Environmental and Natural Resource Economics: An Encyclopedia
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Value of Statistical Life

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Life is precious. Environmental economists are keenly aware of this fact and also that human life is affected by environmental quality. Health is affected by a variety of factors. Biological factors such as genetic endowment and age, lifestyle factors such as diet and exercise, and health care such as inoculations and medications along with pollution are all factors that affect health. Environmental economists continue to contribute to the evidence that exposure to air pollution, water pollution, and toxic substances pose risks to life. Their main contribution, however, is a conceptually sound framework for valuing changes in risks to health and estimates of values of those changes.

The basic idea is straightforward: values of life are reflected in trade-offs individuals are willing to make. The values are the amounts that individuals trade for small changes in their own probabilities of living. Paying higher rent for an apartment that is located farther away from a Superfund site gets a reduction in exposure to toxic substances and reduction in risk. Paying for a basement ventilation system gets a reduction in risk due to exposure to radon. Working for lower pay at a job that has less risk reflects a similar trade-off. Each of these situations involves a trade-off between money and small changes in mortality risks. Such trade-offs are common in everyday life. Typically trade-offs are between an amount such as $70 per year and a change in annual risk of death such as 0.00001. For ease of comparison among various situations involving small changes in risk, it is common practice to divide the amount of money by the change in risk. This standardized, unit (0–1) change value of $7 million is often referred to as a value of statistical life. The reason is that the situation can be thought of another way. Consider a group of 100,000 people and that it is known that eight will die due to exposure to pollution, but the identities of the individuals who will die are unknown. It is also known that each person is willing to pay $70 for a reduction in pollution that would reduce to number of deaths to seven. Thinking of the situation this way, the value of the unknown, statistical life is the number of individuals times the amount per individual, or $7 million. These values are vital. They are used in benefit–cost analysis of environmental regulations. Since 1981 benefit–cost analysis has been required of all major federal regulations in the United States by Executive Order of the president, where permissible by law. It is not unusual that reductions in mortality risks are the most important benefits in the economic analysis for environmental regulations.

Although individuals trade health risk for other desirables on a regular basis, trades are not as easily observed as trades of stocks on Wall Street or purchases of fruits and vegetables at a grocery store. Markets for trading money and health risks rarely, if ever, exist. Consequently, economists have engaged in detective work to uncover situations in which there is sufficient information to infer values of the risk changes. Much of the evidence comes from the labor market. Different jobs have different working conditions. If similar workers have choices between jobs which are the same except for work-related risk of death and pay, then market equilibrium implies that workers who choose riskier jobs are compensated by higher pay. Through statistical analysis that explains differences in pay by differences in worker characteristics and job characteristics, economists isolate these risk-compensating wage differences. These trade-offs yield estimates of values of small changes in mortality risks, that is, values of statistical life.

Additional evidence about trade-offs comes from decisions made by consumers. Different houses have different characteristics, some of which depend on location. Through statistical analysis that accounts for differences in house prices by differences in structural, neighborhood, and environmental characteristics and information about the effect of environmental quality of health, the trade-offs between housing prices and mortality risks can be estimated. Different motor vehicles have different characteristics, one of which is inherent safety. Through statistical analysis that explains vehicle prices by characteristics such as associated fatal crash rates, trade-offs between money and fatality risks can be estimated. Related analyses of highway travel speeds and motorist use of safety equipment reveal trade-offs between valuable time and fatality risks and also yield estimates.

Yet another source of estimates of values is constructing realistic survey or experimental situations and asking individuals directly if they would make the specified trade-offs. Contingent valuation constructs a market-like situation in which individuals can state what trade-offs they are willing to make between their own money and small changes in mortality risks. The situation might be asking how an individual would vote for a referendum that would reduce air pollution from electric power–generating plants, reduce fatality risks, be accompanied by a specified amount added to each utility bill, and be implemented by the relevant government authorities and electric company if a majority supports the referendum and is willing to pay. Advantages of contingent valuation are that the situations can be designed to closely match risks associated with exposure to pollution and to value risks about which the typical individual does not have much information beforehand. These advantages are strengths compared to values revealed through statistical analysis of worker or consumer choices. A concern about contingent valuation is that estimates could be unreliable because the situations are hypothetical; individuals might not really support and pay as they say. Skeptics still exist, but more than 40 years development of stated preference techniques has yielded ways to

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mitigate hypothetical bias and produce reliable estimates of values of changes in mortality risks. Many studies of worker choices in labor markets, consumer choices in product markets, and citizen choices in constructed experimental and contingent markets have produced a sizable body of evidence on trade-offs that show how much individuals are willing to pay for changes in mortality risks. The typical value for adults falls in a range from $2 to $12 million (2012 U.S. dollars). This information has guided decisions about environmental policy and proven useful despite what may appear to be a wide range. In economic analysis of regulations the U.S. Environmental Protection Agency (EPA) now tends to use an average value of about $8 million, again measured in 2012 dollars. In other words, if an environmental regulation is expected to benefit 100,000 people by reducing each person's risk of death by 0.00001, then EPA uses a value of about $80 per person for the reduction in risk, and this benefit of the regulation is valued at $8 million for the group of beneficiaries. The agency also uses a range of values to determine the sensitivity of estimates of total social net benefits to this value.

Although environmental economists have a clear understanding of the meaning of value of statistical life, the EPA has become sensitive to meanings that have been misconstrued by others who are interested in environmental policy. In contrast to ordinary trade-offs involving small risks, others have envisioned noncomparable situations such as the amount a captive can offer to avoid certain execution, a situation that is quite different from environmentally related changes in risk. To promote clearer understanding, the EPA is considering new terminology. The new term would be values of mortality risks, where the standard unit, for convenience of comparison, would be the value of a 0.00001 change per person per year. In other words, the small changes in mortality risks would be standardized to one in a million.

Something to keep in mind is that no single value exists that is universal for all individuals in all circumstances. Trade-offs that individuals are willing to make for changes in mortality risk are expected to be different among individuals. They could vary because of ability to deal with exposure to pollution, health status, family situation, religion, income, or age. Values are expected to increase over time with real income growth in a country, and values are expected to be higher in richer countries than poorer countries. One of the more intriguing findings of recent research is that trade-offs appear to vary with age and that parents appear to value reducing risks to their children more than they value reducing their own risks. Although caution is warranted due to the small number of studies, indications are that the values for children are substantially higher. Evidence of trade-offs that senior citizens are willing to make is less clear and policy implications are controversial. At this time the EPA usually uses one value for all, regardless of age, income, or other personal characteristics of the beneficiaries.

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The values environmental economists use for policy analysis are based on trade-offs that individuals are willing to make between small changes in mortality risks and money. They do not use an ad hoc measure such as foregone earnings that would generate no or low values for improvements for children, retirees, or others who do not work in the formal labor market. Use of values of statistical life, or values of mortality risks, inferred from observed or stated trade-offs is the way in which environmental economists incorporate the preciousness of mortality risks into economic analysis of regulations that reduce exposure to air pollution, water pollution, and toxic substances. In this way, small changes in risks to life are treated as precious, but not priceless.

See also Averting Behavior;
See also Contingent Valuation;
See also Executive Order 12291;
See also Health;
See also Hedonic Price Method;
See also Nonmarket Valuation

Further Reading

Cameron, Trudy. 2010. Euthanizing the Value of Statistical Life. *Review of Environmental Economics and Policy* 4(2): 161–178.

Cropper, Maureen, James K. Hammitt, and Lisa A. Robinson. 2011. Valuing Mortality Risk Reductions: Progress and Challenges. *Annual Review of Resource Economics* 3: 313–336.

Executive Office of the President, Office of Management and Budget. 2013 Draft Report to Congress on the Benefits and Costs of Federal Regulations and Agency Compliance with the Unfunded Mandates Reform Act. http://www.whitehouse.gov/sites/default/files/omb/inforeg/2013_cb/draft_2013_cost_benefit_report.pdf. Accessed June 6, 2013.

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