THE VALUE OF RISK-FREE CIGARETTES - DO SMOKERS UNDERESTIMATE THE RISK?*

Henrik Hammar[1] *and Olof Johansson-Stenman*

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Department of Economics
Göteborg University

ABSTRACT
The health risk of smoking is valued using the contingent valuation method, applied to a Swedish sample of smokers. The respondents were asked to put a value on newly developed cigarettes with no associated health risks. The average additional willingness to pay for the new cigarettes is estimated to be between10 and 41 SEK per packet. Using medical data on life shortening effects of smoking, the results indicate fairly reasonable values put on a lost life year, compared to existing estimates based on other methods. However, there are remaining methodological questions and we found little sensitivity to scope.

Key words: cigarette consumption, value of life year, contingent valuation

JEL classification: I18, J17

[1] Corresponding author, Göteborg University, Department of Economics, P.O. Box 640, SE 405 30 Göteborg, Sweden, Phone: +46 (31) 7735251, Fax: +46 (31) 7731043, e-mail: henrik.hammar@economics.gu.se

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1 INTRODUCTION

The purpose of this paper is twofold: (1) to estimate the subjective value smokers put on reduced health risks of smoking, and (2) to contribute to the discussion about whether smokers tend to underestimate or overestimate this risk. The (expected) value of the health benefits associated with reduced smoking cannot be directly observed from revealed market data, since there is no market for these health risks per se.[2] The approach taken here is that of simply asking cigarette smokers for their maximum Willingness To Pay (WTP) for reducing their health risks from smoking. More specifically, respondents are asked for their WTP for newly developed risk-free cigarettes in a contingent valuation (CV) survey. Other than being risk-free, the imagined cigarettes are identical to the respondent's currently preferred brands.

The validity of the CV method is heavily debated. See, for instance, Kahneman and Knetsch (1992), Diamond and Hausman (1994) and Hausman (1993) for critical views. However, some of the problems related to the Contingent Valuation method are not applicable to our study, since we are valuing a private good. Consequently there is no (or little) "warm glow" (Andreoni 1989, 1990) or "purchase of moral satisfaction" (Kahneman and Knetsch 1992) for contributing to an overall good social cause.

Still, the interpretation of the results from surveys such as ours is by no means straightforward due to possible after-rationalization, or cognitive dissonance (Akerlof and Dickens 1982), individual heterogeneity in processing risk information (Viscusi, 1991; Viscusi et al. 1999), possible over-optimism (Weinstein 1998), time-inconsistent discounting of future health benefits, etc. Contrary to many earlier studies on valuing risk, we do not provide the respondents with any quantitative information about how dangerous smoking is in terms of the increased risk of getting lung cancer etc. Instead we are genuinely interested in their *subjective* health-risk valuations, and the corresponding risk reductions. So, even though the perceived health risks differ, we can still find the *subjective* value respondents put on them. Nevertheless, there are remaining methodological problems. For example, it is a non-trivial cognitive task to

[2] Indirectly, the value put on health has been estimated by hedonic methods. See Viscusi (1993) for a nice overview.

answer survey questions of this sort, and it is known from other studies that many people tend to apply various kinds of heuristic choice rules.

It is well documented that people in general are quite poor at dealing with low-probability events (e.g. Viscusi 1992a, Hammit and Graham 1999, Slovic 2000a), and hence also low-probability *health* risks. Hammit and Graham (1999) provide a survey of 25 CV studies on health protection (but with no references to smoking-related health risks), without finding a single one with adequate WTP sensitivity with respect to the magnitude of the risk reduction. However, their survey only concerns small risk changes. We ask smokers for their WTP for a considerable health risk reduction, equivalent to cutting cigarette consumption in half or quitting. Hence, if one believes that the insensitivity to scope problem typically found in risk-related CV studies are primarily a result of individuals' inability to deal systematically with small risks, then one would expect this problem to be smaller in our study. However, as we will see, this turns out not to be the case. Whether insensitivity to scope is inherent in the CV methodology, irrespective of application to risk or something else, is debated (e.g. Kahnemann and Knetch 1992, Carson 1997, Krupnick et al., 1999).

On average, smokers die at an earlier age than non-smokers do, and it is not challenging to say that smokers are aware of this. But do smokers underestimate or overestimate the health risks? The empirical evidence is mixed. Viscusi (1990, 1992b, 2000) finds that smokers (as well as non-smokers) over-estimate the risk of getting lung cancer from smoking. The same goes for other smoking related health risks. For example, Viscusi (1992b) finds that smokers' assessed life expectancy loss due to smoking is nine years, which is an overestimation of expected life loss. Viscusi refers to the 1968 Report of the Surgeon General, which estimated the smoking-related life loss to four years for those smoking less than half a pack per day, and eight years for heavy smokers. According to Slovic (2000b, c), on the other hand, there is considerable evidence that particularly young smokers severely underestimate the health risks associated with smoking, partly due to over-optimism with respect to their own ability to quit smoking at will (cf. Weinstein 1998). Moreover, Schoenbaum (1997) finds that heavy smokers' (more than 25 cigarettes per day) expectations of reaching the age of 75 are twice as high as actuarial predictions, while other groups have subjective expectations in line with probability of surviving to the age of 75.

Given the difficulty to communicate risk estimates, as discussed by Hammit and Graham (1999) and Corso et al (2001) among others, an alternative is to investigate whether people behave *as if* they underestimate or overestimate the risks involved. In our case we are interested in whether people are willing to pay more or less to reduce or eliminate the risks of smoking, compared to what is found in other studies on risk reductions. Given the WTP for a specific risk reduction, we can calculate the value per expected lost life year by using available average dose-response functions. We choose to focus on the Shaw et al. (2000) estimate of an average loss of life due to smoking of 6.5 years, or 11 minutes per cigarette. We then compare our findings to other available estimates of value per life years, enabling us to judge whether people on average, implicitly in their (hypothetical) choices, tend to overestimate or underestimate the health risks of smoking.

2 EMPIRICAL ANALYSIS

2.1 THE DATA

The data was gathered using a questionnaire[3] that, in the fall of 2000, was mailed to 935 individuals in the counties of Norrbotten and Västerbotten in the northern part of Sweden. All subjects had been identified as smokers in a previous study.[4] Seven questionnaires were returned as undeliverable because the individuals had moved. The overall response rate was 57%, or 527 respondents. After removing pipe-smokers and those who had quit smoking we were left with 452 observations. Table 1 below provides the summary statistics of the data used.

[3] The questionnaire consists of four parts: (i) questions on smoking habits, health risks, social context of the smoking behavior and attitudes towards anti-smoking policies, (ii) a choice experiment evaluating hypothetical policies, (iii) a contingent valuation experiment on health risks associated with smoking and (iv) socioeconomic questions.

[4] The sample was identified in a study on the health effects of moist snuff by Kjell Asplund at Umeå University Hospital, from whom we obtained the sample register.

Table 1. Summary statistics.

		Mean	Std.Dev	Min	Max
DISK	Discount factor	2.20	0.71	1.05	5.92
BID	Bid	16.31	13.83	3	40
DISBID	Bid*discount factor	35.68	33.36	3.41	161.46
WTPBID	If accepting offered bid	0.40	0.49	0	1
EQINC	Monthly household income, after tax	10342	4369	385	36471
HALV	=1 if 50% replacement of risk free cigarettes	0.53	0.50	0	1
CIG	Number of cigarettes smoked per day the last month	13	6	0	40
SMOKEILL	=1 if specific health related problems related to smoking	0.12	0.32	0	1
QUITRISK	=1 if want to quit smoking	0.43	0.50	0	1
UNI	=1 if completed at least one semester at university level	0.19	0.39	0	1
AGE	Age of respondent	52	10	20	76
MALE	=1 if male	0.41	0.49	0	1
BIGRISK	=1 if self perceived risk of smoking is considerable	0.62	0.49	0	1
NORISK	=1 if no self perceived risks of own smoking	0.03	0.16	0	1

We see that more than a third of the respondents want to quit smoking, and roughly 10% experienced health problems related to own smoking. The mean cigarette consumption, 12 per day, is somewhat less than the benchmark of 16 cigarettes per day for British male smokers used later on when calculating value of life year.

Of particular interest here is that almost 60 % perceive considerable health risks from their own smoking, and that only 3 % believe that there are no health risks. Hence, according to these figures it appears safe to say that most smokers are well aware of the health risks of smoking.

2.2 THE SURVEY

After some pre-tests, a pilot survey was sent to 100 respondents (smokers). Here, we solely used open-ended WTP questions which enabled us to find reasonable bids for the Dichotomous Choice (DC) WTP questions. In the final version of the questionnaire, respondents were asked a closed-ended question, followed by an open-ended question. The former is typically recommended in the CV literature (e.g. Arrow et al. 1993) based on incentive compatibility perspectives, and since it more closely resembles a real-market situation. There are, however, also closed-ended problems including limited information per respondent, which often makes the estimations quite sensitive with respect to specification, and possible yea-saying problems (Boyle et al. 1998). Open-ended questions naturally provide much more information per respondent, and the combination of pen-ended and closed-ended questions makes it possible to compare the

results without violating the advantages of using closed-ended questions. Moreover, open-ended questions make it possible to identify protest zero-bid responses.

Half of the respondents stated WTP for replacing 50% of the ordinary cigarettes, while the other half stated WTP for 100% replacement, enabling us to make an external test of the sensitivity to scope. A respondent could face one of five possible bids: 3, 5, 10, 20 and 40 SEK (in addition to the price of a package of cigarettes, or about 35 SEK), for the improvement of either a 50% or 100% replacement of ordinary cigarettes by the new risk-free ones. The use of the same bid-vector for both 50% and 100% replacement, along with a split sample, imply a rather strong sensitivity-to-scope test. If, on the other hand, we had used either a within-sample test where the same respondents would answer both a 50% and a 100% replacement WTP question, or had used lower bids in the 50% case, it is hard to imagine that a scope-test (in terms of statistical significance) would not have been passed. However, we believe that the value of such a test would have been close to zero. The wording of the WTP question (50% version in parentheses) is:

"Imagine that you could buy a pack of cigarettes where all (half) of the cigarettes are risk free, for the rest of your life. Would you be willing to pay an additional SEK X per pack of 20 cigarettes, where all (10) of them are of the new risk free type?" [5]

2.3 IDENTIFYING PROTEST ZERO-RESPONSES

The open-ended questions were used to identify respondents with zero WTP (which turned out to be an admittedly high figure of 41 %), since one would believe that almost all would value a drastic risk reduction positively. As expected, however, a large majority of the zero-responses can be categorized as protest responses, and not as if they truly have a zero WTP.

To sort out protest zero-responses, respondents are asked about their reasons for stating zero WTP, as reported in Table 2. The zero-responses which were motivated by lack of resources to pay for a risk free cigarettes, or by low perceived health risks or "other reasons (not protests)" are treated as "true zeros," while the remaining zero-responses, almost 80 %, are treated as protest zeros.

[5] The complete scenario is in the Appendix.

Table 2. Stated reasons for zero willingness-to-pay for risk free cigarettes.

	Lack of resources	Do not believe in scenario	Small health risks	Get rid of other things besides health risks	Other reasons (protests)	Other reasons (not protests)
50% and 100% replacement (n=185)	24 (13.0%)	112 (60.5%)	3 (1.6%)	23 (12.4%)	12 (6.4%)	11 (6.0%)

In Table 3, we see that those with "specific health related problems related to smoking" are less likely to provide a protest response, while those who have a wish to quit smoking are more likely to provide a protest zero response. Also, the older the respondent is, the more likely he/she is to protest by stating a zero WTP.

Table 3. Probit regression of giving a protest zero-response.

	Coeff.	P-value
Constant	-0.980	0.010
Monthly household income, after tax	0.000	0.934
50% risk reduction	-0.199	0.136
Specific health related problems related to smoking	-0.433	0.048
Want to quit smoking	0.315	0.021
University	-0.144	0.420
Age	0.013	0.051
Male	-0.210	0.130

In the subsequent analysis it is assumed that the remaining respondents "play along" with the scenario. Still, we cannot rule out that some respondents with a positive stated WTP could be directly influenced by the scenario construction, and hence that their responses would be biased.

2.4 WTP FROM THE DICHOTOMOUS CHOICE APPROACH

The analysis is based on a standard random-utility framework (McFadden, 1974). Between the alternatives of accepting or not accepting the bid, the individual is assumed to choose the alternative with the highest perceived utility. Since utility is unobserved and the CV response is a binary variable, we define a binary response variable, y_i, i.e. the modeling utilizes the latent variable regression approach, where $y_i = 1$ means that the bid is accepted by individual *i*; consequently $y_i = 0$ means that the bid is not

accepted. Aside from a systematic part of the utility function, *V,* there is a random term, ε, so that the utility derived for individual *i* from accepting the bid ($y_i = 1$) becomes

$$u_{i1} = V_{i1} + \varepsilon_{i1} . \quad (1)$$

The probability of accepting equals the probability that the utility from accepting is greater than the utility of not accepting. Hence we have

$$\Pr(y_i = 1) = \Pr(V_{i1} + \varepsilon_{i1} > V_{i0} + \varepsilon_{i0}) = \Pr(\varepsilon_{i1} - \varepsilon_{i0} > V_{i0} - V_{i1}) . \quad (2)$$

The systematic part of the utility function is assumed to be linear in the attributes within the interval considered:

$$V_i = \alpha + \beta^x f(x_i) + \beta^h h_i \quad (3)$$

where *x* is income, *h* is a health index and the βs are corresponding parameters. It is assumed that health and income are evaluated at the same moment in time, such as the present time. For the two cases where the individual accepts and does not accept, respectively, it can be written:

$$V_{i1} = \alpha + \beta^x f(x_i^0 - s_i \Delta x_i) + \beta^h (h_i^0 + \Delta h_i) \quad (4a)$$

$$V_{i0} = \alpha + \beta^x f(x_i^0) + \beta^h h_i \quad (4b)$$

where s_i is a discount factor to adjust for the fact that the health effects, in terms of lost days of life, occur later than the money spent to avoid the risk. s then reflects how much the WTP should have been multiplied by if the health effects would have occurred at the same time as the money was spent. Since the respondents are assumed to pay for the risk-free cigarettes for the rest of their lives, the discount factor can be written $s_i = \frac{e^{rl_i} - 1}{rl_i}$, where r is discount rate per year (we use 5% per year), and l is expected time left to live, i.e. $l_i = T_i - t_i$, where T_i is the expected age of death and t_i is the current age. This factor is positive for all respondents and hence it hence magnifies the value of health risks from smoking. Substituting (4a) and (4b) into (2) implies,

$$\Pr(y_i = 1) = \Pr\left(\beta^x \left(f(x_i^0) - f(x_i^0 - s_i \Delta x_i)\right) - \beta^h \Delta h_i < \varepsilon_{i1} - \varepsilon_{i0}\right). \quad (5)$$

We will consider two different functional forms, $f(x_i) = x_i$ and $f(x_i) = \log(x_i)$, implying respectively:

$$\Pr(y_i = 1) = \Pr\left(\beta^h \Delta h_i - \beta^x s_i \Delta x_i > \varepsilon_{i1} - \varepsilon_{i0}\right) \quad (6a)$$

$$\Pr(y_i = 1) = \Pr\left(\beta^h \Delta h_i + \beta^x \log\left(1 - \frac{\Delta x_i}{x_i^0} s_i\right) > \varepsilon_{i1} - \varepsilon_{i0} \right). \quad (6b)$$

Given that the error terms of (1) are iid normal with a variance of 0.5, it follows that the error difference ε is standard normal (with a variance of 1), and that the parameters are estimated consistently with a binary Probit model (see e.g. Hanemann and Kanninen 1999). The corresponding predicted maximum *WTP,* or Compensating Variation (CV), for the health improvement Δh_i (normalized to one in the regressions) is in the linear case for an arbitrary individual *i* given by:

$$CV_i = \frac{\beta^h}{\beta^x} + \varepsilon_i \quad (7a)$$

where β^h is equal to the estimated intercept, and where β^x is the marginal utility of income, which is equal to minus the estimated coefficient for the bid. In the log-case we have instead:

$$CV_i = x_i^0 \left(1 - e^{-\frac{\beta^h + \varepsilon_i}{\beta^x}}\right). \quad (7b)$$

Hence, the linear model predicts that the WTP for a health improvement is proportional to the health change, and is independent of initial income. The log-model, on the other hand, predicts that the WTP increases at a decreasing rate in the health change, and that it is proportional to initial income, implying an income elasticity of unity. The mean and median WTPs in the linear case are straightforward, since ε is assumed to be independent of the covariates, and to have zero mean and median. They are then calculated as follows:

$$E(CV) = M(CV) = \frac{\beta^h}{\beta^x} \quad (8)$$

where the operator *E* denotes mean value, and *M* median value. The mean and median WTPs in the log-case are slightly more complicated. We have:

$$E(CV) = E(x^0) E\left(1 - e^{-\left(\frac{\beta^h + \varepsilon}{\beta^x}\right)}\right) = E(x^0)\left(1 - e^{-\frac{\beta^h}{\beta^x}} E\left(e^{-\frac{\varepsilon}{\beta^x}}\right)\right) = E(x^0)\left(1 - e^{-\left(\frac{\beta^h}{\beta^x} + \frac{1}{2\beta^{x^2}}\right)}\right) \quad (9a)$$

$$M(CV) = M\left(x^0 \left(1 - e^{-\frac{\beta^h + \varepsilon}{\beta^x}} \right) \right). \qquad (9b)$$

There is no way to simplify (9b) further, and this expression must therefore be calculated using simulations.

In Table 4a we present the regression results with zero discount rate, divided between those who received 50% risk reduction and those who received 100% risk reduction questions. As expected, the higher the offered bid, the lower the probability of bid acceptance. Further, insensitivity to scope is indicated by a Likelihood Ratio test for the linear model, which shows that we cannot reject the pooled sample specification (LR-stat= 3.2). Hence, the external test of sensitivity to scope shows no significant scope effects. For the log model, the 50% replacement model does not converge, and the parameter for log of bid is not significant, which is why we shall not trust the estimated WTP in this specification.

Table 4a. Parameter estimates and estimated WTP: scope sensitivity between 50 and 100% substitution with risk free cigarettes

	Linear model 6(a) Whole sample	**Linear model 6(a)** Only 100%	**Linear model 6(a)** Only 50%	**Log model 6(b)** Whole sample	**Log model 6(b)** Only 100%	**Log model 6(b)** Only 50%
Intercept	1.29***	0.88***	1.77***	1.16***	-0.66***	1.39***
Bid	-0.082***	-0.053***	-0.118***			
Log(1+Bid/income)				723.630***	348.86***	643.70
Median WTP	15.6	16.7	14.9	15.9	18.0	21.5
Mean WTP	15.6	16.7	14.9	16.5	19.0	22.9
Number of individuals	303	139	164	283	127	156
Log likelihood	-175	-84	-89	-167	-78	-92
Restricted log likelihood	-207	-96	-111	-194	-88	-106

*significant at the 10% level
**significant at the 5% level
***significant at the 1% level

In Table 4b we present estimated WTPs when assuming an implicit discount rate of 5%. The WTP can then be interpreted as how much the respondent would have been willing to pay if the expected time gained would appear at the same time as the money is paid for the cigarettes, instead of in the future. The interpretation may not be perfectly straightforward, but one can consider the value of lost days each year.

Compared to Table 4b, we naturally see that WTP increases due to the positive discount rate. Hence, estimated WTPs are greater when assuming that the lost time

would occur today, rather than in the future. Using a Likelihood Ratio test, we can, however, still not reject insensitivity to scope.

Table 4b. Parameter estimates and estimated WTP assuming that WTP for reducing health effects would occur today

	Linear model 6(a) Whole sample	**Linear model 6(a)** Only 100%	**Linear model 6(a)** Only 50%	**Log model 6(b)** Whole sample	**Log model 6(b)** Only 100%	**Log model 6(b)** Only 50%
Intercept	1.08***	0.83***	1.37***	0.84***	0.58***	1.10***
Bid*discount factor	-0.030***	-0.024**	-0.038***			
Log(1+Bid*disc. factor/income)				209.46***	139.66***	282.66***
Corresponding heteroscedasticity term for bid variable	0.0093**	0.0066	0.013*	-60.10	-15.23	-92.24**
Median WTP	35.9	34.8	35.9	40.0	41.3	38.8
Mean WTP	35.9	34.8	35.9	41.5	41.4	41.3
Number of individuals	303	139	164	283	127	156
Log likelihood	-180	-86	-93	-174	-80	-92
Restricted log likelihood	-207	-96	-111	-194	-88	-106

*significant at the 10% level
**significant at the 5% level
***significant at the 1% level

2.5 OPEN-ENDED WTP RESULTS

Table 6 shows the results for the open-ended WTP question, which followed after the dichotomous choice WTP question.

Table 6. Willingness-to-Pay (open-ended) for risk-free cigarettes in addition to the price of SEK 35 per packet. (Protest zero responses removed).

	Median	Mean	Std. Dev.	Min.	Max.	No. of zeros	N
All observations, 0% discount rate	10	12.86	15.34	0	100	17%	288
100% replacement, 0%	10	12.91	16.00	0	100	19%	134
50% replacement, 0%	10	12.82	14.81	0	100	15%	154
All observations, 5% discount rate	16.94	28.89	35.89	0	218	20%	286
100% replacement, 5%	16.13	29.76	38.48	0	218	22%	132
50% replacement, 5%	17.46	28.13	33.62	0	218	18%	154

We see that the WTP figures arising from the open-ended question are slightly below the values obtained from the dichotomous choice question, as is typically found in the literature. The mean differences found here are, however, smaller than in most previous research. One reason is that we have no split sample between DC and OE respondents, and that those who have said yes to a certain bid may feel obliged to state a value in the open-ended question which is at least equally as large. Further, Halvorsen and

Saelensminde (1998) find that correcting for heteroscedasticity in the bid variable, as we did, typically reduces the WTP difference between dichotomous choice and open-ended. Again, we find no significant sensitivity to scope.

There could be several reasons for scope insensitivity. For example, some respondents "count backwards" (see below) and their stated WTP is what they feel they can afford when other costs are withdrawn, i.e. they do not make tradeoffs between risk reductions and other goods. Alternatively, completely risk-free cigarettes may sound unrealistic, implying that the responses may be based on a somewhat vague "major risk-reduction" in both cases. Anchoring on the price of a cigarette is also possible since the WTP per pack of cigarettes was chosen as the payment vehicle. Finally, it is cognitively difficult to transform the perceived risk reductions into WTP figures, implying that many respondents may apply simplified "heuristics"; see e.g. Slovic (2000a).

2.6 How did the respondents think?

We asked the respondents six follow-up questions about how they were making their choices and providing the WTP numbers, and the answers are summarized in Table 7. We see that 63% respond that they had weighed benefits of risk free cigarettes against other benefits, as is predicted by economic theory. However, several respondents (33%) seem to have relied, partly or totally, on the cognitively easier strategy of *counting backwards*, i.e. by calculating what is left when they have deducted fixed costs, indicating that some respondents do not make tradeoffs between reduced health risks and other goods. Some (22%) also report a low WTP due to a wish to quit anyway.

Table 7. Arguments for WTP for risk free cigarettes without protest zeros.

	%
Agreeing to trade between risk free cigarettes and other goods	63
WTP is explained by money left after fixed costs	33
Low WTP due to low perceived health risks from smoking	11
Agreeing to pay more if respondent had more money	28
Low WTP because the respondent wanting to quit anyway	22
High WTP due to the fact that respondents would be helped to quit by higher price	26

3 IMPLICIT VALUE OF LIFE YEAR

The expected number of minutes lost due to smoking an additional cigarette may depend on many variables such as the age of smoking initiation, the number of cigarettes smoked per day as well as individual genetic and lifestyle factors. Following Gruber (2001) and Gruber and Köszegi (2000), we will adopt the admittedly crude, recent estimate by Shaw et al. (2000) of an average value of 11 minutes of life lost per cigarette, corresponding to 3.67 hours of life lost per cigarette pack, or 0.00042 years per cigarette pack.[6] The estimate by Shaw et al. is based on the difference in life expectancy between male smokers and non-smokers, and that the median male smoker starts smoking at age 17 and smokes 16 cigarettes per day until the average male smoker dies at age 71.[7] Shaw et al. further assume that each cigarette makes the same contribution to death.

We present the value of life year for 50 and 100% replacement separately, assuming that 50% corresponds to cutting cigarette consumption in half, and 100% equals quitting. If the additional WTP per packet of risk-free cigarettes with 100% risk reduction is 10 SEK, we get 10/(0.000418569) SEK/year = 23,891 SEK per year, or about 2,250 USD per year. Using this approach we get the results in Table 9.

Table 8. Average implicit value of life year for a major risk reduction in USD (USD 1=SEK 10.60).

	Average value of life year using maximum WTP in open-ended follow up question	Average value of life year using dichotomous choice format
Discount rate 5% 100% replacement	3600-6700	7800-9300
Discount rate 0% 100% replacement	2300-2900	3800-4300
Discount rate 5% 50% replacement	7900-12700	16200-18600
Discount rate 0% 50% replacement	4500-5800	6700-10300

Value of life year ranges from USD 2,300 to 6,700 when we do not use a positive discount rate, and from 3,600 to 18,600 with a 5% discount rate. Bearing in

[6] The calculation by Gruber is instead based on the estimate by Manning et al. (1991) using 7 minutes per cigarette.

[7] Nordlund et al (1999) conclude that men and women have similar relative risks of smoking-related cancers at equals levels of smoking.

mind that many protest-responded due to a perceived unrealistic scenario, it is possible that many (non-protest) responses reflect a major risk reduction, other than the one specified. If so, the result from the 50% replacement categories would be more reliable. The values in Table 8 can be compared to Dardis and Keane (1995), who use values of life year between USD 25,000 and 75,000 (VOSL= USD 0.72-1.21 millions depending on 5% and 10% discount rates respectively) based on value of life estimates from Fisher et al. (1989) and Shepard and Zeckhauser (1984). In a similar way, but instead using value of life figures from Viscusi (1993) along with figures of the time lost from smoking in Manning et al. (1991), Gruber (2001) and Gruber and Köszegi (2000) calculate internal costs of smoking to be roughly USD 30 per pack of cigarettes, which corresponds to a value of life year of USD 115,000. However, these value of life year estimates are calculated from value of life estimates, without appropriate correction for a lower quality of life at a higher age. Cropper et al. (1994) and Johannesson and Johansson (1997) estimate, using the CV method, the public's priorities among different age groups, finding that saving a life of a high age should have a much lower weight than others. For example, Johannesson and Johansson (1997) find that saving 41 70-year-olds is equivalent to saving one 30-year-old. This ratio is clearly much larger than the ratio of the remaining expected life years. The only study to our knowledge that explicitly tries to calculate the value of a life year at an advanced age is Johannesson and Johansson (1996), who find very low values compared to the ones mentioned above. They estimate the average WTP for a life extension of one year in a random sample of Swedes, given that they had already survived to age 75, to be less than USD 1,500 (framed as an insurance premium for using a new medical program or technology). A given explanation for this relatively low estimate is that the respondents' own predictions regarding the quality of life at this age are rather bleak. However, their CV question was posed as a once-and-for-all payment, which might bias the result downwards.

Ippolito and Ippolito (1984) derive value of life years from increased information about the risks of smoking, based on revealed-preference data. They find a mean value of life year saved estimate of USD 5,700 ($1980) for smokers, which is of a similar order of magnitude as our figures. They also find that smokers behave more "risky" than non-smokers, implying a lower value of life year, which is consistent with

a great deal of other empirical evidence (see e.g. Viscusi et al.,1999). The importance of quality of life is highlighted in the study by Johnson et al (2000), which analyzes the preferences for longevity among smokers aged 50-64 using a choice experimental approach. They use four different classes of quality of life, and find that smokers have quite a large WTP for improved longevity if quality of life is good, but that the WTP is actually negative if quality of life is poor. In general, they find WTP is more sensitive to changes in quality of life than changes in longevity expectations.

Hence, we cannot draw the conclusion that smokers underestimate the adhering health risks from smoking. It should be noted though that the sample consists of experienced smokers, and it may still be the case that people, when they start smoking, underestimate the health risks or overestimate their own ability to quit. Indeed, to test the latter hypothesis we included the following question: *When you started smoking, did you then believe that you would still be smoking today?* It turned out that as many as 86% answered *no* to this question, indicating that optimism-bias may have been an important issue *when they started smoking*, even though they may still, on average, be able to reasonably judge the health effects *at present*.[8]

4 CONCLUDING REMARKS

Contrary to most previous studies discussing whether or not smokers underestimate the health risks of smoking, we do not present any quantitative risk information for smokers to value, nor do we ask smokers to quantify the risk. Instead, we are interested in whether smokers behave *as if* they underestimate the risk, which we test by asking them how much they would pay for newly developed risk-free cigarettes in a CV framework. Our results are equivalent to fairly reasonable value-of-life year estimates, implying that we cannot reject the hypothesis that smokers make a rational valuation of the health risks of smoking. This conclusion is however related to the fact that there is little empirical evidence on the value of a life year at an advanced age. We can therefore not rule out the fact that we would have to revise this conclusion if reliable and very

[8] However, Viscusi (1991) finds, on the contrary, that individuals aged 16-21 have higher risk perceptions of lung cancer than older age groups.

different estimates, compared to the present ones, would be presented. We also find evidence of initial optimism-bias regarding people's own ability to quit smoking at will.

There are many reasons to be careful when using the findings here for policy purposes and, as is common with survey methods, there are remaining methodological problems. First, we found no significant sensitivity to scope, using an external test. Second, there is evidence that some respondents do not seem to make tradeoffs between reduced health risks and other goods, as predicted by economic theory. Nevertheless, this study presents implicit value of life year estimates based on a new methodology, which involves large risk reductions rather than small ones, and we believe that it is interesting to compare the order of magnitudes of the results with existing empirical evidence.

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APPENDIX

WTP Scenario TRANSLATED VERSION (additional text in 50% version shown in parenthesis)

Part C. – A Risk Free Cigarette

The purpose of this section is to find out what value you put on a totally risk free cigarette.

Imagine that you have been randomly chosen to try a new type of cigarette that has been developed by Swedish researchers. Everybody else will continue smoking ordinary cigarettes, and unless you do not want to, no one will know that you now use a new totally risk free type.

(Imagine that you have been offered to change half of the cigarettes you smoke today to new cigarettes that do not produce any negative health effects. The cigarette packs look exactly the same as the ones you usually buy. The only difference is that half of the cigarettes are the new risk free type. The ordinary type in the pack is identical to the kind you usually smoke.)

The risk free cigarette has the same taste as the cigarette you usually smoke. It also looks the same, gives you the same feeling of satisfaction, and neither you nor those around you can separate it from an ordinary cigarette. Further, it is also addictive in the same way as ordinary cigarettes, and is perceived in the same way by those around you in terms of smoke, smell, eye irritations, etc. However, it is completely harmless for you as well as for those around you.

(It is known that reduced smoking implies reduced health risks. For instance, if you previously smoked 20 cigarettes per day, and now replace 10 of them with the new risk free type, you also cut your health risks from smoking in half.)

Note that one really knows that the new cigarettes are totally harmless. If you think that this sounds unrealistic, we ask that you answer as if you accept this as a fact. The only problem with the new cigarette is that it is more expensive that the ordinary ones. We now ask you to answer two questions:

Question 1. Imagine that you could buy a pack of cigarettes where all (half) of the cigarettes are risk free. Would you, for the rest of your life, be willing to pay an additional SEK X per pack of 20 cigarettes, where all (10) of them are of the new risk free type?

(Note! We ask you to consider that your income is limited, and your money must cover many other items)

❒ Yes ➜ Go to question 2a
❒ No➜ Go to question 2b

Question 2a. You are *willing* to pay an additional SEK X per pack (where half of the cigarettes are) of the new risk free type. Now we wonder how much you are willing to pay, at a *maximum*?

I am willing to pay …….. SEK per pack of the new risk free type *for the rest of my life*.

Question 2b. You are *not willing* to pay an additional SEK X per pack (where half of the cigarettes are) of the new risk free type. Now we wonder how much you are willing to pay, at a *maximum*?

I am willing to pay …….. SEK per pack of the new risk free type *for the rest of my life*.