THE NATIONAL SWEDISH VALUE OF TIME STUDY

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1. INTRODUCTION

In Sweden, cost benefit evaluations have been part of the planning process for many years. In these cost benefit evaluations, the value of time (hereafter referred to as VoT) play an important role. Traditionally, these evaluations have been carried out predominantly in the road sector, and its use in other sectors - specifically in the rail sector - is more recent. Over time, different attempts have been made to co-ordinate resource allocation over different transportation sectors. In 1994, the responsibility for such co-ordination was given to the Swedish Institute for Transport and Communications Analysis (SIKA).

The VoT's for private trips that had been used previously were based on Revealed Preference studies concerning local and regional traffic. For business travel, wages plus overheads were used together with an assumption of the share of travel taking place during work hours. These values had been debated for some time, and the need for a broader and more consistent knowledge concerning the VoT's was recognised. This was true also for other Nordic countries, and in December 1991, a Nordic seminar on VoT was held in Finland, bringing together researchers, representatives form different transportation sectors and international expertise for a discussion on theories and methods of estimation of VoT's.

In 1994, SIKA initiated a comprehensive VoT study, financed by the Communication Research Board, the National Road Administration and the National Rail Administration. The study was commissioned to the Transek consultancy. The project organisation included a work group with representatives from the participating agencies as well as members from the Norwegian VoT study, and a reference group also containing experts with experience from the UK and the Netherlands VoT studies.

It was thought that since there seemed to be a general unanimity concerning the methodology of a VoT study, results could be available at the end of 1994, which was required according to the time schedule of the planning process. The general design of the study was also based on the 1991 seminar, and was confirmed at the first reference group meeting in April 1994. However, the study turned out to be more of a process than a mere execution of a well defined project plan, which had its consequences for the time schedule. This was probably due to the deep involvement of the participating agencies, and it is our belief that this has been not only of great value for the study as such and for a better understanding of VoT issues where they are going to be applied, but also necessary for the recommended values to be accepted, which is a prerequisite for the planning process to succeed.

The work was carried out within a very narrow time frame, which meant that every aspect could not be dealt with as thoroughly as would be desirable. The data will therefore be subject to further analysis in subsequent research projects.

The next section of the paper will briefly describe the underlying theories and the methodology used in the project, including the field work. In the third section, results for private trips are shown, followed by a description of the results for business trips in the fourth section. I the final section, the recommendations made by SIKA based on the results of the study are presented.

Last, it should also be said that all reported values are in Swedish crowns, of which it takes about 9.4 to equal an Ecu. All VoT's are per hour.

2. AIM OF THE STUDY

The more specific short term aim of the study was to provide VoT's for new guidelines for project evaluation. A more general aim of the study was to provide more insight in VoT issues, especially for business trips.

The value of time for business trips is more complicated than the VoT for private trips, in that it relates to the VoT for both the travelling individual and the employer. The basic approach was to estimate the private and the employer values separately. However, stated or observed behaviour would reflect combinations of the private and employer VoT's, and would be of interest also in its own right. Another possibility of observing a combined VoT would be in the case of self-employed persons, who could be expected to consider the consequences not only for their trip as such but also for the productivity. As the aim was to look deeper into business trips, it was decided to extract samples also for behaviour values and for the group of self-employed persons.

For private as well as for business trips, it was decided to concentrate on regional and long distance trips, since they would be the most important trip types in the evaluation work, and since some information already existed for local trips.

The VoT may vary between modes, and the following modes were defined to be of interest. Abbreviations are written in parenthesis:

Car	
Air	
Long distance train	(X2000 train and IC-train)
Regional train	(Reg. train)
Long distance bus	(LD bus)
Regional bus (Reg. bus)	

For long distance trains, the sample was drawn to give equal shares of respondents choosing the faster and higher standard X2000 train and the older generation intercity trains (IC-trains) respectively.

Of course, not only in-vehicle time was of interest. It was therefore decided to study also transfer time, frequency and - for long distance trains - delay time. Obviously, one singe trip may involve more than one of the modes listed above. For each trip, however, one mode was selected for the analysis (the one where the respondent was intercepted). All travel time components were related to this mode. Thus, transfer time was defined to be transfer within the the same mode (and not, for instance, between an access mode and a long distance mode). Delay time was defined to be unexpected extra travel time on the long distance train.

3. METHODOLOGY

3.1 Theory

The theoretical base for the study was in principle the same as had been used for the studies in the UK and the Netherlands (Bates et al 1987, HCG 1990). For private trips, this is the neo-classical model of individual utility maximisation, under budget and time constraints. The VoT can then under certain assumptions be derived as the ratio of the time and cost parameters in a discrete choice model for choice of alternatives involving different cost and time requirements.

For business trips, a travel time reduction may benefit the employer and/or the employee. Thus, there are two issues that need to be considered in different ways, which was done using the Henscher approach (Hensher 1977). This approach means that for the employer, the time saved is evaluated as a productivity effect, which requires information on the marginal productivity of the individual, to what extent the time saved will be used for work, the amount of travel time used for work and the productivity of the latter. (An issue that had been raised is whether the wage rate plus overhead is a relevant measure of productivity, but this was not dealt with in the current study.) The value of the time saved for the employee can be estimated as for private trips.

At a later stage in the project, it was decided to also include separate samples for business trips, in order to estimate behavioural values, and in order to study how self-employed persons value travel time savings.

3.2 Estimation Technique

The chosen approach thus requires information on choices of alternatives involving different cost and time requirements. Based on previous experience and recommendations from earlier VoT studies in the UK and in the Netherlands, the Stated Preference technique was chosen as the most suitable technique to obtain such data. The data was then analysed using logit models, yielding the relevant time and cost coefficients.

3.3 Study Design

The study was designed as a telephone survey, in which socio-economic information of the respondent and her household, information related to business trips and responses to SP experiments was collected. The respondents were contacted during a trip, in order to give the SP experiment a realistic context.

It was also considered to carry out the interview on board the public transport modes, since such a procedure had the potential of being more productive (one interviewer could conduct several interviews simultaneously, if computers were handed out). However, difficulties in collecting information on business trips that were not yet completed, and the fact that field work organisations were not trained for computerised on board surveys, did not allow such a procedure. The use of a telephone survey for all modes also gives the advantage of making the results more comparable.

3.4 SP Game Design

In order to be able to look deeper into the mode specific differences in the VoT's, VoT's for alternative modes ought to be estimated, requiring a specific SP game for an alternative mode. The design of the SP games was therefore such that respondents on all modes but long distance train got two games, one game related to the actual mode and one game related to an alternative mode. For long distance train, an additional game concerning delay was added. In the table below, the factors that were included in the games are shown:

	Included in			
	Chosen modes		Alternative modes	
Factor	Car	Public transport	Car	Public transport
Cost	x	x	x	x
In-vehicle time	x	x (not in delay game)	x	x
Frequency		x (not in delay game)		x
Transfer time		x (not in delay game, not for long distance bus)		
Delay		x (long distance train only)		

The games were designed so that the respondent was presented one base alternative, and a change from this alternative. This had the advantage that the design did not contain dominant alternatives, which could make the respondents annoyed if included and could cause estimation problems if excluded. A drawback might however be that it makes it easier for the respondents to escape to a "no change" choice. To reduce this problem, the reported data on actual time and cost was randomly multiplied by 0.9 or 1.1, so that it would not appear to be exactly the same. The base alternative was also referred to as the "C" alternative, which was to be compared to A, B, D, E etc.

To give information on the value of time losses as well as time savings, changes representing gains and losses were presented equally often (4 times each in each game). The first choices were randomly gains or losses, to avoid bias depending on the initial question.

3.5 Field Work

For all categories but the special sample of self-employed persons, the principle for the field work was first to contact a person during a trip and then to make the interview by telephone on the agreed day. For the car mode, however, this meant that license plate numbers were noted at selected road sections, and then the car owners were contacted and asked for the person who drove the car at the specific time and location. For the air mode, the respondents were contacted before entering the airport gate, and for the other public transport modes, respondents were contacted on board each mode.

The sample size for the base part (comprising private values for private and business trips) contained about 1000 car interviews, and about 500 interviews for each of the 5 public transport modes. For the behavioral part (business trips only), about 200 interviews for each of car, air and train modes were collected. Also for the self-employed part, about 200 interviews for each of car, air and train modes were collected.

The response rate for the car interviews was about 65 percent (50 percent for company cars), and about 90 percent for the public transport modes. The latter is somewhat overestimated, in that it is defined as the percentage responding given that the respondent had accepted to participate. The share of persons refusing at the first contact was however very small. For self-employed persons, the response rate was about 30-40 percent.

In addition to the main survey, a supplementary survey of about 170 interviews with business travellers was carried out on the long distance trains between Stockholm and Gothenburg.

4. PRIVATE TRIPS

4.1 Main results

The data for the different modes for private trips was merged into one data set, and was then analysed using different types of segmentation. At an early stage, distance and income effects were analysed. The data was analysed using the same type of segmentation approach that had been used in the UK VoT study (Bates et al 1987). The utility function of an alternative in the SP game was of the type (for chosen mode m)

$$U_{im} = b_{ck}*C_{im} + \Sigma b_{tm}*T_{imt}$$

where	U_{im}	utility of alternative i for mode m
	b_{ck}	cost parameter of income class k
	C_{im}	cost of alternative i for mode m
	b_{tm}	parameter for time component t for mode m (summation over t)
	T_{imt}	time component t of alternative i for mode m

According to this analysis, where the samples for the different modes was pooled, there was a strong distance effect implying a much lower VoT for shorter trips. For application, a suitable definition of shorter trips would be trips generated by models for regional travel, which would correspond to trips shorter than about 50 kilometres.

By separating the sample with respect to this distance criterion (and simplifying the utility function by taking away the distance dependence of the in-vehicle time parameter), it was found that both the time parameter and the cost parameter varied according to distance. The differences of the VoT's for the two distance groups may be related to the frequency of the trips, where the shorter trips are likely to be more frequent, thus having a larger budget impact. It may also be that the time constraint is more binding for longer trips, giving a higher value. Yet another reason may be that cost changes that are relatively small (such as those on longer and therefore more expensive trips) may have a lower effect.

The data was thus divided first into two groups - over and under 50 kilometre trip length. Then, the shorter trips were further divided into separate samples of trips for commuting and other trips respectively. In table 4.1, the values of invehicle time are presented for the three separate categories.

Table 4.1 *In-vehicle time values (Swedish crowns per hour)*

	Car	Air	IC-train	X2000	Reg. train	LD bus	Reg. bus
Commuting < 50 km	34	-	-	-	54	47	43
95 % confidence interval	ñ 6				10	22	6
Other trips < 50 km	27	-	-	-	43	38	28
95 % confidence interval	ñ 6				7	7	8
Trips > 50 km	81	88	74	102	70	65	50
95 % confidece sinterval	ñ 6	12	7	17	8	3	5

As mentioned above, the VoT's are considerably higher for longer trips. The largest difference concerns the car mode. A possible explanation for this may be that the convenience of the car mode is counteracted by fatigue effects when driving long distances. The table shows further that in most cases the differences between work trips and other trips as well as the differences for longer trips between different modes are insignificant.

In table 4.2, the values of transfer time are presented. The relative transfer time weight (compared to in-vehicle time) varies between 1.4 to 2.5. Transfer time seems to be relatively higher valued when transfer conditions are less pleasant - air transfer time shows the lowest relative value, whereas regional bus shows the highest relative value. Transfer was not included for long distance bus, since transfers are not very frequent in this case.

Table 4.2 *Transfer time values*

	Air	IC-train	X2000	Reg. train	LD-bus	Reg. bus
Work trips < 50 km	-	-	-	57	-	62
Other trips < 50 km	-	-	-	70	-	69
Trips > 50 km	121	176	176	166	-	121

Frequency was analysed as headway. Previous findings had shown that the relative value of headway decreases as headway increases, which is probably due to the fact that the possibilities of utilising the extra headway minutes are larger for longer headways. This type of relationship is found here as well. In table 4.3, the VoT's for headway are shown for different headway ranges. The values are estimated using the following piecewise linear expression:

$$U_{im} = \ldots + b_{h1m}*\min(H_{im},60) + b_{h2m}*\min(H_{im} -60,120 | H_{im}>60) + b_{h3m}*(H_{im}-120 | H_{im}>120).$$

where

U_{im} utility of alternative i for mode m

b_{h1m} headway parameter of mode m, for part between 30-60 minutes

b_{h2m} headway parameter of mode m, for part between 61-120 minutes

b_{h3m} headway parameter of mode m, for part between 121- minutes

H_{im} headway of alternative i for mode m

The values are to be interpreted as values of extra minutes (the value of a two hour headway is the value of the first 60 minutes multiplied by the value for the 30-60 interval, plus the value for the next 60 minutes multiplied by the value for the 61-120 minutes interval).

The relative values of headway time range from around 0.5 for the highest frequency to around 0.1 for the lowest frequency - or, if we assume that waiting time is half the headway, the relative values of waiting time range from around 1 to 0.2. This result is considerably below the conventional wisdom of a factor of 2 for waiting time. However, that result is often derived from situations in local traffic where the frequency is much higher. In this study, the maximum frequency was 2 departures per hour. The results are also in accordance with other SP studies that have been carried out for similar situations (Lindh and Widlert 1989, HCG 1986). Still, one might doubt whether these results reflect the full value of an increased frequency. Utilising a higher frequency implies that the respondent would think of using another departure, and if, by the instructions, the respondents relate too close to the trip actually made, they would not be able to do so.

Table 4.3 *Headway time values*

	Headway interval	Air	IC-train	X2000	Reg. train	LD.-bus	Reg. bus
Work trips < 50 km	30-60	-	-	-	19	-	15
	61-120				8	(9)	9
	121-				5	(5)	7
Other trips < 50 km	30-60	-	-	-	19	-	16
	61-120				11	12	7
	121-				4	-	5
Trips > 50 km	30-60	54	30	30	30	-	25
	61-120	23	17	17	17	-	12
	121-	10	10	10	6	8	4

Delay time was dealt with for long distance trains only, and was found to have a value of 133 crowns per hour. The relative value with respect to invehicle time is approximately 1.5.

4.2 Value of Time and Income

Income is a potentially important source of variation for the VoT. Not only would there be equity aspects to consider, but there would also be consequences for future VoT's which may be of significant importance with regard to the lifetime of infrastructure investments.

According to theory, income should affect the marginal utility of money. Therefore, as outlined above, different cost parameters were estimated for different income ranges (expecting lower cost parameters for higher income ranges). In principle, the time parameters could also change indirectly, in that higher income would allow more activities, which would make the time restriction more binding. However, only effects on the cost parameter was analysed at this stage.

Most studies that have examined the relationship between the VoT and income have used household income. To be comparable, the household composition should then also be taken into account. The measure of household income that was defined in the study does not take into account different subsidies, such as general extra allowance for children. Especially for low income categories, actual income may therefore be underestimated.

To control for some of these problems, different household categories have been analysed separately. In table 4.4, three main categories have been defined - single persons, households with two employed adults and children, and finally households with two employed adults and no children. The table shows relative values, and index is set to 100 for the lowest income category.

Table 4.4 Index of Value of Time, for trips > 50 km. The VoT in the lowest income range is set to 100.

Income range: (thousands of crowns/year)	Singles	Household income: 2 employed. with children	Household income: 2 employed without children	Individual income: 2 employed. with children	Individual income: 2 employed without children
-100	100	100	100	100	100
101-150	128	83	40	135	113
151-200	127	50	63	92	107
201-250	127	77	65	102	141
251-300[1)]	206	85	72	160	140
301-350		68	60		
351-400		80	74		
401-450		85	75		
451-		83	89		

1) 251- for singles

The relationship between income and VoT is, as in many other studies, positive but fairly week. It may, however, be somewhat obscured by the difficulties to assess the actual household income. It also seems as if the relationship with income is more pronounced if individual income is used. This may, however, be influenced by gender differences - men have higher income, but also higher VoT's. If the lowest income category is disregarded, and if the rest of the categories are grouped in two halves, then the household income elasticity of the VoT is 0.46 for single person households and ranges from 0.07 to 0.24 for 2 person households with and without children respectively. The individual income elasticity ranges from 0.23 to 0.42 for 2 person households with and without children respectively.

The conclusion based on these results was to be restrictive with assumptions on future adjustments in the VoT based on economic growth. In the previous guidelines for project evaluation, no adjustments with respect to future income changes were suggested, and it was not recommended to alter this approach. The issue of the influence of income on the VoT was then not brought any further. Most of the analysis was however carried out with income segmented cost parameters.

4.3 VoT for alternative modes

Also, values for non-chosen modes were estimated. In most cases, the differences are such that the VoT for the alternative mode is higher or about the same, reflecting some self selectivity. When this is not the case, the differences are often not significant. From these results, it would be difficult to conclude that there are mode specific differences.

5. BUSINESS TRIPS

Hensher (1989) has defined the value of a time saving for business trips in the following formula:

$$TV = (1 - r - pq) * MP + (1-r) * vw + r * vl + MPF$$

where:

TV	= the value of saved travel time for business trips
r	= the share of saved travel time that is used for leisure
p	= the share of the time saved that was used productively
q	= relative productivity of time saved that was used for work
MP	= marginal productivity of labour
vw	= the value to the employee of saved travel time otherwise spent in work
vl	= the value to the employee of saved travel time otherwise spent in leisure
MPF	= the value of increased productivity of reduced fatigue

In this study, the value of time to the employee was not differentiated depending on whether the time saved would be spent at work or on leisure, and it was thus implicitly assumed that the private VoT (vp) is the same in both cases, or that vw equals vl. Also, the MPF factor was not dealt with in the base approach, which allows the formula to be written

$$TV = (1 - r)*MP - pq * MP + vp$$

This expression defines three terms, which allows us to focus on three different effects of a travel time saving. The first term describes the share of the reduction in travel time that will be spent working instead of travelling (1-r), multiplied by the value of work time (MP). This term needs however to be adjusted with regard to the fact that the person might have been working on board - a reduction of the travel time would also reduce the amount of work carried out on board the vehicle. The work on board may not be as efficient as in the office, and therefore the share of time worked on board (p) is first multiplied by an efficiency factor and then valued at the same rate as normal work time (MP). The last term reflects the value to the employee himself, that is his private value of a reduced travel time (regardless of whether it is inside or outside normal working hours). These parts are discussed further in the subsequent sections.

5.1 Private values

The value of travel time to the employee was estimated in the same way as for private trips. No differentiation was made with respect to whether the employee would have been working or at leisure. The following VoT's were obtained (values for regional train and the bus modes are not shown since they are based on very few observations), based on the same utility functions as for private trips:

Table 5.1 The private part of the VoT for business trips - invehicle time

Car	Air	IC-train	X2000
104	118	104	113

Compared to private trips, the average values for business trips are about 10 - 40 percent higher for the more frequent modes, but this seems to be mainly an income effect.

The VoT's for business trips relate to personal income in a similar but smoother way. The income elasticity is about 0.45, if calculated as above for private trips. Household income was not tested. Contrary to private trips, the distance effect was not very significant.

The value of transfer time relates to invehicle time with a factor of about 2, although air is an exception where the difference is very small.

Table 5.2 *Transfer time values*

Air	IC-train	X2000
123	206	206

Frequency exhibits the same pattern as for private trips, and the relative headway weight ranges from about 0.5 for the highest frequency to about 0.1 for the lowest frequency.

Table 5.3 *Headway time values*

Headway	Air	IC-train	X2000
30-60	53	44	44
61 -120	32	22	22
121-	9	10	10

Delay time was found to be valued at 179 crowns per hour. Also for delay time the relative value is similar to private trips (1.6 compared to 1.5 for private trips).

5.2 Productivity effects

The survey was set to collect the different components in the Hensher formula. In table 5.4 the mean values of the different components are presented.

As might be expected, the highest share of people working in the vehicle is found on the train. What may be less expected is that the corresponding share for the car mode is almost as high. This may be due to the high ownership of cellular phones in Sweden. However, the share of travel time that is devoted to work is lower for the car mode than for train. The data also show a high efficiency of the work in the vehicle relative to work in the office. On the other hand, a large share of a time saving would be spent on leisure. As a matter of fact, the high share of business travellers working that efficiently for so long seems to make it inefficient (for the employer) to reduce train travel times - the net effect is negative!

Table 5.4 Mean values for components of the Henscher formula, subdivided into business travellers working during their trip (a) and business travellers not working at all during their trip (e).

Mode	r_a	r_e	q_a	p_a	Mp_a*1,3786 [1]	Mp_e*1,3786 [1]	a	e
Car	0,44	0,63	1,01	0,30	197	194	0,481	0,519
self employed	0,50	0,80	1,20	0,21	143	134	0,47	0,53
Air	0,65	0,91	0,97	0,50	219	203	0,252	0,748
self employed	0,65	0,92	1,02	0,42	197	179	0,25	0,75
Long dist. train	0,69	0,90	1,03	0,49	184	155	0,562	0,438
self employed	0,63	0,89	1,08	0,45	178	178	0,52	0,48
X2000	0,71	0,90	1,04	0,49	192	166	0,569	0,431
LD t excl X2000	0,53	0,86	0,98	0,50	170	134	0,551	0,449
Company car	0,42	0,57	1,11	0,27	199	166	0,696	0,304

[1] Overhead.

These conclusions did not seem very credible, and the different components were discussed a lot. One issue was that of the efficiency of work carried out in the vehicle relative to the office (q). The value was defined to be the amount of time spent working on board relative to the amount of time the same work would have taken in their office. The high values were partially caused by values well over 100 percent, and it was suspected that some respondents had mixed calendar time with actual work time (you are less disturbed in a train, and it would take much less calendar time to read a paper on board even if the efficient reading time would be the same). In a sensitivity analysis, q was maximised to 100 percent for all travellers.

Another issue was the fact that the total amount worked could be reduced by a time saving. This might be due to the phrasing of the question concerning the amount of saved time that would be used for work/leisure. This question was related to a specific time reduction (in the beginning of the trip and at the end of the trip), which should be relevant for nonworking business travellers. However, working travellers might well chose another time to do their work than the calendar time actually saved (if the morning train has become quicker and therefore leaves later, one might well get up later and instead do more work in the evening).

For this reason, another sensitivity analysis was carried out, implying that the total amount of work would not be reduced for any individual (by setting (1-r) to max (1-r, pq)).

A third issue that was discussed was that the efficiency (q) of the work did not say anything about the value of the work on board. All work time is valued by the marginal productivity, and it might be argued that the work on the train may be less valuable (such as reading a computer magazine that would never had been read at the office).

In order to obtain some more information on these issues, a supplementary survey was carried out on an X2000 train between Stockholm and Gothenburg (and return). In this survey, business travellers were asked whether their work on board would have been carried out if they did not have the opportunity to work on the train. It turned out that less than 10 percent of the work would not have been carried out at all. This was taken as a support for assuming that the amount of work would not be reduced as a consequence of a time reduction.

The survey also showed that the average value of work time on board compared to work time in the office was about 0.6. This factor would also include the efficiency factor described above, which was about 0.9 on the X2000. A further sensitivity analysis was undertaken, using the value of 0.65 (0.6/0.9, since the efficiency factor would be included in the 0.6 value) as the relative value of working time on board. It was felt that this value, obtained on the X2000 train, should be an upper limit for other modes where working conditions appear less favourable.

It might however also be argued that all work may not be perceived as equally productive, even if it has to be done. If necessary (but seemingly less productive) work is allocated to train trips, then it ought to be regarded to be as productive as work in the office. The obtained values may therefore be underestimating the value of the work on board.

In table 5.5, VoT's for business trips are presented using the initial data and with respect to the assumptions (or "corrections", since they are believed to be closer to reality than the original data) that

- the maximum efficiency of work on board is 100 percent relative to work in the normal work place ($q \leq 1$)
- a time saving would not imply that less work would be carried out ((1-r) is max(1-r, pq))
- the value of the work on board is worth 65 percent of average work in the normal work place (q = q*0.65)

Table 5.5 VoT for business trips, based on Henshers formula, using original survey data and "corrected" data respectively

Mode	Private value of time	Productivity effect (Henscher) original	Productivity effect (Henscher) "corrected"	Business VoT (Henscher) original	Business VoT (Henscher) "corrected"
Car	104	41	63	145	167
Air	118	4	23	122	141
IC-train	104	-6	25	98	129
X2000	113	-13	21	100	134

As would be expected, the "corrected" VoT's are higher, and the largest relative difference concerns train.

The Henscher formula contains the MPF factor, which is an extra value for the employer of reduced fatigue of the employee due to the time saving. Various ways of estimating this was discussed, including interviewing company representatives that are responsible for company travel policies, studying self employed people and estimating behavioural values. The last two options were carried out, and are discussed in the next two sections.

5.3 Self employed business travellers

The project also contained a special survey concerning self employed business travellers. These are relatively rare, so a special sampling procedure was used to draw the sample. For this sample, the respondents' last business trip was used to set the game context. The reason to specifically study this subgroup is the fact that self employed persons are likely to base their travel decision on their private values of time as well as its productivity effects (including fatigue effects, or the so called MPF factor).

Their assessment of the productivity effect can however be assumed to be based on the effect for themselves (that is net of taxes) rather than for society as a whole. An extra hour work time would mean an extra income to the self-employed persons firm. This extra income could be taken out as salary, which would give him some extra money, amounting to the extra income for the firm, reduced by taxes for the firm (so called social costs) and further reduced by income tax on his salary. The remaining part (about a third of the income to his firm) is what he would personally gain on a time saving (given that he did not work on the trip, in which case adjustments for lost work would be needed). The average extra income of the firm was assumed to be the average personal income plus overhead (social costs).

Therefore, the costs in the SP game were adjusted with respect to the private net effect of productivity effects (based on salary plus overhead), so that the price of the time saved (or compensation for time loss) was a net private price. The values derived in this way would then include the productivity effect, including the so called MPF factor.

If the private productivity effect (based on salary plus overhead) is considered in the obtained VoT, then the resulting value would be comparable to the private VoT's of other business travellers, except for the MPF part. In table 5.6, a comparison between these two groups is shown.

Table 5.6 Comparison between VoT of self employed (S) and other business travellers (O).

Income	Car		IC-train		Air		X2000	
range	S	O	S	O	S	O	S	O
-100	80	81	74	83	89	91	126	90
101 -200	73	94	67	97	81	106	115	104
201 -300	112	101	103	104	124	113	176	112
301 -400	138	139	128	143	154	156	218	154
401-	-	144	-	148	-	161	-	159

The only obvious difference concerns the X2000 train. It is however hard to find that there would be a general extra value, allowing an extra MPF-value to be added to the VoT derived with the basic approach. It was recommended to set the MPF factor to zero for all modes.

5.4 Behavioural values

Estimation of behavioural values is of course of interest in its own right. It had however also been argued that this would constitute another approach to getting a more comprehensive valuation of business travel time, in that the employers travel policy was likely to consider all productivity effects as well as the need to compensate business travellers for their travel discomfort (i.e. the private value of travel time).

Against this it can be said that travelling regulations also reflect fringe benefits rather than VoT's for business travel. The regulations normally also relate to choice of mode, and are typically not detailed enough to guide between choices encountered in the SP games (which also to some extent questions the validity of the behavioural values obtained). The values are reported in table 5.7, and are based on the same utility function as for private trips.

The behavioural VoT's differ quite significantly from the private ones, in that the private values are about half. The only difference would be that for behavioural values the respondents were asked to choose according to their current travelling rules (the interpretation of which was left to the traveller), whereas they for private values were supposed to pay with own taxed money.

Table 5.7 *Behavioural VoT's for business trips*

Income range	Car	Air			Long distance train				
(individual income)	Inveh. time	Inveh. time	Headway	Transfer time	Inveh. time, not X2000	Inveh. time X2000	Headway	Transfer time	Delay time
0 -100'	*	*	*	*	*	*	*	*	*
100'-200'	161	227	66	216	147	296	30	339	373
200'-300'	182	258	74	246	166	336	34	384	423
300'-400'	213	303	87	288	195	395	40	452	497
400'-	206	293	84	278	189	381	38	436	480

The conclusion drawn from the different business VoT studies was that the values derived with the basic approach, "corrected" with the additional assumptions and data described above were the best estimate of business VoT that could currently be made.

6. VALUES CHOSEN FOR PROJECT EVALUATION

The values presented above constitute the main findings of the VoT study. Decisions on values for project evaluation was taken by SIKA. The decisions on VoT's to use were taken jointly with similar decisions on other values, such as for accidents, pollution etc. SIKA also had a scientific advisory board to guide its decisions. The scientific board contained one member of the VoT work group.

A principle of the SIKA was to be conservative and avoid large changes of recommended values. Since the results of the VoT study in many cases differed substantially from the previous values, it was feared that later findings might call for a change back again.

The values recommended for project evaluation for short private trips were in principle those of the study - they were very close the previous values. For longer private trips, the VoT’s for time savings were chosen - partially because of being conservative, partially because it was argued that these values were the correct ones. For short and long trips, the values for the different modes were weighted with respect to their shares according to the latest travel survey, yielding a single value to be used for all modes. For business trips, the values based on the Henscher approach, “corrected“ as described above, were chosen. Beside this, some adaptation was made to account for local traffic.

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