a negative impact of high frequencies on lifestyle quality.

Telework center telecommuting has a negative impact on lifestyle. The longer the one-way commuting, the more beneficial the impact of telecommuting on lifestyle, mainly for women. Finally, the presence of a child in pre-school age in the household increases the beneficial impact of telecommuting on lifestyle.

All the explanatory variables for cost are directly proportional to the average number of commuting days per week, except for the variable related to equipment costs. Day care costs and transportation costs are shown to increase as the commuting frequency increases. Home office utility costs decrease as the commuting frequency increases.

Other things being equal, employees expect telecommuting to significantly increase their utility level. The utility derived from adopting a program decreases with a salary reduction and increases with a salary increase. If a positive impact on lifestyle is expected, the derived utility, and consequently the probability of adoption increases. If an increase in work related costs is expected, the probability of adoption decreases.

DEMAND FOR TELECOMMUTING

The model system described herein can be used to obtain an indication of the potential of telecommuting to reduce work trips. We use the program design model to calculate the probability of each alternative telecommuting program being designed by the employer. Then we use the offering decision model to calculate the probability of each telecommuting arrangement being offered to the employee, given that it is selected. These calculations are done separately for organizations with a primary team and a primary individual task structure.

Table 5 The employee's adoption decision model

Variable Description	estimate	t-statistic
LATENT VARIABLES		
Lifestyle		
minimum telecommuting required	-0.148	-6.56
maximum telecommuting allowed, team structure	0.102	3.02
maximum telecommuting allowed, individual structure	-0.036	-1.99
telework center telecommuting	-1.021	-14.75
travel time, female	0.690	7.47
travel time, male	0.272	3.21
child under 6 years old in the household	0.546	7.46
Work-Related Cost		
day care proxy	0.393	2.00
home office proxy	-0.362	-2.70
equipment costs	0.759	2.50
weekly transportation costs	0.648	2.91
UTILITY FUNCTION		
telecommuting constant	2.015	8.94
lifestyle (latent variable)	0.994	7.01
work related costs (latent variable)	-0.368	-3.12
higher salary paid to telecommuters	0.495	1.12
lower salary paid to telecommuters	-2.357	-5.78
Number of observations	440	
Complete log-likelihood at convergence	-9392.88	
Log-likelihood of choice model at zero	-304.99	
Log-likelihood of choice model at convergence	-204.70	
Adjusted rho-squared	0.35	

We assume that only one arrangement is proposed to the employee. We use the adoption decision model to calculate the probability of each arrangement being adopted by the average employee, given that it is offered. We combine these probabilities to calculate the expected number of work trips that can be reduced by telecommuting as follows.

We calculate the marginal probability of the minimum telecommuting days required being equal to each of its possible values (zero to five). The expected minimum telecommuting days required is the sum of all possible values weighted by the corresponding marginal probabilities. Similarly, we calculate the marginal probability of the maximum telecommuting days allowed being equal to each of its possible values (from one to five). The expected maximum telecommuting days required is the sum of all possible values weighted by the corresponding marginal probabilities.

The results indicate that the average employer from this stratum of the population would offer a telecommuting program with a probability of 80%. Small organizations, and organizations with a team structure are unlikely to require a minimum telecommuting frequency and would allow for a maximum of up to 3 telecommuting days per week. On the other hand, in large organizations in which employees work primarily on individual tasks, employers would require a minimum of 2.3 telecommuting days per week. These employers are also more likely to allow for up to 5 telecommuting days per week.

These results demonstrate that employers from organizations with a prevailing team structure believe in the potential of telecommuting to increase productivity, and therefore would be willing to make a program available to their employees. However, they are unable to take advantage of the telecommuting cost savings potential by requiring a minimum frequency. Employers from organizations where individuals work primarily on individual tasks, on the other hand, can benefit from the productivity increase potential, by making telecommuting available, and from the cost reduction potential, by requiring a minimum telecommuting frequency, so that the office space available for employees to work on commuting days can be reduced. Requiring a minimum frequency also helps such organizations to comply with traffic reduction mandates.

The forecasting exercise indicates that, under the base case, 46% of the surveyed population, or 16% of the US civilian employees, would telecommute an average of one day per week. About 88% of this total would telecommute from home, and 12% from telework centers. This implies a potential elimination of about 6.0% of the total work trips nationwide, and the reduction of the commuting distance of another 0.8% of these trips.

As the employer's exposure to telecommuting increases, the level of adoption in the surveyed population can increase up to 79%. This striking result comes to favor the current policy of support of telecommuting demonstration projects adopted by the public sector as an efficient means to foster adoption.

It should be noted that this analysis is based on a convenience sample, and that respondents are likely to be individuals who have some interest on the subject. Even though efforts have been made to adjust the results to be representative of the population as a whole, the models could only be corrected for bias if applied to revealed preference data, which were not available for this study.

CONCLUSIONS

In this paper we develop and demonstrate a framework to explain the telecommuting adoption process, incorporating both the employer's and the employee's perspective. The results indicate that the characteristics of a telecommuting program significantly affect the employer's perceptions of its potential impacts on productivity and costs, and the employee's perceptions of its potential impacts on lifestyle and work related costs.

Productivity growth is more significant than potential cost savings for the average employer to decide whether to make telecommuting available. Nevertheless, some arrangements are perceived to provide significant cost savings possibilities.

Even though the level of congestion employees need to face during their commuting trip has a significant impact on the decision to adopt telecommuting, transportation related issues are not the only sources of motivations for employees to join a telecommuting program. Factors such as lifestyle, work related costs and income are also relevant to the decision.

An overall negative perception of telecommuting centers by both employers and employees was identified, pointing to the necessity to conduct further research to identify the market for this type of arrangement.

This study shows that telecommuting certainly constitutes a powerful tool to reduce work trips. Its potential can be further increased as the exposure of employers to such arrangements increases. However, these results reflect a segment of the population to whom telecommuting is feasible and attractive. Further research efforts should adjust these results to be representative of the overall population.

ACKNOWLEDGMENTS

This research was partially supported by the Brazilian Government, through the CNPq fellowship, by a grant from NEC Corporation Fund for Research in Computers and Communications to MIT, and by the UPS Doctoral Fellowship.

REFERENCES

Bernardino, A.T., Ben-Akiva, M., and Salomon, I. (1993) *A stated preference approach to modeling the adoption of telecommuting.* Transportation Research Record 1413, pp.22-30.

Bernardino, A. T. (1995) *Adoption of Telecommuting: Modeling the Employer 's and the Employee 's Decision Processes.* Doctoral dissertation, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology.

Mokhtarian, P.L. and Salomon, I. (1994a) *Modeling the choice of telecommuting: setting the context.* Environment and Planning A 26(5), pp.749-766.

Mokhtarian, P.L. and Salomon, I. (1994b) *Modeling the choice of telecommuting 2: a case of the preferred impossible alternative.* Submitted to Environment and Planning A.

Mokhtarian, P.L. and Salomon, I. (1994c) *Modeling the desire to telecommute: the importance of attitudinal factors in behavioral models.* Submitted to Transportation Research B.

Mokhtarian, P.L. and Salomon, I. (1995) *Modeling the choice of telecommuting 3: identifying the choice set and estimating binary choice models for technology-based alternatives.* Submitted to Environment and Planning A.

Sullivan, M.A., Mahmassani, H.S., and Yen, J.-R. (1993) *A choice model of employee participation in telecommuting under a cost-neutral scenario.* Transportation Research Record 1413, pp.31-41.

Yen, J.-R. and Mahmassani, H.S. (1994) *The Telecommuting Adoption Process: Conceptual Framework and Model Development.* Research Report 60055-1. Center for Transportation Research, University of Texas at Austin.