POLYNOMICS

Working Paper No. 201501

# Does end-of-life healthcare expenditure reflect individual and societal preferences?

Barbara Fischer, Harry Telser, Viktor von Wyl, Konstantin Beck, Andreas Weber

December 2017

POLYNOMICS

**Polynomics Working Paper No. 201501**

# Does end-of-life healthcare expenditure re-flect individual and societal preferences?

December 2017

Corresponding author
barbara.fischer@polynomics.ch

Publisher
Polynomics AG
Baslerstrasse 44
4600 Olten
Tel. +41 62 205 15 70
polynomics@polynomics.ch
www.polynomics.ch

# Does end-of-life healthcare expenditure reflect individual and societal preferences?

Barbara Fischer[1,2*], M.A., Harry Telser[1,3], Ph.D., Viktor von Wyl[4], Ph.D., Konstantin Beck[5,6,7], Ph.D., Andreas Weber[8], M.D.

[1] Polynomics AG, Baslerstrasse 44, 4600 Olten, Switzerland

[2] Department of Business Administration, University of Zurich, Plattenstrasse 14, 8032 Zurich, Switzerland

[3] Center for Health, Policy and Economics, University of Lucerne, Frohburgstrasse 3, 6002 Lucerne, Switzerland

[4] Institute for Epidemiology, Biostatistics & Prevention, University of Zurich, Hirschengraben 84, 8001 Zurich, Switzerland

[5] CSS-Institute for Empirical Health Economics, Tribschenstrasse 21, 6002 Lucerne, Switzerland

[6] Department of Economics, University of Zurich, Blümlisalpstrasse 10, 8006 Zurich, Switzerland

[7] Department of Economics, University of Lucerne, Frohburgstrasse 3, 6002 Lucerne, Switzerland

[8] Palliative Care Unit, Dept. of Internal Medicine, GZO Hospital Wetzikon, Spitalstrasse 66, 8620 Wetzikon, Switzerland

*Corresponding author

This version: December 2017

## Abstract

End-of-life healthcare expenditure (HCE) is a substantial contributor to overall HCE. A widely discussed driver are new drugs with high cost per quality-adjusted life year (QALY); however, little is known about either individual or societal willingness to pay (WTP) for them and for end-of-life medical interventions more generally.

In this study, preferences for end-of-life cancer treatment are elicited using a discrete choice experiment (DCE) via an online survey involving 1,529 Swiss individuals in 2014. The DCE has two parts, an individual and a societal setting. In the individual setting, respondents choose between the status quo and a hypothetical drug with varying characteristics (with out-of-pocket payment constituting the price attribute), adopting the perspective of a hypothetical terminal cancer patient. In the societal setting, they are asked to choose between the status quo and a social health insurance contract with a varying degree of coverage of new cancer drugs for end-of-life treatment. Here, the price attribute is the increase in the annual contribution.

The mean individual WTP per QALY attains CHF 96,150, (1 CHF = 1 USD as of 2014). Societal mean WTP for a QALY amounts to CHF 213,500 for an adult patient, CHF 255,600 for a child, and CHF 153,600 for an elderly person, respectively. Evidently, at least for the respondents sampled in this DCE a QALY is not a QALY since their WTP depends on the type of beneficiary. All estimated societal values clearly exceed their individual counterparts, suggesting the presence of altruism. However, they vary considerably with respondents' socio-demographic characteristics, testifying of heterogeneous preferences in the Swiss population.

## Introduction

It has long been known that end-of-life HCE is a substantial contributor to overall HCE (Lubitz and Riley 1993; Riley and Lubitz 2010; Hoover et al. 2002; Stooker et al. 2001; Shugarman, Decker, and Bercovitz 2009). For example, Lubitz and Riley (1993) showed that for persons aged 65 years and older, about 30 percent of HCE funded by Medicare accrued in their last year of life, with 50 percent of this share concentrated in the last two months of life. In view of this evidence, end-of-life investment in health does not seem to make economic sense because their payback period is so short. This reasoning also applies to recently launched drugs with a cost per QALY in excess of US$ 100,000 (Fojo and Grady 2010), causing concerns that their use by patients with low remaining life expectancy is financially unsustainable.

Values of this magnitude exceed by far the thresholds proposed by health technology assessment (HTA) bodies, which range from USD 18,000 to 85,000 per QALY (Eichler et al. 2004). In the UK, cost-effectiveness thresholds of GBP 20,000 to 30,000 per QALY (1 GBP = 1.6 USD as of 2014) are applied by NICE, although a higher value is deemed acceptable for end-of-life treatment (Collins and Latimer 2013). In many countries, a frequently used benchmark is USD 100,000 per QALY, but its origin is unclear (Neumann, Cohen, and Weinstein 2014). In Switzerland, the Federal Supreme Court recently used a threshold of CHF 100,000 (1 CHF = 1 US$ as of 2014) per life year gained (BGE 136 V 395).

However, the ultimate criterion from an economic point of view is whether an individual (acting privately or in concertation with others) is willing to pay the extra cost engendered by the provision of the good or service in question. If his or her WTP exceeds the extra cost, there is no reason for denying the individual access to the good or service. In competitive markets, one can be reasonably sure that an individual paying the market price has a (marginal) WTP exceeding this price (which in turn usually approximates the marginal cost of provision). However, in the healthcare sector with its finance through taxes or contributions to social health insurance, patients pay nothing or only a co-payment at the point of utilization. Moreover, fees and prices are negotiated or set by decree and so bear little relationship with cost. In this situation, market observations are not informative, leaving experimental evidence as an admittedly second-best alternative.

The objective of the present study is to obtain information about the WTP of individuals (both as potential patients and as members of society) for costly treatment of terminal cancer using a discrete choice experiment (DCE). For estimating individual WTP, the price attribute is out-of-pocket cost (net of health insurance); for estimating societal WTP, it is the increase in health insurance contribution needed to finance treatment with an expensive hypothetical drug.

## Empirical Approach and Data

### Discrete Choice Experiment

Over the last few years, discrete choice experiments (DCE) 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 the present context of end-of-life choices, WTP values for survival time, quality of life, and chance of being cured afforded by treatment with a hypothetical drug can be estimated.

The DCE was divided into two parts, the first involving choices of contracts in mandatory social health insurance (SHI henceforth), reflecting a societal viewpoint. The second part involved individual treatment (IT henceforth) choices, reflecting the viewpoint of the individual. Here, participants were asked to assume the role of a patient with terminal cancer; in the (fixed) status quo with standard cancer treatment, they would have six months (three months, respectively) to live, with quality of life

equal to 50 (30, respectively) on a scale from 0 (worst imaginable health) to 100 (best imaginable health).

In the IT setting, respondents had to choose between drugs, which differed w.r.t. survival time, quality of life, and chances of being cured (often referred to as 'hope' in the pertinent literature). The price attribute was a high copayment, to be paid out of pocket (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 option, with 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 for persons receiving the novel treatment, i.e. six months more than with the status quo cancer treatment. An example is provided in Table 8 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): The number of patients who would benefit from it, (prevalence), their age, 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. The price attribute was the increase in the annual contribution occasioned by the inclusion of the hypothetical drug in the benefit list. An example is provided in Table 7 of the appendix.

**Table 1 Attributes and levels in the experiment**

| | Status quo | 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 | | | |
| Subsample with 3 months in status quo | 3 | 2, 5, 9 | 2, 5, 9 |
| Subsample with 6 months in status quo | 6 | 5, 8, 12 | 5, 8, 12 |
| Quality of life in points (scale 0 to 100) | | | |
| Subsample with 30 points in status quo | 30 | 10, 20, 50, 80 | 10, 20, 50, 80 |
| Subsample with 50 points in status quo | 50 | 20, 30, 70, 100 | 20, 30, 70, 100 |
| Hope (chance of being cured) in percent | | | |
| Subsample without hope | 0 | 0 | 0 |
| Subsample with hope | 0 | 0.1, 1 | 0.1, 1 |
| Additional treatment cost per case in TCHF[a] | 0 | - | 50, 150, 300 |
| Additional insurance premium per year in CHF | 0 | - | 120, 360, 600 |
| Additional out-of-pocket costs in TCHF[a] | 0 | 5, 10, 20, 50 | - |

[a] *TCHF: CHF '000, CHF 1 = US$ 1 as of 2014*
*Status quo: Patients with terminal cancer undergoing standard treatment survive for six months (three months, respectively), with quality of life equal to 50 (30, respectively) on a scale from 0 to 100 and no chance of being cured.*

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 parts of the DCE, as a large share of re-

spondents always chose the new drug. A detailed description of attributes can be found in Table 6 of the appendix.

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. The experimental design is based on the D-efficiency criterion and was generated using Ngene[1]. 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 Table 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 a quality of life equal to 50 and survival time equal to six months but differed from all others by the inclusion 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.

**Table 2 Subsamples 1-4 with different status quo values and subsample 5 with hope**

| | Subsample 1 | Subsample 2 | Subsample 3 | Subsample 4 | Subsample 5 |
|---|---|---|---|---|---|
| Survival time with standard treatment | 6 months | 3 months | 6 months | 3 months | 6 months |
| Quality of life with standard treatment | 50 points | 50 points | 30 points | 30 points | 50 points |
| 'Hope' with new treatment | no | no | no | no | yes |
| Number of respondents | 306 | 307 | 306 | 306 | 304 |

In addition to the DCE, respondents were asked to indicate their experience with cancer, their attitude towards end of life and death as well as organ donation, and their socio-economic characteristics including state of health, and health insurance status.

## Data

The main survey took place in August 2014, 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 9 of the appendix; 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 a higher income, high-income individuals might also be overrepresented. The most important socioeconomic characteristics are shown in Table 3.

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

**Table 3 Socio-economic characteristics of respondents**

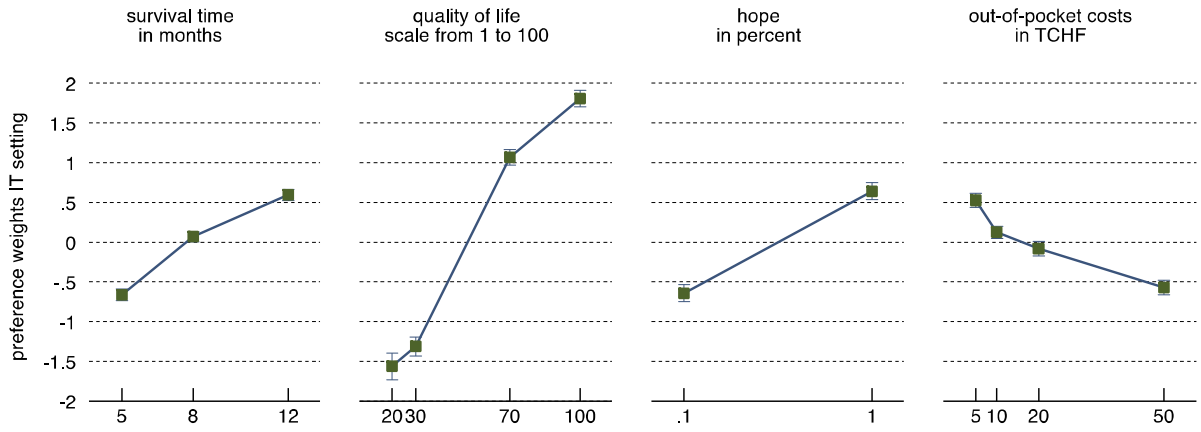
| Characteristic | Sample number (n) | Sample value |
|---|---|---|
| Total respondents with completed interviews | 1,529 | 100% |
| Age (mean) | | 47 years |
| Male | 749 | 49% |
| German-speaking | 1,177 | 77% |
| Know someone close with cancer | 856 | 56% |
| Higher education | 657 | 43% |
| High deductible (>1,000 CHF) | 673 | 44% |
| High income (>8,000 CHF p.m.) | 306 | 20% |
| Decision against organ donation | 153 | 10% |
| Signed advance decision | 245 | 16% |

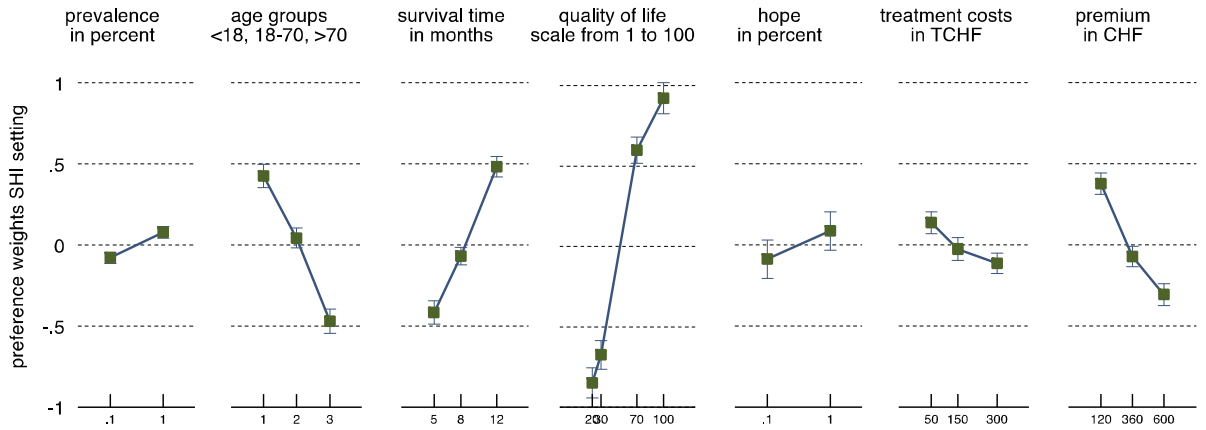
## Statistical Model

The statistical model is the alternative-specific conditional logit (McFadden's choice model) a variant of the more general conditional logistic regression model (McFadden 1974), with estimation using Stata 13. Cluster-robust standard errors were used to account for intragroup correlation.

In a first step, we used a dummy model where all attributes are effects coded (Bech and Gyrd-Hansen 2005). Figure 1 shows the preference weights of all levels of the included attributes with the respective 95% confidence interval. All the weights show the expected signs and are significant with a few exceptions. A comparison between the IT and SHI setting is instructive. The coefficients pertaining to 'survival time' have a range of 1.3 (-0.7 to +0.6) in the IT setting and 0.9 (-0.4 to +0.5) in the SHI setting; apparently, there is no big difference between the individual and societal vantage points in this respect. However, whereas the coefficients pertaining to 'quality of life' have a range of 3.4 (-1.6 and +1.8) in the IT setting, they are bounded to 1.7 (-0.8 to 0.9) in the SHI setting, suggesting that from a societal point of view, quality of life compared to survival time afforded to cancer patients close to their end of life is less important than from an individual one. Likewise, the coefficients pertaining to 'hope' are -0.6 and +0.6 at the individual level but -0.1 and +0.1, respectively at the societal level, where 'hope' does not seem to matter at all. These differences are a first indication that societal preferences may indeed diverge substantially from individual ones.

**Figure 1 Preference weight per attribute level with 95% confidence intervals**






In a second step, the specification was simplified by entering all attributes in linear form since the patterns displayed in Figures 2 do not indicate substantial nonlinearities. Exceptions are the age groups of patients benefiting from cancer treatment, where those aged 70+ are of particular interest and the out-of-pocket cost in the IT setting. Therefore, we include dummy variables for each age category and a quadratic term for out-of-pocket cost (price attribute). Furthermore, dummy variables for 'gain/loss of survival time' (IT setting) and 'gain/loss of quality of life' (IT and SHI setting) were included. Preference heterogeneity is accounted for by including respondents' socio-economic characteristics (see Table 3). In view of the potential role of altruism in the SHI setting, it is noteworthy that 10 percent of respondents had signed a declaration designed to prohibit donation ('against donation') of their organs. Conversely, 16 percent had signed an advance decision (also known as living will) to make sure that their wishes with regard to medical treatment will be respected in a situation where they are incapable of deciding on their own.

Since a respondent's characteristics are invariant between the status quo and the selected alternative, they drop out of the specification unless they are associated with a general propensity to opt for the status quo (or the alternative, respectively). So-called status quo preference was found to go along with age, gender, 'against organ donation', 'advance decision', 'know someone close with cancer', and 'high deductible'. If respondent characteristics are to modify the influence of an attribute on choice, they need to be interacted with the attribute. As these gives rise to many possible interaction terms, only those of statistical significance are retained in the final specification; this was the case with age, 'against organ donation', 'advance decision', 'high income' and 'high education' w.r.t. 'quality of life' and 'survival time' and language w.r.t. 'premium'.

### Calculation of marginal willingness to pay and willingness to pay per QALY

Louviere, Hensher, and Swait (2000) show that the marginal rate of substitution between an attribute $x$ and the price attribute $c$ is equal to the marginal willingness to pay (MWTP),[2] which for a linearized utility function ($V$) results in the negative of the ratio of the corresponding estimated coefficients $(\beta_x, \beta_c)$,

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

Since the price attribute enters with a squared term in the IT setting, this formula is modified as follows, where $\beta_{c^2}$ symbolizes the coefficient pertaining to $c^2$,

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

[2] There exist also others methods to derive measures of welfare from DCE (see e.g. Lancsar and Savage 2004).

as usual, this is evaluated at the mean value of *c*. For calculating WTP for a QALY, MWTP for survival time and quality of life were integrated starting from the status quo values, up to prolonging life to one year in perfect quality of life (which amounts to one QALY)

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 all respondents as in the IT setting, where they all were 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 was divided by 44,000, the mean number of affected patients ('prevalence') used in the DCE.

## Results

In the IT (SHI) setting, 22 (22) percent of respondents always selected the status quo, while 18 (7) percent always preferred the new 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 4 presents the results of the alternative-specific conditional logit model. 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). All attributes, except 'hope' in the SHI setting, are statistically highly significant and show the expected signs, vindicating Figure 2.

In the IT setting, gains in quality of life lose importance with increasing age of respondents, while they are more strongly valued by those with high incomes and high education. Similarly, gains in survival time are of less value with increasing age but of higher value to those with high incomes (and possibly those with high education; the pertinent coefficient does not quite reach conventional significance levels). Interestingly, gains in survival time are less important to respondents who are against organ donations, as well as to those having signed an advance decision.

Preference heterogeneities of this type were not found in the SHI setting, with one exception. German speaking respondents are slightly more concerned (with a coefficient of -0.0016 rather than -0.0010) about the increase in the premium that would be associated with inclusion of the drug in the list of benefits. This homogeneity is to be expected for theoretical reasons. Anything that is included in the benefit list of a mandatory social insurance comes close to a public good, which is (partially) defined by its availability to all regardless of their ability to pay [the other property is nonrivalry in consumption; see Samuelson (1954)]. Given that the hypothetical drug would be used in the treatment of all patients, income (indeed, all personal characteristics, among them, education) are predicted to play no role in the valuation of the drug's attributes (in contradistinction to status quo preference, to be discussed below).

Turning to the constant and personal characteristics, a negative coefficient is to be interpreted as an increase in the likelihood for choosing the status quo. Both the IT and the SHI setting show a clear preference for the status quo as the (highly significant) constant has a negative sign. In both settings, status quo is reinforced by age and by being against organ donation; in the SHI setting, 'advance decision' and 'high deductible' additionally exert a reinforcing effect. Conversely, status quo preference is mitigated by male gender in the IT setting [in keeping with the finding by Halek and Eisenhauer (2001) that males are less risk averse than females], and knowing someone close with cancer in the SHI setting (which might trigger a degree of altruism).

## Table 4 Alternative specific conditional logit model, IT and SHI settings

| | IT setting | | | SHI setting | | |
|---|---|---|---|---|---|---|
| | coefficient | robust SE | p-value | coefficient | robust SE | p-value |
| prevalence | - | - | - | 0.16 | 0.04 | 0.000 |
| age group (0-18) of beneficiary | - | - | - | 0.43 | 0.04 | 0.000 |
| age group (18-70) of beneficiary | - | - | - | 0.05 | 0.03 | 0.097 |
| age group (70+) of beneficiary | - | - | - | -0.48 | - | - |
| survival time | 0.23 | 0.04 | 0.000 | 0.14 | 0.01 | 0.000 |
| loss/gain of survival time | -/+0.16 | 0.04 | 0.000 | - | - | - |
| quality of life | 0.38 | 0.04 | 0.000 | 0.10 | 0.02 | 0.000 |
| loss/gain of quality of life | -/+0.80 | 0.06 | 0.000 | -/+0.50 | 0.06 | 0.000 |
| hope | 1.48 | 0.13 | 0.000 | 0.23 | 0.14 | 0.089 |
| treatment cost | - | - | - | -0.001 | 0.0002 | 0.000 |
| premium | - | - | - | -0.0013 | 0.0001 | 0.000 |
| out-of-pocket cost | -0.055 | 0.01 | 0.000 | - | - | - |
| out-of-pocket cost$^2$ | 0.00055 | 0.00 | 0.000 | - | - | - |
| quality of life*age of respondent | -0.002 | 0.001 | 0.004 | - | - | - |
| quality of life*high income (yes/no) | +/-0.04 | 0.01 | 0.004 | - | - | - |
| quality of life*high education (yes/no) | +/-0.02 | 0.01 | 0.030 | - | - | - |
| survival time*age of respondent | -0.003 | 0.001 | 0.000 | - | - | - |
| survival time*high income (yes/no) | +/-0.03 | 0.01 | 0.007 | - | - | - |
| survival time*high education (yes/no) | +/-0.02 | 0.01 | 0.052 | - | - | - |
| survival time*against organ donation (yes/no) | -/+0.04 | 0.02 | 0.03 | - | - | - |
| survival time*advance decision (yes/no) | -/+0.04 | 0.01 | 0.004 | - | - | - |
| premium*language (German/French) | - | - | - | -/+0.0003 | 0.0001 | 0.001 |
| age of respondent | -0.01 | 0.004 | 0.009 | -0.008 | 0.002 | 0.001 |
| gender of respondent (male/female) | +/-0.11 | 0.05 | 0.043 | - | - | - |
| against organ donation (yes/no) | -/+0.23 | 0.11 | 0.029 | -/+0.28 | 0.07 | 0.000 |
| advance decision (yes/no) | - | - | - | -/+0.20 | 0.06 | 0.000 |
| know someone close with cancer (yes/no) | - | - | - | +/-0.17 | 0.04 | 0.000 |
| high deductible (yes/no) | | | | -/+0.13 | 0.04 | 0.000 |
| constant | -0.88 | 0.22 | 0.000 | -0.60 | 0.16 | 0.000 |

| | | |
|---|---|---|
| N observations | 18,348 | 21,406 |
| N respondents | 1,529 | 1,529 |
| Log pseudolikelihood | -4,830.2 | -6,329.2 |
| Wald chi-square | 1,527.4 | 746.8 |
| Prob > chi2 | 0.0000 | 0.0000 |

- All dummy variables are effects coded, therefore the coefficients show the differences from the mean of all attribute levels. For example, the coefficient for a loss of survival time is -0.16 and +0.16 for a gain of survival time, respectively.

### WTP per QALY

The starting point for calculating WTP per QALY are the MWTP values for survival time and quality of life evaluated at the mean sample value of the included categorical variables and the mean sample age of 47 years. In the IT setting, annual MWTP amounts to CHF 4,758 per additional month of survival, while an increase in the quality of life has a MWTP of CHF 8,069 CHF per 10 points (see Table 5). In the SHI setting, annual MWTP for an additional month of beneficiaries' survival drops to CHF 95; this is roughly 2 percent of the nationwide average premium of almost CHF 4,800 per year.[3] However, when scaled to the value per cancer patient (see above), societal MWTP becomes CHF 14,032. For a ten-point increase in beneficiaries' quality of life, MWTP measured as a premium increase amounts to CHF 70; scaled again to a per-patient value, this becomes CHF 10,386.

However, with a value of CHF -40,502, status quo preference weighs heavily. To overcome it in the IT setting, the hypothetical drug would have to afford an extension of survival of 7.5 months (=(40,502-5,010)/4,758) or an increase in quality of life of almost 20 points (=(40,502-25,865)/8,069). In the SHI setting, societal status quo preference is CHF -53,022 per affected patient; it would take an extension of survival by almost 4 months (=53,022/14,032) or an improvement in the beneficiaries' quality of life by not even 2 points (=(53,022-51,464)/10,386) to overcome it. Therefore, status quo preference can be said to be weaker at the societal than the individual level, likely reflecting a degree of altruism combined with the insight that a new medical technology comes close to being a public good (Philipson et al. 2010).

**Table 5 Marginal willingness to pay for survival time and quality of life**

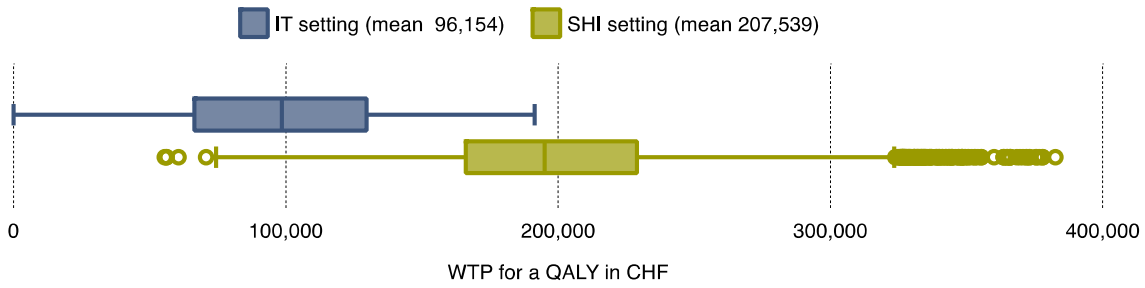
| Marginal willingness to pay in CHF | IT setting (individual MWTP) | SHI setting (individual MWTP) | SHI setting (societal MWTP) |
|---|---|---|---|
| Survival time per month | 4,758 | 95 | 14,032 |
| Gain/loss of survival time | +/-5,010 | - | - |
| Quality of life per 10 points (scale 0 to 100) | 8,069 | 70 | 10,386 |
| Gain/loss of quality of life | +/-25,865 | +/-348 | +/-51,464 |
| Constant | -40,502 | -359 | -53,022 |

- The values are based on the mean sample value of the included categorical variables and the mean sample age (47 years).

From status quo preference serving as the benchmark, one may integrate the MWTP over the two attributes, 'survival time' and 'quality of life' to obtain the WTP value for a QALY. In the IT setting, this results in CHF 96,150 [95% CI: 73,800 - 120,700] for a QALY and CHF 207,500 [95% CI: 190,400 - 224,600] in the SHI setting. However, these values come with extremely wide range of socio-economic group values. In the IT setting, this interval ranges from CHF 0 to 190,000 (implying that some persons do not have a positive WTP), while in the SHI setting, it ranges from CHF 55,000 to 380,000 (see Figure 2).

[3] http://www.bag.admin.ch/themen/krankenversicherung/00261/index.html?lang=de

**Figure 2 Range of individual predicted WTP per QALY**




Once again, substantial heterogeneity in preference emerges. In the IT setting (see Figure 4), there is a clear divide between respondents who decided against an organ donation (exhibiting relatively low WTP) and those who did not, as well as between those who signed an advance decision (again exhibiting relatively low WTP) and those who did not. By comparison, having a higher education, a high income, and being male does not seem to make much of a difference (but note the variation in scale). In keeping with the estimation result reported in Table 4, WTP per QALY consistently decreases with age of the respondent.

In the SHI setting (see Figure 5), the divide between respondents who decided against organ donation or signed an advanced decision and their respective counterparts is again marked, with the latter displaying much higher WTP values suggesting altruism and/or insight in the public good characteristic of a novel medication. Knowing someone with terminal cancer does not seem to make so much of a difference. Interestingly, having a contract with a high deductible (in excess of CHF 1,000 annually) is associated with a somewhat lower WTP value. Therefore, the effect of a higher deductible on WTP may reflect either the attempt of limiting one's own moral hazard (which would be triggered by a costly novel drug being covered by social insurance) or an individual lacking in altruism (often called solidarity in Europe). The two explanations cannot be distinguished with the evidence available. Another big divide separates German speaking from French speaking respondents, with the latter exhibiting a WTP that is 70 percent higher. This very likely reflects a cultural difference; the French speaking Swiss tend to consider one's health to be a personal responsibility to a much lesser degree than their German-speaking compatriots. This has already been observed in other studies for Switzerland (Zweifel et al., 2006). Finally, WTP values decrease with age of the respondent, with a local maximum among respondents aged 45-54, confirming earlier research suggesting that WTP to have access to new medical technology through health insurance is particularly high in this age group (Zweifel et al., 2006).

**Figure 4 WTP per QALY for different socio-economic groups – IT setting**

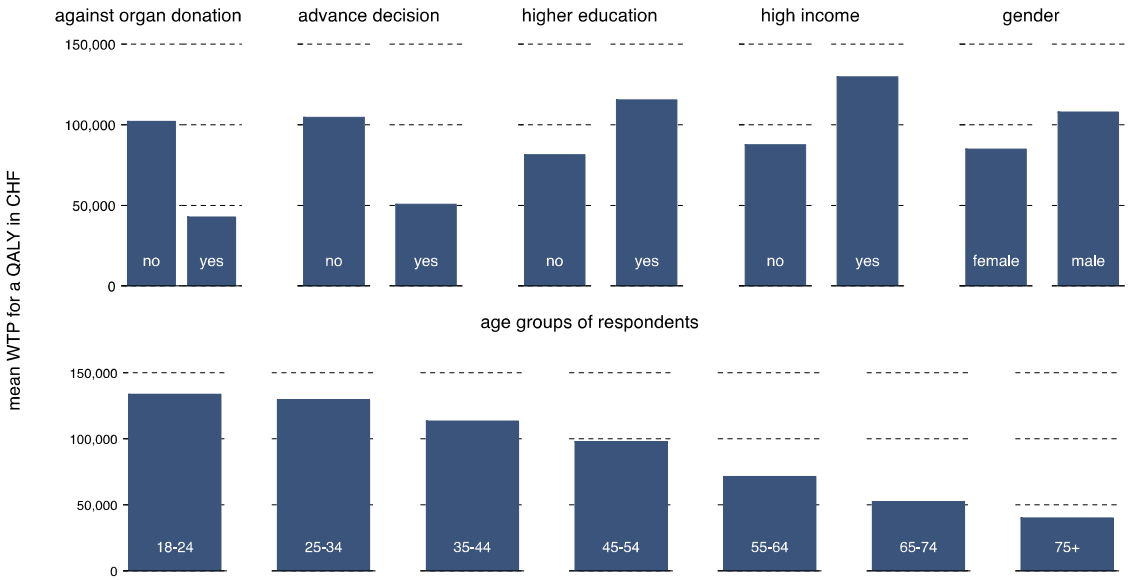
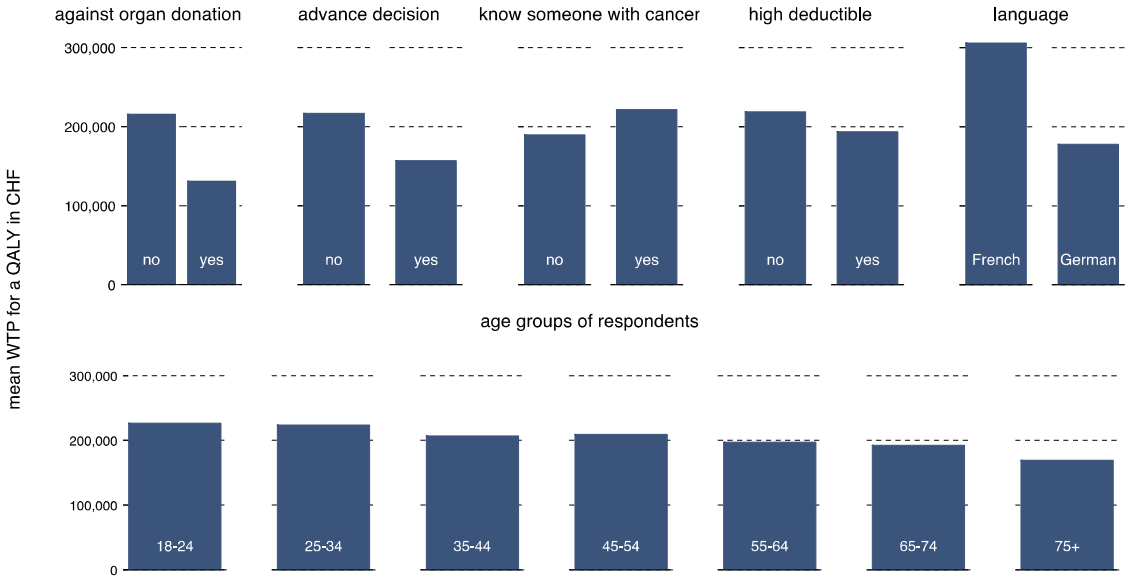



**Figure 5 WTP per QALY for different socio-economic groups – SHI setting**




## Discussion

The results of the discrete choice experiment reported here show that the Swiss population has a high WTP for end-of-life treatment. The mean values for a QALY (individual WTP of CHF 95,160 and societal WTP of CHF 207,500, with 1 CHF = 1 US$) lie far above the thresholds used by HTA bodies. Also, they exceed most cost-effectiveness ratios for cancer drugs, suggesting that respecting the preferences of actual as well as potential patients would lead one to include more novel drugs for cancer treatment in the benefit list of social health insurance (of a national health service, respectively) than currently admitted. There is one important proviso, however. According to this study, a gain in quality of life at the individual level is three times more important than an equivalent gain in survival time, in line with (Pinto-Prades et al. 2014). Therefore, drugs designed for terminal cancer treatment which merely prolong survival time for a few months without improving quality of life may not meet with acceptance by patients. Yet they may nevertheless make it into the list of benefits because preferences

at the societal level seem to be skewed in favor of survival time rather than beneficiaries' quality of life.

Preference heterogeneity concerning end-of-life treatment looms large among the Swiss population. Regardless of setting, 22 percent of respondents always chose the status quo in the DCE, indicating that the extension of life and improvement in the quality of life afforded by the hypothetical drug was not worth its price.

As noted above, WTP for a QALY is higher in the SHI than the IT setting, which means that societal preferences concerning end-of-life treatment differ from individual ones. Potential causes for this divergence are altruism (solidarity, respectively) and realization that a novel drug covered by social insurance comes close to constituting a public good. A partial indication suggesting altruism is the fact that being against organ donation (interpreted at least partially as lack of altruism) goes along with an increased preference for the status quo and hence against the alternative with the drug in both settings. If lack of altruism did not matter, one would expect an effect on status quo preference in the SHI setting but not in the IT setting, where respondents pay themselves for the drug as a private good. Furthermore, this research shows that the value of a QALY depends on its definition (Ahlert, Breyer, and Schwettmann 2013). In principle, the logic of QALYs calls for one year in perfect health (score=100) to be equivalent to two years in medium health (score=50). Yet one additional year in perfect health is associated with a WTP of CHF 96,150 in the IT setting, while WTP for two years in medium health comes to about CHF 87,000. Likewise, in the SHI setting one extra year with score 100 has a WTP estimated at CHF 207,500; two extra years with score 50, roughly CHF 270,000. This is a consequence of the fact that at the societal level, beneficiaries' survival time is valued much more highly relative to their quality of life than at the individual level. Also, societal mean WTP for a QALY benefiting patients aged 70+ can be estimated at CHF 153,600; it is CHF 213,500, almost 40 percent higher for patients between 18 and 70 years old and CHF 255,600, no less than 66 percent higher for children. This confirms the existing literature that a QALY is not a QALY as stipulated by theory; people's preferences differ depending on who is affected (Johansson-Stenman and Martinsson 2008).

This work is subject to several limitations. First, it is based on an experiment that does not involve any actual payment. In particular, there are no financial incentives designed to induce truth telling and avoid strategic responses. All one can say is that pretest participants could identify with the scenario descriptions; quite generally, a DCE creates realistic decision situation by calling for choices involving several attributes (which makes responding strategically difficult, too). Second, findings relate to end-of-life treatment of cancer using a novel drug that affords only small gains in survival time. However, some studies (van Houtven, Sullivan, and Dockins 2008; Viscusi, Huber, and Bell 2013) identify a cancer premium, suggesting that extrapolation to other end-of-life condition may not be warranted. For example, (Viscusi, Huber, and Bell 2013) show that the value of a statistical life is 21 percent higher in the case of cancer risks compared to acute fatalities. But then, Linley and Hughes (2013) find neither a cancer nor an end-of-life premium in their study. Third, individuals with high income, higher education, and high deductible in their health insurance policy are somewhat over-represented in the sample. Since survival time and quality of life can safely be assumed to constitute normal goods, higher income goes along with higher WTP, causing WTP for a QALY to be overestimated. However, sampling bias is unlikely to be important, at least in the SHI setting where no correlation between WTP and high income is observed, likely reflecting the fact that access to a novel drug included in the benefit list of social insurance is not limited by income. Conversely, the value of a QALY might be underestimated in the SHI setting because respondents with a high deductible, while over-represented, exhibit a lower WTP than the rest. Finally, since the logit function is nonlinear, unobserved heterogeneity may bias not only standard errors but also coefficients and hence WTP values. This is an issue especially if the status quo is made to change from one choice scenario to the next (Mühlbacher et al. 2016); however, in this DCE the status quo point was held fixed, enabling identification of a respondent's indifference curve and hence MWTP values. In sum, three findings of this study are likely to be robust: Both individual and societal WTP values for a QALY in the context of end-of-life cancer treatment exceed the threshold values commonly used in HTA, individual values are strongly hetero-

geneous, and societal values are comparatively homogeneous due to equal access to treatment guaranteed by social health insurance (a national health service, respectively).

## Conclusion

A discrete choice experiment performed in 2014 and involving 1,527 Swiss citizens reveals that willingness to pay (WTP) for a QALY in the context of terminal cancer treatment exceeds by far the thresholds commonly applied to a new drug for inclusion in the list of benefits. This holds true both of individual and societal WTP values, the latter derived from choices between contract variants in mandatory social health insurance. This implies that standard health technology assessment (HTA) methods such as cost-utility analysis run the risk of neglecting both actual and potential patients' preferences regarding end-of-life treatment. However, individual and societal preferences differ in one an important aspect. At the individual level, quality of life is clearly more important than quantity of life, i.e. extension of survival time. At the societal level, in contrast, extension of survival time afforded to beneficiaries is valued more highly than an equivalent increase in their quality of life. Accordingly, drugs designed for the treatment of terminally ill cancer patients should be assessed depending on whether they are paid for out-of-pocket to a substantial degree or covered by social health insurance (a national health service, respectively). In the first financing mode, they should improve the quality of life rather than just prolong it by a few months. In the second financing mode, they should above all contribute to an increase in survival time of affected patients, at least as long as they do not cause a deterioration in their quality of life. Evidently, these results argue against the use of a unique threshold value in cost-effectiveness analysis. Rather, they support the application of cost-benefit analysis, where benefit is measured by WTP values, permitting to pit benefit directly against cost. While subject to several limitations, this study is the first to quantify the WTP value of a QALY in Switzerland. Whether its findings are applicable to other countries and beyond terminal cancer treatment cannot be determined without further research, which however should be of considerable interest to policy makers.

**Acknowledgements** The authors thank Peter Zweifel for critical reading of the manuscript and very helpful comments and recommendations.

**Funding** This study was funded by the Swiss National Science Foundation within the National Research Program 67 'End of Life' (grant number 406740 _145096 / 1).

## Reference

Ahlert, Marlies, Friedrich Breyer, and Lars Schwettmann. 2013. "What You Ask Is What You Get: Willingness-to-Pay for a QALY in Germany." 4239. Vol. 49. CESifo Working Paper.

Bech, Mickael, and Dorte Gyrd-Hansen. 2005. "Effects Coding in Discrete Choice Experiments." *Health Economics* 14 (10):1079–83. https://doi.org/10.1002/hec.984.

Clark, Michael D., Domino Determann, Stavros Petrou, Domenico Moro, and Esther W. de Bekker-Grob. 2014. "Discrete Choice Experiments in Health Economics: A Review of the Literature." *PharmacoEconomics* 32 (9):883–902. https://doi.org/10.1007/s40273-014-0170-x.

Collins, Marissa, and Nicholas Latimer. 2013. "NICE's End of Life Decision Making Scheme: Impact on Population Health." *BMJ* 346 (mar21 1):f1363. https://doi.org/10.1136/bmj.f1363.

Eichler, Hans-Georg, Sheldon X. Kong, William C. Gerth, Panagiotis Mavros, and Bengt Jönsson. 2004. "Use of Cost-Effectiveness Analysis in Health-Care Resource Allocation Decision-Making: How Are Cost-Effectiveness Thresholds Expected to Emerge?" *Value in Health* 7 (5):518–28. https://doi.org/10.1111/j.1524-4733.2004.75003.x.

Fojo, Tito, and Christine Grady. 2010. "Response: Re: How Much Is Life Worth: Cetuximab, Non-Small Cell Lung Cancer, and the $440 Billion Question." *Journal of the National Cancer Institute* 102 (15):1207–10. https://doi.org/10.1093/jnci/djq247.

Halek, Martin, and Joseph G. Eisenhauer. 2001. “Demography of Risk Aversion.” *The Journal of Risk and Insurance* 68 (1):1–24. https://doi.org/10.2307/2678130.

Hoover, Donald R., Stephen Crystal, Rizie Kumar, Usha Sambamoorthi, and Joel C. Cantor. 2002. “Medical Expenditures During the Last Year of Life: Findings from the 1992-1996 Medicare Current Beneficiary Survey.” *Health Services Research* 37 (6):1625–42.

Houtven, George van, Melonie B. Sullivan, and Chris Dockins. 2008. “Cancer Premiums and Latency Effects: A Risk Tradeoff Approach for Valuing Reductions in Fatal Cancer Risks.” *Journal of Risk and Uncertainty* 36 (2):179–99. https://doi.org/10.1007/s11166-008-9032-2.

Johansson-Stenman, Olof, and Peter Martinsson. 2008. “Are Some Lives More Valuable? An Ethical Preferences Approach.” *Journal of Health Economics* 27 (3):739–52. https://doi.org/10.1016/j.jhealeco.2007.10.001.

Lancsar, Emily, and Jordan J. Louviere. 2006. “Deleting ‘Irrational’ Responses from Discrete Choice Experiments: A Case of Investigating or Imposing Preferences?” *Health Economics* 15 (8):797–811. https://doi.org/10.1002/hec.1104.

Lancsar, Emily, and Elizabeth Savage. 2004. “Deriving Welfare Measures from Discrete Choice Experiments: Inconsistency Between Current Methods and Random Utility and Welfare Theory.” *Health Economics* 13 (9):901–907. https://doi.org/10.1002/hec.870.

Linley, Warren G., and Dyfrig A. Hughes. 2013. “Societal Views on NICE, Cancer Drugs Fund and Value-Based Pricing Criteria for Prioritising Medicines: A Cross-Sectional Survey of 4118 Adults in Great Britain.” *Health Economics* 22 (8):948–64. https://doi.org/10.1002/hec.

Louviere, Jordan J., David Hensher, and Joffre Swait. 2000. *Stated Choice Methods: Analysis and Applications*. Cambridge: Cambridge University Press.

Lubitz, James D., and Gerald F. Riley. 1993. “Trends in Medicare Payments in the Last Year of Life.” *The New England Journal of Medicine* 328 (15):1092–96.

McFadden, Daniel. 1974. “Conditional Logit Analysis of Qualitative Choice Behavior.” In *Frontiers in Econometrics*, edited by P. Zaremka, 105–42. New York: Academic Press.

Mühlbacher, Axel C., Anika Kaczynski, Peter Zweifel, and F. Reed Johnson. 2016. “Experimental Measurement of Preferences in Health and Healthcare Using Best-Worst Scaling: An Overview.” *Health Economics Review* 6. https://doi.org/10.1186/s13561-015-0079-x.

Neumann, Peter J., Joshua T. Cohen, and Milton C. Weinstein. 2014. “Updating Cost-Effectiveness — The Curious Resilience of the $50,000-per-QALY Threshold.” *New England Journal of Medicine* 371 (9):796–97. https://doi.org/10.1056/NEJMp1405158.

Philipson, Tomas J., Gary Becker, Dana P. Goldman, and Kevin M. Murphy. 2010. “Terminal Care and the Value of Life Near Its End,” NBER Working Papers, , 1–29.

Pinto-Prades, Jose Luis, Fernando Ignacio Sánchez-Martínez, Belen Corbacho, and Rachel Baker. 2014. “Valuing QALYs at the End of Life.” *Social Science & Medicine* 113. Elsevier Ltd:5–14. https://doi.org/10.1016/j.socscimed.2014.04.039.

Riley, Gerald F., and James D. Lubitz. 2010. “Long-Term Trends in Medicare Payments in the Last Year of Life.” *Health Services Research* 45 (2):565–76.

Samuelson, Paul A. 1954. “The Pure Theory of Public Expenditure.” *The Review of Economics and Statistics* 36 (4):387–89. https://doi.org/10.2307/1925895.

Shugarman, Lisa R., Sandra L. Decker, and Anita Bercovitz. 2009. “Demographic and Social Characteristics and Spending at the End of Life.” *Journal of Pain and Symptom Management* 38 (1):15–26.

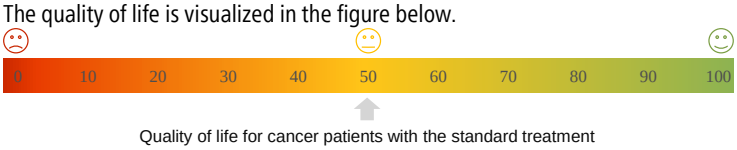
Stooker, Tom, Joost W. van Acht, Erik M. van Barneveld, René C. J. A. van Vliet, Ben A. van Hout, Dick J. Hessing, and Jan J. V. Busschbach. 2001. “Costs in the Last Year of Life in The Netherlands.” *Inquiry* 38 (1):73–80.

Viscusi, W. Kip, Joel Huber, and Jason Bell. 2013. “Assessing Whether There Is a Cancer Premium for the Value of a Statistical Life.” *Health Economics* 23 (4):384–96. https://doi.org/10.1002/hec.2919.

Zweifel, Peter, Harry Telser, and Stephan Vaterlaus. 2006. “Consumer Resistance Against Regulation: The Case of Health Care.” *Journal of Regulatory Economics* 29 (3):319–32.

# Annexe

## Table 6 Description of the attributes and levels of the experiment

| | 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 the patients. The patients have terminal cancer and on average 6 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 a cure), 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.<br>The quality of life is visualized in the figure below.<br>  <br>Depending on the drug, the quality of life can improve or deteriorate due to side effects.<br>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.<br>In case of a deterioration of the quality of life, the symptoms get worse; more hospitalizations may also be required.<br>The change in quality of life always refers to the entire remaining lifetime. |
| Additional treatment costs, 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 the cost themselves or choose the standard treatment. |
| Additional premium per year, in CHF | If you decide that the new drug is to be included in the basic health insurance, your health insurance premium increases regardless of whether 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 costs, 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 7 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 of 1,000 patients are cured |
| Cost of treatment | 150,000 Swiss francs per patient |
| Increase of your health insurance premium | 120 Swiss francs per year (= 10 francs per month) |
| ☐ yes<br>☐ no | |

## Table 8 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 at 6 months |
| Your chance of being cured | 10 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 9 Socio-demographic characteristics of the sample and the Swiss population

| | Sample<br>18 years old and older | Swiss population[1)]<br>15 years old and older |
|---|---|---|
| Number of individuals | 1,529 | 6,838,268 |
| Shares, in % | | |
| Gender | | |
| male | 49.1 | 49.0 |
| female | 50.9 | 51.0 |
| Age | | |
| 18-34 resp. 15-34 | 27.4 | 28.7 |
| 35-54 | 37.0 | 35.9 |
| 55+ | 35.6 | 35.4 |
| Language area | | |
| German | 76.8 | 71.2 |
| French | 23.2 | 24.2 |
| Italian | 0 | 4.50 |
| Education (24 years old and older) | | |
| compulsory education (ISCED 2) | 2.6 | 13.4 |
| secondary level II (ISCED 3) | 51.7 | 53.5 |
| tertiary level (ISCED 5-6) | 45.7 | 33.1 |
| Deductible | | |
| 300 CHF | 32.4 | 35.0 |
| 500 CHF | 12.8 | 15.4 |
| 1,000 CHF | 6.6 | 6.3 |
| 1,500 CHF | 13.9 | 14.5 |
| 2,000 CHF | 6.0 | 4.0 |
| 2,5000 CHF | 24.4 | 15.9 |
| don't know | 3.9 | 8.9 |
| Health status | | |
| good to very good | 85.2 | 82.8 |
| fair | 11.8 | 13.6 |
| bad to very bad | 2.2 | 3.6 |
| Income (monthly gross income) | | |
| up to 4,000 CHF | 23.7 | |
| 4,000 to 6,000 CHF | 22.4 | |
| 6,000 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 | |

| | Sample<br>18 years old and older | Swiss population[1)]<br>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, closer 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 | |

[2] FSO, Swiss Health Survey 2012