

Valuing Mortality Risk Reductions for Environmental Policy

Presentation to EPA's Science Advisory Board -
Environmental Economics Advisory Committee

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Outline

- Current EPA Guidance
- Brief History of EPA-SAB interaction on this issue
- Summary of Key Issues
 - Short term
 - Long term
- Charge Questions

Background

- In December 2010, EPA issued its updated *Guidelines for Preparing Economic Analyses*
 - 2010 version retains 2000 guidance on mortality risk valuation
- We will make further updates as needed, possibly including changes based on recommendations of this SAB-EEAC review

Current EPA Guidance

- VSL estimate of \$4.8 million in 1990 real dollars should be used in all analyses (\$7.9m in 2008)
 - Mean of a probability distribution fit to twenty-six published VSL estimates
 - 21 hedonic wage and 5 stated preference studies with publication dates ranging from 1977 to 1991
- Adjust for inflation and real income growth over time
- Do **not** adjust for differences in sources of risk or population characteristics

History

- July 2000 SAB recommendations on “*Valuing the Benefits of Fatal Cancer Risk Reduction*”
 - Empirical literature supported only accounting for latency and income growth
 - Other adjustments could be addressed using sensitivity analysis
- August 2001 SAB report, “*Arsenic Rule Benefits Analysis: An SAB Review*”
 - Generally supported EPA’s estimate of VSL
 - Account for the time between reduced exposure and reduced mortality risks (coined “cessation lag”)

History (cont.)

- May 2004 consultation: “gather more information on meta-analysis”
- 2007 SAB Advisory report
 - Meta-regression should be used to examine how study design characteristics influence the VSL estimates, but...
 - meta-regression is “not appropriate [for] combin[ing] VSL estimates” into a summary measure
 - Other statistical techniques should be used to determine a central estimate or range of estimates

The Valuation Challenge

Section 2

- EPA policies are inherently public in nature, raising issues about altruism
- Environmental risk reductions may be valued differently from workplace or auto accidents or other risks found in existing studies
- Mortality risk reductions are intertwined with morbidity outcomes, suggesting a valuation model that includes both factors

Key Issues

- Change in terminology
- Altruism and WTP for mortality risk
- Valuing cancer risks
- Relevant studies
- Methods for combining estimates from multiple studies

Terminology

Section 3.1; Charge Question 1

- Value of statistical life (VSL) term has caused undue confusion and angst (as described, e.g., in Cameron 2009, 2010)
- Propose a change to the use of the “value of mortality risk” (VMR)
 - Units reported using standard metric prefixes to indicate the size of the risk change and the duration of the time period
 - e.g., $\$/\mu\text{r}/\text{yr}$ [dollars per micro-risk, 10^{-6} , per year]

Altruism

Section 3.2; Charge Question 3

- Benefit-cost analyses of EPA programs, which are inherently public, may need to account for altruistic preferences
- How can existing WTP estimates inform altruistic values?
 - Standard assumptions seems to be that utility depends on own consumption & risks, not those of others
 - Hedonic wage studies do not incorporate altruism
 - Some SP studies may incorporate altruistic preferences

Cancer Risk Reductions

Section 3.3 ; Charge Question 2

- Benefit transfer factors for cancer risk reductions have been limited to
 - Discounting over cessation lag or latency
 - Adding cost-of-illness to the VSL
 - Accounting for income change over time
- Do people value cancer risks differently than other risks?
 - Findings in the literature are mixed, but some evidence of a positive differential
- We suggest an interim differential of +50% for cancer risk reductions

Selecting Relevant Data: SP

Section 4.1.2; Tables 2 & 3; Charge Question 4

- Stated Preference (SP) dataset
 - Selection criteria: Size=100; general population; high-income country; exclusive dataset; English; can calculate WTP; WTP rather than WTA; adult risks and values
 - Selecting estimates: One estimate from each study reported as WTP for risk reduction of 10^{-6}
 - Forty independent estimates

Selecting Relevant Data: HW

Section 4.2.4; Table 4; Charge Question 4

- Hedonic Wage (HW) dataset
 - Selection criteria: similar to Bellavance *et al.*, 2009 but also limited to sample size > 100; high income countries; eliminated SOA data-based studies and studies of extremely dangerous jobs
 - Selecting Estimates: one estimate from each study reported as WTP for risk reduction of 10^{-6}
 - Thirty-seven study estimates

Income Elasticity

Section 5; Charge Question 5

- Adjust VSL to account for changing income (per-capita GDP) over time
- Typically apply a range based on prior literature reviews (0.08, 0.4, 1.0)
 - Viscusi and Aldy (2003) meta-analysis finds a range of 0.5 to 0.6
- New income elasticity estimates (e.g., Kneisner *et al.* 2009) are more consistent with prevailing estimates of coefficient of relative risk aversion
- Estimates are on the low end of the current range of estimates and may need to be updated

Meta-analysis

Section 6.1; Question 6

- Parametric distribution
 - Update EPA's current approach
 - Use all independent estimates or one per study?
 - Which estimates? Non-cancer and non-latent?
Public and private risk SP studies?
- Classical Econometrics
 - Use all independent estimates or one per study?
 - Address correlated errors and heteroskedasticity
 - Use WLS or random effects model
- Bayesian Meta-regression
 - Good for small samples
 - Use panel model with a hierarchical prior

Structural Benefit Transfer

Section 6.2 and Appendix A; Question 8

- Can consistently combine estimates using different benefit concepts or measures
- Theoretical consistency imposed on out-of-sample extrapolations
- Can account for potential behavioral responses
- Could be based a life-cycle framework to account for the timing of exposure and risk changes

Standardized Protocol

- Need for regular updates to account for new literature
 - New studies
 - Emerging issues
- Standardized method
 - Would allow EPA to incorporate new findings in an expedited manner
 - Would increase transparency

Charge Questions

Proposed Terminology change

1. Current EPA guidelines and standard practice use “Value of Statistical Life” (VSL) as the metric for valuing mortality risks. Section 3.1 of the white paper discusses the VSL terminology commonly used in mortality risk valuation exercises in greater detail.

The white paper suggests that the Agency move away from using the traditional VSL terminology in favor of a new term of art for estimates of the marginal rate of substitution between health risks and income (see section 3.1). Specifically, the white paper suggests that the Agency refer to these estimates as the “value of mortality risk,” and report the associated units using standard metric prefixes to indicate the size of the risk change, e.g., \$/mr/person/yr (dollars per milli[10⁻³]-risk per person per year), or \$/μr/person/yr (dollars per micro[10⁻⁶]-risk per person per year), etc.

Does the Committee agree that the Agency should pursue such a change? Does the Committee believe that making these changes would ease or exacerbate the misunderstandings documented by Cameron (2010)? Would some other terminology or approach be preferable? Please explain.

Charge Questions (Cont.)

Cancer Differential

2. The white paper concludes that research since the 2000 EPA *Guidelines* suggests that people are willing to pay more for mortality risk reductions that involve cancer than for risk reductions from accidental injury (see section 3.3).

Our preliminary review suggests that a “cancer differential” of up to 50% over immediate accidental or “generic” risk valuation estimates may be reasonable.

Conceptually, would the weight of evidence (both theoretical and empirical) suggest there is a cancer differential? If so, does the Committee believe that our estimate of the differential is appropriate? If not, how does the Committee recommend the Agency incorporate cancer differentials in benefits analysis involving reduced cancer risks?

Charge Questions (Cont.)

Public vs. Private WTP and the role of Altruistic Preferences

3. (a) Should EPA rely on studies that estimate willingness to pay for both public and private risk reductions?

If so, is it sufficient to control for this key characteristic in the modeling framework? Or, should EPA limit the analysis to studies according to the type of risk reduction in the study?

If using only one type of study is recommended, should EPA use studies that estimate public or private risk reductions? If we are to limit the studies used to one type, is there a role for the excluded group?

Charge Questions (Cont.)

Public vs. Private WTP and the role of Altruistic Preferences

3. (b) Studies that estimate willingness to pay for public risk reductions may allow EPA to better capture altruistic preferences in benefit-cost analysis.

Did the white paper adequately capture the theory on how to incorporate altruism into the value of mortality risk reduction?

How should altruistic preferences be treated in benefit-cost analysis?

Should the Agency incorporate altruism into the value of mortality risk reductions, even if we are unable to distinguish the specific form of altruism involved (i.e., paternalistic or non-paternalistic)?

More generally, what alternatives should the Agency pursue in the short-term to appropriately account for altruistic preferences when evaluating public programs, if any?

Charge Questions (Cont.)

Data Selection

4. (a) The selection criteria employed in creating the two data sets are carefully outlined in the paper (see sections 4.1.2 and 4.2.4). Please consider these criteria in answering the following questions:
- i. Should additional criteria be added to screen studies for inclusion in the datasets? If so, please specify those criteria. Should any criteria be eliminated or modified?
 - ii. Section 4.2.2 of the white paper discusses problems of measurement error associated with some common sources of occupational risk information among other concerns with the hedonic wage approach. Should EPA limit its selection of hedonic wage studies by the source of occupational risk information? For instance, studies relying on data from the Society of Actuaries (SOA) have been omitted from the described data set. Should the SOA studies be excluded? Should other sources be excluded as well?

Charge Questions (Cont.)

Data selection (cont.)

4. (b) Should any of the studies included in the datasets be eliminated?
If so, please specify those studies and the reasons for eliminating them.

- (c) Is the committee aware of relevant empirical studies in the stated preference and hedonic wage literatures that are not adequately captured in this review? If so, please provide citations.

Charge Questions (Cont.)

Income Elasticities

5. Income elasticities are discussed briefly in section 5 of the white paper. In keeping with Agency practice, we created the two databases by adjusting all estimates for income growth over time using an income elasticity value of 0.5 based on prior Agency reviews of the literature and results Viscusi and Aldy, 2003. In addition, we adjusted all estimates for inflation as well as for purchasing power parity where necessary, as recommended by the EEAC's October 2007 report.

Does the Committee agree with this approach to accounting for income growth over time?

Does the Committee believe the Agency should adjust its value of income elasticity for use in policy analysis in light of recent findings in the literature? If so, what value or range of values does the Committee believe should be used?

Charge Questions (Cont.)

Simplified approach for updating mortality risk valuation estimates

6. The white paper describes a simplified approach for updating the Agency's recommended mortality risk value estimate(s) (see section 5.1.1). This approach involves fitting a parametric distribution to the set of estimates from selected studies. This is similar to the approach used for EPA's current default VSL estimate.
 - (a) Should EPA pursue this approach for updating its mortality risk valuation guidance in the near term (until a more detailed analysis can be conducted)?
 - (b) If so, should the databases on which values are based be created using only one estimate drawn from each study or multiple estimates from each study?
 - (c) If only one estimate per study should be used, what criteria should the Agency apply in selecting the appropriate estimate? How would these criteria vary from one segment of the literature to the other? The paper describes the methods used to select independent estimates from each study. Does the Committee agree with the methods used?

Charge Questions (Cont.)

Simplified approach for updating mortality risk valuation estimates (cont.)

- (d) How important is it that estimates be drawn from non-overlapping subsamples? If multiple estimates per study are recommended in the construction of the meta-datasets, should the estimates be selected to avoid overlapping sub-samples?
- (e) Does the Committee still favor analyzing the stated preference and hedonic wage estimates separately? If so, how should the separate results of these analyses be used in evaluating new policies? If not, how should they be combined in a single analysis?
- (f) Would the Committee support the development and application of separate means or ranges generated from the two segments of the literature? Given separate means and/or ranges from each segment, should the results be weighted and combined to produce a single point estimate or range? If so, how? Are other presentations of the results preferable? More generally, how should uncertainty in the estimated value(s) of mortality risk reductions be handled in benefits analyses?

Charge Questions (Cont.)

Development of a Standardized Protocol for updating Agency value estimates

7. We are interested in developing a standardized protocol for updating the Agency's recommended mortality risk value estimates on a regular basis—for example, every 5 years or so—to incorporate new estimates from relevant economic valuation studies as they appear in the literature.

Such a protocol might be based on the approach outlined in Section 5.1.1 or something similar. This approach, combined with a set of rigorous criteria for determining which new studies and value estimates are suitable for inclusion in the pool for meta-analysis, would allow the Agency to update its guidance in a more timely and transparent manner.

After a working protocol was put in place, it then could be modified over time to match changes in the Agency's general mortality risk valuation approach and meta-analysis methods, as necessary. See charge question 8.

Does the committee believe that developing such a protocol is feasible and desirable? Please explain.

Charge Questions (Cont.)

Longer term: development of benefit function transfer approach

8. In addition to the short-term issues that underlie charge questions 1-7, we are interested in supporting and conducting additional research to further develop EPA's health risk valuation methods over the longer-term. In particular, we would like to begin the transition from the point value transfer approach to a benefit function transfer approach. With this longer-term research and guidance development objective in mind, please answer the following questions:
 - (a) Should EPA continue to use its current approach—that is, a point value or range of values, possibly with an adjustment for cancer risks—or is there now a sufficient body of empirical research to support the development of a more detailed form of functional benefit transfer?
 - (b) If a functional transfer approach is feasible given the existing body of empirical results, should this be based on a meta-analysis or a calibrated structural preference function or perhaps some hybrid of these?

Charge Questions (Cont.)

Longer term: development of benefit function transfer approach

Question 8 (continued)

- (d) If the body of empirical literature is sufficient to estimate or calibrate some form of structural preference function, what are the key variables that should be included in such a function? That is, based on a priori theoretical considerations and previous empirical findings, which attributes of the affected individuals and the policy scenario should be included? What specifications are feasible given data availability?
- (e) Have the econometric issues we identified (unobserved heterogeneity, heteroskedasticity, and small sample size) been adequately addressed by the recent meta-analyses reviewed in Sections 4.1.1 and 4.2.3? Would the classical approaches that we suggest for overcoming these data limitations improve upon previous work? If a new meta-analysis is conducted, what statistical approach(es) would be preferred?
- (f) What role, if any, does the Committee believe that the life-cycle consumption and mortality risk framework could play in evaluating health risk reductions? In particular, does the Committee believe that this framework could be used as a foundation for some form of structural benefit transfer function?