SOCIAL BENEFITS OF TIME SAVINGS

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ABSTRACT

Assessing the values of time is an important topic in transport research. Time values are used for estimating the benefits of projects that aim to reduce travel times, and for predicting travel choices. The assessment of values of time is generally based on observed or stated human choices. The resulting values are basically correct for predicting future choices, but it is a question whether they can also be used for the estimation of the societal benefits of travel time reducing projects: the individual motives behind actual choices might be not compatible with the collective objectives. The paper addresses this question.

The value of time is the ratio of the marginal utilities of time and money. The argumentation in the paper focuses on the utility component. The main approach is to discuss the relation between the marginal utility of travel time and prosperity in a theoretical way, and to compare this relation to the observed relation between the actually used values of time and prosperity. The analysis is done for both working time and non-working time, relevant for saved time in business/commercial transport and private transport respectively. For both types of time, the actual time values are positively correlated with prosperity. For working time, a clear negative relation between the marginal utility of travel time and prosperity is theoretically argued, while this relation is unclear for non-working time. The negative relation for working time is based on the assumption that saved time is spent on production and that the marginal utility of production decreases when total production volume (and consequently prosperity) increases. The assumed negative relation is supported by studies in happiness science. The latter suggest that in the wealthiest countries the marginal values of working time are close to zero or even negative.

Fundamental studies on travelling give additional arguments for zero or negative marginal values of time in prosperous countries. They demonstrate that time spent on travelling is independent from prosperity, and that travelling itself can generate a positive utility. Zero or negative marginal utilities of time imply zero or negative marginal values of time. These differ from the observed clear positive applied values of time and suggest that the latter are not correct. Using the current values of time might overestimate the social benefits of time savings, at least in the developed wealthy countries. The consequence is that in these countries travel time saving projects might be approved too frequently.

Keywords: value of time, prosperity, time budget, happiness

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INTRODUCTION

Assessing the values of time is an important topic in transport research. Time values are used for estimating the benefits of projects that aim to reduce travel times, and for predicting travel choices. Both application types have a quite different nature. Where the first reflects the rather abstract importance of saved time for society, is the latter the more mechanical representation of behavioural rules. Generally, the same values of time are used for both applications. This paper raises the question whether this is correct. Do people consider the objective time values fully in making their subjective travel choices? There are reasons to doubt about this. One reason is that the scope of choices is individual and short term, while the objective values have a collective and long term dimension. The decision to buy a new luxury car may be based on only individual preferences and not take into account that it makes the neighbour unhappy who loses the position of owner of the most prestigious car in the street. A compulsive drinker who strongly likes to stop consuming alcohol may still decide to buy new liquor. A second reason for divergence from socially desired travel choices is that choice behaviour can be driven by societal pressure unlike by individual needs, for instance in buying products/services that come into fashion. Then society itself may enforce socially undesired behaviour.

As discussed later in this paper, values of travel time estimations are usually based on observed or stated travel choices. Using these for predicting travel behaviour will in principle produce correct results. Then the discussion constricts to the question whether the current values of time can be used for the assessment of societal benefits of time savings. If we indicate the 'true' societal benefits of one unit of saved travel time by VTTS (Value of Travel Time Savings) and the currently used time values by VTT (Value of Travel Time), the question is whether VTT is equal to VTTS. This question is addressed in this paper.

In discussing this question, we consider that the value of time is the ratio of the marginal utility of time and the marginal utility of money (Hensher and Goodwin, 2004). The utility component reflects the real importance of time; the monetary component adds the degree people can afford to spend money for time savings or alternative goods/services, and makes the benefits of savings comparable with other monetary quantities. Our argumentation focuses on the utility component, assuming that a conceivable incorrect estimation of VTTS by VTT should be attributed to errors in this component. The main approach to grasp the abstract concept of marginal utility of time followed in the paper is to investigate how it is related to prosperity and then to compare this relation with the observed relation between VTT and prosperity. This comparison will not definitely answer the research question because VTT includes the marginal utility of money that might be expected to be related to prosperity as well. Nevertheless, the comparison might give an idea or feeling about the correctness of using VTT for the assessment of social benefits.

The discussion starts with a brief description of the most common methods for assessing the value of travel time (VTT) and an explanation of the relation to prosperity. Then the relation between the marginal utility of time and prosperity is discussed, separately for working time and for non-working time. By comparing the relations of both VTT and the marginal utility of

time with prosperity, some conclusions will be drawn regarding the correctness of VTT for estimating VTTS.

METHODS FOR TIME VALUING

Originally, the value of saved time was assumed to be equal to the earnings that would have been received if this time was used for economic production. Value of time then equals the individual wage rate (Jara-Diaz, 2000). However, it was noticed that saved time is not always fully employed for productive activities; part of the time saved may be used for leisure. In the case of travel time, a distinction is made between time savings in commercial or business transport and savings in private transport. The former are assumed to be fully employed for economic production, the latter are assumed to enlarge time that is available for leisure activities. In addition to the wage rate, the willingness to pay for saving a certain time period was used as basis for assessing the benefits of time savings. The willingness to pay is a subjective factor that varies for different individuals and different situations. It is related to the characteristics of travellers and trips. For instance, the willingness to pay proves to be relatively high for high-income people as well as for business trips.

In the case of business/commercial transport, wage rate or income seems the most appropriate basis for calculating the benefits of time savings. For savings in private travel the willingness to pay seems most appropriate. Still, in practice both methods are applied for both kinds of time savings. For instance, the Oregon Department of Transportation Policy & Economic Analysis Unit (2004) bases the assessment of time savings in both business travel and private travel on wages. In the case of business travel, the benefits of time savings are set equal to the income that can be earned in the time saved, in the case of private travel the benefits are set equal to a fraction of this income. Two Dutch studies are examples of using willingness to pay for different kinds of travel time savings. Gunn et al. (1999) do so for person travel, including business travel. De Jong et al. (2004) use willingness to pay for assessing time savings in freight transport. In this study the willingness to pay regards not the willingness of truckers but that of carriers and shippers.

Both methods are to a large extent rooted in human choice behaviour. The income that someone earns reflects the value of his/her contribution to the production of goods and services. This value is directly related to consumer's demand which is the outcome of the human purchasing choices. Willingness to pay is generally derived from observed or stated choices between several travel alternatives with varying costs and durations. The dependency of VTT on observed choice behaviour implies the assumption that actual behaviour reflects socially desired behaviour when VTT is used for valuing travel time savings.

RELATION BETWEEN APPLIED VALUES OF TIME AND PROSPERITY

The values of time, calculated according to the methods described in the preceding section, prove to be positively related to prosperity. Gunn (2000) mentions an income elasticity of 0.5, implying that a 10% rise in income would increase the value of time by 5%. The British Department for Transport even recommends an elasticity of 1.0 for working time, including time for business and commercial transport, and an elasticity of 0.8 for non-working time, including time for private travel (Mackie et al., 2003). The consequence is a long term growth of values of time in the range of 1.5-2% per annum (Rus and Nash, 2007).

The positive relation between prosperity and value of time can be explained simply. If value of time is based on wages or income, a positive relation is obvious; prosperity is directly related to income. If value of time is based on willingness to pay, the argument is also simple. Increasing prosperity implies that people earn higher incomes and are able to spend more money. The higher ability for spending will generally increase the willingness to pay for a certain good or service, like time.

RELATION BETWEEN UTILITY OF TIME AND PROSPERITY

The former section dealt with the observed relation between the traditional calculated values of time and prosperity. Next will be discussed the relation between the marginal utility of time, one of the two components of value of time, and prosperity. Starting-point is the assumption that the marginal utility of time equals the marginal utility that is gained from alternative spending. Two types of alternative spending are distinguished: economic production (working time) and leisure (non-working time). In addition, attention will be paid to findings in fundamental studies on travelling that add some general arguments to the discussion.

The utility of working time

If saved time is spent on productive activities, the utility of the savings is equal to the utility of the additional production. It can be argued that this utility decreases when production and related prosperity increase. Assuming rational behaviour, people will first spend their money on goods that satisfy their most urgent needs. When earnings increase, the extra income is spent on goods that have a decreasing utility. One could talk about the law of diminishing returns in consumer behaviour. If time savings, or other factors, bring about more production, the marginal utility of the extra production will generally be smaller in wealthy societies than in poor societies. This is illustrated by Figure 1. The figure shows the macro economic relation between production volume and the utility that people gain from the production. Both production volume and utility are aggregated quantities for a society. An increase from the low initial production level p_1 to p_2 creates a much larger utility increase (u_1-u_2) than the comparable increase from the high initial production level p_3 to p_4 (u_3-u_4).
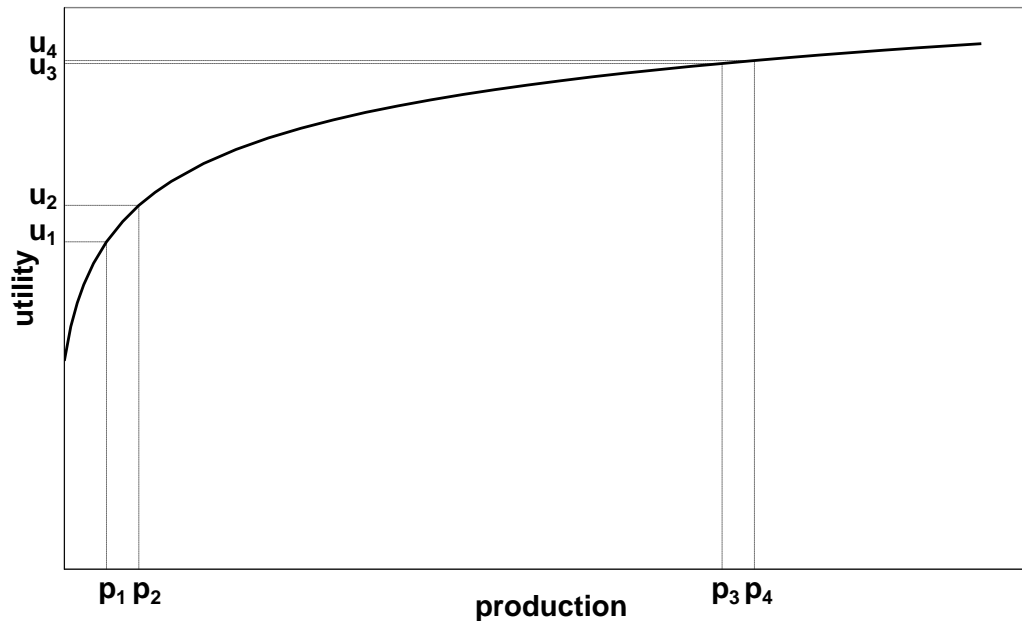
Figure 1 – Macro economic production-utility curve

Using happiness or life satisfaction as a proxy for utility, the theoretically expected diminishing returns represented by the curve are supported by studies in the field of happiness science. Studies that compare countries with different levels of prosperity find a clear decreasing positive relation between happiness and prosperity (Veenhoven, 1991; Lane, 2000). Slightly different results are found in studies that focus on the developments in time within the more prosperous countries. They observe that inhabitants with higher incomes are happier, but that also an increase of overall income has no effect on happiness of the whole population (Easterlin, 1995). This result would imply a horizontal course of the curve, at least for the more wealthy countries. There are even indications that the curve has a maximum. Exceeding a certain high prosperity level, the relation between production and happiness would then be negative. In the USA, the most wealthy country, a decrease of happiness is observed during the last half century, despite a huge increase in the national product (Lane, 2000; Ferrer-i-Carbonell, 2005).

Two factors are assumed to be responsible for the observed absence of a relation between income and happiness in studies on the development within prosperous countries. First, increasing income leads to higher expectations regarding the standard of living. This means that a higher production level is needed to attain the same level of life satisfaction. Second, life satisfaction is positively related to the own individual income and negatively related to the income of others who belong to the same social group. This is the so called "comparison income effect" (Ferrer-i-Carbonell, 2005). A rise of income of a small group will then have two opposite effects: an increase in happiness of those who earn a higher income and a decrease in happiness of those whose income remains stable and who observe that others are better off. A rise of the income of the whole population will have the same opposite effects, but then both effects apply to everyone. Everyone is happy to earn a higher income but at the same time the income increase of others lowers overall happiness. Vendrik and Woltjer (2007) who analyzed the development of happiness in Germany in the period 1984-

2001, found exactly the same size for both effects if everyone's income would increase at the same rate. An overall income increase will then have no effect on overall happiness. Interestingly, Ferrer-i-Carbonell (2005) who also studied the development in Germany, found quite different results for the wealthy West Germans and the less prosperous East Germans. The positive effect of an increase of the own income is considerably larger in Eastern Germany than in Western Germany. Moreover, the negative effect of rising income of others seems to exceed the positive effect of a similar rise of the own income in Western Germany, while the opposite is true for Eastern Germany. These findings support the decreasing marginal aggregate utility assumed in Figure 1, and they are in line with the possible existence of a maximum of the curve.

The two factors that dim the impact of growing prosperity on happiness, increasing expectations on the standard of living and the comparison income effect, have as a consequence that the utility of an additional good for society is lower than the utility for the individual consumer. Yet, the consumers' decision to buy a good is driven by the individual utility. Deriving utilities from choice behaviour will then give values that exceed the social utilities. If both utilities are assumed to be equal and both are derived from choice behaviour, the social utility of additional production will be overestimated. Keeping in mind that the marginal utility of saved working time equals the marginal utility of the additional production, and assuming that the true marginal utility of money is considered in choice behaviour, the overestimation of the marginal utility of production implies an overestimation of the true value of working time (VTTS) by the currently applied values (VTT). Comparison of the finding that the curve in Figure 1 seems horizontal or even declining in the more prosperous countries (which means that the negative impacts of human choice decisions equal or even exceed the positive impacts that underlie the decisions) with the observation that the values of VTT are ever increasing, suggest that the overestimation of VTTS for working time can be considerable.

The utility of non-working time

Let us now turn to the relation between the utility of saved time and prosperity if this time is spent on leisure activities. Assuming our starting-point that the marginal utility of saved time equals the marginal utility that is gained from alternative spending, the question is how prosperity influences the marginal utility of spending saved non-working time. Next a number of arguments for both positive and negative impacts are discussed.

First, one can argue that rising prosperity provides increasing possibilities for spending leisure time, implying a positive relation between prosperity and utility of leisure time. For instance, today we have the choice between reading a book and watching TV, while 100 years ago only reading a book was an option (if one was able to read). Supposing that someone who chooses to watch TV gains a higher utility from this activity than from reading a book, the value of his/her time spending is higher than it would have been 100 years ago. However, the increasing possibilities for time spending are not always considered as beneficial; sometimes simplicity of life in former days is idealized. At that time people played

together games in a social atmosphere while today everyone is playing his/her individual game behind the personal computer.

A second factor influencing utility of additional leisure time is the amount of free time that is available for spending. One could hypothesize that the higher the initial amount of free time, the lower will be the utility of additional time available for leisure. This can be considered as another law of diminishing returns. This raises the question how the amount of free time is related to prosperity. On the one hand, the more time people spend on productive activities, leaving less time for leisure, the higher will be production volume and wealth. Then the relation between the amount of free time and prosperity is negative. On the other hand, history learns that growing wealth is mainly induced by increasing labour productivity that simultaneously gave people more leisure time. Robinson and Godbey (1999) report a small increase in free time for the US between 1965 and 1985 and no further increase after, Chlond and Zumkeller (1997) observe an increase in Germany. Then free time and prosperity correlate. A reasonable amount of leisure time is even considered as one of the achievements of prosperity. Following this argument, the utility of spending one saved hour non-working time could decrease slowly when prosperity increases. An important point here is, that the latter conclusion is only valid as far as there is no 'autonomous' increase in the utility of leisure time, that is as far as the marginal utility is constant at a constant total amount of free time. However, it is conceivable that an autonomous increase in the marginal utility, for instance due to the increased possibilities for spending, is one of the driving forces behind the slowly increasing amount of non-working time. In that case, the balance of both effects, the autonomous increase and the decrease due to an increasing amount of total free time, is undetermined.

The conclusion is that there is no firm relation between the marginal utility of non-working time and prosperity. Assuming that the marginal utility of money is negatively related to prosperity, VTTS might be positively related to prosperity just like VTT. These arguments give no reason for suspecting that VTT and VTTS differ for non-working time.

Fundamental research on travelling

An additional contribution to the discussion of the marginal utility of non-working time is given by findings in fundamental research on travel behaviour. Two kinds of studies are relevant: studies on travel time budget (TTB) and studies on the (positive) experience of travelling.

Studies on TTB suggest that time saved in travelling will again be spent on travelling. Schafer (1998) found that travel time per person per day is independent from prosperity. Findings of Szalai (1972) suggest no relation between average travel speed and travel time per person per day in cities. In various cities with quite different modal splits, including cities where walk, bicycle, car, or public transport is the dominant mode in commuting, no relation between travel times per person per day and the speed of the most frequently used mode(s) was found. If the alternative spending of saved travel time is travelling again, the amount of time spent on all non-travelling activities (work and leisure) remains unchanged and its marginal utility is unaffected. The benefits of travel time savings depend then on the excess

utility of minutes spent on travelling that were initially saved by a speed-up of the transport system. The utility of travel time is related to the utility of trips. The utility of a trip is generally considered to be the sum of the excess utility of being at another location and the disutility of travelling. The excess utility of travelling after a speed-up of the transport system can theoretically be derived from visiting more destinations (the saved time would then be used for making more trips) or from visiting more distant destinations (the saved time would then be used for lengthening existing trips). Behavioural studies suggest that mainly the latter happens (Hupkes, 1977; van Goeverden, 2007). The excess utility of initially saved travel time is then equal to the difference in utilities of visiting the original and the new more distant destinations, assuming a constant disutility of one unit of travel time.

Would the utility component of VTT be equal to the difference of the utilities between two destinations? This seems not always the case. Assume that the additional utility of the more distant destination is effectuated by a higher level of consumption. For example, someone travels to a more distant and larger shopping centre that provides more and better products. In that case the decreasing marginal utility in Figure 1 will be applicable for non-working time as well, suggesting also an overestimation of VTTS for non-working time in developed countries.

A second type of findings in fundamental research on travel behaviour regards the experience of travelling. Mokhtarian and Salomon (2001) found that travelling in itself generates a positive utility in addition to the generally assumed disutility. This is not only true for trips which motive is just travelling, like going for a ride or walk, but also for directed travel. This finding undermines the widely used assumption that travel time in itself has always a disutility and therefore travel time savings are always beneficial. This assumption underlies travel models and the concept of VTT. Still, it does not necessarily imply that deriving the marginal utility of time from choice behaviour is not correct. Assuming that the disutilities of travelling generally exceed the utilities, choice-based VTT might reflect the net disutilities.

The probability that disutilities of travelling generally exceed utilities is lowered by a related finding of Mokhtarian and Salomon. They found an indication for an ideal commute time larger than zero. Nearly all commuters in their survey preferred travelling for at least a few minutes to work, half of them preferred travelling for more than 20 minutes. The observation of ideal travel times for commuting gives rise to the assumption that there are ideal travel times for other purposes as well. One can hypothesize that people tend to bring their travel times close to the ideal times. Due to restrictions with respect to the times needed to travel to eligible destinations, the actual times will generally differ from the ideal times. In a stable transport system an optimum might be achieved where the too short travel times and too large travel times cancel out. Following this hypothesis, an intervention in the transport system that either raises or lowers the speed will initially move the travel times from the optimum and creates negative benefits. People will likely react in adapting their travel times in order to bring them as close as possible to the ideal times again. One should note that this assumption is in line with the findings on TTB. The adaptation would annul the initial

disbenefits, leaving neither a positive nor a negative effect of the intervention in the long run. This suggests a zero value of VTTS, also for non-working time.

However, as was already noted in the discussion on TTB, a speed-up of the transport system has the result that more distant destinations are visited. These possibly have an excess utility compared to the original destinations. In that case, the speed-up still generates benefits. The product of the initial time savings and VTT may or may not reflect these benefits correctly. One should note that excess utility is not a necessary explanation for the shift of destinations. The shift might be fully explained by the tendency to strive for ideal travel times. In conformance with the discussion of the utility of working time, an excess utility is more likely to exist in the developing world than in the developed world. In poor countries, an improved transport system might enable ill people to visit hospitals or children to visit schools. In wealthy countries, faster transport tempts people to travel to more exotic holiday resorts or to the larger shopping centres mentioned before. It would be interesting to study whether there is any excess utility in the wealthy countries. Possibly, techniques in happiness science can be used for this research. If there is no excess utility, the marginal utility of travel time as well as VTTS are zero for non-working time, and VTT is not a good measure for VTTS. If, on the other hand, an excess utility can be proved, the difficult question should be answered whether the excess utility is represented by the utility component of VTT. A plausible outcome is that in poor countries the excess utilities are of a larger order of magnitude than in wealthy countries. This would conflict with the observed positive relation between VTT and prosperity, and suggest that VTT generally overestimates VTTS in developed countries.

DISCUSSION

The question whether the applied values of travel time (VTT) represent correctly the societal values of travel time savings (VTTS) can not be answered definitely. The argumentation in the paper focuses fully on the marginal utility of time; for a full answer also the marginal utility of money would have been discussed. Nevertheless, the tentative analysis of the paper shows that there are strong indications for VTT overestimating VTTS substantially in developed countries. It is even doubtful whether VTTS has a positive value in the wealthiest countries and time savings will create benefits at all. The arguments for overestimation are stronger for working time (business/commercial transport) than for non-working time (private transport). The overestimation might not, or to a lesser extent, be valid for developing countries.

The assumed overestimation of VTTS in the developed world has the practical consequence that the benefits of projects aiming to increase the speed of the transport system are overestimated and hence such projects will be approved too frequently. Politicians should be aware of the high uncertainty that is stuck to the traditionally calculated benefits of travel time savings and give these a modest role in the decision process.

In addition to VTTS, the overestimation is also valid for the (absolute value of) negative benefits of time losses due to travelling at a low speed, for instance in the case of congestion. In fact such negative benefits do not differ essentially from the positive benefits

of time savings: the negative benefits represent the benefits of savings from an intervention that raises the speed to a 'normal' level. In the Netherlands, for instance, congestion is put down as the largest traffic problem in the political debate, even despite the fact that the calculated congestion costs, based on VTT, are substantially lower than the costs calculated for traffic accidents or air pollution (Annema and van Wee, 2004; Schreyer et al., 2004). Assuming that congestion costs are overestimated, the focus could better shift to the other external costs of traffic.

We will stress that the assumed overestimation of VTTS by VTT is only valid for the assessment of the benefits of time savings (or disbenefits of time losses). Application of VTT for predicting travel behaviour is basically correct. Therefore, VTT can be used in behavioural modelling and for making calculations like the estimate of the revenues from tolled roads. The difference between actual travel choices and socially desired choices creates the interesting possibility that the investment for a new road can be expected to be fully returned while the costs exceed the social benefits.

The discrepancy between VTT and VTTS raises the question how VTTS can be given a correct value that makes it comparable with other monetary quantities like infrastructure investments. This question is outside the scope of this paper, but still we can say a few things about this. Observing that VTTS of working time seems to be close to zero in developed countries, simply a zero value can be assumed. Then the benefits of time savings are assumed equal to the traditionally calculated benefits for private travel only. Leaving out benefits for business/commercial transport reduces the benefits by some tenths of percents. A Dutch study on the congestion costs on motorways that includes calculations for varying time values for both business and private transport estimates shares of costs for business/commercial transport that range from 63% to 76% (NEA, 1997). The resulting benefits are likely to represent the true benefits better, though it is still unclear whether these are accurate. The reason is the high uncertainty about the correctness of VTT for non-working time. Research on this topic would be highly useful. The starting-point could be the assumption that saved travel time is used for lengthening existing trips and that the marginal utility of saved time is equal to the excess utility of visiting the more distant destination. Results and techniques from happiness science might be useful in this research.

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