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Gap between Willingness-to-Pay (WTP) and Willingness-to-Accept (WTA) Measures of Value of Travel Time: Evidence from Norway and Sweden

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ABSTRACT *A main purpose of this paper is to stress the existence of the gap between willingness-to-pay (WTP) and willingness-to-accept (WTA) measures of value of time that is larger than could be explained in a Hicksian framework. The explanation of the gap is of great importance in welfare analysis. This is a subject that has not been paid much attention to in value-of-time studies and there is great need for further research on the subject. This paper relies on the evidence from Norwegian and Swedish value-of-time studies to examine the gap between WTP and WTA measures of value of time. These studies use different techniques for data collection. The evidence from both studies suggests that the observed WTA measure of value of time is about 1.5– 2.0 times larger than WTP measure. Alternative model formulations in the Swedish study to address 'inertia factors' for WTP and WTA, or the exclusion of zero values for WTP and WTA measures in the Norwegian study, reduce the gaps. The reductions of the observed gaps in the WTP and WTA measures are analysed in the framework suggested by Zhao and Kling in 2001. They put forward 'commitment cost' as an explanation for WTP and WTA gap. An agent forms a commitment cost, in a similar manner to a 'real option', due to a lack of information, knowledge and uncertainty about his own valuations and also because a decision about a transaction has to be made rather swiftly. The theoretical framework suggested by Zhao and Kling is in line with additive utility functions underpinning the neo-classical economics. If indeed 'commitment costs' is the explanation for the observed WTP and WTA gaps, the observed small values of small time savings should be interpreted as short-term valuations. The long-term values of small time savings should be quite higher than the short-term values.*

Introduction

In a Hicksian framework equivalent loss is associated with willingness-to-pay (WTP) and equivalent gain is associated with willingness-to-accept (WTA). The gap between equivalent loss and equivalent gain is explained by income effect (Willig, 1976). The gap between WTP and WTA measures obtained from contingent

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valuation studies is usually larger than can be explained by income effect (Horowitz and McConnell, 2003). The WTP and WTA disparities and the interpretation of the disparities have been the focus of numerous studies. For a review of some of the literature, see, for example, Horowitz and McConnell (2002) and Plott and Zeiler (2005). A theory that has gained considerable support to explain the WTP and WTA gap is reference-dependent preferences (Kahneman and Tversky, 1979; Tversky and Kahneman, 1991), also referred to as loss aversion or the endowment effect (Thaler, 1980). This theory puts forward a structure of a utility function that depends upon the endowment of the consumer; the consumers value goods more highly once they own them. Hanemann (1991) offers an alternative explanation and suggests that the large gap between equivalent loss (EL) and equivalent gain (EG), and hence WTP and WTA, can be explained by income and substitution effects. Zhao and Kling (1998) look into real options for explaining the gap. They suggest that observed WTA and WTP diverge from equivalent loss and equivalent gain can be explained by commitment costs. Information and learning as well as the intrinsic values of the good in question determine the gap.

Others suggest that the observed gap is the artefact of the elicitation mechanisms used in laboratory experiments or contingent valuation surveys (Plott and Zeiler, 2005). Plott and Zeiler summarize the WTP–WTA disparities by stating:

> The literature reveals two important facts. First, there is no consensus regarding the nature or robustness of WTP–WTA gaps. Second, while experimenters are careful to control for subject misconceptions, there is no consensus about the fundamental properties of misconceptions or how to avoid them. (p. 530)

Unlike some experimental studies (e.g. Plott and Zeiler, 2005), it is very difficult, if not impossible, to design a value-of-travel-time study that would take the respondents through a learning process. While respondents in a value-of-time study are familiar with the relation of time and cost of their trips, time is a private non-market good. And most likely the respondents' 'misconceptions' are larger than in experimental studies that deal with market goods. Finally, the nature of the gap between WTP and WTA measures of value of time is of great importance for policy-relevant welfare measures. Hence, it is important to explain the nature of the gaps between WTP and WTA measure of time within a theoretical framework.

This paper focuses on the evidence on WTP and WTA gaps in value-of-time studies in Sweden and Norway. The WTP and WTA gaps are significant in these studies. These gaps have been reported in previous studies (e.g. Ramjerdi *et al.*, 1997; Algers *et al.*, 1998; Hultkrantz and Mortazavi, 2001). However, these studies do not address the nature of these gaps. De Borger and Fosgerau (2006) recently examined the nature of the gaps between WTP and WTA measures of value of time by using theory of reference-dependent preferences. To the present authors' knowledge this is the first study that addresses the nature of WTP–WTA disparities in value of time. This paper relies on the theoretical framework offered by Zhao and Kling to explain the WTP and WTA gaps in the Swedish and the Norwegian studies.

The next section will briefly present some alternative theories that describe the nature of the WTP and WTA gaps and their implications for welfare analysis. The paper continues by presenting the evidence on WTP and WTA gaps from

the Norwegian and the Swedish value-of-time studies, which is followed by an analysis of the gaps. It then summarizes the results and concludes in the final section.

Theory and Method

Probably the most popular explanation for the WTP and WTA gap is prospect theory, and endowment effect. Kahneman and Tversky (1979) developed prospect theory as an alternative to the expected utility theory (also called Von Neumann–Morgenstern utility). Under prospect theory values are assigned to gains and losses, and the value function is defined on deviations from a reference point (Figure 1). The function is normally concave for gains (implying risk aversion), convex for losses (risk seeking) and is generally steeper for losses than for gains (loss aversion). This is often referred to as reference-dependent preferences.

The endowment effect explains the WTP and WTA gap by assuming that people's valuation of the objects they own is higher than of the objects they do not own (Thaler, 1980). Endowment effect theory is similar to prospect theory in the sense that it explains preferences related to a reference point, and preferences exhibit loss aversion. The reference-dependent preference assumption in prospect theory or the endowment effect approach is in contrast to additive utility functions underlying the neo-classical economics.

Others have suggested that the observed gap is the artefact of the elicitation mechanisms used in laboratory experiments or contingent valuation surveys. It seems that by providing agents information (or by allowing the agent to require information) about the value of an object, the WTP and WTA gap disappears. In this context, Plott and Zeiler (2005) state that:

> The issue explored here is not whether a WTP–WTA gap can be observed. Clearly, the experiments of KKT and others show not only that gaps can be observed, but also that it is replicable. Instead, our interest lies in the interpretation of the observed gaps. The primary conclusion derived from the data reported here is that observed WTP–WTA gaps do not reflect a fundamental feature of human preferences. (p. 542)

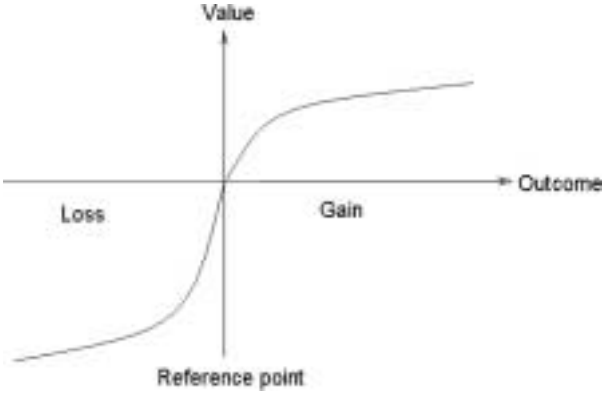

Figure 1. Value function defined on the deviation from a reference point

The authors refer to the study by Kahneman *et al.* (1990) as the KKT experiment. Plott and Zeiler observe that:

> By implementing different procedures, the phenomenon can be turned on and off. When procedures used by papers that report the gap are employed, the gap is readily observed. When a full set of controls is implemented, the gap is not observed. (p. 542)

Hanemann (1991) offers an alternative theory that attributes the large gap between equivalent loss and equivalent gain (and hence WTP and WTA) to income effect and when substitution for the good being valued is difficult. But substitution effects cannot explain the observed WTP and WTA divergences in many studies.

Zhao and Kling (1998, 2001) look into real options for explaining the gaps (e.g. Arrow and Fisher, 1974; Dixit and Pindyck, 1994). That leads them to explain the observed WTA and WTP gaps by 'commitment costs'. They suggest that 'timing' is an important factor that determines the observed WTP and WTA gap, even when the Hicksain measures, compensation variation (CV) and equivalent variation (EV), are equal. A consumer who faces uncertainty about the value of a good (measured by CV or EV) and a non-trivial transaction requires information for making a decision about buying or selling and there is a (option) value in waiting to gather more information. If the consumer has to give up the option of gathering information, he requires compensation for giving up information about the good's value. Hence, the time at which WTP and WTA are formed can affect their magnitude (for a formal model, see Zhao and Kling, 1998). The result is a lower WTP than CV and higher WTA than EV or:

$$\text{WTP} = CV - CC_p$$
$$\text{WTA} = EV - CC_a$$

where CC_p and CC_a are the option values (commitment costs) associated with collecting information when the agent is purchasing or selling. The two commitment costs generate the WTP and WTA gap. This model suggests that the WTP and WTA gap diverges from the CV and EV gap. The conditions for commitment costs to form are when (1) the consumers are uncertain about the value of a good, (2) they can expect that they could learn more about the value in future, (3) they have some willingness to wait, (4) they expect a cost associated with reversing the transaction (buying or selling), and (5) they are forced to make a trading decision now even if they might prefer to delay their decisions.

The theories put forwards by either Hanemann or Zhao and Kling are within the framework of neo-classical economics.

Data and Results

The focus of this section will be the evidence on the WTP and WTA gap in the Swedish Value of Time Study. The data collected for the 1994 Swedish Value of Time Study (Algers *et al.*, 1995) is used in this work. The section will briefly describe the data and some of the results on the WTP and WTA gaps. A gap (WTP = SEK63/h and WTA = SEK113/h) is significantly reduced when WTP and WTA estimates are based on models that account for 'inertia'. The section proceeds by

describing the data and evidence from the National Norwegian Value of Time Study (Ramjerdi *et al.*, 1997). The evidence from this study also suggests that the WTP and WTA gap is large (WTP = NOK68/h and WTA = NOK107/h) and is significantly reduced when observations with zero value for WTP or WTA are excluded.

Swedish Evidence

The focus of the Swedish study was on regional and long-distance trips by six different modes: car, air, long-distance train, regional train, long-distance bus, and regional bus, and for both private and business travel purposes. The study was designed as a telephone survey collecting socio-economic information from the respondent and the household, and responses to stated choice (SC) experiments.

The principle of the fieldwork was first to contact a person during a trip in order to conduct the SC experiment in a realistic context and then make the interview by telephone on an agreed day. For the car mode, license plate numbers were noted at selected road sections and the owners identified through a public register. Shortly thereafter the car owners were contacted to identify the persons who drove the cars at the specific times and locations. About 850 interviews were completed for car with a response rate of 64%. A low response rate for car (compared with other modes) was explained by not finding a licence plate number in the register (probably due to an error in noting the licence plate number), by not finding a telephone number for contact (an unlisted number), and for not answering the telephone call or the unavailability of the targeted driver when contacted by telephone. The results reported here are based on data collected for car trips over 50 km and for private travel purposes (Lindqvist Dillén, 2003).

SC Design in the Swedish Study In the SC experiment a base alternative was presented to be compared with alternatives trips (with the same mode). The alternatives were produced by a change from the base alternative. The base alternative was tied to the observed trip of the respondent by randomly multiplying the actual time and cost of the observed trip by 0.9 or 1.1. The base alternative was also referred to as the 'C' alternative, which was to be compared with A, B, D, E, etc. Factors included in the car experiment were cost and time only. To obtain information on the value-of-travel-time losses (WTA measure) and the value-of-travel-time savings (WTP measure), the number of changes representing gains and losses were the same (four times each in each game). The first choices were randomly a gain or a loss in order to avoid a bias related to the initial question. In this SC experiment, a hypothetical trip was always compared with a base alternative that was closely tied with the actual trip.

The following section presents the estimates of values of time using logit models. For a descriptive analysis of the data and details about the modelling work, see Lindqvist Dillén and Algers (1999).

Table 1 shows the estimation results from separate logit models for the segments with time gains (WTP) and time losses (WTA). It shows that the WTA measure of value of time is about SEK113/h and almost twice as large as WTP measure of value of time, which is about SEK63/h.

Table 2 shows the estimation results for separate logit models for WTP and time WTA while accounting for what Lindqvist Dillén and Algers call an 'inertia factor'. A comparison of the values of time in Table 2 with corresponding values in Table 1

Table 1. Logit models for WTP and WTA without inertia

	WTP		WTA	
Variable	Coefficient	*t*-value	Coefficient	*t*-value
Cost	–0.02927	(8.4)	–0.03539	(10.1)
Time	–0.03082	(10.1)	–0.06660	(14.0)
Log-likelihood	–713.52		–608.23	
Observation	1122		1121	
Value of time (SEK/h)	63.2		112.9	

shows that inertia factors result in increases in both WTP and WTA measures of value of time. The WTP measure has increased from about SEK63/h to about SEK94/h, while the WTA measure has increased from SEK113/h to SEK114/h (though not statistically significant). Also note that the estimated value of the inertia factor for WTP is positive; while the inertia factor for WTA is negative, but statistically insignificant. Also note that the inertia factor for WTP is significantly larger than the inertia factor for WTA. Table 2 also shows that the WTP and WTA gap has decreased significantly after accounting for the inertia factors (from about 2.0 to 1.2). An interesting observation is that the inertia factor for WTA is quite small (and not significant); while the inertia factor for WTP is relatively large (and significant). This suggests an asymmetry in the inertia values associated with buying and selling.

Lindqvist Dillén and Algers examine the goodness-of-fit of the models with inertia factors and conclude that there is no significant difference between WTP and WTA measures of value of time. Only a larger variance is associated with responses to WTP. Table 3 shows the results.[1]

In another study a mixed-logit approach (also called random parameters logit or random coefficient logit) was applied to the same data (Algers *et al.*, 1998). This approach allows for the estimation of distributed parameters.[2] A mixed-logit specification has the following advantages:

- Does not exhibit the Independence of Irrelevant Alternatives (IIA) property.
- Accounts for potential correlation over repeated choices made by a respondent.
- Can be derived from utility-maximizing behaviour.
- Can approximate multinomial probit models.

Unlike a probit model, in a mixed-logit model the coefficients can follow other distributions than the normal. Revelt and Train (1998) and Brownstone and Train

Table 2. Logit models for WTP and WTA with inertia

	WTP		WTA	
Variable	Coefficient	*t*-value	Coefficient	*t*-value
Cost	–0.02836	(8.1)	–0.03345	(10.0)
Time	–0.04429	(10.4)	–0.03552	(10.7)
Inertia	0.54250	(5)	–0.03345	(0.3)
Log-likelihood	–700.68		–608.19	
Observation	1122		1121	
Value of time (SEK/h)	93.7		114.5	

Table 3. Logit model with different inertia for WTP and WTA

Variable	Coefficient	*t*-value
Cost	–0.03062	(12.2)
Time	–0.05242	(14.9)
Inertia, WTP	0.70230	(7.5)
Inertia, WTA	0.17810	(2.0)
Log-likelihood	–1314.07	
Observation	2243	
Value of time (SEK/h)	102.7	

(1998) show that when using the estimates for forecasting, one may obtain counterintuitive and unrealistic results by imposing a normal distribution on some coefficients.

Algers *et al.* (1998) have estimated all possible combinations of normal and fixed parameters for the three coefficients of the models (time, cost and inertia) on the subsamples related to WTP and WTA. They report that ignoring individual heterogeneity appears to lead to systematically higher values of time. Relaxing the assumption of fixed coefficients in a model captures the individual heterogeneity in this study. Table 4 shows separate mixed-logit models for time gains (WTP) and time losses (WTA) while accounting for inertia. In these models the coefficients for cost and time are normally distributed, while the coefficient for inertia is assumed to be fixed.[3] These model specifications were significantly better with respect to fit than models reported in Table 2. While the estimates of the WTP and WTA measures of value of time are lower than those derived from a model with fixed coefficients, the gap between WTP and WTA measures increases from about 1.2 to 1.5.

Table 4 also shows that the estimated value of the inertia factor for WTP is positive; while the inertia factor for WTA is negative. And the inertia factor for WTP is significantly larger than the inertia factor for WTA, suggesting an asymmetry in the inertia values associated with buying and selling.

Mixed-logit models for WTP and WTA with alternative assumptions about the distributions of the coefficients were not estimated. It is difficult to speculate how alternative assumptions about the distributions of the coefficients would have changed the values for WTP and WTA, in particular when log-normal distributions can better describe WTP and WTA (Lindqvist Dillén and Algers, 1999). A

Table 4. Mixed-logit models for WTP and WTA with inertia

	WTP		WTA	
Variable	Coefficient	Standard error	Coefficient	Standard error
Cost (mean)	–0.23172	0.04765	–0.15304	0.02676
Cost (SD)	0.19913	0.04816	0.18784	0.03456
Time (mean)	–0.23343	0.03543	–0.24320	0.03659
Time (SD)	0.18236	0.02807	0.11899	0.02111
Inertia	1.34671	0.35488	–0.56017	0.29254
Log-likelihood	–499.96		–468.97	
Observation	1012		1012	
Value of time (SEK/h)	60.44	7.20	95.37	13.20

corresponding mixed-logit model to the logit model in Table 3 (assuming the same values for WTP and WTA measures but allowing for different inertia values for WTP and WTA) was not estimated either. And it is difficult to speculate how the coefficients, in particular the coefficient for inertia for WTA, would have changed.

Hultkrantz and Mortazavi (2001) use the Swedish data to estimate WTP and WTA based on a non-linear model derived from a second-order approximation to the utility function. The model includes linear and quadratic terms for time and cost differences as well as interaction terms of socio-economic variables and the time and cost of a trip.[4] They estimate bivariate random-effect probit models on the WTP and WTA questions. They show that both value functions indicate threshold effects, similar to inertia. Furthermore, the threshold effect is larger for WTP than for WTA, similar to the pattern observed for inertia factors reported by Algers *et al.* (1998). Hultkrantz and Mortazavi also report that the estimates of WTA values exceed the estimates of WTP values. However, they fail to provide an explanation for the nature of the gap, e.g. if the difference could be explained by the endowment effect (prospect theory), by income and substitution effects (the explanation offered by Hanemann), or by income effect and option value (the explanation by offered by Zhao and Kling). It is important to emphasize that the nature of gap between WTP and WTA measures of value of time is of great consequence in welfare analysis.

Norwegian Evidence

This section presents some evidence from the Norwegian Value of Time Study (Ramjerdi *et al.*, 1997). The study covers long-distance travel by five main modes: car, air (main line and short landing and take off), rail (long distance and regional), bus (long distance and regional), and ferry, and for private and business travel purposes.[5] The long-distance study was carried out in two waves in 1995. Table 5 shows an overview of the design of the interurban study.

The aim, as in the Swedish study, was to contact a person during a trip in order to give the choice experiments a realistic context. The interviews were conducted on board or at home shortly after the contacts. For mode car recruitment was made by telephone. Home interviews were arranged with those who had made a long-distance trip by car in the previous week. The response rate in this study was quite high for all modes (75–85%).[6]

SC and TP designs in the Norwegian study Both SC and Transfer Price (TP) techniques were used in the Norwegian study. The SC games were presented as

Table 5. Overview of the design of the long-distance study

	Number of interviews	Recruited at:	Interviewed at:
Air	500	airport/on board	home
Rail	900	on board	on board
Bus	500	on board	on board
Ferry	600	on board	on board
Car, 30 to ≥ 300 km	900	telephone	home
Total	3400		

Table 6. Value of time (NOK/h) for private inter-urban travel for trips > 50 km

	Car	Ferry	Rail	Bus	Air
In-vehicle time	86	75	54	48	163
95% confidence interval	±10	±13	±7	±8	±25

paired alternatives and a respondent was asked to state their preferred choices. The alternatives were produced by changes in the attributes (time and cost) of the observed trip of the respondent. Each respondent was presented nine paired choices (a fractional factorial design). The SC design in the Norwegian study avoids a fixed reference for evaluation of preferences. However, the drawback is that it does not lend itself to the examination of WTP and WTA measures of value of time. For this purpose TP technique was explored. The TP questions followed the SC games. This paper presents responses to the following TP questions: WTP for a 25% decrease in travel time, WTP for a 10% decrease in travel time and WTA for a 25% increase in travel time.[7] The time and cost of the actual trip of a respondent was used as a reference in the TP design. In total about 3040 respondents had answered all the TP questions.

The SC data was analysed using logit models. Table 6 shows values of travel time savings for private travel longer than 50 km.

The evaluations of the TP responses are presented in Table 7. It shows the percentage of the respondents who had stated a zero WTP or WTA for a change in travel time. The number of respondents with a zero WTP for a 25% decrease in travel time is significantly larger than the number of respondents with a zero WTA for a 25% increase in travel time. This mirrors the observed asymmetry associated with WTP and WTA in the Swedish study. And a significantly larger number of respondents had zero WTP for a 10% decrease in travel time compared with a WTP for 25% decrease in travel time. Obviously, when travel time is decreased by 10%, a smaller number of bids are large enough to persuade the respondents to undertake a transaction compared with the exercise in which travel time is decreased by 25%.

Table 8 shows the average WTP or WTA measures of value of time for different segments. It indicates that the WTP and WTA gaps are significant and the gaps decrease when the observations with zero WTP or WTA are excluded.

To analyse the factors that influence respondents to state a zero WTP or WTA logistic regression models were estimated. In a logistic regression model, the dependent variable is dichotomous: zero for the respondents with zero value and 1 for the respondents with positive values. Travel purpose, travel distance, income, gender, and mode of travel were used as explanatory variables. Table 9

Table 7. Distributions of WTA and WTA

	WTA_{25}*		WTP_{25}**		WTP_{10}***	
	WTA = 0	WTA > 0	WTP = 0	WTP > 0	WTP = 0	WTP > 0
Total	29.7	70.3	40.8	59.2	70.4	29.6

*Willingness-to-accept for 25% increase in travel time; **willingness-to-pay for 25% decrease in travel time; **willingness-to-pay for 10% decrease in travel time.

Table 8. WTP and WTA measures of value of time (NOK/h) for different segments

	Total	$WTP_{25} > 0$	$WTP_{10} > 0$	$WTA_{25} > 0$
Number of observations	3040	1802	460	2137
Percentage of observations	100	59	30	70
WTP_{25}	67.8	113.4		
WTP_{10}	40.8		136.2	
WTA_{25}	107.4			152.4

shows the results of these estimations. The probability of a non-zero WTP for a decrease of 25% in travel time increases with income and travel distance and with travel purpose business. The probability of a non-zero WTA for an increase of 25% in travel time increases with travel distance and with travel purpose business. The probability of a non-zero WTP for a decrease of 10% in travel time increases with travel distance, travel purpose and with gender male. Mode of travel can influence (differently) the probability of a zero value in WTP or WTA. These results suggest that there is probably an income effect associated with the WTP and hence WTP and WTA gap. Furthermore, the respondents are more likely to state a zero WTP or WTA when the bids involve small changes in travel time (note that travel time is correlated with travel distance). Other studies have also reported that the value of time increases with the size of time differences (e.g. Hultkrantz and Mortazavi, 2001). They use the data in the Swedish Value of Time Study for their empirical study.

The least-squares method was used for the estimations of WTP and WTA measures of value of time. Zero values were excluded. The examination of the data shows that WTP and WTA are best described by log-normal distributions. Hence, the following regression models were used:

Table 9. Logistic model for $WTP_{25,}$ WTA_{25} and WTP_{10}

	WTP_{25}			WTA_{25}			WTP_{10}		
Number of observations	2954			2954			1488		
–2LL	3784.2			3484.7			1701.6		
Variable	β	Wald statistic	p	β	Wald statistic	p	β	Wald statistic	p
Travel distance[a]	9E–4	26.68	0.00	8E–4	20.57	0.00	8E–4	16.11	0.00
Income[b]	16E–4	24.77	0.00	–4E–5	0.15	0.70	1E–4	0.54	0.46
Male	–18E–3	0.04	0.84	14E–3	0.02	0.88	–0.407	9.40	0.00
Business	0.238	5.78	0.02	0.377	13.47	0.00	0.165	1.30	0.25
Air	–1.369	97.35	0.00	–0.996	47.22	0.00	–1.186	30.52	0.00
Ferry	–0.560	20.03	0.00	–0.458	11.27	0.00	–1.266	32.13	0.00
Bus	0.650	24.42	0.00	0.043	0.10	0.75	0.759	20.46	0.00
Rail	–0.116	1.13	0.29	–0.709	37.49	0.00	0.065	0.16	0.69
Constant	0.010	0.01	0.93	0.968	0.85	0.00	–0.842	42.85	0.00

[a]Travel distance (km).
[b]Personal income in NOK1000/year.

Table 10. Regression models for WTP_{25}, WTA_{25} and WTP_{10} for private travel

	WTP_{25}		WTA_{25}		WTP_{10}	
Number of observations	1113		1273		291	
R^2	23.16		33.87		29.35	
Adjusted R^2	22.74		33.56		27.86	
	β	t-value	β	t-value	β	t-value
c, Constant	–0.925	–4.63	–0.811	–4.35	–0.527	–1.17
a, ln(D)	0.095	3.00	0.072	2.50	0.046	0.66
b, ln(W)	0.107	4.68	0.153	6.81	0.097	2.27
d_1, Air	1.118	11.80	1.063	13.21	1.534	7.18
d_2, Ferry	–0.012	–0.15	0.323	4.65	0.456	2.20
d_3, Bus	–0.273	–4.42	–0.569	–9.60	–0.406	–3.50
d_4, Rail	–0.224	–3.79	–0.265	–4.70	–0.326	–2.70

$$\ln(\mathrm{WTP}) = \mathrm{c} + \mathrm{a}\ln(\mathrm{D}) + \mathrm{b}\ln(\mathrm{W}) + \mathrm{d}_1\mathrm{Air} + \mathrm{d}_2\mathrm{Ferry} + \mathrm{d}_3\mathrm{Bus} + \mathrm{d}_4\mathrm{Rail} + \varepsilon$$

$$\ln(\mathrm{WTP}) = \mathrm{c} + \mathrm{a}\ln(\mathrm{D}) + \mathrm{b}\ln(\mathrm{W}) + \mathrm{d}_1\mathrm{Air} + \mathrm{d}_2\mathrm{Ferry} + \mathrm{d}_3\mathrm{Bus} + \mathrm{d}_4\mathrm{Rail} + \varepsilon,$$

where:

D	travel distance (km),
W	average hourly income,
Air	= 1 if air is the mode of travel; zero otherwise,
Ferry	= 1 if ferry is the mode of travel; zero otherwise,
Bus	= 1 if bus is the mode of travel; zero otherwise,
Rail	= 1 if rail is the mode of travel; zero otherwise,
ε	error term,
a, b, c, d_1, d_2, d_3 and d_4	model parameters.

Table 10 shows the results of the estimations of the regression models for WTP_{25}, WTP_{10} and WTA_{25} for private travel purposes.

Table 11 shows the comparison of the results from the TP and SC studies. It shows that WTP measures are smaller than WTA measures of value of time, but the differences are not as large as it is presented in Table 8 for the total sample (zero value included). An exception is travel mode Ferry. It also suggests that the differences between WTP measures of small and large time savings disappear once zero values are excluded from the analysis.

Table 11. Value of travel time (VOT, NOK/h) for private travel

	TP			SC
Mode	WTA_{25}	WTP_{25}	WTP_{10}	VOT
Car	79 (±11)	64 (±13)	69 (±15)	86 (±10)
Ferry	106 (±15)	62 (±18)	103 (±16)	75 (±13)
Rail	56 (±11)	49 (±12)	49 (±14)	54 (±7)
Bus	39 (±9)	44 (±10)	45 (±13)	48 (±8)
Air	236 (±26)	208 (±28)	313 (±31)	163 (±25)

Figures in parentheses show the 95% confidence interval.

Analysis of the Results

The divergence between WTP and WTA measures of value of time and the nature of the divergence is of great importance in welfare analysis. A reference-dependent preference approach as an explanation for the divergence suggests that WTP and WTA gaps are larger than EG (equivalent gain) and EL (equivalent loss) gaps, and time gain and loss should be valued according to WTP and WTA, and not according to EG and EL. While theories that explain the gap in the framework of the neo-classical economic theory, time gain and loss are valued according to EG and EL.

Different studies suggest that by providing an agent information (or by allowing the agent to require information) about the value of an object the WTP and WTA gap disappears.[8] As suggested above, unlike some experimental studies, it is very difficult, if not impossible, to design a value-of-travel-time study that would take the respondents through a learning process.

Both the Swedish and Norwegian evidence suggest that income effect alone cannot explain the observed WTP and WTA gaps. Stated Choice (SC) experiment was used in the Swedish Value of Time Study. Transfer Price (TP) technique was used in the Norwegian Value of Time Study. While different data collection methods were used in these studies, the structures of WTP and WTA gaps have striking similarities (see the third section). The evidence from the Norwegian and the Swedish Value of Time Studies suggests that the observed WTA measure of value of time is about 1.5–2.0 times larger than WTP measure of value of time. Similar asymmetries associated with WTP and WTA can be observed in both studies. In the Swedish study, the gap between WTP and WTA decreases after using different 'inertia' factors for WTP and WTA in the estimations (from a factor of about 2.0 to a factor of about 1.2–1.5). The gap between WTP and WTA in the Norwegian study is reduced by excluding those observations with zero WTP or WTA (from a factor of about 1.5 to a factor of about 1.1 to 1.2).

The present paper examined the possibility of real option (or commitment cost) for the explanation of the WTP and WTA gap (Zhao and Kling, 1998, 2001). While time is a private non-market good, commitment costs (option values) are likely to form since (1) the travellers are uncertain about their valuation of time, (2) they expect to learn more about their valuation in future, (3) have some willingness to wait, (4) they perceive a transaction cost associated with their decision, and (5) they are forced to make a decision in the experiments (Zhao and Kling, 2001).

In the Swedish study the inertia factors capture the commitment costs (real options) associated with buying or selling. In the Norwegian study the existence of a commitment factors can be examined the zero response to WTP or WTA. Once a bid is attractive enough to override their option values the respondents are willing to go through a transaction. By accounting for commitment costs in these studies the WTP and WTA gaps significantly decrease. It is difficult to speculate to what extent income effect explains the remaining WTP and WTA gaps. It is also quite likely that improvement in modelling approach to reduce WTP and WTA gaps further.

If indeed 'option value' is the explanation for the disparities between WTP and WTA measures of value of time, then the results could be interpreted as a short-run response, and that in the long run small time savings, or losses, will have larger values than the short-run values.

And if indeed 'option value' explains the WTP and WTA gaps in these studies, it has implication for welfare analysis. In some situations, such as investment under uncertainty, option values are important component of decision-making (Dixit and Pindyck, 1994). In the context of 'value of time' people learn about their valuations (though implicitly). Hence, the WTP and WTA gap should correspond to the divergence between equivalent gain and equivalent loss.

The nature of data on WTP and WTA is such that a value function can be estimated in the support of reference-dependent preference theory for the explanation of the divergence of the two. Yet such a value function does not justify ruling out other theories for the explanation of the gap.

Summary and Conclusions

The main purpose of this paper is to stress the existence of the gap and the importance of further research on this subject. While different theories could be used to explore the gaps, unlike other experimental studies, it is very difficult, if not impossible, to design a value-of-travel-time study that would take the respondents through a learning process. Nonetheless, the nature of the gap is of great consequence for policy-relevant welfare measures.

The evidence from the Norwegian and the Swedish value-of-time studies suggests that the observed WTA measure of value of time is about 1.5–2.0 times larger than the WTP measure of value of time. Alternative model formulations in the Swedish study to address inertia or the exclusion of zero values for WTP and WTA measures in the Norwegian study reduce the gaps. An explanation for the reduction of the observed gaps between the WTP and WTA measures can be the existence of an 'option value' among respondents due to the lack of information and knowledge about their own valuations and the fact that respondents have to make a decision about a transaction immediately in these studies as well as the possible existence of income effect. If indeed option values explain the WTP and WTA gaps in these studies, the small time savings will have a larger value in the long run than the short run.

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Notes

1. The standard deviations for WTP and WTA in Table 2 are about 11 and 8, respectively. The standard deviation for the value of time in Table 3 based on the pooled sample is about 6. The standard deviations of these estimates are underestimated by about 50% when a jack-knife procedure is used. This procedure is used to account for the fact that the choices of an individual are not independent (Lindqvist Dillén and Algers, 1999).
2. The mixed-logit procedure described by Revelt and Train (1998) and Train (1998) has been adopted in the present study.
3. These models were the best among alternatives according to the log-likelihood values.
4. Lindqvist Dillén and Algers (1999) estimate a non-linear model based on the third-order approximation to the utility function. They show that the observed distribution of value of time is closer to the estimated distribution based on the third-order approximation than the estimated distribution based on the second-order approximation.

5. This study addresses both urban and long-distance (interurban) travel. It focuses on the evidence related to long-distance travel in order to make it comparable with the Swedish evidence.
6. For mode car there is not a good record of how many telephone calls were placed to locate the targets (those who had undertaken a long-distance travel journey in the previous week). The response rate was about 75% among the targets.
7. This technique was actually closer to the open-ended format of contingent valuation than to transfer pricing, since the respondents were offered changed attribute levels.
8. Or it should be reduced to the EG and EL gaps.

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