Methods of eliciting time preferences for health
A pilot study

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Contents

Abstract

In the present paper four methods of eliciting time preferences are tested in a pilot study, with the aim of disclosing 1) individual time preference incorporating uncertainty, 2) individual time preference excluding elements of uncertainty, 3) social interpersonal preference incorporating elements of equity and 4) social intertemporal preference.

The results are that a significantly higher individual time preference is elicited when applying the standard gamble methods. In addition, the relative size of the social interpersonal preference suggests the existence of a preference for an equitable distribution of life-years over life-time, whereas the magnitude of the individual time preference excluding uncertainty, and the fact that this time preference was not significantly different from the social intertemporal preference, suggests that diminishing marginal utility over life-time only has a minor effect on time preference rates.

The analysis proposes that equity and uncertainty have significant and major impacts on the time preference over life-time. Hence, applying the social intertemporal preference when estimating the present value of a stream of life-years may seriously overestimate the true present value of health streams by ignoring preferences for equity and uncertainty over life-time. However, more elaborate analyses must be performed in order to verify the results presented in this paper.

Introduction

In recent years there has been a debate amongst economists as to what discount rate to apply in economic evaluations. To date no unique solution or recommendation of the handling of this issue has been reached. The debate is based on theoretical arguments as well as empirical evidence. Economists who believe in consumer sovereignty have in a series of analyses tried to elicit the discount rate which best corresponds to people's preferences. This paper will focus on *methods* of eliciting such time preferences.

Several empirical studies have shown that individuals' time preferences for health are different than for other goods. Moreover, there has been empirical evidence showing that individuals commonly discount health more heavily than other goods; estimated discount rates range from 2% to 45% depending on time period and elicitation method (1-6). There has also been evidence suggesting that a constant discount rate might not reflect individuals' time preferences for health gains (1-2;6-8). In the empirical works to date several types of time preferences have been introduced. Empirical time preference studies can essentially be divided into three subgroups; individual preferences for private temporal choices (3-5), intertemporal social preferences for intertemporal choices of providing health care to a number of statistical individuals now as opposed to later (1,2,6) and interpersonal social preferences, which focus on interpersonal social preferences, i.e. how health gains are distributed among people (5). There is, however, no reason to believe that these time preferences will be of the same magnitude, since each type of time preference will include different preference attributes, as described below.

Private intertemporal choices over life-time are elicited through choices involving own health or own risk of death. Individual time preference includes a pure time preference effect, diminishing marginal utility and possibly an uncertainty effect (if risk is included as an element in the question posed), see also (9,10) for a discussion. Diminishing marginal utility refers to the fact that individuals may value life-years in the future less than life-years at present, not because of the timing of those life-years, but because a life-year in the distant future implies a long life; it is a satiation effect. The uncertainty effects describes the uncertainty connected with life-years in the future; how will my life be then? Will I be alive? There is a risk of not consuming later life-years, and this makes life-years closer to the present more valuable because they are more certain.

Social time preferences are elicited via choices primarily dealing with other people's health or other people's risk of dying at different points in time. Possible rational reasons for social time preferences are listed by Olsen (2), who suggests that one explanation for high time preferences for health could be that the caring externality for other people's health declines rapidly over time, analogously to what it apparently does over space. An alternative reason for positive time preference may be based on the fact that people do not like to take from the ill and give to the healthy, as one does if one prefers preventive programmes to programmes that save lives in the present.

Finally, society may also have *interpersonal preferences* based on equity preferences over health benefits which extend over time when these are distributed between different groups of people. Society may prefer to add or improve a few life-years amongst a large group of people, rather than giving a greater health improvement to a smaller group. This type of time preference may be elicited through questions that ask the respondent to state the number of persons, each of whom gains a long duration of health quality improvement, which is equivalent to a larger number of persons each

gaining a shorter duration of the same health quality improvement. This elected preference over future streams of health benefits will incorporate elements of equity preferences as well as pure time preference, diminishing marginal utility and possibly uncertainty (if the question includes some element of risk).

In a recent article (11), it was argued that in economic evaluation one may include the social intertemporal preference in combination with either the individual time preference or the social interpersonal preference. Several economists argue for the use of the social intertemporal preference in economic evaluation. Olsen (12) argues that social intertemporal choices deal with the allocation of health care resources to programmes which produce benefits at different times in the future, and such social choices should be governed by social preferences alone. Others (13,14) argue against the inclusion of individual time preference on the basis that individuals's pure time preference reflects an impatience that is irrational. Gyrd-Hansen and Søgaard (11) argue that the criticism of applying individual time preferences as a basis for social intertemporal choices may be justifiable. Nevertheless, such preferences may indeed be relevant when valuing own future consumption of health. Gyrd-Hansen and Søgaard suggest that social intertemporal preferences should govern social intertemporal choices when prioritising between the saving of lives now or in the future, while the present value of an individual's stream of future health benefits is a matter of private consumption and hence individual time preferences or social interpersonal preferences could be applied when evaluating the value of extended life or improved quality of life. The strength of both the individual time preference and the social interpersonal preference is that not only is pure time preferences contained in these, but also other elements such as diminishing marginal utility, uncertainty and possibly elements of interpersonal equity.

Such a discounting model takes the stand that lives are saved at the time of the risk reduction, and that these lives are therefore to be valued at this point in time. The present value of a life is calculated by discounting future life-years back to the time of the risk reduction using individual time preference or social interpersonal preferences as a discount factor. In such a model a life-year is no longer a physical unit, but rather a utility measure incorporating pure time preference as well as marginal utility, uncertainty over lifetime and perhaps equity preferences. The life (be it improved or saved), as valued at the time of the risk reduction is subsequently discounted to present time using the social intertemporal preference rate[1]. This two-stage model has previously been suggested by Lipscomb (3).

The focus of this paper

In the present paper four methods of eliciting time preferences are tested in a pilot study, with the aim of disclosing 1) individual time preference incorporating uncertainty, 2) individual time preference excluding elements of uncertainty, 3) social interpersonal preference incorporating elements of equity and 4) social intertemporal preference.

The various methods of elicitation are investigated in order to test:

- whether the methods of elicitation are applicable
- whether the methods produce significantly different time preference estimates
- whether possible variations in time preferences reflect ex ante hypotheses
- whether the introduction of individual/social interpersonal time preferences entail implications for economic evaluation

[1] The model operates similarly for life-saving and life-improving interventions, in the latter case the timing of the initial health improvement would suggest the point in time at which the present value of a life should be valued.

Methods

Questionnaires were distributed to a sample of 78 respondents including master level students in Economics/Public Health and physicians doing a course in health economics. The questionnaire was answered in class. Each student received 1 questionnaire with a set of 4 questions, but not all questions were similar across questionnaires.

QUESTION 1

Individual time preferences including uncertainty were elicited using *standard gamble questions*. The respondent was to imagine that he suffers from a chronic illness which has no effect on quality of life, but which will definitely shorten his life-expectancy. The respondent is told that he will live 20 years with certainty if no medication is given. With medication life-expectancy may be prolonged to 40 years with a probability of P, but the patient may also die suddenly 10 years (in some cases 5 years) from now with a probability of (1-P), due to bad tolerance of the medication. The respondents is then asked to state a P value which makes him indifferent between the 20 years with certainty and the gamble. In a second version the life-expectancy with no medication is set at 10 years and the gamble involves a life-expectancy of 25 years (or 20 years) if medication is tolerated and 5 years (or 2 years) if it is not. The initial standard gamble was designed to extract time preferences over a time-period of 40 years. Since several studies (1,2) have shown that a constant discount rate does not reflect individuals' time preferences, it was expected that the time preference elicited from this question would be significantly lower than for the latter question, in which the maximum time period considered is only 20 years. Although non-constant discounting models have been confirmed for social intertemporal choices only, we

assume that such a preference structure may also be observed for private intertemporal choices. Possible variations in implicit discount rates are also likely to be caused by the degree of risk involved in each question. The perceived degree of risk involved may be explained by the absolute number of years that are potentially lost, or the relative proportion of ones life which is at stake. Alternatively, the perceived risk may merely be dictated by the number of life-years that remain if one is intolerant of the medication. We hypothesise that a high degree of perceived risk will produce a higher time preference rate, but we fail to determine which of the above factors influence the perception of risk. We hypothesise that the gamble 20;40:10 will produce lower discount rates than the gamble 20; 40:5, since the risk in absolute and relative terms is higher in the latter. In contrast, we cannot say how perceived risk will influence the relative time preferences extracted from gambles 10; 25,5 and 10;20,2. Whereas the former signifies a higher absolute loss of life-years relative to the initial situation, the latter entails fewer remaining life-years. The relative loss of life-years is almost identical in both scenarios. However, the difference in time-horizon is likely to dominate the relative results of these two gambles, which means that we may observe higher time preference rates in the 10;20,2 gamble.

The implicit discount rate (r) was calculated from the P-value obtained in the questionnaire by solving the following equation:

$$\frac{(1+r)^{t(init)}-1}{(1+r)^{t(init)}*r}=\frac{(1+r)^{t(win)}-1}{(1+r)^{t(win)}*r}*p+\frac{(1+r)^{t(lose)}-1}{(1+r)^{t(lose)}*r}*(1-p)$$

where t(init) is the life-expectancy the individual is to imagine he is endowed with, and t(win) is the life-expectancy obtained if the individual wins the gamble, and t(lose) is the shorter life-expenctancy which remains if the individual does not tolerate the medication.

QUESTION 2

An individual time preference, excluding elements of uncertainty, was also elicited *using two time-tradeoff questions* - a method suggested and applied by Olsen (9). A less than perfect health state (wheelchair bound with minor pains) was described to the respondents. The respondents were told that they could expect to live 30 years in this health state if they received no medication. If they accepted medication they could attain perfect health, but life-expectancy would decrease. The respondent was subsequently asked how many years in perfect health the individual would require in order to be indifferent between this option and the alternative option of 30 years in a wheelchair. Consecutively, a similar time-tradeoff question was posed, the only difference being that initial life-expectancy was shortened to 7 years. The implicit discount rate and the constant health state value was subsequently derived, by solving the simultaneous equations such that the present value of the less than perfect health state equates the present value of the perfect health state, in both scenarios. It was expected that the discount rate elicited through the time-tradeoff question would be lower than those elicited through the standard gamble approach, since the latter incorporates uncertainty as opposed to the TTO method. In order to stress the implications of a comparison we chose a time horizon which could verify the above hypothesis. Since the gambles 20; 40,10 and 20;40,5 basically elicit an average time-preference across time periods of 20 and 40 years, the TTO question, which operates with an average time-preference across a period of 30 and 7 years, should produce higher time preference rates ceteris paribus. Hence, a lower time-preference elicited via this TTO question emphasise the effect of including a risk element in time preference questions.

The implicit time preference rate (r) is calculated by solving the following equation:

$$\frac{PV_{t_a}}{PV_{T_a}} = \frac{PV_{t_b}}{PV_{T_b}}; \qquad \frac{\frac{(1+r)^{t_a}-1}{(1+r)^{t_a}*r}}{\frac{(1+r)^{T_a}-1}{(1+r)^{T_a}*r}} = \frac{\frac{(1+r)^{t_b}-1}{(1+r)^{t_b}*r}}{\frac{(1+r)^{T_b}-1}{(1+r)^{T_b}*r}}$$

where T_a and T_b are the initial life-expectancy (in this specific case 30 years and 7 years, respectively) the individual is endowed with, and t_a and t_b are the minimum life-expectancies the respondent is willing to accept if health is improved to perfect health. The value of the fractions PV(ta)/PV(Ta) or PV(tb)/PV(Tb) indicate the QALY value of the health status in question.

QUESTION 3

When disclosing the social interpersonal preference respondents were asked to act as decision makers in a scenario in which not all patients could receive life-time treatment for their illness. The illness was described as being chronic with limited mobility and periodic pains. The respondents were given the possibility of giving 100 patients treatment and improving all patients' quality of life for a period of 5 years (option A). Alternatively, resources could be distributed such that 20 individuals receive treatment, but each person receives treatment for a period of 25 years (option B). If respondents preferred the first option (option A), they were subsequently asked how many individuals one should treat under option B, if respondents were to be indifferent between option A and option B.

It is not entirely clear how the interpersonal time preference will differ from the individual time preference based on TTO. Neither of these time preferences include uncertainty, and both include diminishing marginal utility across life-time albeit from

different angles. Whereas the TTO question is based on individual preferences, the interpersonal question is posed as a societal question perhaps causing the perception of diminishing marginal utility, and pure time preference, to differ. However, if we assume that the effect of perspective is negligible[2], the only difference between these two types of time preference will be that the social interpersonal preference incorporates an equity element, whereas the individual time preference does not. Under this assumption, the time preference rate based on the TTO questions is likely to be lower than the time preference rate based on the interpersonal preference question. Another reason for a higher interpersonal preference rate may be the difference in the time periods used, which is slightly longer in the TTO question.

Based on the number of patients the respondent requires to be treated for 25 years, the implicit discount rate (r) can be deduced by solving the equation below:

$$A * \frac{(1+r)^{t_a} - 1}{(1+r)^{t_a} * r} = B * \frac{(1+r)^{t_b} - 1}{(1+r)^{t_b} * r}$$

where t is the time period in which a life improvement can be obtained ($t_a<t_b$), and A and B are the number of individuals treated in each case. In this specific scenario A=100, t_a=5 and t_b=25.

QUESTION 4

In the final question, social intertemporal preferences were extracted. Respondents were asked whether they would prefer to save 100 lives 5 years from now or alternatively, 100 lives 25 years from now. Those respondents who preferred the first option, were then asked to find a point of indifference by stating how many lives

[2] This assumption is based on the belief that individuals may apply own preferences for health over life-time, when answering this question.

should be saved in 25 years, if the two options were to be judged as equally good. The social intertemporal preference was expected to be lower than the interpersonal social preference as well as the individual time preferences, since it does not incorporate elements of equity or uncertainty and diminishing marginal utility across life-years. An additional argument is that the social intertemporal preference is elicited based on life-saving questions, whereas the other methods of elicitation were based on life-improving scenarios. Olsen (2) has demonstrated that life-saving scenarios produce lower time preference rates than life improving scenarios.

Nevertheless, the relationship between the social intertemporal preference and alternative time preferences is uncertain, since the basis for the "pure" time preference is different. In the context of the social intertemporal choice justification for having a positive time preference may be that one does not like to take from the ill and give to the healthy, as one does if one prefers preventive programmes to programmes that save lives in the future. In the context of individual time preference, the motivations are - as Pigou (14) as well as Pearce and Nash (13) put it - less rational and primarily based on impatience. This difference suggests that the "pure" time preference captured by the social intertemporal preference may exceed the individual pure time preference. If this is the case our hypothesis will not hold.

The social intertemporal preference was elicited by solving the following equation:

$$A * \frac{1}{(1+r)^{t_a}} = B * \frac{1}{(1+r)^{t_b}}$$

where A is the number of lives saved t_a years from now, and B is the number of lives saved t_b years from now. In this specific case A=100, t_a=5 and t_b=25.

Ex ante hypotheses

Based on the arguments listed above we can list the following hypothesis to be confirmed by the empirical study:

- The standard gamble questions (Q1) are expected to produce higher time preference rates than the time-tradeoff question (Q2).
- The standard gamble questions will produce different individual time preference rates.
- The expected order is (with those producing the lowest time preference rates listed first):
  (20;40,10), (20;40,5), (10;25,5) and (10;20,2).
- The social interpersonal preference is expected to be higher than the individual time preference elicited via the time trade-off question.
- The social intertemporal preference is lower than all other time preferences listed here.

In addition to the above we hypothesise that personal characteristics have an impact on time preference, as indicated by the results of empirical work done by F.X. Cairns (1). We do, however, expect personal characteristics to have a greater impact on individual time preference rates.

Results

A total of 78 questionnaires were returned. Mean age of respondents was 34.9, ranging between 23 and 58 years of age. The proportion of respondents who had children amounted to 53.8%, and 61.5% of respondents were female.

In table I are listed the estimated time preference values bases on responses to question 1. Mean time preferences were estimated including and excluding negative r values and r values above 1. Some respondents gave answers (P=1) which implied

an infinitely high discount rate. These could not be included when estimating mean values, but the frequency of these answers are listed.

Table II contains the estimated time preference rates based on questions 2-4. The mean individual time preference based on the time trade-off question is calculated including positive time preferences only. Infinite rates were excluded for obvious reasons. Negative values were excluded from analyses, because an $r<0$ elicited from the two time trade-off questions not necessarily reflects a negative time preference, but may instead reflect a non-constant discount rate, where discount rates are higher in the near future, and decrease in the more distant future. Since we cannot determine the true preferences that underlie the negative values for r, we have chosen to exclude them. In the case of the time trade-off question another problem arose, which was an unwillingness to trade when life-expectancy was short (T=7 years). A total of 21 responders would not trade when the time period was short, but were willing to trade when the time period was long (30 years). This combination of preferences made estimation of time preference and Qaly values impossible. The mean Qaly value derived from question 2 was 0.786 (CI 95%:0.737-0,834) with a median value of 0.84.

In the results of the social interpersonal preference question, the mean time preference also excludes negative values. The reason for this being that question 3 was not formulated in a manner that gave data input to the estimation of negative r values.

Table I. Results; QUESTION 1: Standard gamble

Gamble:	p-value responses mean	**Mean** time preference (CI; 95%) Including r<0 and r>1	**Mean** time preference (CI; 95%) Excluding r<0 and r>1	**Median** time preference Excluding r<0 and r>1	Excluded responses r⇒∞	Un-answered questions
20; 40,10 years	0.746 (n=39)	0.156 (0.128-0.184); n=37	0.167 (0.142-0.192); n=35	170	n=2	0
20; 40, 5 years	0.915 (n=38)	0.211 (0.181-0.241); n=35	0.219 (0.196-0.243); n=34	219	n=3	1
10;25,5 years	0.722 (n=35)	0.311 (0.225-0.397); n=34	0.336 (0.252-0.420); n=32	291	n=1	1
10;20,2 years	0.914 (n=41)	0.502 (0,406-0,597);n=33	0.446 (0.374-0.518); n=31	450	n=8	1

Table II. Result; QUESTIONS 2 - 4:

Type of time preference	Mean time preference (CI; 95%)	Median time preference	Excluded responses	Number of unanswered questions
Individual; TTO 30,7 years	0.070 (0.049-0.091) n=39	56	n=38; ∞:1; neg:16; no trade:21	1
Social interpersonal 25,5 years	0.208 (0.160-0.256) n=54	14	n=22; ∞:11; neg:11	2
Social intertemporal 25,5 years	0.071 (0.058-0.084) n=71	72	n=1 ∞:1	6

We analysed the effect of personal characteristics on individual time preference rates and social intertemporal preference rates, respectively. We chose to analyse the data from questions 2 and 4, since all respondents received similar versions of these two questions. A regression analysis was performed with the estimated time preference rates as the dependent variable. The effect of the independent variables: age, gender, and whether one has children were analysed.

Table III. Effect of personal characteristics on time preference

Time preference	β_{AGE}	β_{CHILD}	β_{FEMALE}
Individual (TTO)	-0.00016	0.06120	0.00013
	(p<033)	(p<0.01)	(p<0.48)
Intertemporal	0.00075	0.02090	-0.00103
	(p<0.01)	(p<0.01)	(p<0.27)

Table III illustrates that gender has no significant impact on the magnitude of either individual or social intertemporal preference. Whether one has at least one child does have significant impact on both types of time preferences, albeit a greater impact on individual time preference. In contrast, age has no influence on individual time preference, whereas the social intertemporal preference will change by 2.65% (in absolute numbers) over the age-range 23 to 58 years.

Discussion

ARE THE METHODS OF ELICITATION APPLICABLE?

In looking at tables I and II it is apparent, that the TTO method of eliciting individual time preferences is the elicitation method, which is most problematic. Out

of a sample of 78 responses almost 50% (n=38) had to be excluded from further analyses. The major reasons were an unwillingness to trade off life-years in the short run (n=21) and a high frequency of estimated negative time preferences. Starting with the latter problem, a preference for a negative discount rate is not a cause for disqualification. The reason for the exclusion is rather that it is not possible to determine whether the negative time preference is indeed a preference, or an artefact of constraining the time preference rate to being constant over time. If, for example, a respondent is willing to give up 4 life-years out of a life-expectancy of 7 years in order to restore his health, but only 15 years out a life-expectancy of 30 years, the results of the estimation methods used here will be a negative discount rate. The reason being that if a constant discount rate is assumed, only a negative discount rate can explain why the respondent is willing to give up a larger proportion of his life-time in the short run than in the long run. An alternative explanation could be found in a non-constant discount rate over time, where time-periods in the nearer future are discounted more heavily. Regarding the problem of no trade-off, all 21 respondents who were disinclined to trade did not wish to trade when life-expectancy was only 7 years, whereas the willingness was there if life-expectancy was long (30 years). Several respondents argued that they did not want to trade because they had smaller children, suggesting a possible contradiction between this motivation and the positive impact of having children on the discount rate (see table III). There may be several explanations for this potential paradox. Firstly, individuals may have a special time preference function when they have children. The period that goes beyond the child raising phase may be discounted more heavily compared to the phase in which the children are dependent on the parent. This theory suggests a non-constant time preference, and implies higher discount rates in the longer term. A second - more simple - explanation could be that respondents have failed to think in fractions of years. In a future survey, it should be made explicit to the respondent that it is permissible to trade off less than a year.

The standard gamble questions did not suffer from similar problems. Very few negative r-values were encountered, and the number of responses implying infinite time preferences only occurred in significant numbers as the risk involved increased (see gamble 10;20,2 in table II), which is a logical trend. Looking at the p-value responses, these varied across questions implying that individuals varied their answers according to the scenario they were presented with.

Eliciting the social intertemporal preference was least problematic, with only one infinite time preference, and 6 respondents omitting to answer. More problematic was the disclosing of the social interpersonal preference. A high proportion of respondents had infinitely high time preferences implying that giving 100 patients treatment for 5 years and 25 years respectively, is equally good - the most important factor being that an equal amount of patients receive treatment in both scenarios. Equity is in this case an overriding factor. The high proportion of individuals with a negative discount rate, i.e. those who choose the alternative which gives fewer patients treatment for a longer period, is not entirely surprising. It is plausible that some respondents believe that additional utility is derived from the knowledge of receiving treatment for a longer period - it is in fact a sequence effect. Such thoughts may also lie inherent in other respondents' answers, thereby generally affecting the estimated interpersonal time preference.

Generally, respondents were inclined to answer the questions, relatively few questions remained unanswered. From this result, we can draw no conclusions as to what the statistics would look like if we were to perform a similar investigation amongst the general population. Students of economics and public health have a higher incentive to answer questionnaires (to please their teacher!), and they also have a better grasp of the concepts involved . It should, however, be noted the physicians also participated (n=30), with no major problems involved.

DO THE METHODS PRODUCE SIGNIFICANTLY DIFFERENT TIME PREFERENCE ESTIMATES?

The standard gamble questions representing different time periods and levels of risk produce different time preference estimates, which are also significantly different at the 95%-level if r<0 and r>1 are excluded. If these estimates are included the differences are only near-significant.

All standard gamble questions result in significantly higher individual time preference estimates than elicited through the time trade-off method.

The social interpersonal preference estimate is significantly higher than the social intertemporal preference. The individual time preference elicited by the time trade-off is, however, not significantly different from the social intertemporal preference.

DO THE VARIATIONS IN TIME PREFERENCES REFLECT EX ANTE HYPOTHESES?

The estimated individual time preferences based on the responses to question 1 involving standard gamble questions produce relative levels of time preference estimates in accordance with the listed ex ante hypotheses. As the time period involved is decreased and the level of risk increased, the implicit discount rate increases. The effect of the time period on the implicit discount rate is best illustrated by comparing the implicit r-values for gambles (20;40,5) and (10;25,5). In the former gamble the risk is greater both in absolute and relative terms. The major reason for the higher r-value in the latter gamble, must be explained by the near-future being discounted more heavily than the more distant future. The individual time preference rate elicited via time trade-off is, as expected, lower than those elicited from the standard gamble questions. The individual time preference based on the TTO question is also lower than the interpersonal preference - as hypothesised, which

suggests that equity preferences has a major impact on preferences over time. The one hypothesis that was not confirmed was that of the social intertemporal preference being lower than all other time preferences disclosed in this analysis. Interestingly, the individual time preference which excluded uncertainty but contains pure time preference and diminishing marginal utility, is not different from the social intertemporal preference. If this result holds, it could suggest that the diminishing utility over life-time is of an insignificant magnitude. Alternatively, the result may be explained by a higher pure time preference rate when the context is societal, as discussed earlier.

WILL AN INTRODUCTION OF INDIVIDUAL OR SOCIAL INTERPERSONAL TIME PREFERENCES ENTAIL IMPLICATIONS FOR ECONOMIC EVALUATIONS?

If the above results hold in a larger scale survey, applying the individual time preference excluding elements of uncertainty over life-time in order to estimate the present value of a stream of future life-years in a two-stage discounting model, will not produce different results than if only the intertemporal time preference were applied. If, however, individual time preferences including elements of uncertainty or interpersonal time preference reflecting equity preferences are incorporated into the two-stage discounting model, the effect will be a significantly lower present value of future effects.

General comments

In the present analysis we attained a mean time preference of 0.070 (median: 0.056) in the TTO question and the mean Qaly value was estimated at 0.786 (CI 95%:0.737-0,834) with a median value of 0.84. Olsen (5) posed a similar question with a similar health description, the only difference being that the time periods applied were 20 and 5 years, respectively. His question resulted in a mean time

preference of 0.1 (median: 0.02) and a mean Qaly value of 0.84 (median:0.8). These rather similar results support the validity of the TTO question and its results.

Generally, there is a problem in the interpretation of the time preference estimates based on the standard gamble questions. The results support the hypothesis of increasing implicit discount rates as the level of risk is increased. This confirmation of ex ante hypotheses is supportive of the applicability of applying this method for eliciting time preferences. Furthermore, the results illustrate the importance of including elements of uncertainty in time preferences, since a high degree of risk will have a significant effect on the magnitude of the time preference remains. The question which remains is: which level of risk is appropriate to include in economic evaluations? How does one in a simple standard gamble question capture the relevant levels of risk over lifetime? Moreover, should the level of risk reflect the subjective perception of the individual's own risk, or should it be based on gender specific and age specific statistical evidence? Although this study has illustrated the importance of including risk and uncertainty over time in an economic analysis, it leaves a lot of questions unanswered, and consequently creates scope for further research.

Analysing the effect of personal characteristics on time preferences, illustrated that gender generally had no effect on time preference. This confirms the results of others (1,2). Having at least one child did have significant impact on both intertemporal and individual time preference, although the effect was greater on the latter, as hypothesised. In the empirical work by Cairns (1) a significant impact of this variable was not disclosed.

Interestingly, age has a significant influence on the social intertemporal preference, whereas no significant effect of this variable could be observed for the

individual time preference. That age has a positive impact on time preference coincides with the non-constant discounting model, where health is discounted more heavily in the shorter run, since as age increases, the shorter run becomes more dominating. Although Cairns (1) could find no linear relationship between age and time preference, his evidence suggested that the time preference initially falls with age, and subsequently rises with increasing age. An explanation for the fact that intertemporal time preference is influenced by age whereas individual time preference is not, may be explained by dimishing marginal utility over life-time. As life-time becomes shorter with age, the effect of diminishing marginal utility over life-time decrease, thereby negating a possible increase in pure time preference across age.

Conclusion

The results of this analysis suggest that the methods used here to elicit time preferences vary in applicability with the time-trade off method being the most troublesome. Generally, the relative magnitude of the estimated discount rates confirm ex ante hypotheses. This result supports the validity of the respondents' answers to the time preference questions posed in this analysis.

The effect of uncertainty over time is confirmed by significantly higher time preferences being elicited in the standard gamble methods. In addition, the relative size of the social interpersonal preference suggests the existence of a preference for an equitable distribution of life-years over life-time, whereas the magnitude of the individual time preference excluding uncertainty, and the fact that this time preference was not significantly different from the social intertemporal preference, suggests that diminishing marginal utility over life-time only has a minor effect on time preference rates.

More elaborate analyses must be performed in order to verify the results presented in this paper. The analysis proposes that equity and uncertainty have significant and major impacts on the time preference over life-time. Hence, applying the social intertemporal preference when estimating the present value of a stream of life-years may seriously overestimate the true present value of health streams by ignoring preferences for equity and uncertainty over life-time. Focussing on social intertemporal choices with the aim of incorporating individuals' preferences into economic evaluations, may be a job only half done.

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