Environ Resource Econ (2011) 49:511–538
DOI 10.1007/s10640-010-9444-8

Context and the VSL: Evidence from a Stated Preference Study in Italy and the Czech Republic

Anna Alberini · Milan Ščasný

Accepted: 16 December 2010 / Published online: 13 January 2011

Abstract We report on the results of a survey based on conjoint choice experiments that was specifically designed to investigate the effect of context on the Value of a Statistical Life (VSL), an important input into the calculation of the mortality benefits of environmental policies that reduce premature mortality. We define "context" broadly to include (1) the cause of death (respiratory illness, cancer, road traffic accident), (2) the beneficiary of the risk reduction (adult v. child), and (3) the mode of provision of the risk reduction (public program v. private good). The survey was conducted following similar protocols in Italy and the Czech Republic. When do not distinguish for the cause of death, child and adult VSL are not significantly different from one another in Italy, and the difference is weak in the Czech sample. When we distinguish for the cause of death, we find that child and adult VSLs are different at the 1% level for respiratory illnesses and road-traffic accidents, but do not differ for cancer risks. We find evidence of a "cancer premium" and a "public program premium." In both countries, the marginal utility of income is about 20% lower among wealthier people, which makes the VSL about 20% higher among respondents with incomes above the sample average. The discount rate implicit in people's choices is effectively zero. We conclude that there is heterogeneity in the VSL, and that such heterogeneity is primarily driven by risk characteristics mode of delivery of the risk reduction, and income, while other individual characteristics of the respondent (e.g., age and education) are less important. For the most part, our results are in agreement with environmental policy analyses that use the same VSL for children and adults, and that apply a cancer premium.

A. Alberini (✉)
University of Maryland, AREC, 2200 Symons Hall, College Park, MD 20742, USA
e-mail: aalberini@arec.umd.edu

A. Alberini
FEEM, Venice, Italy

M.Ščasný
Charles University Prague, Prague, Czech Republic

Keywords VSL · Conjoint choice experiments · Mortality risk reductions · Cost-benefit analysis · Forced choice questions

JEL Classification I18 · J17 · K32 · Q51

1 Introduction

When examining the costs and benefits of environmental policies that save lives, the benefits are typically estimated as L × VSL, where L is the expected number of lives saved by the policy,[1] and VSL is the Value of a Statistical Life, a summary measure of the willingness to pay for a small reduction in the risk of dying. In policy assessments, however, analysts often rely on estimates of the VSL based on labor market studies (US Environmental Protection Agency 2000) or the traffic accident context (Rowlatt et al. 1998; UK Department of Food, Rural and Environmental Affairs 2008).

Questions have been raised about the appropriateness of this practice, since the beneficiaries of environmental regulations are often the very old (see Krupnick 2007) or the very young, and the causes and timing of death associated with environmental exposures are very different from workplace accidents. Concern about these differences has led some other government agencies, such the Department of Food, Rural and Environmental Affairs in the UK, to introduce VSL adjustments for cancer and cause of death (see Rowlatt et al. 1998; UK Department of Food, Rural and Environmental Affairs 2008). A cancer premium of 50% was later recommended by the Directorate General-Environment of the European Commission.[2] Such adjustments are, however, based on limited evidence.

In this paper we report on the results of a survey based on conjoint choice experiments that was specifically designed to investigate the effect of context on the VSL. We broadly define context to include (1) cause of death, (2) adult v. child beneficiary of the risk reduction, and (3) public v. private risk reductions. The alternatives in the conjoint choice questions are defined by five attributes, namely (1) the cause of death (respiratory illnesses, cancer, or road-traffic accidents), (2) the public program v. private good nature of the risk reduction, (3) latency, expressed as the number of years that elapse before the risk reduction begins, (4) the size of the risk reduction itself, and (5) the cost to the respondent's household, a one-time payment to be incurred right away. The survey was self-administered using the computer by residents of Milan, Italy, and a broadly representative sample of residents of the Czech Republic, in late November and December 2008.

In benefit-cost analyses, the correct way to estimate the benefits of a policy that saves lives is to ask the beneficiaries of the mortality risk reduction how much they would be willing to pay to obtain this risk reduction. This approach would clearly present difficulties in the case of children, as children have neither the cognitive skills nor the financial resources to clearly define their willingness to pay for a mortality risk reduction. We deployed the parental perspective (Scapecchi 2006), asking parents to engage in tradeoffs involving money and reductions in one of their own children's risk of dying. In contrast to previous studies (e.g., Dickie and Messman 2004; Hammitt and Haninger 2010), we use a split sample design, in that parents value risk reductions for either themselves or for one of their children, but not for both within the same interview.

[1] In this paper, we use the expressions "save lives" or "lives saved" for the sake of brevity, but of course the correct notion is that a policy only prevents or reduces *premature* fatalities.

[2] See http://europa.eu.int/comm/environment/enveco/others/recommended_interim_values.pdf.

We use the responses to the conjoint choice experiments to answer five research questions: First, what is the VSL for children and what is that for adults? Evidence from previous literature is mixed as to the rate of substitution between child and adult mortality risk reductions, and we wish to find out what this rate is.

Second, all else the same, does the VSL vary with the cause of death, perhaps because of different perceived controllability, voluntarity, and other attributes of the risks? If so, the common practice of transferring to the environmental policy context estimates of the VSL from labor markets or the road-traffic accident context may be inappropriate.

Third, all else the same, are people willing to pay different amounts of money when the risk reductions are delivered by public programs and when these programs bring benefits to the population in an entire country, rather than being strictly private goods? Fourth, what is the discount rate that people apply when we ask them to pay now for reductions in the risk of dying that occur in the future? Fifth, we wish to examine whether the WTP for risk-reducing interventions is affected by individual characteristics of the respondent and/or of the beneficiary of the risk reduction.

Briefly, we find that in the Italy sample the child VSL is €4.7 million, a figure that is not statistically different from that implied by the parents for themselves (€4.0 million). In the Czech sample, child VSL is about 30% higher than adult VSL, and the latter is €1.1 million at purchasing power parity with the Czech crown. Based on these comparisons, it is reasonable to conclude that any child premium is modest at best in this study. People are willing to pay more when the risk reductions are delivered by public programs, suggesting that altruistic considerations prevail over possible doubts about the effectiveness of program interventions.

When we distinguish for the cause of death, we find that the VSL varies across causes of death, with that for cancer being the highest and that for road-traffic risks being the lowest. Even more important, the value of preventing a child or adult cancer fatality is virtually the same, implying that the marginal rate of substitute between child and adult cancer death risk is 1. In Italy, this figure is around €5 million, in the Czech Republic about €1.8 million. In both countries, we find that the child VSL for the other two causes of death is somewhat higher than the adult VSL for the same causes of death. Risk reductions delivered in near future (up to 10 years) are valued the same as risks reduced immediately: the discount rate is zero.

Finally, in both countries, the marginal utility of income is lower among wealthier people, which implies that the VSL is 20% higher among respondents with income above the sample average. With the possible exception of gender for own risk reductions, other individual characteristics are relatively unimportant. We conclude that any heterogeneity in the VSL is explained primarily by the attributes of the alternatives (public program v. private risks, cause of death), depending on the beneficiary of the risk reduction. Income matters, but other individual characteristics are generally less important.

Our results are for the most part in agreement with environmental policy analyses that use the same VSL for adults and children, and apply a cancer premium. They also confirm the results of a recent study by Dickie and Gerking (2007), who find that the marginal rate of substitution between child and adult health is one, but are in sharp contrast with those by Hammitt and Haninger (2010).

The remainder of this paper is organized as follows. Section 2 contains background information and previous literature. Section 3 lays out the research questions and study design. Section 4 presents the model. Sampling frame and survey administration are described in Section 5. Section 6 presents the model, Section 7 the data and Section 8 the estimation results. Section 9 concludes.

2 Background and Methods

The Value of a Statistical Life is defined as the marginal Willingness to Pay (WTP) for a small change in the risk of dying. There are two main approaches to estimating the WTP for a mortality risk reduction. The first approach, revealed preference studies, uses actual behaviors to infer the rate at which individuals trade off income for safety, and includes compensating wage studies (see Viscusi and Aldy 2003), consumer behavior studies (e.g., Blomquist et al. 1996; Jenkins et al. 2001), and hedonic pricing approaches (e.g., Atkinson and Halvorsen 1990; Andersson 2005).

These studies assume that individuals know exactly the risks implied by their choices of residential location, occupation, automobile, and use of risk-reducing products. Because of their reliance on observed tradeoffs and the specific contexts they apply to, revealed preference studies are often ill-suited to deal with the issue of latency—namely, when the policy or investment to reduce pollution is undertaken now, but the risk reduction takes places only in the future, as is the case with many environmental regulations.[3]

The second approach to estimating the VSL—stated preference studies—queries individuals about what they would do under specified hypothetical circumstances (see Bateman et al. 2002 for a recent review of these methods). Unlike revealed preference studies, stated-preference studies can be designed to cater to any population and any risk of interest. In addition, since they rely on hypothetical scenarios created by the researchers, stated preference studies can be designed to deal squarely with the issue of latent risks.

In this paper, we use conjoint choice experiments. In conjoint choice experiments, respondents are asked to indicate the most preferred out of K hypothetical alternatives ($K \geq 2$), where the alternatives are described by a vector of attributes, including a mortality risk reduction and cost. Researchers interpret and model the responses to conjoint choice surveys by assuming that individuals pick the alternative to which they attach the highest utility (see Alberini et al. 2007a,b). Conjoint choice experiments were used to value mortality or cancer risk reductions in Tsuge et al. (2005), Alberini et al. (2007a,b), Tonin et al. (2009).[4]

3 The Role of Context

In this paper we wish to investigate how the VSL depends on context, where context is broadly defined to include (1) the cause of death, (2) whether the beneficiary of the risk reduction is a child or an adult, and (3) whether the risk reduction is delivered by a public program or a private good or behavior.

---

[3] In addition, labor market studies are fraught with econometric difficulties. Siebert and Wei (1994), Leigh (1995), Miller (2000), Black et al. (2003), Black and Kniesner (2003), Hintermann et al. (2010) discuss several reasons why the estimates of the VSL from compensating wage studies are econometrically fragile.

[4] In Contingent Valuation (CV) surveys about risk reductions, respondents are usually queried directly about their willingness to pay for a public program, product or good that reduces their risks. CV surveys were used, among others, by Johannesson and Johansson (1996), Johannesson et al. (1997), Krupnick et al. (2002), Alberini and Chiabai (2007a,b), Alberini et al. (2006a,b) for samples of adults and the elderly. Dickie and Gerking (2006) present the results of a CV survey that elicits WTP to reduce the risk of contracting fatal skin cancer in adults and children. Bateman et al. (2009) recently used the “chained” method to estimate the VSL for children and adults. This approach first elicits the WTP for a treatment that eliminates an episode of illness or the effects of an accident. Next, the respondent is asked to imagine that this treatment may cause instant and painless death with probability p, and is successful with probability (1-p). What is the highest p for which the respondent would still accept to undertake the treatment? The VSL is estimated as the WTP for the treatment divided by this value of p. See Carthy et al. (1999).

Regarding (1), economic theory suggests several reasons why the VSL for one cause of death might be different from that for another. Eeckhoudt and Hammitt (2001) consider competing risks and show that if the utility of a bequest at death is positive, then the marginal WTP for reducing one type of risk (i.e., the VSL for that cause of death) depends on the magnitude of the other risks of dying. Based on their model, a person in poor health with a high risk of dying from a chronic illness in this period would have a very low WTP for a small reduction in the risk of dying in a car accident or because of pollution exposures, which account for very small share of this person's total risk of dying (the "why bother" effect).

Another reason why people might be willing to pay different amounts of money to reduce the risk of dying from different causes may simply lie in the timing of the risk reduction. Economic theory shows that the VSL at time t for a risk reduction to be incurred L periods later is equal to the VSL for an immediate risk reduction in period (t+L), discounted back to the present (by L periods; see Cropper and Sussman 1990).

In addition, the psychometrics literature shows that risk perceptions are influenced by the attributes of the risk beyond its sheer magnitude (e.g., its controllability, familiarity, dread, and whether it is voluntarily faced or not) (Fischhoff et al. 1978). It is possible that such differences in perceptions influence the WTP to reduce the various types of mortality risks, even holding the magnitude of the risks and latency the same. For example, evidence from surveys suggests that people consider it very important to reduce cancer deaths (Jones-Lee et al. 1985), and might be willing to commit more resources to reduce risks with which they are not familiar and/or they consider outside of their own control (see McDaniels et al. 1992; Savage 1993a; Rowlatt et al. 1998).

Regarding (2), theory has examined how the VSL may change with age (Shepherd and Zeckhauser 1982), but there are only a handful of willingness to pay studies that examine the effect of age systematically (summarized in Krupnick 2007; also see Aldy and Viscusi 2007), and they focus primarily on the elderly. In this paper we wish to study the VSL for adults and children. To elicit the latter, we adopt the parental perspective. In other words, we ask parents to engage in choice questions concerning interventions that would reduce mortality risks for one of their children. Specifically, respondents answered conjoint questions about reductions in either their own risk of dying or the risk of dying for one of their children (selected at random), but not both. We use the responses to the conjoint choice questions to estimate the WTP for a marginal risk reduction, i.e., the VSL.

Theory does not provide unambiguous predictions about the VSL for self v. that for a child. Consider, for example, a (single) parent with one child, who, in a simple single-period static framework, derives utility from household consumption X and disutility from his own (R_A) and his child's (R_C) risk of dying:

$$U = U(R_A, R_C, X). \tag{1}$$

Assume that it is possible for this parent to reduce his own risk of dying by engaging in some form of private risk-reducing behavior M_A, which can be purchased at price p_A per unit:

$$U = U(R_A(M_A), R_C, X). \tag{2}$$

The parent will thus choose X and M_A to optimize utility subject to the budget constraint that $y = X + p_{A*}M_A$. The first order conditions imply that at optimum the marginal rate of substitution between consumption and the risk-reducing activity is equal to the price per unit of risk p_A (since the price per unit of consumption is normalized to one). The first order conditions also imply that—given the child's risk—the marginal utility of risk reductions divided by the marginal utility of consumption, i.e., the VSL, is equal to p_A divided by the risk reduction afforded by the last unit of M_A:

$$\text{VSL}_A = \frac{\partial U}{\partial R_A} \Big/ \frac{\partial U}{\partial X} = \frac{p_A}{\partial R_A / \partial M_A}. \tag{3}$$

If the parent is to reduce his child's risk, instead of his own, through a risk reducing behavior M_C that costs p_C per unit, then the first order conditions will similarly imply that child VSL is

$$\text{VSL}_C = \frac{\partial U}{\partial R_C} \Big/ \frac{\partial U}{\partial X} = \frac{p_C}{\partial R_C / \partial M_C}. \tag{4}$$

In this paper, we estimate VSL (3) and (4) separately, as the marginal utility of a risk reduction divided by the marginal utility of income, from parents who are to value either own or child risk reductions. Will the VSL for parent and child be equal or differ? The answer to this question depends on the price per unit of risk reduction, and on the effectiveness of prevention in reducing mortality risks at the margin. Both may vary across adults and children, and across type of risk. Without further assumptions or documentation about these variables, we do not know a priori whether the VSL for adults is smaller than, equal to, or larger than parental VSL for children. We also do not know a priori whether any such differences vary with the cause of death.

Dickie and Gerking (2007) present a variant on this model. They consider multiple periods, transfers between parents and children, and two goods that can be used in a household production function setting to reduce risks. The two goods have the same unit price and the same effectiveness (in percentage terms). Their model provides the framework for interpreting a survey where parents have to report their WTP for risk reductions for themselves and for their children. Under their assumptions, the marginal rate of substitution between child and adult health is one. Their expectations are borne out in the survey data.

Consistent with these mixed conclusions, earlier studies that have examined possible differences of values between adults and children have reported mixed findings. Some have found that the value of children's health benefits is higher than those of adults (Liu et al. 2000; Agee and Crocker 2001; Dickie and Messman 2004; Braun and Ščasný 2006; Bateman et al. 2009; Hammitt and Haninger 2010; or Dickie and Gerking 2001); however, these studies are all based on contingent valuation questions, and, with the exception of the latter two, elicited WTP to avoid morbidity risks. Other studies that aimed at valuing mortality risks found that either the WTP for child and adult health outcomes is similar (Blomquist 2002; Mount et al. 2000), or that the VSL for a child is actually lower than the value of a statistical adult's life (Jenkins et al. 2001).

4 Study Design

We used a split sample approach to study child and adult VSL. Our computer program randomly assigned respondents to scenarios where the risk reduction profiles were for the respondent only, *or* for one of the respondent's children, selected at random among those aged 17 and younger. We opted for this approach because we did not want parents to feel implicitly cued to report WTP amounts for their children at least as high as those reported for themselves (Dickie and Messman 2004).

The conjoint choice experiment portion of the questionnaire thus started with stating clearly who the beneficiary of the risk reductions about to be described was—the respondent or the selected child, depending on the computer program's random assignment. We also emphasized that the respondent himself, or the respondent's child, would be the only beneficiary of the risk reduction within the respondent's family (unless a risk reduction is delivered by a public program).

Once this aspect of the scenario was established, the hypothetical alternatives in the conjoint choice experiments were described by 5 attributes: (1) the cause of death (respiratory illnesses, cancer, road traffic accidents), (2) whether the risk reduction is attained by a public program or is private, (3) the risk reduction itself, (4) latency, expressed as the number of years that elapse before the risk reduction begins, and (5) cost. Attributes and attribute levels are summarized in Table 1. A sample conjoint choice question is reproduced in Fig. 1.

Regarding (1), we focused on cancer and respiratory causes of death because these have been linked to environmental exposures and are addressed by many environmental programs. Both figure prominently among the effects of air pollution and can be reduced by air pollution control policies. Moreover, cancers and chronic respiratory illnesses often entail long periods

Table 1 Summary of attributes and attribute levels in the conjoint choice experiments

Attribute	No. levels	Levels
Context (cause of death)	3	Cancer
		Road traffic accidents
		Respiratory illnesses
Private good or public program	2	Private good (no other beneficiaries);
		Nationwide public program (other beneficiaries)
Latency	4	0, 2, 5, 10 years
Size of the risk reduction	4	2, 3, 5, 7 in 10,000 over 5 years
(One-time) Cost to the respondent	4	200, 500, 1,000, 2,000 euro (Italy)
		3,200, 8,000, 16,000, 32,000 CZK (Czech Republic)

Comparison 2. Let us now consider two more interventions that reduce the probability of dying for a person your age, gender, health status and preventive actions, which is currently equal to 57 in 10.000 over 5 years. These interventions are described below.

Characteristics	Intervention C	Intervention D
Cause of death	Road-traffic accidents	Respiratory illnesses
Type of initiative	Government program	individual preventive action
Other beneficiaries of the reduction in the probability of dying?	Other adults	No
Reduction in the probability of dying	1 in 10.000 in 5 years	1 in 10.000 in 5 years
When does the reduction in the probability of dying begin?	In 2 years	Immediately
Total cost to your household	300 euro	500 euro

2. Which intervention would you choose, intervention C, intervention D, or neither?

☐ Intervention C ☐ Intervention D ☐ Neither intervention (I would pay nothing and obtain no reduction in the probability of dying)

Fig. 1 Example of a conjoint choice experiment question (for TFORMAT=2) of morbidity and reduced quality of life before death, and can be experienced by both adults and children, although they are more prevalent among the elderly.

We also include mortality risks for road traffic accidents for three reasons. First, they are salient and plausible to most people, since virtually everyone uses the roads and is aware of road traffic risks. Second, road traffic risks affect both children and adults, and can be addressed through both individual behavior and public programs.

There is no question that most people would regard road traffic risks as familiar and controllable (at least to some extent). They are thus well suited for the purposes of our survey, and can serve as a useful comparison with less common risks (such as respiratory risks) and risks that are accompanied by high dread, morbidity and pain (cancer risks). Third and last, the willingness to pay of individuals to reduce road traffic fatality risks has been extensively studied in other countries, such as the U.K. (Jones-Lee 1989), Sweden (Johannesson et al. 1996; Persson et al. 2001) and the US (e.g., Atkinson and Halvorsen 1990) using both stated preference and revealed preference approaches, but we are not aware of any such work for Italy or the Czech Republic, suggesting that our work has the potential to fill knowledge gaps in transportation safety policy as well as environmental policy analysis.

Public v. private risk reductions (item (2) above) were presented to the respondents with a reminder that the former imply that there are other beneficiaries of the risk reduction beyond the respondent (or the respondent's selected child), whereas the respondent (or the respondent's child) is the sole beneficiary of the risk reduction when the action is private. We described public programs as being "nationwide" (i.e., covering all adults in the nation or all children in the nation), but did not provide any specifics beyond the nature of the risk to be targeted by the program.

Our interest in the public v. private nature of risk reduction stems from the fact that stated preference studies about mortality risk reductions need to devise a credible mechanism for delivering the risk reduction. In many cases, the most plausible or appropriate mechanism for delivered risk reductions is a public program. One problem with this approach, however, is that the respondents' altruistic considerations may result in double-counting. Economic theory (Jones-Lee 1991, 1992) has worked out the conditions under which double-counting will and will not occur, showing that they depend crucially on (1) the type of altruism affecting the responses (paternalistic or non-paternalistic), and (2) what the respondent is told to assume about the payments made by other people.

Unfortunately, in applied work it is very difficult to observe the nature of each respondent's altruism, and efforts to tell respondents what to assume about other people's payments have proven awkward and confusing (Johannesson and Meltzer 1998). This has prompted many researchers to turn to valuing private risk reductions (e.g., Dickie and Gerking 1996; Krupnick et al. 2002), even though this is likely to produce only a lower bound for WTP.[5]

We wish to find out whether there is large difference in the VSL across the public program v. private good approach. In studying this issue, we must keep in mind that altruistic considerations are not the only reason for differences in WTP across public and private risk reductions: Respondents may also attach a different probability of provision and/or effectiveness of the risk reduction to government programs and private actions.[6]

[5] Private risk reductions are generally thought to result in conservative estimates of the VSL, but we are aware of at least one study (Johannesson et al. 1996) that actually found them to be *larger* than the VSL estimate for a comparable risk reduction in a public program context.

[6] Evidence from focus groups and one-on-one development work indeed revealed that some individuals do not believe that the government can be trusted to provide the proposed programs. Others trust better private risk-reduction actions under their own control.

Latency is expressed as the number of years that elapse before the risk reduction begins. To avoid confounding between the cause of death and the latency aspect, we used latency levels of 0 (=immediate risk reduction), 2, 5 and 10 years, and we varied this attribute independently of the context of death, the other attributes, and the beneficiary of the risk reduction (adult or selected child). We limited the horizon to a maximum of 10 years, because in focus groups and initial questionnaire development work we learned that people were not prepared to make decisions now about risk reductions that would be experienced by their children when they are middle-aged adults.

We used four possible levels for the risk reduction, namely 2, 3, 5 and 7 in 10,000 over 5 years. We presented risks and risk reductions as X in 10,000 over 5 years throughout the questionnaire to make it possible for us to display them on a grid with 10,000 squares.[7]

Finally, each alternative risk reduction plan had a price tag. This cost would be incurred by the respondent's household immediately and would be paid only once. We used four possible cost amounts ranging from €200 to €2,000, or their equivalents in Czech crowns recalculated by using purchasing power parity (see Table 1). Under various assumptions about the discount rates, these cost amounts correspond to VSL of a few hundred thousand to several million euro.

Our conjoint choice experiments incorporated several treatments. First, as mentioned above, random assignment determined whether the main beneficiary of the risk reduction plans in the questionnaire was the respondent or the selected child. Second, each respondent was randomly assigned to a set of five pairs of risk reduction profiles. There were a total of 32 possible sets, and we imposed certain restrictions on them in an effort to ease the respondent's task. For example, the first two pairs to be viewed by the respondents (profiles A and B, and C and D) focused on the same cause of death, which was selected at random between the three studied in this project. In addition, within each pair, the latency period was restricted to be the same.[8] Identification of the discount rate relies on within- and between-respondent variation in the time horizon when the risk reduction would be realized.[9]

7 Risk reductions on an annual basis were too small to be represented by individual squares in a grid of 10,000 squares. See Corso et al. (2001) for a comparison of different visual aids and the sensitivity of WTP for a risk reduction to the size of the risk reduction.

8 Our original plan was to let the degree of latency vary between alternative A and B of each choice set. The first and second pilots were indeed based on such a design. But when we analyzed the data from the pilots, it became clear that when asked to choose between alternative A and B with different latency periods, respondents would usually choose the one with the more immediate risk reduction, regardless of the other attributes, which would result in very high estimated VSLs *and* discount rates. Observation of respondents in the field and debriefs showed that respondents were blending latency and probability of provision of the risk reduction, especially when the risk reduction was delivered by a public program. (In Italy, the government changes frequently, requiring frequent elections and essentially putting on hold staff and government programs until a new government is appointed.) The shorter the latency, the more likely that this government program *will* be implemented. Since it would be impossible to disentangle the subjective probability of provision of the risk reduction, we opted for holding latency constant across the alternatives within the same choice set. Monte Carlo simulations showed that our design and sample size resulted in unbiased and precise estimates of the (assumed) discount rate. One possible concern that is when an attribute is held constant across the alternatives in a choice set, respondents may fail to notice it. We are unable to test if this is the case in this study. However, in previous research that kept latency constant across alternatives within a choice set, the discount rate was a robust and strongly statistically significant 7% (Alberini et al. 2007a,b).

9 These 32 sets of pairs were selected at random and without replacement from the full universe of non-dominated pairs that satisfied all of the abovementioned requirements. Due to a software error, however, the last pair in set 8 contained a dominated choice. In the analyses reported in this paper, for good measure we check the robustness of results of the non-linear conditional logit after deleting the responses to the questions about this pair from the sample. Results are virtually unchanged.

Third, we created an additional treatment whereby about one half of the respondents first faced a forced choice question (choose between A and B), and then were asked which they would prefer between A, B and the status quo (no payment and no risk reduction). The remainder of the respondents was asked to choose directly between A, B and the status quo. Assignment to one or the other variant of this treatment is random.[10] The purpose of this split sample treatment is to check whether the forced choice exercise influences the responses. In practice, we found that it did not (see Alberini et al. 2009), and for this reason in this paper we pool the responses from both versions of the questionnaire.

5 Administration of the Survey and Sampling Plan

5.1 Sampling Plan

Our questionnaire is self-administered by the respondents using the computer. We chose this option because we use visuals and our study design involves numerous treatments and variants.

In both countries, attention was restricted to parents with at least one child younger than 18. The sample was to be evenly divided among three age groups, namely persons aged less than 35, 35–45, and older than 45, and to be comprised of an even number of men and women (fathers and mothers, respectively). The education level was to match that of the universe.

In Italy, we imposed the additional restriction that 50% of the sample had annual household income below €30,000 (the mean household income), and that homemakers be limited to no more than 20% of the respondents. The parents themselves were to be between 20 and 60 years old.

For practical reasons, and because we wanted the results of the study to be applicable to the likely targets of environmental policies, the Italy survey was administered at one locale—Milan, a highly polluted city in Northern Italy.[11] The final survey took place in two dedicated facilities in Milan. Respondents received a token compensation of €10 for their participation in the study.

In the Czech Republic, the only restriction imposed on the sample so that the parent to be interviewed must be older than 18. However, only 1.5% of the Czech respondents are younger than 20 and 3.7% are older than 60, so the Italy and Czech Republic samples are similar for age. The Czech survey was carried out at the respondent's home in six different regions controlling for representation of cities of different sizes. To ensure comparability with the Italian sample, we over-represented respondents from the largest and most polluted Czech cities (Prague, Ostrava and Brno). Although the Czech survey was conducted out at the respondent's homes, we asked the interviewers to help the respondents only when technical assistance was needed. In this way, for all practical purposes the survey in the Czech Republic was self-administered by the respondent.

[10] Respondents assigned to treatment TFORMAT=1 thus engaged in a total of $2 \times 5 = 10$ conjoint choice tasks each; respondents assigned to TFORMAT = 2 engaged in $1 \times 5 = 5$ conjoint choice tasks each.

[11] Focus groups held in 2006 also suggested that Milan residents tend to be well informed about the health effects of air pollution and about other types of pollution (e.g., contaminated sites). The evidence from the focus groups was confirmed by the results of a pen-and-paper questionnaire that participants in Pilot 1 took once they had completed their computer questionnaire.

In both countries, the survey firms were instructed to ask potential respondents to participate in a survey about "interesting current topics." No mention was ever made about health, the environment, or mortality risks at the recruiting stage.

5.2 Structure of the Questionnaire

The interview begins with the respondent entering his or her gender, age, marital status, and the names of his or her children, along with their genders and ages. The computer selects at random one of the children among those aged less than 18. In the remainder of the survey, the questionnaire always refers to this selected child by his or her first name, e.g. "Paolo" or "Marina."

Section A asks questions about the health status of the selected child and B about the respondent's own health. Section C elicits extensive information about use of roadways, lifestyle, environment, genetic predisposition to cancer and familiarity with it. The purpose of this section is to understand salience of and exposure to certain risks.

Section D of the questionnaire contains the probability tutorial. We start with a simple and intuitive presentation based on tossing a coin or casting a die, but point out that the notion of chance also applies in other familiar situations. For example, when the weather forecast calls for a 10% chance of rain, it is unlikely that it will rain. This is followed by a simple quiz to make sure that people have grasped the basics of probability.

We then move to explaining the notion of risk of dying. We use two visual representations of risk: (1) a grid with 10,000 squares, which we use when attention is restricted to a reference group or population, and (2) bar charts, which we use when we want to show how risks vary across age groups (and hence change as a person ages).

In section E of the questionnaire we inform the respondent that it is possible to reduce own's risk of dying in many ways. Using respiratory illnesses, cancer and road traffic accidents as examples, we tell people that risk reductions can be brought about by individual actions (e.g., getting a flu shot, purchasing a car with safety equipment) or government programs (e.g., an air pollution control program). We also emphasize that some actions are specific for adult men or women (e.g., pap smears), or children (child seats in cars).

Section F contains an exercise that strips risks of all attributes and makes respondent focus on the magnitude of baseline risks and risk reductions.[12] In section G we zero in on the three causes of death that are at the heart of this questionnaire, namely cancer, respiratory illnesses, and road-traffic accidents. In addition to providing some basic information about them, we also ask for people's subjective assessments of the comparative importance of these risks for themselves or the selected child.

[12] Question F1 read as follows: "Suppose that the probability of dying for cause X in [country] is FILL1 in 10,000 over the next 5 years, while that for cause Y is FILL2 in 10,000 over the next 5 years. Also suppose that two interventions are being considered. Intervention A reduces the probability of dying for cause X by 5 in 10,000, bringing it to [FILL1–5] in 10,000. Intervention B reduces the probability of dying for cause Y by 5 in 10,000, bringing it to [FILL2–5] in 10,000. Suppose that it was possible to implement only one of the two interventions. If the two interventions cost the same, which would you choose, intervention A or intervention B?" FILL1 ranged from 5 to 10 and was always smaller than FILL2, which was either 50 or 100. Causes of death X and Y were left unidentified so that people wouldn't get distracted by their specifics. Clearly, those who choose intervention A prefer the larger proportional risk reduction, whereas those who choose B prefer to reduce (in one of our test respondent's words) "the more common cause of death." In Italy, 37.65% of the respondents chose A, 28.01 chose B, and 34.34% was indifferent between the two interventions. The percentage of respondents that chose A was as high as 42% when FILL1 = 5, so that intervention A would have eliminated this cause of death completely.

In section H, people express their opinions on the effectiveness of private actions and public programs in reducing the risk of dying for each of the three causes of death studied in this project. Section I is dedicated to the conjoint choice questions. At the beginning of section I, respondents were reminded of the baseline risk of dying (for all causes) for the beneficiary of the risk reductions (the respondent or the selected child). To avoid informational overload, we did not try to break this baseline down into the baseline risk of dying from cancer, respiratory illnesse and road-traffic accidents. Moreover, we displayed the same baseline risks for men and women (even though in real life they are different) and in both countries. In this way, any differences in WTP for men and women in the same age group can be attributed to preferences, and not to different baselines. A similar reasoning applies when we compare the WTP for people in the same age group in the two different countries.

At the end of the conjoint choice experiments, we ask debriefing questions and explore reasons for the observed choices. The questionnaire ends with questions about the respondent's sociodemographics.

6 The Model

We assume that the responses to the conjoint choice experiment questions are driven by a random utility model. We posit that the deterministic portion of the indirect utility function is:

$$\bar{V}_{ij} = \alpha \cdot \mathrm{DR}_{ij} \cdot \pi(L) + \beta \cdot (y_i - C_{ij}), \tag{5}$$

where DR is the discounted risk reduction (see below), $\pi(L)$ is the probability of surviving L years, until the risk reduction begins, α is the marginal utility of a unit of risk reduction, β is the marginal utility of income, $(y - C)$ is residual income, and subscripts i and j denote the individual and the alternative, respectively.

Assuming constant exponential discounting, the discounted risk reduction is defined as:

$$\mathrm{DR} = \Delta R \cdot e^{-\delta \cdot L}, \tag{6}$$

where ΔR is the risk reduction offered by a hypothetical alternative and δ is the discount rate.

On appending an error term, which captures aspects of the indirect utility that are known to the respondent but not the analyst, we obtain the random utility model:

$$V_{ij} = \bar{V}_{ij} + \varepsilon_{ij}. \tag{7}$$

In each conjoint choice experiment question, the respondent is asked to examine K $\geq$ 2 alternatives and to indicate the most preferred option.[13] We assume that the respondent will choose the one with the highest indirect utility. If we further posit that the error terms in (7) are i.i.d. and follow a standard type I extreme value distribution, the probability that respondent i chooses alternative k is:

$$\Pr(k) = \frac{\exp(\bar{V}_k)}{\sum_{j=1}^{K} \exp(\bar{V}_j)}. \tag{8}$$

Expression (8) is the contribution to the likelihood of a conditional logit model where the indirect utility is a non-linear function of the parameters.

[13] K is equal to 2 in the forced choice questions, and to 3 when we ask the respondent to choose among two hypothetical risk reduction profiles and the status quo.

The VSL is:

$$\text{VSL} = \frac{\hat{\alpha}}{\hat{\beta}} \times 10,000, \quad (9)$$

where the hats denote the maximum likelihood estimates. Multiplication by 10,000 is necessary because in our estimation routine we express the risk reduction as, say, 3 or 4 (in 10,000) instead of 0.0003 or 0.0004.[14]

Equations (5) and (9) assume that the VSL is constant for all individuals in the sample, and that the cause of death or the source of the risk reduction does not matter. The model is easily amended to allow for the cause of death and the mode in which the risk reduction is attained (a public program versus a private behavior) to affect utility and to result in potentially different VSLs:

$$\bar{V}_{ij} = (\text{DR}_{ij} \times \mathbf{Z}_{ij} \times \pi(L))\boldsymbol{\alpha} + \beta \cdot (y_i - C_{ij}), \quad (10)$$

where $\mathbf{Z}$ denotes the attributes of risk in alternative j, and $\boldsymbol{\alpha}$ is a vector of marginal utilities of the different types of risk reductions.

Finally, we enter in the model interactions between DR and individual characteristics of the respondent or of the beneficiary of the risk reduction (e.g., age of the child, whether a boy or a girl, etc.) to test whether the VSL depends on these characteristics.

One concern with the above specifications is that they posit a restrictive functional form, namely that the indirect utility function is linear in the discounted mortality risk reduction, and the status quo is perfectly described by letting $\text{DR} = 0$ and $C = 0$. We relax this assumption by estimating a conditional logit with dummies for risk reductions of different sizes in lieu of DR.

Finally, we note that if the discount rate is equal to zero, the indirect utility is simplified to one that is linear in the attributes and the parameters. This makes it easy to fit a mixed logit to accommodate unobserved heterogeneity in the marginal utility of the risk reduction.

7 The Data

We interviewed a total of 1906 respondents in Italy and 1506 in the Czech Republic. Descriptive statistics of these two samples are reported in Tables 2 and 3. As spelled out in our sampling plan, we have a roughly even number of men and women, and the respondents are uniformly distributed among the 20–34, 35–44 and 45–60 age groups in Italy. In the Czech Republic, persons aged less than 35, and persons aged 45–60 account for 38 and 39% of the sample, and persons aged 35–44 for the remaining 23%. Regarding the educational attainment of the respondents, the samples are in line with the populations of Milan and the Czech Republic, respectively. In Milan, mean (after tax) household income is about €30,000 a year, whereas in the Czech Republic sample, it is about €23,000 a year (using the PPP exchange rate).[15]

[14] Since the cost of the alternative is expressed in hundred Czech crowns (CZK) in our computer programs, the expression in Eq. (10) must be further multiplied by 100 to get VSL for the Czech sample.

[15] We compared our Czech sample with the data from the 2008 EU-SILC, a survey on income, social exclusion and living conditions, which has been conducted every year in all EU-27 countries, plus Norway, Switzerland and Turkey since 2006. Despite oversampling of specific cities and quota sampling for age, in terms of proportion of males, education, and income our sample is comparable with the populations of parents in the Czech Republic, parents with at least one child younger than 15 in the Czech Republic, parents with dependent children, and parents in the regions that were selected for the purpose of the present study. Our

Table 2 Descriptive statistics of the sample (discrete variables)

Variable	Italy		Czech Republic	
	N valid	Percentage of the sample	N valid	Percentage of the sample
Male	1,906	49.06	1,505	46.91
Age: younger than 35	1,901	33.56	1,506	38.11
Age: 35 to 44	1,901	32.93	1,506	22.58
Age: older than 45	1,901	33.51	1,506	39.31
Elementary school diploma	1,906	0.21	1,506	3.05
High school	1,906	30.59	1,506	35.79
High school diploma	1,906	43.23	1,506	46.81
College degree	1,906	24.29	1,506	11.75
Graduate work (PhD)	1,906	1.57	1,506	2.59
Homemaker	1,906	7.29	1,506	1.73
Household income above 30,000 euro	1,891	43.68	1,317	26.35
0–1,000 inhabitants	*n.a.*	*n.a.*	1,506	11.22
1–5,000 inhabitants	*n.a.*	*n.a.*	1,506	14.28
5–20,000 inhabitants	*n.a.*	*n.a.*	1,506	12.48
20–100,0000 inhabitants	*n.a.*	*n.a.*	1,506	22.64
More than 100,000 inhabitants *(Prague, Brno, Ostrava in Czech; Milan in Italy)*	1,906	100.00	1,506	39.38
Married	1,906	86.78	1,506	74.9
Divorced or separated	1,906	4.41	1,506	13.08
Widowed	1,906	0.73	1,506	1.73
Single	1,906	8.08	1,506	10.23
Fulltime	1,906	73.24	1,506	75.80
Part time	1,906	12.22	1,506	3.65
Job other	1,906	1.89	1,506	2.65

Table 3 Descriptive statistics of the sample

	Italy					Czech Republic				
	N	Mean	s.d.	Min	Max	N	Mean	s.d.	Min	Max
Age	1,906	**39.70**	*9.99*	20	59	1,500	**39.61**	*10.59*	18	65
Income (Euros)[a]	1,891	**30,463**	*12,120*	5,000	87,500	1317	**23,606**	*9,574*	3,529	50,471
Household size	1,906	**3.21**	0.698	1	8	1,503	**3.50**	0.920	1	9
Number of children	1,906	**1.31**	*0.549*	1	5	1,506	**1.56**	*0.688*	1	5

Continuous variables

[a] Income in Czech crowns was recalculated by purchasing power parity assuming 17 CZK per Euro. Mean net annual income in national currency amounts 401,310 CZK (s.d. = 162,757 CZK) with minimum of 60,000 CZK and maximum of 858,000 CZK

Table 4 Probability comprehension

Variable	Description	Italy		Czech Republic	
		Valid N	Percent	Valid N	Percent
FLAG1	Failed first quiz (question D1)	1,903	5.67	1,496	9.16
FLAG2	Failed second quiz (question D2)	1,892	14.48	n/a	n/a
FLAG3	Failed third quiz (question D3)	1,905	10.23	n/a	n/a

About 62 and 50% of the Italian and Czech children, respectively, selected by the computer for the purposes of the survey were boys. The mean age of the selected child is 8 in Italy and almost 10 in the Czech sample.

Our questionnaire included several questions designed to test whether respondents understood the material about probabilities that was presented to them. Table 4 shows that in Italy over 95% of the respondents were able to answer correctly question D1, which asked them to compute the probability of winning a lottery where 10,000 tickets were sold (and there is only one winner). In the Czech Republic, about 9% of the respondents failed this test.

Question D2 asked respondents to read a bar chart and identify the chance of dying over the next 5 years for children aged 0–4, young adults aged 25–29, and adults aged 40–44. About 86% of the respondents were able to tell that the group with the highest chance of dying over the next 5 years is the latter, and 14.48% answered incorrectly.

Question D3 checks if people are capable of understanding the numerator in probabilities. If the chance of dying over the next 5 years for 20–24-year-olds is 30 in 10,000, how many deaths do we expect to see in a population of 100,000 people in this age group? Wrong answers were provided by 10.23% of the sample. (In the Czech Republic, question D3 was omitted from the questionnaire. Question D2 was asked of the respondents, but due to a technical glitch the responses to this question were not recorded and are not available for analysis.)

8 Estimation Results

8.1 Basic Model

The estimation results for the model described in Eqs. (5)–(9) are reported in Table 5. The model was estimated separately for the two countries and, within each country, for own or child risk reductions. All models use the objective probability of survival implicit in the mortality risks shown to the respondents in the questionnaire (which is the same for men and women, and in both countries, to make the two studies as comparable as possible).[16] For good measure, we exclude from the usable sample those respondents who failed the first probability quiz.

Footnote 15 continued
sample compares favorably even when compared with the households (as opposed to parents) in the Czech EU-SILC for 2008.

16 The respondent was aware of this probability since we showed him the baseline risk of dying for a person like him using the grid of squares visual device. In our econometric models, we also experimented with the setting such survival probabilities to one, or, for the Italy sample only, to those stated directly by the respondent. All these alternate procedures yield virtually the same results.

Table 5 Basic model

Model parameters	Child		Adult	
	Coeff.	t Stat	Coeff.	t Stat
A. Italy				
ALPHA	0.2139	18.362	0.1752	16.942
BETA	−0.0005	−15.441	−0.0004	−15.984
DELTA	0.0163	1.872	−0.0062	−0.736
log L	−5,366.38		−6,197.87	
N	5,904		6,741	
VSL estimates	VSL	s.e. (VSL)	VSL	s.e. (VSL)
mil. €	4.673	0.301	4.031	0.26
B. Czech Republic				
ALPHA	0.1204	9.869	0.0956	8.118
BETA	−0.0049	−21.962	−0.0052	−23.38
DELTA	−0.0033	−0.228	0.0089	0.49
log L	−4,327.06		−4,576.54	
N	4,746		5,115	
VSL estimates	VSL	s.e. (VSL)	VSL	s.e. (VSL)
mil. CZK	24.661	2.213	18.248	2.000
mil. €	0.986	0.088	0.730	0.080
mil. € (PPP)	1.459	0.131	1.080	0.118

Samples exclude the responses to one choice experiment with a dominated alternative, and all of the responses provided by individuals who failed the first probability quiz (FLAG1 = 1 deleted)

Table 5 shows that the marginal utility of a risk reduction is always positive and significant, and so is the marginal utility of income (since the coefficient on cost, which is the negative of the marginal utility of income, is negative and significant). In the Italy study, child VSL is €4.7 million and adult VSL is €4.0 million.[17] These results are striking: the VSL is higher than the figures currently used for the purpose of policy analysis within the European Union, but the child and adult VSL figures are not very different from each other.[18] A Wald statistic of 2.60 (p value 0.105) indicates that the child and adult VSL are not significantly different from each other at the 5% significance level or better.

In the Czech Republic, child VSL is around CZK 25 million (€1.44 million) and adult VSL is CZK 18 million (€1.14 million).[19] A Wald statistic equal to 4.62 (p value = 0.03) implies that child and adult VSL are marginally statistically different.

[17] Excluding respondents who failed the first probability quiz, as we did in Table 6, has a negligible effect on the estimated coefficients and the VSL. If we exclude from the usable sample those respondents who failed the second and the third probability quiz, and obtained a VSL of €4.460 million for adults, and €3.907 million for adults.

[18] The standard errors around the estimates of the VSL are computed using the delta method.

[19] We apply a purchasing power parity of 16.90 CZK per Euro in 2008 as derived by OECD (www.oecd.org/std/ppp). VSL expressed by the average 2008 exchange rate (25.01 CZK/Euro) is €0.99 million for a child and €0.73 million for an adult.

Table 6 VSL by cause of death

Model estimates	Child		Adult	
	Coeff.	t stat	Coeff.	t stat
A. Italy				
ALPHA	0.2245	17.302	0.1626	15.168
ALPHA_CANCER	0.0044	0.379	0.0919	8.199
ALPHA_ROAD	−0.0348	−3.223	−0.0276	−2.992
BETA	−0.0005	−15.8	−0.0005	−17.071
DELTA	0.0125	1.418	−0.0073	−0.912
log L	−5,359.44		−6,127.51	
N	5,904		6,741	
VSL estimates	VSL, mill.€	s.e. (VSL)	VSL, mill.€	s.e. (VSL)
Respiratory	4.697	0.303	3.405	0.222
Cancer	4.789	0.341	5.329	0.346
Road traffic acc.	3.97	0.307	2.827	0.225
B. Czech Republic				
ALPHA	0.1155	8.782	0.0783	6.223
ALPHA_CANCER	0.0503	3.884	0.0875	5.402
ALPHA_ROAD	−0.0207	−1.822	−0.0136	−1.073
BETA	−0.005	−22.22	−0.0054	−23.362
DELTA	−0.0048	−0.359	0.0165	0.989
log L	−4,310.85		−4,547.12	
N	4,746		5,115	
VSL estimates	mill.czk	s.e. (VSL)	mill.czk	s.e. (VSL)
Respiratory	22.987	2.330	14.605	2.110
Cancer	32.998	3.000	30.917	3.088
Road traffic acc.	18.869	2.261	12.062	2.183

Samples exclude the responses to one choice experiment with a dominated alternative, and all of the responses provided by individuals who failed the first probability quiz (FLAG1 = 1 deleted)

Another striking result is that the discount rate is very low, and in fact insignificant. Discount rates of 0–1% are well within the range of values inferred from people's choices between money now and mortality risk reductions later.[20]

8.2 Does the Cause of Death Matter?

In Table 6, we estimate a separate marginal utility of the risk reduction for each cause of death studied in this paper, namely respiratory illnesses, cancer and road-traffic accidents. in Italy (Table 6, panel A), the child VSL is about €4.7 million for respiratory illnesses, €4.8 million for cancer, and €4 million for road traffic accidents. The former two are not statistically different from one another (Wald statistic 0.04, p value = 0.84), and are statistically

[20] The discount rates estimated in the life-saving context have ranged from 2 to about 14% (Moore and Viscusi 1990; Horowitz and Carson 1990; Alberini et al. (2006a,b); Alberini and Chiabai 2007b; Alberini et al. 2007a,b).

different from the latter only at the 10% level (Wald statistics 2.84 and 3.18, respectively, with p values = 0.07 and 0.09).

The adult VSL is €3.4 million for respiratory illnesses, €5.3 for cancer, and €2.8 for road traffic accidents. Wald tests indicate statistically significant differences between the VSL for cancer and for respiratory illnesses, and between the VSL for cancer and road traffic accidents (Wald statistics 21.90 and 36.75, respectively, p values < 0.00001), but not between the VSL for respiratory illnesses and road traffic accidents (Wald statistic 2.30, p value = 0.13).

In sum, there is a always a "cancer premium" for adults, but for children, cancer and respiratory causes of death are valued similarly, and the "cancer premium" applies only with respect to road traffic risks. Road traffic accident risks are the least valued for both children and adults, a result that is consistent with the notion that people may link road traffic risks with one's behavior and regard them as controllable. Even more important, the cancer VSL is not statistically different across children and adults, although the point estimate is slightly higher for adults. For the other two causes of death, however, there is a "child premium."

The results from the Czech Republic (Table 6, panel B) are similar, in that they suggest that (1) people are willing to pay more to reduce cancer risks, (2) the "cancer premium" is much more pronounced for adults than for children, and (3) road traffic accident risks elicit similar values as respiratory illnesses. The VSL in the respiratory illness context is CZK 23 million (€1.36 million) for children and CZK 15 million (€0.86 million) for adults. The VSL for road traffic accidents are CZK 19 million (€1.12 million) for children and 12 million (€0.71 million) for adults.

The cancer VSL is significantly different from the respiratory illness VSL and the road-traffic accidents VSL for both children and adults (Wald statistics 6.94 and 14.14 for children, and 19.02 and 24.86 for adults), and the respiratory illness VSL and the road traffic accident VSL are similar to one another, regardless of the beneficiary (Wald statistics 1.61 for children and 0.70 for adults). As with the Italy sample, the cancer VSL for children is statistically indistinguishable from that for adults, but those for the other causes of death are statistically different at the 1% level across the two types of beneficiaries.

In sum, for respiratory illnesses and road-traffic accidents, the marginal rate of substitution between child and adult VSL is about 1.4 in Italy and 1.6 in the Czech Republic. For cancer, however, the marginal rate of substitution is about 1 in both countries.

8.3 Public v. Private Risk Reductions

Table 7 reports the results of models that account for all of the attributes of the alternatives in this survey. To avoid imposing undue restrictions on the utility function, the regressions in Table 7 include dummies for the cause of death, and PUBLIC × cause interactions.

In both the Italy and the Czech Republic study, all else the same people are prepared to pay more if the risk reduction is delivered by a public program. In the Italy study, this premium (approximately €1.8–2 million when the beneficiary is the child and €1–1.3 million when the beneficiary is the adult respondent) is the same for all causes of death. Qualitatively similar results hold for the Czech Republic, where the public program premium is higher for children (CZK 12 million) than for the adults, and is not significant among the latter.

At any rate, the results of Table 7 suggest that the "public program" premium is additive, and that the model can be simplified to one where the interactions between PUBLIC and cause are suppressed. This is the specification that we adopt in the next sections.

Table 7 Public v. private risk reductions

	Child		Adult	
	Coeff.	t Stat	Coeff.	t Stat
A. Italy				
ALPHA	0.1625	12.139	0.128	10.669
ALPHA_CANCER	0.0136	0.982	0.1004	7.266
ALPHA_ROAD	−0.0472	−3.2	−0.0332	−2.52
PUBLIC	0.0917	7.23	0.052	4.567
PUBLIC_CANCER	−0.0273	−1.443	−0.0216	−1.242
PUBLIC_ROAD	0.007	0.371	0.0056	0.325
BETA	−0.0005	−15.546	−0.0005	−16.602
DELTA	−0.0052	−0.667	−0.0137	−1.756
log L	−5,293.73		−6,102.72	
N	5,904		6,741	
B. Czech Republic				
ALPHA	0.0784	5.631	0.0655	4.467
ALPHA_CANCER	0.0336	2.207	0.0775	4.18
ALPHA_ROAD	−0.0199	−1.232	−0.0093	−0.531
PUBLIC	0.0531	3.646	0.0196	1.281
PUBLIC_CANCER	0.041	1.985	0.0112	0.492
PUBLIC_ROAD	−0.0064	−0.314	−0.0122	−0.528
BETA	−0.005	−22.155	−0.0054	−23.401
DELTA	−0.0202	−1.745	0.0021	0.125
log L	−4,274.79		−4,544.61	
N	4,746		5,115	

Samples exclude the responses to one choice experiment with a dominated alternative, and all of the responses provided by individuals who failed the first probability quiz (FLAG1=1 deleted)

8.4 Individual Characteristics of the Respondents

Tables 8 and 9 report the results of models where the (discounted) risk reductions are interacted with characteristics of the respondent and/or the beneficiary of the hypothetical risk reductions in our questionnaires. When attention is restricted to the respondents' own risk reductions (Table 8), the estimation results confirm the earlier findings that (i) cancer death risk reductions are valued more than respiratory death risks and road traffic accident risks, and (ii) respondents are prepared to pay more for mortality reductions delivered by public programs. One might speculate that the VSL should be higher for single parents and for persons with more children (controlling for income), since these persons are responsible for dependents, but we found no empirical evidence for this conjecture.

Respondent education is not significantly related to the WTP for a given risk reduction in Italy, whereas in the Czech Republic persons with a high school diploma were willing to pay more than respondents with other education levels. In both countries, we found that women respondents were willing to pay less for an own risk reduction than men.

This effect is relatively large. In Italy, for example, in Italy a woman's VSL is €0.866 less than a man's. We noticed a similar effect in an earlier survey in Italy (Alberini et al. 2007a,b)

Table 8 Full model with regressors: adults

ADULT	ITALY		Czech Republic (A)		Czech Republic (B)	
	Coeff	t Stat	Coeff	t Stat	Coeff	t Stat
ALPHA	0.1574	5.818	0.0214	0.506	0.0442	1.016
ALPHA_CANCER	0.0826	8.164	0.0926	6.114	0.0954	6.160
ALPHA_ROAD	−0.0243	−2.848	−0.0155	−1.306	−0.0144	−1.190
PUBLIC	0.0453	6.968	0.0267	2.970	0.0283	3.081
HHCHILDREN	0.0022	0.189	0.0064	0.449	0.0061	0.416
SINGLE2	0.0334	1.859	−0.0292	−1.632	−0.0309	−1.694
MATURA	−0.0115	−0.860	0.0327	2.114	0.0352	2.234
SOMECOLLEGE	0.0420	1.548	0.0324	1.453	0.0357	1.575
COLLEGE	0.0181	1.170	−0.0063	−0.439	−0.0055	−0.375
MOTHER	−0.0433	−3.875	−0.0184	−1.713	−0.0189	−1.729
LESS30	−0.0039	−0.196	0.0079	0.288	0.0073	0.263
AGE3140	−0.0262	−1.466	0.0384	1.514	0.0390	1.515
AGE4150	−0.0392	−2.160	0.0513	2.033	0.0510	1.995
VILLAGE			0.0571	3.066	0.0596	3.125
METRO			0.0875	5.006	0.0337	1.645
BETA	−0.0005	−15.095	−5.72*E-5	−20.851	−6.55*E-5	−19.810
BETA2 (high income)	0.0001	2.654	1.42*E-5	4.197	1.24*E-5	3.623
BETA3 (high income X metro)					2.06*E-5	4.817
DELTA	−0.0171	−2.230	0.0095	0.638	0.0134	0.869
log L	−6,521.348		−4,921.72		−4,910.18	
N	7,201		5,555		5,555	

Samples exclude the responses to one choice experiment with a dominated alternative

that focused on mortality risks associated with exposures to pollutants at contaminated sites. Inspection of our survey data reveals that women report higher level of dread for cancer, leukemia, fire and road-traffic accident deaths, and were similar to men in their fear of respiratory and cardiovascular deaths, suggesting that their lower WTP for risk reductions is not due to lower levels of dread (see Savage 1993b; Davidson and Freudenburg 1996, for earlier research on gender and risk perceptions). Since three-quarters of our female respondents reported to contribute up to 50% of the total household income, we suspect that this effect might be due to women's reluctance to (hypothetically) spend family money without first checking with their spouses.

We were curious about the effect of age on the WTP for an own risk reduction, but the empirical evidence is mixed and inconclusive. Perhaps this lack of unambiguous results is due to the relatively young sample. In Krupnick et al. (2002); Alberini et al. (2004), for example, only after age 70 are people in Canada and the US found to report a lower WTP (by about 20–30%).[21]

[21] In runs not reported in this paper, we also checked whether the choice responses were affected by the baseline risks of the beneficiary of the risk reduction at the time the risk reduction would start, but found no statistically significant association. Also see Alberini and Ščasný (2010).

Table 9 Full model with regressors: child

Child	Italy		Czech Republic (A)		Czech Republic (B)	
	Coeff	t Stat	Coeff	t Stat	Coeff	t Stat
ALPHAR	0.1884	4.423	−0.0830	−2.378	−0.0771	−2.194
ALPHA_CANCER	0.0046	0.448	0.0479	3.880	0.0476	3.863
ALPHA_ROAD	−0.0378	−3.900	−0.0266	−2.361	−0.0263	−2.346
PUBLIC	0.0755	10.233	0.0737	7.991	0.0732	7.939
HHCHILDREN	−0.0375	−2.844	−0.0054	−0.552	−0.0053	−0.544
SINGLE2	0.0297	1.516	−0.0583	−3.442	−0.0583	−3.449
MATURA	0.0041	0.272	0.0316	2.113	0.0316	2.118
SOMECOLLEGE	0.0578	2.031				
COLLEGE	0.0436	2.554	0.0602	2.705	0.0605	2.723
MOTHER	−0.0228	−1.783	0.0198	1.393	0.0195	1.369
AGECHILD	0.0014	0.763	0.0037	2.272	0.0037	2.263
BOY	−0.0029	−0.225	0.0104	0.755	0.0105	0.765
LESS30	0.0261	0.784	0.1046	3.713	0.1043	3.705
AGE3140	0.0119	0.427	0.0962	4.116	0.0957	4.100
AGE4150	−0.0184	−0.934	0.0592	2.788	0.0592	2.793
VILLAGE			0.0187	1.057	0.0185	1.046
METRO			0.0910	5.389	0.0770	3.841
BETA	−0.0005	−13.585	−5.61*E-5	−20.734	−5.81*E-5	−18.455
BETA2 (high income)	0.0001	1.762	1.35*E-5	3.976	1.29*E-5	3.766
BETA3 (high income X metro)					5.49*E-6	1.257
DELTA	−0.0051	−0.640	−0.0007	−0.068	−0.0011	−0.103
log L	−5,703.72		−4,706.01		−4,705.22	
N	6,342		5,274		5,274	

Samples exclude the responses to one choice experiment with a dominated alternative. The "Child" regressions are based on samples that include only responses by individuals whose selected child was younger than 18
village=vb=1 or vb=2 which means pop less than 5,000
metro=vb=5 which means pop more than 100,000

In Italy the study was conducted in a single locale—Milan, which is a large city, whereas the Czech Republic sample was broadly representative of the entire country. For this reason, when we estimate the models of Tables 8 and 9 for the Czech Republic sample we also include interactions between discounted risks and a dummy for "village" (a community with less than 5,000 people) and one for larger city (population 100,000 and more). The results indicate that residents of a village have preferences that are similar to those of mid-sized towns, but residents of larger cities are willing to pay significantly larger figures to reduce their own mortality risks.

We attribute this effect to two possible reasons. The first is the higher cost of living in cities, which may encourage individuals to express higher values out of comparison with other goods. The second is that residents of larger cities may believe that they may be at higher risks (because of higher pollution, for example) and/or they may have fewer opportunities to avoid risks at low or no cost to them.

Empirical work based on models of lifetime consumption (e.g., Blundell et al. 1994) suggests that the marginal utility of income diminishes with income, and this expectation is borne out in both the Italy and the Czech Republic sample data. In both places, the marginal utility of income is smaller by about 20% among people with income above the mean. In the Czech Republic, living in a relatively large city further increases the marginal utility of income.

The model specifications for the respondent's child are similar, except that we further enter interactions between discounted risk reductions and child age and gender. In Italy, these child characteristics do not affect the VSL. The VSL, however, does decrease with the number of children in the household, even if we control for income, suggesting a quantity v. quality effect, and is higher among persons with higher educational attainment. As before, mothers hold lower VSL values than fathers and respondent age does not matter.

In the Czech sample the gender of the parent is not important. Single parents hold lower VSL values, education is positively correlated with the VSL, and parents are willing to pay more for older children. The marginal utility of income is lower among wealthier persons, but is no higher among residents of larger cities.

8.5 Additional Checks

Since the rate at which people discount future risks is not statistically different from zero, in this section we posit that $\delta = 0$, so that the indirect utility in Eq. (5) is simplified to

$$V_{ij} = \alpha \cdot \Delta R \cdot \pi_{ij} + \beta \cdot (y_i - C_{ij}) + \varepsilon_{ij} \tag{11}$$

and the statistical model becomes a conditional logit with a linear argument. Starting from this simplified specification, we amended the model to allow for correlation within each respondent's observations. Doing so improves the fit of the model, but results in estimated coefficients and t statistics are very close to those of the model with responses that are independent within (and across respondents).[22]

We also explicitly checked for the presence of unobserved heterogeneity in the marginal utilities using a mixed logit model (see Train 2003; Hensher and Greene 2003). Mixed logit does not impose a restrictive substitution pattern, and accommodates situations where some people view an attribute as desirable and others regard it as unattractive (see Hensher and Greene 2003). Briefly, once interactions between the attributes and individual characteristics of the respondents were entered in the model, there was little evidence of remaining

[22] For example, in Italy, from a specification similar to that of Table 6 (but δ set to 0) and the sample who valued own risk reductions, we obtained a coefficient of 0.139 on the risk reduction, 0.0986 on the interaction between risk reduction and cancer, −0.0288 on the interaction between the risk reduction and road-traffic accidents, and 0.0478 on the interaction between risk reduction and the public program dummy. Coefficient β is equal to −0.00470. When the responses are allowed to be correlated within an individual, the coefficients are (in order) 0.146, 0.105, −0.03, 0.0495 and −0.00051. The latter are thus within 8% of the former. The t statistics are also very close (within 2% of each other). The VSL for respiratory illnesses, cancer and road-traffic accidents are slightly smaller than those from the unconstrained model of Table 6, but very similar to one another whether or not the responses are regarded as independent. Specifically, they are €2.96 million, €5.05 million, and 2.34 million when we assume independent responses within an individual, and €2.88 million, €4.95 million, and €2.29 million when the responses are correlated. When attention is restricted to the sample who valued child risk reductions, the coefficients differ by at most 12%, and the VSLs for respiratory illnesses, cancer, and road-traffic accidents are €3.59 million, €3.63 million and €2.70 million (independent responses) and €3.28 million, €3.45 million, €2.55 million (correlated responses). We also checked the models with interactions for both children and adults (i.e., simplified variants of the models shown in Tables 8, 9), and the coefficients are usually 2–7% of one another, with only two being 20% apart. The models based on the data from the Czech Republic behaved similarly.

unobserved heterogeneity for the marginal utility of the risk reduction. The *only* marginal utility that exhibited variation over the sample was the one on the interaction between the risk reduction and public program. This is consistent with results from the questionnaire development work, where people reported different levels of trust in the effectiveness of public program v. private behaviors (prevention) in reducing risks.[23]

Another concern with our logit models based on Eq. (6) is that they may impose an unduly restrictive functional form on the utility function. One approach to circumvent this problem is to estimate a conditional logit where the continuous (discounted) risk reduction variable is replaced by dummies for each risk reduction size.[24]

We report the results of such a model in Table 10, where the dummies for each risk reduction size are further multiplied by the discount factor (to be estimated along with the marginal utilities) and by the probability of survival to the age when the risk reduction starts. As shown in Table 10, people value larger risk reductions more. This is a comforting result: The responses to the choice questions exhibit scope, no matter what functional form we choose for the indirect utility function.

However, the willingness to pay for a risk reduction is not strictly proportional to the size of the risk reduction. Table 10, panel B, shows that the VSL derived from the estimated coefficient ranges from approximately €4 million (for the largest risk reduction covered in this questionnaire, which is 7×10^{-4} over 5 years, or 1.4×10^{-4} a year) to €10 million (for the smallest risk reduction, which is 2×10^{-4} over 5 years, or 0.4×10^{-4} a year) for Italy.[25] We observe a similar pattern for out Czech respondents, where the VSL ranges from CZK 20 million to CZK 69 million (€1.2 million to €4.1 million). In both countries, the VSL for the average risk reduction is similar to the figures estimated using model (6)–(9).

As before, we find no evidence of a statistically significant difference between child and adult VSL values in our Italy sample. The story is different in our Czech sample, where the VSL is statistically different across child and adult at all risk sizes except for the largest (7×10^{-4}).

9 Conclusions

Using conjoint choice experiments in hypothetical settings and with samples drawn from the populations of Milan, Italy, and from six regions in the Czech Republic, we have found that parents are willing to spend significant amounts of money to reduce the risk of dying of one of their children. Parents are also willing to spend significant amounts of money to reduce

[23] In Alberini and Ščasný (2010) we find that the effectiveness rating of public programs and private behaviors is an important predictor of the VSL.

[24] Another approach is to enter an alternative-specific intercept for the "status quo" option in model (6)–(9). When we did that, the coefficient on the status quo intercept was negative and significant. The average VSLs (for all types of risk reductions and/or distinguishing for the different causes) estimated using this approach were larger than that the figures we obtained using the model(s) of Tables 5, 6, 7, 8, 9, 10, but the marginal VSL (i.e., that implied by the increase in WTP when we increase the size of the risk reduction) smaller. One possible interpretation for this finding is the possible presence of "action bias"— that people are willing to pay something to have the option to reduce risk and to move away from the status quo (Tsuge et al. 2005). The model with the dummies for the risk reduction sizes subsumes the "status quo" alternative-specific intercept, and for this reason we prefer to report this model in the paper.

[25] The model predicts that in Italy the WTP figures for a 2, 3, 5 and 7 in 1,000 risk reduction are €1,850 (s.e. 132), €2,120 (s.e. 135), €2,367 (s.e. 134), and €2,641 (s.e. 138), respectively. These figures are statistically different from one another. Wald statistics equal to 8.28 (p value = 0.004), 7.51 (p value = 0.006) and 8.64 (p value 0.003) indicate that the first figure differs statistically from the second, the second from the third, and the third from the fourth at the 1% level.

Table 10 Model with risk size dummies

Model estimates	Italy				Czech RepubLic			
	Child		Adult		child		Adult	
	Coeff.	t Stat	Coeff.	t Stat	Coeff.	t Stat	Coeff.	t Stat
A. Conditional logit and VSL estimates								
ALPHA2	1.042	15.027	0.943	15.276	0.756	11.096	0.432	6.967
ALPHA3	1.251	17.882	1.080	17.343	0.931	12.564	0.467	7.348
ALPHA5	1.374	18.241	1.206	17.575	0.863	11.392	0.458	6.694
ALPHA7	1.575	18.472	1.345	18.132	0.902	11.700	0.719	8.549
BETA	−0.001	−17.735	−0.001	−18.984	0.000	−25.016	0.000	−23.708
DELTA	0.011	1.386	−0.005	−0.684	0.002	0.154	0.005	0.323
log L	−5,753.23	6,424	−6,574.53	7,261	−4,740.75	5,284	−5,019.64	5,595
N	6,424		7,261		5,284		5,595	

VSL estimates	Italy				Czech RepubLic			
	Child		Adult		child		Adult	
	mill.€	s.e. (VSL)	mill.€	s.e. (VSL)	mill.czk	s.e. (VSL)	mill.czk	s.e. (VSL)
2 in 10,000	10.24	0.75	9.25	0.65	68.93	5.94	42.11	5.64
3 in 10,000	8.19	0.56	7.07	0.46	56.56	4.36	30.37	3.91
5 in 10,000	5.40	0.34	4.73	0.29	31.48	2.53	17.87	2.42
7 in 10,000	4.42	0.27	3.77	0.22	23.50	1.79	20.05	2.12

	Italy			Czech Republic		
	Wald	p value	reject at 5%	Wald	p value	reject at 5%
B. Wald tests for VSL being the same across adults and children						
2 in 10,000	0.991	0.31939	Fail to reject	10.730	0.00105	Reject
3 in 10,000	2.428	0.11916	Fail to reject	20.006	0.00001	Reject
5 in 10,000	2.280	0.13102	Fail to reject	15.100	0.00010	Reject
7 in 10,000	3.574	0.05868	Fail to reject	1.548	0.21348	Fail to reject

Samples exclude the responses to one choice experiment with a dominated alternative. The "Child" regressions are based on samples that include only responses by individuals whose selected child was younger than 18

their own risk of dying. In Milan, the implied VSL figures are €4.7 million and €4 million, respectively. These figures are not statistically different from each other. In the Czech Republic, the "child premium" is a bit larger—about 30%. Taken together, these findings suggest that child premium, if any, is modest at best.

This runs against the view that the WTP for child health (or improved chances of survival) "should" be greater than for a parent or another adult (see Dickie and Messman 2004; Scapecchi 2006). That the "child premium" is small or non-existent is, however, not at odds with earlier empirical work. A "child premium" has been found in several morbidity valuation studies, but only two studies (Dickie and Gerking 2001; or Hammitt and Haninger 2010) have uncovered a "child premium" in the valuation of fatalities. Since the latter two elicited WTP to reduce own risks of parent as well as risk of her child in the same survey, the child premium might be induced by the experiment setting, i.e., respondents might respond to an implicit cue to report values for reducing child risks at least as large as those for reducing own risks.

Our VSL estimate of €1.1 million for the Czech adults is in line with the figures from a previous CV study (see Alberini et al. 2006a,b), which found the VSL for cardiovascular and respiratory illness risk to be €0.6 million, and is in sharp contrast with the VSL estimated from the Czech labor market.[26] That underscores the importance of empirical studies looking at specific contexts when one wishes to estimate the benefits of certain measures.

To shed light on the effect of context, in our conjoint choice experiments the cause of death was one of the attributes of the hypothetical alternatives being compared. Our risk reduction plans were couched in terms of risk of dying for respiratory illnesses, cancer, and in road-traffic accidents. We found evidence of a significant cancer premium, which was especially pronounced for adults. This finding is consistent with the high levels of dread the respondents associated with cancer. That people value cancer mortality risk reduction more than other causes of death is consistent with policy analysis practice within the European Commission, which applies a 50% cancer premium, and in the UK. Road traffic accident VSLs seem to be the smallest among three concerned causes of death, their difference with respiratory illness VSL is not statistically different at the conventional levels.

We also found that in each country the cancer VSL was effectively the same for adults and children. Since our respondents were aware that cancer is rare among children and more common among adults, especially after middle age, the VSL in this particular case is unrelated to the baseline risks. Taken together, these findings suggest that the so-called child premium is modest at best. However, we come to a different conclusion if child and adult VSLs are compared for different causes of death: while VSLs for cancers are not statistically different across child and adult beneficiaries, the child VSL figures for the other causes of death are about 40% larger in Italy and almost 60% larger in the Czech Republic than the adult VSL figures.

We also find that people are prepared to pay significantly larger amounts for reductions that are delivered by public programs, where there would be other beneficiaries of the risk reductions, in addition to the respondent or one of the respondent's children. This suggests that for the average respondent altruistic considerations prevailed over potential doubts about the provision of the risk reduction itself. The public program premium is the same for all three causes of death here examined.

Somewhat surprisingly, we found that the discount rate that people seemed to apply to future risk reductions was effectively zero. This is consistent with previous empirical findings, but is in sharp contrast with the results of an earlier stated preference survey in Italy (Alberini et al. 2007a,b), where we found that the discount rate was 7%.

Economic theory predicts that the marginal utility of income is lower for higher-income respondents, and this expectation is borne out in our data. We also find that, even controlling for income, women are willing to pay less for own risk reductions. Since they dread the listed causes of death no less than men do, we suspect that this effect might be due to women's reluctance to commit family financial resources without first consulting their spouses. For comparison, labor market studies have found that there are substantial wage compensating differentials for non-fatal injury risks for women that are similar to men's (Hersch 1998) but mixed evidence about compensating wage differentials for fatal risks, which are present only among blue-collar female workers and are econometrically fragile (Leeth and Ruser 2003).

[26] For instance, Ščasný and Urban (2008) reports VSLs derived from hedonic wage differentials in a range of €10 to €16 million depending on data and sample used. Melichar et al. (2010) then experiment in their hedonic wage models with the job risk rates subjectively perceived and directly stated by worker, and report VSL of about €3.4 million (at purchasing power parity).

Estimating these wage differentials is complicated by the fact that women experience much lower rates of fatal and non-fatal injuries at work and tend to sort into low-risk occupations.

The effect of education is mixed, and that of respondent (or beneficiary) age is likewise ambiguous. Since age effects have been noted only among the eldest of the elderly (Krupnick et al. 2002), our respondent may have been too young for us to detect any age effects.

In sum, the overall goal of this research project was to look for evidence of heterogeneity in the VSL, focusing on four possible sources of heterogeneity: (1) the cause of death, (2) the beneficiary of the risk reduction (an adult or his/her child), (3) the private v. public program nature of the risk reduction, and (4) other individual characteristics of the respondent. We found that items (1) and (3) have relatively large effects on the VSL, whereas the impact of (2) is mixed. If we do not distinguish for the cause of death, there are modest or no differences across child and adult VSL. If we do distinguish for the cause of death, we find that the cancer VSL is virtually the same for adults and children, whereas for respiratory illnesses and road-traffic accidents the child VSL tends to be 40–60% larger than the adult VSL. By contrast, the heterogeneity in valuations attributable to individual characteristics is comparatively smaller, with effects of 20% if household income is above the mean, and about 20% if the respondent is a woman.

References

Agee MD, Crocker TD (2001) "Smoking Parents' Valuations of Own and Children's Health," Paper presented at the association of environmental and resource economists conference, Bar Harbour, Maine, June

Alberini A, Cropper ML, Krupnick A, Simon N (2004) Does the value of a statistical life vary with age and health status? Evidence from the U.S. and Canada. J Environ Econ Manage 48(1):769–792

Alberini A, Ščasný M, Kohlová MB, Melichar J (2006) The value of statistical life in the Czech Republic: evidence from contingent valuation study. In: Menne B, Ebi KL (eds) Climate change and adaptation strategies for human health. Springer, Steinhopff Verlag, Darmstadt, pp 373-393. ISBN: 3-7985-1591-3

Alberini A, Chiabai A (2007a) Urban environmental health and sensitive populations: how much are the Italians willing to pay to reduce their risks? Reg Sci Urban Econ 37(2):239–258

Alberini A, Chiabai A (2007b) Discount rates in risk versus money and risk versus risk tradeoffs. Risk Anal 27(2):483–498

Alberini A, Chiabai A, Tonin S (2009) The VSL for children and adults: evidence from conjoint choice experiments in Milan, Italy. Paper presented at the annual EAERE meeting, Amsterdam, June 2009

Alberini A, Cropper M, Krupnick A, Simon NB (2006) Willingness to pay for mortality risk reductions: does latency matter? J Risk Uncertain 32:231–245

Alberini A, Longo A, Veronesi M (2007) Basic statistical models for conjoint choice experiments. In: Kanninen B (ed) Valuing environmental amenities using choice experiments: a common sense guide to theory and practice. Springer, Darmstadt, Germany

Alberini A, Tonin S, Turvani M, Chiabai A (2007) Paying for permanence: public preferences for contaminated site cleanup. J Risk Uncertain 34(2):155–178

Alberini A, Ščasný M (2010) Does the cause of death matter? The effect of dread, controllability, exposure and latency on the VSL. FEEM working paper 2010.139, Milan, Italy, October

Aldy JE, Viscusi WK (2007) Age differences in the value of statistical life: revealed preference evidence. Rev Environ Econ Policy 1:241–260

Andersson H (2005) The value of safety as revealed in the swedish car market: an application of the hedonic pricing approach. J Risk Uncertain 34(1):211–239

Atkinson SE, Halvorsen R (1990) The valuation of risks to life: evidence from the market for automobiles. Rev Econ Stat 72(1):133–136

Bateman I et al (2002) Economic valuation with stated preference techniques: a manual. Edward Elgar, Cheltenham, UK

Bateman IJ, Bolt K, Day B, Ferrini S, Loomes G, Ščasný M, Kohlová MB, Škopková H (2009) Can stated preferences yield robust estimates of the value of statistical life? Lab and field applications of conventional and novel techniques for estimating adult and child VSL within an environmental context. Paper

presented at the 17th annual conference of the European association of environmental and resource economists, VU University in Amsterdam, The Netherlands, June 2009
Black DA, Kniesner TJ (2003) On the measurement of job risk in hedonic wage models. J Risk Uncertain 27(3):205–220
Black DA, Galdo J, Liqun L (2003) How robust are hedonic wage estimates of the price of risk? Final report to the USEPA, June 2003, R 82943001
Blomquist GC (2002) Self-protection and averting behavior, values of statistics lives, and benefit-cost analysis of environmental policy. Revision of contribution in U.S. environmental protection agency, National Center for Environmental Economics Report #EE-0064
Blomquist GC, Miller TR, Levy DT (1996) Values of risk reduction implied by motorist use of protection equipment values of risk reduction implied by motorist use of protection equipment. J Trans Econ 30(1):55–66
Blundell R, Browning M, Meghir C (1994) Consumer demand and the life-cycle allocation of household expenditures. Rev Econ Stud 61:57–80
Braun Kohlová M, Ščasný M (2006) Averting behaviour and parental altruism in infant morbidity valuation: a CV survey in the Czech Republic. Paper presented at the 3rd world congress of environmental and resource economists, Kyoto, July
Carthy T, Chilton S, Covey J, Hopkins L, Jones-Lee M, Loomes G, Pidgeon N, Spencer A (1999) On the contingent valuation of safety and the safety of contingent valuation: part II—the CV/SG 'Chained' approach. J Risk Uncertain 17(3):187–213
Corso PS, Hammitt JK, Graham JD (2001) Valuing mortality-risk reductions: using visual aids to improve the validity of contingent valuation. J Risk Uncertain 23(2):165–184
Cropper M, Sussman F (1990) Valuing future risks to life. J Environ Econ Manage 19:160–174
Davidson DJ, Freudenburg WR (1996) Gender and environmental concerns: a review and analysis of available research. Environ Behav 28:302–339
Dickie M, Gerking S (1996) Formation of risk beliefs, joint production and willingness to pay to avoid skin cancer. Rev Econ Stat 78(3):451–463
Dickie M, Gerking S (2001) Parents' valuation of latent health risks to their children. Paper presented at the US environmental protection agency workshop "Valuing of a statistical life: assessing the state of the art for policy applications," Silver Spring, MD, November
Dickie M, Messman VL (2004) Parental altruism and the value of avoiding acute illness: are kids worth more than parents? J Environ Econ Manage 48:1146–1174
Dickie M, Gerking S (2006) "Valuing children's health: parental perspectives," Chapter 3 in OECD, economic valuation of environmental risks to children. OECD Publishing, Paris
Dickie M, Gerking S (2007) Altruism and environmental risks to health of parents and children. J Environ Econ Manage 53(3):323–341
Eeckhoudt LR, Hammitt JK (2001) Background risks and the value of a statistical life. J Risk Uncertain 23(3):261–279
Fischhoff B, Slovic P, Lichtenstein S, Read S, Combs B (1978) How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. Policy Sci 9:127–152
Hammitt JK, Haninger K (2010) Valuing fatal risks to children and adults: effect of disease, latency, and risk aversion. J Risk Uncertain 40(1):57–83
Hensher D, Greene WH (2003) The mixed logit model: the state of practice. Transportation 30(2):133–176
Hersch J (1998) Compensating differentials for gender-specific job injury risks. Am Econ Rev 88(3):598–607
Hintermann B, Alberini A, Markandya A (2010) Estimating the value of safety with labor market data: are the results trustworthy? Appl Econ 42(9):1085–1100
Horowitz JK, Carson RT (1990) Discounting statistical lives. J Risk Uncertain 3(4):403–413
Jenkins R, Owen N, Wiggins L (2001) Valuing reduced risks to children: the case of bicycle safety helmets. Contemp Econ Policy 19(4):397–408
Johannesson M, Johansson P-O (1996) To be, or not to be, that is the question: an empirical study of the WTP for an increased life expectancy at an advanced age. J Risk Uncertain 13:163–174
Johannesson M, Johansson P-O, O'Conor RM (1996) The value of private safety versus the value of public safety. J Risk Uncertain 13:263–275
Johannesson M, Johansson P-O, Lofgren K-G (1997) On the value of changes in life expectancy: blips versus parametric changes. J Risk Uncertain 15(3):221–239
Johannesson M, Meltzer D (1998) Some reflections on cost-effectiveness analysis. Health Econ 7:1–7
Jones-Lee MW, Hammerton M, Philips P (1985) The value of safety: results of a national sample survey. Econ J 95:49–72
Jones-Lee MW (1989) The value of safety and physical risk. Blackwell, Oxford
Jones-Lee MW (1991) Altruism and the value of other people's safety. J Risk Uncertain 4:19–213

Jones-Lee MW (1992) Paternalistic altruism and the value of statistical life. Econ J 102:80–90
Krupnick A (2007) Mortality-risk valuation and age: stated preference evidence. Rev Environ Econ Policy 1:261–282
Krupnick A, Alberini A, Cropper M, Simon N, O'Brien B, Goeree R, Heintzelman M (2002) Age, health and the willingness to pay for mortality risk reductions: a contingent valuation study of ontario residents. J Risk Uncertain 24:161–186
Leeth JD, Ruser J (2003) Compensating wage differentials for fatal and non-fatal injury risk by gender and age. J Risk Uncertain 27(3):257–277
Leigh JP (1995) Compensating wages, value of a statistical life, and inter-industry differentials. J Environ Econ Manage 28(1):83–97
Liu J-T, Hammitt JK, Wang J-D, Liu J-L (2000) Mother's willingness to pay for her own and her child's health: a contingent valuation study in Taiwan. Health Econ 9:319–326
Melichar J, Ščasný M, Urban J (2010) Hodnocení smrtelných rizik na trhu práce: studie hedonické mzdy. Politická ekonomie (forthcoming)
Miller TR (2000) Variations between countries in values of statistical life. J Trans Econ Policy 34(2):169–188
McDaniels TL, Kamlet MS, Fischer GW (1992) Risk perception and the value of safety. Risk Anal 12:495–503
Moore MJ, Viscusi WK (1990) Models for estimating discount rates for long term health risks using labor market data. J Risk Uncertain 3(4):381–402
Mount T, Schulze W, Weng W, Kim H, Chestnut L (2000) Valuing reduced risk for households with children or the retired. Presented at the American economics association annual convention, Boston, MA, January 7-9, 2000
Rowlatt P, Spackman M, Jones S, Jones-Lee M, Loomes G (1998) Valuation of deaths from air pollution. National Economic Research Associates, London, UK
Persson U, Norinder A, Hjalte K, Gralen K (2001) The value of a statistical life in transport: findings from a new contingent valuation study in Sweden. J Risk Uncertain 23(2):121–134
Savage I (1993a) An empirical investigation into the effect of psychological perception on the willingness-to-pay to reduce risk. J Risk Uncertain 6:75–90
Savage I (1993b) Demographic influences on risk perceptions. Risk Anal 13(4):413–420
Scapecchi P (2006) "Valuation differences between adults and children," Chapter 2 in OECD, Economic valuation of environmental risks to children. OECD Publishing, Paris
Ščasný M, Urban J (2008) Application of the hedonic wage model: value of statistical life derived from employee's choice in the Czech labor market. In: Ščasný M, Braun Kohlová M et al (eds) Modelling of consumer behaviour and wealth distribution. Matfyzpress, Praha, pp 125-145. ISBN: 978-80-7378-039-5
Shepherd DS, Zeckhauser RJ (1982) Life-cycle consumption and willingness to pay for increased survival. In: Jones-Lee MW (ed) The value of life and safety. North Holland, Amsterdam, The Netherlands
Siebert WS, Wei X (1994) Compensating wage differentials for workplace accidents: evidence for union and non-union workers in the UK. J Risk Uncertain 9(1):61–76
Tonin S, Alberini A, Turvani M (2009) The value of reducing cancer risks at contaminated sites: are more heavily exposed people willing to pay more? FEEM working paper 09.60, Milan, Italy, July
Train K (2003) Discrete choice methods with simulation. Cambridge University Press, Cambridge, UK
Tsuge T, Kishimoto A, Takeuchi K (2005) A choice experiment approach to the valuation of mortality. J Risk Uncertain 31(1):73–95
UK Department of Food, Rural and Environmental Affairs (2008) DEFRA flood and coastal defence appraisal guidance. Social appraisal. Supplementary note to operating authorities. Assessing and valuing the risk to life from flooding for use in appraisal of risk management measures, May 2008. Available at http://www.defra.gov.uk/environment/flooding/documents/policy/guidance/fcdpag/risktopeople.pdf (accessed 22 March, 2010)
US Environmental Protection Agency (2000) Guidelines for preparing economic analyses, EPA-R-00-003, Washington, DC, September
Viscusi WK, Aldy JE (2003) The value of a statistical life: a critical review of market estimates throughout the world. J Risk Uncertain 27(1):5–76