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Contingent Valuation of Mortality Risk Reduction in Developing Countries: A Mission Impossible?

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Abstract

Using the contingent valuation method in developing countries to value mortality risk reduction is particularly challenging because of the low level of education of the respondents. In this paper, we examine the effect of training the respondents regarding probabilities and risk reductions, in addition to using visual aids to communicate risk and risk reductions, in a contingent valuation survey. Our results indicate a significantly higher WTP for the trained sub-sample, and WTP is sensitive to the magnitude of risk reduction both with and without the training.

Keywords: contingent valuation; risk reduction; WTP; effect of training; sensitivity to scope; Bangladesh.

JEL Classification: I1, D6, D8, H4

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1. Introduction

The contingent valuation method (CV) has been widely used to value mortality risk reduction, but mostly in developed countries (e.g. Corso et al., 2001; Persson et al., 2001; Krupnick et al., 2002). The CV method involves eliciting people's willingness-to-pay (WTP) for a hypothetical reduction in the risk of dying during a given time period (see Hammitt and Graham, 1999). The individual's rate of trade-off between own money and a small risk change[1] i.e. the marginal rate of substitution, is defined as the value of a statistical life (VSL) (Weinstein et al., 1980; Viscusi, 1993; Johansson, 2002). The individuals' WTPs for a reduction in the mortality risk are converted to VSL by dividing the WTPs by the risk change in question. However, most previous CV studies have found unreasonably low sensitivity of WTP to the size of the risk reduction. One likely reason for the lack of sensitivity is a poor understanding of probabilities and a lack of intuition regarding small risk changes (see Hammitt and Graham, 1999). However, recent evidence by Corso et al. (2001) suggests that there are ways to increase the sensitivity by using visual aids in the presentation of risks in the CV survey.

It is particularly challenging to use the CV method to value mortality risk reductions in developing countries.[2] The main reason is the difficulty to communicate probabilities and risk reduction to the respondents, since many either have very low levels of education or are illiterate. Moreover, most people are unfamiliar with the concept of trading income for the risk reduction and therefore might face greater uncertainty in placing a value on the risk reduction. A brief training of the respondents in the survey regarding probability, risk, and risk changes may enable the respondents to

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[1] For example, a change in risk of dying from 5 in 10,000 to 4 in 10,000.

[2] However, by a careful survey design, it is generally possible to conduct high quality CV surveys in developing countries (see Whittington, 1998; 2002).

process risk information better and thus the respondents will become more elaborate about their preferences for risk reduction. Therefore, one might expect that by reducing any uncertainty regarding the object of valuation, the training would yield lower variation in the responses, as well as an increase in the sensitivity to scope. This paper reports on a CV study of mortality risk reduction conducted among a random sample of rural households in Bangladesh. The objective of the study was to examine the effect of training regarding probability, risk, and the implication of risk reductions on the WTP responses and not to obtain an absolute magnitude of the VSL, as well as to investigate whether training affects the sensitivity to scope.

The validity and reliability of the CV method is intensely debated (see e.g. Kahneman and Knetsch, 1992; Diamond and Hausman, 1994; Hanemann, 1994). However, some of the criticisms attached to the CV method, such as "warm glow," or the "purchase of moral satisfaction" phenomenon for contributing to overall social causes, is not applicable when valuing individuals' own risk reductions through vaccinations.[3] On the other hand, it can be highly cognitively demanding for the respondents to compare expected welfare effects from the risk reductions to the effects of monetary changes (Beattie et al., 1998; Hammit and Graham, 1999; Carlsson et al., 2004). The sensitivity of the estimated WTP to the magnitude of the good in question is regarded as a test of the validity of CV estimates (Mitchell and Carson, 1989; NOAA, 1994; Diamond and Hausman, 1994). Assuming that risk reduction is a desired good, the theoretical expectation is that WTP for mortality risk reduction should be positively associated with the magnitude of the risk reduction. Furthermore, for sufficiently small risk changes, WTP should be proportional to the magnitude of risk reduction (Weinstein

[3] Although vaccinations can be seen as a good with a positive externality, we find no indication that people consider this while deciding for their own vaccination.

et al., 1980; Hammitt and Graham, 1999; Hammitt, 2000). This means e.g. that WTP should be twice as high for a two-fold reduction in risk. However, a problem of stating risk in a survey is when the respondents treat the given probabilities as not applicable to them and hence form posterior risk estimates based on their prior beliefs and on information contained in the scenario. In this case, the stated WTP will not be proportional to the magnitude of the stated risk reduction presented; rather, it would rather be proportional to changes in the perceived risk (Viscusi, 1985; 1989).

The use of visual aids has proven to be useful (e.g. Corso et al., 2001; Krupnick et al., 2002) in obtaining responses consistent with the theoretical expectations (sensitive to scope). Examples of visual aids include verbal probability analogies, risk ladders, and graph paper with squares and an array of dots. Corso et al. (2001) found that graph paper and a risk ladder with logarithmic representation of the risk performed the best.

Accordingly, we used graph paper to communicate risk and risk reduction in our survey. We stated either a 25% or a 50% reduction in the risk that corresponds to the respondents' subjective risk of dying during the next five years; subjective risk is based on age-related statistical risks of dying for the same period presented in the CV scenario. Therefore, the insensitivity of scope problem can be expected to be smaller in view of the fact that we include a relatively large risk change together with training on risk reduction, particularly if the insensitivity is related to the poor understanding or lack of intuition about small risk changes on the part of the respondents. Another reason why the theoretical proportionality prediction would not hold in our case is that we deal with substantial risk changes; WTP would increase but less than proportionally to the risk changes and hence the resulting VSL is expected to be smaller compared to the case when small risk changes are valued. The results indicate a significant difference in the distribution of the WTP between the sub-sample receiving training and the sub-sample receiving no training. However, we find no significant difference in the variance, but rather that WTP increases with training. We also find that estimated WTP is sensitive to the scope of the risk reduction, both with and without training.

The remainder of the paper is organized as follows: Section 2 presents the design of the CV survey including sample characteristics, respondents' risk perceptions etc., Section 3 discusses WTP results, Section 4 presents the econometric analysis, and the paper is concluded in Section 5.

2. Design of the CV survey

Two versions of the CV survey were constructed: one version including a brief training vis-à-vis probability and risk, and the other without such training.[4] The enumerators, used to conduct the survey, were trained beforehand using the guidelines of Whittington (2002). In particular, the enumerators were trained regarding the risk presentations, and the CV methodology in brief, i.e. the purpose of the CV survey, the notion of maximum WTP, etc. The same enumerators were used in the pilot and in the final survey, and they were closely supervised during the fieldwork. We furthermore test for possible enumerator effects when analyzing WTP responses. The CV questionnaire was tested using focus groups and two pilot studies, which, together with the feedback from the enumerators, enabled us to simplify the risk presentations, the CV scenario and the CV question. The survey-questionnaire and the CV scenario were translated back to English

[4] Ideally, it would be better to train people for a longer period; however, we intend to see whether a brief training as part of the questionnaire makes any significant difference in the responses since such education is the most realistic kind that can be pursued.

from Bengali to ensure the exact meaning of the original English version. The final survey was administered, using a random sample technique, among rural households in the following five districts of Bangladesh: Netrokona, Mymensingh, Manikganj, Gazipur, and Narayanganj. The sample is therefore not representative of the Bangladesh population, which consists of 64 districts. Moreover, the villages were chosen so that the respondents of the Hindu religion are over-represented (compared to the national average of 11 %), in order to facilitate religious comparisons. The enumerators were allocated to different parts of the selected villages and were then asked to perform household surveys and the CV experiments. The interviews were conducted with the household head as the decisions made within households are normally made, or at least approved of, by the household head. If a household head was not around, the enumerators were instructed to return later. If the respondent was not home at the second visit, the enumerator moved to next household.[5] The participation rate of household heads approached for interviews was 99 %. The respondents were paid (100 Taka) as an appreciation of their time and cooperation. Table 1 presents the sample statistics for the full sample. The household survey also included detailed questions on respondent health and risk perceptions, in addition to the socioeconomic questions. The CV survey took on average 15 to 30 minutes to complete. 774 individuals were interviewed. Table 1 presents the sample statistics.[6]

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[5] However, in the villages people from the same family-chain normally live in a cluster of 4-5 households. Thus, a replacement from the next household or next to the next household (in some cases) should not bias the results. There were 22 % replacement households in our sample.

[6] We have excluded observations related to very old individuals (older than 75), as the risk reduction presented in the CV survey is for a five -year period.

>>> TABLE 1 HERE

The respondents were asked to state their maximum WTPs for obtaining a stated risk reduction that corresponded to their stated subjective risk of dying during the next five years, which was elicited after the average age-related objective risk had been presented to them. We choose the open-ended format as it provides more information than the closed-ended (dichotomous choice question) format, although many researchers would favor the latter (see e.g. Bateman et al., 2002; Hanley et al., 2003). Moreover, it has been shown in experiments, that dichotomous choice overestimates values more than the open-ended questions in the case of auction values as well as private goods (see Balistreri et al., 2001).

Based on a *t*- test, we do not find any statistically significant differences (p-value>0.05) in terms of socio-economic characteristics between the populations of the two sub-samples, i.e. training and no training. Therefore, differences in the WTP responses (relating to a specific risk reduction), between these two sub-samples could be attributed to receiving training in the survey.

The responses can be divided into the following categories: (1) training and a 50% risk reduction, (2) training and a 25% risk reduction, (3) no training and a 50% risk reduction, and (4) no training and a 25% risk reduction.

2.1 Training and risk understanding

In the CV questionnaire, the training involved concepts of probability of different events occurring, risks, and implications of risk changes (presented in Figure 1). In particular, we used coin flipping, dice throwing and a lottery example to introduce the concept of probabilities to the respondents. Mortality risk was discussed using the example of risk of dying from traffic accidents. The chance of winning in a lottery and the mortality risk example were explained with the use of graph paper containing 100 and 1,000 squares, respectively. The respondents were asked test questions after each example. If the respondent had a correct answer, the enumerator continued to the next example. To facilitate understanding the respondents received more explanation following a wrong answer, before being asked the same question again. If a respondent still did not have a correct answer after the third, then the enumerator continued to the next example after explaining the correct answer.

>>> FIGURE 1 HERE

The results of the probability test questions are summarized in Table 2. A respondent is considered to have passed the entire test if he/she provided the correct answer to each of the three probability test questions on the first attempt. Only 24% of the respondents passed the entire test.

>>> TABLE 2 HERE

In the second stage of the training, the meaning of the risk reductions was explained to the respondents (presented in Figure 2, read by the enumerators). To begin with, the respondents were informed about the average risk of dying for an adult in Bangladesh in the next five years (40 in 1,000).[7] This risk was explained using a graph paper containing 1,000 squares of which 40 were colored black (see Appendix). Then

[7] This is based on Bangladesh life table estimates for the year 2000 provided by the World Health Organization (WHO, 2004).

the respondents were told that with appropriate public policy this mortality risk could be reduced to for example 35 in 1,000. The two risk levels were shown simultaneously using graph papers to explain the differences with five of the black squares becoming white in the second graph.

>>> FIGURE 2 HERE

The implication of the risk changes from 40 in 1,000 to 35 in 1,000 was explained to the respondents by saying that 5 out of 40 lives could be saved through a policy measure. In a similar fashion, the meaning of further risk reduction was explained to the respondents, i.e. reducing the risk from 40 in 1,000 to 20 in 1,000 and reducing the risk from 40 in 1,000 to 10 in 1,000. Each risk reduction example was explained up to three times to facilitate the respondents' understanding. Almost 95% of the respondents revealed that they had understood all risk reduction examples after the first explanation. This might reflect a "yea saying" bias as the question (Do you understand this risk reduction?) is of a yes/no type. However, when asked in the end of the training to indicate which of the above three risk reduction examples they would prefer, almost 98 % of the respondents preferred the largest risk reduction example (reducing the risk from 40 in 1,000 to 10 in 1,000), which suggests that they had understood the risk reduction examples.

2.2 Objective risk and risk perception

All respondents in the survey, before being presented with the CV scenario, were first informed about the average mortality risk of persons aged 30-34 and persons aged 55-59 as 15 in 1,000 and 90 in 1,000, respectively, in the next five year period (see Figure

3). Then the respondents were asked to mention their perceptions of their own risks of dying during the same period taking into consideration their ages, health and lifestyles in particular.

>>> FIGURE 3 HERE

Thus, we customize the mortality risk for each individual according to his or her own perception. Figure 4 shows the mean mortality risk, both objective and subjective, for various age groups of respondents during the next five years. As observed, people on average overestimate mortality risk at younger ages and underestimate it at older ages. This supports earlier findings (Viscusi, 1992) that people tend to overestimate small risks and underestimate large risks. Based on a non-parametric (Wilcoxon matched-pairs signed-rank) test, we can conclude that respondents' subjective and objective (age-related) risks are significantly different (p- value <0.001).[8] That people have a biased risk perception is also consistent with much research in psychology (Tversky and Kahneman, 1992; Kahneman and Tversky, 2000; Gilovich et al., 2002).

>>> FIGURE 4 HERE

We estimate ordinary regression to see what characteristics explain the risk perception of individuals. For obvious reasons we do not focus on gender differences in risk perception since we only have 9% female respondents.[9] As age and age-related objective risk are highly correlated, we estimate two separate models. The first model

[8] The difference between objective and subjective risk is positive, negative and zero in 446, 290 and 35 cases, respectively.

[9] We do not focus on gender difference in any of the subsequent analyses of this paper.

includes age-related objective mortality risk and the second model includes respondents' ages, in addition to other explanatory variables. Based on a PE test (Greene, 2000), we can reject the null hypothesis of a linear specification in favor of a log-linear specification (PE coefficient 70.61, p-value 0.000), in the case of the first model. For the second model, however, we cannot reject neither the null hypothesis of a linear specification (PE coefficient 18.97, p-value 0.285), nor the null hypothesis of a log-linear specification (PE coefficient 0.010, p-value 0.335). In Table 3, we present the results of log-linear specifications for both models.

>>> TABLE 3 HERE

We observe that the respondents' risk perception increases by only 0.5 % for a 1% increase in the average age-related objective risk. We find that respondent's health status significantly affects the perception of the risk of dying; people with chronic illness show a 16% higher risk perception (first model) compared to people not having any chronic illness. Although weakly significant, the Muslim respondents seem to have a 15% higher risk perception compared to the Hindu respondents.

We further observe that the smokers' perception of the risk of dying is 19% higher compared to non- smokers. Thus, it seems like smokers are quite aware of the health risk of smoking even in the rural areas of a developing country such as Bangladesh. On average, smokers' life expectancy is shorter than for non-smokers. For example, Shaw et al. (2000) estimate that average loss of life due to smoking is 6.5 years or 11 minutes per cigarette. Studies have shown that the risk of developing lung cancer is 22% higher for smokers and that the mortality risk from cardiovascular disease (heart disease) is almost double for smokers (including ex-smokers) compared to non-smokers

(Newcomb and Carbone, 1992; ILO, 2002).[10] Given these estimates, it is hard to say whether smokers overestimate or underestimate the risk of dying in our case. The empirical evidence regarding smokers' risk perception is otherwise mixed.[11]

2.3 The CV scenario

Finally, the respondents were presented with the CV scenario (see Figure 5) and WTP questions to elicit their preferences for a risk reduction. The specific risk reduction (either a 25% or a 50% reduction) corresponds to the respondent's stated perceived risk of dying during the next five years and was communicated by separating the black squares representing perceived risk into 25-75 or 50-50 splits. The risk reductions, as told to the respondents, were to be achieved through participation in a program involving various vaccinations. Each respondent was asked about his/her maximum WTP for the stated risk reduction. If the respondent stated zero WTP for the risk reduction, he or she was asked several follow-up questions in order to ascertain possible scenario rejections.

>>> FIGURE 5 HERE

[10] The risk for contracting other types of cancer is also relatively higher for smokers (Newcomb and Carbone, 1992).

[11] For example, studies in developed countries find that smokers overestimate the risk of getting lung cancer from smoking and that their assessed loss in life expectancy due to smoking is quite high (Viscusi, 1990; Viscusi 1992). For a sample of smokers in Sweden, Hammar and Johansson-Stenman (2004), however, did not find support for the conclusion that smokers overestimate the health risk from smoking. Slovic (2000) discusses the fact that particularly young smokers considerably underestimate the health risk due to smoking.

3. WTP results

Approximately 10 % of the respondents stated zero WTP. Those who stated zero WTP were asked if they instead would want to receive the vaccination free of cost; 77 % of respondents with zero stated WTP mentioned that they would rather want the risk reduction free of cost. To ascertain scenario rejection, all these respondents (including the ones who would not want free vaccination) were asked why they would not be willing to pay for vaccinations; possible answers (reasons) were read to the respondents and the respondents could choose more than one answer (see Table 4). Among those 79 respondents, 84 % had chosen more than one answer; we believe these responses indicate scenario rejection.[12] We do not include these responses in our further statistical analysis of this paper.

>>> TABLE 4 HERE

However, we analyze the probability of scenario rejection using a standard probit model. In Table 5, we see that the only significant variable that explains scenario rejection is the respondent's religious belief; Muslim respondents are more likely to provide a protest zero. We also see that respondents receiving training in the survey are less likely to reject the scenario at the 10% level.

>>> TABLE 5 HERE

[12] Respondents who had chosen any response than (i) or had chosen more than one responses are believed to have provided protest zeros when answering the WTP question.

Alberini (2004) discusses about the robustness of CV estimates and different types of outliers. We look for WTP outliers in relation to income. There is no *a priori* reason to assume that WTP for reducing the risk of dying should be a small part of income, since the payment for the risk reduction was to be made once for a five-year period. We choose to keep WTP responses equal to or less than 50% of respondent annual income per capita. The coefficient of income remains roughly the same with this exclusion.[13] We finally have 692 observations for further statistical analysis. Table 6 reports the descriptive statistics of WTP for different sub-samples; in the Appendix, we present histograms of the distribution of WTP, where a visual inspection of WTP data reveals the existence of some focal points.

>>> TABLE 6 HERE

We find that the mean WTP is TK. 487 (TK. 672) for a 25% (50%) risk reduction, for the no-training sub-sample. For the trained sub-sample, the mean WTP is TK. 671 (TK. 970) for a 25 % (50%) risk reduction. Thus, we find that the training in the CV survey increases the mean and reduces the variances of WTP. We can reject the hypothesis that for the specific risk reduction (either 25% or 50%), WTP for the two sub-samples (training and no training) comes from the same underlying distribution (in both cases, p-value<0.001). As reported in Table 6, the results also indicate a smaller variation in the CV responses for the training sub-sample, which in turn implies that a brief training facilitates respondent ability to better process the risk information, and

[13] However, the mean WTP (and not median WTP) for the sub-samples reduces between 1- 27 % with the exclusion of these responses.

hence yields lower variation in the CV responses. We conduct more tests regarding the differences in WTP in the econometric analysis in Section 4.

3.1 Implied value of statistical life

We calculate the individual VSL from the data by dividing individual WTP by the changes in the individually perceived risk; the mean VSL is in the US$ 1,783 to US$ 2,922 range. As depicted in Table 6, we also calculate the individual VSL by dividing the changes in the individual's average age-related mortality risk. We observe a different pattern for the mean VSL (but not for the median VSL) based on the subjective risk changes, between the trained and the not trained sub-samples. In the no-training sub-sample, the mean VSL is higher for the higher (50%) risk reduction level, and in the trained sub-sample, the mean VSL is higher for the lower (25%) risk reduction levels. If the observed WTP were less than proportional to the magnitude of the risk change, we would obtain a lower VSL for the higher risk reduction level. The result we mentioned above is due to some very high WTPs related to very low perceived risks, in the case of the no-training sub-sample. This pattern is not observed for VSL based on objective risk changes; the mean VSL is lower for the higher risk reduction level.

The magnitude of the VSL, however, is very low compared to the available estimates for developing countries.[14] For example, using results from several VSL studies, Miller (2000) predicts a VSL for Bangladesh in the range of US$ 30,000 to US$ 1,000,000. The lower absolute values of VSL in our case may be attributed to the fact that unlike many other studies we had relatively large risk reductions, if we assume that

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[14] Using data from the Indian labor market, Shanmugam (2000) provides VSL in the range of US $ 0.76 million -$1.026 million and Simon et al. (1999) provide VSL for India from an independent wage-risk study in the range of US$ 0.15- US$ 0.35 million.

there is inadequate sensitivity to scope. For example, Carlsson et al. (2004) suggests that VSL tends to decrease rapidly when the size of the risk reduction increases.

Moreover, stating WTP for a risk reduction is somewhat difficult for people unfamiliar with the concept of trading income for risk reduction. Therefore, it is likely that people would suffer from initial anchoring when constructing an answer as to how much they would be willing to pay (Tversky and Kahneman, 1974; Kahneman et al., 1982; Green and Tunstall, 2001). For example, the respondents might anchor on the price of vaccination or on their other expenditures. People in rural areas, in a developing country like Bangladesh, have a general perception that vaccinations are to be provided free by the government, as is the case with the children's vaccination programs. For example, Cropper et al. (2004) estimated demand for a hypothetical malaria vaccine in rural Ethiopia and their results suggest that at very low prices few vaccines are purchased; "at an annualized price of US$ 3, half of the households in Tigary would purchase no vaccines." Moreover, in the context of a developing country, household consumption expenditures are usually low on average, particularly in the rural areas. Therefore, when placing a value on a desired and substantial risk reduction, the respondents might anchor initially to such low expenditures, and adjust thereafter. In addition, the incidence of financial limitations coupled with poorly functioning credit markets also results in lower WTPs, particularly if the respondents are asked for one-time payments rather than continuing monthly or yearly payments.[15] Training seems to reduce this potentially downward bias in WTP as we observed a significantly higher WTP for the training sub-sample.

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[15] As observed by Carson (2000), "A one-time payment generally produces more conservative estimates since it does not offer the opportunity to spread payments over time," compared to a continuing payment (p. 1416).

4. Econometric analysis

An appropriate econometric model for analyzing the WTP data that also includes zeros would be Tobit with selection, as it allows for modeling zero and positive WTP separately (for a discussion, see Carlsson and Johansson-Stenman, 2000). However, with only 13 (non-protest) observations with a zero WTP, it is doubtful whether a sample selection model can be justified in our case. Moreover, it is unclear whether there is any true negative WTP. Therefore, we estimate a truncated regression model where WTP is truncated at zero. Based on a PE test (p-value = 0.017) we can reject a linear specification in favor of a log linear one. We use log (WTP + 1) as the dependent variable, which is truncated at zero.

In the previous section, we observed that the distributions of WTP significantly differ between the sub-samples concerning training. Given this result, we first estimated a model allowing for heteroscedasticty concerning training, where dummy variables are included identifying training in pooling the data. However, the heteroscedastic term is not significantly different from zero (p value=0.96). Therefore, we cannot reject the null hypothesis of homoscedasticity; the variances of WTP between the two sub-samples do not differ significantly. Hence, we estimate the model assuming homoscedasticity and dummy variables are included identifying training and risk reduction levels in pooling the data. It is expected that people who passed the entire training would show higher sensitivity to scope compared to other respondents; hence, we include separate interaction variables.

We first estimate two models; one assuming that there are no enumerator effects on WTP responses, and the other taking the enumerator effects into consideration by including dummy variables for the enumerators (see e.g. Köhlin, 2001). Out of 13 enumerators, we found only one enumerator to be significant and negative. Based on a likelihood ratio test, we can reject the null hypothesis of "no enumerator effect" (p-value 0.013). Therefore, we present the results from the latter model in Table 7, where we control for the enumerator effects.

The coefficient "training" is highly significant and implies that WTP for a larger reduction in risk is 79% ($e^{0.58} - 1$) higher for the group receiving the training. The coefficient on a 50% reduction is highly significant and indicates that WTP for the larger risk reduction is 45% higher than the WTP for the smaller reduction. The WTP difference concerning risk reduction is even higher for the training sub-sample (16% higher) in general and for the group who passed the tests (6% higher) in particular, although these differences are not statistically significant. We find that people with higher levels of prior education have on average 7% higher WTPs compared to illiterate people; however, this difference is not statistically significant.

>>> TABLE 7 HERE

We also estimate a separate model controlling for the WTP difference concerning the training as well as the risk reduction levels by interacting these variables with respondents' educational background variables. However, the interaction terms are not significant, based on a likelihood ratio test (p-value 0.36); hence, we can accept the results of the model presented in Table 7. Although it can be expected that people with higher levels of education might have higher values for risk reduction, other studies, e.g. Krupnick et al. (2002) and Alberini et al. (2004), have found that more highly educated people report lower WTPs.

The estimated marginal effects for income[16] are positive and significant, with an income elasticity of 0.43. The result that the income elasticity of the VSL is well below unity is also found in many other CV studies (e.g. Carlsson et al., 2004; Persson et al., 2001). In cross-country comparisons of VSL studies, Miller (2000) as well as Viscusi and Aldy (2003) found the income elasticity of VSL in the range of 0.85 to 1 and 0.5 to 0.6, respectively.

We find that the effect of age on WTP is negative at younger ages, until a minimum is reached at age 46, and then increases. Alberini et al. (2004) found, using a sample over 40-year olds that WTP does not decline until age 70. Although subjective risk positively affects respondents' WTPs for risk reduction, this is not significant.[17] The result that subjective risk does not have any significant effect on WTP for risk reduction is somewhat surprising, but consistent with other studies in developed countries (e.g. Corso et al., 2001). We also observe that having a chronic illness has no significant effect on WTP, which is consistent with the finding of Alberini et al. (2004) that having a chronic condition does not reduce the WTP for mortality risk. Although smokers' risk perceptions were higher compared to non-smokers, being a smoker does not significantly increase the WTP. We find that the level of overall individual happiness significantly and positively affects WTP for risk reduction, all else remaining the same.

[16] It should be noted here that the distribution of income is highly skewed and hence we estimated separate models excluding relatively high income. However, as the coefficient of income is roughly the same, we decided to keep them in our final model presented here.

[17] As respondent age and subjective risk might be correlated (risk perception is based on age-related objective risk), we also estimate a separate model excluding the subjective risk. However, the results are roughly the same.

From the estimated results, we formally test for the sensitivity to scope. We calculate the mean WTP ratio, i.e. ratio of mean WTP for a 50% risk reduction to the mean WTP for a 25% risk reduction, using the regression coefficients. The WTP ratios for both the sub-samples are presented in Table 8. We obtain the standard errors for these ratios as well as for the differences between these two ratios using the Delta method (Greene, 2000) and hence, construct the corresponding confidence intervals.

>>> TABLE 8 HERE

We can reject the hypothesis that WTP is insensitive to the magnitude of risk reduction for both the no-training and training sub-samples. We also find that sensitivity to scope is higher (higher WTP ratio) for the trained sub-sample; however, the difference between two WTP is not statistically significant.

5. Discussion and Conclusion

Past studies have discussed that it is problematic to consistently measure the value of statistical life using the CV method, largely due to the cognitive burden that the respondents face when comparing expected welfare effects of a small reduction in the risk to those of small monetary changes (Beattie et al., 1998; Hammit and Graham, 1999; Carlsson et al., 2004). However, the main objective of this study was not to obtain an absolute measure of VSL. Rather, we used substantial risk changes to be valued and measured the effect of training regarding probability and risks on the WTP responses and on the sensitivity to scope.

In the survey, we customize the mortality risk for respondents by asking them to report their perception of the risk of dying based on their health and information about age-related risks of dying provided in the survey. We find that people on average overestimate the risk at younger ages and underestimate the risk at older ages. This result is consistent with previous studies in the context of developed countries.

We find a significant difference in the WTP distributions between the sub-sample receiving training and the sub-sample receiving no training. However, we find no significant difference in the variance, but rather in the levels. We have found that estimated WTP is sensitive to the size of the risk reduction in both the sub-samples. Although sensitivity is higher for the trained sub-sample, the difference is not statistically significant, which implies that the training does not affect the sensitivity to scope. Although the implied VSL is higher for the trained sub-sample, it is still substantially lower compared to other studies, which may be attributed to the fact that compared to other studies we used relatively large risk reductions. Moreover, the respondents in the survey were asked for a one-time payment, rather than for continuing monthly or yearly payments, and there is possibility of respondents anchoring on the often zero price that people pay for vaccination in reality.

Overall, it appears constructive to train the respondents regarding probabilities and risk reductions. Training reduces the extent of cognitive burden that the respondents face and thus increases the ability of the respondents to value the risk reduction in a situation where the respondents are not familiar with the notion of probabilities and/or risk/–money trade-offs. As discussed earlier, the respondents are likely to suffer from initial anchoring in stating WTP for the risk reduction, which may be related to their other expenditures that are usually low and which may result in a downward bias in WTP. Training seems to reduce this potentially downward bias, since WTPs are substantially higher in the trained sub-sample. However, there might also be some problems with providing training in the CV survey. The respondents may get tired if they find it boring and this may cause fatigue effects. Moreover, by talking a lot about uncertainties and probabilities, the respondent can get the impression that avoiding risks is very important. Hence, they will tend to state higher WTP in the training version. This is then not because they are better trained but because they think that it is expected of them. However, while some respondents may respond in this way, others are able to draw inferences about the risk reduction, and training facilitates a cognitive structure that is essential to draw such inference in such a situation.

Finally, using the CV method to elicit people's VSLs is not a "mission impossible." CV risk-reduction can be performed in a developing country with very low levels of education. A comprehensible training on probability and risk concepts, interspersing risk examples with questions to maintain respondent interest as well as to check understanding, should be given before presenting the CV scenario of risk reduction to the respondents. There are remaining problems but most of these appear to be related to the CV methodology *per se*, rather than to CV studies being performed in developing countries.

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Table 1. Sample Statistics (N=767)

Variable	Mean	Standard deviation	Minimum	Maximum
Male	0.91	0.28	0	1
Muslim religion	0.66	0.47	0	1
Hindu religion	0.34	0.47	0	1
Age	43.6	12.4	19	75
Income per capita [a]	22,594	29,117	807	3,63,650
Illiterate (cannot read and write)	0.31	0.46	0	1
Low education (not illiterate and/or education up to high school level)	0.55	0.50	0	1
High education (education above high school level)	0.14	0.35	0	1
Having chronic illness [b]	0.39	0.49	0	1
Currently smoking	0.56	0.50	0	1
Self reported happiness [c]	5	2.2	0	10

[a] Total yearly household income was divided by [Number of adults + 0.5*number of children] $^{0.75}$, to adjust for household size. N=765. Median 15508 Taka. 57.8 Taka=1 USD at the time of the survey (October 2003).

[b] If the respondent has been suffering from any of the chronic diseases: heart disease, high blood pressure, asthma, bronchitis, cancer, or diabetes.

[c] Responses, on an 11-point scale, to the question: “As a whole, how happy would you say you are? The scale is described as follows: 0 means “extremely unhappy,” 10 means “extremely happy’,” and 5 indicates average happiness such that half the population in Bangladesh is above 5 and half is below five.

Table 2. Understanding of probability and risk for the sub- sample with training

Probability/ risk questions [a]	% of respondents answered the test questions correctly	% of respondents answered correctly after 2nd explanation	% of respondents answered correctly after 3rd explanation	% of respondents never answered correctly
Dice throwing (PT1)	31	22	18	29
Lottery winning (PT2)	74	20	5	1
Mortality risk (PT3)	83	15	2	0.25

[a] See Figure 1 for exact wording of the test questions.

Table 3. Ordinary least square estimates of subjective risk

Dependent variable	Log(subjective risk)	Log(subjective risk)
Received training in the survey	-0.104	-0.106
	(0.072)	(0.072)
Log (age-related objective risk)	0.501***	
	(0.038)	
Log (age)		-0.548
		(2.69)
Log(age)-squared		0.302
		(0.362)
Having chronic illness	0.149**	0.133*
	(0.074)	(0.075)
Low education	-0.011	-0.018
	(0.083)	(0.083)
High education	-0.043	-0.050
	(0.123)	(0.123)
Muslim religion	0.144*	0.147*
	(0.076)	(0.076)
Log (income per capita)	-0.070	-0.076
	(0.045)	(0.046)
Currently smoking	0.185**	0.153**
	(0.076)	(0.077)
Constant	2.08***	1.82**
	(0.462)	(5..01)
Adjusted R-square	0.206	0.220
Number of observations	765	765

Standard errors are in parentheses. Superscripts ***, **, * denote statistical significance at the 1 %, 5%, and 10% level, respectively.

Table 4. Follow-up questions asked to respondents who stated zero WTP (N = 79)

		Sub-sample of respondents who would want free vaccination (77%)	Sub-sample of respondents who would not want free vaccination (23%)
	Reasons for not being willing to pay for vaccination [a]	% of respondents agree	
i)	I cannot afford vaccinations, even though I believe it is good to have them.	79%	-
ii)	I think the government should pay for the vaccinations.	77%	11%
iii)	I do not think the vaccine would really be safe.	-	17%
iv)	I do not think it is possible to reduce the mortality risk by vaccines.	7%	33%
v)	I do not believe in reducing mortality risk by any means.	7%	44%
vi)	Other reasons stated by the respondents: Reluctant to answer, not interested, dislike vaccination, not sure if (s) he would be willing to pay for vaccination.	3%	39%

[a] All the respondents who stated zero WTP were asked, "Why would you not be willing to pay for vaccinations?". Then a list of possible reasons were read to them and the respondents were allowed to choose more than one reason. They were also allowed to express other reasons.

Table 5. Probit regression of scenario rejection (N=79)

Variable	Marginal effects	Standard error
Received training in the survey	-0.120	0.085
50% risk reduction	-0.067	0.081
Age in years	0.005	0.002
Low education [a]	0.144	0.093
Muslim religion	0.416***	0.145
Log (income per capita)	0.477	0.482
Having chronic illness	-0.065	0.084
Currently smoking	-0.138	0.109

Standard errors are in parentheses. Superscripts ***, **, * denote statistical significance at the 1 %, 5%, and 10% level, respectively.

[a] We cannot estimate the marginal effect of high education as all eight observations from this group are dropped because, for this group, all the zero WTPs imply a scenario rejection.

Table 6. WTP results for different sub samples [a]

	No training		Training	
	25% risk reduction	50% risk reduction	25% risk reduction	50% risk reduction
Sample size	162	168	175	189
Mean WTP	487	672	671	970
Standard deviation	1531	1934	1377	1324
Median WTP	100	200	500	500
Mean WTP ratio [b]	1.38		1.45	
Null Hypothesis: Mean WTP ratio=1 [c]	p- value <0.001		p- value <0.001	
VSL based on changes in subjective risk				
Mean VSL	1,03,074	1,06,585	1,68,905	1,07,697
Median VSL	20,000	13,333	33,333	30,000
95% confidence interval for mean VSL	43,742 – 1,62,407	32,164 – 1,81,005	1,03,714 – 1,34,097	81,167 - 1,34,228
VSL based on changes in average age related objective risk				
Mean VSL	81,861	56,539	1,31,353	75,617
Median VSL	18,118	9,615	36,363	18,461
95% confidence interval for mean VSL	32,499 – 1,31,225	30,142 – 82,936	82,932 – 1,79,774	54,268 – 96,967

[a] WTP and VSL are expressed in Bangladesh Taka. 57.8 Taka =1 US $, at the time of survey (October 2003).

[b] Ratio of mean WTP for a 50% risk reduction to mean WTP for a 25% risk reduction.

[c] Using both the non-parametric Wilcoxon –Man-Whitney test and the *t* test.

Table 7. Estimated WTP by sub-samples: truncated regression model [a]

Dependent variable Log (WTP+1)		
Variable	Coefficient	Standard error
Constant	15.12**	6.89
Received training	0.583***	0.146
Passed probability test	0.170	0.230
50% risk reduction	0.371***	0.137
Received Training × 50% risk reduction	0.146	0.203
Passed probability test × 50% risk reduction	0.060	0.310
Muslim religion	-0.005	0.092
Log(age)	-7.02*	3.73
Log(age)-squared	0.912*	0.502
Log (subjective risk)	0.021	0.052
High education	0.070	0.090
Low education	-0.064	0.074
Log(income per capita)	0.425***	0.063
Having chronic illness	-0.010	0.102
Currently smoking	0.016	0.102
Self reported happiness	0.070***	0.023
Disturbance standard deviation	1.22	0.033
Log-Likelihood	-1100.12	
Number of observations	692	

Superscripts *** and ** denote statistical significance at the 1 % and 5% levels, respectively.

[a] We control for the enumerator effects but do not present the parameter estimates of the enumerator dummies.

Table 8. Sensitivity to scope

	No training	Training
Mean WTP ratio[a]	1.45	1.51
Standard error	0.198	0.160
95 % confidence interval	1.06 - 1.84	1.20 – 1.83
Difference of mean WTP ratio	0.065	
Standard error	0.073	
95% confidence interval	-0.08 – 0.21	

[a] Ratio of mean WTP for a 50% risk reduction to mean WTP for a 25% risk reduction. The ratio is calculated using the regression coefficients of the dummy variable for risk reduction and the mean values of other explanatory variables.

Figure 1. Training - Probability and risk examples [a]

Now I will discuss the chances and risks of events occurring using some examples.
Example 1: Sometimes we toss a coin to decide which of two things to choose. When we toss a coin [Enumerator: show tossing a coin], we get either a head or a tail. We cannot be sure of the result of the toss. As there are two things that can happen from a coin toss, the chance of getting a head is 1 in 2. The same is true for getting a tail.
Similarly, when we roll a dice (chakka) [Enumerator: show throwing a chakka] we may either see on the top 1, 2, 3, 4, 5, or 6, but we don't know which one beforehand. Since there are six different numbers from 1 to 6, we may see any of them on the top. The chance of seeing a 5 on the top is 1/6.
Is this example clear to you?
[Enumerator: If no, explain again and make sure that the respondent understands. Write down how many times you had to explain. If the respondent has not understood after three times, write" 4" and continue.]
PT1. Now, if I throw this "chakka" (dice), what is the chance that 2 will be shown on top?
Answer:
[Enumerator: If the answer is wrong, explain with example until the correct answer is given. Write down how many times you had to explain. If the respondent did not have it right after a third explanation, explain the answer and write 4.]
Example 2: Consider buying a lottery ticket. Many people buy lottery tickets and most people do not win. Suppose that there is only 1 prize in a lottery and 100 people buy one lottery ticket each. [Enumerator: Show grid table 1]. In this case we say that the chance of winning the prize will be 1 in 100.
Is this example clear to you?
[Enumerator: If no, explain again and make sure that the respondent understands. Write down how many times you had to explain. If the respondent has not understood after three times, write" 4" and continue.]
PT2. Now, suppose there are two lotteries. The chance of winning in one lottery is 5 in 1000 and the chance of winning in the other lottery is 10 in 1000. [Enumerator: Show the grid table- 2 and grid table 3, when explaining]. Which lottery has the larger chance of winning?
5 in 1000 1
10 in 1000 2
Answer: …………
[Enumerator: If the answer is wrong, explain with example until the correct answer is given. Write down how many times you had to explain. If the respondent did not have it right after a third explanation, explain the answer and write 4.]
Example 3: Question
PT3. Now, suppose there are two roads that are both very prone to accidents. The risk of dying on road A is 1 in 1000 and the risk of dying on road B is 3 in 1000. [Enumerator: Show the grid table-4 and grid table 5, when explaining]. Which road is more risky to take?
Road A 1
Road B 2
Answer: ………
[Enumerator: If the answer is wrong, explain with example until the correct answer is given. Write down how many times you had to explain. If the respondent did not have it right after a third explanation, explain the answer and write 4.]

[a] The training is read by the enumerators.

Figure 2. Training - Explaining risk reduction

Example 4: Suppose the average risk of dying for an adult person during the next 5 years is 40 in 1000.

[Enumerator: show grid table 6 when explaining].

Suppose a reduction in mortality risk, through some kind of public measure, could reduce the mortality risk from 40 in 1000 to 35 in 1000

[Enumerator: show grid table 6 and grid table 7 together to explain the difference].

This means that, on average, 5 out of 40 would be saved by the measure.

PT4. Do you understand this risk reduction?

Yes 1

No 2

Answer:

[Enumerator: If no, explain again and make sure that the respondent understands and write down how many times you had to explain. If the respondent has not understood after three times, continue and write 4]

Example 5: Similarly, if the risk was reduced from 40 in 1000 to 20 in 1000[Show grid table 6 and grid table 8 together to explain the difference], then 20 out of 40 would be saved on average.

PT5. Do you understand this risk reduction?

Yes 1

No 2

[Enumerator: If no, explain again and make sure that the respondent understands and write down how many times you had to explain. If the respondent has not understood after three times, continue and write 4]

Answer:

Example 6: If the risk was reduced from 40 in 1000 to 10 in 1000[show grid table 6 and grid table 9 together to explain the difference], then 30 out of 40 would be saved on average.

PT6. Do you understand this risk reduction?

Yes 1

No 2

[Enumerator: If no, explain again and make sure that the respondent understands and write down how many times you had to explain. If the respondent has not understood after three times, continue and write 4]

Answer:

Example7- Question

PT7. Which of the above risk reductions would you prefer?

[Enumerator: Show the cards and let the respondent point]

a) 40 in 1000 to 35 in 1000

b) 40 in 1000 to 20 in 1000

c) 40 in 1000 to 10 in 1000

Figure 3. CV questionnaire: Risk perception

It has been estimated that in Bangladesh, an average of 15 out of 1000 people in the 30-34 age group will die over the next five years from various causes, and 90 out of 1000 people in the 55-59 age group will die over the next five years from various causes Enumerator: [show grid table 10 and 11].

R1. *Thinking about your own life and the way you are living it, what do you think the risk of you dying in the next five years is? [Enumerator: Let the respondent also see the tables 10 and 11 again, at the same time].*

Answer: in 1000

[Enumerator: Use the grid table 12, which is an empty grid table to represent the respondent's subjective risk of dying in the next five years. Let the respondent look at it.]

Figure 4. Objective and subjective mortality risk during the next five years as a function of age

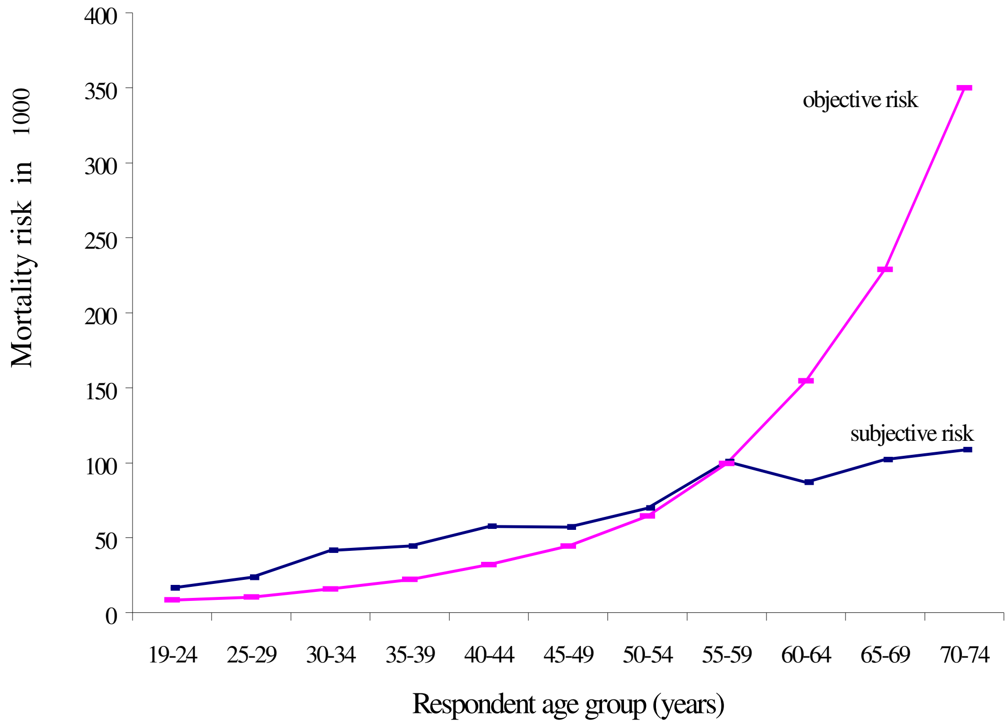


Figure 5. CV scenario

Preventative vaccines could reduce the risk of dying from many infectious diseases.

Suppose that you could participate in a program involving various kinds of vaccinations against infectious diseases. The vaccines, if received, would reduce your risk of dying during the next five years.

Assume that the vaccines would be completely safe and would have no side effects. However, the effects of the vaccines would not last beyond the five-year period.

If received, such vaccines would reduce the risk of you dying over the next five years by one quarter/ one half.

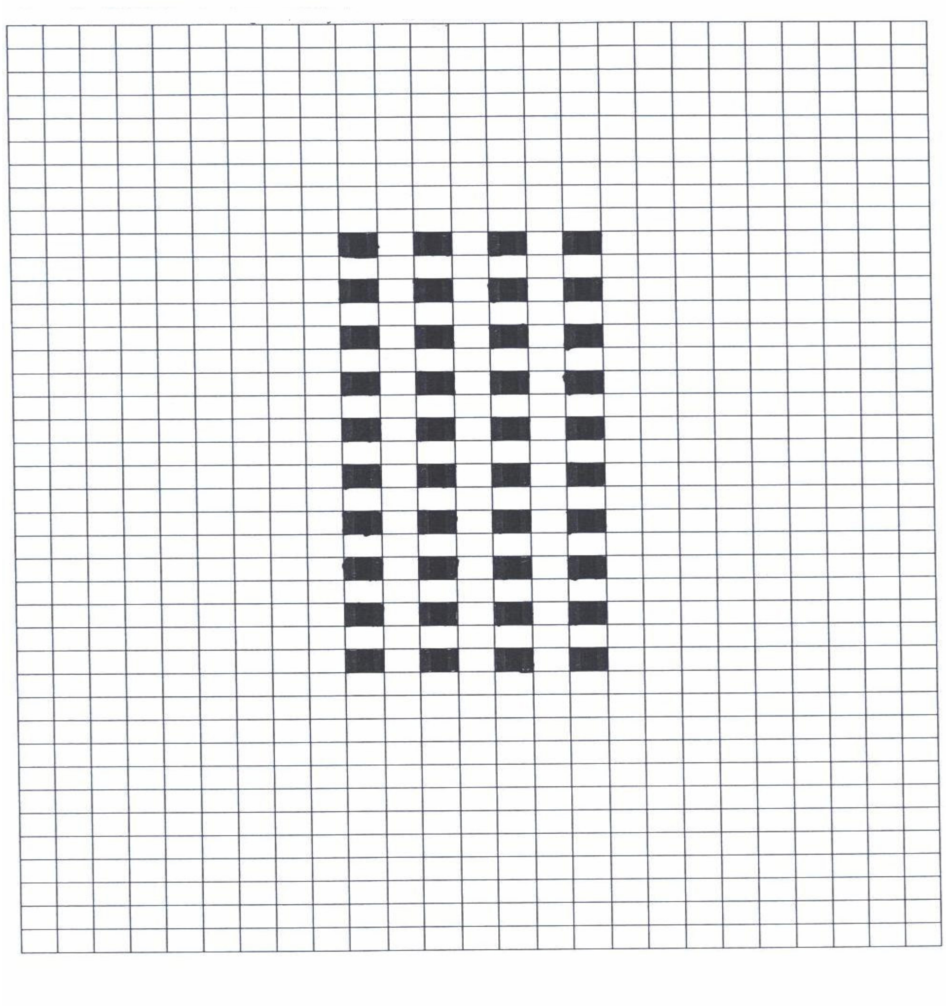
[Enumerator: Show grid table 12 in which the stated risk from question C10 has been included by filling in the number of squares representing this subjective risk. Split the filled in area into 25-75%/50-50%. Then while mentioning the risk reduction, point at the 25% / 50% part of the split box and while mentioning the remaining risk on the other part of the split box.]

CV1. What is the maximum, as a one-time fee, you would be willing to pay to obtain such vaccines for yourself? You should also remember that if you were to pay for the vaccines, you would have less money left for other purposes.

Maximum ………………Taka

Appendix 1. Visual aid for risk understanding.

Figure 1. Grid table showing mortality risk of an adult in the next five years as 40 in 1000



Appendix 2. Distribution of WTP (Histogram)

Figure 1. Distribution of WTP for sub-sample: no training and 25% risk reduction

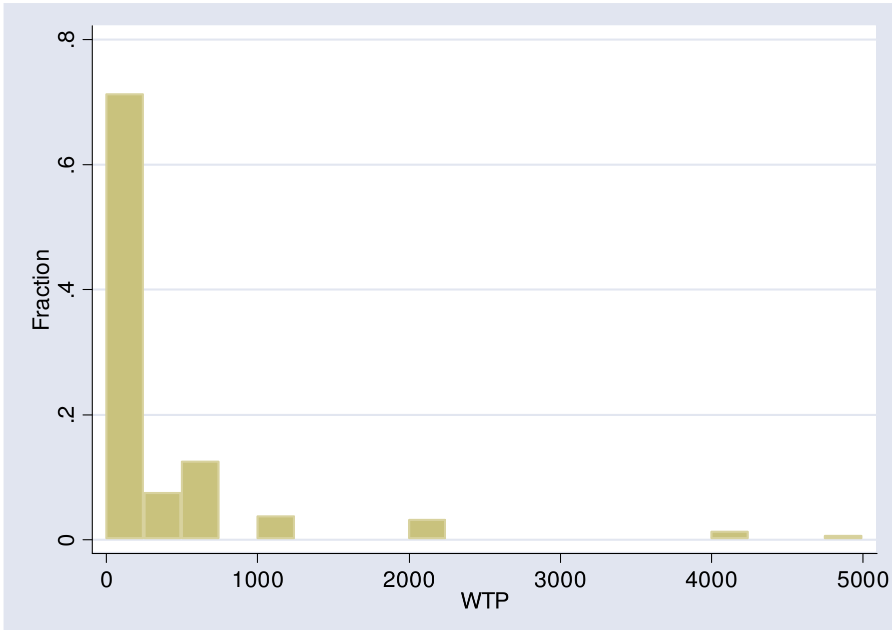


Figure 2. Distribution of WTP for sub-sample: training and 25% risk reduction

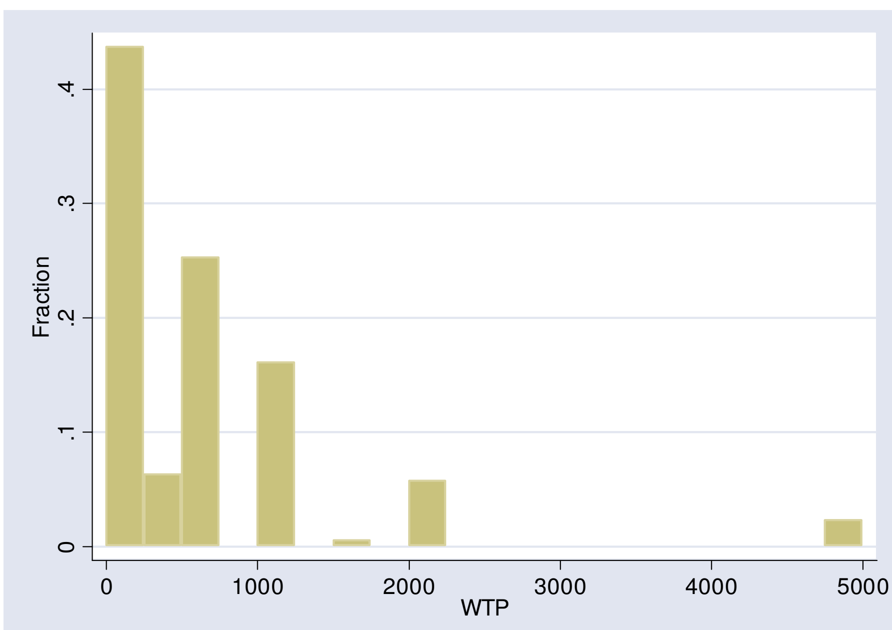


Figure 3. Distribution of WTP for sub-sample: no-training and 50% risk reduction

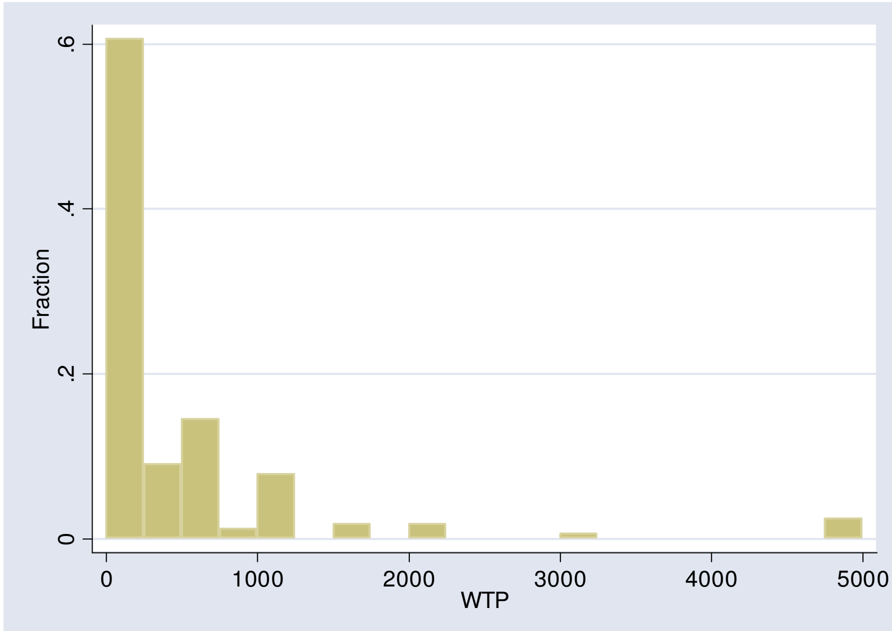


Figure 4. Distribution of WTP for sub-sample: training and 50% risk reduction