ESTIMATING THE VALUE OF TIME SAVINGS – EXPECTED TRAFFIC ACCIDENT COST AND CONTINGENT VALUATION METHOD

Yong Nam SONG
Assistant Professor
Department of Economics
Chonbuk National University
1-Ga 664, Duckjin-Dong, Chonju
Chollabuk-Do, 561-756, Korea
Facsimile: +82-63-270-3040
E-mail: ysong@chonbuk.ac.kr

Abstract: The valuation of travel time savings is a well-established subject, where majority of them are mode choice studies. Mode choice models are built upon the assumption that individuals decide on their mode choice by comparing time and money costs of modes available, and did not take the traffic accident costs into when calculating the full cost of traveling. Excluding the traffic accident costs from full cost of traveling would result in biased estimates of the value of travel time savings, and valuation methods based on revealed preference such as mode choice model have its own limitations. In this paper, based on the mode choice model and CVM, I estimate VTTS with traffic accident costs considered.

Key Words: VTTS, CVM, WTP, Traffic Accident Cost

1. INTRODUCTION

Enhanced comfort of private transportation, sprawl of cities, free parking provided by many companies to their employees, the decline of mass transit service, and easier private auto ownership due to increase in income and improved financing system contributed to the exponential increase in private vehicle travel over the last decade, which resulted in very severe road congestion. However, rather than exercising continuous and indefinite investment in transportation facilities, it is time for us to seek greater efficiency in road use. Therefore, we need to evaluate the costs and benefits of transportation projects more accurately.

Travel time savings by road users is found to be one of the most dominant economic benefits of transportation projects, and therefore, measuring the value of travel time savings accurately is essential if transportation facilities are to be designed and priced efficiently.

The valuation of travel time savings is a well-established subject. Numerous methods have been implemented: studies of route choice, speed choice, choice of location, and choice of modes, where majority of them are mode choice studies.

Beesley (1965), Lisco (1967) and many others have used mode choice data for commuting to estimate the value of travel time for commuters: Hensher (1977) and Deacon and Sonstelie (1985) estimated the value of travel time for leisure trip; Gronau (1970) estimated the value of travel time dealing with the travel market using the trips by air, rail and bus between New

York and the 38 most frequent travel destinations from that city; and Carruthers and Hensher (1976) measured the value of travel time using the data from the Business Air Travel Time.[1]

Most mode choice models are built upon the assumption that individuals decide on their mode choice by comparing time and money costs of modes available. However, none of above mode choice models took the traffic accident costs as a part of full cost of traveling.[2] Excluding the traffic accident costs from full cost of traveling would result in biased estimates of the value of travel time savings (VTTS).

Furthermore, valuation methods based on revealed preference such as mode choice model have the virtue of relying on actual behavior but can be applied only when the analyst knows what decision alternatives and consequences were perceived by the decision maker.

In this paper, based on the traditional mode choice model without traffic accident costs considered, I estimate VTTS. Then, using the mode choice model and Contingent Valuation Method, I estimate VTTS, and compare the results.

2. MODEL

2.1 Mode Choice and the Value of Travel Time Savings (VTTS)

In this section, I show the consumer's utility maximization problem and its implication on mode choice and VTTS. Assume that the city is on a flat undifferentiated surface. Commuters in the city maximize utility defined over composite goods, amenities of traveling, and leisure. Composite goods are both produced and consumed in the city and imported from other markets. Their price, P, does not vary within the city.

Mode choice model, considered in this paper, concerns only the journey to work.[3] Therefore, I consider a short-run model in which home and work locations, hence the choice of frequency, destination and timing can be safely assumed to be fixed. For simplicity, we also assume that two modes of transportation are available, auto and bus.

Assume that individuals work a fixed number of hours.[4] Leisure equals the number of nonworking hours less time spent commuting. Therefore, leisure consumption is:

$$l((t^i r^i)T) = \bar{T} - (t^i r^i)T \qquad (2\text{-}1)$$

where $\bar{T}$ is the total time available for leisure and other activities, T is number of trips taken, t^i is time it takes to travel a certain distance, r^i is the distance of travel, and $t^i r^i$ is total time spent commuting per trip by either auto or bus.[5] The time spent commuting contributes negatively to this commuter's utility.

Each commuter faces a money cost for commuting, consisting either of a bus fare or an out-of-pocket driving cost both of which are functions of the travel distance from home to workplace. Therefore, the total money cost of travel can be expressed as:

$$F = f(r^i) \qquad (2\text{-}2)$$

where f is either bus fare for bus riders or the out-of-pocket cost of driving for auto drivers.

Given these assumptions, consider the problem of a representative household who seeks to maximize:

$$U(X, T, l((t^i r^i)T)) \tag{2-3}$$

subject to his time and budget constraints:

$$l((t^i r^i)T) = \quad \bar{T} \quad - \quad (t^i r^i)T$$

$$\text{and} \qquad I = P\,X + FT \tag{2-4}$$

where X is the composite commodity, T is the number of commuting trips, l is leisure, and $t^i r^i$ is time spent commuting per trip by either auto or bus.

Following Mohring (1976), we have

$$U_T / U_x = F + t^i r^i V \tag{2-5}$$

where $V(.) = U_l / U_x$, which is the ratio of the marginal utility of leisure to the marginal utility of dollars, can be interpreted as VTTS in dollars per unit of time.

Equation (2-5) tells us that the consumer equates the ratio of the marginal utility of trips to that of dollars with the out-of-pocket cost plus the time cost of a trip. Therefore the RHS of equation (2-5) is the full price of a trip. It is a mode choice model that rests on the notion of a "Full Price" of a trip--money and value of time for a trip (Mohring, 1976).

Let $t^a r^a$ be time spent if the commuter chooses to drive, and $t^b r^b$ be time spent if the commuter chooses to ride bus.

Then for car drivers, from equation (2-5), the full price is:

$$f(r^a) \quad + \quad t^a r^a V \tag{2-6}$$

and for bus riders, the full price is:

$$f(r^b) \quad + \quad t^b r^b V \tag{2-7}$$

where subscript a is for car and b is for bus, and where $f(r^b)$ is bus fare, and $f\ (r^a)$ is out-of-pocket cost for auto drivers. Out-of-pocket cost can be written as:

$$f(r^a) = \$/\text{kilometer} * \text{distance of driving} \tag{2-8}$$

We can see that the commuters will decide on their mode choices, depending on:

$$f(r^a) \quad + \quad t^a r^a V \quad \lesseqgtr \quad f(r^b) \quad + \quad t^b r^b V \tag{2-9}$$

i.e., the selection of one mode depends on the difference between the full prices of the modes.[6]

Therefore, we can define VTTS in terms of money cost as:

$$f(r^a) - f(r^b) / (t^b r^b - t^a r^a) \quad (2\text{-}10)$$

i.e., the difference in money cost between two modes divided by difference in time cost between two modes (See Winston, 1985).

2.2 Traffic Accident Costs and VTTS

Every commuter faces the risk of being involved in traffic accident, which causes significant costs, such as damage to vehicles and other property, and injuries and deaths to people. However, in calculating full cost of traveling, most commuters, if not all, ignore the possible traffic accident costs, and the exclusion of it from full cost of traveling would result in biased estimates of VTTS. Therefore, I modify above mode choice model so that VTTS with full cost including traffic accident costs can be estimated.

By observing how much traffic accident costs commuters are willing to pay(bear with) in order not to forgo their driving, we can learn how much they value their travel time savings.

If we define the expected traffic accident cost as EC, and the maximum amount commuters are willing to pay in order not to forgo their driving as C, then the equation (2-9) becomes:

$$f(r^a) + EC + t^a r^a V + C = f(r^b) + t^b r^b V \quad (2\text{-}11)$$

or, $$EC + C = V(t^b r^b - t^a r^a) + (f(r^b) - f(r^a)) \quad (2\text{-}12)$$

where EC = P*Accident Cost, and P is the probability of getting involved in a traffic accident.

Hence, VTTS in terms of money and traffic accident cost, which includes the expected traffic accident costs and maximum amount commuters are willing to pay additionally, can be redefined as:

$$V^2 = (f(r^a) - f(r^b) + EC + C)/(t^b r^b - t^a r^a)$$

Or $$V^2 = V^1 + (EC + C)/(t^b r^b - t^a r^a) \quad (2\text{-}13)$$

Where $V^1 = f(r^a) - f(r^b) / (t^b r^b - t^a r^a)$.

3. EMPIRICAL STUDIES

The purpose of this paper is essentially to estimate commuters' VTTS using individual mode choice model and CVM with traffic accident costs considered. The survey was carried out for the faculty and staff members of Chonbuk National University located in Chonju city during fall 2000, when the weather was clear and nice. This data set has a sample size of 269 commuters. I removed data for people who declined to provide relevant information including mode choice, commuting time, and all necessary socio-economic variables such as age, sex, income, and variables of household characteristics. This left 206 commuters.

This data set contains information on trip times for the mode chosen and alternative mode, and individual and household demographic characteristics. However, due to difficulties in obtaining comprehensive and accurate information through interviews alone, data on the cost of travel for modes were generated using other sources of information such as the Transportation Agencies and auto manufacturers. For automobile, fuel cost was estimated to be approximately between 6 cents and 11 cents per kilometer depending on the type and size of automobiles driven.[7] This fuel cost does not include the price of the vehicle, insurance and maintenance costs that are independent of the miles driven, and vehicle opportunity cost. Total vehicle ownership cost, which includes all these costs together, is approximately 36-64 cents per kilometer, which is approximately six times the vehicle fuel cost. Since both commuting time and the distance of driving are available, we were able to find the accurate out-of-pocket costs per trip. Driving costs were estimated using information in Table 1.

Table 1
Fuel and Maintenance Costs of Private Autos (Korea and U. S.)

	1500cc/less	1500cc-1990cc	1991cc-2490cc	2491cc-2990cc	2991cc and up
Fuel cost*	6c/km	7c/km	8c/km	9c/km	11c/km
(Korea)	9.6c/mile	11.2c/mile	12.8c/mile	14.4c/mile	17.6c/mile
(U. S.)	-	5.3c/mile	-	6.7c/mile	7.7c/mile
Operating Cost**	9c/km	11c/km	12c/km	14c/km	16c/km
(Korea)	14.4c/mile	17.6c/mile	19.2c/mile	22.4c/mile	25.6c/mile
(U. S.)	-	8.1c/mile	-	9.8c/mile	11.1c/mile
Ownership cost***	36c/km	44c/km	48c/km	56c/km	64c/km
(Korea)	58c/mile	70c/mile	77c/mile	90c/mile	102c/mile
(U. S.)	-	31.6c/mile	-	37.9c/mile	42.4c/mile

* Fuel costs are manufacturers' ideal figures, and actual fuel costs are higher.
** Operating Cost includes gasoline and oil, maintenance, and tires costs.
*** Ownership cost includes tax, insurance, fuel costs, repair costs, loan finance charge and depreciation. This figure was calculated for the annual driving distance of 15,000miles (24,000 kilometers) based on figures by Runzheimer and Company (1991), Song (1997). Korea's figure is for September 2000.

3.1 Mode Choice Model and the estimation of VTTS

3.1.1 Mode Choice Model and VTTS

Suppose that we have a set of n individuals and their utilities are represented by:

$$U_{im} = V_{im} + \varepsilon_{im} \tag{3-1}$$

where subscripts i and m indicates individual i and travel mode respectively.

This is the random utility model where utility has an observable component V_{im} and an unobservable (random) component ε_{im}. We specify the observable component V_{im} as:

$$V_{im} = \beta_{om} + \beta_{1m}X_1 + \beta_{2m}X_2 \quad (3\text{-}2)$$

where the matrices X_1 and X_2 contain variables that are respectively, specific to the individual (socio-economic characteristics such as income, age, gender and so on) and the trip (time and money cost differences).

Thus, the probability that individual i chooses mode m is the probability that the utility of mode m is greater than that of alternative mode. It is shown by equation (3-3):

$$\begin{aligned} P_{i1} &= Prob(U_{i1} > U_{i2}) = Prob(V_{i1} + \varepsilon_{i1} > V_{i2} + \varepsilon_{i2}) \\ &= Prob(V_{i1} - V_{i2} > \varepsilon_{i2} - \varepsilon_{i1}) \end{aligned} \quad (3\text{-}3)$$

Assuming that $\varepsilon_{i2} - \varepsilon_{i1}$ has Weibull distribution with i. i. d, the basic model form is binomial logit:

$$P_{im} = \exp(V_{im}) / \sum_{j=1,2} \exp(V_{ij}) \quad (3\text{-}4)$$

3.1.2 Results

Table 2 has detailed description of variables used in this study, and the model was estimated using a binary logit model by maximum likelihood methods. Table 3 presents the results.

Table 2
Variables for the mode choice model

Variable	Description
Costdif	Cost difference between two mode choices Autocost - buscost (cents)
Timedif	Time difference between two mode choices Bus time - Auto time (minutes)
Income	Yearly Income (cents)
Age	Commuter's age
Schoolyr	Commuter's education level (years of schooling)
Occupa	1 if commuter is faculty member 0 otherwise
Gender	1 if commuter is male 0 otherwise
Marital	1 if commuter is married 0 otherwise
Mode	1 if commuter drive 0 if commuter choose transit

Two explanatory variables are of particular interest for this study. The variable "costdif" is negative and significant, implying that the cost difference between modes plays a very important role for mode choice in the way that the log of odds of driving is higher as the cost difference gets bigger. The variable "timedif" is positive and significant in our study, implying that as the time difference gets bigger, the log of odds of driving is higher.

Table 3
Mode Choice Coefficients

Variable	Without Expected Traffic Accident Cost		With Expected Traffic Accident Cost	
Constant	- 3.6511	(-1.772)*	-3.6760	(-1.794)
Costdif	- 0.43632	(1.823)	-0.37158E-02	(-1.640)
Timedif	0.34319E-01	(2.635)	0.34403E-01	(2.703)
Income	0.24091E-05	(0.819)	0.23765E-01	(0.972)
Age	0.32679E-01	(0.676)	0.38715E-01	(0.894)
Marital	2.7990	(2.897)	2.7107	(2.857)
Sex	- 0.10053	(-0.164)	-0.15377	(-0.251)
Schoolyr	0.19690E-01	(0.171)	0.25468E-01	(0.225)
Occupa	1.3364	(2.096)	1.2696	(1.977)

* t-ratio

The value of commuting time savings is estimated in a very simple manner. It is the coefficient of time difference divided by coefficient of cost difference.[8] VTTS without traffic accident cost is estimated to be $4.72. The average hourly wage for the region is approximately $10.00 per hour.[9]

Table 4
The Values of Travel Time Savings (per hour)

VTTS	Without Traffic Accident Cost (V^1)	With Expected Traffic Accident Cost	With Expected Traffic Accident Cost and WTP (V^2)
	$4.72	$5.48	$6.04

Therefore, VTTS is approximately 47% of the average hourly wage, which is similar to the results in Song (1997), but higher than that of other countries, which is between 25 % and 50 % of wage and the median value is 40% of wage.[10] Not surprisingly, this discrepancy could be explained by the fact that commuters in Korea want to get to their destinations faster and comfortably, therefore highly value their time savings.

3.2 Contingent Valuation Method (CVM) and the estimation of VTTS

3.2.1 CVM

In this section, we consider a new method of estimation of VTTS where traffic accident cost is included in full cost of traveling. Full cost of transportation can be classified into internal costs consisting of money and time costs and crash cost, and external costs consisting of congestion, air pollution, noise, and crash cost. However, only internal traffic accident cost is considered in this study since other costs of driving such as congestion and environmental costs are not directly inflicted on drivers, and commuters do not take them into account when deciding on their mode choices. For the calculation of the full cost of transportation, see Anderson *et al.* (1999).

Valuation methods based on revealed preference such as mode choice model have the virtue of relying on actual behavior but can be applied only when the analyst knows what decision alternatives and consequences were perceived by the decision maker. Recently, Contingent Valuation Method (CVM) has been widely used to estimate the monetary value of changes in probabilities of injury, health, environment, and transportation safety measures (Jones-Lee *et al.*, 1985, 1995). Therefore, in this study, we employ CVM as a new method of estimating VTTS along with mode choice model. However, Because CVM is often used to elicit values of goods that are rarely purchased in markets, CV questions can be difficult for respondents to comprehend and answer. Furthermore, stated WTP is, in general, inadequately sensitive to the magnitude of the risk reduction because respondents do not understand probabilities or lack intuition for the changes in small probabilities (Hammit *et al.*, 1999).

In this study, in order to enhance the understanding of the concept of the probabilities of traffic accidents and CV questions, the respondents were provided with objective probabilities and costs of various types of traffic accident in the region, and assumed to use this information in deciding their perceived and maximum risks they can tolerate before giving up driving.

The respondent is first presented, based on the information on objective probabilities, with questions designed to elicit perceived risk measures qualitatively:
"Is your probability of getting involved in traffic accident greater or less than the average driver? By how much? "

The respondent is then presented with CV question to elicit up to how much the maximum amount (or, up to how much the probability increase) of additional traffic accident costs the respondent is willing to bear with in order not to forgo driving:
"What is the maximum increase in probability can you tolerate in order not to forgo driving?"[11]

Then, based on the mode choice model and CVM, I estimated VTTS.

3.2.2 Results

To the first question "Is your probability of getting involved in traffic accident greater or less than the average driver? By how much?" answers vary from 0% to 170% of average driver, where the mean value is 58%. It implies that the average respondents believe that their probability of getting involved in traffic accident is 58% of average driver.

When asked about how much traffic accident cost additionally they were willing to bear with not to forgo their driving, commuters answered between \$0 and \$7.00, where the mean value is \$0.6. Hence, using the equation (2-13), and VTTS obtained by mode choice model, we can get VTTS with traffic accident cost considered, $6.04.

$$V^2 = V^1 + (EC + C)/(t^b r^b - t^a r^a) \quad (2\text{-}13)$$

These results have important implications on transportation policies such as improvement in road safety device. Furthermore, in designing policies for improvement in road system, enhancing road safety as well as reducing travel time must be considered.

4. CONCLUSION

Most mode choice models are built upon the assumption that individuals decide on their mode choice by comparing time and money costs of modes available. However, none of mode choice models took the traffic accident costs into consideration when calculating the full cost of traveling, which resulted in biased estimates of the value of travel time savings (VTTS).

Furthermore, valuation methods based on revealed preference such as mode choice model can be applied only when the analyst knows what decision alternatives and consequences were perceived by the decision maker.

In this paper, based on the mode choice model without traffic accident costs considered, I first estimated VTTS. Then, using RP and CVM approaches combined, I estimated the commuters' VTTS, where traffic accident cost was included in full cost of traveling, and compared the results. The results indicate that with traffic accident costs considered, VTTS is higher than that without traffic accident costs.

ACKNOWLEDGMENTS

This research was financially supported by Research Funds of Chonbuk National University.

REFERENCES

Anderson, D. *et al.* (1999) "Transportation and Regional Growth Study: The Full Cost of Transportation in the Twin Cities Region," **Center for Transportation Studies**, University of Minnesota.

Barton-Aschman Associates Inc. (1977) Parking Policies and Multi-Occupancy Vehicle Utilization in the Twin Cities Metropolitan Area, **Barton-Aschman Associates Inc. Report**, 77-11.

Beesley, M. E. (1965) "The Value of Time Spent in Traveling: Some New Evidence," **Economica** , 174-185.

Carruthers, R. C. and Hensher, D. A. (1976) "Resource Value of Business Air Travel," in **Modal Choice and the Value of Travel Time** edited by Heggie, Ian G.

Deacon, R. and Sonstelie, J. (1985) "Rationing by Waiting and the Value of Time: Results from a Natural Experiment," **Journal of Political Economy, Volume 93**, 627-647.

Gronau, R. (1970) **The Value of Time in Passenger Transportation: The Demand for Air Travel**, National Bureau of Economic Research.

Hammit, J. *et al.* (1999) "Willingness to Pay for Health Protection: Inadequate Sensitivity to Probability?" **Journal of Risk and Uncertainty, 18**, 33-62.

Hensher, D. A. and Stopher, P. R. (1977) **Behavioral Travel Modeling**.

Jones-Lee, M. *et al.* (1995) "Valuing the Prevention of Non-Fatal Road Injuries: Contingent Valuation vs. Standard Gambles," **Oxford Economic Papers 47**, 676-695.

Jones-Lee, M. *et al.* (1998) "On the Contingent Valuation of Safety and the Safety of Contingent Valuation: Part 1-*Caveat Investigator*, " **Journal of Risk and Uncertainty, 17**, 187-213.

Jones-Lee, M. *et al.* (1999) "On the Contingent Valuation of Safety and the Safety of Contingent Valuation: Part 2-The CV/SG "Chained" Approach," **Journal of Risk and Uncertainty, 17,** 5-25.

Korea Labor Institute (1997) **KLI Labor Statistics**.

Lisco, Thomas E. (1967) **The Value of Commuters' Travel Time: A Study in Urban Transportation**, Ph.D. Dissertation, Department of Economics, University of Chicago.

Lisco, T. and Thair, N. (1974) **Travel Mode Choice Impact of Potential Parking Taxes in downtown Chicago**, Illinois Department of Transportation.

Mohring, H. (1976) **Transportation Economics**, Cambridge: Ballinger Publishing Company, 25-58.

Mohring, H. *et al.* (1987) "The Values of Waiting Time, Travel Time, and a Seat on a Bus," **Rand Journal of Economics, Vol 18, no. 1**.

Oi, W. (1962) "Labor as a Quasi-Fixed Factor of Production," **Journal of Political Economy, 70**, 538-555.

Runzheimer and Company (1980-1991) **Your Driving Costs** .

Shoup, Donald C. (1993) "Cashing Out Employer-Paid parking: A Precedent for Congestion Pricing?" **Proceeding of Congestion Pricing Symposium**, TRB.

Song, Yong N. (1999) "Inferring the Value of Walking Time from Parking Rent Gradient," **Journal of the Eastern Asia Society for Transportation Studies, Vol . 3, No. 4**, 253-260.

Song, Yong N. (1997) "The Values of Commuters' Travel Time and Differential Unpleasantness, " **Journal of Korean Society for Transportation Vol. 15, No. 4**, 9-18.

Spear, Bruce D. (March 1977) "Applications of New Travel Demand Forecasting: Techniques to Transportation Planning," **A Study of Individual Choice Models**.

Veith, H. G. (1977) **Public Transportation in a Circular City**, Ph. D. Dissertation, University of Minnesota.

Waters II, W. G. (1995) "Issues in the Valuation of Travel Time Savings for Road Project Evaluation," ***Proceeding*** of An International Symposium on the Latest Developments in Transport Economics and Their Policy Implications, KOTI, 107-147.

Westin, R. B. and Gillen, D. W. (1978) "Parking Location and Transit Demand," **Journal of Econometrics 8**, 75-101.

Winston, C. (1985) "Conceptual Developments in the Economics of Transportation: An Interpretive Survey," **Journal of Economic Literature, Vol 23**, 54-87.

NOTES

[1] See Waters(1995) for complete details of valuation of travel time savings.

[2] Only traffic accident cost is considered in this study since other costs of driving such as congestion costs, and environmental costs are not directly inflicted on drivers, and commuters do not take them into account when deciding on their mode choices. For the Calculation of the full cost of transportation, see Anderson and McGullough (1999).

[3] This model draws heavily on Song (1997).

[4] It is safe to assume that the individual has little choice as to the number of hours worked, i. e., fixed labor supply is assumed. See Oi (1962).

[5] Some literature assumes that individuals are indifferent between time spent working and traveling. Therefore, any time being saved by taking alternative mode can be used for production (See Veith(Tauchen) (1977), Waters (1995)). This assumption is not realistic. For the advantage of using an individual choice model, see Spear (1977).

[6] Note that parking cost is not included in the equation. It implies that parking cost does not play an important role for mode choice in the model. Some literature found that the parking tax strategies might not be effective at reducing congestion in the central city (Spear, 1977), and others found that the parking tax strategies might be effective in reducing congestion in the central city by forcing people to switch the mode from private vehicle to public transit mode (Shoup (1993), Gillen and Westin(1978)). For more details on the parking policies, see Barton Aschman Associates Inc.(1977), and Lisco and Thair (1974).

[7] Some literature assume that the out-of-pocket expenses of vehicle operation are the only costs considered in deciding whether to use mass transit or a private vehicle in the journey to work (Beesley, 1965). However, the out-of-pocket expense understates the true costs of relevance (Mohring, 1976). Lisco (1967) showed several cases where marginal cost is not relevant true cost of driving auto vehicles.

[8] Rational of this calculation is shown in Mohring (1976). If the time difference between the two modes were to increase by one minute and the cost difference fall by \$β(time

difference)/β(cost difference), then modal choice probabilities would be unchanged. Thus by his behavior, the individual is revealing that one minute is equivalent to \$β(time difference)/β (cost difference).

[9] The Exchange Rate we used between Korean Won and \$ is 1200: 1 as of September 2000 when the survey was conducted.

[10] See Waters (1995).

[11] Note that, in order to enhance the reliability and validity of WTP-based monetary values questions, respondents were reminded of their budget constraints before they were asked second question. Also, rather than asking directly how much the commuters were willing to pay in order not to forgo their driving, the questionnaire was designed to elicit the answer by asking them indirectly.