



How Much Will People Pay for Longevity?

Alan J. Krupnick

Cost-benefit analyses having anything to do with air pollution generally show huge benefits, primarily in terms of an individual's willingness to pay to reduce mortality risks, which far outweigh the costs incurred. In a controversial case to be decided this spring, the U.S. Supreme Court will consider whether the U.S. Environmental Protection Agency (EPA) should rely on these analyses to set its air quality standards, among other issues. New research at RFF indicates that individuals, particularly the older ones most at risk, may place a much smaller dollar value on how much they would pay to live longer than has previously been used by EPA.

Prolonging people's lives is arguably the most important outcome from improving air quality and drinking water. Together with morbidity improvements, these effects serve as the primary drivers for many of the major legislative mandates in the United States and Canada, such as the U.S. Clean Air Act and the Canadian Environmental Protection Act. The challenge before policymakers is to strike a balance between potential benefits in terms of lives prolonged (or, equivalently, death risks reduced) and the use of scarce resources to prolong them.

Striking this balance requires not only an estimate of the risk reductions related to reductions in pollution, but also an estimate of the public's preferences for obtaining this benefit, expressed in terms of their willingness to pay for it. Existing methods for determining the value of a statistical life (VSL)—a shorthand expression for the willingness to pay divided by the mortality risk reduction being experienced—have common shortcomings,

according to our research. They tend to focus on the value adults in the prime of their life place on reducing their risk of dying, even though most of the people who benefit from environmental programs are older and/or may be suffering from chronic heart and lung diseases.

The existing methods also tend to focus only on immediate risk changes. When environmental programs reduce exposure to a carcinogen, the costs of doing so are often incurred in the present, whereas cancer-related mortality risks are reduced in the future, following a latency period. What is needed for an effective policy addressing pollutants with latent effects is an estimate of how much people would pay now for a reduction in their risk of dying in the future.

In our research, we aimed to address these shortcomings by focusing on persons 40 to 75 years old to elicit their "willingness to pay" (WTP) for reductions in current and future risks of death. We wanted to determine the WTP for a reduction in death risk in an

appropriate context for pollution, how WTP would vary with age, whether WTP would be influenced by current health status, and how latency would affect WTP.

Our findings yielded interesting and, in some cases, somewhat unexpected results. In general terms, what turns out to matter more than income or educational level in explaining people's WTP was their overall mental health and, specifically, whether or not they were specifically suffering from cancer. If they were in good mental health or had cancer, they were willing to pay more to see their risks reduced; with regard to cancer, respondents would pay substantially more (about 45%). At the same time, other expressions of physical health—and many were included in our survey—were not related to WTP.

Age does not influence WTP until age 70, according to our statistical findings. The 70–75 age group was willing to pay approximately one-third less than the average for a given reduction in annual mortality risk.

Our mean WTP estimates for a reduction in the risk of death over the next 10 years show that the value of a statistical life varies from approximately \$1.2 million to \$3.8 million (1999 C\$), depending on the size of the risk value changed. These figures are 10% to 70% lower than Health Canada's age-adjusted VSL of \$4.3 million (1999 C\$), which was recently used in an analysis of proposed ambient air quality standards, and one-half (or less) the size of the \$7.5 million (1999 C\$) figure used by the U.S. Environmental Protection Agency (EPA).

Research Methods

The methods for developing empirical estimates of individual WTP for mortality risk reductions may be divided into two groups. Revealed preference studies primarily examine whether more risky jobs come with a higher wage. Stated preference studies rely on survey methods (termed contingent valuation methods) that pose realistic but hypothetical situations to individuals in which they can express their preferences in money terms for these complex effects.

Each approach to measuring WTP has its drawbacks. Revealed preference studies make untested assumptions about individuals' risk perceptions: that is, that risk perceptions correspond to objectively measured risks. Furthermore, it is often difficult to separate objective risk measures from other attributes of the job or product being examined. Stated preference studies are, in principle, capable of testing whether individuals correctly perceive mortality risks or changes in mortality risks.

However, these stated preference studies are not without their own pitfalls: respondents may not understand the risk changes they are asked to value, may not believe that the risk changes apply to themselves, and may lack experience in trading money for quantitative risk changes or lack the realization they are engaged in this activity. The result may be that WTP is found not to vary with the size of the risk change—an essential method of testing whether individuals correctly comprehend risk information that many existing studies omit.

Our approach was to devise and implement a contingent valuation study that would address these problems by:

- developing graphic depictions of risk and a series of education statements to enhance respondent comprehension;
- testing in several ways for respondent understanding of risk and other facets of the survey; and
- providing examples of comparable activities from everyday life, such as obtaining mammograms or colon cancer screening tests, to inform people about how they spend money to reduce death risks in their everyday lives.

Survey Sample Profile

The survey was administered to 930 people in Hamilton, Ontario, in 1999, by a Canadian survey-research firm. Respondents were recruited by phone through random-digit dialing and asked to go to a facility in downtown Hamilton to participate in the survey. There, they worked on computers with simplified keypads, which were color-coded and specially labeled for use with the survey. Respondents moved through the survey at their own pace. Words on each screen appeared in a large font and there was a voice-over accompaniment.

The goals of the survey were to estimate what older people would pay for a reduction in their risk of dying and to examine the impact of health status on WTP. We sought a target population aged 40 years (the mean age of workers in the wage compensation studies) to 75 years and were able to assemble a sample of people that was very similar to the Ontario population in age, income, and the like.

The average age of the respondents was 54 years, with 31% of the sample above age 60, and 9% above age 70. Although 80% of the sample completed high school, only 20% had completed a university degree. The average household income in the sample was \$54,000 (1999 C\$). Most respondents rated their health as very good to excellent, although 41% reported some chronic respiratory or heart disease. The majority of

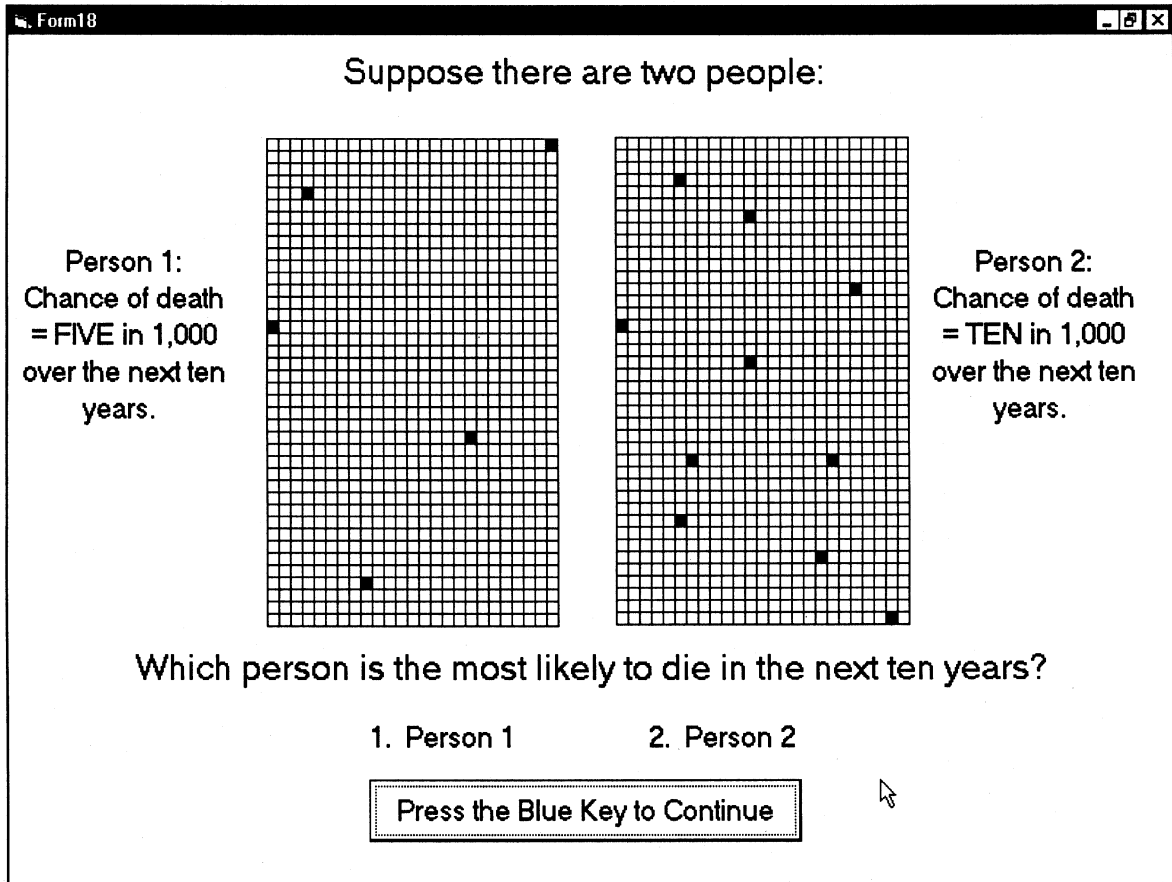


Figure 1. Use of Grids to Represent Probabilities in Mortality Risk Questionnaire.

respondents also described themselves as being in good mental health.

Survey Structure

Survey development is still more of an art than a science. Our survey instrument was developed over several years and is based on extensive one-on-one interviews, work with many focus groups, and even a 300-person pretest survey administered in Japan. The survey was divided into five parts. Part I introduced the project's sponsors—RFF, Health Canada, and McMaster University in Hamilton, Ontario—and elicited personal information about the respondent, including questions about the respondent's health as well as the health of immediate family members.

Part II introduced the subject to simple probability concepts through coin tosses and roulette wheels. The probabilities of dying and surviving over 10-year periods were then depicted

using a 1,000-square grid. The respondent went through simple exercises to become acquainted with our method of representing the probability of dying. The respondent was then shown two 25 by 40 grids: one for person 1, with 5 red squares (representing death), and one for person 2, with 10 red squares (see figure 1 above).

The respondent was asked to indicate which person faces the higher risk. If the respondent picked person 1, he or she was provided with additional information about probabilities and the question was asked again. The respondent was then asked which person he or she would rather be. Individuals responding "person 2" (the person with the higher risk) were asked a followup question to verify this answer and were given the opportunity to change their answer if they wished. The baseline risk of death for a person of the respondent's age and gender was then presented numerically and graphically.

RESOURCES FOR THE FUTURE

Part III presented the leading causes of death for someone of the respondent's age and gender. Common risk-mitigating behaviors were listed together with the quantitative risk reductions they achieve and a qualitative estimate of the costs associated with them ("inexpensive," "moderate," and "expensive"). The purpose of this section is twofold. We wanted, first, to acquaint the respondent with the magnitude of risk changes delivered by common risk-reducing actions and products (for example, cancer screening tests and blood pressure medication) and, second, to remind the respondent that such actions have a cost, whether out-of-pocket or not.

Part IV elicited WTP by asking if respondents were willing to pay a given amount and then, depending on their answer, they were given a followup bid to accept or reject. In all, three sets of WTP questions were asked. Respondents were first asked if they were willing to pay for an abstract product that, when used and paid for over the next 10 years, would reduce their current risk of dying over the next 10-year period by 5 in 1,000; that is, by 5 in 10,000 annually. In the second WTP question, risks were reduced by 1 in 1,000; that is, by 1 in 10,000 annually. And in the third WTP question (to those 65 and under), risks were reduced by 5 in 1,000 again, but not until age 70, reminding respondents that they might not be alive to experience this benefit and asking them how likely it was they thought they would live to this age. The first and second questions were reversed for half the sample in order to test formally, and with separate samples, whether the larger risk change resulted in a larger WTP.

The product in question was defined in abstract terms—"a drug or a product not covered by health insurance"—because we found that more specificity resulted in many respondents rejecting the scenarios as not applicable to them. We also made it clear that the risk reductions would be obtained by use of a private good. In practice, most environmental programs reduce mortality risks for all persons in an exposed population—in other words, risk reductions are a public good. However, in order to factor out potential altruism on the part of respondents, it was necessary to focus only on private WTP. To the extent that it is appropriate to consider altruism—a complicated issue—our estimates are biased downward, but no more so than the existing estimates commonly used by EPA and others.

Part V included an extensive series of debriefing questions, followed by some final questions regarding education and household income. The debriefing questions were used to identify respondents who had trouble comprehending the survey or did

not accept the risk reduction being valued. The computerized survey was then followed by a standard 36-question, pencil-and-paper survey addressing the respondent's physical and mental health in detail and permitting the construction of standardized physical and mental health indexes for use in explaining why WTP varied across individuals.

Conclusion

One key measure of the success of a contingent valuation study like this one is that, when different groups of respondents are asked to value risk changes of different magnitudes, WTP increases with the size of the risk change. Our research shows that the size of the risk reduction has a strong influence on WTP. Mean WTP for an annual reduction in risk of death of 5 in 10,000 is about 1.5 times the WTP for an annual risk reduction of 1 in 10,000. WTP, therefore, is sensitive to the size of the risk reduction but not strictly proportional to it (median WTP is closer to changing proportionally with risk). This lack of proportionality means that the VSL also varies with the size of the risk change, raising a question as to which VSL is appropriate in any given case.

Indeed, the overarching technical conclusion of our study is not only that the VSL may be lower than that in use for pollution-related benefit–cost analyses, but also that different VSLs may be appropriate in some circumstances regarding the age and health of affected populations. The lack of an effect of physical health status on WTP (with the possible exception of the presence of cancer) suggests that any potential proliferation of VSLs may be limited.

In terms of public policy, we would conclude that benefits of air pollution reductions, which do not have a cancer effect and affect primarily an older population, are being significantly overestimated in the United States and possibly in Canada, as well as in other countries that rely on the current literature or mimic U.S. practice.

Alan J. Krupnick is the director of RFF's Quality of the Environment Division and a senior fellow. This article is adapted from a longer article he co-authored with Anna Alberini, Maureen Cropper, Nathalie Simon, Bernie O'Brien, Ron Goeree, and Martin Heintzelman. "Age, Health, and the Willingness to Pay for Mortality Risk Reductions: A Contingent Valuation Survey of Ontario Residents" can be found on the RFF Web site, at www.rff.org/disc_papers/PDF_files/0037.pdf.

Funding for this project came in part from Health Canada, the umbrella federal agency focusing on health policy and disease prevention, and from a grant program run jointly by EPA and the National Science Foundation.