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Charge Questions for SAB-EEAC Review of an EPA White Paper: “Valuing mortality risk for environmental policy: a meta-analytic approach” and Technical Memorandum: “Income Elasticity of VSL”

February 2016

White Paper: Meta-analysis dataset

The White Paper assembles a database of stated preference and hedonic wage estimates of the value of statistical life (VSL) and, where possible, their standard errors. Criteria for inclusion in the database are based on recommendations from the SAB-EEAC (U.S. EPA Science Advisory Board 2011) (see section 4.4, page 13-20). EPA requests comments on whether the selection criteria previously recommended by the SAB-EEAC were appropriately interpreted and applied both for selecting studies to include in the meta-analysis and for selecting estimates within studies. **In answering questions 1(a) – 1(c), in addition to responding to the specific questions, please comment, in general, on whether the selection criteria previously recommended by the SAB-EEAC have been appropriately interpreted and applied in the White Paper.**

1a. Evidence of validity for stated preference studies: The SAB noted in its earlier advisory report (U.S. EPA Science Advisory Board 2011) that each selected stated preference study “should provide evidence that it yields valid estimates” (page 16). The SAB did not, however, specify how validity should be assessed. In applying this criteria, EPA included studies and estimates that passed a weak scope test or provided other evidence of validity (e.g., a positive coefficient on the risk variable as in the appendix for Viscusi, Huber and Bell 2014) as explained in Appendix B of the White Paper. Please comment on whether the methods EPA used in the White Paper to assess the validity of studies and estimates are appropriate and scientifically sound.

1a. The methods used to assess validity are largely satisfactory but incomplete. More detail should be provided, in some instances, on the nature of the population sample. Further, information on the payment mechanism and the specific preference elicitation format should also be provided. Conformity to the strict proportionality assumption relies heavily on conformity with expected utility assumption, which is generally violated in estimates from both the stated preference and hedonic pricing studies.

1b. Construct of the risk variable in hedonic wage studies: The SAB noted in its earlier advisory that the EPA should “Eliminate any study that relies on risk measures constructed at the industry level only (not by occupation within an industry)” (U.S. EPA Science Advisory Board 2011, page 18). It is not clear whether the SAB’s parenthetical addition was meant as an example or as a directive. Only four studies constructed the risk variable by occupation and industry and met other selection criteria. In applying this criteria EPA included studies and estimates where the risk measure is differentiated by industry and at least one other characteristic (e.g., occupation,

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gender, age). Please comment on whether the hedonic wage studies included in the White Paper constructed the risk variable in a manner appropriate for use in the meta-analysis.

1b. The risk variable used in the hedonic studies included in the meta-analysis is good in that it is occupation and industry specific. The earlier SAB-EEAC admonition against using an industry specific risk rate that averages across occupation would appear to be justified by simple examples such as looking at the oil industry and seeing that oil rig workers have relatively high fatality rates while computer programmers in the oil industry do not. These differences would be well known to workers. The opposite, however, is not true. Computer programs for the oil industry and the financial sector are likely to face similar risks. The current approach tends to limit the set of workers on which the estimates are based and does so in a way that may have implications for the range of VSL estimates.

1c. Estimates for immediate risk reductions: To estimate the average value of the marginal willingness to pay for reduced risk of immediate death, the EPA selected estimates from the Stated Preference literature that are most closely comparable to the accidental deaths from the hedonic wage literature. The EPA made several judgement calls in determining the appropriate estimates to use from the stated preference literature. Specifically, Viscusi, Huber and Bell (2014) estimate reductions in risk of bladder cancer that will occur in 10 years. The authors discount the estimates to derive a comparable estimate for an immediate risk reduction. Alberini, et al. (2004) estimate a willingness to pay for an annual reduction in risk over 10 years. We include estimates from both of these studies in the meta-analysis. Please comment on whether appropriate estimates from the stated preference literature were used in the White Paper to estimate the marginal willingness to pay for reduced risk of immediate death.

1c. Many of the risks that U.S. EPA regulates involves substantial durations between exposure and the manifestation of adverse consequences. This suggests using VSL estimates from studies focused on such risks. The need to incorporate discounting with such estimates is unavoidable. Discounting needs to be done in a consistent way across studies and in a way that is consistent with how the estimates will be used. Sensitivity of results can be examined by using different discount rates.

2. Please comment on whether relevant empirical studies in the stated preference and hedonic wage literatures are adequately captured in the White Paper. If additional studies should be included in the white Paper please provide citations.

2. There is an inevitable conflict between trying to include the largest number of studies and basing estimates for policy purposes on studies that are thought to be well done and of high quality. Concerns arise from well-known publication bias effects that may systematically exclude studies with results falling into particular categories. It would be good to explicitly summarize what is known about the larger set of available studies from a reasonable number of publically available meta-analyses and whether that information is consistent with white paper recommendations.

3. Some estimates in the meta-analysis dataset in the White Paper are constructed by weighting subpopulation-specific estimates within a study in order to approximate an estimate for the general population. The specific weights used are described in Appendix B of the White Paper.

Please comment on whether the population-weighting approach used in the White Paper is appropriate and scientifically sound.

4. In some cases EPA estimated standard errors in the White Paper using information within studies or provided by the study authors, as described in Appendix B. Please comment on whether the methods used in the White Paper to estimate standard errors when such information was not readily available are appropriate and scientifically sound.

3&4. Weighting to match the characteristics of the population of interest and the calculation of confidence intervals is a messy process when not done in the original study. The general strategies for dealing with these two issues appear to be conceptually sound. Implementation details for specific studies are often inadequately described.

White Paper: Analysis

Section 4 of the White Paper describes methods used to estimate representative VSL estimates from the meta-analysis dataset and presents results.

5. Please comment on whether the methodology used in the White Paper to analyze the data represents an appropriate and scientifically sound application of meta-analytic methods to derive generally applicable VSL estimates for environmental policy analysis.
5. The general approach to doing a meta-analysis in what is effectively a regression framework that tries to control for a range of possible effects and to get more accurate confidence intervals is consistent with current best-practice. The relatively small number of studies makes it hard to estimate how influential particularly study features are.
6. The White Paper classifies estimates into independent samples, also called groups, as described in Section 4. Estimates from some hedonic wage studies that use the same or very similar worker samples are grouped together for the analysis. Similarly, some of the stated preference estimates using the same sample are grouped together. Please comment on whether this methodology represents an appropriate and scientifically sound approach for accounting for potential correlation of results that rely on the same underlying data.
6. Having estimates that are clearly correlated because they draw on related samples is common in meta-analyses. The appropriate way to examine this issue is to give the set of estimates from each study equal weight. This is done in some of the estimates in the meta-analysis presented. Giving the same weight to all estimates when some studies have large number of estimates based on the same dataset is a weighting scheme that should not be used for the final VSL estimate.
7. Section 4.1 of the White Paper presents an expression that characterizes optimal weights that account for sampling and non-sampling errors, a framework that guides EPA's approach. Please comment on whether this is an appropriate and scientifically sound approach for addressing sampling and non-sampling errors.

7. The set up in section 4.1 is a fairly standard one in terms of the assumptions made. There may be difficulties with assumption that the non-sampling error has an zero mean expectation and there is likely be correlation across estimates from different studies due to study authors following procedures adopted in earlier studies.

8. The analysis in the White Paper adopts both non-parametric and parametric approaches (sections 4.1 and 4.2, respectively). Please comment on whether these approaches span a reasonable range of appropriate, scientifically sound, and defensible approaches to estimating a broadly applicable VSL for environmental policy and whether there are other methods that are more appropriate than those used in the White Paper.

8. The range spanned by the different VSL estimates in sections 4.1 and 4.2 is reasonably narrow. The greater threat to validity is the choice of the set of studies included rather than the particular method chosen to summarize the information in those studies.

White Paper: Results

9. The White Paper presents estimates using parametric and non-parametric models, pooled across stated preference and hedonic wage studies as well as balanced (i.e., equal weight to each study type), and weighted using different approaches. Of the range of estimates presented (see Section 4) the White Paper proposes the use of estimates from the following models:

- Non-parametric model, balanced, mean of study mean
- Parametric, balanced

Please comment on whether these proposed estimates represent reasonable and scientifically sound conclusions from the analyses in the White Paper and whether there is a different set (or sets) of results that are preferable based on the data and analysis in the White Paper.

9. The hedonic pricing and stated preferences have different strengths and some shared weaknesses. These should be laid out in more detail. There is no reason a priori to favor one approach over the other which leads to favoring the balanced approach. The standard benefit-cost framework favors the use of the mean VSL. From a statistical perspective, the mean VSL is often not well-identified in stated preference surveys due to the inability to use implausibly high cost stimuli. A related issue arises in hedonic pricing studies but is usually masked by the parametric functional form assumptions made. The general finding of substantial asymmetry in the VSL distribution within the population of interest raises interesting policy questions which go beyond the meta-analysis presented.

10. The results section of the White Paper concludes with an influence analysis. Please comment on whether this analysis is a reasonable way to characterize the influence of individual studies on the estimated VSLs, whether the results of the influence analysis suggest any changes or modifications to the estimation approach, and whether it is important to include an influence analysis.

10. The sensitivity analysis suggests that the estimates are not large dominated by those from any single study. In this sense, it is reassuring as it suggests a sort of general consistency in the set of estimates used.

Establishing a Protocol for Future Revisions:

11. In the previous SAB advisory report (USEPA Science Advisory Board 2011), the SAB endorsed the idea of establishing a standardized protocol and regular schedule for future updates to the Agency's mortality risk valuation estimates. Please comment on relevant statistical criteria for the inclusion of additional eligible estimates and/or the exclusion of older estimates that could help inform the development of a standardized protocol for future updates and the timing or frequency of those updates.

11. Given the heavy reliance on a few datasets for the hedonic price estimates and the relatively small number of stated preference studies included in the meta-analysis, the major issue facing U.S. EPA is how to get more high quality study into the database being used for conducting the meta-analysis.

12. In its 2011 report the SAB-EEAC recommended "...EPA work toward developing a set of estimates...for policy-relevant cases characterized by risk..." (U.S. EPA Science Advisory Board 2011, pp. 10). Among the studies that meet the selection criteria in the current White Paper, three stated preference studies provide values for reductions in risks of cancer (i.e., Hammitt and Haninger 2010, Chestnut, Rowe, and Breffle 2012, and Viscusi, Huber and Bell 2014). Only two of those studies (Hammitt and Haninger 2010 and Chestnut, Rowe, and Breffle 2012) allow for a within study comparison of values for cancer and non-cancer risk reductions. However, EPA could augment the literature by modifying the selection criteria to include studies from other countries or from the grey literature, and/or using other methods (e.g., risk-risk studies). Please comment on whether, and if so how, selection criteria for identifying studies for estimating a cancer differential should differ from those used in the current White Paper. Does the literature support a non-zero cancer differential?

12. There is at best weak support for higher cancer differential. This may be due to the small number of studies or very substantial differences in the health status profiles associated with different types of cancer. On this issue, the Lindhjem et al. (2011) meta-analysis draws on a broader range of studies across countries and does not find a systematic cancer differential.

Technical Memorandum: Income elasticity

13. The EPA document *Technical Memorandum: Income Elasticity* presents a summary of the recent income elasticity literature based on a review presented in Robinson and Hammitt (2015). Please comment on whether Robinson and Hammitt (2015) and the EPA Technical Memorandum provide an appropriate and scientifically sound summary of the income elasticity of VSL (IEVSL) and income elasticity of non-fatal health effects literatures. If there are additional relevant empirical studies that should also be included in the summary, please provide citations.
14. Several reported mean income elasticity estimates from stated preference studies are quite low, sometimes even zero. The “balanced” approach in the EPA Technical Memorandum does not include reported mean estimates of zero, but does include very low reported mean estimates (e.g., 0.1). Please comment on whether this an appropriate and scientifically sound choice. How should very low, non-zero, mean reported income elasticity results be addressed in the analysis?
15. Please comment on whether the selection criteria applied by Robinson and Hammitt (2015) are clearly enumerated, appropriate, and scientifically sound and whether the additional inclusion of Viscusi, Huber, and Bell (2014) in the Technical Memorandum is appropriate based on results reported in the study’s on-line appendix (attached).
16. Given the relatively limited number of studies upon which to draw for estimating the income elasticity of VSL, the EPA Technical Memorandum describes two alternatives for arriving at a central IEVSL estimate and range for use in environmental policy analysis. Of these alternatives which is the most appropriate and scientifically sound? Please provide the rationale for your choice. Would it be appropriate to consider using the alternative as a sensitivity or uncertainty characterization?
17. As described in Robinson and Hammitt (2015), there are limited data on income elasticity of non-fatal health effects. As a result the Technical Memorandum recommends using the IEVSL to estimate income elasticity for the value of these non-fatal health risks. Please comment on whether this represents an appropriate and scientifically sound approach given the available data.

13-17. Determination of the relationship between changes in income and the value of changes in mortality or morbidity risks is on much less firm ground than that of the VSL meta-analysis. In part, this is driven by a much smaller number of studies. The argument for constraining source of the estimates used here is much less persuasive than in the case of the VSL estimates. To pin down the income elasticity parameter, it is useful to be able to observe VSL estimates at very different income levels. This suggest reaching out over longer time horizons or to estimates from outside the United States. Much of the problem with the income elasticity is that studies are generally not design to measure the parameter. This is in stark contrast to the effort in hedonic wage and stated preference studies to pin down a theoretically consistent VSL estimate. In part this comes from income being subject to considerable measurement errors in the surveys that underlie both types of estimtaes. This will often substantially attenuate the estimate

coefficient on income toward zero. Further, the typical income variable used, pre-tax household income, is not the correct variable from a welfare economics standpoint. What is needed is a measure of medium-term discretionary income. The problem is confounded by most studies using cross sectional data whereas the use U.S. EPA wants for the income elasticity estimate is to help address the question of what would happen if the current population's real income was changed. This issue, acknowledged, in the report lies at the heart of the debate over the validity of the cross-country growth regression framework. Using the estimate of 1.1 from Viscusi (2015) is at odds with the Doucouliagos, Stanley, and Viscusi (J. of Health Econ, 2014) who put forward a range of 0.25–0.63 using a much larger database. The argument that the income elasticity of a VSL from studies that don't use the CFOI risks is not convincing. What matters more here is that the same analytical approach be used at different points in time. This is controlled for in the Doucouliagos et al. study. The large Lindhjem et al. (Risk Analysis, 2011) meta-analysis of stated preference studies across countries comes up with point estimates of 0.7-0.9 based on using the full set of studies, but notes that this falls to 0.3-0.4 when the subset of studies deemed to be high quality is used. The higher end of the income elasticity range comes from Costa and Kahn (JRUC, 04) who use data from 1940 to 1980 and find an income elasticity of 1.5 to 1.7. Their analysis could be replicated using the 1990 and 2000 census as well as roughly equivalent data from the American Community survey to see if the estimated income elasticity is falling over time. A major problem with using data from the last decade or so is that median income has remained largely unchanged in real term while there have been changes in the tails of the distribution.

References

- Alberini A, Cropper M, Krupnick A, Simon NB. 2004. Does the value of a statistical life vary with age and health status? Evidence from the US and Canada. *Journal of Environmental Economics and Management* 48(1): 769-792.
- Chestnut LG, Rowe RD, Breffle WS. 2012. Economic valuation of mortality-risk reduction: stated preference estimates from the United States and Canada. *Contemporary Economic Policy* 30(3):399-416.
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3/4/16 Preliminary draft comments from individual members of the SAB Environmental Economics Advisory Committee. These comments do not represent consensus SAB advice or EPA policy.

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Viscusi WK, Huber J, Bell J. 2014. Assessing whether there is a cancer premium for the value of a statistical life. *Health Economics* 23:384-396. [On-line appendix available at: <http://onlinelibrary.wiley.com/doi/10.1002/hec.2919/supinfo>]