VALUATION OF SMALL IMPROVEMENTS IN LONGEVITY: IS THE UTILITY LINEAR IN TIME?

Maria Knoph Kvamme

Master thesis

Institute of Health Management and Health Economics

Supervisors: Ivar Sønbø Kristiansen, Dorte Gyrd-Hansen, Jan Abel Olsen

UNIVERSITETET I OSLO

17.12.2007

SUMMARY

BACKGROUND: Economic evaluations are used as a tool for making priorities in the health care sector and this tool should in principle, reflect individuals' preferences. In economic theory, utility is seen as a way to describe preferences. The utility of life years gained in economic evaluations of health care programmes has commonly been treated as a linear function of life years gained even though some empirical evidence suggest a diminishing marginal utility for lifetime. A power function with a factor less than 1 in the quality-adjusted life-years (QALY) model has been suggested to account for risk aversion and positive time preferences.

METHODS: In this study, the utility of gain in lifetime up to 1 year was examined in a random sample of 2,400 Norwegians aged 40 to 59 years old. In hypothetical scenarios, respondents with untreated remaining lifetime of 1 or 10 years were offered treatment with a life gain ranging from 1 week to 1 year. The utility of the treatment was measured as willingness-to-pay (WTP) in an individual perspective.

RESULTS: The acceptance rates for offers of life extension treatments with a fixed price per week was increasing with longer life extensions and this indicates an increasing marginal utility for lifetime gains up to one year. However, the maximum WTP/week was decreasing with longer lifetime gains, which might be attributed to reduced ability to pay for longer gains. There was no clear lower threshold value for a gain in life extension to be considered worthwhile.

CONCLUSION: If an increasing marginal utility for lifetime gains up to one year reflects the population's preferences, the standard linear QALY model and the power QALY model proposed may yield misleading results for decision-making, and QALY weights obtained through TTO may be biased.

ACKNOWLEDGEMENTS

A grant from HERO financed the data collection performed by TNS Gallup Norway. In addition, I received a scholarship from HERO for my work on the master thesis.

I would like to thank my main supervisor, Professor Ivar Sønbø Kristiansen, Institute of Health Management and Health Economics, University of Oslo for all support, guidance and criticism. I would also like to thank my additional supervisors Professor Dorte Gyrd-Hansen, University of Southern Denmark and Professor Jan Abel Olsen, University of Tromsø for useful and important comments.

TABLE OF CONTENTS

ACRONYMS

CBA	cost-benefit analysis
CE	closed-ended (approach of WTP)
CEA	cost-effectiveness analysis
CI	confidence interval
CUA	cost-utility analysis
EUT	expected utility theory
NOK	norske kroner 7,9475 NOK per Euro 14.12.2007
OE	open-ended (approach of WTP)
OR	odds ratio
PC	payment card (approach of WTP)
QALY	quality-adjusted life-years
SG	standard gamble
SSB	Statistics Norway
TTO	time trade-off
WTP	willingness-to-pay

1. ECONOMIC ANALYSES AND HEALTH CARE

An economist analyses the word by developing models of social phenomena. A model is a simplified representation of reality and the model's power occurs from the elimination of irrelevant detail. This enables the economist to focus on the features of the reality he is trying to understand. In the analysis of human behaviour, there is a need for a framework on which to base the analysis. A framework built on two principles is used in much of economic analyses. The first is **the optimisation principle:** People try to choose the best patterns of consumption they can afford. The second is **the equilibrium principle:** People adjust until the amount people demand of something is equal to the amount that is supplied (Varian 1990).

The perfect market model in economic theory is an ideal model in which the marginal social value equals the marginal social costs. This implies that the last unit of production/service produced has a value for society that equals the production cost of the same unit. In the real world no market mirrors this model perfectly. Some markets work better than others and in the health care market there are several market failures. Key assumptions behind the perfect market model are: full information, impersonal transactions, private goods/services, selfish motivation, many buyers and sellers, free entry and homogenous goods/services (Dolan and Olsen 2002).

One of the most essential market failures in health care is information asymmetries. The potential consumers of health care do not have full information about when they might fall ill or what costs to expect due to illness. The patient often lacks information about the quality of health care and about the effect of different health care interventions. In comparison to physicians, the consumers generally know significantly less with regard to treatment effects and the quality of health care. Because of the uncertainties about if and when an individual might fall ill and the possibility of accompanying high costs, individuals would have a strong incentive to take out health insurance (Dolan & Olsen 2002). In Norway, the main costs are covered by society, which implies that society is responsible for the main part of the health insurance.

Another important failure is the assumption of private goods/services as there are externalities in health care. A private good is something that only affects the person consuming it. An example of an externality in health care is vaccination. Not only the person who receives a vaccine for an infectious disease receives a benefit from the intervention, many other people who else could have been contaminated by the not-vaccinated person also benefit from the intervention (Dolan & Olsen 2002).

In the health care sector, there is no normal competition on price. Demand and supply are not in equilibrium as in the market model. Since the market in health care is associated with several market failures there are reasons for governmental intervention. The main categories of intervention are public provision of health care, commodity taxes and subsidies, regulation and transfer programs (Folland and Stano 2004). Instead of the competition on price, there is a need for alternatives for making priorities in health care. Economic evaluation is a tool that can be utilised in priority setting when markets fail to achieve an optimal distribution of resources. Even in an unregulated market, evaluation of utility could be an effective means for the actors to set the right price on services.

2. UTILITY THEORY

The theory of how to measure and maximise utility is called *utility theory* (Baron 2000). The concept of utility can be defined slightly different depending on the discipline or the perspective of the author. In economic theory, consumer behaviour is formulated in terms of consumer preferences under a budget constraint, and utility is seen as a way to describe preferences. Earlier, in Victorian days, economists and philosophers thought of utility as a numeric measure of a person's happiness (Varian 1990).

Another view is that utility, as a concept, can encompass the variety of human goals. In other words; what people want to achieve. The amount of money we would be willing to pay to achieve an outcome does not necessarily represent the utility of the outcome, as money is not a universal means to achieve all that we want. We can for example not pay for a total absence of disease. We can pay for an injection in order to avoid a disease but we have to endure the pain accompanying it. Neither is utility the same as happiness or satisfaction. We can be happy when we are expecting to achieve our goals even if we are not achieving them now and we get satisfied when we have achieved our goals. There can be many important goals which we do not achieve in our lives (Baron 2000).

A third way of describing utility is as a summary measure of to what degree outcomes affect our ultimate goals or values. According to Broome, utility is not a perfect word since it leads us to believe that an outcome only has a value as a means to something else. He means "good" is better and defines utility as the amount of good or goodness (Broome 1991).

As seen above, the concept of utility can have slightly different meanings. In this thesis, the concept of utility is seen as a way to describe consumer preferences, as in standard economic theory.

The total utility for society is the unweighted sum of household utilities according to a utilitarian or Benthamite social welfare function but this distribution of utility can be a source for controversies (Johansson 1991). The distribution of total gains across patients, i.e. if many receive a little or if a few receive much, is ignored in standard economic evaluations used in health care. The assumption is that the effects of differences in distribution are negligible when comparing programs. This means that the utility of a large gain to a few is equal to a small gain to many if the total utility is the same in the two distributions (Olsen 2000). Societal value as a simple, unweighted sum of health benefit is referred to as the assumption of *distributive neutrality* (Nord 1999).

The assumption of distributive neutrality has been criticised in recent years. The maximisation of health gains may be at the expense of fairness. Some distributions can be viewed as more fair than others and society might want to reach a balance between maximisation of health gains and treating individuals in a fair way (Nord 1999) (Williams 1997).

The concept of utility is used in policy decisions. The public's preferences for different benefits compared to others can be used in many of the economic evaluations to evaluate which programme generates most utility. Consumer preferences are important to elicit since they constitute the basis in the economic concept of utility.

Different types of preferences form the basis for valuation of benefits of health care. The valuation can be formed from two main perspectives. If an individual is asked to consider what he/she prefers for himself/herself, the individual perspective is used. If he is asked to consider how he would have chosen to spend an amount of societal resources if he was to decide, it is called the societal perspective.

The underlying preferences in the *individual* perspective is based on the amount of health gained, measured as time and quality. There might be a positive time preference, *i.e.* a discounting of future health gains relative to health gains today. The individual might prefer certain gains over risky gains as the majority of people are risk averse regarding gains and prefer the expected value of a gamble to the gamble itself (Kahneman and Tversky 1984). Life situation variables such as age, fulfilled wishes or missions, level of goal achievement and whether one has dependants might also influence the valuation of health benefits. There might be a minimum threshold quantity of health gains (both in terms of longevity and quality) before a gain is considered worthwhile (Dolan et al. 2005). This can for example mean that if a gain in longevity is considered too small to be of any significant value one would not appreciate the treatment that gave the effect to the same extent as a treatment that gave a longer increase in longevity.

The underlying preferences in a *societal* perspective can also be the amount of health gained, positive time preference and risk aversion. The positive time preference implies that programmes with shorter duration (less to many) are preferred over programmes with a longer duration because the present value of the health experienced over the longer time period is diminished with relatively more. A preference for equity, *i.e.* it is better the more divisible health gains are between people, give the same effect. Previous research seem to indicate that the marginal social value is decreasing both with increases in quality and length of life. Another indication is that people seem to have preferences for distribution of health gains to persons who have dependants and to persons who have a bad lifetime health prospect (Dolan et al. 2005). People may also have a preference for equity between patients with respect to total life outcome. Williams argues that everybody is entitled to a lifetime of around 70-75 years and if you don't achieve this you have in a sense been "cheated" and if you get more you have in fact got "borrowed" time. This is called *the fair innings argument* (Williams 1997). The possibility of a threshold effect could apply also in the societal perspective if the argument is concerning effectiveness of treatment. In the societal perspective, this means that if a health gain is considered too small to be of any value one would rather prefer to concentrate the gains to a few until the value of the health gain is considered to be of a significant size.

How can we measure utility or preferences and how can we decide which bundle of treatments that is most preferred by health consumers? Economic evaluations are used as a tool for making priorities and this tool should in principle, reflect individuals' preferences. In this thesis, I focus on examining whether economic evaluations really reflect individual preferences.

3. ECONOMIC EVALUATION IN HEALTH CARE

Economic evaluations are used in health care since the market fails to achieve an optimal distribution of resources with competition on price. The aim is to help achieving optimal resource allocation given available resources. Resources for medical care are limited and choices must be made between alternative uses. The real cost of a health programme is the value of the benefits of another health programme that could have been implemented instead of the one that was funded. This is called the opportunity cost (Drummond et al. 2005). Any medical decision entailing the use of resources implicitly excludes those resources from other possible uses (Weinstein and Fineberg 1980).

Priorities among patients in the Norwegian health care system was recommended to be based on three dimensions according to the Lønning II- committee (NOU 1997:18). The two basic priority criteria are the *severity of the health state* and the *expected health of a measure*. In addition, the available resources should be used in the most *cost-efficient* way. In the earlier priority criteria in NOU 1987: 23, the *severity of the health state* was strongly emphasised. In the criteria from 1997 the committee pointed out that there are *three* relevant dimensions and in comparison with the earlier guiding principles the measures *expected health* and *cost-efficiency* should be weighted more heavily (NOU 1997:18). The Patients Rights Law states that the patient has a right to necessary help from the special health services. The right is only valid if the patient has an expected health gain from the intervention and the costs are in a reasonable relationship to the effects of the intervention (Lov om pasientrettigheter LOV-1999-07-02-63).

Even though economic evaluation is only one of several considerations in priority decisions it is important because it can help identifying where the resources used give most effect in health outcomes. In a full economic evaluation both costs and consequences of the alternatives considered are examined. In addition, there is a comparison of two or more alternatives, since economic analysis is concerned with choices. If these two criteria are not fulfilled, the analysis can be a partial evaluation, for example a cost analysis which is only concerned about costs (Drummond et al. 2005).

Consumer preferences of health care gains, to be used in economic evaluations, can be measured as a single common effect, for example life-years gained or cases detected in a screening programme. It could also be measured as a set of health outcomes such as quality-adjusted life-years (QALYs) or it could be measured in monetary units.

There are three types of full economic evaluations that can be used as tools when we need to make priorities. When the output of the intervention is measured in natural units and a single common effect, a cost-effectiveness analysis (CEA) is used. In a cost-utility analysis (CUA) the output is measured as QALYs and one QALY represents one life year in full health (Dolan et al. 2005). Finally, when the consequences of a programme are measured in monetary units, a cost-benefit analysis (CBA) is the right tool. (Drummond et al. 2005).

3.1 Welfare- and extra welfarist perspectives

Underpinning the CBA is a branch of economics called *welfare economics*. Welfare economics can address normative issues because it includes value judgements as opposed to positive economics which address questions of how the world of economics functions in practise. The two value judgements in welfare economics are: 1) each member of society is contributing to the social welfare by their own welfare or utility and 2) individuals are the best to judge their own welfare. In addition, it is assumed that resource allocation is propelled by a competitive market in equilibrium and that the existing income distribution is suitable. These assumptions underlie two well-known principles. Alfredo Pareto worked out the first in the utilitarian tradition and stated that: A policy that makes one or more persons better off without making any other person worse off is an *actual Pareto improvement.* Two other economists stated another principle called *potential Pareto improvement* which is building on the first. It claims that if, in theory, gainers could compensate losers after a policy change then in total society has benefited. Since this compensation does not have to be paid, the principle can raise equity concerns. This last version of the Pareto principle was worked out by Nicholas Kaldor and John Hicks and it forms the foundation for CBA. Cost-benefit analysis can be said to be the broadest measure of value of the three methods since it can allow for comparison with alternative programmes of value to society, outside the health care sector. (Drummond et al. 2005). The logical following from a CBA being based on welfare economics is that the method used in CBA, called willingness-to-pay (WTP) is based on the same approach. It aims at measuring the maximum amount an individual is willing to forgo in return for an intervention. An important consideration of this method is that the level of wealth or ability to pay will be a precondition for what has to be forgone at the margin, to be willing to pay a certain amount of money. This implies that WTP will be greater among wealthier populations than among less wealthy populations, ceteris paribus (Birch and Donaldson 2003). WTP is a scale that cannot represent all values in life, only those that can be bought for money. The relationship between utility and crowns is the marginal utility of income, which can vary between individuals. It can even vary for the same individual if they are presented with large enough health gains (Gyrd-Hansen 2005).

An opposing branch of economics is called *extra welfarism.* In extra welfarism, individual's utilities are not considered enough for measuring social welfare. It introduces a non-utility view of quality of life in terms of relevant characteristics. The particular characteristics to be used instead of, or in addition to utilities remain unclear. How these should be incorporated for measurement alongside utilities is also discussed. One example of such a characteristic is health. For measuring the characteristic health, QALYs have been proposed. However, also in the different approaches of measuring QALYs, individuals' preferences are used as a basis. The welfarist perspective is that health is incorporated in the individual's utility function and what matters by an intervention is not what is produced by the particular intervention but whether the individual values what is produced (Birch & Donaldson 2003). The extra-welfarist perspective is to define the output of healthcare according to its contribution to health itself and not in terms of preferences for health compared to other goods. The other two full economic evaluations; CEA and CUA are based on the extra-welfarist notion and CUA is seen as a special form of CEA in this context (Gyrd-Hansen 2005).

In a cost-utility analysis, the health benefit can be measured in number of QALYs gained. Every QALY represents one life year in full health and the QALY is a product of the value of health states and their duration (Dolan et al. 2005). The QALY model relates Q (health state) and t (lifetime) as follows:

$$U(Q, t) = V(Q) * t$$

This model implies that the utility of duration is linear and V (Q) is the correction factor for health state. The standard QALY calculation assumes risk neutrality with respect to life duration. This implies that when health quality is fixed, a certain lifetime with expected duration *t* is rated as equal to an uncertain lifetime with the same expected duration *t* (Miyamoto et al. 1998).

The number of QALYs gained for each individual is added according to the QALY maximisation rule. The rule states that the social value from a health benefit is the product of gains in quality of life, length of life and the number of patients treated. A recent review of QALY maximisation suggests that the QALY maximisation rule is not valid. The finding is that the social value is reduced in marginal increases in both quality and length of life. Reductions in health inequalities are appreciated and the social value seems to be increased if the persons who receive the QALYs have dependants and if they have a bad lifetime health prospect (Dolan et al. 2005).

In a study by Rodríguez-Míguez and Pinto-Prades the importance of concentration and dispersion of individual health benefits was measured. They found that the respondents preferred to concentrate life-time increases under 9.1 years and to spread gains over this value in time. This can be illustrated in an indifference curve between U(t) and life-time increases (years) which at first is concave, until 9 years and then changes shape to become convex with increases in life-time years. The authors concluded that participants in their study prefer health programmes, which distribute life-years over a larger number of people if the gain to each recipient is sufficiently high. The threshold value for a gain to be considered sufficiently high was found to be 9.1 years of life prolongation. One important limitation of the study was the utilisation of a convenience sample of 61 undergraduate students who cannot be considered a representative sample of the whole population. Indeed, the authors stress the pilot nature of the study (Rodriguez-Miguez and Pinto-Prades 2002).

3.2 WTP per QALY

To increase the usefulness of the QALY, the possibility of establishing a link between WTP and QALYs have been proposed (Johannesson 1995). In recent years, there has been a debate on the possibility to establish a threshold value for a QALY and the theoretical issues that arises (Bleichrodt and Quiggin 1999;Dolan and Edlin 2002;Gyrd-Hansen 2005;Johannesson 1995). The authors point to several obstacles in the establishing of this link. First, one might question whether the QALY is a valid utility function for an individual since it does not include decreasing marginal utility of health. If this requirement would be fulfilled, a constant WTP per QALY require that marginal utility of income is constant among individuals. In WTP, the scale is in monetary terms but in QALY, a scale often used is time trade-off (TTO) in which the marginal utility of time is considered. The marginal utility of time can also vary between individuals (for example individuals with different life expectancy). These two measurements; marginal utility of income and time should be linearly related if a constant WTP for a QALY would be a precise estimation. If the QALY cannot be considered a measure of cardinal utility, or a measure of health (as in the extra welfarist perspective) the idea of a constant WTP per QALY is not realistic. However, even if a theoretical link between CEA and CBA is not to be found, a more pragmatic view on the issue can include finding a threshold value for CEAs which cold be used for guiding decision-making in health care. A WTP per QALY based on individual preferences should not be applied as an absolute threshold, considering the weaknesses with the method, but could be used in guiding decision making. It might be an indicator of the cost per QALY is reasonable or if other considerations, not included from the individual perspective, could be additional reasons for implementing an intervention (Gyrd-Hansen 2005).

3.3 Hypotheses

My research question is:

Is the relationship between utility and duration of life gain linear for increased lifetime up to one year?

The main question can be formulated in two sub questions:

a) Is the marginal utility of life duration constant up to one year?

b) Is there a threshold value for a gain in life duration under one year?

The zero hypotheses to be tested in this thesis are given in the following. The relationship between utility of a life gain and duration of a life gain is linear up to one year; the marginal utility of increased life duration is constant for values of (t) up to one year and there is no threshold value before a gain in lifetime is considered worthwhile.

Reasons for not believing that the utility over duration is linear and the marginal utility is constant are a diminishing marginal utility of length of life due to positive time preference, risk aversion or satiation. If there is a threshold value before a gain is considered worthwhile, it could disrupt a linear curve.

4. METHODS

4.1 Research design

Research can be said to be a decision process and the research design is a plan for this process. The choice of research design is in this case a cross sectional study. A cross sectional study includes data on specific dependent and independent variables from a randomly selected sample of units at one point in time. The data are mainly quantitative, from interviews, surveys or register data.

In order to be able to generalize to the Norwegian population, a large representative sample was sought. Gallup Norway has a large, rather representative sample of the Norwegian population at their disposal and it is possible to select participants from relevant age groups. I chose to use Gallup for the data collection. This would save time compared to performing the study myself. The choice fell on an internet study because of budget constraints. An interview study would be much more costly with the same number of respondents. The aim was to include as many participants as possible within the budget constraint.

Because I wanted the questionnaire distributed by Gallup to be as appropriate as possible for testing my hypotheses, I developed a questionnaire and performed a pilot study.

4.2 Choosing the measurements

4.2.1 Outcome measurements

Increased lifetime is measured as t_e. The utility of t_e is defined as U. The point in time in the future when t_e will occur is defined as t_p. One assumption is that the U (t_e) is dependent on t_p

The measurement of the utility of t_e can be conducted in different ways. The gain in longevity can be traded against other values as explained below.

Willingness-to-pay (WTP)

A first option is WTP. This method implies asking respondents how much they are willing to pay for t_e. The utility of an increased lifetime (t_e) given t_p can be derived from the amount that respondents on average are willing to pay. An argument against this method is the low convergent validity of explicit ranking of health care programmes and implicit ranking derived from WTP (Olsen et al. 2005). Another argument against the utilisation of WTP is that WTP can depend on the ability to pay. The latter argument might partly be controlled for if the respondents report their income in the study. In addition, the marginal utility of income can vary between individuals and it can vary with the size of the gain. Varying marginal utility of income between individuals is partly possible to correct with information on income.

Time trade-off (TTO)

A second option is TTO in which longevity can be traded against quality of life. In this case, the same reduction in quality of life to different t_e at different points in time, i.e. different values of t_p should be considered. One argument against this method is that a described health status can be given different valuations from different respondents, in which case the responses cannot be compared between individuals. This could be partly controlled for if respondents report their health state. The valuation of a health state could also be non-linear with an increase in time. It is possible that being ill for a week is a possible endurable state but being in the same condition for years could be thought of as unbearable.

Standard gamble (SG)

A third way of eliciting preferences for t_e is to trade A) a certain low increase in t_e against B) a gamble of a risk of getting no increase in t_e and the possibility of receiving a larger gain of t_e than in A. The arguments against this method are that since most subjects cannot readily understand and utilise probabilities, the standard gamble method is often supplemented with visual aids, which can be difficult to achieve in a questionnaire. One-to-one, face-to-face interviews is the traditional method of obtaining SG measurements (Drummond et al. 2005). In addition, there is a possibility of measuring the willingness of risk taking behaviour instead of the U of (t_e).

A fourth option is to ask respondents of what gains in longevity they consider worthwhile without any costs. The argument against this option is that a utility-maximising respondent would accept all improvements in longevity no matter size of the gain. According to economic theory, an individual will choose the bundle of goods that maximizes his/her utility within a budget constraint (Stiglitz and Walsh 2002).

The chosen option, given available resources, was to conduct a survey with a questionnaire containing questions which trade increases in lifetime (t_e) against money (WTP). A pilot study was conducted in December 2006, followed by the main survey in February 2007.

4.2.2 Confounders and effect modifiers

In addition to my interest in exploring the shape of the function $U(t_e, t_p)$, I had to try to control for other variables. There could be many sources of randomness in the sample. The individual life situation, the state of mind the respondent experienced at the time of the survey and biases resulting from the layout and wording of the questionnaire.

Gallup had collected several variables concerning the life situation of the respondents. I used these to perform a stratified sampling with equal number of respondents from each age group and sex and to control for individual life situations in logistic- and linear regressions.

4.3 Data analysis

STATA was selected for the data analysis because the programme is powerful and suited for the intended analyses. I was also recommended to use STATA by my supervisors since it is broadly used by health economists.

The data was sent from Gallup in four separate SPSS-files 02.03.2007. The SPSS files where converted to STATA files.

Our sample from Gallup was deviant vis-à-vis the Norwegian population regarding the level of household income. In the sample, the median household income was slightly above NOK 600 000. The median household income reported from Statistics Norway (SSB) for 2005 was NOK 312 000. The median is chosen for comparison since it often gives a better view of the general income level than the mean, which can be strongly influenced by extreme high or low incomes.

Gallup reports that in all surveys there is an overestimation of level of income and education, which is a problem when comparisons against the general population are sought. To get very representative numbers, one has to stratify after income on telephone. SSB has studied the correlation between data from interviews and register data and reports that many respondents have problems in giving correct numbers. Many respondents do not know what other household members earn and many wish to give the impression of being close to what they think is the average household income.

4.3.1 Developing a logistic regression model

As the first step in the development of a model, I wanted to determine a set of likely predictor variables that could influence the tendency to accept the offer of life extension to the given price and the respondents' WTP for life extension. Many different respondent characteristics were available from Gallup and from these, six were chosen for further analyses. The chosen variables were picked because they were thought to have the possibility to influence the respondents' acceptance rates and WTP. These were: age, gender, level of education, household income, marital status and if the respondent is living with children under 15 years old.

To indicate the potential application region for the model an examination was made on the chosen variables mean, standard deviation, minimum and maximum and a correlation matrix is made to be able to examine the simple relationships between the variables. There were no strong correlations found between pairs of independent variables. If there would have been strong correlations between two background variables this might have given a multicolinearity problem if they were both included as predictor variables in the model.

Next, the different background variables were tabulated against the dependent variable "accepted_r" which represents the respondents yes/no answers to the offers of life extension. A logistic regression was made on each of the background variables and "accepted_r" in order to examine the separate background variables influences. The variables that showed a significant effect, given a p-value of 0.05, were household income (positive P=0.000), living with a co-habitee, vis-a-vis being married (negative P=0.020) and having a university level of education vis-à-vis 9-years of compulsory school (positive P=0.012 and P=0.017 for education up to 4 years and over 4 years respectively). The income effect was as expected and the other relationships were not considered strong enough for the variables to be excluded from the model.

Finally, the life extension offers in weeks was included in the model. The aim was to find out if different offers of life extensions, to the same price per week, could influence the tendency to accept. The same models were also divided in the two perspectives for when the life extensions would occur. The perspectives used in this study were the 1-year perspective and the 10-years perspective.

Linear regressions were made on respondents WTP_week. The same model of background variables as in the logistic regression on acceptance rates was chosen as basis for the analysis. The different offers of life extensions were included in the model and the two perspectives: 1-year and 10-years were analysed separately.

4.3.2 Further analyses

For the results to be considered trustworthy, the respondents who had answered the different questionnaires could not be very deviant. Therefore, an overview of the respondents in the different questionnaires was made. The respondents were characterised and summarised by the chosen variables age, gender, level of education, household income, marital status and if they were living with children under 15 years old.

The rate of acceptance for different offers of life extensions was analysed for the two perspectives to see if there were any differences in acceptance levels.

A summation of the WTP per week, including median- and mean price per week for the different life extensions in the 1 year- and the 10-years perspectives was made. An analysis was also made that shows the number of respondents answering “yes” to the yes/no question of a predefined length of life extension to a given price (2500 NOK/week or 500 NOK/week) depending on perspective (1 year or 10 years).

The respondents who had answered that they did not want the life extension offer and who did not want to pay anything for it, i.e. with a zero WTP, were analysed with the intension of finding out if this group had any tendency to become increasing or decreasing with longer life extension offers.

The respondents were divided into four groups, depending on their internal pattern of maximum WTP/week for the three life extensions given in their questionnaires. The categories were labelled: L=linear, I=increasing, D=decreasing and U=uncertain. The category was determined by the respondents WTP/week. Analyses were made of respondents' linearity and household income and of linearity and questionnaire (life extension offer). A new variable called WTP_capped was made which ignores the answers with the 5 % highest WTP/week. The reason was to try to avoid the extreme answers at the top of the data range. Corresponding regressions were made on WTP_capped as with WTP_week.

A binomial test was performed on the rate of acceptance for different offers of life extensions to test the hypothesis of linear valuation of different life extension offers. Since the price per week was the same for the different life extension offers in the same time perspective; 1- or 10 years, the percentage acceptance would be the same in the same time perspective if respondents had a linear valuation. The mean percentage acceptance was used as the reference value, i.e. the basis for the expected value. The binomial test was chosen because it allows for tests of the proportion of successes on a two-level categorical dependent variable compared to a hypothesized value. The "yes" or "no" answers to the offers of life extensions match this description. The hypothesized value in this case is the mean value, calculated separately for the two perspectives.

5. REFERENCES

Baron, J. 2000. *Thinking and deciding*, Third Edition ed. Cambridge University Press.

Birch, S. & Donaldson, C. 2003. Valuing the benefits and costs of health care programmes: where's the `extra' in extra-welfarism? *Social Science & Medicine*, 56, (5) 1121-1133 available from: http://www.sciencedirect.com/science/article/B6VBF-45JGXJ9-3/2/0d02648b04d098ffd9c7970de0c1d0d0

Bleichrodt, H. & Quiggin, J. 1999. Life-cycle preferences over consumption and health: when is cost-effectiveness analysis equivalent to cost-benefit analysis? *Journal of Health Economics*, 18, (6) 681-708 available from: http://www.sciencedirect.com/science/article/B6V8K-3Y9V2DT-1/2/8a81c0d7898bd1d3323f14bf3e921365

Broome, J. 1991. *Weighing goods: Equality, uncertainty and time.* Oxford, Basil Blackwell.

Dolan, P., Shaw, R., Tsuchiya, A., & Williams, A. 2005e. QALY maximisation and people's preferences: a methodological review of the literature. *Health Econ.*, 14, (2) 197-208 available from: PM:15386656

Dolan, P. & Edlin, R. 2002. Is it really possible to build a bridge between cost-benefit analysis and cost-effectiveness analysis? *Journal of Health Economics*, 21, (5) 827-843 available from: http://www.sciencedirect.com/science/article/B6V8K-45FSTC2-1/2/076c75ab4cb0ec1a45855dbbae70a5a4

Dolan, P. & Olsen, J.A. 2002. *Distributing health care: Economics and ethical issues 273* New York, Oxford University Press.

Drummond, M.F., Sculpher, M.J., Stoddart, G.L., O'Brien, B.J., & Torrance, G.W. 2005a. *Methods for the economic evaluation of health care programmes*, 3rd ed ed. Oxford, Oxford University Press.

Folland, S.G.A.C. & Stano, M. 2004. *The Economics of Health and Health Care*, Fourth Edition ed. Pearson Prentice Hall.

Gyrd-Hansen, D. 2005. Willingness to Pay for a QALY: Theoretical and Methodological Issues. *Pharmacoeconomics*, 23, (5) 423-432 available from: http://ejournals.ebsco.com/direct.asp?ArticleID=4A5EA4FD0D5B9308ABD9

Johannesson, M. 1995. The relationship between cost-effectiveness analysis and cost-benefit analysis. *Social Science & Medicine*, 41, (4) 483-489 available from: http://www.sciencedirect.com/science/article/B6VBF-3YS8D9V-4D/2/0f87a9cd4db5b3f2d75c817d3d9be33f

Johansson, P.-O. An introduction to modern welfare economics. 1991. Cambridge, Cambridge University Press.
Ref Type: Serial (Book,Monograph)

Kahneman, D. & Tversky, A. 1984. Choices, values and frames. *American Psychologist*, 39, (4) 341-350

Miyamoto, J.M., Wakker, P.P., Bleichrodt, H., & Peters, H.J.M. 1998. The Zero-Condition: A Simplifying Assumption in QALY Measurement and Multiattribute Utility. *Management Science*, 44, (6) 839-849

Nord, E. 1999. *Cost-value analysis in health care* Cambridge University Press.

Olsen, J.A. 2000. A note on eliciting distributive preferences for health. *J.Health Econ.*, 19, (4) 541-550 available from: PM:11010240

Olsen, J.A., Donaldson, C., & Shackley, P. 2005. Implicit versus explicit ranking: on inferring ordinal preferences for health care programmes based on differences in willingness-to-pay. *J.Health Econ.*, 24, (5) 990-996 available from: PM:15893827

Rodriguez-Miguez, E. & Pinto-Prades, J.L. 2002. Measuring the social importance of concentration or dispersion of individual health benefits. *Health Econ.*, 11, (1) 43-53 available from: PM:11788981

Stiglitz, J.E. & Walsh, C.E. 2002. *Principles of microeconomics*, Third edition ed. New York, W.W. Norton & Company, Inc.

Varian, H.R. 1990. *Intermediate microeconomics: a modern approach* New York, Norton.

Weinstein, M. C. & Fineberg, H. V. Clinical Decision Analysis. 1980. Philadelphia, W.B. Saunders Company.
Ref Type: Generic

Williams, A. 1997b. Intergenerational equity: an exploration of the 'fair innings' argument. *Health Econ.*, 6, (2) 117-132 available from: PM:9158965

VALUATION OF SMALL IMPROVEMENTS IN LONGEVITY: IS THE UTILITY LINEAR IN TIME?

Maria Knoph Kvamme

Master thesis article

Institute of Health Management and Health Economics

Supervisors: Ivar Sønbø Kristiansen, Dorte Gyrd-Hansen, Jan Abel Olsen

UNIVERSITETET I OSLO

17.12.2007

Summary

The utility of life years gained in economic evaluations of health care programmes has commonly been treated as a linear function of life years gained even though some empirical evidence suggest a diminishing marginal utility for lifetime. A power function with a factor less than 1 in the quality-adjusted life-years (QALY) model has been suggested to account for risk aversion and positive time preferences.

In this study, the utility of gain in lifetime up to 1 year was examined in a random sample of 2,400 Norwegians aged 40 to 59 years old. In hypothetical scenarios, respondents with untreated remaining lifetime of 1 or 10 years were offered treatment with a life gain ranging from 1 week to 1 year. The utility of the treatment was measured as willingness-to-pay (WTP) in an individual perspective.

The majority of the results of this study indicate an increasing marginal utility for lifetime gains up to one year without a clear lower threshold value. If these results reflect the population's preferences, the standard linear QALY model and the power QALY model previously proposed may yield misleading results for decision-making, and QALY weights obtained through TTO may be biased.

Keywords: Utility measurement, Life years gained, QALYs, time trade-off

Introduction

In economic evaluations, health gains can be measured in terms of a single common effect, for example life-years gained, a set of health outcomes such as quality-adjusted life-years (QALYs) or in terms of monetary units (Drummond et al. 2005). The utility function of life-years and QALYs gained has been considered linear over time except that future gains have been discounted. The linearity in duration implies that a gain gives the same increase in utility regardless of the distribution of the gain among recipients. This assumption of linearity has been challenged for several reasons (Dolan et al. 2005;Olsen 2000;Williams 1997). A non-linear relationship would have implications for the results of economic evaluations using life-years or QALYs as outcome measure. The standard linear QALY model is represented by:

(1) $U(q,t) = H(q)\ t$

where U and H denotes utility, q the health state (quality of life) and t a life year gain (Bleichrodt et al. 2005).

If the time trade-off (TTO) method is used for valuing health states (q) individual time preferences will influence q. It is possible to account for varying time preferences by dividing the number of discounted life-years in full health by the number of discounted life years in the assessed health states (Johannesson et al. 1994). It is not clear, however, how this method can be used in programme evaluations, and the standard procedure is to discount QALYs at the social discount rate disregarding how the preference weights were obtained (Drummond et al. 2005). Other time preferences are usually not taken into account when the quality weights are obtained. In the standard gamble (SG) method, the time considered (t) is usually the same in the alternatives between which the respondent has to consider. If individuals have different time preferences this does not bias the utility indifference in the alternatives (Drummond et al. 2005). In contrast, if different values for t are used, such as the case with TTO, this can give a distorted preference weight if the marginal utility of time varies with duration.

Assumptions in QALY calculations

The estimation of QALYs is based on the theoretical framework of expected utility theory (EUT), even though there is clear evidence that individuals violate the theory. In EUT, utility is a linear function of probability, but not of outcome if the individual is risk averse or risk seeking. The standard QALY model, however, implies risk neutrality (Johannesson et al. 1994). Three conditions have been put forward for a risk neutral QALY to be a valid representation of individual preferences: (1) the utility of life years and quality are independent. The independence assumption implies that the shape of the utility function over life years will be the same for all health states; (2) the constant-proportional-trade-off property must hold which means that the proportion of remaining life that one would be willing to trade for a quality improvement is independent of remaining life years; (3) Individuals are risk neutral with respect to life time, which means that the utility function over life years is linear (Johannesson et al. 1994). If the last assumption is relaxed, a more general risk-adjusted QALY model is needed. General QALY models for use in cost-utility analyses, in which the assumption of linearity is loosened, exist. These models allow for curved utility functions for duration, but are rarely seen in economic evaluations (Abellán-Perpiñán et al. 2006;Doctor et al. 2004). A utility function for the risk-adjusted QALY, with weights derived from SG has been formulated as:

(2) $U(q,t) = H(q)\ tr$

If the weights have been derived from TTO, the corresponding equation was:

(3) $U(q,t) = [V(q)\ t]^{r}$

where r is a risk aversion parameter and V is the value of any health state (q) (Johannesson et al. 1994). Under expected utility theory the power coefficient may reflect risk aversion ($r<1$; diminishing marginal utility) or risk neutrality ($r=1$) (Abellán-Perpiñán et al. 2006). In 1998, Miyamoto and co-workers questioned the assumption of linear utility over life duration. The authors suggest a revised QALY model, which relaxes the assumption of utility independence in the case of linear utility and replace it by standard gamble invariance in the case of nonlinear utility of life duration. This is achieved by the use of the zero-condition. This condition implies that when the survival time/life increase is zero, the health state does not matter. The authors suggest dropping the assumption of linearity and use an alternative model, which they call a generalized QALY model:

(4) $U(q, t) = H(q)\,W(t)$

$W(0) = 0$. W is the function that values life duration and does not have to be linear (Miyamoto et al. 1998).

The authors of a recent paper on QALY models (Abellán-Perpiñán et al. 2006) examined the impact of utility curvature on TTO values. They state that if utilities derived from TTO were biased by a curved utility function then the algorithm used by EuroQol would also be biased. They tested the predictive validity of three different models: the linear-, the exponential- and the power QALY models. TTO was used to elicit preferences for health states. The aim was to examine possible differences between predicted and observed differences in values for t by different questions in two samples. The null hypothesis was that there is no significant difference between the values of t obtained by the two ways of measuring t for the linear model. The results showed significant differences for almost all health states tested when the linear model was used. The smallest differences were obtained by using the power QALY model. The linear QALY model is the most used in practice but the exponential and the power models have also been applied in medical decision-making (Abellán-Perpiñán et al. 2006). The findings Abellán-Perpiñán and co-workers present indicate that the power QALY model yields the best predictive validity, and the authors conclude that the best-fitted power coefficient is 0.65. This parameter indicates that the utility function for lifetime is concave; *i.e.* diminishing marginal utility of lifetime.

Doctor and co-workers warn that most empirical tests of the standard QALY assumptions have given discouraging results which undermine the validity of QALYs as a base for medical decision making (Doctor et al. 2004). They performed a test of the QALY model, derived by use of the SG method based on nonexpected utility formulas, more precisely prospect theory. Doctor and co-workers tested the assumption of constant proportional coverage in a standard gamble experiment. Constant proportional coverage implies both constant proportional risk aversion and constant absolute risk aversion regarding duration risk. Only a linear utility model is consistent with both constant proportional and absolute risk aversion. Their results showed aversion to duration risk and at the same time support for the QALY model. These two findings should be mutually exclusive under expected utility theory. The authors recommend that probability weighting and loss aversion should be taken into account when utilities for health care are computed. Prospect theory does not imply that the utility for duration is linear. In the study, the authors used three different power functions with $r < 1$, which all imply a concave function. Their values for t ranged from 0 to 20 years (Doctor et al. 2004). Another study also found the utility function for duration to be a power function with a coefficient of about 0.7 (Bleichrodt and Pinto 2000).

Valuation of short life extensions

The values for t are normally given in years or in months and smaller t's are usually not considered. In practice, however, most health interventions yield less than one year, frequently in the order of days and weeks (Wright and Weinstein 1998). In a recent review of QALYs and preferences, the results may indicate a threshold effect below which people consider the benefit too small to prioritise (Dolan et al. 2005). The hypothesis of a minimum lifetime/health gain below which people prefer to concentrate gains has been presented earlier (Olsen 2000) and there are some empirical evidence supporting a threshold value (Gyrd-Hansen and Kristiansen 2007;Rodriguez-Miguez and Pinto-Prades 2002). In (Olsen 2000) and (Rodriguez-Miguez & Pinto-Prades 2002), the societal perspective is used for eliciting preferences, whereas in (Gyrd-Hansen & Kristiansen 2007), both the individual and the societal perspectives are used.

In the present study, we will further explore the issue of a possible minimum threshold in an individual perspective. We will search for a threshold at lower levels, however, than is the case in previous research.

If each individual had identical thresholds for appreciation of lifetime gains, this would be observed as a zero growth region in the beginning of the utility curve for duration. If the individuals had varying thresholds this would be observed as a slow growth region in the beginning of the marginal utility of lifetime up to one year. A faulty assumption of a linear utility function of lifetime in economic evaluations of health gains could lead to unintended and incorrect priorities and inefficient allocation of resources for at least two reasons. First, in the standard QALY model (1), the t value might be over- or under valued depending on the length of the lifetime gain considered. Second, if TTO is used for deriving the QALY weights, these could be under- or over valued depending on the time periods used for eliciting the weights. TTO utilities could be biased upwards if the marginal utility for duration is increasing and downwards if it is diminishing (Miyamoto J M and Eraker A 1985). We wanted to test the assumption of a linear relationship between increases in lifetime and utility for increases in life duration up to one year. The increases considered were riskless and the utility was measured in willingness-to-pay (WTP). We tested the following hypotheses. The relationship between utility and duration of a life gain is not linear up to one year, individuals have an increasing or diminishing marginal utility of life extensions and individuals have a threshold for when a life gain is considered long enough for being valuable.

Methods

We used the internet-based panel of TNS Gallup Norway for the study. This panel encompasses 32 000 Norwegians aged 15 years and over. The panel members have volunteered to participate in surveys and they receive bonus points for participation. The points can be exchanged for gifts or donations to charities. A random sample from this panel was used in the main study, stratified by gender and age.

We conducted a pilot study to test the appropriateness of the questions for valuing life extensions and to identify relevant prices per week of life extension. The respondents were asked to imagine that they had a disease that would give them only one year (t_p=1) or 10 years (t_p=10) to live ($_p$ =perspective). They were offered a treatment that would give them a specified increased lifetime, in addition to 1 or 10 years, denoted t_e ($_e$ = life extension). This notation is also used for the main study presented below. The sample in the pilot study consisted of 38 persons, 22 male and 16 female, in the age range from 23 to 85 years old. The respondents were employees at a physical therapy department, employees at a medical centre or friends or family of the author. The main questions concerned whether the respondent was willing to pay a price of NOK 100 (≈€12) per week to increase their life expectancy. The price was set low to avoid that the respondents' ability to pay would affect the results largely. The price per week was the same for the perspectives of 1 and 10 years. The results were analysed for mean and median WTP per week for different offers of life extensions. The values from the 50th percentile for t_p=1 and the 46th percentile for t_p=10 were used as the prices for the offer of life extensions in the main study. From the percentile distribution of maximum WTP per week, a payment card was constructed that was used in the main study.

The respondents in the pilot were asked to value only one single life extension (t_e) with two time perspectives (t_p=1 and t_p=10). Thus, it was not possible to perform analyses within the respondent, considering his/her linearity in WTP. In the main study, we limited each respondent's perspective to either 1 or 10 years and increased the life extension offers (t_e), to three per respondent in order to analyse within-respondent responses. The respondents were asked to assume that the health state would be equal to their current state, also within the additional lifetime.

We used a combination of closed-ended questions (yes/no) and a payment card with equal proportional increasing sums for the three different life extension offers that each respondent was given. The respondents were first asked to accept or reject an offer of life extension to a given price per week and thereafter to state their maximum WTP for the life extension, which could be higher or lower than the given offer. The price per week was set to NOK 2500 (≈€300) for t_p=1 and NOK 500 (≈€60) for t_p=10.

The main survey was performed in February 2007. The total number of respondents was limited to 2,400 for financial reasons, and the age of the respondents was 40-59 years old. We had four different questionnaire versions with 600 respondents for each. Each version had t_p=1 or t_p=10 and t_e=1 week, 1 month and 4 months, t_e=2 weeks, 2 months and 8 months or t_e=3 weeks, 3 months and 1 year (Appendix). From previous surveys, TNS Gallup had information on age, gender, level of education, household income, personal income, marital status and whether the respondent was living with children under 15 years old. Data were analysed in STATA/SE 9.2. Here, we used descriptive statistics, logistic regression, linear regression and binomial tests.

Several types of responses were considered invalid and these responses were removed from further analyses. The respondents indicated on a 5-point scale how certain they were about their answers. Respondents who indicated "very uncertain", were removed from further analyses concerning these answers (654 answers). This was done because we wanted to reduce the level of uncertainty in the given answers. Respondents who had zero WTP for the life extension were asked to state a reason for their answer. If respondents had stated difficulties in relating to the question, (162 answers) these answers were removed. Respondents who had given explanations that were considered invalid, encompassing respondents who protested against the study design or gave answers such as "I mean the government should pay for health care" were considered not to have accepted or understood the preconditions in the study, and were removed (204 answers or 68 respondents). Illogical responses were also withdrawn. The answers were classified illogical if a respondent had been willing to pay an amount of money for a short life extension but nothing at all for a longer life extension (186 answers or 62 respondents). The total number of responses on the three WTP questions was 7,206. The number of omitted answers was 1,206 which leaved 6,000 (83%), for the analysis.

The four respondent groups were similar in terms of age, gender, level of education, household income and marital status (Table 1). The rate of acceptance for different offers of life extensions was analysed for the two perspectives individually (Table 2). A binomial test was performed on the rate of acceptance for different offers of life extensions to test the zero hypothesis of a linear valuation of different life extension offers. We used logistic regression analysis to explore responses to the discrete choice question and linear regression analysis to explore the maximum WTP for additional lifetime. The two perspectives (t_p=1 and t_p=10) were tested separately. In these regressions, we had three responses for each respondent, and we consequently used a robust cluster technique to estimate confidence intervals of the regression model parameters.

Results

Responses to the dichotomous choice question

In the 1-year perspective, 44 % of the respondents were willing to pay the stated price for one-week life extension with percentages of 51%, 53%, 57% and 59% for 2 weeks, 4 weeks, 2 months, 4 months and 8 months, respectively. In the 10-years perspective, 53% were willing to pay the stated price for two weeks life extension with corresponding percentages of 57%, 60%, 62%, 63% and 75% for 3 weeks, 2 months, 3 months, 8 months and 1 year.

Because the price per week was kept constant (NOK 2500 for t_p=1 and NOK 500 t_p=10) in the different life extension offers (t_e), the percentage acceptance would be the same within each of the two time perspectives (t_p) if the respondents had linear utility functions. The mean percentage acceptance was used as the reference value, *i.e.* the basis for the expected value. In the 1-year perspective, the mean rate of acceptance was 53% and in the 10-years perspective, it was 61%. The mean acceptance rates were used in the calculation of the expected value in the binomial tests. In the 1-year perspective, the offer of 1 week had a significantly lower rate of acceptance compared to the mean value ($p<0.001$). The offer of 8 months had a significantly higher rate of acceptance ($p=0.019$). In the 10-years perspective, the offers of 2- and 3 weeks had significantly lower acceptance rates ($p<0.001$) and ($p= 0.019$) respectively. The offer of 1 year had a significantly higher rate of acceptance ($p<0.001$).

There was no strong correlation between the independent variables included in the logistic regression model (-0.56< r<0.27). The odds for accepting the offer was increasing with increasing t_e from (odds ratio (OR) 1.367, 95% confidence interval (CI) 1.039-1.799, $p=0.026$) to OR=1.958, 95% CI 1.487-2.578, $p<0.001$ in the one year perspective. In the ten years perspective the OR was increasing from 1.217, 95% CI 0.923-1.603, $p=0.163$ to OR=3.182, CI 2.350-4.308, $p<0.001$ with increasing t_e (Table 3). This implies that the longer the life extension, the greater the odds that the respondent accepted the offer at a constant price per week. A part from life extension, household income was the only variable that was significant in both perspectives, 1 year OR=1.406, 95% CI 1.248-1.581, $p<0.001$ and 10 years OR=1.300, 95% CI 1.140-1.483, $p<0.001$.

For t_p=1, men were less likely to accept an offer of life extension compared to women (OR=0.787, 95% CI 0.619-1.002, $p=0.052$). All increasing levels of education were positive in comparison to nine-year compulsory school, and all levels were significantly positive (OR=2.380, 95% CI 1.385-4.047, $p=0.002$), (OR=2.288, 95% CI 1.313-3.957, $p=0.003$) (OR=1.977, 95% CI 1.098-3.524, $p=0.023$). This implies that a respondent having more education than nine-year compulsory school seemed to be more likely to accept the offer of life extension. Household income was positive and significant which implies that the higher the level of household income, the higher was the probability for accepting the offer. Respondents being previously married were significantly more inclined to accept the offer compared to married (OR=1.875, 95% CI 1.199-2.983, $p=0.006$). The significant variables in this perspective were life extension, household income, all levels of increasing education and being previously married. For t_p=10, the results were a bit different. The significant variables in this perspective were life extension, household income, living with a partner (OR=0.553, 95% CI 0.396-0.772, p<0.001) and age (OR=0.968, 95% CI 0.942-0.995, p=0.020). Gender, unmarried and respondents living with children under 15 years old were not significant in any of the perspectives.

The variable extension (life extension offer in weeks) was tested for interactions with the background variables. In the 1-year perspective, one significant interaction was found between extension and household income. The higher the income for the respondent, the more inclined was the respondent to prefer the longer life extension offers to the shorter life extension offers. In the 10-years perspective, a significant interaction was found, in addition to extension and household income, between extension and living with children under 15 years old. Respondents who were living with children under 15 years old had a higher tendency to prefer longer offers of life extensions to shorter offers of life extensions.

WTP for life extensions

Both for t_p=1 and t_p=10 the mean WTP was indicating an overall decreasing trend, which might imply a diminishing marginal valuation of increasing life extension offers, but the trend was not clear. In the 10-years perspective there was a slight increase in WTP with the offers of 8 months and 1 year. In the 1-year perspective, the mean WTP of the 8 months offer is slightly higher than the 4 months offer. Deviant was also the offer of 2 weeks, which had a higher mean than the offer of 1 week, in the 1-year perspective. The standard deviations were high, and extreme values could easily affect the mean values in this analysis, which made the results uncertain (Table 4). The mean WTP per week life extension for t_p=1 was NOK 4830 (NOK 251 138 per year) and for t_p=10 it was NOK 3367 (NOK 175 061 per year). The difference between perspectives corresponds to a discount rate of 4.1 %.

An analysis of the WTP/week-answers revealed a decreasing share of respondents not willing to pay anything at all, with increasing life extension offers. For t_p=1, the percentage respondents with zero WTP was 34% for 1 week, and for 8 months, the share had decreased to 15 %. For t_p=10, the percentage respondents with zero WTP constituted 37% for 2 weeks and 14% for 1 year. The share of respondents not willing to pay anything was decreasing with all offers of longer life extension in both the 1-, and the 10-years perspectives (Table 5).

A linear regression was made of independent variables, the same as in the acceptance rate analysis, and maximum WTP/week for life extension offers. For t_p=1, the significant variables were life extension 1 month, 2 months, 4 months and 8 months (from Coef. -1470, 95% CI -2303-(-637), *p*=0.001 to Coef. -2498, 95% CI -3583-(-1413), *p*<0.001), university up to 4 years (Coef. 2895, 95% CI 590.4-5200, *p*=0.014), upper secondary school (Coef. 1301, 95% CI 161.0-2440, *p*=0.025) and living with a partner (Coef. -1249, 95% CI -2352-(-147.2), *p*=0.026). The results indicated that the WTP/week was lower for the longer life extension offers, which opposes the results from the analysis of acceptance rates. Higher education seemed to indicate higher WTP/week compared to nine-year compulsory school. For t_p=10, there was only one significant variable: 3 months life extension (Coef. -3835, 95% CI -7404-(-265), *p*=0.035) which indicates that the offer of a life extension of 3 months had a lower WTP than the offer of 2 weeks (reference value) in price per week. Age, gender, university over 4 years, household income, unmarried, previously married and living with children under 15 years old were non-significant variables in both perspectives. The included variables were tested for interactions and one significant interaction was found, between extension and living with a partner in the one year perspective. This finding was not considered a serious problem for the model (Table 6).

The respondents were categorised in four groups, depending on their internal pattern of maximum WTP/week for the three life extensions given in their questionnaire. The categories were labelled: L=linear, I=increasing, D=decreasing and U=uncertain. Analyses were made of the connection between respondents' linearity and household income and of linearity and questionnaire (life extension offer). A minority of the respondents were strictly linear in their WTP (32 %). The largest group was decreasing (37 %), 27% were increasing and 4% were classified as uncertain in their WTP for increasing life extensions. When the respondents were classified according to household income, a different pattern came up. In all income groups, except the group 400,000 to 599,999 and the highest income group (1,200,000 or more) the largest group of respondents were decreasing (D). In the group (400,000 to 599,999), the largest group was linear (L) and in the highest income group, the largest part was increasing

(I). There is a clear difference in the distribution of respondents between the lowest and the highest income groups. In the lowest group, the percentage decreasing respondents is 48%, 21% are increasing and 25% are linear. In the highest income group, the percentage decreasing respondents is 32%, 35% are increasing and 28% are linear. In the two highest income groups: 1,000,000 to 1,199,000 and 1,200,000 or more, the percentage increasing respondents (I) was 35%. In the other groups taken together, the percentage was 26% (Table 7).

The presentation of distribution of linearity of respondents on the different questionnaires did not indicate any large differences. The percentage decreasing respondents varied between 34% and 39% and the corresponding numbers for increasing respondents were 23% and 31% and for linear 30% and 35%. The only questionnaire which results were a bit different from the others was questionnaire nr 4 with life extension offers of 3 weeks, 3 months and 1 year, in a 10-years perspective. It had a lower percentage of decreasing and a higher percentage of increasing respondents in comparison to the average respondent in all questionnaires; (D) 34 versus 37 and (I) 31 versus 27.

Health states of respondents

31.9% of the respondents considered their own health "very good" and 46.3% considered it "good". 17.3% meant their health was "neither good nor poor", 4.4% considered it "poor" and 0.2% considered it "very poor". In other words, over 75% of the respondents meant their health state was "very good" or "good" and fewer than 5% meant their health state was "very poor" or "poor". The acceptance rates of the offers of life extensions were monotonically diminishing with inferior health state. Since the respondents with inferior health states were relatively few, their responses did not have any large influence on the overall results. The variable including the health states was non-significant both in the logistic-, and in the linear regressions and was omitted from the models.

Discussion

The results from this study indicate that people may have increasing marginal utility of small life year gains which would imply that the standard QALY model might be misleading for priority setting. The results however, should be seen against the limitations of the study methodology. The WTP method was chosen over SG because the aim was to have a large representative sample of a general population and we wanted the questions to be easy to understand. SG questions are more complicated and resource demanding, and would ideally require personal interviews which would imply a smaller sample. Respondents have few problems in understanding WTP questions even if they can find them difficult to answer (Ryan et al. 2001). An argument against WTP is the low convergent validity of explicit ranking of health care programmes and implicit ranking derived from WTP (Olsen et al. 2005). In this study, different health care programmes were not compared. The respondents were only faced with one life-extending treatment but with different gains in longevity. Another property of WTP is that the WTP depends on the ability to pay. The latter argument is partially controlled for, since the respondents report their income.

The payment card (PC) and the closed-ended (CE) approaches of WTP, used in the main study have both given higher response rates, lower item non-response and fewer zero responses than the open-ended (OE) approach. Several studies have found evidence of "yea-saying" with the CE approach and range bias with the PC approach (Ryan et al. 2001). The design in our study can give a "yea-saying" bias in the tendency to accept the offer of life extension but this effect would probably apply equally to all extensions and would therefore give a bias toward linearity in utility, which is the focus in our study. One recent study found support for the existence of range bias (Whynes DK et al. 2004) while another did not find any evidence for neither range nor mid-point bias (Ryan et al. 2004). In the case of range bias, which could give the respondents an increased tendency to relate their bids to the selected price range, this would not give a serious distortion in our case, again as the focus is on the linearity in WTP and less on the actual level of the bid. If there would be a range bias, this would probably move the results toward linearity in utility.

A limitation of our study is that the offers of life extension were presented in the same order, from the shortest to the longest extensions, in all questionnaires. It would have been preferable to have the ordering of the questions randomised to reduce anchoring effects.

The Norwegian Ministry of Finance has indicated NOK 425,000 (in NOK 2005) as a value of a statistical life year to be used in analyses of mortality including mortality due to reduced health. This value could be quality adjusted by H(q) for relevant diseases (Finansdepartementet 2005). In accordance with the World Bank Group, a pragmatic limitation of the cost per QALY corresponding to the BNP per capita has also been suggested (NOK 350,000) (Kristiansen and Gyrd-Hansen 2007). These values are considerable higher than the WTP for a QALY obtained in this study. However, the offered price per week could have an anchoring effect and the range of values in the payment card could give a range bias.

Positive time preferences and risk aversion both imply a diminishing marginal utility of lifetime in agreement with standard economic theory. Some of the results from this study suggest that the marginal utility for life extensions is increasing, as the acceptance rate for the longer life extension offers was higher than for the lower offers when the price per week was the same. If the marginal utility of lifetime was increasing up to 1 year, the utility function for duration would be convex up to this point in time. This result contradicts earlier suggestions of diminishing marginal utility of lifetime and a concave utility curve over life years due to risk aversion (Johannesson et al. 1994).

The logistic regression models indicated an increasing valuation of life extensions with increasing lifetime offers. The results when the acceptance rates are analysed separately also indicated an increasing valuation of life extensions up to one year. The acceptance level increased with longer life extensions in both the 1-, and the 10-years perspectives. The increases in lifetime examined ranged from 1 week to 8 months when the life extension would occur in 1 year’s time and from 2 weeks to 1 year when the life extension would occur in 10 years time. These findings indicate an increasing marginal utility for life gains up to one year.

The results from the linear regression on maximum WTP/week indicated a diminishing marginal valuation for t_p=1 in contrast to the acceptance rates analysed in the logistic regression which indicated an increasing marginal valuation both for t_p=1 and t_p=10. The results from the maximum WTP elicited by the payment card gave values with high standard deviations that make the mean values uncertain. The diminishing marginal valuation was significant for most life extensions when t_p=1 but only for one of the five extensions for t_p=10.

These results could reveal a reduced ability to pay when the life extensions became longer and the prices higher. An increasing marginal utility of income when higher prices are considered could have limited the possibility to increase the maximum WTP for the longer life extension offers in the majority of income groups. In the highest income group, 35% of the respondents had an increasing valuation of life extensions measured in maximum WTP and 32 % had a decreasing valuation. In the rest of the income groups, the overweight of respondents were decreasing in their maximum WTP per week. These results might indicate that when the income is on such a high level that the respondent did not need to consider it noteworthy, the valuation of life extension could be increasing. The results of the analysis of respondents with zero WTP support this interpretation. The share of respondents with zero WTP was decreasing with increasing life extension offers.

No clear threshold value for when a gain in lifetime is considered worthwhile could be revealed, as the increases in acceptance rates were rather smooth. The answers on acceptance of different offers of life extensions showed a clear increasing trend for longer life extension offers in both the 1- and the 10-years perspectives. As the "yes"-answers increased from 44% to 58% for t_p=1, when the offers increased from 1 week to 8 months and from 53% to 75% for t_p=10 when the offers increased from 2 weeks to 1 year this could mean that the respondents had different threshold values. The offer of 1 week was the only offer given in the study with an acceptance level under 50% if one would like to choose this as a threshold value. However, the trend of increasing acceptance for longer life extensions as well as the declining level of respondents not willing to pay anything when offers of life extensions were increased, both point to individual thresholds. The share of respondents who answered "benefit not large enough" among those not willing to pay anything was decreasing with longer life extension offers in both perspectives. As the increases and decreases were rather smooth, one interpretation of this could be that the respondents were quite spread in where they had a threshold between 1 week and 1 year of life extensions.

In previous studies, the increases in lifetime evaluated have usually been longer time periods than in our study. In Johannesson and co-workers study, the life years considered were 1-10 years, in a paper of Dolan and Jones-Lee the authors examined whole life years and in the study by Rodríguez-Míguez and co-workers the values for lifetime increases ranged from 1 to

50 years (Dolan and Jones-Lee 1997;Johannesson et al. 1994;Rodriguez-Miguez & Pinto-Prades 2002). In other studies the range of values for lifetime has comprised shorter time periods as in the study by Abellán-Perpiñán and co-workers where a reference period of 10 years was used for chronic health states and months were used for nonchronic health states (Abellán-Perpiñán et al. 2006). Doctor and co-workers used lifetime periods that ranged from 0 to 20 years in their study for a test of the QALY model derived by SG and in the discrete choice experiment by Gyrd-Hansen and Kristiansen, the life increases considered ranged from 1- to 180 months (Doctor et al. 2004;Gyrd-Hansen & Kristiansen 2007) .

The results of this study indicate an increasing marginal utility for lifetime up to one year and oppose a power function for t with a coefficient $r < 1$. A power function for t with a coefficient $r < 1$ in a general QALY model has been suggested by several authors:

$U(q,t) = H(q)t\ r$

(Abellán-Perpiñán et al. 2006;Bleichrodt & Pinto 2000;Doctor et al. 2004). The power QALY model proposed ($r = 0.65$), indicate that the utility function for life duration is concave rather than linear (Abellán-Perpiñán et al. 2006). Since the life extensions in our study were relatively short, this might imply that the utility function for life duration has a shape that is convex in the beginning (up to one year) and then becomes concave at a later point in time.

If the utility function for duration is not linear but has an increasing marginal utility in the start, this can affect economic evaluations in health care at different levels. First, in the derivation of QALYs by use of the TTO method, this implies that the trade-offs in time have varying marginal utility depending on the length of the time period considered. If variations in marginal utility of time are not taken into account, TTO can give biased health state valuations. The same argument can apply to the SG method if the questions involved for deriving the quality weights involve gamble questions varying in survival duration. If all survival duration in the gamble considered are over 1 year, this argument might not be valid. Second, in the QALY formula:

$U(q, t) = H(q)\ W(t)$

(t) might in reality neither have a linear function, nor an exponential- or power coefficient but a different shape which allows for an increasing marginal valuation of duration up to one year. Third, this could affect also cost-effectiveness analyses using life years gained as outcome

measure. Four, when incremental cost/QALY or incremental cost/life years gained is measured, the incremental time gain might be valued differently if one considers it from time zero or if it is added to other treatments, which also give gains in lifetime.

The above presented arguments concern the methods in economic evaluations including duration in their formulas. Further questions concern if, and how these concerns should be taken into account in resource allocation decisions.

Conclusion

Most respondents were not strictly linear in their valuation of increased lifetime. The majority of the results of this study indicate that respondents had an increasing marginal utility for lifetime up to 1 year. No minimum threshold value was found for the value of lifetime. A gradually increasing tendency to accept longer offers of life extensions indicate individual thresholds up to one year. In the highest income group, an overweight of respondents had an increasing valuation of longer life extensions when the outcome measure was maximum WTP/week. The proportion of respondents not willing to pay anything was decreasing with all offers of longer life extensions and the proportion of respondents who answered "benefit not large enough" among those with zero WTP was decreasing with longer life extension offers. On the contrary, it cannot be excluded that a decreasing mean of maximum WTP/week in the majority of respondents could mean a diminishing marginal utility of lifetime up to 1 year.

Table 1. Characteristics of respondents by type of questionnaire

Questionnaire	1	2	3	4	Total
Number of respondents	600	600	602	600	2402
Age (mean)	49.1	49.1	48.8	49.3	
Min	40	40	40	40	
Max	59	59	59	59	
Female (%)	49.7	50.0	48.7	49.5	
Education (%)					
Nine years	5.67	6.00	6.64	7.33	6.41
Secondary	39.8	39.0	42.9	39.3	40.3
Univ ≤ 4y	32.2	31.5	29.6	29.8	30.8
Univ > 4y	22.3	23.5	20.9	23.5	22.6
Household Inc (%)					
< 200 000	2.00	2.17	2.82	2.50	2.37
2-400 000	18.5	16.5	15.3	18.3	17.2
4-600 000	28.7	29.8	30.1	26.8	29.1
6-800 000	29.0	30.2	32.6	33.2	31.2
8-1 000 000	14.5	15.2	11.6	11.3	13.2
1- 1 200 000	3.50	3.17	4.49	4.83	4.00
>1 200 000	3.83	3.00	2.33	3.00	3.04
Marital status (%)					
Married	65.5	64.2	64.2	63.8	64.4
Partner	12.3	13.7	14.3	12.8	13.3
Unmarried married	10.8	9.50	7.82	10.8	9.75
Previously married	11.3	12.7	13.6	12.5	12.5

Table 2. Proportions accepting an offer of life extensions for a fixed amount per week (NOK 2500 per week with one year perspective and NOK 500 in 10 years perspective).

		N	Yes	95 % CI
Life expectancy without treatment= 1 year				
Life extension with treatment[1]	1 week	512	44.3 %	(40.1; 48.4 %)
	2 weeks	497	51.3 %	(46.9; 55.5 %)
	4 weeks	509	52.5 %	(48.1; 56.6 %)
	2 months	495	56.8 %	(52.3; 61.0 %)
	4 months	510	57.5 %	(53.1; 61.6 %)
	8 months	495	58.6 %	(54.3; 62.8 %)
Life expectancy without treatment = 10 years				
Life extension with treatment[2]	2 weeks	490	53.3 %	(48.8-57.6 %)
	3 weeks	490	56.5 %	(52.0-60.6 %)
	2 months	517	60.0 %	(55.7; 64.0 %)
	3 months	486	62.3 %	(58.0; 66.5 %)
	8 months	505	63.2 %	(59.0; 67.1 %)
	1 year	481	74.8 %	(70.9; 78:4 %)
	Total	5 987	57.5 %	

Table 3. Logistic regression of responses to an offer of life extensions for a fixed amount per week (NOK 2500 or NOK 500)

	Perspective = 1 year 918 clusters in respid			Perspective = 10 years 911 clusters in respid		
Explanatory variables	Odds Ratio	P>|z|	[95% Conf. Interval]	Odds Ratio	P>|z|	[95% Conf. Interval]
Age (in years)	0.995	0.709	(0.970; 1.021)	0.968	0.020	(0.942; 0.995)
Gender (0=female, 1=male)	0.787	0.052	(0.619; 1.002)	0.913	0.471	(0.712; 1.170)
Level of education						
Nine years (reference)	1			1		
Upper second.	2.380	0.002	(1.385; 4.047)	0.743	0.268	(0.440; 1.257)
Univ. max 4y	2.288	0.003	(1.313; 3.957)	0.784	0.388	(0.451; 1.362)
Univ over 4y	1.977	0.023	(1.098; 3.524)	0.734	0.293	(0.413; 1.306)
Household income (7 levels[3])	1.406	0.000	(1.248; 1.581)	1.300	0.000	(1.140; 1.483)
Marital status						

[1] Price per week NOK 2500
[2] Price per week NOK 500
[3] Household income in NOK, level 1: < 200 000, level 2: 200 000-399 999, level 3: 400 000-599 999, level 4: 600 000-799 999, level 5: 800 000-999 999, level 6: 1 000 000-1 999 999, level 7: ≥1 200 000

Married (reference)	1			1		
Partner	1.009	0.963	(0.716; 1.419)	0.553	0.000	(0.396; 0.772)
Unmarried	0.895	0.737	(0.446; 1.771)	0.919	0.828	(0.441; 1.961)
Previously m	1.875	0.006	(1.199; 2.983)	1.504	0.120	(0.900; 2.514)
Living with children < 15 years (0=no, 1= yes)	1.108	0.476	(0.835; 1.471)	0.794	0.145	(0.582; 1.083)
Life extension						
1 week	1 (reference)			Not included in 10 years persp.		
2 weeks	1.367	0.026	(1.039; 1.799)	1 (reference)		
3 weeks	Not included in 1 year perspective			1.217	0.163	(0.923; 1.603)
1 month	1.420	0.000	(1.236; 1.633)	Not included in 10 years persp.		
2 months	1.780	0.000	(1.299; 2.250)	1.342	0.000	(1.176; 1.532)
3 months	Not included in 1 year perspective			1.596	0.001	(1.206; 2.111)
4 months	1.762	0.000	(1.458; 2.128)	Not included in 10 years persp.		
8 months	1.958	0.000	(1.487; 2.578)	1.611	0.000	(1.324; 1.960)
1 year	Not included in 1 year perspective			3.182	0.000	(2.350; 4.308)
	Log pseudolikelihood = -1746.4205 Pseudo R2 = 0.0454			Log pseudolikelihood = -1636.1753 Pseudo R2 = 0.0429		

Table 4. Maximum WTP (NOK, NOK8 ≈€1) per week life extension

	Median WTP/week (NOK)	Mean WTP/week (NOK)	Min	Max	Std. Dev.
1 year: 1 week	500	6393	0	500 000	25 358
2 weeks	2 500	8835	0	1 000 000	55 308
4 weeks	2 500	4184	0	125 000	8 540
2 months	2 500	3366	0	62 500	5 045
4 months	2 500	2958	0	62 500	4 790
8 months	2 500	3283	0	100 000	7 418
10 years: 2 weeks	500	5696	0	500 000	36 280
3 weeks	500	2227	0	50 000	4 643
2 months	500	3982	0	1 000 000	44 279
3 months	500	1403	0	10 000	2 416
8 months	500	3326	0	1 000 000	44 567
1 year	500	3519	0	1 000 000	45 517

Table 5. Percentage of respondents with zero WTP for the different offers and number of respondents who answered "benefit not large enough" among those with zero WTP

Offer of life extension	N	Percentage zero WTP/week	Benefit not large enough
Perspective 1 year: 1 week	514	34.2	112
2 weeks	496	28.4	85
4 weeks	514	25.9	81
2 months	496	23.4	68
4 months	515	19.0	54
8 months	497	14.9	27
Perspective 10 years: 2 weeks	493	36.5	135
3 weeks	496	33.5	109
2 months	520	29.6	112
3 months	487	27.1	88
8 months	504	19.1	70
1 year	482	13.7	36

Table 6. Linear regression of maximum WTP per week life extension

	Perspective = 1 year 933 clusters in respid			Perspective = 10 years 928 clusters in respid		
Explanatory variables	Coef.	P>|t|	[95% Conf. Interval]	Coef.	P>|t|	[95% Conf. Interval]
Age (in years)	82.66	0.419	(-117.9; 283.2)	2.459	0.990	(-365; 370.3)
Gender (0=female, 1=male)	1068	0.173	(-467.9; 2606)	-1619	0.588	(-7487; 4249)
Level of education						
Nine years (reference)	1			1		
Upper second.	1301	0.025	(161.0; 2440)	909.0	0.358	(-1031; 2849)
Univ. max 4y	2895	0.014	(590.4; 5200)	780.4	0.761	(-4262; 5823)
Univ over 4y	765.0	0.539	(-1676; 3206)	3977	0.206	(-10138; 2185)
Household income (7 levels[4]).	1305	0.058	(-44.08; 2656)	4953	0.127	(-1416; 11322)
Marital status						
Married (reference)	1			1		
Partner	-1249	0.026	(-2352; -147.2)	5860	0.371	(-6978; 18698)
Unmarried	1448	0.416	(-2044; 4940)	22305	0.185	(-10696;55307)
Previously m	839.0	0.364	(-974.0; 2652)	6306	0.144	(-2148; 14761)
Living with children < 15 years (0=no, 1= yes)	1846	0.217	(-1085; 4777)	-2626	0.274	(-7333; 2080)

[4] Household income in NOK, level 1: < 200 000, level 2: 200 000-399 999, level 3: 400 000-599 999, level 4: 600 000-799 999, level 5: 800 000-999 999, level 6: 1 000 000-1 999 999, level 7: ≥1 200 000

Life extension						
1 week	1 (reference)			Not included in 10 years persp.		
2 weeks	2794	0.283	(-2315; 7903)	1 (reference)		
3 weeks	Not included in 1 year perspective			-2070	0.104	(-6553; 612.7)
1 month	-1470	0.001	(-2303; -637)	Not included in 10 years persp.		
2 months	-1948	0.002	(-3208; -688)	-942	0.511	(-3760; 1874)
3 months	Not included in 1 year perspective			-3835	0.035	(-7404; -265)
4 months	-2498	0.000	(-3583; -1413)	Not included in 10 years persp.		
8 months	-2009	0.004	(-3379; -640)	-1505	0.365	(-4759; 1750)
1 year	Not included in 1 year perspective			-1495	0.607	(-7197; 4207)
	Prob > F = 0.0000 R-squared = 0.0150			Prob > F = 0.0003 R-squared = 0.0267		

Table 7. The relationship between household income and linearity in max WTP (NOK, NOK8 ≈€1) within the respondent[5]

Yearly household income before taxes in NOK	D Decreasing	I Increasing	L Linear	U Uncertain	Total
under 200,000	23	10	12	3	48
	47.9%	20.8%	25.0%	6.3%	100%
200,000 to 399,999	139	81	111	10	341
	40.8%	23.8%	32.6%	2.9%	100%
400,000 to 599,999	197	141	201	23	562
	35.1%	25.1%	35.8%	4.1%	100%
600,000 to 799,999	214	166	187	31	598
	35.8%	27.8%	31.3%	5.2%	100%
800,000 to 999,999	93	71	88	8	260
	35.8%	27.3%	33.9%	3.1%	100%
1,000,000 to 1,199,000	32	26	12	4	74
	43.2%	35.1%	16.2%	5.4%	100%
1,200,000 or more	18	20	16	3	57
	31.6%	35.1%	28.1%	5.3%	100%
Total	716	515	627	82	1,940
	36.9%	26.6%	32.3%	4.2%	100%

[5] Each individual responded to three different offers. The responses to these three will indicate Decreasing marginal utility of life years, constant marginal utility and Linear utility function, Increasing marginal utility or Uncertain if the respondent is both decreasing and increasing.

Figure 1. Proportion accepting offer according to life extension (NOK 2500 in 1 year perspective and NOK 500 in 10 years perspective)

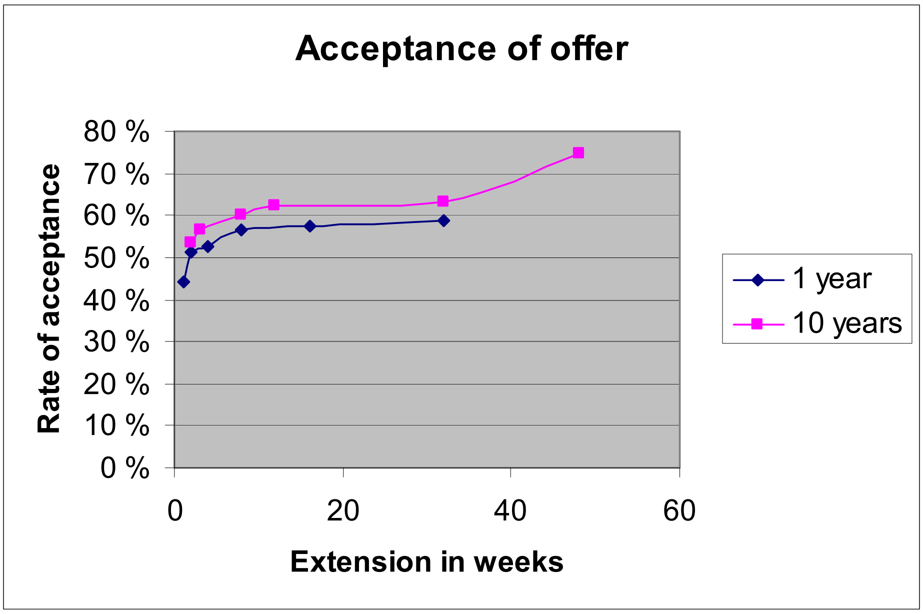
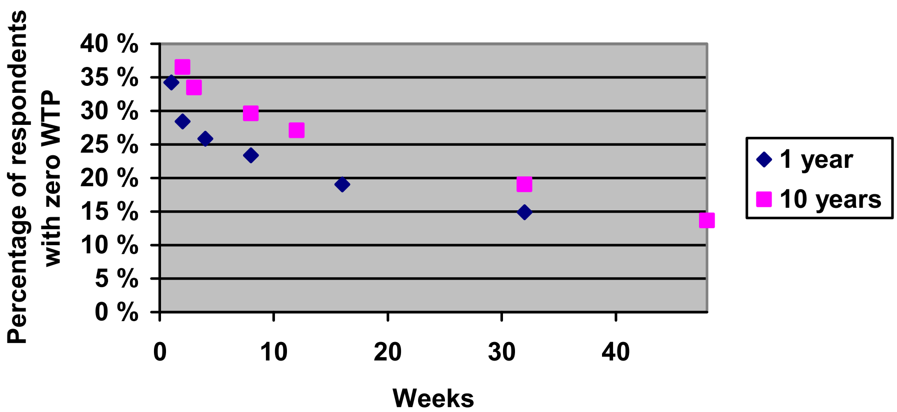


Figure 2. Proportion with zero WTP according to life extension



Appendix

Questionnaire 1

Valuation of life extension treatments

Dear respondent,

Decision makers in the health care service are increasingly frequent put in situations where they have to choose between treatment options and make priorities. The aim with this survey is to give society a better foundation for priorities and choices. In the following, we will ask you to imagine yourself in a situation where you have to pay for the treatment yourself. The aim with the study is <u>not</u> to introduce self-financing for medical treatment. The aim is to find out how much you valuate different possible life extending treatments.

The situation in the questions is hopefully far from your present life and we ask you therefore to consider the questions carefully before you answer. We ask you to consider the life extension you will achieve by taking the treatment and how much you would be willing to use from your own or your family's budget.

One year left to live
Imagine that you go to your general practitioner (GP). The GP tells you that you have a serious disease with expected lifetime of **1 year** from today. The physician can offer you an injection against the disease. The injection is taken once. The treatment will give muscular tenderness and a little stiffness at the place of the injection for a couple of days but no other side effects.

Treatment a) If you take his treatment you will expect to *extend* your lifetime with about **1 week** in the same health state as today. It will cost **NOK 2 500** and you have to pay the amount yourself.

Would you have taken the treatment?	☐ Yes	☐ No

What would you be willing to pay as a maximum for such a treatment? Please mark the alternative that suits you best or state another sum.

☐	NOK 0
☐	NOK 100
☐	NOK 1 000
☐	NOK 2 500
☐	NOK 5 000
☐	NOK 10 000
☐	NOK 15 000
☐	At maximum I would be willing to pay NOK

How certain are you on your answers?	☐ ☐ ☐ ☐ ☐ Very certain Very uncertain

If you answered you did not want treatment **a** to the given price and you did not want to pay anything for it, please mark one of the boxes below:

☐ This treatment has no value to me
☐ I cannot afford the treatment
☐ I don't think the benefit is large enough
☐ I think it is difficult to relate to the question
☐ Other reason (please explain)

Treatment b) Imagine the situation is the same (one year left to live), but the treatment will extend your lifetime with about **4 weeks** in the same health state as today. The treatment costs **NOK 10 000** and you have to pay the amount yourself.
.

Would you have accepted this treatment?	☐ ☐ Yes No

What would you be willing to pay as a maximum for such a treatment? Please mark the alternative that suits you best or state another sum.

☐	NOK 0
☐	NOK 400
☐	NOK 4 000
☐	NOK 10 000
☐	NOK 20 000
☐	NOK 40 000
☐	NOK 60 000
☐	At maximum I would be willing to pay NOK

How certain are you on your answers?	☐ ☐ ☐ ☐ ☐ Very certain Very uncertain

Treatment c) Imagine the situation is the same (one year left to live), but the treatment will extend your lifetime with about **4 months** in the same health state as today. The treatment costs **NOK 40 000** and you have to pay the amount yourself.

Would you have accepted this treatment?	☐ Yes ☐ No

What would you be willing to pay as a maximum for such a treatment? Please mark the alternative that suits you best or state another sum.

☐	NOK 0
☐	NOK 1 600
☐	NOK 16 000
☐	NOK 40 000
☐	NOK 80 000
☐	NOK 160 000
☐	NOK 240 000
☐	At maximum I would be willing to pay NOK

How certain are you on your answers?	☐ ☐ ☐ ☐ ☐ Very certain Very uncertain

If you answered you did not want treatment **c** to the given price and that you did not want to pay anything for it, please mark one of the boxes below:

☐	This treatment has no value to me
☐	I cannot afford the treatment
☐	I don’t think the benefit is large enough
☐	I think it is difficult to relate to the question
☐	Other reason (please explain)

Your current health state

How do you consider your own general health?

☐	Very good
☐	Good
☐	Neither good nor poor
☐	Poor
☐	Very poor

References

Abellán-Perpiñán, J.-M., Pinto-Prades José-Luis, Méndez-Martínez, I., & Badía-Llach, X. 2006. Towards a better QALYmodel. *Health Economics*, 15, 665-676

Bleichrodt, H., Doctor, J., & Stolk, E. 2005. A nonparametric elicitation of the equity-efficiency trade-off in cost-utility analysis. *Journal of Health Economics*, 24, (4) 655-678 available from: http://www.sciencedirect.com/science/article/B6V8K-4F3NY18-2/2/3fa615efd20b112d3cdd54f8ac17d0e9

Bleichrodt, H. & Pinto, J.L. 2000. A parameter-free elicitation of the probability weighting function in medical decision analysis. *Management Science*, 46, (11) 1485 available from: http://proquest.umi.com/pqdweb?did=65973791&Fmt=7&clientId=28039&RQT=309&VName=PQD

Doctor, J.N., Bleichrodt, H., Miyamoto, J., Temkin, N.R., & Dikmen, S. 2004. A new and more robust test of QALYs
1. *Journal of Health Economics*, 23, (2) 353-367 available from: PM:15019761

Dolan, P., Shaw, R., Tsuchiya, A., & Williams, A. 2005. QALY maximisation and people's preferences: a methodological review of the literature
22. *Health Economics*, 14, (2) 197-208 available from: PM:15386656

Dolan, P. & Jones-Lee, M. 1997. The time trade-off: A note on the effect of lifetime reallocation of consumption and discounting. *Journal of Health Economics*, 16, (6) 731-739 available from: http://www.sciencedirect.com/science/article/B6V8K-3SWSJND-6/2/f4388b1617b378fd6d16c7e19df93dfb

Drummond, M.F., Sculpher, M.J., Stoddart, G.L., O'Brien, B.J., & Torrance, G.W. 2005. *Methods for the economic evaluation of health care programmes*, 3rd ed ed. Oxford, Oxford University Press.

Finansdepartementet 2005, *Veileder i samfunnsøkonomiske analyser* Oslo.

Gyrd-Hansen, D. & Kristiansen, I.S. 2007. Preferences for 'life-saving' programmes: small for all or gambling for the prize? *Health Econ* available from: PM:17990283

Johannesson, M., Pliskin, J.S., & Weinstein, M.C. 1994. A Note on QALYs, Time Tradeoff, and Discounting. *Medical Decision Making*, 14, 188-193

Kristiansen, I.S. & Gyrd-Hansen, D. 2007. Prioritering og helse - bør det innføres makspris på leveår? *Tidsskr.Nor Laegeforen.*, 127, (1) 54-57

Miyamoto J M & Eraker A 1985. Parameter estimates for a QALY utility model. *Med Decis Making*, 5, 191 available from: http://mdm.sagepub.com

Miyamoto, J.M., Wakker, P.P., Bleichrodt, H., & Peters, H.J.M. 1998. The Zero-Condition: A Simplifying Assumption in QALY Measurement and Multiattribute Utility. *Management Science*, 44, (6) 839-849

Olsen, J.A., Donaldson, C., & Shackley, P. 2005. Implicit versus explicit ranking: on inferring ordinal preferences for health care programmes based on differences in willingness-to-pay. *J.Health Econ.*, 24, (5) 990-996 available from: PM:15893827

Olsen, J.A. 2000. A note on eliciting distributive preferences for health. *Journal of Health Economics*, 19, (4) 541-550 available from: http://www.sciencedirect.com/science/article/B6V8K-40F1RG2-8/2/9ccd0160d5a48f46781b5409afacee1f

Rodriguez-Miguez, E. & Pinto-Prades, J.L. 2002. Measuring the social importance of concentration or dispersion of individual health benefits. *Health Economics*, 11, (1) 43-53 available from: PM:11788981

Ryan, M., Scott DA, Reeves C, Bate A, van Teijlingen ER, Russell EM, Napper M, & Robb CM 2001. Eliciting public preferences for healthcare: a systematic review of techniques. *Helath Technology Assessment*, 05, (05) available from: http://www.hta.ac.uk/project/1020.asp

Ryan, M., Scott, D.A., & Donaldson, C. 2004. Valuing health care using willingness to pay: a comparison of the payment card and dichotomous choice methods. *Journal of Health Economics*, 23, (2) 237-258 available from: http://www.sciencedirect.com/science/article/B6V8K-4B4VMK3-1/2/f1341ff7dffdd1e52f96f770d8a002d1

Whynes DK, Wolstenholme JL, & Frew E 2004. Evidence of range bias in contingent valuation payment scales. *Health Econ*, 13, (2) 183-190

Williams, A. 1997. Intergenerational equity: an exploration of the 'fair innings' argument. *Health Economics*, 6, (2) 117-132 available from: PM:9158965

Wright, J.C. & Weinstein, M.C. 1998. Gains in life expectancy from medical interventions--standardizing data on outcomes. *New England Journal of Medicine*, 339, (6) 380-386 available from: PM:9691106

Appendix

I CONSTRUCTION OF THE QUESTIONNAIRE

I.1 Construction of the WTP question.

I.1.1 Fixed price per week and varying length of the offer.

By asking the respondent, the same question with varying life extension but with equal price per week I would expect the same ratio between yes and no if the valuation is linear.

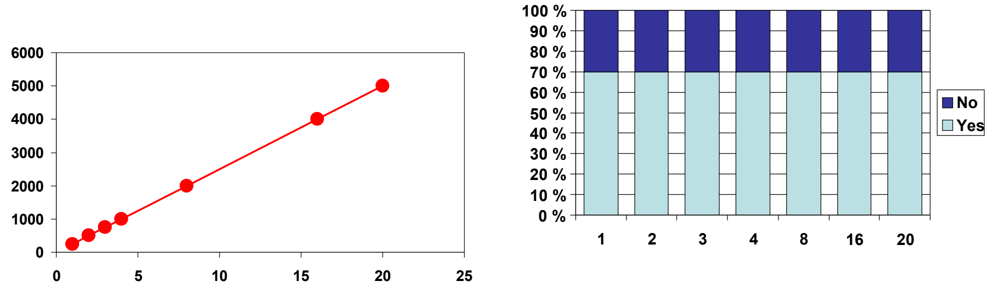


Figure 1 Linear willingness to pay for increasing weeks of life gain. Left graph shows WTP as amount. Right graph shows ratio of Yes to No if offered extensions with equal price per week.

A threshold in the valuation of short extensions should result in fewer people answering yes to the shorter extensions than to the longer ones.

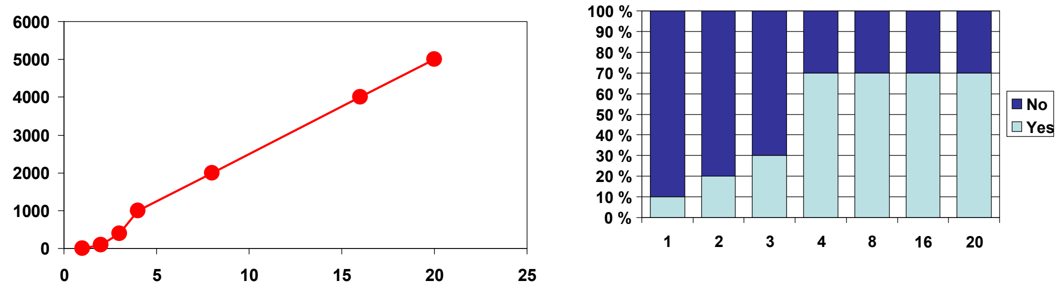


Figure 2 Threshold in the willingness to pay for increasing weeks of life gain. Left graph shows WTP as amount. Right graph shows ratio of Yes to No if offered extensions with equal price per week.

By comparing the ratios of acceptance, I can evaluate whether there is a threshold and possibly try to locate it.

The fixed price question could show false results if different extensions would result in different distributions of WTP. Thus, I have included a question to find each individual's WTP for each offer. Specifically I am interested in how many who don't value the offer at all and the change in the high WTP that could be an effect of limits in disposable income.

I.1.2 Cheap talk protocol

Questions on willingness to pay for health are difficult to formulate and the respondents' context is highly variable. In order to try to start all the respondents in the same context I have designed a short introduction which sets the scene.

I.1.3 Bias towards linearity

I want to test my hypothesis that willingness to pay is non-linear with regards to time. Therefore I have constructed the questionnaire with a bias towards linearity. If a respondent chooses the middle values or the same numbered option in each of the three questions this will be a linear response. There is thus a larger probability for false positives for linearity than for non linearity and this should result in a stronger test for my hypothesis.

I.1.4 Within subjects and between subjects analysis

Each subject is given three different offers. Thus each respondent may be tested for linearity. There are four editions of the questionnaire with different combinations of extensions and perspectives. Through between subjects analysis I can test a range from 1 week to close to a year in both 1 year and 10 years perspective.

I.1.5 Internal consistency checks

Checks for protests and uncertainties are implemented through two questions of whether the respondents are certain of their answer and a possibility to answer why he did not want the offer.

In addition, the respondent should give an increasing utility (increasing amounts in the willingness to pay question) to increasing offers. If the respondent answers with declining utility, this is considered inconsistent.

I.2 Pilot study

A pilot study was conducted in order to identify practical problems in the study. The aim was to collect standardised data of high quality and to avoid having to change the main study when it was underway. The pilot study was also intended to give answers concerning the overall quality of the questionnaire and the accuracy of the range of numbers used in it.

Six different versions of a questionnaire were filled in by a sample of 38 respondents in total. The respondents were collected from three different groups and responded on a voluntary basis. The first group consisted of employees at the Physical therapy department at Akershus University Hospital, the second group consisted of employees at the Interventional Centre at Rikshospitalet and the third group consisted of friends and family of the author. From the first two groups, around 1/3 of the available respondents in each group filled in the questionnaire. The questionnaires were distributed in the break rooms at the departments and were to be placed in an allotted envelope after they had been filled in. It was anonymous and respondents were registered by a number.

The questionnaire consisted of one part of background variables and one part with two main questions. The main questions concerned whether the respondent was willing to pay a price of 100 NOK per week to increase their life expectancy. The price was set low because the aim was to avoid the respondents' ability to pay to affect the results to a large extent. The described scenarios explained that the respondent had got a disease which gave him/her only one more year to live in question a) and only 10 more years to live in question b). The respondents were offered an injection which could increase their life expectancy by a specified amount of time. The different questionnaires had different life increases, as seen below. The price/week was the same for the perspectives of 1 and 10 years. Some respondents were classified as invalid in the analysis because of answers like: "I am willing to pay a lot" but did not give a figure. They were also withdrawn if they had refrained from answering "yes" or "no" to the question of whether they would accept the injection but had written that they were uncertain.

Questionnaire	**Perspective 1 year**	**Perspective 10 years**	**Number of respondents**	**Number of valid answers**
1	1 week	1 week	8	8
2	2 weeks	2 weeks	5	5
3	1 month	1 month	5	5
4	3 months	3 months	5	5
5	6 months	6 months	8	6
6	1 year	1 year	7	5
			38	34

Table 1 Combinations of life extension and perspective in the 6 questionnaires

The results revealed a mean willingness to pay (WTP) per week as seen below:

Life extension	1 week	2 weeks	1 month	3 months	6 months	1 year
1 year left	3 400	2 575	12 906	11 083	3 269	3 077
10 years left	1 900	25	1 220	4 250	1 362	3 397

Table 2 Mean willingness to pay in NOK per week of life extension

There were a few answers on 1 week and 3 months with values far over the others that affected the mean values. When the number of respondents is low, the mean values are easily affected by the highest and lowest values. The median (50th percentile) WTP per week extension was 2500 NOK for the 1-year perspective and the 46th percentile WTP per week prolongation was 500 NOK for the 10 year perspective. The 46th percentile value was selected because of the round figure instead of the 50th percentile.

From the values in the pilot study, a payment card was constructed to be used in the main study.

Price per week In NOK for 1-year perspective	Percentile	Price per week In NOK for 10 year perspective	Percentile
0	0-2	0	0-6
100	3-17	100	29-39
500	Ca 24	150	Ca 41
1000	29	250	46
1500	33	350	Ca 49
2500	50	500	Ca 55
5000	70	1000	71
10000	80-87	5000	Ca 84
15000	90	10000	Ca 94

Table 3 Selected payment cards for each perspective and corresponding percentiles

Since the respondents only had one life extension to consider, with two perspectives (1 and 10 years) it was not possible to perform analysis within the respondent, considering his/her linearity in WTP. In the main study, we limited each respondent's perspective to either 1 or 10 years and increased the life extensions to three per respondent in order to be able to make analysis also within the respondent.

II DATA COLLECTION

The main survey was performed in February 2007 by Gallup, Norway. The total number of respondents was 2400 and they were divided in four groups, which each received a different questionnaire, answered by 600 persons. The respondents were 40-59 years old. This age group was chosen since they were thought to be more likely to have reflected upon life/death and disease questions than younger persons and these questions would probably seem more relevant to an older respondent. The limit of 59 years was chosen because we wanted all respondents to be able to understand and answer the questions. The four questionnaires differed in life extensions and perspectives as seen below:

Questionnaire	Question a)	Question b)	Question c)	Perspective	Price per week in NOK
1	1 week	1 month	4 months	1 year	2500
2	2 weeks	2 months	8 months	1 year	2500
3	2 weeks	2 months	8 months	10 years	500
4	3 weeks	3 months	1 year	10 years	500

Table 4 Combinations of life extensions and perspectives in the 4 questionnaires used in the Gallup survey

The life extensions in question a) are multiplied by four for questions b) and c) and the price per week is constant in each questionnaire. The four different questionnaires were sent to Gallup Norway who performed the data collection. They distributed the questionnaires to the relevant age group on the internet. When the agreed upon number of respondents had responded, i.e. 600 for each questionnaire, the link to the questionnaires was closed.

IIIDETAILED DATA TRANSFORMATION

The data was sent from Gallup in four separate SPSS-files 02.03.2007. As STATA cannot import SPSS-files directly, the import had to be done through an intermediate file and some manual steps. The files were exported from SPSS as SAS transport format and imported into STATA using the command *fdause*. Some of the variable names were renamed into slightly shorter and more consistent forms and the original descriptions of the variables from the SPSS-files were added. The questionnaire alternatives were coded by *label define* to relate the values to the corresponding answers and then the correct labels were attached to the variables by *label values.* This process was repeated for each questionnaire. The answers from the different questionnaires were saved as g1, g2, g3 and g4.

In the original SPSS-files, not all respondent characteristics that I wanted to analyse were included. The two additional characteristics: “marital status” and “living with children under 15 years old” were received by separate SPSS-files 07.03.2007. They were transformed and imported as described above and “-koblet” was appended to the filename to separate them from the earlier files.

III.1 Data manipulation and analyses

In order to make it possible to analyse the WTP for a respondent on the different life extensions and his/her linearity, additional STATA do-files were created. The first was called "PriceWeek1Year" and recalculated the price the respondent had given to the different life extension offers in questions a), b) and c), to price per week. This file was run on questionnaires 1 and 2, which both have a one-year perspective. A corresponding file, called "PriceWeek10Years" was made for questionnaire 3 and 4, which have a 10-year perspective. The respondents who had responded by one of the prices in the payment card were calculated first, followed by calculations for the ones who had set their own price.

All data manipulation and transformation is done by a common STATA do-file called "MakeAll". This has been updated several times and all analyses rerun for each update. New variables called “skjema” 1, 2, 3 and 4 were created from g1, 2, 3 og 4. “Skjema” was later renamed “questionnaire”. New data-files were created which contained the answers to questions a, b and c respectively. They were saved as galla, gallb and gallc. New variables were created to match the separate data-files, called “accepted” (yes/no answers), “WTP” (maximum WTP), “sure” (level of certainty in the respondents answer), “whynot” (explanation of a negative answer). New variables for the 2 perspectives; 1 and 10 years were created, called “perspective” and for the different life extensions (“extension”). In order to be able to make a logistic regression and other additional analyses on the data, the dataset where changed from parallell to a sequential layout. The three datasets galla, gallb and gallc were appended and the resulting file was named “gcombined”. Another variable, called w4kr, was created. It divided the respondents into four new groups, coded L, I, D and U. L=linear, I=increasing, D=decreasing and U=uncertain. The category was determined by the respondents WTP. The respondent could be linear, increasing or decreasing in the maximum price per week they had given on the increasing life extension offers. Uncertain respondents had a deviant price in the middle, on question b), but were linear in questions a) and c).

III.2 Description of the variables in STATA

```
Contains data from gall.dta
  obs:         2,402
 vars:            71                          16 Oct 2007 20:30
 size:     2,985,686 (85.8% of memory free)
-------------------------------------------------------------------------------
              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
respid          int    %10.0g
id              str7   %9s                    id
intrep          byte   %10.0g      intrep     Intrep
kjonnx          str1   %9s                  * Kjønn
age             byte   %10.0g                 Age
fylke05         byte   %16.0g      fylke05    County
education       byte   %60.0g      education  Highest completed education
persinnt        byte   %24.0g      persinnt   Yearly personal income before taxes in NOK
houshold_inc    byte   %28.0g      houshold_inc Yearly houshold income before taxes in NOK
livsopph        byte   %35.0g      livsopph   What is your main income source?
antpers0        byte   %20.0g      antpers     How many persons live normally in this household,
                                              when counting all adults and children
kjonn           byte   %10.0g      kjonn      Sex
stdalder        byte   %10.0g      stdalder
xalder          byte   %10.0g      xalder
stdgeo          byte   %17.0g      stdgeo
grgeo           byte   %13.0g      grgeo
intern          byte   %10.0g      intern
q38             byte   %10.0g      q38        1 year left to live. 1 additional week for 2 500
                                              NOK.
q39             byte   %51.0g      q39        How much would you pay as a maximum for this
                                              treatment?
q39_o           str85  %85s                   How much would you pay as a maximum for this
                                              treatment?
q40             byte   %17.0g      q40        How sure are you on your answers?
q41             byte   %56.0g      q41        If you answered you did not want treatment A or
                                              did not want to pay anything for
q41_o           str200 %200s                  If you answered you did not want treatment A or
                                              did not want to pay anything for
q42             byte   %10.0g      q42        1 year left to live. 4 additional weeks for
                                              10 000 NOK.
q43             byte   %51.0g      q43        How much would you pay as a maximum for this
                                              treatment?
q43_o           str60  %60s                   How much would you pay as a maximum for this
                                              treatment?
q44             byte   %17.0g      q44        How sure are you on your answers?
q51             byte   %56.0g      q51        If you answered you did not want treatment B or
                                              did not want to pay anything for
q51_o           str200 %200s                  If you answered you did not want treatment B or
                                              did not want to pay anything for
q46             byte   %10.0g      q46        1 year left to live. 4 additional months for
                                              40 000 NOK
q47             byte   %51.0g      q47        How much would you pay as a maximum for this
                                              treatment?
q47_o           str171 %171s                  How much would you pay as a maximum for this
                                              treatment?
q48             byte   %17.0g      q48        How sure are you on your answers?
q49             byte   %56.0g      q49        If you answered you did not want treatment C or
                                              did not want to pay anything for
q49_o           str200 %200s                  If you answered you did not want treatment C or
                                              did not want to pay anything for
q50             byte   %23.0g      q50        How do you find your own health?
kommenta        str200 %200s                  Comments or views on the questionnaire?
q41_k           byte   %25.0g      reason_not_accepted
q51_k           byte   %25.0g      reason_not_accepted
q49_k           byte   %25.0g      reason_not_accepted
q38_k           byte   %9.0g
q42_k           byte   %9.0g
q46_k           byte   %9.0g
q39_k           byte   %9.0g
q43_k           byte   %9.0g
```

```
q47_k            byte    %9.0g
q39_kr           float   %9.0g
q43_kr           float   %9.0g
q47_kr           float   %9.0g
w4kr             str1    %9s
under15y         byte    %18.0g      under15y   Persons in the household under 15 years old
sivil            byte    %10.0g                 Hva er din sivil status?
_merge           byte    %8.0g
questionnaire    byte    %15.0g      questionnaire
livsforlengelse  byte    %9.0g
perspective      str8    %9s
qA_status        byte    %18.0g      status
qB_status        byte    %18.0g      status
qC_status        byte    %18.0g      status
sex_r            float   %9.0g       sex_r
childrenunder15  float   %9.0g       childrenunder15
maritalstatus    float   %9.0g       maritalstatus
ja_a             float   %9.0g
ja_b             float   %9.0g
ja_c             float   %9.0g
spma             float   %9.0g       offer
spmb             float   %9.0g       offer
spmc             float   %9.0g       offer
remove           float   %9.0g
WTP_avg          float   %9.0g                  Average WTP per week calculated from q39_kr,
                                                q43_kr and q47_kr
WTP_se           float   %9.0g                  WTP per week Standard error from the linearity
                                                of q39_kr, q43_kr and q47_kr
                                              * indicated variables have notes
```

Table 5 Gall.dta described

```
Contains data from gcombined.dta
  obs:         7,206
 vars:           104                          16 Oct 2007 20:30
 size:    11,680,926 (44.3% of memory free)
-------------------------------------------------------------------------------
              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
respid          int    %10.0g
id              str7   %9s                    id
intrep          byte   %10.0g      intrep     Intrep
kjonnx          str1   %9s                  * Kjønn
age             byte   %10.0g                 Age
fylke05         byte   %16.0g      fylke05    County
education       byte   %60.0g      education
                                              Highest completed education
persinnt        byte   %24.0g      persinnt   Yearly personal income before
                                                taxes in NOK
houshold_inc    byte   %28.0g      houshold_inc
                                              Yearly houshold income before
                                                taxes in NOK
livsopph        byte   %35.0g      livsopph   What is your main income source?
antpers0        byte   %20.0g      antpers    How many persons live normally
                                                in this household, when
                                                counting all adults and c
kjonn           byte   %10.0g      kjonn      Sex
stdalder        byte   %10.0g      stdalder
xalder          byte   %10.0g      xalder
stdgeo          byte   %17.0g      stdgeo
grgeo           byte   %13.0g      grgeo
intern          byte   %10.0g      intern
q38             byte   %10.0g      q38        1 year left to live. 1
                                                additional week for 2 500 NOK.
q39             byte   %51.0g      q39        How much would you pay as a
                                                maximum for this treatment?
q39_o           str85  %85s                   How much would you pay as a
                                                maximum for this treatment?
q40             byte   %17.0g      q40        How sure are you on your answers?
q41             byte   %56.0g      q41        If you answered you did not want treatment A or
                                              did not want to pay anything for
q41_o           str200 %200s                  If you answered you did not want treatment A or
                                              did not want to pay anything for
q42             byte   %10.0g      q42        1 year left to live. 4 additional weeks for
                                              10 000 NOK.
q43             byte   %51.0g      q43        How much would you pay as a
                                                maximum for this treatment?
q43_o           str60  %60s                   How much would you pay as a
                                                maximum for this treatment?
q44             byte   %17.0g      q44        How sure are you on your
                                                answers?
q51             byte   %56.0g      q51        If you answered you did not want treatment B or
                                              did not want to pay anything for
q51_o           str200 %200s                  If you answered you did not want treatment B or
                                              did not want to pay anything for
q46             byte   %10.0g      q46        1 year left to live. 4 additional months for
                                              40 000 NOK
q47             byte   %51.0g      q47        How much would you pay as a maximum for this
                                              treatment?
q47_o           str171 %171s                  How much would you pay as a maximum for this
                                              treatment?
q48             byte   %17.0g      q48        How sure are you on your answers?
q49             byte   %56.0g      q49        If you answered you did not want treatment C or
                                              did not want to pay anything for
q49_o           str200 %200s                  If you answered you did not want treatment C or
                                              did not want to pay anything for
q50             byte   %23.0g      q50        How do you find your own health?
kommenta        str200 %200s                  Comments or views on the questionnaire?
q41_k           byte   %25.0g      reason_not_accepted

q51_k           byte   %25.0g      reason_not_accepted

q49_k           byte   %25.0g      reason_not_accepted

q38_k           byte   %9.0g
q42_k           byte   %9.0g
q46_k           byte   %9.0g
```

q39_k	byte	%9.0g		
q43_k	byte	%9.0g		
q47_k	byte	%9.0g		
q39_kr	float	%9.0g		
q43_kr	float	%9.0g		
q47_kr	float	%9.0g		
under15y	byte	%18.0g	under15y	Persons in the household under 15 years old
sivil	byte	%10.0g		Hva er din sivil status?
_merge	byte	%8.0g		
questionnaire	byte	%15.0g	questionnaire	
livsforlengelse	byte	%9.0g		
perspective	str8	%9s		
qA_status	byte	%18.0g	status	
qB_status	byte	%18.0g	status	
qC_status	byte	%18.0g	status	
sex_r	byte	%9.0g	sex_r	
childrenunder15	byte	%9.0g	childrenunder15	
maritalstatus	byte	%9.0g	maritalstatus	
ja_a	byte	%9.0g		
ja_b	byte	%9.0g		
ja_c	byte	%9.0g		
spma	byte	%9.0g	offer	
spmb	byte	%9.0g	offer	
spmc	byte	%9.0g	offer	
remove	byte	%9.0g		
WTP_avg	float	%9.0g		Average WTP per week calculated from q39_kr, q43_kr and q47_kr
WTP_se	float	%9.0g		WTP per week Standard error from the linearity of q39_kr, q43_kr and q47_kr
accepted	byte	%9.0g		
accepted_c	byte	%9.0g	accepted_C	
WTP	byte	%9.0g		
WTP_c	byte	%9.0g		
WTP_o	str171	%171s		
WTP_week	float	%9.0g		
sure	byte	%9.0g		
whynot	byte	%9.0g		
whynot_c	byte	%25.0g	reason_not_accepted	
whynot_o	str200	%200s		
status	byte	%18.0g	status	
extension	byte	%9.0g		
offer	byte	%9.0g	offer	
accepted_r	byte	%9.0g	accepted_r	
married_previ~m	byte	%9.0g		
maritalstatus~r	byte	%9.0g		
marita~nmarried	byte	%9.0g		
maritalstatus~m	byte	%9.0g		
marita~_married	byte	%9.0g		
education_upp~l	byte	%9.0g		
education_u~g4y	byte	%9.0g		
education_u~_4y	byte	%9.0g		
education_nin~s	byte	%9.0g		
children_1	byte	%9.0g		
children_2	byte	%9.0g		
children_3	byte	%9.0g		
children_0	byte	%9.0g		
atleast50	byte	%9.0g		
age40	byte	%9.0g		
age45	byte	%9.0g		
age50	byte	%9.0g		
age55	byte	%9.0g		
w4kr	str1	%9s		
WTP_week_capped	float	%9.0g		

Table 6 Gcombined described

IV REMOVAL OF INVALID ANSWERS

The first adjustment concerned the respondents' conviction to their answers. The respondents had first answered yes/no to an offer of life extension for a given price and then set their maximum WTP for the same life extension. Next, they had been asked to indicate how sure they were on their preceding answers, on a five-point scale. The answer to the question of the offer of life extension and the maximum WTP for the extension were removed if the respondent had answered "very uncertain". If they were not "very uncertain" on their answers to the other questions in the questionnaire they were not withdrawn from the other questions. The reason for this data correction was to remove uncertainty in the given answers.

The next corrective concerned those respondents who had answered "no" to the life extension offer and did not want to pay anything for the treatment. They were asked to explain the reason for their given answers. If their reason was the treatment had no value, they could not afford it or they did not consider the benefit large enough they were included in the data set for the analysis. If they had given the answer they had difficulties in relating to the question, their answers were removed from the study concerning the preceding question. If they had difficulties, relating to an offer of 1 week it is not obvious that they would have difficulties in relating to an offer of 1 month or 4 months. The respondents were removed if they had given other explanations that were considered not valid for being included in the study. It could be respondents who had protested against the given conditions in the study and given answers like "I mean the state should pay for health care". These respondents were considered not to have accepted or understood the preconditions in the study and were removed from the analyses for all of their given answers. The corrections are performed by the STATA do-file called "RemoveInvalidanswers" that was run on each of the four groups.

The table below presents the answers given by the respondents who had answered that they did not want the life extension to the given price and did not want to pay anything for it. The different answers were categorised in 1) No value 2) Cannot afford 3) Benefit not large enough 4) Cannot relate to question 5) Other valid exp (included) 6) Other invalid (excluded).

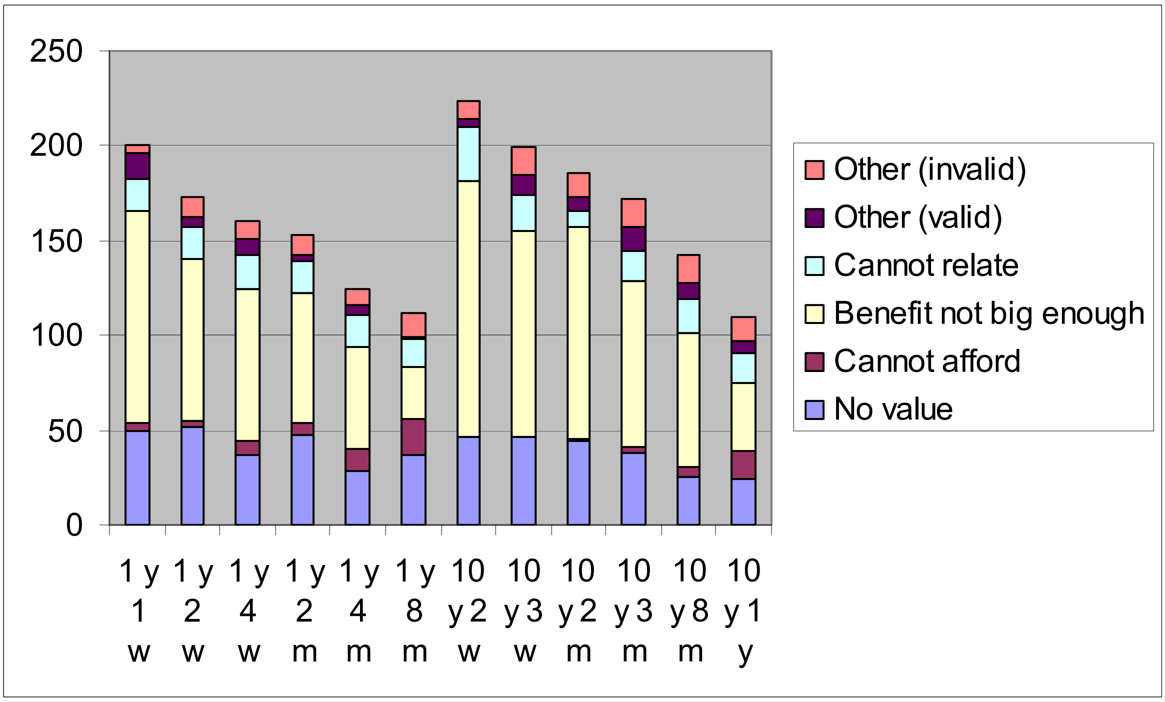


Figure 3 Distribution of answers to the question of why the respondent did not want to pay anything for the offered treatment

Offer	No value	Cannot afford	Benefit not big enough	Cannot relate	Other (valid)	Other (invalid)	Total
1 y 1 w	50	4	112	17	13	4	200
1 y 2 w	52	3	85	17	5	11	173
1 y 4 w	37	7	81	17	9	9	160
1 y 2 m	47	7	68	17	3	11	153
1 y 4 m	29	11	54	17	5	8	124
1 y 8 m	37	19	27	15	1	13	112
10 y 2 w	46	0	135	29	4	10	224
10 y 3 w	46	0	109	19	11	14	199
10 y 2 m	44	1	112	9	7	13	186
10 y 3 m	38	3	88	16	12	15	172
10 y 8 m	25	6	70	18	9	14	142
10 y 1 y	24	15	36	16	6	13	110
Total	475	76	977	207	85	135	1,955

Table 7 Number of respondents for each reason for declining to pay anything for the offered treatment

Illogical responses were also withdrawn. The answers were classified illogical if a respondent had been willing to pay an amount of money for a short life extension but nothing at all for a longer life extension.

A presentation of included and excluded respondents follows below. The table presents the answers from the original data set, included and excluded in the analysis. The excluded answers are divided in four categories, depending on the reason for the exclusion. The categories are: 1) Not understood 2) Not able to relate to question 3) Very uncertain and 4) Illogical. If a respondent is classified 1) or 4), his answers are not considered trustworthy and the respondent is removed from the dataset. If he is classified 2) or 3) the answers from the preceding question is removed.

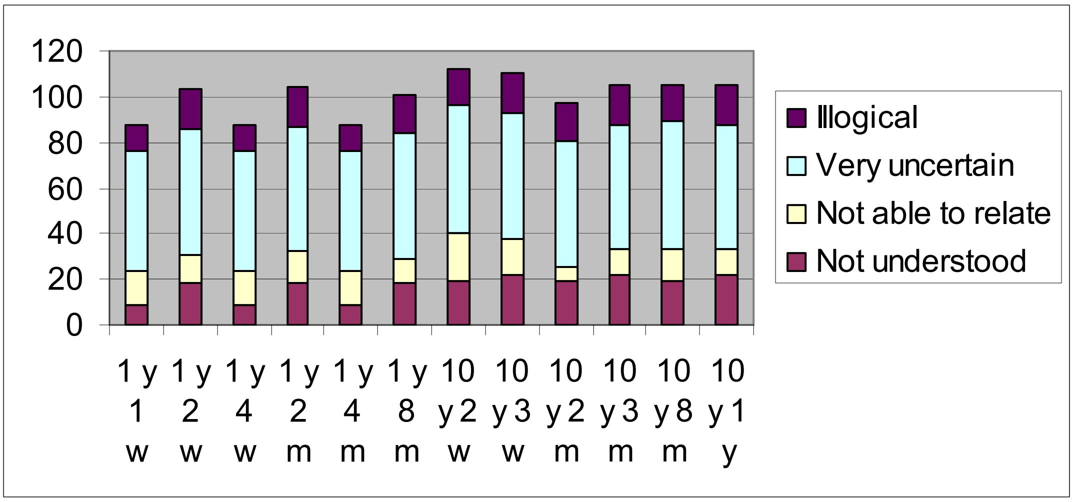


Figure 4 Number of answers removed for each consistancy check

offer	Included	Not understood	Not able to relate	Very uncertain	Illogical	Total
1 y 1 w	512	9	15	52	12	600
1 y 2 w	497	18	13	55	17	600
1 y 4 w	512	9	15	52	12	600
1 y 2 m	496	18	14	55	17	600
1 y 4 m	512	9	15	52	12	600
1 y 8 m	499	18	11	55	17	600
10 y 2 w	490	19	21	56	16	602
10 y 3 w	490	22	16	55	17	600
10 y 2 m	505	19	6	56	16	602
10 y 3 m	495	22	11	55	17	600
10 y 8 m	497	19	14	56	16	602
10 y 1 y	495	22	11	55	17	600
Total	6000	204	162	654	186	7206

Table 8 Number of answers removed for each consistancy check

The total number of answers for the four questionnaires is 7206. The number of removed answers is 1206 which leaves 6000 or 83.26 %, for the analysis. Very uncertain answers constitute the largest group of removed answers (654), 162 answers were removed due to difficulties in relating to the question and 204 answers (68 persons) were removed for not having understood and 186 answers (62 persons) due to illogical answers.

V STATISTICAL ANALYSES

V.1 Level of acceptance for the different offers

A binomial test was performed on the rate of acceptance for different offers of life extensions to test the hypothesis of linear valuation of different life extension offers. Since the price per week was the same for the different life extension offers in the same time perspective; 1- or 10 years, the percentage acceptance would be the same in the same time perspective if respondents had a linear valuation. The mean percentage acceptance was used as the reference value, i.e. the basis for the expected value. The binomial test was chosen because it allows for tests of the proportion of successes on a two-level categorical dependent variable compared to a hypothesized value. The "yes" or "no" answers to the offers of life extensions match this description. The hypothesized value in this case is the mean value, calculated separately for the two perspectives.

In the 1-year perspective, the lowest offer was 1 week and the acceptance rate was 44.3 %. The acceptance rate was increasing up to the highest offer of 8 months to 58.6 %, with one exception. The offer of 2 months had an acceptance rate of 56.8%, followed by the offer of 4 months, which had 57.5%. The highest rise in acceptance level per week was found between 1 and 2 weeks extension with a difference of 7 percentage points, from 44.3% to 51.3%. The offer of 1 week is the only offer given in the study with an acceptance level under 50%.

In the 10-years perspective, the lowest offer was 2 weeks and the acceptance rate was 53.3%. The acceptance level increased with longer life extensions up to the highest offer. For the highest offer of increased lifetime; 1 year, the level of acceptance was 74.8%. As in the 1-year perspective, the highest rise in acceptance level per week was found between the lowest life increase levels but in the 10-years perspective, this was between 2 and 3 weeks. The percentage increase was 3.2%, from 53,3 to 56.5%.

For the 1-year perspective, the mean rate of acceptance was 53.45 % and for the 10-years perspective, the mean rate of acceptance was 61.64 %. The mean acceptance rates were used in the calculation of the expected value in the binomial tests. In the 1-year perspective, the offer of 1 week had a significantly lower rate of acceptance compared to the mean value (P=0.000022). The offer of 8 months had a significantly higher rate of acceptance (P=0.012121). In the 10-years perspective, the offers of 2- and 3 weeks had significantly lower acceptance rates (P= 0.000097) and (P= 0.011762) respectively. The offer of 1 year had a significantly higher rate of acceptance (P= 0.000000).

V.1.1 Table and figure

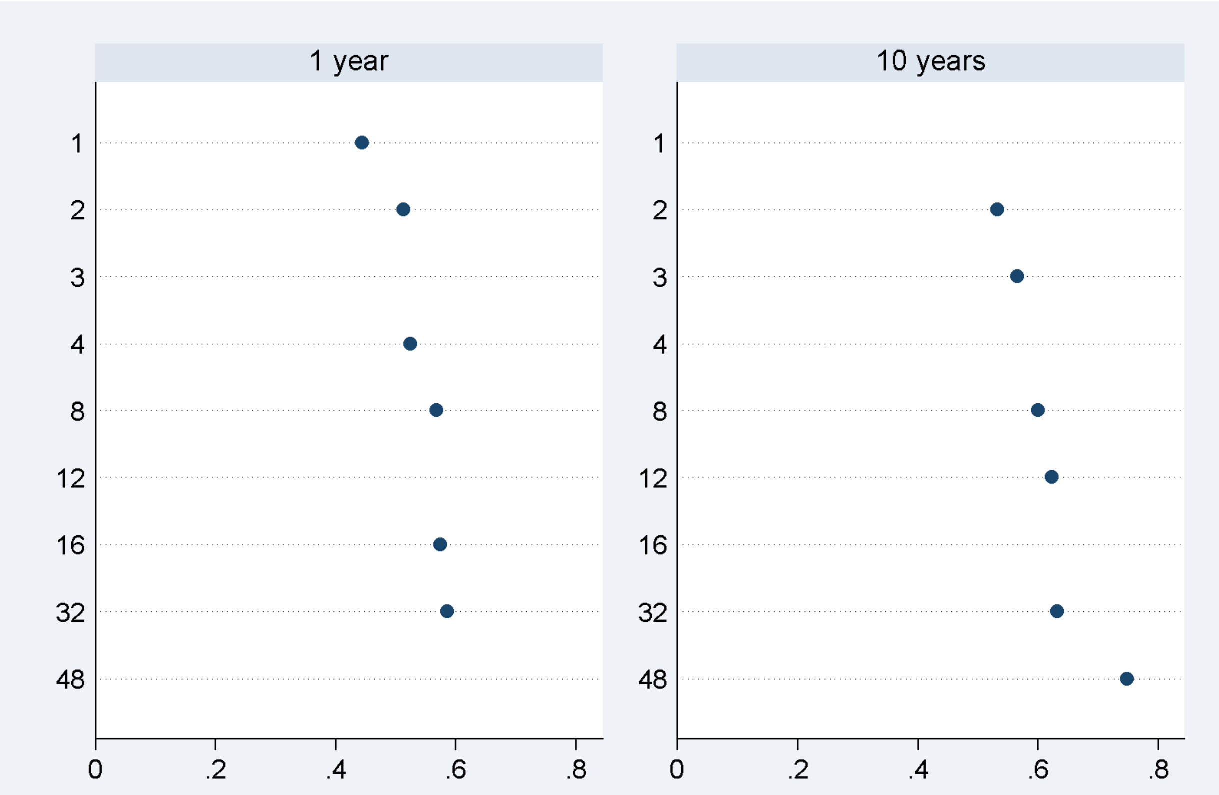


Figure 5 Acceptance rates for offers of life extensions in weeks one or ten years from today. Graphs by perspective

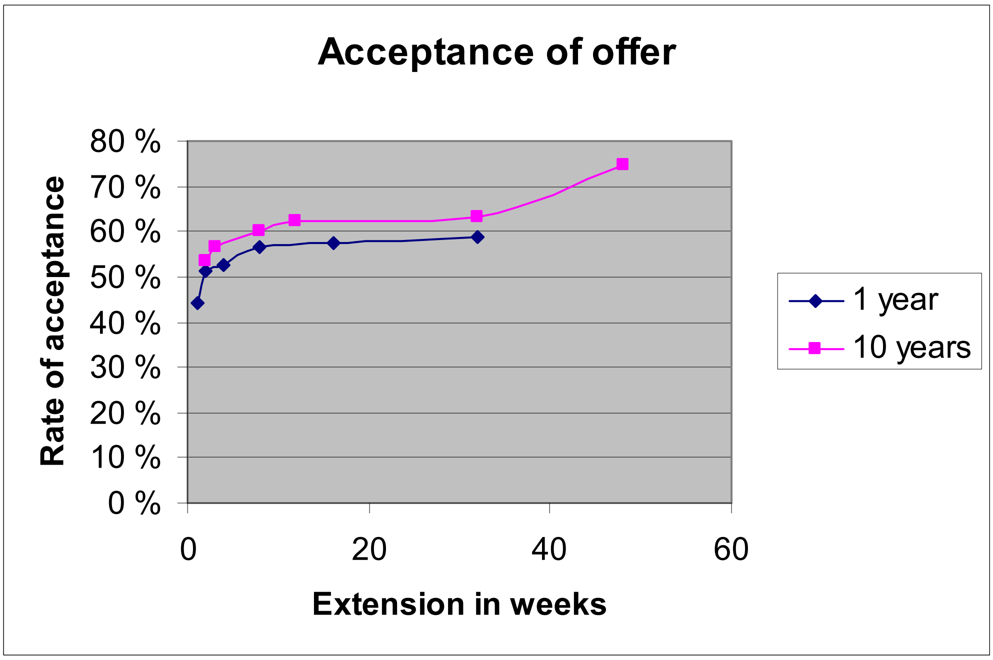


Figure 6 Percentage of respondents accepting the offer of life extension. One plot for each percpective and weeks of life extension on the horisontal axis

Offer	Yes	No	Total	Yes	No
1 y 1 w	227	285	512	44,3 %	55,7 %
1 y 2 w	255	242	497	51,3 %	48,7 %
1 y 4 w	267	242	509	52,5 %	47,5 %
1 y 2 m	281	214	495	56,8 %	43,2 %
1 y 4 m	293	217	510	57,5 %	42,5 %
1 y 8 m	290	205	495	58,6 %	41,4 %
1 y total	1,613	1,405	3,018	54,5 %	46,6 %
10 y 2 w	261	229	490	53,3 %	46,7 %
10 y 3 w	277	213	490	56,5 %	43,5 %
10 y 2 m	310	207	517	60,0 %	40,0 %
10 y 3 m	303	183	486	62,3 %	37,7 %
10 y 8 m	319	186	505	63,2 %	36,8 %
10 y 1 y	360	121	481	74,8 %	25,2 %
10y total	1,830	1,139	2,969	61,6 %	38,4 %
Total	3,443	2,544	5,987	57,5 %	42,5 %

Table 9 Number and percentage of respondents accepting the offer of life extension for each perspective

V.1.2 Acceptance rates, sorted by level of income

Yearly houshold income before taxes in NOK

offer	under 200	200 000 399 999	400 000 599 999	600 000 799 999	800 000 999 999	1 000 000 1 199 999	1 200 000 And more	Total
1 y 1 w	60.0 %	41.9 %	36.1 %	49.0 %	44.7 %	60.0 %	57.1 %	44.3 %
	10	93	147	145	76	20	21	512
1 y 2 w	45.5 %	46,9 %	41.5 %	53.7 %	63.0 %	62.5 %	70.6 %	51.3 %
	11	81	142	149	81	16	17	497
1 y 4 w	70.0 %	47.3 %	46.9 %	55.8 %	52.5 %	65.0 %	71.4 %	52.5 %
	10	91	147	147	73	20	21	509
1 y 2 m	45.5 %	48.1 %	49.3 %	61.6 %	66.2 %	62.5 %	76.5 %	56.8 %
	11	81	142	151	77	16	17	495
1 y 4 m	50.0 %	51.1 %	48.6 %	62.3 %	63.6 %	65.0 %	85.7 %	57.5 %
	10	92	144	146	77	20	21	510
1 y 8 m	36.4 %	35.8 %	56.2 %	65.3 %	70.1 %	62.5 %	87.5 %	58.6 %
	11	81	144	150	77	16	16	495
Total	50.8 %	45.3 %	46.4 %	58.0 %	60.1 %	63.0 %	74.3%	53.4%
	63	519	866	888	461	108	113	3018

Table 10 Number of respondents and percentage of respondents accepting the offer of life extension for different levels of yearly household income before taxes for 1 year left to live

Yearly houshold income before taxes in NOK

offer	under 200	200 000 399 999	400 000 599 999	600 000 799 999	800 000 999 999	1 000 000 1 199 999	1 200 000 And more	Total
10 y 2 w	31,2 %	55,2 %	50,6 %	50,9 %	64,4 %	66,6 %	62,5 %	53,2 %
	16	67	156	163	59	21	8	490
10 y 3 w	37,5 %	46,8 %	54,5 %	62,3 %	62,0 %	56,5 %	61,5 %	56,5 %
	8	94	132	162	58	23	13	490
10 y 2 m	50,0 %	61,9 %	55,4 %	57,6 %	74,1 %	73,9 %	55,5 %	59,9 %
	16	71	166	170	62	23	9	517
10 y 3 m	50,0 %	53,1 %	56,1 %	69,3 %	70,1 %	63,6 %	75,0 %	62,3 %
	8	94	130	163	57	22	12	486
10 y 8 m	37,5 %	60,8 %	56,4 %	65,0 %	77,9 %	90,0 %	55,5 %	63,1 %
	16	69	163	169	59	20	9	505
10 y 1 y	62,5 %	56,3 %	71,2 %	81,8 %	85,7 %	91,3 %	86,6 %	74,8 %
	8	94	125	160	56	23	15	481
Total	43,0 %	55,2 %	56,9 %	64,4 %	72,3 %	73,4 %	68,1 %	61,6 %
	72	489	872	987	351	132	66	2969

Table 11 Number of respondents and percentage of respondents accepting the offer of life extension for different levels of yearly household income before taxes for 10 years left to live

V.1.3 Binomial tests of acceptance rates

```
. by offer, sort : bitest accepted_r =0,53446 if perspective=="1 year"

-> offer = 1 y 1 w
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      512         227     273.6435      0.53446      0.44336

  Pr(k >= 227)            = 0.999985  (one-sided test)
  Pr(k <= 227)            = 0.000022  (one-sided test)
  Pr(k <= 227 or k >= 320) = 0.000044  (two-sided test)

-> offer = 1 y 2 w
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      497         255     265.6266      0.53446      0.51308

  Pr(k >= 255)            = 0.841482  (one-sided test)
  Pr(k <= 255)            = 0.181202  (one-sided test)
  Pr(k <= 255 or k >= 277) = 0.345300  (two-sided test)

-> offer = 1 y 4 w
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      509         267     272.0401      0.53446      0.52456

  Pr(k >= 267)            = 0.688995  (one-sided test)
  Pr(k <= 267)            = 0.343022  (one-sided test)
  Pr(k <= 267 or k >= 278) = 0.657100  (two-sided test)

-> offer = 1 y 2 m

    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      495         281     264.5576      0.53446      0.56768

  Pr(k >= 281)            = 0.075232  (one-sided test)
  Pr(k <= 281)            = 0.936789  (one-sided test)
  Pr(k <= 248 or k >= 281) = 0.149313  (two-sided test)

-> offer = 1 y 4 m
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      510         293     272.5745      0.53446      0.57451

  Pr(k >= 293)            = 0.038227  (one-sided test)
  Pr(k <= 293)            = 0.968619  (one-sided test)
  Pr(k <= 252 or k >= 293) = 0.075725  (two-sided test)

-> offer = 1 y 8 m
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      495         290     264.5576      0.53446      0.58586

  Pr(k >= 290)            = 0.012121  (one-sided test)
  Pr(k <= 290)            = 0.990462  (one-sided test)
  Pr(k <= 239 or k >= 290) = 0.024181  (two-sided test)
```

```
. by offer, sort : bitest accepted_r =0.61637 if perspective=="10 years"

-> offer = 10 y 2 w
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      490         261     302.0209     0.61637     0.53265

  Pr(k >= 261)            = 0.999933  (one-sided test)
  Pr(k <= 261)            = 0.000097  (one-sided test)
  Pr(k <= 261 or k >= 343) = 0.000164  (two-sided test)

-> offer = 10 y 3 w
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      490         277     302.0209     0.61637     0.56531

  Pr(k >= 277)            = 0.990775  (one-sided test)
  Pr(k <= 277)            = 0.011762  (one-sided test)
  Pr(k <= 277 or k >= 327) = 0.022736  (two-sided test)

-> offer = 10 y 2 m
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      517         310     318.6628     0.61637     0.59961

  Pr(k >= 310)            = 0.796670  (one-sided test)
  Pr(k <= 310)            = 0.229703  (one-sided test)
  Pr(k <= 310 or k >= 328) = 0.442152  (two-sided test)

-> offer = 10 y 3 m
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      486         303     299.5554     0.61637     0.62346

  Pr(k >= 303)            = 0.393085  (one-sided test)
  Pr(k <= 303)            = 0.642361  (one-sided test)
  Pr(k <= 296 or k >= 303) = 0.779644  (two-sided test)

-> offer = 10 y 8 m
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      505         319     311.2664     0.61637     0.63168

  Pr(k >= 319)            = 0.254659  (one-sided test)
  Pr(k <= 319)            = 0.773939  (one-sided test)
  Pr(k <= 303 or k >= 319) = 0.492761  (two-sided test)

-> offer = 10 y 1 y
    Variable |        N   Observed k   Expected k   Assumed p   Observed p
-------------+------------------------------------------------------------
  accepted_r |      481         360     296.4736     0.61637     0.74844

  Pr(k >= 360)            = 0.000000  (one-sided test)
  Pr(k <= 360)            = 1.000000  (one-sided test)
  Pr(k <= 230 or k >= 360) = 0.000000  (two-sided test)
```

V.2 The logistic regression model

Logistic regression was chosen because "accepted_r" is a dichotomous variable, coded 1 for yes and 0 for no. In STATA's help manual, logistic regression is recommended for binary outcome data. The basic model is maximum-likelihood logistic regression, reporting odds ratios.

Since each respondent was asked to answer yes/no to three offers of life extension there is a risk of bias in the data if the answers were treated as independent answers. Therefore, the answers from each respondent are treated together by a command named: "robust cluster". Robust cluster adjusts standard errors for intragroup correlation. This does not change the level of correlation between variables but increases the standard error term and thereby also the P-value.

V.2.1 Correlations among background variables

The strongest correlations were found, in decreasing order, between age40 and not having any children (negative correlation -0.4200), age55 and not having any children (positive correlation 0.3792) age40 and having 2 children (positive correlation 0.3003), household income and maritalstatus_earlierm (negative correlation -0.2855), university over 4 years and household income (positive correlation 0.2671), household income and maritalstatus_married (positive correlation 0.2638). These correlations were not considered large enough for a multicolinearity problem to occur.

```
. corr age40 age45 age50 age55 sex_r education_nine_years education_upper_secondary_school
education_university_including4y education_university_over_4y houshold_inc
maritalstatus_married maritalstatus_partner maritalstatus_unmarried maritalstatus_earlierm
children_0 children_1 children_2 children_3 extension, mean
(obs=6276)

    Variable |         Mean     Std. Dev.           Min            Max
-------------+-----------------------------------------------------
       age40 |     .2605163      .4389513             0              1
       age45 |     .2734226      .4457514             0              1
       age50 |     .2600382      .4386901             0              1
       age55 |     .2060229      .4044794             0              1
       sex_r |     .5076482      .4999813             0              1
education_~s |     .0669216      .2499061             0              1
education_~l |     .4072658      .4913643             0              1
educatio~g4y |     .3059273      .4608358             0              1
educatio~_4y |     .2198853      .4142017             0              1
houshold_inc |     3.789675      1.191495             1              7
mar~_married |     .7385277      .4394716             0              1
maritalsta~r |     .1524857      .3595196             0              1
mar~nmarried |     .0310707      .1735228             0              1
maritalsta~m |     .0779159      .2680605             0              1
  children_0 |     .5310707      .4990734             0              1
  children_1 |     .2313576       .421734             0              1
  children_2 |     .1696941      .3753937             0              1
  children_3 |     .0678776      .2515558             0              1
   extension |     13.97658      14.58906             1             48
```

	age40	age45	age50	age55	sex_r	educat~s	educat~l	educ~g4y	educ~_4y	housho~c
age40	1.0000									
age45	-0.3641	1.0000								
age50	-0.3519	-0.3637	1.0000							
age55	-0.3023	-0.3125	-0.3020	1.0000						
sex_r	-0.0341	-0.0759	0.0411	0.0761	1.0000					
education_~s	-0.0500	0.0117	0.0462	-0.0087	-0.0079	1.0000				
education_~l	0.0666	0.0045	-0.0145	-0.0614	-0.0224	-0.2220	1.0000			
educatio~g4y	0.0314	0.0117	-0.0270	-0.0176	0.0313	-0.1778	-0.5503	1.0000		
educatio~_4y	-0.0837	-0.0253	0.0194	0.0977	-0.0035	-0.1422	-0.4401	-0.3525	1.0000	
houshold_inc	-0.0616	-0.0177	0.0297	0.0542	0.0878	-0.1117	-0.2424	0.0789	0.2671	1.0000
mar~_married	-0.1103	-0.0328	0.0229	0.1310	0.0733	-0.0148	-0.0094	-0.0157	0.0375	0.2638
maritalsta~r	0.1118	0.0023	-0.0302	-0.0911	-0.0052	0.0514	0.0246	-0.0075	-0.0518	-0.0044
mar~nmarried	0.0506	0.0632	-0.0434	-0.0776	-0.0716	-0.0369	0.0198	-0.0232	0.0247	-0.2181
maritalsta~m	-0.0019	0.0097	0.0310	-0.0422	-0.0669	-0.0208	-0.0304	0.0508	-0.0079	-0.2855
children_0	-0.4200	-0.1306	0.2033	0.3792	-0.0651	0.0715	-0.0087	-0.0372	0.0086	0.0520
children_1	0.0798	0.1187	-0.0255	-0.1898	0.0097	-0.0335	0.0090	0.0269	-0.0203	-0.0582
children_2	0.3003	0.0341	-0.1461	-0.2051	0.0657	-0.0242	-0.0145	0.0508	-0.0248	0.0071
children_3	0.2512	0.0093	-0.1426	-0.1281	0.0149	-0.0495	0.0239	-0.0472	0.0540	-0.0162
extension	-0.0027	0.0010	0.0020	-0.0003	-0.0016	0.0105	-0.0033	-0.0059	0.0042	0.0003

	marita..	marita~r	m~unma~d	marita~m	childr~0	childr~1	childr~2	childr~3	extens~n
mar~_married	1.0000								
maritalsta~r	-0.7129	1.0000							
mar~nmarried	-0.3010	-0.0760	1.0000						
maritalsta~m	-0.4885	-0.1233	-0.0521	1.0000					
children_0	0.0883	-0.0331	-0.0470	-0.0699	1.0000				
children_1	-0.0656	-0.0183	0.0716	0.0858	-0.5839	1.0000			
children_2	-0.0324	0.0314	-0.0076	0.0159	-0.4811	-0.2480	1.0000		
children_3	-0.0167	0.0494	-0.0155	-0.0288	-0.2872	-0.1480	-0.1220	1.0000	
extension	-0.0025	0.0026	-0.0103	0.0073	-0.0098	0.0161	-0.0048	-0.0005	1.0000

An alternative model is also examined with age from 40 to 59 years old in one variable and living with children under 15 years as a dichotomous variable (yes or no). In the alternative model the strongest correlations were found, in decreasing order, between age and living with children under 15 years old (negative correlation -0.5603), household income and maritalstatus_earlierm (negative correlation -0.2855), university over 4 years and household income (positive correlation 0.2671), household income and maritalstatus_married (positive correlation 0.2638). These correlations were not considered large enough for a multicolinearity problem to occur.

```
. corr age sex_r education_nine_years education_upper_secondary_school education_university_including4y education_university_over_4y houshold_inc
maritalstatus_married maritalstatus_partner maritalstatus_unmarried maritalstatus_earlierm childrenunder15 extension, mean
(obs=6276)
```

Variable	Mean	Std. Dev.	Min	Max
age	48.98327	5.612184	40	59
sex_r	.5076482	.4999813	0	1
education_~s	.0669216	.2499061	0	1
education_~l	.4072658	.4913643	0	1
educatio~g4y	.3059273	.4608358	0	1
educatio~_4y	.2198853	.4142017	0	1
houshold_inc	3.789675	1.191495	1	7
mar~_married	.7385277	.4394716	0	1
maritalsta~r	.1524857	.3595196	0	1
mar~nmarried	.0310707	.1735228	0	1
maritalsta~m	.0779159	.2680605	0	1
childrenu~15	.4689293	.4990734	0	1
extension	13.97658	14.58906	1	48

	age	sex_r	educat~s	educat~l	educ~g4y	educ~_4y	housho~c	marita..	marita~r	m~unma~d	marita~m	child~15	extens~n
age	1.0000												
sex_r	0.0944	1.0000											
education_~s	0.0277	-0.0079	1.0000										
education_~l	-0.0801	-0.0224	-0.2220	1.0000									
educatio~g4y	-0.0355	0.0313	-0.1778	-0.5503	1.0000								
educatio~_4y	0.1178	-0.0035	-0.1422	-0.4401	-0.3525	1.0000							
houshold_inc	0.0882	0.0878	-0.1117	-0.2424	0.0789	0.2671	1.0000						
mar~_married	0.1572	0.0733	-0.0148	-0.0094	-0.0157	0.0375	0.2638	1.0000					
maritalsta~r	-0.1352	-0.0052	0.0514	0.0246	-0.0075	-0.0518	-0.0044	-0.7129	1.0000				
mar~nmarried	-0.0918	-0.0716	-0.0369	0.0198	-0.0232	0.0247	-0.2181	-0.3010	-0.0760	1.0000			
maritalsta~m	-0.0169	-0.0669	-0.0208	-0.0304	0.0508	-0.0079	-0.2855	-0.4885	-0.1233	-0.0521	1.0000		
childrenu~15	-0.5603	0.0651	-0.0715	0.0087	0.0372	-0.0086	-0.0520	-0.0883	0.0331	0.0470	0.0699	1.0000	
extension	0.0010	-0.0016	0.0105	-0.0033	-0.0059	0.0042	0.0003	-0.0025	0.0026	-0.0103	0.0073	0.0098	1.0000

V.2.2 The separate background variables influences

There is almost no difference in acceptance level between the age groups age40 and age45 when age is analysed separately (odds ratio .993). For age50 the odds of accepting are lower (odds ratio .886) and for age55 the acceptance level is even lower, and on the borderline of becoming significant (odds ratio .808, P=0.056). If the respondents are divided in only two groups: under- and over 50 years old, the difference in acceptance level becomes significant. For the group "atleast50" the odds ratio is .853 for acceptance and the P-value is 0.041.

The difference in acceptance level of the offer of life extension between the sexes is a bit smaller when sex is analysed separately than in the general model. When gender is analysed separately, men show a lower acceptance tendency than women with an odds ratio of .930 (P=0.348). When gender is analysed in the model, the lower acceptance for men has an odds ratio of .844 and becomes significant (P=0.048).

The lowest level of education: nine-year compulsory school is used as reference. The odds ratio for accepting when the respondent has completed upper secondary school, compared to a respondent with the highest level of education being nine-year compulsory school, is 1.33 (P=0.085) which is a non-significant difference. For the variable: education_university_including4y (university up to and including 4 years) there is a significant difference in acceptance level compared to respondents with nine-year compulsory school. The odds ratio is 1.50 (P=0.017) which implies that the respondent who has spent up to 4 years at a university is more likely to accept the offer of life extension to the given price. Finally, for education_university_over_4y (university over 4 years) the level of acceptance is the same as in the group with up to 4 years of university compared to the nine-year compulsory school group. The odds ratio is 1.52 (P=0.017).

For household income the level of acceptance is significantly higher with increasing income levels both when the variable is analysed separately and in the model. The odds for accepting with an increase in income level is 1.25 (P=0.000) when the variable is analysed separately.

Marital status: married, is used as reference. First, maritalstatus_partner (living with a co-habitee) is examined. The odds ratio for accepting when the respondent is living with a partner in comparison to a married respondent is .765 (P=0.020). The married respondent is significantly more likely to accept the offer than the respondent who is living in a partnership. The odds ratio for accepting when the respondent is unmarried is .851 (P= 0.231). In this case, the difference between being married and being unmarried is not significant. The odds ratio for accepting when the respondent has previously been married (widow/widower or divorced), in comparison to a married respondent is .985 (P=0.900). The married and the previously married respondents are very similar in their level of acceptance of the life extension-offer when marital status is analysed separately.

Not living with children is used as reference. The odds ratio for accepting when a respondent is living with 1 child under 15 years old is 1.18 (P=0.127) which implies that there is a tendency for higher acceptance among respondents living with 1 child compared to those living without children. Living with 2 children under 15 years old has an odds ratio for accepting of 1.03 (P=0.812). In this case, there is just a small difference in acceptance rates between the groups living with 2 children compared to those living without children. Finally, for respondents living with 3 or more children the odds ratio is .899 (P=0.511). This result is slightly surprising as it implies a tendency for a lower acceptance rate among respondents living with 3 or more children compared to those living without children. The difference is going in the opposite direction to the previously seen trends among respondents living with children. However, the difference is not significant.

```
. logistic   accepted_r  age45 age50 age55, robust cluster (respid)
Logistic regression                                 Number of obs    =       5987
                                                    Wald chi2(3)     =       4.43
                                                    Prob > chi2      =     0.2182
Log pseudolikelihood = -4077.3224                   Pseudo R2        =     0.0012

                              (Std. Err. adjusted for 2092 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       age45 |   .9921903   .1069824    -0.07   0.942     .8031831    1.225675
       age50 |   .8995132   .0990135    -0.96   0.336     .7249564      1.1161
       age55 |   .8134353   .0918367    -1.83   0.067     .6519625    1.014901
------------------------------------------------------------------------------

. logistic   accepted_r  age45 age50 age55, robust cluster (respid) coef
Logistic regression                                 Number of obs    =       5987
                                                    Wald chi2(3)     =       4.43
                                                    Prob > chi2      =     0.2182
Log pseudolikelihood = -4077.3224                   Pseudo R2        =     0.0012

                              (Std. Err. adjusted for 2092 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       age45 |  -.0078404   .1078245    -0.07   0.942    -.2191725    .2034918
       age50 |  -.1059016   .1100745    -0.96   0.336    -.3216437    .1098405
       age55 |  -.2064888   .1128998    -1.83   0.067    -.4277683    .0147906
       _cons |   .3755652   .0770564     4.87   0.000     .2245375    .5265928
------------------------------------------------------------------------------

. logistic   accepted_r  atleast50, robust cluster (respid)
Logistic regression                                 Number of obs    =       5987
                                                    Wald chi2(1)     =       3.50
                                                    Prob > chi2      =     0.0612
Log pseudolikelihood = -4078.1915                   Pseudo R2        =     0.0010

                              (Std. Err. adjusted for 2092 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   atleast50 |   .8634114   .0677331    -1.87   0.061     .7403592    1.006916
------------------------------------------------------------------------------

. logistic   accepted_r  atleast50, robust cluster (respid) coef
Logistic regression                                 Number of obs    =       5987
                                                    Wald chi2(1)     =       3.50
                                                    Prob > chi2      =     0.0612
Log pseudolikelihood = -4078.1915                   Pseudo R2        =     0.0010

                              (Std. Err. adjusted for 2092 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   atleast50 |   -.146864   .0784483    -1.87   0.061    -.3006198    .0068919
       _cons |   .3716165   .0539052     6.89   0.000     .2659643    .4772687
------------------------------------------------------------------------------
```

Table 12 Logistic regressions on age

```
            |        sex_r
 accepted_r |     woman        man |     Total
-----------+----------------------+----------
        No |     1,243      1,301 |     2,544
           |    41.70%     43.28%|    42.49%
-----------+----------------------+----------
       Yes |     1,738      1,705 |     3,443
           |    58.30%     56.72%|    57.51%
-----------+----------------------+----------
     Total |     2,981      3,006 |     5,987
           |   100.00%    100.00%|   100.00%
```

Table 13 Percentage of respondents answering yes to the offer split by sex

```
. logistic   accepted_r  sex_r, robust cluster (respid)
Logistic regression                                 Number of obs   =       5987
                                                    Wald chi2(1)    =       0.69
                                                    Prob > chi2     =     0.4079
Log pseudolikelihood = -4081.3527                   Pseudo R2       =     0.0002

                              (Std. Err. adjusted for 2092 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       sex_r |    .937278   .0733536    -0.83   0.408     .8039913    1.092661
------------------------------------------------------------------------------


. logistic   accepted_r  sex_r, robust cluster (respid) coef
Logistic regression                                 Number of obs   =       5987
                                                    Wald chi2(1)    =       0.69
                                                    Prob > chi2     =     0.4079
Log pseudolikelihood = -4081.3527                   Pseudo R2       =     0.0002

                              (Std. Err. adjusted for 2092 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       sex_r |  -.0647753   .0782624    -0.83   0.408    -.2181668    .0886162
       _cons |   .3352072   .0544683     6.15   0.000     .2284512    .4419632
------------------------------------------------------------------------------
```

Table 14 Logistic regression on sex

```
           |          Highest completed education
accepted_r | nine-year  upper sec  universit  universit |     Total
-----------+--------------------------------------------+----------
        No |       195      1,067        746        536 |     2,544
           |    51.05%     43.78%     40.39%     40.58% |    42.49%
-----------+--------------------------------------------+----------
       Yes |       187      1,370      1,101        785 |     3,443
           |    48.95%     56.22%     59.61%     59.42% |    57.51%
-----------+--------------------------------------------+----------
     Total |       382      2,437      1,847      1,321 |     5,987
           |   100.00%    100.00%    100.00%    100.00% |   100.00%
```

Table 15 Percentage of respondets answering yes to the offer split by education

```
education_university_over_4y, robust cluster (respid)
Logistic regression                               Number of obs   =       5987
                                                  Wald chi2(3)    =       8.02
                                                  Prob > chi2     =     0.0456
Log pseudolikelihood = -4072.9653                 Pseudo R2       =     0.0022

                              (Std. Err. adjusted for 2092 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
education_~l |   1.338903   .2243379     1.74   0.082     .9641117    1.859392
educatio~g4y |    1.53901   .2635208     2.52   0.012     1.100253    2.152735
educatio~_4y |   1.527207   .2697923     2.40   0.017     1.080256    2.159081
------------------------------------------------------------------------------


. logistic   accepted_r  education_upper_secondary_school education_university_including4y
education_university_over_4y, robust cluster (respid) coef
Logistic regression                               Number of obs   =       5987
                                                  Wald chi2(3)    =       8.02
                                                  Prob > chi2     =     0.0456
Log pseudolikelihood = -4072.9653                 Pseudo R2       =     0.0022

                              (Std. Err. adjusted for 2092 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
education_~l |   .2918507   .1675535     1.74   0.082    -.0365481    .6202496
educatio~g4y |   .4311395   .1712274     2.52   0.012     .0955399    .7667391
educatio~_4y |   .4234405   .1766573     2.40   0.017     .0771985    .7696825
       _cons |  -.0418909    .155917    -0.27   0.788    -.3474827    .2637008
------------------------------------------------------------------------------
```

Table 16 Logistic regression on eductation

accepted_r	Yearly household income before taxes in NOK: under 200	200 000 t	400 000 t	600 000 t	800 000 t	1 000 000	1 200 000	Total
No	72	503	839	724	281	75	50	2,544
	53.33%	49.90%	48.27%	38.61%	34.61%	31.25%	27.93%	42.49%
Yes	63	505	899	1,151	531	165	129	3,443
	46.67%	50.10%	51.73%	61.39%	65.39%	68.75%	72.07%	57.51%
Total	135	1,008	1,738	1,875	812	240	179	5,987
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 17 Percentage of respondents answering yes to the offer split by household income

```
. logistic   accepted_r  houshold_inc, robust cluster (respid)
Logistic regression                                 Number of obs   =       5987
                                                    Wald chi2(1)    =      45.13
                                                    Prob > chi2     =     0.0000
Log pseudolikelihood = -4029.3933                   Pseudo R2       =     0.0129

                              (Std. Err. adjusted for 2092 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
houshold_inc |   1.243523   .0403451     6.72   0.000      1.16691    1.325167
------------------------------------------------------------------------------
```

```
. logistic   accepted_r  houshold_inc, robust cluster (respid) coef
Logistic regression                                 Number of obs   =       5987
                                                    Wald chi2(1)    =      45.13
                                                    Prob > chi2     =     0.0000
Log pseudolikelihood = -4029.3933                   Pseudo R2       =     0.0129

                              (Std. Err. adjusted for 2092 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
houshold_inc |   .2179488   .0324441     6.72   0.000     .1543594    .2815382
       _cons |  -.4781347   .1220363    -3.92   0.000    -.7173215    -.238948
------------------------------------------------------------------------------
```

Table 18 Logistic regression on household income

```
           |                   maritalstatus
accepted_r |   married    partner  unmarried   earlierm |     Total
-----------+--------------------------------------------+----------
        No |     1,601        372        258        313 |     2,544
           |    41.27%     47.94%     44.95%     41.46%|    42.51%
-----------+--------------------------------------------+----------
       Yes |     2,278        404        316        442 |     3,440
           |    58.73%     52.06%     55.05%     58.54%|    57.49%
-----------+--------------------------------------------+----------
     Total |     3,879        776        574        755 |     5,984
           |   100.00%    100.00%    100.00%    100.00%|   100.00%
```

Table 19 Percentage of respondents answering yes to the offer split by marital status

```
Below, marital status: married, is used as reference
maritalstatus_partner=living with a co-habitee
maritalstatus_unmarried=never have been married
maritalstatus_earlierm=widow/widower or divorced

. logistic accepted_r maritalstatus_partner maritalstatus_unmarried maritalstatus_earlierm,
robust cluster (respid)
Logistic regression                               Number of obs   =       5984
                                                  Wald chi2(3)    =       6.18
                                                  Prob > chi2     =     0.1034
Log pseudolikelihood = -4073.7408                 Pseudo R2       =     0.0016

                              (Std. Err. adjusted for 2091 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
maritalsta~r |   .7632662   .0886583    -2.33   0.020     .6078598     .958404
mar~nmarried |   .8608054   .1172954    -1.10   0.271     .6590498    1.124325
maritalsta~m |   .9924658   .1186268    -0.06   0.950      .785188    1.254462
------------------------------------------------------------------------------

. logistic accepted_r maritalstatus_partner maritalstatus_unmarried maritalstatus_earlierm,
robust cluster (respid) coef
Logistic regression                               Number of obs   =       5984
                                                  Wald chi2(3)    =       6.18
                                                  Prob > chi2     =     0.1034
Log pseudolikelihood = -4073.7408                 Pseudo R2       =     0.0016

                              (Std. Err. adjusted for 2091 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
maritalsta~r |  -.2701484   .1161565    -2.33   0.020     -.497811   -.0424859
mar~nmarried |  -.1498868   .1362624    -1.10   0.271    -.4169561    .1171825
maritalsta~m |  -.0075627   .1195274    -0.06   0.950    -.2418321    .2267066
       _cons |   .3526694   .0490468     7.19   0.000     .2565394    .4487994
------------------------------------------------------------------------------
```

Table 20 Logistic regression on marital status

```
           | Persons in the household under 15 years old
accepted_r | No childr    1 child  2 childre  3 or more |     Total
-----------+--------------------------------------------+----------
        No |     1,189        467        397        165 |     2,218 
           |    43.13%     39.38%     43.01%     45.33% |    42.41% 
-----------+--------------------------------------------+----------
       Yes |     1,568        719        526        199 |     3,012 
           |    56.87%     60.62%     56.99%     54.67% |    57.59% 
-----------+--------------------------------------------+----------
     Total |     2,757      1,186        923        364 |     5,230 
           |   100.00%    100.00%    100.00%    100.00% |   100.00%
```

Table 21 Percentage of respondents who answers yes to the offer split by number of children under 15 years in the household

```
Below, not living with children is used as reference.
Living with children under 15 years old is coded as:
       children_1 (1 child)
       children_2 (2 children)
       children_3 (3 or more children)

. logistic   accepted_r children_1 children_2 children_3, robust cluster (respid)
Logistic regression                               Number of obs   =       5230
                                                  Wald chi2(3)    =       2.86
                                                  Prob > chi2     =     0.4134
Log pseudolikelihood = -3561.4149                 Pseudo R2       =     0.0009

                              (Std. Err. adjusted for 1829 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  children_1 |   1.167476   .1245543     1.45   0.147     .9471871    1.438997
  children_2 |   1.004688    .116247     0.04   0.968     .8008351    1.260431
  children_3 |   .9145447    .150395    -0.54   0.587     .6625621     1.26236
------------------------------------------------------------------------------

. logistic   accepted_r children_1 children_2 children_3, robust cluster (respid) coef
Logistic regression                               Number of obs   =       5230
                                                  Wald chi2(3)    =       2.86
                                                  Prob > chi2     =     0.4134
Log pseudolikelihood = -3561.4149                 Pseudo R2       =     0.0009

                              (Std. Err. adjusted for 1829 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  children_1 |   .1548438   .1066869     1.45   0.147    -.0542586    .3639462
  children_2 |   .0046766   .1157046     0.04   0.968    -.2221002    .2314535
  children_3 |   -.089329    .164448    -0.54   0.587    -.4116411    .2329831
       _cons |   .2766883   .0574446     4.82   0.000      .164099    .3892776
------------------------------------------------------------------------------
```

V.3 Logistic regression on independent variables and tendency to accept offer of life extension

V.3.1 The independent variables influences in the chosen model

Different combinations of independent variables were tried out in a larger model. In order to maximize the log likelihood of the model, the different background variables were taken out of the model separately. The highest log likelihood was found when all the chosen variables were included in the model. The model is presented first with coefficients and then with odds ratio in the following. This model was further refined before it was included in the article. The variable age is treated as one independent variable (from 40 to 59) instead of the four groups presented below and living with children under 15 is treated as a dichotomous variable (yes/no) instead of the four groups. This was done mainly to simplify the model after the independent variables had been examined.

A logistic regression was performed on a model with the chosen background variables: age, sex, level of education, household income, marital status and living with children under 15 years old and the dependent variable: accepted_r. Age is divided in four groups: age40 includes respondents from 40 to 44 years old, age45 includes respondents from 45 to 49 years old, age50 includes respondents from 50 to 54 years old and age55 includes respondents from 55 to 59 years old. Sex is coded 0 if the respondent is a woman and 1if it is a man. Education is coded in the original ordinal groups from Gallup, in four levels. These were: nine-year compulsory school, upper secondary school, university up to and including 4 years and university over 4 years. The lowest level of education: nine-year compulsory school, is used as reference because this group can be seen as a starting point for comparisons with groups of respondents with higher education even if they do not constitute the largest group. The largest group is respondents with upper secondary school. Household income is coded as an ordinal variable in seven groups, from 1 to 7 as it was received from Gallup. This coding was kept because it was the highest available level of precision for the variable. Marital status was originally divided in four nominal groups; married, living with a partner, unmarried and previously married (widow/widower/divorced). No label of marital status is an obvious starting point to be used as reference but in this regression model, marital status: married is used as reference as these respondents constitute the largest group in the age range included. Living with children under 15 years old was also originally divided in four groups. These were labelled: no child, 1 child, 2 children and 3 or more children. Among those, no child is chosen as the reference point because this is the largest group and it can be seen as the natural starting point. Finally, the different offers of life extensions are included in the model, labelled extension. Accepted_r is positive if a respondent has answered “yes” to an offer of life extension to a given price. The name ending with a _r is chosen because the variable has been adjusted to fit in the regression model. Two models were made; one with a 1- year perspective for when the life extension would occur and one with a 10-year perspective for when the life extension would occur. A robust cluster on respondent identification is made in the regressions since each respondent had three different offers of life extensions.

In the 1-year perspective, in the chosen model, there is a tendency for older respondents to be less positive toward the offer. The tendency to respond “yes” is not significantly lower for any age group. Men are less inclined to accept an offer of life extension compared to women, but the tendency is non-significant (P=0.062). All increasing levels of education are positive in comparison to nine-year compulsory school, and all levels are significantly positive (P=0.002) (P=0.004) (P=0.02). This implies that for this perspective, a respondent having more education than nine-year compulsory school seem to be more likely to accept the offer of life extension. Household income is positive and significant in the regression model (P=0.000) which implies that the higher the level of household income, the higher is the tendency for accepting the offer. The influence of household income was expected. It can be explained by a lower opportunity cost for the life extension price for higher income groups compared to lower income groups. Respondents living with a partner and unmarried respondents are less likely to answer positively compared to married respondents, but this tendency is non-significant. Respondents being previously married are significantly more inclined to accept the offer compared to married (P=0.007). This last result is not the same as the result we get when the variable marital status is analysed separately. Then, respondents being previously married have about the same level of acceptance as married respondents (odds ratio .985). The result in the main model, which looks a little odd, might be explained by the lower number of respondents being previously married than married respondents and their different pattern of household income. The higher percentage of acceptance among the lower income group among these respondents can explain the results in the main model. Respondents who have one or two children are more inclined to accept the offer than respondents without a child but the tendency is non-significant. Respondents with 3 or more children are less inclined to accept the offer than respondents without any children but the tendency is non-significant. The offer of life extension is significantly positive (P=0.000) which implies that the longer the life extension, the more likely is the respondent to accept the offer. The significant variables in this perspective were life extension (positive), household income (positive), all levels of increasing education (positive), and being previously married (positive).

In the 10-years perspective, the results are a bit different from the 1-year perspective. The increasing levels of education are negative in comparison to nine-year compulsory school, but the trend is non-significant. This implies that a respondent having more education than nine-year compulsory school seem to be less likely to accept the offer of life extension. but the tendency is so weak that it could be a coincidence. For this perspective, is seemed that respondents with children are a bit less likely to accept the offer, but the tendency is again not significant. The significant variables in this perspective were life extension (positive P=0.000), household income (positive P=0.000), living with a partner (negative P=-0.001) age55 (negative P=-0.013) age50 (negative P=-0.029).

```
. * The respondents answers to the offers of life extension is coded in accepted_r.
. * All respondents have answered yes/no to 3 offers and that is the reason for making
. * a robust cluster on respondent identification in the regressions.
.
. by perspective, sort:logistic  accepted_r  age45 age50 age55 sex_r
education_upper_secondary_school education_university_including4y education_university_over_4y
houshold_inc maritalstatus_partner maritalstatus_unmarried maritalstatus_earlierm children_1
children_2 children_3 extension, robust cluster (respid) coef
```

```
-> perspective = 1 year
Logistic regression                               Number of obs   =       2645
                                                  Wald chi2(15)   =      81.20
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -1750.4051                 Pseudo R2       =     0.0432

                               (Std. Err. adjusted for 918 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       age45 |  -.0003176   .1739149    -0.00   0.999    -.3411846    .3405494
       age50 |  -.0426901   .1895106    -0.23   0.822    -.4141241    .3287439
       age55 |  -.2016001   .2061618    -0.98   0.328    -.6056698    .2024696
       sex_r |   -.229708   .1229056    -1.87   0.062    -.4705985    .0111824
education_~l |   .8695195   .2748348     3.16   0.002     .3308532    1.408186
educatio~g4y |   .8346578   .2826724     2.95   0.003     .2806301    1.388686
educatio~_4y |   .7095553   .2995015     2.37   0.018      .122543    1.296567
houshold_inc |   .3352456   .0605327     5.54   0.000     .2166038    .4538874
maritalsta~r |   -.005978   .1746562    -0.03   0.973    -.3482979    .3363419
mar~nmarried |   -.169944    .354671    -0.48   0.632    -.8650863    .5251983
maritalsta~m |     .61959   .2329191     2.66   0.008     .1630769    1.076103
  children_1 |   .1121212   .1649424     0.68   0.497      -.21116    .4354024
  children_2 |      .0513   .1917063     0.27   0.789    -.3244374    .4270374
  children_3 |  -.0612145   .2767507    -0.22   0.825    -.6036359    .4812069
   extension |   .0161242   .0030948     5.21   0.000     .0100586    .0221899
       _cons |  -2.011726   .3699379    -5.44   0.000    -2.736791   -1.286661
------------------------------------------------------------------------------
```

```
-> perspective = 10 years
Logistic regression                               Number of obs   =       2585
                                                  Wald chi2(15)   =     125.31
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -1638.6669                 Pseudo R2       =     0.0414

                               (Std. Err. adjusted for 911 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       age45 |   -.244424   .1713458    -1.43   0.154    -.5802555    .0914075
       age50 |  -.4137854   .2024837    -2.04   0.041    -.8106462   -.0169245
       age55 |   -.561972   .2270668    -2.47   0.013    -1.007015   -.1169292
       sex_r |  -.0872275   .1267861    -0.69   0.491    -.3357236    .1612686
education_~l |  -.2809747   .2654443    -1.06   0.290    -.8012361    .2392866
educatio~g4y |  -.2285949   .2795983    -0.82   0.414    -.7765976    .3194078
educatio~_4y |  -.2799683   .2909175    -0.96   0.336    -.8501562    .2902196
houshold_inc |   .2640543    .066606     3.96   0.000     .1335089    .3945998
maritalsta~r |  -.5782672    .169642    -3.41   0.001    -.9107595    -.245775
mar~nmarried |  -.1165612   .3944224    -0.30   0.768     -.889615    .6564926
maritalsta~m |   .3945341   .2624265     1.50   0.133    -.1198123    .9088805
  children_1 |  -.1004751   .1750203    -0.57   0.566    -.4435085    .2425584
  children_2 |  -.3675701   .1999261    -1.84   0.066     -.759418    .0242777
  children_3 |   -.435441   .2599025    -1.68   0.094    -.9448405    .0739585
   extension |   .0192439   .0020584     9.35   0.000     .0152094    .0232783
       _cons |  -.0265317   .3735054    -0.07   0.943    -.7585888    .7055253
------------------------------------------------------------------------------
```

Table 22 Logistic regression with coefficients on selected model for both perspectives

```
. by perspective, sort:logistic  accepted_r  age45 age50 age55 sex_r
education_upper_secondary_school education_university_including4y education_university_over_4y
houshold_inc maritalstatus_partner maritalstatus_unmarried maritalstatus_earlierm children_1
children_2 children_3 extension, robust cluster (respid)
```

```
-> perspective = 1 year
Logistic regression                               Number of obs    =       2645
                                                  Wald chi2(15)    =      81.20
                                                  Prob > chi2      =     0.0000
Log pseudolikelihood = -1750.4051                 Pseudo R2        =     0.0432

                               (Std. Err. adjusted for 918 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       age45 |   .9996824   .1738597    -0.00   0.999     .7109277     1.40572
       age50 |   .9582083   .1815907    -0.23   0.822     .6609189    1.389222
       age55 |   .8174218   .1685211    -0.98   0.328     .5457088    1.224423
       sex_r |   .7947656   .0976811    -1.87   0.062     .6246283    1.011245
education_~l |   2.385764    .655691     3.16   0.002     1.392155    4.088531
educatio~g4y |   2.304026   .6512844     2.95   0.003     1.323964    4.009576
educatio~_4y |   2.033087   .6089126     2.37   0.018     1.130368    3.656723
houshold_inc |   1.398284   .0846418     5.54   0.000     1.241852    1.574421
maritalsta~r |   .9940398   .1736153    -0.03   0.973     .7058885    1.399818
mar~nmarried |    .843712   .2992402    -0.48   0.632     .4210152    1.690794
maritalsta~m |   1.858166   .4328024     2.66   0.008     1.177127    2.933227
  children_1 |   1.118648   .1845126     0.68   0.497     .8096445    1.545585
  children_2 |   1.052639   .2017974     0.27   0.789      .722934     1.53271
  children_3 |   .9406214   .2603176    -0.22   0.825     .5468198    1.618026
   extension |   1.016255   .0031451     5.21   0.000     1.010109    1.022438
------------------------------------------------------------------------------
```

```
-> perspective = 10 years
Logistic regression                               Number of obs    =       2585
                                                  Wald chi2(15)    =     125.31
                                                  Prob > chi2      =     0.0000
Log pseudolikelihood = -1638.6669                 Pseudo R2        =     0.0414

                               (Std. Err. adjusted for 911 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       age45 |   .7831555   .1341904    -1.43   0.154     .5597553    1.095715
       age50 |   .6611428   .1338707    -2.04   0.041     .4445707    .9832179
       age55 |   .5700838   .1294471    -2.47   0.013     .3653079    .8896482
       sex_r |   .9164686   .1161955    -0.69   0.491     .7148206    1.175001
education_~l |   .7550474   .2004231    -1.06   0.290     .4487739    1.270343
educatio~g4y |   .7956508   .2224626    -0.82   0.414     .4599684    1.376312
educatio~_4y |   .7558077   .2198777    -0.96   0.336     .4273482    1.336721
houshold_inc |   1.302199   .0867343     3.96   0.000     1.142831     1.48379
maritalsta~r |   .5608694    .095147    -3.41   0.001     .4022186    .7820982
mar~nmarried |   .8899756   .3510264    -0.30   0.768     .4108139    1.928018
maritalsta~m |   1.483693   .3893603     1.50   0.133     .8870869    2.481543
  children_1 |   .9044077   .1582897    -0.57   0.566     .6417808    1.274506
  children_2 |   .6924148   .1384318    -1.84   0.066     .4679387    1.024575
  children_3 |   .6469793   .1681515    -1.68   0.094     .3887416    1.076762
   extension |    1.01943   .0020984     9.35   0.000     1.015326    1.023551
------------------------------------------------------------------------------
```

Table 23 Logistic regression with odds ration on selected model for both perspectives

V.3.2 Testing for interactions – illustrated with figures

Next, the variable extension (life extension offer in weeks) was tested for interactions with all the included background variables in the model. In the 1-year perspective, the only significant interaction was found between extension and household income. This is interpreted as: the higher the income is for the respondent, the more inclined becomes the respondent to prefer the longer life extension offers over the shorter life extension offers. In the 10-years perspective, a significant interaction was found, in addition to extension and household income, between extension and living with children under 15 years old. Respondents who are living with children under 15 years have a higher tendency to prefer longer offers of life extensions to the shorter life extension offers. The interaction between extension and household income is illustrated below.

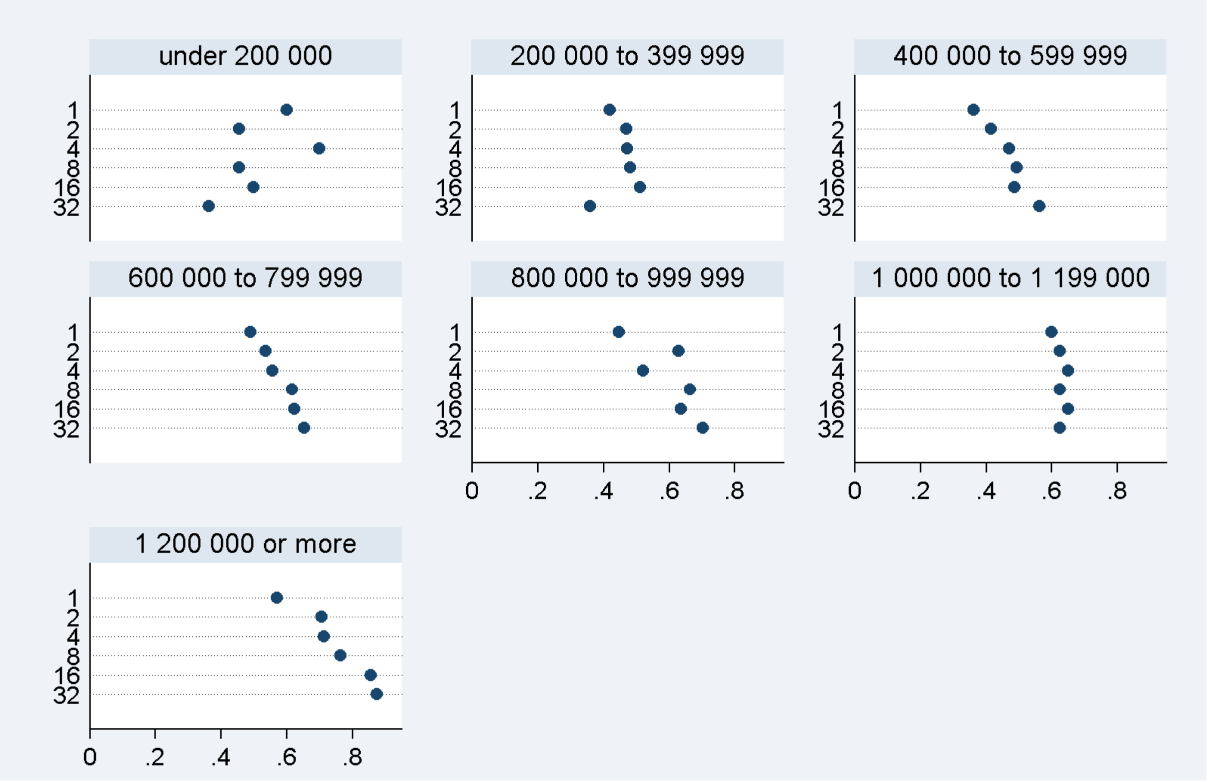


Figure 7 Interaction between extension and household income. Acceptance rates for offers of life extensions in weeks one year from today grouped by household income.

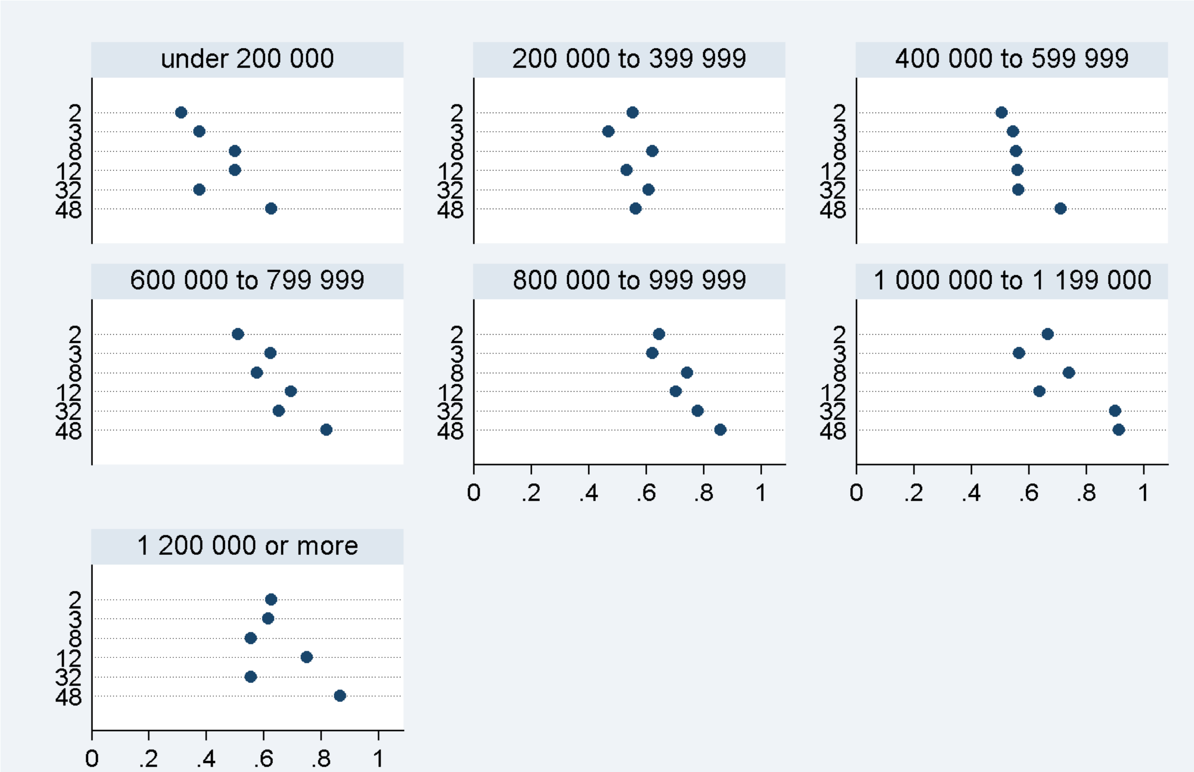


Figure 8 Interactions between extension and household income. Acceptance rates for offers of life extension in weeks ten years from today grouped by household income.

V.4 Maximum WTP/week life extension

offer	Freq	mean	Std.Dev.	min	median	max
1 y 1 w	514	6393.093	25374.21	0	500	500000
1 y 2 w	496	8834.778	55345.33	0	2500	1000000
1 y 4 w	514	4184.192	8545.494	0	2500	125000
1 y 2 m	496	3365.688	5048.077	0	2500	62500
1 y 4 m	515	2958.118	4793.289	0	2500	62500
1 y 8 m	497	3283.331	7422.913	0	2500	100000
10 y 2 w	493	5695.842	36304.72	0	500	500000
10 y 3 w	496	2226.915	4645.955	0	500	50000
10 y 2 m	520	3982.416	44307.59	0	500	1000000
10 y 3 m	487	1403.285	2417.688	0	500	10000
10 y 8 m	504	3326.457	44596.74	0	500	1000000
10 y 1 y	482	3518.82	45548.06	0	500	1000000
Total	6014	4104.23	30618.19			

Table 24 Min, mean, median, std.dev, and max for respondents answers to their willingness to pay for each offer.

V.5 Respondents with zero WTP

The respondents who had answered that they did not want the life extension offer and who did not want to pay anything for it, i.e. with a zero WTP, were analysed. The results show a decreasing percentage of respondents who did not want to pay anything with longer life extension offers. This result indicates an increasing valuation of longer life extensions. No clear threshold value is identified.

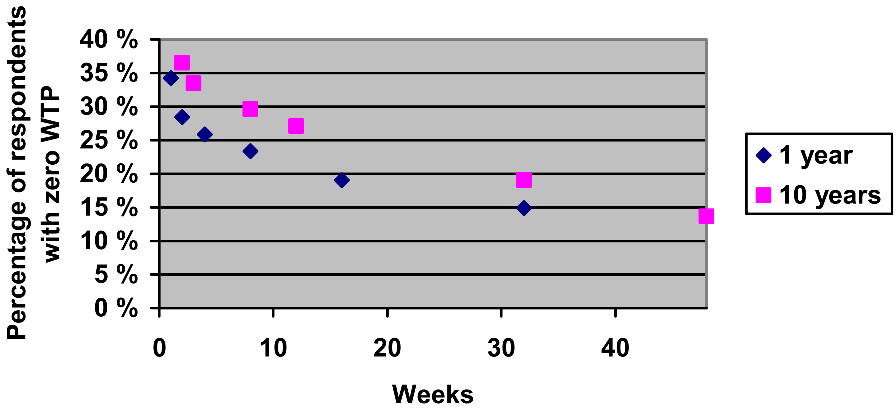


Figure 9 Percentage of respondents who answer 0 to the question of how much they would be willing to pay for the offer of life extension

offer	Number of respondents with zero WTP	Percentage of respondents with zero WTP	Number of respondents
1 y 1 w	176	34.24 %	514
1 y 2 w	141	28.43 %	496
1 y 4 w	133	25.88 %	514
1 y 2 m	116	23.39 %	496
1 y 4 m	98	19.03 %	515
1 y 8 m	74	14.89 %	497
10 y 2 w	180	36.51 %	493
10 y 3 w	166	33.47 %	496
10 y 2 m	154	29.62 %	520
10 y 3 m	132	27.10 %	487
10 y 8 m	96	19.05 %	504
10 y 1 y	66	13.69 %	482
Total	1,532	25.47 %	6,014

Table 25 Number and percentage of respondents who answer 0 to the question of how much they would be willing to pay for the offer life extension

V.6 Linear regression on independent variables and WTP of life extension offers

The respondents' maximum WTP/week were analysed with the variable WTP_week. In linear regression, the outcome variable should be continuous. Different combinations of background variables were tested as in the logistic regression on acceptance rates but the final model was the same. The robust cluster- command was also included as in the logistic regression models.

In the 1-year perspective, the significant variables were life extension (negative P=0.004), education_university_including4y (positive P=0.014), marital status_partner (negative P=-0.030) and education_upper_secondary_school (positive P=0.028). Household_inc was almost significant (positive P=0.058). These results indicate that the WTP/week is lower the longer the life extension offers. This opposes the results from the acceptance offers. Higher education seems to indicate higher WTP/week compared to nine-year compulsory school. Higher household income seems to generate higher WTP/week, which is logical and as expected.

The capped-model, which excludes the answers with the 5 % highest WTP/week, is used to avoid the extreme values. In the capped model, life extension is still significantly negative (P=-0.001), the influence of education changes a little bit as education_university_over_4y becomes significantly positive (P=0.016) and education_upper_secondary_school becomes non-significant. Education_university_including4y (positive P=0.041) is significant also in this model. The other variables are not significant in the capped model.
In the 10-years perspective, there were no significant variables. The offer of life extension was weakly positive, but non-significant.
In the capped model, extension becomes negative and significant (P=0.000) and household income becomes positive and significant (P=0.000). The other variables remained non-significant.
It does not seem as the capped model changes the basic regression model to such a large degree that it should be used instead of the basic model. It is seen as a complement in the analysis.

```
. by perspective, sort:reg WTP_week age sex_r education_upper_secondary_school
education_university_including4y education_university_over_4y houshold_inc
maritalstatus_partner maritalstatus_unmarried maritalstatus_earlierm childrenunder15 extension,
robust cluster (respid)
```

-> perspective = 1 year

Linear regression

Number of obs = 2662
F(11, 932) = 3.72
Prob > F = 0.0000
R-squared = 0.0109
Root MSE = 22951

Number of clusters (respid) = 933

WTP_week	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	86.05482	104.9382	0.82	0.412	-119.8877	291.9973
sex_r	1016.613	757.4195	1.34	0.180	-469.8322	2503.058
education_~l	1271.327	579.0609	2.20	0.028	134.9126	2407.741
educatio~g4y	2907.864	1176.025	2.47	0.014	599.9011	5215.828
educatio~_4y	724.7939	1256.529	0.58	0.564	-1741.16	3190.748
houshold_inc	1312.158	692.1139	1.90	0.058	-46.12455	2670.44
maritalsta~r	-1191.697	547.3101	-2.18	0.030	-2265.8	-117.594
mar~nmarried	1256.805	1717.389	0.73	0.464	-2113.592	4627.202
maritalsta~m	990.4587	912.2044	1.09	0.278	-799.7539	2780.671
childrenu~15	1863.188	1504.03	1.24	0.216	-1088.489	4814.865
extension	-94.37601	32.97051	-2.86	0.004	-159.0811	-29.67097
_cons	-6752.919	7140.487	-0.95	0.345	-20766.21	7260.376

-> perspective = 10 years

Linear regression

Number of obs = 2601
F(11, 927) = 1.38
Prob > F = 0.1743
R-squared = 0.0255
Root MSE = 36575

Number of clusters (respid) = 928

WTP_week	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	-6.816186	177.2537	-0.04	0.969	-354.6813	341.0489
sex_r	-1577.852	2950.743	-0.53	0.593	-7368.762	4213.059
education_~l	1016.063	1020.244	1.00	0.320	-986.1919	3018.318
educatio~g4y	832.585	2617.688	0.32	0.751	-4304.697	5969.867
educatio~_4y	-3922.468	3103.121	-1.26	0.207	-10012.42	2167.488
houshold_inc	4925.691	3220.477	1.53	0.126	-1394.58	11245.96
maritalsta~r	5926.194	6603.278	0.90	0.370	-7032.913	18885.3
mar~nmarried	22174.62	16778.76	1.32	0.187	-10754.14	55103.37
maritalsta~m	6241.721	4256.995	1.47	0.143	-2112.745	14596.19
childrenu~15	-2640.995	2398.992	-1.10	0.271	-7349.081	2067.09
extension	2.738287	42.40376	0.06	0.949	-80.48021	85.95679
_cons	-14580.88	17066.99	-0.85	0.393	-48075.3	18913.53

Table 26 Linear regression for the first model on willingness to pay per week.

```
. by perspective, sort:reg WTP_week_capped age sex_r education_upper_secondary_school
education_university_including4y education_university_over_4y houshold_inc
maritalstatus_partner maritalstatus_unmarried maritalstatus_earlierm childrenunder15 extension,
robust cluster (respid)

-> perspective = 1 year
Linear regression                                      Number of obs =     3159
                                                       F( 11,   1052) =    2.83
                                                       Prob > F      =   0.0012
                                                       R-squared     =   0.0159
Number of clusters (respid) = 1053                     Root MSE      =   5886.5
------------------------------------------------------------------------------
             |               Robust
WTP_week_c~d |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -7.24869   35.63294    -0.20   0.839    -77.1684    62.67102
       sex_r |   170.211   331.7588     0.51   0.608   -480.7733    821.1953
education_~l |  1038.832    697.995     1.49   0.137   -330.7888    2408.453
educatio~g4y |  1490.892   726.9388     2.05   0.041    64.47719    2917.307
educatio~_4y |  1872.564   777.0715     2.41   0.016    347.7775    3397.351
houshold_inc |  241.9923   163.3052     1.48   0.139   -78.44864    562.4332
maritalsta~r |  329.4083   482.3387     0.68   0.495   -617.0471    1275.864
mar~nmarried | -1046.886   826.3979    -1.27   0.206   -2668.461    574.6903
maritalsta~m |   774.693   672.2854     1.15   0.249   -544.4799    2093.866
childrenu~15 |  251.4182   394.4444     0.64   0.524    -522.569    1025.405
   extension | -24.44359    7.31509    -3.34   0.001   -38.79742   -10.08976
       _cons |  3216.156   2046.561     1.57   0.116   -799.6507    7231.963
------------------------------------------------------------------------------

-> perspective = 10 years
Linear regression                                      Number of obs =     3117
                                                       F( 11,   1038) =   14.44
                                                       Prob > F      =   0.0000
                                                       R-squared     =   0.0398
Number of clusters (respid) = 1039                     Root MSE      =     3254
------------------------------------------------------------------------------
             |               Robust
WTP_week_c~d |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age | -15.10501   19.74165    -0.77   0.444   -53.84311    23.63308
       sex_r |  113.6709   173.7582     0.65   0.513   -227.2865    454.6284
education_~l | -381.3189   363.4747    -1.05   0.294   -1094.548    331.9101
educatio~g4y | -592.2303   377.8391    -1.57   0.117   -1333.646    149.1852
educatio~_4y | -447.0576   393.9056    -1.13   0.257       -1220    325.8845
houshold_inc |  345.8194   88.89153     3.89   0.000    171.3918    520.2469
maritalsta~r | -140.0744   247.3937    -0.57   0.571   -625.5232    345.3743
mar~nmarried |  121.6797   457.6317     0.27   0.790    -776.309    1019.668
maritalsta~m |  271.4346   339.0338     0.80   0.424   -393.8351    936.7044
childrenu~15 | -238.0771    215.658    -1.10   0.270   -661.2524    185.0981
   extension |   -30.779    2.58377   -11.91   0.000   -35.84901   -25.70899
       _cons |  2943.695     1144.8     2.57   0.010    697.3096     5190.08
------------------------------------------------------------------------------
```

Table 27 Linear regression for the same model on willingness to pay per week capped in order to remove outliers.

An alternative model is presented below in which extension is separated in the different life extension offers in weeks. This is the model finally chosen to include in the article.

```
. reg WTP_week age sex_r education_upper_secondary_school education_university_including4y
education_university_over_4y houshold_inc maritalstatus_partner maritalstatus_unmarried
maritalstatus_earlierm childrenunder15 ext2 ext4 ext8 ext16 ext32 if perspective=="1 year",
robust cluster (respid)

Linear regression                                      Number of obs =    2662
                                                       F( 15,    932) =    3.58
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.0150
Number of clusters (respid) = 933                      Root MSE      =   22919
------------------------------------------------------------------------------
             |               Robust
    WTP_week |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   82.65799    102.219     0.81   0.419    -117.9481     283.264
       sex_r |   1068.881   783.0766     1.36   0.173    -467.9161    2605.679
education_~l |   1300.651   580.7088     2.24   0.025     161.0025    2440.299
educatio~g4y |   2895.221   1174.423     2.47   0.014     590.4003    5200.042
educatio~_4y |    765.021   1243.696     0.62   0.539    -1675.748     3205.79
houshold_inc |   1305.874   687.8684     1.90   0.058    -44.07606    2655.825
maritalsta~r |  -1249.378   561.6321    -2.22   0.026    -2351.588   -147.1678
mar~nmarried |   1448.205   1779.471     0.81   0.416     -2044.03    4940.439
maritalsta~m |    838.969   923.6473     0.91   0.364    -973.7004    2651.638
childrenu~15 |   1845.966   1493.482     1.24   0.217    -1085.011    4776.942
        ext2 |   2794.395   2603.331     1.07   0.283    -2314.675    7903.465
        ext4 |  -1469.864    424.353    -3.46   0.001    -2302.662   -637.0659
        ext8 |  -1947.938    642.135    -3.03   0.002    -3208.136   -687.7402
       ext16 |   -2498.33      552.9    -4.52   0.000    -3583.404   -1413.257
       ext32 |  -2009.304   697.9352    -2.88   0.004     -3379.01   -639.5969
       _cons |  -6712.844   7650.763    -0.88   0.380    -21727.56    8301.875
```

Table 28 Linear regression for selected model with nonlinear fit of willingness to pay to extension. 1 year perspective

```
. reg WTP_week age sex_r education_upper_secondary_school education_university_including4y
education_university_over_4y houshold_inc maritalstatus_partner maritalstatus_unmarried
maritalstatus_earlierm childrenunder15 ext3 ext8 ext12 ext32 ext48 if perspective=="10 years",
robust cluster (respid)

Linear regression                                      Number of obs =    2601
                                                       F( 15,    927) =    2.79
                                                       Prob > F      =  0.0003
                                                       R-squared     =  0.0267
Number of clusters (respid) = 928                      Root MSE      =   36581
------------------------------------------------------------------------------
             |               Robust
    WTP_week |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   2.458648   187.4265     0.01   0.990    -365.3709    370.2882
       sex_r |  -1618.706   2989.985    -0.54   0.588     -7486.63    4249.219
education_~l |    908.959    988.621     0.92   0.358    -1031.236    2849.154
educatio~g4y |   780.4208   2569.353     0.30   0.761    -4262.003    5822.845
educatio~_4y |  -3976.834   3139.528    -1.27   0.206    -10138.24    2184.573
houshold_inc |    4953.01   3245.629     1.53   0.127    -1416.622    11322.64
maritalsta~r |   5860.072   6541.628     0.90   0.371    -6978.045    18698.19
mar~nmarried |   22305.19    16815.8     1.33   0.185    -10696.27    55306.65
maritalsta~m |   6306.334   4307.959     1.46   0.144    -2148.149    14760.82
childrenu~15 |  -2626.394   2398.371    -1.10   0.274     -7333.26    2080.471
        ext3 |  -2969.928     1825.5    -1.63   0.104     -6552.52    612.6628
        ext8 |  -942.6898   1435.353    -0.66   0.511    -3759.607    1874.228
       ext12 |  -3834.579   1818.848    -2.11   0.035    -7404.116   -265.0411
       ext32 |  -1504.517   1658.315    -0.91   0.365    -4759.005     1749.97
       ext48 |  -1494.726   2905.403    -0.51   0.607    -7196.656    4207.203
       _cons |  -13229.34   17372.91    -0.76   0.447    -47324.14    20865.45
```

Table 29 Linear regression for selected model with nonlinear fit of willingness to pay to extension. 10 years perspective

V.7 Linearity in maximum WTP within the respondent

A minority of the respondents were strictly linear in their WTP (32.3 %). The largest group was decreasing (36.9 %), 26.6 % were increasing and 4.23 % were classified as uncertain in their WTP for increasing life extensions. When the respondents were classified according to household income the pattern was different. In all income groups, except the group 400 000 to 599 999 and the highest income group (1 200 000 or more) the largest groups of respondents were decreasing (D). In the group (400 000 to 599 999) the largest group was linear (L) and in the highest income group, the largest part was increasing (I). There is a clear difference in the distribution of respondents between the lowest and the highest income groups. In the lowest group, the percentage decreasing respondents is 47.9 %, 20.8 % are increasing and 25.0 % are linear. In the highest income group, the percentage decreasing respondents is 31.6 %, 35.1 % are increasing and 28.1 % are linear.

Yearly household income before taxes in NOK	w4kr D	I	L	U	Total
under 200 000	23 47.92%	10 20.83%	12 25.00%	3 6.25%	48 100.00%
200 000 to 399 999	139 40.76%	81 23.75%	111 32.55%	10 2.93%	341 100.00%
400 000 to 599 999	197 35.05%	141 25.09%	201 35.77%	23 4.09%	562 100.00%
600 000 to 799 999	214 35.79%	166 27.76%	187 31.27%	31 5.18%	598 100.00%
800 000 to 999 999	93 35.77%	71 27.31%	88 33.85%	8 3.08%	260 100.00%
1 000 000 to 1 199 00	32 43.24%	26 35.14%	12 16.22%	4 5.41%	74 100.00%
1 200 000 or more	18 31.58%	20 35.09%	16 28.07%	3 5.26%	57 100.00%
Total	716 36.91%	515 26.55%	627 32.32%	82 4.23%	1,940 100.00%

Table 30 Changes in willingness to pay split by household income. D=Decreasing, I=Increasing, L=Linear and U=Undecided (Neither of the others)

questionnaire	w4kr D	I	L	U	Total
questionnaire 1	186 37.13	133 26.55	165 32.93	17 3.39	501 100.00
questionnaire 2	184 37.94	123 25.36	151 31.13	27 5.57	485 100.00
questionnaire 3	187 38.72	114 23.60	168 34.78	14 2.90	483 100.00
questionnaire 4	159 33.76	145 30.79	143 30.36	24 5.10	471 100.00
Total	716 36.91	515 26.55	627 32.32	82 4.23	1,940 100.00

Table 31 Changes in willingness to pay split by questionnaire. D=Decreasing, I=Increasing, L=Linear and U=Undecided (Neither of the others)

V.8 Health states of respondents

How do you find your own health?	Freq.	Percent	Cum.
Very good	2,301	31.93	31.93
Good	3,333	46.25	78.18
Neither good nor poor	1,245	17.28	95.46
Poor	315	4.37	99.83
Very poor	12	0.17	100.00
Total	7,206	100.00	

Table 32 Respondents health state as reported

How do you find your own health?	accepted_r No	Yes	Total
Very good	728	1,141	1,869
	38.95%	61.05%	100.00%
Good	1,184	1,619	2,803
	42.24%	57.76%	100.00%
Neither good nor poor	496	558	1,054
	47.06%	52.94%	100.00%
Poor	128	122	250
	51.20%	48.80%	100.00%
Very poor	8	3	11
	72.73%	27.27%	100.00%
Total	2,544	3,443	5,987
	42.49%	57.51%	100.00%

Table 33 Percentage of respondents accepting the offer of life extension split by health state

offer	How do you find your own health? Very good	Good	Neither good nor poor	Poor	Very poor	Total
1 y 1 w	49.7%	42.1%	41.3%	50.0%	.	44.3%
	145	261	92	14	0	512
1 y 2 w	50.9%	52.5%	53.2%	34.8%	1	51.3%
	171	223	79	23	1	497
1 y 4 w	59.6%	50.2%	48.5%	46.7%	.	52.5%
	146	257	91	15	0	509
1 y 2 m	60.0%	55.9% .	55.7%	43.5%	100%	56.8%
	170	222	79	23	1	495
1 y 4 m	66.9%	57.1%	46.7%	40.0%	.	57.5%
	142	261	92	15	0	510
1 y 8 m	61.9%	58.2%	58.2%	36.4%	100%	58.6%
	168	225	79	22	1	495
Total	58.1%	52.4%	50.2%	41.1%	100%	53.4%
	942	1449	512	112	3	3018

Table 34 Percentage of respondents accepting the offer of life extension and number of respondents split by extension and health state. 1 year perspective

offer	Meget god	God	Verken go	Dårlig	Meget dår	Total
	How do you find your own health?					
10 y 2 w	53.2%	55.2%	49.4%	51.7%	0%	53.2%
	154	221	85	29	1	490
10 y 3 w	62.5%	55.1%	49.5%	62.5%	0%	56.5%
	155	225	93	16	1	490
10 y 2 m	60.7%	62.2%	55.7%	54.8%	0%	60.0%
	158	238	88	31	2	517
10 y 3 m	62.9%	54.5%	54.7%	62.5%	0%	62.3%
	154	220	95	16	1	486
10 y 8 m	66.0%	67.0%	55.2%	46.7%	0%	63.2%
	153	233	87	30	2	505
10 y 1 y	79.0%	76.0%	68.1%	62.5%	0%	74.8%
	153	217	94	16	1	481
Total	64.0%	63.4%	55.5%	55.1%	0%	61.6%
	927	1354	542	138	8	2969

Table 35 Percentage of respondents accepting the offer of life extension and number of respondents split by extension and health state. 10 years perspective

V.8.1 Health state influence in the logistic- and linear regression models

```
reg WTP_week age sex_r education_upper_secondary_school education_university_including4y
education_university_over_4y houshold_inc maritalstatus_partner maritalstatus_unmarried
maritalstatus_earlierm childrenunder15 ext2 ext4 ext8 ext16 ext32 q50 if perspective=="1 year",
robust cluster (respid)
Linear regression                                      Number of obs =     2662
                                                       F( 16,    932) =     3.39
                                                       Prob > F      =   0.0000
                                                       R-squared     =   0.0151
                                                       Root MSE      =    22924
                                  (Std. Err. adjusted for 933 clusters in respid)
```

WTP_week	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	83.43428	103.2342	0.81	0.419	-119.1641	286.0326
sex_r	1071.746	785.7617	1.36	0.173	-470.3211	2613.813
education_~l	1305.111	572.4182	2.28	0.023	181.7333	2428.489
educatio~g4y	2882.321	1183.257	2.44	0.015	560.1652	5204.477
educatio~_4y	758.3055	1261.677	0.60	0.548	-1717.751	3234.362
houshold_inc	1294.493	650.0825	1.99	0.047	18.69823	2570.288
maritalsta~r	-1243.353	560.6499	-2.22	0.027	-2343.635	-143.0703
mar~nmarried	1429.535	1749.753	0.82	0.414	-2004.377	4863.447
maritalsta~m	808.6845	862.0015	0.94	0.348	-883.0042	2500.373
childrenu~15	1828.06	1443.492	1.27	0.206	-1004.81	4660.931
ext2	2792.09	2600.458	1.07	0.283	-2311.341	7895.522
ext4	-1469.989	424.4007	-3.46	0.001	-2302.881	-637.0975
ext8	-1950.318	643.3085	-3.03	0.002	-3212.819	-687.8167
ext16	-2497.121	553.3158	-4.51	0.000	-3583.01	-1411.232
ext32	-2012.047	697.8273	-2.88	0.004	-3381.542	-642.552
q50	-131.5106	588.4076	-0.22	0.823	-1286.268	1023.247
_cons	-6441.248	7159.43	-0.90	0.369	-20491.72	7609.224

Table 36 Linear regression for selected model expanded with health state. 1 year perspective

```
. reg WTP_week age sex_r education_upper_secondary_school education_university_including4y
education_university_over_4y houshold_inc maritalstatus_partner maritalstatus_unmarried
maritalstatus_earlierm childrenunder15 ext3 ext8 ext12 ext32 ext48 q50 if perspective=="10
years", robust cluster (respid)
Linear regression                                      Number of obs =    2601
                                                       F( 16,    927) =    2.65
                                                       Prob > F      =  0.0004
                                                       R-squared     =  0.0297
                                                       Root MSE      =   36533
                               (Std. Err. adjusted for 928 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
    WTP_week |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -32.95278   174.2356    -0.19   0.850    -374.8948    308.9893
       sex_r |  -1599.787   2971.885    -0.54   0.590    -7432.189    4232.615
education_~l |   1040.214   1112.143     0.94   0.350    -1142.396    3222.823
educatio~g4y |   1183.763   2805.084     0.42   0.673    -4321.288    6688.814
educatio~_4y |  -3465.796   2855.189    -1.21   0.225    -9069.181    2137.588
houshold_inc |   5107.194   3345.709     1.53   0.127    -1458.849    11673.24
maritalsta~r |   5937.708   6573.279     0.90   0.367    -6962.524    18837.94
mar~nmarried |      22266   16715.88     1.33   0.183    -10539.35    55071.35
maritalsta~m |   6763.787   4626.527     1.46   0.144    -2315.894    15843.47
childrenu~15 |  -2537.348   2349.214    -1.08   0.280    -7147.743    2073.047
        ext3 |  -2875.498   1778.517    -1.62   0.106    -6365.884    614.8893
        ext8 |  -992.0245   1411.298    -0.70   0.482    -3761.734    1777.685
       ext12 |  -3748.507   1775.376    -2.11   0.035    -7232.729   -264.2849
       ext32 |   -1577.31   1624.194    -0.97   0.332    -4764.834    1610.215
       ext48 |  -1435.266   2892.986    -0.50   0.620    -7112.828    4242.296
         q50 |   2474.381   1839.296     1.35   0.179    -1135.286    6084.048
       _cons |  -17315.64   20085.92    -0.86   0.389    -56734.78    22103.51
------------------------------------------------------------------------------
```

Table 37 Linear regression for selected model expanded with health state. 10 years perspective

```
. logistic accepted_r age sex_r education_upper_secondary_school
education_university_including4y education_university_over_4y houshold_inc
maritalstatus_partner maritalstatus_unmarried maritalstatus_earlierm childrenunder15 ext2 ext4
ext8 ext16 ext32 q50 if perspective=="1 year", robust cluster (respid)
Logistic regression                               Number of obs   =       2645
                                                  Wald chi2(16)   =     107.67
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -1744.5862                 Pseudo R2       =     0.0464
                               (Std. Err. adjusted for 918 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .9954796   .0129066    -0.35   0.727     .9705018      1.0211
       sex_r |   .7897206   .0974536    -1.91   0.056     .6200589    1.005806
education_~l |   2.389431   .6598952     3.15   0.002     1.390645    4.105566
educatio~g4y |   2.267875   .6430675     2.89   0.004     1.300938    3.953499
educatio~_4y |   1.966407   .5902817     2.25   0.024     1.091836    3.541519
houshold_inc |   1.394457   .0845802     5.48   0.000     1.238158    1.570487
maritalsta~r |   1.014971   .1777907     0.08   0.932      .720029    1.430728
mar~nmarried |   .8788751   .3119111    -0.36   0.716     .4383665    1.762045
maritalsta~m |   1.829422    .427512     2.58   0.010     1.157175    2.892201
childrenu~15 |   1.093071   .1593301     0.61   0.542     .8214369     1.45453
        ext2 |    1.36558   .1916527     2.22   0.026     1.037182    1.797957
        ext4 |   1.419973   .1010711     4.93   0.000     1.235075    1.632552
        ext8 |    1.70803   .2396653     3.82   0.000     1.297352     2.24871
       ext16 |   1.763047   .1699752     5.88   0.000     1.459485    2.129747
       ext32 |   1.957038   .2747139     4.78   0.000     1.486327    2.576822
         q50 |   .9039733   .0712073    -1.28   0.200     .7746495    1.054887
------------------------------------------------------------------------------
```

Table 38 Logistic regression for selected model expanded with health state. 1 year perspective

```
. logistic accepted_r age sex_r education_upper_secondary_school
education_university_including4y education_university_over_4y houshold_inc
maritalstatus_partner maritalstatus_unmarried maritalstatus_earlierm childrenunder15 ext3 ext8
ext12 ext32 ext48 q50 if perspective=="10 years", robust cluster (respid)
Logistic regression                               Number of obs   =       2585
                                                  Wald chi2(16)   =     124.67
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -1633.1276                 Pseudo R2       =     0.0446
                               (Std. Err. adjusted for 911 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
  accepted_r | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .9695465   .0135603    -2.21   0.027     .9433297    .9964918
       sex_r |     .91259    .115615    -0.72   0.470      .711931    1.169805
education_~l |   .7390071   .1953716    -1.14   0.253     .4401656    1.240741
educatio~g4y |   .7680536   .2142245    -0.95   0.344     .4446063    1.326806
educatio~_4y |   .7156721   .2082935    -1.15   0.250     .4045529    1.266056
houshold_inc |    1.28876   .0859108     3.81   0.000     1.130914    1.468638
maritalsta~r |   .5487933   .0934149    -3.53   0.000     .3931138    .7661244
mar~nmarried |   .9171202   .3570006    -0.22   0.824     .4276469    1.966832
maritalsta~m |   1.462952   .3824697     1.46   0.146      .876384    2.442112
childrenu~15 |   .7893659   .1254397    -1.49   0.137     .5781124    1.077816
        ext3 |   1.211253   .1707021     1.36   0.174     .9189141    1.596596
        ext8 |   1.345981   .0913321     4.38   0.000     1.178366    1.537438
       ext12 |    1.59028    .227696     3.24   0.001     1.201154    2.105468
       ext32 |   1.617073   .1624352     4.78   0.000     1.328087    1.968942
       ext48 |   3.175938   .4918101     7.46   0.000     2.344548    4.302143
         q50 |   .8812737   .0678609    -1.64   0.101     .7578192     1.02484
------------------------------------------------------------------------------
```

Table 39 Logistic regression for selected model expanded with health state. 10 years perspective