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End-of-life Healthcare Expenditure: Testing Economic Explanations Using a Discrete Choice Experiment

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Abstract

For years, it has been known that healthcare expenditure (HCE) spent during an individual's last year of life accounts for a high share of lifetime HCE (Lubitz and Riley, 1993; Riley and Lubitz, 2010). From the point of view of standard economics, this finding is puzzling because an investment in health is unlikely to have a sufficiently long payback period. However, Becker et al. (2007) and Philipson et al. (2010) have advanced a theory designed to explain high willingness to pay (WTP) for an extension of life close to its end. Their work has several empirically testable implications, which will be extended by using invoking the concept of 'pain of risk bearing' introduced by Eeckhoudt and Schlesinger † (2006). This contribution seeks to test these implications using evidence from a Discrete Choice Experiment (DCE) performed in 2014, involving 1,529 Swiss adults. An individual setting where the price attribute is substantial out-of-pocket

payment for a novel drug for treatment of terminal cancer is distinguished from a societal one, where it is an increase in contributions to social health insurance. Most of the economic predictions receive empirical support; however, estimated societal WTP may not exceed its individual counterpart, although there is evidence of both altruism and the effect of the public good characteristic of a therapy covered by social health insurance.

Keywords: End-of-life healthcare expenditure, Terminal cancer, Societal willingness to pay, health insurance

JEL codes: C83, D12, D64, I13, J14, J17

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Introduction and motivation

Ever since the work of Lubitz and Riley (1993), it has been common knowledge that a substantial share of people's lifetime healthcare expenditure (HCE) is spent during their last year of life. From an economic point of view, investments of this type do not seem to make much sense for at least two reasons. First, at the individual level, apart from palliative care they often involve effort, discomfort, and even suffering while their expected payback period is very short. Of course, one can always invoke fear of death as a factor boosting willingness to pay (WTP); however, this explanation is not satisfactory because there are states of ill health valued worse than death (Rubin et al., 2016). Second, at the societal level there is the argument that in times where the financing of HCE increasingly meets with difficulties, resources devoted to end-of-life care could be redeployed in favor of more 'promising' patients. This reasoning in particular applies to recently launched drugs with cost per quality-adjusted life year (QALY) in excess of US$ 100,000 (Fojo and Grady, 2010). This raises concerns that their use by patients with low remaining life expectancy (who do not contribute to social health insurance in many countries) cannot be financed anymore. However, Becker et al. (2007) and Philipson et al. (2010) have put forward an economic theory of valuation of life under the threat of imminent death from which a set of predictions can be derived. The objective of this contribution is to test these predictions, using a Discrete Choice Experiment (DCE) designed to measure both individual and societal WTP for a hypothetical drug for the treatment of terminal cancer.

This paper is structured as follows. The next section contains a literature review and a statement of the hypotheses to be tested. This is followed by a description of the DCE performed in 2014, involving 1,529 Swiss participants. In the 'Results' section, econometric estimates of WTP values are reported and pitted against the hypotheses. The final section presents the conclusions of this study, with due mention of its limitations.

Literature review and statement of hypotheses

More than two decades ago, Lubitz and Riley (1993) showed that among persons aged 65 years and older, about 30 percent of healthcare expenditure (HCE) funded by Medicare accrued in their last year of life; 50 percent of this share was even concentrated in their last two months of life. This finding, confirmed by Riley and Lubitz (2010), raises an issue of rationality at two levels. At the individual level, assuming that terminal patients have a realistic estimate of their remaining life expectancy, it is puzzling that they are willing to make an investment that has such a short payback period. While it is true that most of the HCE engendered is borne by health insurance or public support, there often is still a cost falling on patients in the guise of effort, discomfort, and even suffering. At the societal level, a popular argument states that lavishing resources on persons most of whom will die anyway does not seem to make much sense; they might be spent on persons with better prospects, who are also likely to contribute to social health insurance (or pay tax devoted to a national health service, respectively) in future.

These issues became somewhat less acute when Zweifel et al. (1999), using panel data on insured with known time of death, were able to show that the steep rise of HCE just prior to death was independent of their age. Given continuing increases in life expectancy, the last costly year of human life would be one in 85 (say) in future rather than 80 at present, reducing its effect in a lifetime perspective. However, this conclusion abstracts from technological change in medicine, which predominantly constitutes cost-increasing product rather than cost-saving process innovation. In the meantime, many novel drugs have a cost per quality-adjusted life year (QALY) in excess of US$ 100,000 (Fojo and Grady, 2010), causing the irrationality issue to gain importance again.

Yet, if policy regarding costly end-of-life treatment is to reflect what contributors to health insurance and tax payers regard as optimal, it needs to heed the microeconomic condition for the consumer's optimum, stating that the ratio of marginal utility to marginal cost must be equal across goods and services [see e.g. Hirshleifer, Glazer, and Hirshleifer (2005), ch. 4.1]. Marginal utility is reflected by (marginal) WTP; therefore, if contributors and taxpayers exhibit a WTP in excess of the marginal cost of end-of-life treatment, there is no economic rationale for denying them access to it.

Becker et al. (2007) and Philipson et al. (2010) have refined this argument in a number of ways [see also Menzel (2011)]. First, they argue that wealth has no utility to a dead individual; therefore, spending wealth on an extension of life (or just an improvement in its quality) has zero opportunity cost, augmenting WTP for end-of-life care. Second, for the same reason, a minor improvement in the quality of life during survival time has a relatively high WTP value. Third, the authors distinguish between the individual and societal value of end-of-life treatment, arguing that the societal value may exceed its individual counterpart for two reasons. There may be a degree of altruism (often called solidarity in Europe) causing reluctance to deny death-bound persons access to medical care. In addition, contributors and tax payers may realize that once a novel therapy is included in the list of benefits of social health insurance (a national health service, respectively), it comes close to being a public good (Samuelson, 1954). While the non-rivalry-in-consumption condition may be violated, the non-exclusivity condition is satisfied since access is not conditioned on WTP (except for copayment, which is usually minor). Fourth, assuming expected utility maximization by individuals, Becker et al. (2007) show that the probability of survival thanks to treatment (‘hope’ in their terminology) serves to boost WTP. There is an extra effect to the extent that ’hope’ also contributes to quality of life during survival.

Fifth, the authors argue that relying on information gleaned from people still far away from their time of death is misleading for an assessment of end-of-life treatment. This information typically provides an answer to the question, ‘What would be the value of an extension of your life expectancy by six months?’. For a healthy respondent aged 30 (say) with a life expectancy of 50 years, this is a marginal variation; for someone having but a few months to live, it is inframarginal (or rather, supramarginal). Therefore, WTP values relating to people with substantial remaining life expectancy should not be used for scaling up from marginal to total; at the very least, they need to increase (progressively) with age of respondent as an indicator of closeness to death.

To this list, Menzel (2011) adds three more factors that he claims to be beyond conventional economic theory. One is discounting to present value; yet economists have made considerable effort at estimating the rate of time preference [see e.g. Andreoni and Sprenger (2012)]. A second factor is the asymmetry between risk tolerance in the

presence of a possible gain and risk aversion in the presence of a possible loss, as discussed by prospect theory [Kahnemann and Tversky (1979)]. Since the transition between the two depends on the current situation (which serves as the reference point), one can argue that the reference point for a death-bound person lies very close to zero, creating much scope for risk tolerance. Such a person may thus accept odds regarding medical treatment that would not be accepted by someone with 50 years to live [Basiel et al. (2005)]. Finally, Menzel (2011) cites what he calls the 'insurance effect' (well-known as moral hazard in economics), which creates the difficulty discussed below.

Consider again the consumer's optimum, 'Equality of marginal WTP divided by marginal cost across goods and services'. Implementing this simple criterion proves to be challenging in the case of healthcare services. Even with copayment imposed, health insurance as well as public provision cause WTP to be inflated, resulting in increased prices and quantities observed in the market for healthcare services [this moral hazard effect is discussed in detail in Zweifel and Manning (2000)]. On the cost side, most fees and prices are negotiated or set by decree, thus bearing little relation with marginal cost. Therefore, market observations are not informative in the case of healthcare services. In this situation, experimental measurement of WTP may constitute an alternative worth pursuing.

Five predictions (denoted BP) can be gleaned from Becker et al. (2007) and Philipson et al. (2010) and the discussion above. While they state additional ones regarding demand for terminal care insurance and WTP for a QALY, the DCE to be reported below does not cover the demand for insurance, while the valuation of a QALY is subject of another paper (Fischer et al., 2016).

BP1: The farther away from the time of death individuals are, the smaller their WTP for extending life. Conversely, individuals close to death exhibit high individual WTP that cannot be inferred directly from valuations by those far away from it; these valuations have to be scaled up progressively with closeness to death.

BP2: WTP for an extension of life increases with 'hope', i.e. the chance of survival thanks to end-of-life treatment.

BP3: Individual WTP equals wealth when the probability of dying without treatment is 100 percent.

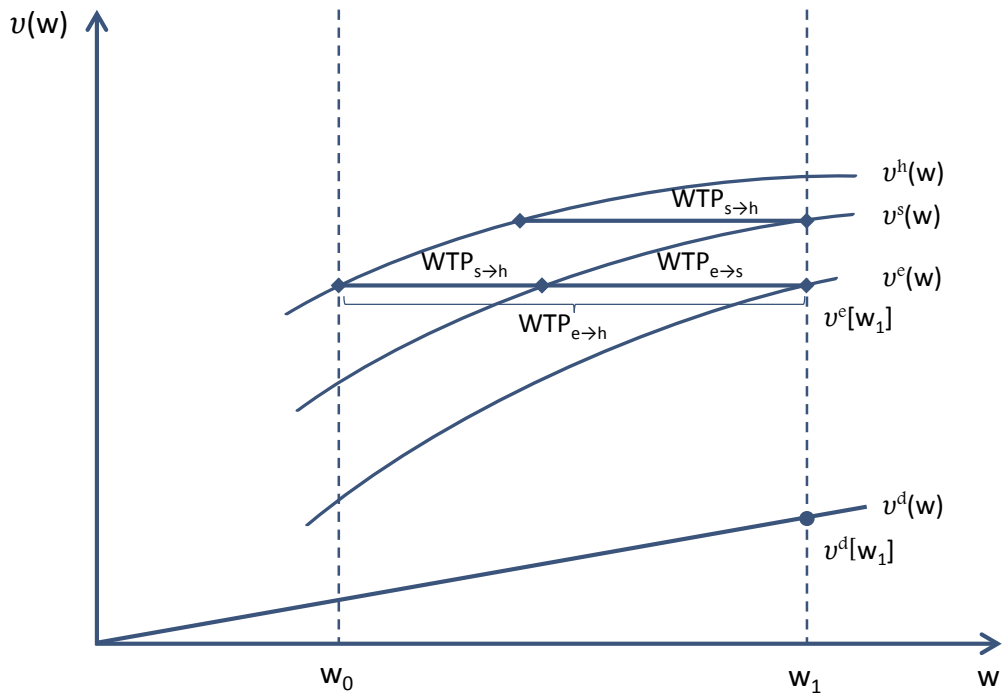
BP4: Even when abstracting from the subsidization of healthcare services, sufficiently strong altruism of contributors combined with moderate altruism on the part of beneficiaries causes societal WTP to exceed its individual counterpart.

BP5: Given sufficiently strong aversion against denying access to new end-of-life technologies, their public good characteristic causes societal WTP to exceed its individual counterpart.

However, these predictions are derived from a risk utility (von Neumann-Morgenstern) function characterized by two properties that are debatable.

(i) According to Becker et al. (2007), wealth (income, respectively in their model) has no utility in the state of death. The implication is that individual WTP for assuring survival is equal to the person's wealth. However, this neglects the bequest motive [see e.g. Laitner and Ohlson (2001)] which causes utility to increase with wealth, although in a particular way. First, in the absence of extreme altruism on the part of the testator, this increase is less marked than in his/her healthy and sick state, respectively (see Figure 1). Second, except for the unlikely case where the testator adopts the beneficiary's risk aversion, his/her own risk aversion w.r.t. wealth can be neglected since the (realized) state of death is riskless, calling for a linear risk utility function such as $\upsilon^d(W)$.

Figure 1. State-dependent risk utility functions and WTP values



States: h = healthy, s = sick, e = end of life, d = death

(ii) In Becker et al. (2007), the marginal utility of (risky) wealth in good health is higher than in ill health. This assumption seems to be supported by Finkelstein et al. (2009), whose empirical approach however neglects the fact that wealth is risky in the present context. Note that Becker et al. (2007) also derive predictions regarding the demand for terminal care insurance, which implies that wealth is risky in their analysis. By way of contrast, Eeckhoudt and Schlesinger † (2006) introduce the concept of 'pain of risk bearing'. Risk-averse people can be safely assumed to minimize this pain by avoiding the accumulation of risks. Conversely, the pain of risk bearing should be particularly marked if both of the two assets considered, 'health' and 'wealth', take on unexpectedly low values. Let such a low value be W_0 in Figure 1. If the individual simultaneously suffers a health loss, the pain of suffering, indicated by the difference in utility values at W_0, must be high. This consideration implies that the vertical distance between $\upsilon^s(W)$ and $\upsilon^h(W)$ is higher at W_0 than at $W_1 > W_0$; hence the marginal utility of (risky) wealth

is higher in the sick than in the healthy state. Evidently, this argument carries over to the sick state compared to the end-of-life state [with risk utility function $\upsilon^e(W)$].

One detail concerning these risk utility functions needs to be pointed out. Usually, they refer to one future time period of unspecified length. In the DCE to be reported below, this will be three months (six months, respectively in one variant) until death, defining the benchmark $\upsilon^e(W)$. Gains in survival time correspond to a movement from $\upsilon^e(W)$ toward $\upsilon^s(W)$ as long as quality of life is held constant. However, in some scenarios quality of life can attain the maximum of 100 points; this amounts to a movement of $\upsilon^e(W)$ beyond $\upsilon^s(W)$ and toward $\upsilon^h(W)$. Finally, in some scenarios there is a minimal probability of one percent (0.1 percent, respectively) of being cured. Since the $\upsilon^h(W)$ function is defined for the benchmark state of 'no hope', this shifts $\upsilon^h(W)$ itself up (see FTZ9 below).

In the following, Figure 1 is used to derive a second set of eight hypotheses (denoted by FTZ) in addition to the ones (BP) stated above.

FTZ1: $WTP_{e\to h}$, (maximum) willingness to pay for returning from end-of-life to healthy status, is the sum of $WTP_{e\to s}$ for returning just to sick status (longer survival but no improvement in quality of life) and $WTP_{s\to h}$, for moving from sick to healthy status (unchanged survival but improvement in quality of life). Consider the utility value $\upsilon^e[W_1]$, a particular value pertaining to the risk utility function $\upsilon^e(W)$ (the reference function) associated with end-of-life status but not death. Applying the 'ransom' concept of Cook and Graham (1977), one can say that $WTP_{s\to h}$ depicts the (maximum) WTP for returning from sick to healthy status, while $WTP_{e\to h}$ denotes the individual's WTP for returning from end-of-life to healthy status. The summation condition is evident.

FTZ2: $WTP_{s\to h}$ increases with (certain) W. This can be seen by comparing $WTP_{s\to h}$ in the neighborhood of W_0 with $WTP_{s\to h}$ at W_1. With increasing wealth, the pain of risk bearing becomes smaller; thus moving up from $\upsilon^s(W)$ to $\upsilon^h(W)$ can be combined with a larger loss in wealth in terms of 'ransom' while maintaining the same level of utility.

FTZ3: $WTP_{e\to h}$ increases with (certain) W. Consider moving point $\upsilon^e[W_1]$ horizontally to the right, in analogy to the transition from W_0 to W_1 in FTZ2.

FTZ4: $WTP_{e\to h}$ increases with the probability of dying without treatment. This means that the 'pain of risk bearing' increases at a given wealth level. Thus, consider moving $\upsilon^e(W)$ down with $\upsilon^h(W)$ unchanged, holding W_1 constant; the 'ransom' increases. Note that this prediction differs from BP1, which relates to time to death.

FTZ5: $WTP_{e\to s}$ increases with the probability of dying without treatment. Again, consider moving $\upsilon^e(W)$ down with $\upsilon^s(W)$ unchanged this time, holding W_1 constant.

FTZ6: $WTP_{e\to s}$ increases faster with the probability of dying without treatment than does $WTP_{e\to h}$. Again consider moving $\upsilon^e(W)$ down with $\upsilon^s(W)$ unchanged, holding W_1 constant. The marginal utility of wealth decreases faster along $\upsilon^s(W)$ than $\upsilon^h(W)$, reflecting the 'pain of risk bearing' view, which implies a higher marginal utility of wealth in the sick than in the healthy state.

FTZ7: When the probability of dying without treatment approaches 100 percent, both $WTP_{e\to h}$ and $WTP_{e\to s}$ approach (but do not equal, contrary to BP3) total wealth W_1. The reason is that in this case points $\upsilon^e[W_1]$ and $\upsilon^s[W_1]$ (the latter not shown in Figure 1) approach point $\upsilon^d[W_1]$. The two 'ransom' values become similar as a result, and they both increase, without however attaining W_1 in general.

FTZ8 (=BP2): When the probability of survival due to treatment increases, $WTP_{e\to h}$ increases because 'hope' indicates a chance of being cured. Recall that $\upsilon^h(W)$ holds for the benchmark case of 'no hope'. With a nonzero chance of being cured, $\upsilon^h(W)$ shifts up, and both $WTP_{e\to s}$ and $WTP_{s\to h}$ increase in view of the summation condition FTZ1.

The Discrete Choice Experiment[1]

Over the last few years, Discrete Choice Experiments (DCEs) have become the 'gold standard' in health economics for eliciting preferences (Clark et al., 2014). The main advantage of a DCE (compared to Contingent Valuation) is that it allows to simultaneously vary the levels of all attributes rather than holding them constant with the sole exception of price. In this way, a realistic choice scenario can be created, simulating everyday experience, where choice of a product other than the incumbent one almost always involves changes in several attributes (starting with package size and ending with the location of the outlet in the case of a toothpaste, say).

The DCE to be reported here involved 1,529 adult Swiss residents and was performed in 2014. It is designed to measure WTP for prolonging life by a few months using a hypothetical novel medication for treating terminal cancer. Two types of WTP are distinguished, individual (where the price attribute is a substantial out-of-pocket copayment) and societal (where the price attribute is an increase in contributions to social health insurance occasioned by inclusion of the drug in the benefit list). A wide range of potential influences are controlled for, enabling most of the predictions stated in the preceding section to be tested.

The DCE was divided into two parts, the first involving choices of contracts in mandatory social health insurance (SHI henceforth), reflecting a societal viewpoint (presumably the easier task). The second part involved individual treatment (IT henceforth) choices, reflecting the viewpoint of the individual. Here, participants were asked to identify with patients having terminal cancer; in the (fixed) status quo with standard cancer treatment, they would have three months (six months, respectively; see Figure 2) to live, with quality of life equal to 50 (30, respectively) on a scale from 0 to 100.

Contrary to the sequence in the DCE, the IT setting is discussed first because the predictions stated in the preceding section mainly relate to individual WTP values. Respondents had to choose between drugs which differed w.r.t. survival time, quality of

[1] This section draws on Fischer et al. (2016).

life, and chance of being cured (see Table 1). Each choice task had two stages. In the first, respondents were asked to choose between two hypothetical drugs. In the second stage, they were given an opt-out possibility, the choice being between the drug selected and the status quo treatment. The attributes ‘Survival time’ and ‘Quality of life’ also featured levels that were worse than in the status quo scenario, which however were not combined because this would have almost certainly led to a dominated alternative. Maximum survival time was 12 months, i.e. six months more than with the status quo cancer treatment. An example is provided in Table A.2 of the Appendix.

In the SHI setting, respondents had to choose between contract variants in mandatory social health insurance, which differed in terms of their coverage of cancer drugs for end-of-life treatment (note that Swiss social health insurance allows contract variants in terms of annual deductible and fee-for-service vs managed care). This time, seven attributes were used with two to four levels each to describe the hypothetical drug (see Table 1 again): The number of patients who would benefit from it (‘Prevalence’), their age group, survival time in months, quality of life (on a scale from 0 to 100), chance of being cured, and treatment cost per patient. The attributes ‘Survival time’ and ‘Quality of life’ were designed as in the IT setting. An example is provided in Table A.3.

The DCE was set up as an online survey and pretested with 89 respondents; in addition, five respondents were invited to participate in think-aloud interviews. The pretest motivated a minor revision of the questionnaire and adjustment of the price attribute in both settings of the DCE, as many respondents always chose the hypothetical drug. A detailed description of attributes can be found in Table A.1.

Table 1. Attributes and their levels used in the DCE

Attribute	IT setting	SHI setting
Prevalence of cancer in percent	-	0.1, 1
Age groups of affected patients	-	0-18, 18-70, 70+
Survival time in months	3, 6	3, 6
Quality of life (scale 0 to 100)	20, 30, 70, 100	20, 30, 70, 100
Hope (chance of being cured) in percent	0, 0.1, 1	0, 0.1, 1
Additional treatment cost per case in TCHF[a]	-	50, 150, 300
Additional insurance premium per year in CHF	-	120, 360, 600
Additional out-of-pocket costs in TCHF[a]	5, 10, 20, 50	-

[a] *TCHF: CHF ,000; 1 CHF (Swiss franc) = 1 US$ as of 2014*
Status quo: Patients with terminal cancer undergoing standard treatment survive for six months, with quality of life equal to 50 on a scale from 0 to 100 and no chance of being cured.

The combination of all attributes and their levels results in a very large number of scenarios (IT setting: $2^1 \cdot 3^1 \cdot 4^2 = 96$, SHI setting: $2^2 \cdot 3^4 \cdot 4^1 = 1{,}296$). To reduce these numbers to a manageable level, a fractional factorial design with 20 (35, respectively) scenarios was created, based on the D-efficiency criterion and generated using Ngene[2]. The sample was split into five blocks with four (IT setting) and seven choice tasks (SHI setting), amounting to a total of 11 choice tasks per respondent.

Furthermore, the sample was divided into five subsamples mainly differing in status quo levels for quality of life and survival time. The five subsamples are detailed in Figure 2. While the status quo point was held fixed in a given subsample, it varied across subsamples w.r.t. quality of life (30 vs. 50 points) and survival time (three vs. six months). The fifth subsample was characterized by ‘Quality of life’ equal to 50 and ‘Survival time’ equal to six months; however, it differed from all others by the inclusion

[2] http://www.choice- metrics.com

of the attribute ‘Hope’, meaning that patients had a small chance (0.1 or 1 percent, respectively) of being cured if using the hypothetical cancer drug. In all other subsamples, there was no chance of survival beyond the number of months indicated.

The survey took place in August 2014, initially involving 2,142 Swiss individuals aged 18 years and older. About 29 percent did not complete the survey, causing them to be excluded from the analysis, leaving 1,529 completed interviews. The sample is representative with regard to age, gender, and French and German speakers (see Table A.4; Italian speakers were not sampled for cost reasons). Persons with compulsory education only are under-represented, while those with a higher education and the highest deductible are slightly over-represented. As these persons tend to have higher incomes, high-income individuals might also be over-represented. The socioeconomic characteristics of respondents retained in estimation are exhibited in Table 2.

Table 2. Socioeconomic characteristics of respondents retained in estimation

Characteristic	Sample value
Female, percent	51.0
Age, years	47.4
French speaking, percent	23.2
Know someone close with cancer, percent	55.7
Higher education, percent	43.4
High deductible (>1,000 CHF), percent	44.3
High income (>8,000 CHF p.m.), percent	20.5
Against organ donation, percent	9.8
Signed advance decision, percent	15.6

For calculating a marginal WTP (MWTP) value, Louviere et al. (2000) show that this equals the marginal rate of substitution between attribute *x* and the price attribute *c*. For a linearized utility function (*V*) , this results in the negative of the ratio of the corresponding estimated coefficients (β_x, β_c),

$$MWTP_x = -\frac{\partial V/\partial x}{\partial V/\partial c} = -\frac{\beta_x}{\beta_c}$$

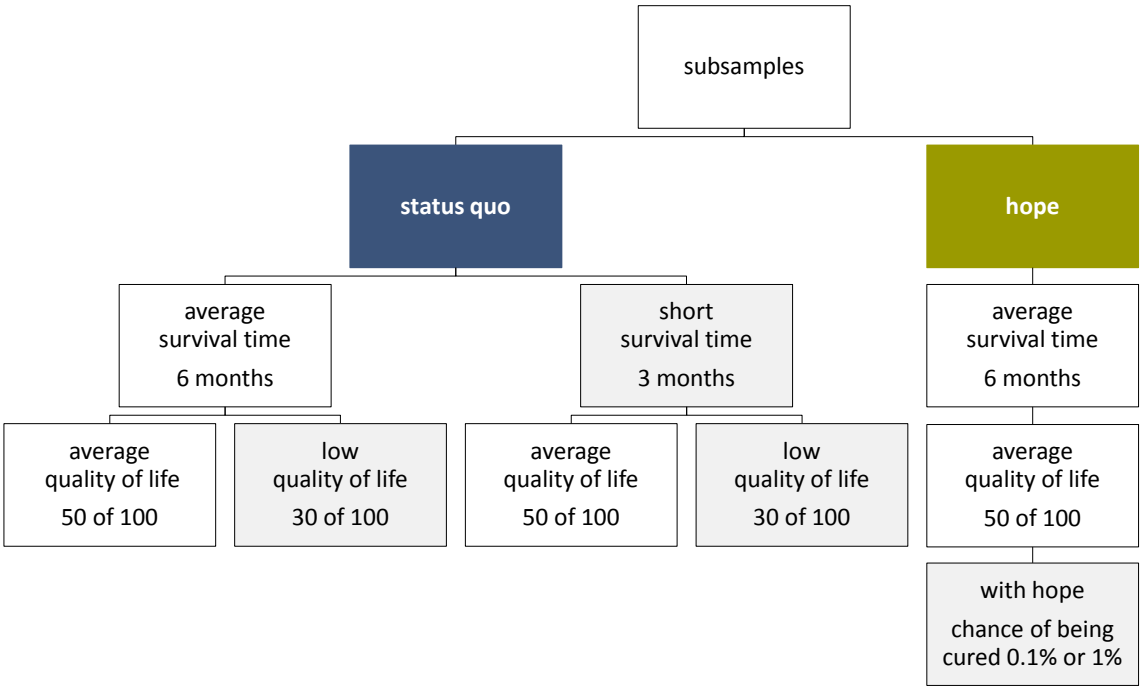
Since the price attribute enters also with a squared term in the IT setting, this formula has to be modified as follows, where β_{c^2} symbolizes the coefficient pertaining to c^2 and c, the price attribute evaluated at its sample mean,

$$MWTP_x = -\frac{\beta_x}{\beta_c + 2\beta_{c^2} c}$$

For deriving societal WTP (SHI setting), MWTP values for improving quality and duration of life need to be adjusted for the fact that they refer to patients rather than to respondents (in the IT setting, all respondents are hypothetical patients). This calls for multiplying estimated WTP values by the number of contributors to Swiss SHI (roughly 6.5 mn). To obtain a per-patient value, this aggregate WTP is divided by 44,000, the mean number of affected patients ('Prevalence') used in the DCE.

For statistical inference, the alternative-specific conditional logit, a variant of the logistic regression model (McFadden, 1974), was estimated using Stata 13. Cluster-robust standard errors account for intragroup correlation.

Figure 2. Subsamples for 'status quo' and 'hope'



Results of the DCE and of hypothesis tests

In the IT (SHI) setting, 22 (22) percent of respondents always selected the status quo, while 18 (7) percent always preferred the hypothetical drug. These respondents are not excluded from estimation because they exhibit a particularly marked preference for the status quo (the alternative, respectively) that is not accounted for in their measured personal characteristics (Lancsar and Louviere, 2006).

Table 3 presents estimation results for the subsample with ‘Hope’ = 0 to be discussed in view of the hypotheses stated above. Here, initial survival time is three and six months; the results for an initial survival time of six months combined with ‘Hope’ >0 are exhibited in Table A.6. All categorical variables are effects coded; therefore the coefficients show differences from the mean of all attribute levels, with the constant reflecting the average effect (Bech and Gyrd-Hansen, 2005). To test for nonlinearity, attributes with more than two levels were split up in dummy variables. However, estimates failed to suggest nonlinearity (with the exception of losses of survival time and quality of life relative to the status quo, motivating separate dummy variables), permitting their coding as shown in Table 1. Most attributes are statistically highly significant and have expected signs.

The results of hypothesis tests are reported below.

Table 3. Logit and WTP estimates, IT setting

	3 months initial survival time			6 months initial survival time		
	Coeff.	Robust SE	WTP[a] (CHF)	Coeff.	Robust SE	WTP[a] (CHF)
Constant	-1.08	0.36	-33,936	-1.39	0.39	-51,080
Survival time, extra six months	0.28	0.07	8,669	0.28	0.06	10,339
Loss of survival time=1	-0.20	0.07	-6,444	-0.11	0.07	-4,049
Quality of life, per 10 points	0.34	0.07	10,623	0.50	0.08	18,491
Loss of quality of life=1	-0.81	0.10	-25,398	-1.02	0.11	-37,299
Out-of-pocket cost	-0.049	0.01	-	-0.045	0.02	-
(Out-of-pocket cost)^2	0.0004	0.0002	-	0.0004	0.0003	-
Survival time*Age of respondent	-0.003	0.001	-4,579	-0.004	0.001	-6,237
Survival time*High income=1	0.01	0.02	-218	0.06	0.02	-1,214
Survival time*High education=1	0.04	0.02	-163	-0.002	0.02	7.4
Survival time*Against organ donation=1	-0.02	0.03	560	-0.03	0.03	960
Survival time*Advance decision =1	-0.04	0.02	845	-0.06	0.02	1,528
Quality of life*Age of respondent	-0.001	0.001	-1,519	-0.005	0.001	-8,242
Quality of life*High income=1	0.01	0.02	-146	0.06	0.02	-1,365
Quality of life*High education=1	0.02	0.02	-89	0.03	0.02	-124
Age of respondent	-0.01	0.01	-15,892	-0.001	0.01	-1,177
Male respondent=1	0.15	0.09	-89	0.13	0.09	-89
Against organ donation=1	-0.32	0.17	8,149	-0.19	0.16	5,452
N observations / N respondents	7,356 / 613			7,356 / 613		
Wald chi-square / Prob > chi-square	585.26 / 0.000			585.26 / 0.000		

a WTP values per unit indicated, evaluated at the sample mean

Table 4. WTP estimates for hypothesis tests, in CHF

IT setting	3 months initial survival time	6 months initial survival time
WTP for six additional months survival time without change of quality of life		
▪ mean respondent	-4,643	-10,545
▪ median respondent	-12,895	-14,298
▪ mean respondent with high income	-1,120	9,068
▪ median respondent with high income	-8,466	10,363
WTP for six additional months survival time and improvement of quality of life to 100 points		
▪ mean respondent	65,099	70,551
▪ median respondent	53,184	56,621
SHI setting	**3 months initial survival time**	**6 months initial survival time**
WTP for six additional months survival time without change of quality of life		
▪ mean respondent	31,344	-9,419
▪ median respondent	69,883	42,136
▪ mean respondent; coefficient 'Treatment cost' = 0	39,250	10,104
WTP for six additional months survival time and improvement of quality of life to 100 points		
▪ mean respondent against organ donation	65,121	63,107
▪ mean respondent not against organ donation	136,391	133,457

BP1: The farther away from the time of death individuals are, the smaller their WTP for extending life. Calculating WTP for six additional months of survival in the IT setting (with quality of life at 50 of 100 points and no hope of being cured) results in CHF -4,643 for the group with an initial survival time of three months and CHF -10,545 for the group with six months (see Table 3). These negative values are mainly caused by the substantial status quo preference indicated by the negative constant and the negative effect of respondent age (which is 47 at the mean) indicated by 'Survival time*Age of respondent'. Since WTP for an extra six months of survival time is more strongly negative if the initial remaining life expectancy is six months rather than three, the prediction is confirmed. The progressivity prediction contained in BP1 cannot be tested since only two values for 'time to death' are available.

BP2: WTP for an extension of life increases with 'Hope', i.e. the chance of survival thanks to treatment. Indeed, the WTP for a one percent chance of being cured ('Hope') is CHF 43,321 (see Table A.5 of the Appendix). Therefore, this prediction is confirmed.

BP3: Individual WTP equals wealth when the probability of dying without treatment is 100 percent. This prediction cannot be tested directly because respondents' wealth levels are not known. However, an out-of-pocket cost of CHF 50,000 comes close to consuming many a respondent's wealth not invested in provision for old age. Indeed, in 2012 the share of taxpayers reporting a net fortune of CHF 50,000 or less was 56 percent.[3] In addition, about 36 percent of the 4.9 mn. potential taxpayers did not pay any federal income and wealth tax in that year[4], indicating that most of them do not have positive net wealth. Therefore, a copayment of CHF 50,000 is almost certain to equal or exceed freely disposable wealth for the median respondent. The question now becomes whether WTP exceeds CHF 50,000. In the IT setting with initial survival time of three months, the WTP value for six additional months and no change in quality of life amounts to CHF -1,120 [=-4,643 + 6·(-1)·(218+369)] for the average respondent with high income and to CHF -8,466 for the median one with high income (see Table 4), respectively. Among those with initial survival time of six months, the values are CHF 9,068 [=-10,545 + 6·(-1)·(-1,214-2,055)] and CHF 10,363, respectively. Therefore, an out-of-pocket cost of CHF 50,000 which approximates freely disposable for the median respondent exceeds individual WTP, indicating that this prediction fails to be confirmed regardless of initial survival time.

BP4: Even neglecting the subsidization of healthcare services, sufficiently strong altruism of contributors combined with moderate altruism of beneficiaries causes societal WTP to exceed its individual counterpart. In the IT setting, respondents are confronted with a substantial copayment which limits their moral hazard. Estimates of individual WTP associated with an extension of six months survival in benchmark quality of life

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[3] http://www.bfs.admin.ch/bfs/portal/de/index/themen/20/02/blank/key/vermoegen.html

[4] http://www.bfs.admin.ch/bfs/portal/de/index/themen/18/02/blank/key/direkte_bundessteuer/natuerliche_personen.html

range from CHF -4,643 to -1,120 if initial survival time is three months and from CHF -14,298 to 10,363 if it is six months (see Table 4). In the SHI setting, average WTP for extending a patients' life by six months lies between CHF 31,344 and 39,250 (three months initial survival time) and CHF -9,419 and 42,136 (six months initial survival time), respectively. Since the societal values are higher than the individual ones throughout, the hypothesis is confirmed.

BP5: Given sufficiently strong aversion against denying access to new end-of-life technologies, their public good characteristic causes societal WTP to exceed its individual counterpart. If respondents were characterized by perfect aversion against denying access to a new therapy, its cost should not make a difference. BP4 was evaluated at the average treatment cost of approximately CHF 164,000, which reduces the WTP by CHF -19,527 [=164·(-120), see Table A.6, six months initial survival time]. To simulate the condition, 'sufficiently strong aversion', this effect would have to be neglected in calculating societal WTP, resulting in a positive WTP of CHF 10,104 (and even higher values for three months initial survival time than found in the context of BP4). Therefore, the hypothesis is confirmed.

In all, four of the five predictions derived from Becker et al. (2007) and Philipson et al. (2010) are supported by experimental evidence. The eight predictions derived from Figure 1 remain to be tested.

FTZ1: $WTP_{e\to h}$, (maximum) willingness to pay for returning from end-of-life to healthy status, is the sum of $WTP_{e\to s}$ for an increase in survival time with no improvement in quality of life and $WTP_{s\to h}$, for changing from sick to healthy status, amounting to an improvement of quality of life but no extension of it. As there were no significant interaction effects between quality of life and survival time, their WTP can be summed up. The hypothesis is therefore confirmed.

FTZ2: $WTP_{s\to h}$ increases with (certain) W. The only indicator of wealth is the dummy variable 'High income=1'. While this precludes a stringent test of the hypothesis, 'High income=1' does add substantially to the WTP pertaining to 'Quality of life' regardless of

initial survival time (not shown in Table 4). Therefore, the hypothesis need not be rejected.

FTZ3: $WTP_{e\to h}$ increases with (certain) W. This time, both survival time and quality of life increase. As $WTP_{e\to h}$ is the sum of $WTP_{e\to s}$ and $WTP_{s\to h}$ (FTZ1) and $WTP_{s\to h}$ increases with (certain) W (FTZ2), one can focus on $WTP_{e\to s}$. Using the indicator, 'High income=1' again, one finds that it adds thousands of CHF to the WTP pertaining to 'survival time' regardless of initial survival time. Therefore, the hypothesis need not be rejected.

FTZ4: $WTP_{e\to h}$ increases with the probability of dying without treatment. This prediction can be tested by calculating WTP for additional six months of survival time and for improving quality of life to 100 points and then summing the values (see FTZ1). In the IT setting these WTP values can then be compared between the two groups differing in initial survival time (three and six months, respectively; the latter can be said to face a lower probability of dying over six months). While WTP for six additional months in prefect quality of life amounts to CHF 65,099 (see Table 4) on average for the group with an initial life expectancy of three months, it is somewhat higher for those with six months and hence a lower probability of dying (CHF 70,551). Therefore, the hypothesis cannot be confirmed; a likely reason is that the difference in the probability of dying is swamped by the prospect of life in perfect rather than mediocre quality of life.

FTZ5: $WTP_{e\to s}$ increases with the probability of dying without treatment. Associating again the probability of dying with initial survival time (see FTZ4), this prediction can be tested as follows. In the context of BP1, the WTP for six additional months of life (with given quality of life of 50 from 100 points and no hope of being cured) was found to be CHF -4,643 for respondents with three months initial survival time and CHF -10,545 for those with six months (see Table 4). Therefore, WTP is higher for the group with the lower initial survival time, in accordance with the hypothesis.

FTZ6: $WTP_{e\to s}$ increases faster with the probability of dying without treatment than does $WTP_{e\to h}$. This can be tested by comparing the differences in WTP values for survival time (FTZ5) with the differences of WTP for survival time in perfect quality of life (FTZ4).

In the context of FTZ5, $WTP_{e\to s}$ increases from CHF -10,543 for respondents with six months to live to CHF -4,641 for those with three months, an increase of CHF 5,902. In the context of FTZ4, the change is from CHF 70,551 to CHF 65,099, a decrease of CHF 5,448. Since FTZ5 could be confirmed (WTP increases with probability of dying) while this is not the case for FTZ4 (WTP is at best independent of probability of dying) the hypothesis need not be rejected.

FTZ7: When the probability of dying without treatment approaches 100 percent, both $WTP_{e\to h}$ and $WTP_{e\to s}$ approach (but do not equal, contrary to BP3) total wealth equal to W_1. In this case, an indirect test is possible. Death is associated with a loss of survival time and quality of life (relative to the status quo), causing a utility loss. According to Table 3 (IT setting, three months initial survival time), WTP to avoid this utility loss amounts to CHF 31,842 (=6,444 for loss of survival time + 25,398 for loss of quality of life). If initial survival time is six months the figure is CHF 41,347 (=4,049 + 37,299). Note that status quo preference (CHF -41,769 and -46,894 for the mean respondent, respectively) does not enter into account because the WTP values refer to the case without treatment, i.e. acceptance of the status quo. Therefore, taking into account standard errors, the approximate equality of $WTP_{e\to h}$ and $WTP_{e\to s}$ need not be rejected. The remaining question is whether these values come close to freely disposable wealth. As argued in the context of BP3, CHF 50,000 is almost certain to equal or exceed freely disposable wealth for the median respondent. Thus, in view of the high concentration of wealth in Switzerland (Jann and Fluder, 2014), WTP values of CHF 32,000 to 41,000 come close to freely disposable wealth, supporting the hypothesis.

FTZ8 (=BP2): When the probability of survival due to treatment increases, $WTP_{e\to s}$ increases. In addition to BP2, another way to at least indirectly test this prediction is to pit 'Hope' against 'Loss of quality of life=1', which arguably indicates a return to less-than-perfect health status. The net effect amounts to CHF 32,015 (= -11,306 + 43,321 see Table A.5, initial survival time six months), confirming the prediction.

In sum, one of the eight additional hypotheses has to be rejected. Moreover, this DCE provides some additional insights. Notably, the fact that the dummies 'Loss of survival

time=1' and 'Loss of quality of life=1' had to be introduced to deal with nonlinearity in the respective attributes points to the possible existence of a reference point (Menzel, 2011) and hence kinks in the conditional risk utility functions (contrary to Figure 1). Also, 'Treatment cost' has a clearly negative influence on the propensity to opt for the alternative in the SHI setting, although the adoption of the novel therapy has a very limited impact on the individual insured. A likely explanation is respondents' fear of the associated moral hazard effect. It receives some support from the fact that respondents with a deductible in excess of CHF 1,000 exhibit a status quo preference that is stronger than among the others (see the negative logit coefficients in Table A.6). Choice of a high deductible is likely to reflect an interest in limiting moral hazard (not least one's own), although it is frequently claimed to show a lack of solidarity because in Swiss social health insurance a higher deductible goes along with a reduction in contributions. Finally, preferences with regard to end-of-life treatment are very heterogeneous. A first indication is that in the SHI setting, the age group of beneficiaries matters greatly, with children evoking a particularly high WTP. The importance of interaction terms such as 'Survival time*High income=1' and 'Quality of life*High income=1' in the IT setting also points to heterogeneity, as does the observation that 'Male respondent=1' (with a logit coefficient of 0.15 and 0.13, Table 3) balances an increase of CHF 9,359 and 9,331, respectively, compared to 'Male respondent=-1' (female respondents) in out-of-pocket cost.

Conclusions

The starting point of this study are the papers by Becker et al. (2007) and Philipson et al. (2010) which argue that willingness to pay (WTP) for terminal care may be so high as to justify novel therapies costing US$ 100,000 and more per quality-adjusted life year. Five predictions are derived from these papers, augmented by eight predictions based on the 'pain of risk bearing' concept introduced by Eeckhoudt and Schlesinger † (2006) which leads one to posit that the marginal utility of (risky) wealth is higher in the

sick than in the healthy state. A Discrete Choice Experiment (DCE) performed in 2014 and involving 1,529 Swiss adults can be used to test all hypotheses. In the DCE, participants were asked to adopt the viewpoint of someone having terminal cancer. Their individual WTP (propensity to opt for the treatment alternative involving a costly hypothetical drug, respectively) could be inferred from the influence of an out-of-pocket payment on their choices; their societal WTP, from the influence of an increase in their contributions to social health insurance.

With the tests resulting in rejection of one of the five hypotheses in the first set and one of eight in the second, one may conclude that the economic analysis of WTP for end-of-life treatment receives a considerable amount of empirical support.

This study is subject to several limitations. The most important is that participants in the DCE lacked a financial incentive to reveal their true preferences. This is particularly important in the setting relating to social health insurance, where responses may reflect a desire to exhibit solidarity [‘warm glow’, see Andreoni (1990)]. An indication is the observation that only 9.8 percent of the sample openly declared to be against organ donations, whereas 57 percent remain undecided. Therefore, societal WTP are likely to be overestimated, qualifying the confirmation of the prediction by Becker et al. (2007) and Philipson et al. (2010) stating that societal exceeds individual WTP. In addition, making individuals 93 percent of whom were never exposed to cancer (see Table A.4) imagine that they had only a few months to live due to terminal cancer may be an excessive requirement. On the other hand, no less than 56 percent stated to have a close friend or family member who had suffered from cancer; when the reference group is extended to also include more distant acquaintances, this share rises to 81 percent. Therefore, the decision-making situation of the DCE may not have been quite so remote from everyday experience for a majority of respondents. One could also argue that most of them were too far away from death to exhibit WTP for treatment of a terminal condition; yet ‘Age of respondent’ in Table 3 has a negative rather than positive coefficient, which moreover lacks statistical significance. Finally, the theoretical development rests on conventional expected utility theory whereas the need to include separate dummy variables for possible losses in survival time and quality of life in the regression points to the existence of a reference point, as in prospect theory. Yet Figure

1 reveals that a kink in the conditional risk utility functions at wealth level W_1 would not affect predictions as long as the pain of suffering continues to decrease with increasing wealth.

In conclusion, two findings of this study are likely to prove robust. First, individual WTP for end-of-life treatment is very high in the case of terminal cancer, approaching freely disposable wealth. Second, societal WTP exceeds its individual counterpart due to the effect of altruism and the realization that a novel therapy comes close to being a public good once it is covered by social health insurance.

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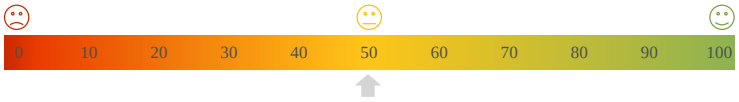
Table A.1. Description of attributes and their levels

Attribute	Description
Prevalence in %	The prevalence indicates how many people are affected by the disease in Switzerland and can be treated with the new drug.
Age groups	It is possible that only certain age groups are affected by the disease
Survival time in months	The new drug affects the survival time of patients. Patients have terminal cancer and on average six months to live with the standard treatment. Average survival time can be prolonged by a few months with a treatment using the new drug. It can also decrease if the drug mainly improves the quality of life.
Hope (chance of being cured) in %	There is a small chance that patients are cured with the new drug.
Quality of life (scale 0 to 100)	The new drug has an effect on patients' quality of life of. In the case of cancer, cancer the following symptoms can limit the quality of life: Pain, chronic fatigue, lack of strength and energy, lack of concentration, dizziness, sleeping problems, sadness, dietary and digestion problems, and accumulation of fluids in arms and legs. Assume that the quality of life of patients with cancer is 50 on a scale from 0 (worst possible health) to 100 (best possible health) with the standard treatment. The quality of life is visualized in the figure below.  Quality of life for cancer patients with the standard treatment Depending on the drug, the quality of life can improve or deteriorate due to side effects. In case of an improvement of the quality of life, the above mentioned symptoms diminish and allow patients e.g. to participate more in society or to perform more activities of daily living. In case of a deterioration of the quality of life, the symptoms get worse; more hospitalizations may also be required. The change in quality of life always refers to the entire remaining lifetime.
Additional treatment cost in TCHF	This is the additional treatment cost per patient of the new drug. If the drug is not reimbursed by basic health insurance, patients would have to pay most of the cost themselves or choose the standard treatment.

Attribute	Description
Additional premium per year, in CHF	If you decide that the new drug is to be included in the list of benefits of basic health insurance, your health insurance premium increases regardless of whether or not you ever seek the treatment. Please bear in mind that the amount you spend for the higher premium will not be available to be spent on other things.
Additional out-of-pocket cost, in TCHF	Since the new drugs are very expensive, you have to pay part of the cost out of pocket in addition to your deductible and the 10% rate of copayment (max. 700 CHF per year). Please bear in mind that the amount you spent on the drug will not be available to be spent on other things for you or your heirs and base your decision on your current financial and family situation.

Table A.2. Choice example, SHI setting

Do you want the drug with the following properties to be reimbursed by health insurance?	
How many are affected?	1 in 1,000, i.e. about 8,000 persons in Switzerland
Who is affected?	Children and adolescents under 18 years
Survival time of patients	Extended from 6 to 12 months (= plus 6 months)
Quality of life of patients	Declines from 50 to 20 on the scale
Chance of being cured	10 in 1,000 patients are cured
Costs of treatment	150,000 Swiss francs per patient
Increase of your health insurance premium	120 Swiss francs per year (= 10 francs per month)
☐ yes ☐ no	

Table A.3. Choice example, IT setting

Do you prefer drug A or B if you had cancer in the terminal stage?		
Part 1/2	Drug A	Drug B
Your survival time	Extended from 6 to 12 months (= plus 6 months)	Reduced from 6 to 5 months (= minus 1 month)
Your chance of being cured	10 of 1,000 patients are cured	1 of 1,000 patients are cured
Your quality of life	Declines from 50 to 20 on the scale	Increases from 50 to 100 on the scale
Your treatment cost	10,000 Swiss francs	50,000 Swiss francs
I prefer	☐	☐

Do you prefer drug A/B or the standard treatment if you had cancer in the terminal stage?		
Part 2/2	Drug A or B	Standard treatment
Your survival time	Extended from 6 to 12 months (= plus 6 months)	Remains 6 months
Your chance of being cured	10 out of 1,000 patients are cured	No chance of being cured
Your quality of life	Declines from 50 to 20 on the scale	Remains at 50 on the scale
Your treatment cost	10,000 Swiss francs	No extra cost
I prefer	☐	☐

Table A.4. Sociodemographic characteristics of the sample and of the Swiss population

Characteristic	Sample (18 years old and older)	Swiss population[1)] 15 years old and older
Number of individuals	1,529	6,838,268
Shares, in %		
Male	49.1	49.0
Female	50.9	51.0
Age of respondent 18-34 (15-34)	27.4	28.7
35-54	37.0	35.9
55+	35.6	35.4
German speaking	76.8	71.2
French speaking	23.2	24.2
Italian speaking	0	4.50
Compulsory education at age 24 (ISCED 2)	2.6	13.4
Secondary level II at age 24 (ISCED 3)	51.7	53.5
Tertiary level at age 24 (ISCED 5-6)	45.7	33.1
Annual deductible 300 CHF	32.4	35.0
Annual deductible 500 CHF	12.8	15.4
Annual deductible 1,000 CHF	6.6	6.3
Annual deductible 1,500 CHF	13.9	14.5
Annual deductible 2,000 CHF	6.0	4.0
Annual deductible 2,500 CHF	24.4	15.9
Don’t know	3.9	8.9
Health status good to very good	85.2	82.8
Health status fair	11.8	13.6
Health status poor to very poor	2.2	3.6
Monthly gross income up to 4,000 CHF	23.7	-
4,000 to 6,000 CHF	22.4	-
6000 to 8,000 CHF	20.4	-
8,000 to 10,000 CHF	10.5	-
10,000 to 15,000	7.9	-
higher than 15,000 CHF	2.1	-
No own income	7.0	-
Don’t know	6.0	-
Have you ever thought about organ donation?		
Yes, I am an organ donor	31.8	-
Yes, I decided against an organ donation	9.8	-

Characteristic	Sample (18 years old and older)	Swiss population[1)] 15 years old and older
Yes, but I haven't done anything about it yet	47.0	-
No, I never thought about it	9.9	-
Don't know	1.4	-
Have you ever thought about an advanced decision?		
Yes, I have a signed an advanced decision	15.6	-
Yes, but I haven't done anything about it yet	59.1	-
No, I never thought about it	24.7	-
Don't know	0.6	-
Do you know someone with end-stage cancer or who died of cancer?		
Yes, close friends or family	55.7	-
Yes, not very close friends, no family	81.4	-
Have you ever suffered from cancer?		-
No	92.9	-
Yes, but healed	6.2	-
Yes	0.9	-

[1] FSO, Swiss Health Survey 2012

Table A.5. **Logit and WTP estimates, IT setting, 'Hope' > 1, survival time 6 months in status quo**

	IT setting		
	Coeff.	Robust SE	WTP[a] (CHF)
Constant	0.18	0.48	5,858
Survival time	0.15	0.09	4,763
Loss of survival time=1	-0.05	0.10	-1,707
Quality of life	0.36	0.08	11,554
Loss of quality of life=1	-0.35	0.13	-11,306
Hope	1.36	0.13	43,321
Out-of-pocket cost	-0.067	0.017	-
(Out-of-pocket cost)2	0.0008	0.0003	-
Survival time*Age of respondent	-0.0005	0.001	-725
Survival time*High income=1	0.04	0.03	-846
Survival time*High education=1	0.03	0.02	-117.6
Survival time*Against organ donation=1	-0.04	0.03	1,074
Survival time*Advance decision =1	0.02	0.03	-347
Quality of life*Age of respondent	-0.001	0.001	-1,688
Quality of life*High income=1	0.06	0.03	-1'055
Quality of life*High education=1	0.03	0.02	-132
Age of respondent	-0.02	0.01	-37,519
Male respondent=1	0.09	0.12	-53
Against organ donation=1	-0.20	0.24	5,241
N observations / N respondents	18,348 / 1,529		
Wald chi-square / Prob > chi-square	1,527.4 / 0.000		

[a] MWTP evaluated at mean values of sample

Table A.6. Logit estimates, survival time three vs. six months in status quo, SHI setting

SHI setting	3 months initial survival time			6 months initial survival time		
	Coeff.	Robust SE	MWTP[a] (CHF)	Coeff.	Robust SE	MWTP[a] (CHF)
Constant	-0.61	0.246	-66,251	-0.85	0.274	-116,389
Prevalence	0.22	0.063	24,288	0.12	0.063	16,640
Beneficiary age 0-18	0.38	0.064	42,045	0.38	0.070	51,626
Beneficiary age 18-70	0.03	0.051	2,934	0.09	0.050	12,377
Survival time, per month	0.14	0.015	15,082	0.12	0.016	16,745
Quality of life, per 10 points	0.05	0.036	5,597	0.11	0.036	14,419
Loss of quality of life=1	-0.64	0.101	-70,450	-0.47	0.101	-64,960
Treatment cost, per TCHF	-0.0004	0.0004	-49	-0.0009	0.0004	-120
Premium	-0.0013	0.0002	-	-0.001	0.0002	-
Premium*German speaking=1	-0.0002	0.0001	-	-0.0004	0.0002	-
Age of respondent	-0.009	0.004	-44,621	-0.008	0.004	-49,903
Against organ donation=1	-0.326	0.101	29,017	-0.257	0.120	29,346
Advance decision=1	-0.169	0.089	12,850	-0.315	0.092	30,888
Know someone close with cancer=1	0.222	0.059	2,848	0.127	0.059	2,201
Deductible > CHF 1,000=1	-0.121	0.059	1,554	-0.253	0.060	4,340
N observations / N respondents	8,582 / 613			8,568 / 612		
Wald chi-square / Prob > chi-square	276.71 / 0.000			271.96 / 0.000		

[a] WTP evaluated at mean values of sample, per patient