

For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.
Do not cite or quote. Updated 3-1-11

1 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2 WASHINGTON D.C. 20460



OFFICE OF THE
ADMINISTRATOR
SCIENCE ADVISORY BOARD

9
10 DATE

11
12
13 EPA-SAB-.....

14
15 Honorable Lisa P. Jackson
16 Administrator
17 U.S. Environmental Protection Agency
18 1200 Pennsylvania Avenue, N.W.
19 Washington, D.C. 20460

20
21 Subject: Review of “Valuing Mortality Risk Reductions for Environmental Policy: A
22 White Paper” (December 10, 2010)

23
24 Dear Administrator Jackson:

25
26 The EPA National Center for Environmental Economics (NCEE) requested the Science
27 Advisory Board’s advice on how the Agency should value mortality risk reductions in its
28 benefit-cost analyses of environmental policy. The NCEE asked the SAB to review its White
29 Paper entitled “Valuing Mortality Risk Reductions for Environmental Policy” (December 2010)
30 and respond to charge questions. To respond to this advisory request, the SAB’s Environmental
31 Economics Advisory Committee was augmented with additional experts. The EEAC Committee
32 met on January 20 – 21, 2011 to deliberate on NCEE’s questions. We provide detailed comments
33 in the attached responses to charge questions while below are some highlights of our review.

34
35 The White Paper recognizes a longstanding problem with the term “value of statistical
36 life” (VSL). A “statistical life” has traditionally referred to the aggregation of small risk
37 reductions across many individuals until that aggregate reflects a total of 1.0 or one statistical
38 life. For example, a decreased risk of mortality in the U.S. of 10^{-6} (1 in a million) would result in
39 310 “statistical lives” saved (given a population of 310 million). The VSL has been a shorthand
40 way of referring to the “value” or tradeoff between income and mortality risk, i.e. the willingness
41 to pay for small risk reductions across large numbers of people but it has lead to confusion
42 because many have interpreted it as referring to the loss of identified lives.. In recognition of the
43 confusion and controversy caused by the VSL term, the White Paper proposed replacing the VSL
44 term with “value of mortality risk.” We enthusiastically endorse a terminology change, but in our

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1 view, a term like “value of risk reduction” (VRR) would better communicate the notion that
2 value is derived from reducing risks rather than the risks themselves. While we recommend this
3 terminology, we recognize that we are not experts in risk communication so EPA might consider
4 focus groups or some other mechanism to explore the language that best communicates this
5 concept to the public. Improved public communication is needed to dispel common
6 misconceptions around this issue.
7

8 When valuing risk reduction, it is important to communicate exactly what kind of risk is
9 being reduced since the public may value risk reduction of one kind of mortality (e.g. cancer)
10 differently from risk reduction of another kind (traumatic injury). The White Paper notes that
11 research shows that people are willing to pay more for mortality risk reductions that involve
12 cancer than for risk reductions from accidental injury. NCEE asked the SAB to comment on a
13 placeholder value that could be used for this cancer premium while the Agency pursues long-
14 term research to differentially value different types of risks. We believe that NCEE’s “first-cut”
15 estimate of a 50 percent premium for reducing mortality risks from cancer should be refined
16 before application.
17

18 The White Paper correctly notes that the amount of money people would be willing to
19 pay for “public” risk reductions (that affect everyone) can differ from willingness to pay for
20 “private” risk reductions (that affect only the individual). While we agree with this conceptually,
21 there is no substantive empirical evidence that altruistic concerns are significant drivers of values
22 for risk reduction. Rather than recommending a categorical restriction against using studies that
23 capture only private risk reduction or only public risk reduction, we recommend the Agency
24 instead focus on finding estimates of values for risk reductions that most closely match the risk
25 under consideration.
26

27 The SAB was asked a number of technical questions about EPA’s database of mortality
28 risk reduction values and the most appropriate statistical approach for deriving a value for
29 mortality risk reduction from existing studies. In the attached, we offer specific technical
30 recommendations on criteria that should be used to select studies for inclusion in the database.
31 Apart from these specific technical considerations, we recommend that the Agency use studies
32 that most closely fit the policy context under consideration while stating clearly what
33 adjustments or assumptions are required to apply value estimates for dissimilar risks or risk
34 levels to the policy context.
35

36 Lastly, the SAB believes the Agency should establish a protocol for updating the value of
37 risk reduction estimates on a regular basis. The estimate that the agency currently uses to value
38 reductions in mortality risk is based on studies that are at least 20 years old. Moreover, the
39 current estimate does not take into consideration the wealth of new studies that make use of
40 better techniques and better data that have been published over the last 20 years. To avoid using
41 estimates based on decades-old research in the future, the Agency should establish a protocol for
42 updating regularly the estimates of the value of risk reduction that it uses in its work.
43

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1 Thank you for the opportunity to provide advice on this White Paper. The SAB looks
2 forward to receiving the Agency's response.

3

4

5

6

Sincerely,

7

8

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

NOTICE

This report has been written as part of the activities of the EPA Science Advisory Board, a public advisory committee providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The Board is structured to provide balanced, expert assessment of scientific matters related to problems facing the Agency. This report has not been reviewed for approval by the Agency and, hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency, nor of other agencies in the Executive Branch of the Federal government, nor does mention of trade names or commercial products constitute a recommendation for use. Reports of the EPA Science Advisory Board are posted on the EPA Web site at: <http://www.epa.gov/sab>.

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1
2 **SCIENCE ADVISORY BOARD STAFF**
3 Dr. Holly Stallworth, Designated Federal Officer, EPA Science Advisory Board Staff Office,
4 Washington, D.C.

For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1
2

3

Table of Contents

4	EXECUTIVE SUMMARY	2
5	RESPONSES TO CHARGE QUESTIONS	5
6	Charge Question 1.....	5
7	Charge Question 2.....	7
8	Charge Question 3.....	10
9	Charge Question 4.....	12
10	Charge Question 5.....	19
11	Charge Question 6.....	20
12	Charge Question 7.....	25
13	Charge Question 8.....	27
14		
15		
16		

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44

Executive Summary

This report was prepared by the Science Advisory Board (SAB) Environmental Economics Advisory Committee Augmented for Valuing Mortality Risk Reduction (the “Committee”) in response to a request by EPA’s National Center for Environmental Economics (NCEE) to review its draft White Paper “Valuing Mortality Risk Reductions for Environmental Policy” (December 10, 2010). The Committee deliberated on the charge questions during a January 20 – 21, 2011 face-to-face meeting and a subsequent conference call on March 14, 2011. The Committee’s draft report was considered and approved by the Chartered SAB in a public teleconference on Three topics were highlighted in the charge questions: EPA’s proposed terminology change, willingness to pay for cancer risk reductions, and the treatment of altruism. Other charge questions covered the selection criteria for inclusion in EPA’s database of studies, the income elasticity of mortality risk reduction values, EPA’s statistical approach for deriving an estimate, more timely updates to the Agency’s guidance and other methods for valuing health risk reduction. This Executive Summary highlights the Committee’s major findings and recommendations.

EPA’s Proposed Terminology Change. The White Paper discusses problems associated with the popular misunderstanding of the “value of statistical life” (VSL) metric that has traditionally been used in benefit-cost analysis. The VSL concept arose in benefit-cost analysis to express society’s willingness to pay for health risk reductions. Since risk-reducing environmental policies come with a cost, decisions are best made when a policy’s cost is compared with its benefits, of which one category is society’s willingness to pay for health risk reductions. Much indignation has been expressed over the VSL term because it is often perceived as the value of life itself or the value of an individual’s life when, in fact, the term is meant to refer to society’s willingness to pay for small changes in risk. In the jargon of economics, we seek a metric that captures the marginal rate of substitution between health risks and income or wealth. To communicate this concept, we agree with NCEE that the Agency should move away from the traditional VSL term in favor of a new term of art that conveys the trade-off between income and health risk reductions. While we favor a term like “value of risk reduction” (VRR) or “value of mortality risk reduction”, we encourage the Agency to undertake some research, possibly including focus groups, on how best to communicate this tradeoff to the public. EPA needs a term that captures the value of small risk reductions for large numbers of people, not a term that can be confused with the value of life itself. Recent research in climate change communication highlights the importance of public understanding for effective policymaking and implementation.

Willingness to Pay for Cancer Risk Reductions. Reducing environmental cancer risk is an important part of EPA’s mission to protect human health. Thus a key question is how to account for individuals’ preferences for reducing cancer risks relative to other types of health risks. In fact, many health threats addressed by environmental policies consist of illness profiles with long latencies and substantial periods of morbidity prior to death. NCEE has correctly noted that research thus far indicates a “cancer premium,” i.e. a higher willingness to pay for

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1 cancer risk reductions versus other kinds of mortality risk reductions though several good studies
2 find no evidence of a differential. NCEE asked the SAB to comment on a placeholder value that
3 could be used for this cancer premium while the Agency pursues long-term research to
4 differentially value different types of risks. We believe that the “first-cut” estimate of a 50
5 percent differential for cancer should be refined before application. In addition to finding ways
6 to communicate the trade-off between income and health risk reductions, we encourage the
7 Agency to explain the *type* of risk to be reduced while seeking ways to differentiate willingness
8 to pay for one kind of health risk reduction versus another. Since these are demands for
9 different goods by different groups of people, a single “one size fits all” metric used to express
10 the marginal rate of substitution between health risks and income oversimplifies the many
11 complex policy contexts in which EPA operates.
12

13 *Altruism.* NCEE asked us to comment on how altruism should be treated in valuing risk
14 reductions for environmental policy. The White Paper correctly notes that the amount of money
15 people would be willing to pay for “public” risk reductions (that affect everyone) can differ from
16 willingness to pay for “private” risk reductions (that affect only the individual). Differences may
17 be on account of altruism, either paternalistic or pure (also called non-paternalistic). Pure
18 altruism occurs when the benefactor respects the preferences of the beneficiary and cares about
19 the welfare gain to the beneficiary. Paternalistic altruism occurs when the benefactor substitutes
20 his own preferences for that of the beneficiary, e.g., cares about the risk reduction but not about
21 any costs imposed on the beneficiary. The literature is clear that values driven by paternalistic
22 altruism should be counted while values driven by pure altruism need not be counted as they do
23 not affect the sign of net benefits. (Preferences concerning the distribution of benefits or costs in
24 the population affect the evaluation and should be counted.) Although the theory is clear, there
25 is not yet substantive empirical evidence that altruistic concerns are significant drivers of values
26 for risk reduction. Rather than recommending a categorical restriction against using studies that
27 capture only private risk reduction or only public risk reduction, we recommend the Agency
28 focus on finding estimates of values for risk reductions that most closely match the risk under
29 consideration. We also advise the Agency to pay close attention to the issue of who is asked to
30 pay for the risk reducing activity and how that is represented in any “stated preference” survey.
31 Individuals’ valuations can be significantly affected by who pays for a particular risk reduction
32 (whether a particular firm or government, whether upper income individuals or lower income)
33 and by the payment mechanism, i.e., whether costs are paid through higher income taxes,
34 property taxes, costs of general or specific goods & services (e.g., electricity).
35

36 *Database Development.* EPA asked the SAB about inclusion criteria for its database of
37 stated preference and hedonic wage studies. The SAB finds that the distinction between stated
38 preference (SP) and revealed preference (RP) studies is less important than matching the risk
39 reduction in the literature with EPA’s policy context. In the attached report, specific
40 recommendations are offered in response to NCEE’s questions about selection criteria and
41 weaknesses in data sets. Overall, the SAB concluded the choice of econometric techniques for
42 combining disparate estimates should depend on the number of estimates to be drawn from each
43 study and the number of observations available for the meta-analysis.
44

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1 *Income Elasticities.* The Agency asks for advice concerning procedures for updating its
2 values to account for income growth. The SAB notes that the decision on how to adjust the value
3 of risk reduction (VRR) for income growth over time is not independent of what approach is
4 adopted to support the VRR value or range of values. The SAB also recommends selecting
5 income-elasticity studies that are matched as closely as possible to the policy context in question.
6

7 *Approach for Updating the Value of Risk Reduction.* The Agency requested guidance on
8 whether it was sensible to use a simplified approach for updating the values of risk reduction
9 using a set of available studies to fit a parametric distribution. As a guiding principle, the SAB
10 suggests that the goal should be to use WTP estimates from studies that match, as much as
11 possible, the policy context in question. Unfortunately, the existing set of available estimates is
12 oftentimes inadequate for current implementation of this strategy. There are too few studies
13 covering too few alternatives and, perhaps more fundamentally, there are apparent
14 inconsistencies across the studies that if used without adjustment, could defy common sense. As
15 an interim approach, the Agency might consider identifying a set of estimates that are based on
16 similar risks and similarly affected populations – even if not directly related to the policy risk or
17 population – to arrive at a best estimate based on the risk/population under consideration. The
18 resulting “best available estimate” for the type of risk and population considered in the original
19 studies can then be evaluated relative to the policy context for which EPA seeks estimates.
20 Sensitivity analyses could then be used to focus specifically on the potential error introduced by
21 the implied benefit transfer.
22

23 *Updating Values.* The SAB urges the Agency to move forward with updating its guidance
24 on valuing mortality risk reduction and establish a protocol for regular updates. The current
25 estimates depend upon studies that are 20 – 35 years old and it is time to take advantage of a
26 wealth of new studies and better data. EPA’s guidance should reflect the improved state of the
27 science on valuing risk reduction.
28

29 *Long-Term Research.* To support improved value estimates in the longer term, the SAB
30 encourages EPA to work towards using structural preference functions, although the committee
31 believes that it will be some time before such an approach will be ready for implementation by
32 the Agency. The Agency also should encourage research to obtain revealed and stated
33 preference estimates for the types of risk and types of affected populations that are relevant to
34 environmental policy contexts.
35

1

Responses to Charge Questions

2 Charge Question 1

3 **Current EPA guidelines and standard practice use “Value of Statistical Life” (VSL) as the**
4 **metric for valuing mortality risks. Section 3.1 of the white paper discusses the VSL**
5 **terminology commonly used in mortality risk valuation exercises in greater detail. The**
6 **white paper suggests that the Agency move away from using the traditional VSL**
7 **terminology in favor of a new term for estimates of the marginal rate of substitution**
8 **between health risks and income (see section 3.1). Specifically, the white paper suggests**
9 **that the Agency refer to these estimates as the “value of mortality risk,” and report the**
10 **associated units using standard metric prefixes to indicate the size of the risk change, e.g.,**
11 **\$/mr/person/yr (dollars per milli[10⁻³]-risk per person per year), or \$/μr/person/yr (dollars**
12 **per micro[10⁻⁶]-risk per person per year), etc. Does the Committee agree that the Agency**
13 **should pursue such a change? Does the Committee believe that making these changes**
14 **would ease or exacerbate the misunderstandings documented by Cameron (2010)? Would**
15 **some other terminology or approach be preferable? Please explain.**

16

17 The SAB strongly supports replacing the “value of statistical life” (VSL) with a term that more
18 accurately reflects what is being measured. The Committee encourages EPA to consider
19 replacing VSL with “value of risk reduction” (VRR) and using VRR to delineate different types
20 of risk. For example, there might be a VRR for sudden workplace death, a VRR for cancer death,
21 a VRR for heart disease, and so forth. A VRR might also vary demographically (eg., a VRR for
22 cancer death for men 40 to 50 years old). The committee chose not to recommend standard units
23 but did discuss micro-risk, milli-risk and nano-risk as obvious possibilities.

24

25 The EPA’s White Paper proposed the terminology “value of mortality risk” (VMR) to replace
26 VSL. The SAB believes that the new term should include “reduction” since the value is typically
27 derived from a reduction in risks rather than from the risks themselves and used to value risk
28 reductions. Also, VMR gives the impression that people have a positive value for risk. Using
29 risk reduction avoids this confusion. The committee also felt that using “mortality” does not
30 always provide a complete description of the risks involved. Different types of risks are often
31 intertwined in valuation studies, and policies often lead to changes in mortality as well as
32 morbidity risks. For example, the morbidity (and other factors such as dread) associated with
33 cancer is difficult to be separated from the mortality risk of cancer. Excluding “mortality” allows
34 for morbidity VRR and mortality VRR distinctions that encompass a broader array of risks. As
35 noted above, the SAB suggests that morbidity or mortality VRR be followed by a policy specific
36 classification of the type of probabilistic outcome, the target population, etc. This is also
37 consistent with the SAB’s recommendation that EPA augment the baseline VRR number with
38 other VRR numbers, each tailored to a specific risk reduction profile.

39

40 While the SAB recommends the terminology VRR, we recognize that we are not experts in
41 communication. For this reason, we suggest that EPA consider testing the VRR terminology and
42 even explore alternative terminologies in focus groups, discussions, and presentations with
43 relevant user groups. Along these same lines and in response to the public misconceptions of

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1 VSL documented in Cameron (2010), the SAB recommends EPA consider conducting or
2 sponsoring research into effective communication of VRR and its role in cost benefit analysis to
3 the general public. The change from VSL to VRR as well as the other suggested changes (e.g.,
4 from one value of VRR to baseline value plus values for specific policy related risk changes)
5 provide a prime opportunity to engage in effective public communication. There have been calls
6 in the past for EPA to start research programs on public communication, and recent
7 developments in climate change communication further highlight the importance of public
8 communication in the effectiveness of policy making and implementation.

9
10 Regardless of the exact language chosen, the SAB believes that making such a change will
11 contribute to easing the public misunderstanding of VSL. We applaud EPA's leadership in this
12 suggestion.
13

1 Charge Question 2

2 **Experts generally agree that *value function transfers* can outperform *point value transfers* in**
3 **cases where the characteristics of the risks and/or the exposed populations differ between**
4 **the source studies and the policy context in measurable ways. That is, the more**
5 **commodity- and individual-specific attributes that can be included in the benefit transfer**
6 **exercise, the better the estimate of willingness to pay. Charge questions 2 and 3 inquire**
7 **about whether applications of benefits transfer methods to value mortality risk reductions**
8 **from environmental pollutants can be improved by controlling for more of the attributes**
9 **that distinguish the source studies from the policy scenario.**

10

11 **The white paper concludes that research since the 2000 EPA Guidelines suggests that**
12 **people are willing to pay more for mortality risk reductions that involve cancer than for**
13 **risk reductions from accidental injury (see section 3.3). Our preliminary review suggests**
14 **that a “cancer differential” of up to 50% over immediate accidental or “generic” risk**
15 **valuation estimates may be reasonable. Conceptually, would the weight of evidence (both**
16 **theoretical and empirical) suggest there is a cancer differential? If so, does the Committee**
17 **believe that our estimate of the differential is appropriate? If not, how does the Committee**
18 **recommend the Agency incorporate cancer differentials in benefits analysis involving**
19 **reduced cancer risks?**

20

21 The SAB commends EPA for its effort to develop appropriate values for mortality risk
22 reductions rather than applying a “one size fits all” value to all cases. In theory, there is no
23 reason to believe that WTP is independent of the characteristics of the hazard, such as whether
24 mortality may occur through traumatic injury or some type of degenerative disease. In principal,
25 it is appropriate to use different values for different types of traumatic injury, cancer,
26 cardiovascular, and other diseases.

27

28 However, theory provides little or no guidance on the magnitude or even direction of hazard-
29 specific differentials and the empirical literature on how WTP varies with risk characteristics is
30 limited. Given individuals’ difficulties in evaluating small changes in mortality risk, the
31 sensitivity of evaluations to framing effects, and significant unexplained variation in results
32 between valuation studies, the SAB recommends that EPA be cautious in applying hazard-
33 specific differentials. Intuitively, the dominant consequence of mortality risk is the chance of
34 losing many years of life; the duration of morbidity before death and other risk characteristics
35 seem likely to be less significant. Indeed, it is not obvious whether people consistently value
36 risks of instant death as worse or less bad than risks of slower death from disease. The disease
37 may impose a period with significant pain and suffering, but also the opportunity for the
38 individual and loved ones to reconcile themselves to the forthcoming death by putting affairs in
39 order or making amends with family or others. In evaluating values of faster vs. slow deaths, it
40 seems important to control for whether the period of morbidity extends life or shortens the period
41 of healthy life (i.e., is the comparison between instantaneous death and manifestation of a fatal
42 disease at the same time, or instantaneous death and death from chronic disease at the same
43 time?).

44

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1 The existing literature on how WTP varies with characteristics of fatal hazards is primarily
2 concerned with cancer, fatal injury, and, to a lesser extent, respiratory and other chronic disease.
3 It may be possible to derive some information for differentially valuing these three types of risks,
4 while remaining sensitive to the likelihood that different types of injury, cancer, and different
5 types of chronic disease are valued differently. In evaluating the literature, it is important to be
6 clear about what comparisons are being made. For example, some of the papers evaluating a
7 cancer differential compare cancer with chronic, degenerative disease, while others compare it
8 with traumatic injury or with acute fatal illness. Some studies provide information on valuation
9 of different types of cancer, suggesting that there is no single differential that is appropriate for
10 all cancers.

11
12 The SAB concurs with EPA's judgment that only the studies that compare values for cancer and
13 other risk reductions are useful for evaluating possible differentials. These include valuation
14 studies of two or more types of fatal risk and risk-risk-tradeoff studies. Stated- and revealed-
15 preference studies of only one type of risk, without internal comparison, are not useful because
16 there is too much unexplained variation between studies to determine how much of the
17 differential is associated with risk characteristics. (Meta-regression may provide some
18 information but existing results seem too sensitive to model specification to permit reliable
19 conclusions.)

20
21 The SAB believes that the "first-cut" estimate of a 50 percent differential for cancer should be
22 refined before application. This estimate is justified as approximating the average differential
23 found in nine studies (reported in footnote 14, page 25). However, no control is made for the fact
24 that different studies compare cancer with different risks (e.g., injury, other disease), and the
25 differential associated with the Van Houtven et al. (2008) study is misreported (the proportional
26 WTP is 3 times higher but the differential is 2 times higher). Any quantitative estimate of a
27 cancer differential will be sensitive to the weight given to the Van Houtven et al. study, which
28 estimates a much larger effect than any of the other studies. (Note that six of the nine studies
29 reported yield estimates between -0.15 and +0.30).

30
31 In evaluating hazard-specific differentials (as for other values), the SAB suggests caution in
32 using results from non-US populations. The effects of different types of disease on welfare may
33 be sensitive to health-care and social-welfare programs that differ significantly among
34 populations, and possibly to other factors as well. Finally, in evaluating hazard-specific
35 differentials it is important to distinguish between differentials that are conditional on
36 characteristics of the illness profile (e.g., duration and severity of morbidity, latency) and
37 differentials that do not control for these characteristics.

38
39 In sum, the SAB suggests that the magnitudes of cancer and other hazard-specific differentials
40 should be evaluated as part of an integrated process used to estimate the value of mortality risk
41 reduction and how it varies with hazard, income growth, and other factors. For example, one can
42 imagine there is an appropriate uncertainty distribution of values of mortality risk reduction for
43 each of several cells defined by hazard and population characteristics. In estimating the value for
44 each cell, one confronts a tradeoff between using only studies that are specifically relevant to that

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

- 1 cell and estimating a functional relationship of values to cell characteristics. The former choice
- 2 will tend to minimize bias at the cost of higher variance, especially of the difference in valuation
- 3 between different cells. The latter choice will tend to increase bias within cells but reduce
- 4 variance and provide a smoother relationship between values and cell characteristics.

1 Charge Question 3

2 **Environmental policies generally provide public risk reductions. However, research,**
3 **particularly stated preference research, provides willingness to pay estimates for both**
4 **public risk reductions as well as private risk reductions. And, some research indicates that**
5 **individuals' willingness to pay for public risk reductions may be different than that for**
6 **private risk reductions. One factor that may contribute to these differences is altruism,**
7 **which, all else equal, should make values for public risk reductions larger than those for**
8 **private risk reductions.**

- 9
- 10 a. **Should EPA rely on studies that estimate willingness to pay for both public and**
11 **private risk reductions? If so, is it sufficient to control for this key characteristic**
12 **in the modeling framework? Or, should EPA limit the analysis to studies**
13 **according to the type of risk reduction in the study? If using only one type of**
14 **study is recommended, should EPA use studies that estimate public or private**
15 **risk reductions? If we are to limit the studies used to one type, is there a role for**
16 **the excluded group?**

17

18 The SAB recommends that when inferring values for risk reductions from existing
19 studies, it is preferable to use values from existing studies that consider risk
20 reductions most similar to those under consideration. Thus if the agency is
21 considering a new regulation that provides risk reduction to many people at once, i.e.
22 a public risk reduction, then it would be best to infer values from studies that also
23 looked at public risk reductions. If the new regulation provides risk reduction that is
24 purely private, then it would be best to infer values from studies that measure purely
25 private risk reductions. The SAB does not recommend categorically restricting
26 inference to studies that are only private or only public, but instead focus on finding
27 existing values that are most closely matched.

- 28
- 29 b. **Studies that estimate willingness to pay for public risk reductions may allow**
30 **EPA to better capture altruistic preferences in benefit-cost analysis. Did the**
31 **white paper adequately capture the theory on how to incorporate altruism into**
32 **the value of mortality risk reduction? How should altruistic preferences be**
33 **treated in benefit-cost analysis? Should the Agency incorporate altruism into**
34 **the value of mortality risk reductions, even if we are unable to distinguish the**
35 **specific form of altruism involved (i.e., paternalistic or non-paternalistic)? More**
36 **generally, what alternatives should the Agency pursue in the short-term to**
37 **appropriately account for altruistic preferences when evaluating public**
38 **programs, if any?**

39

40 The White paper does an adequate job of summarizing the literature on altruism in
41 benefit cost analysis. Values driven by paternalistic altruism are considered
42 legitimate in cost benefit analysis. The literature is clear that pure (non-paternalistic)
43 altruism, altruism for which the benefactor respects the preferences of the beneficiary,
44 can result in over-counting benefits. This is true because welfare gains that may

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1 accrue to the beneficiary, and that are valued by the benefactor, depend on net value
2 for the beneficiary. If the beneficiary were to pay exactly his or her value for a larger
3 quantity of a public good, then the benefactor would receive no altruistic welfare
4 gain. However if beneficiary paid less (more) than his/her value, the benefactor
5 would receive an altruistic welfare gain (loss).

6
7 While the economic literature is clear on how values driven by paternalistic and non-
8 paternalistic concerns should be treated in economic analysis, the state of the art in
9 economic analysis has not evolved to the point of being able to separately measure
10 portions of total value attributable to paternalistic and non-paternalistic altruism. In
11 fact there is no substantive empirical evidence that altruistic concerns are significant
12 drivers of values for risk reduction. It is the SAB's recommendation, at this point in
13 time, that the Agency should strive to adhere to the principle of using studies that
14 most closely match the risk reduction under consideration without any adjustments
15 for altruistic considerations.
16
17

1 Charge Question 4

2 **The two primary literatures used to assess willingness to pay for mortality risk reductions**
3 **are stated preference studies and hedonic wage studies. The white paper assembles two**
4 **databases summarizing studies in both literatures, capturing much of the information**
5 **outlined in number 3 of the SAB-EEAC's recommendations dated October 2007 (see**
6 **section 4).¹ These studies, or a subset thereof, would form the basis of revised guidance in**
7 **the near term as well as possible future meta-analyses.**

- 8
- 9 **a. The selection criteria employed in creating the two data sets are carefully**
10 **outlined in the paper (see sections 4.1.2 and 4.2.4). Please consider these criteria**
11 **in answering the following questions:**
- 12 **i. Should additional criteria be added to screen studies for inclusion in the**
13 **datasets? If so, please specify those criteria. Should any criteria be**
14 **eliminated or modified?**

15

16 General Comments: The EPA assembled two databases summarizing stated preference and
17 hedonic wage studies, following much the SAB-EEAC's recommendations dated October 2007
18 (see especially Section 4). A set of eight criteria was used to select studies included in each
19 database. The selection criteria were presumably designed to exclude low-quality studies and to
20 ensure applicability to the US. These objectives should be stated explicitly to ensure
21 transparency and the selection of appropriate criteria. Below we answer the specific charge
22 questions for each database separately when appropriate.

23

24 The recommendations in response to this charge question aim to guide the development of
25 defensible selection criteria for studies, and specific estimates to be included in a meta analysis.
26 None of the selection criteria specifically relate to 'closeness' of the study context with the
27 policy-context. If this selection criteria is not ultimately adopted, a meta database may be
28 developed in which VRR estimates are assembled which are not consistent with the policy
29 context. This is clearly the case with the hedonic wage literature estimates, and may also be the
30 case with stated preference estimates. When estimates are not available that are consistent with
31 the policy context, the EPA should follow the recommendations as outlined in response to
32 XXX...

33

34 *Stated Preferences Studies*

35 With respect to stated preference studies, the white paper indicates eight selection criteria. These
36 are:

37 (1) Minimum sample size of 100.

38 The SAB believes a better criterion would be to determine a minimum acceptable sample
39 size that is linked to the stated preference experimental design. For instance, criteria should
40 be developed that consider a minimum sample size for a referendum-style discrete choice
41 valuation survey separately from the criterion for a conjoint choice survey.

¹ The recommendations included specific features of hedonic wage and stated preference studies that should be identified in the studies.

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

- 1
2 (2) Sample frame based on general population.
3 The SAB suggests that the sample frame be the “appropriate population” rather than the
4 general population, to the extent practicable. The EPA should be clear in its determination of
5 what the appropriate sample frame is, and then seek studies that use that sample frame. For
6 example, if the EPA is seeking to value reductions of risks that are specific to a particular
7 segment of the population, the study should focus on obtaining values that are relevant for
8 members of that segment of the population.
9
- 10 (3) Conducted in a high-income country.
11 The SAB agreed that surveys should be limited to those conducted in the United States. To
12 the extent that preferences, cultural norms, institutions, and demographic profiles can affect
13 willingness to pay for risk reductions, and that WTP estimates reflect such social, cultural
14 and institutional environments, studies upon which WTP point estimates are drawn should be
15 U.S. based.
16
- 17 (4) Results based on exclusive dataset.
18 The SAB disagrees with this criterion. In economic research, multiple estimates for an
19 outcome of interest (in this case, a point estimate of the VSL) are often reported which are
20 based partially or wholly on overlapping samples. Model uncertainty, covariate
21 measurement uncertainty, and interest in heterogeneity of impacts across subpopulations all
22 lead to varying outcome estimates. Rather than apply a zero weight to the information
23 contained in multiple estimates arising from a single database, or overlapping databases, the
24 SAB recommends that the EPA select observations for inclusion in the meta-data set based
25 on its set of criteria and take all estimates that meet those criteria. If possible, EPA should
26 control statistically for within-study correlations.
27
- 28 (5) Written in English.
29 The SAB agrees with this criterion.
30
- 31 (6) Provides enough information to calculate a WTP estimate if one is not reported in the paper.
32 The SAB agrees with this criterion.
33
- 34 (7) Provides estimates for willingness to pay (willingness to accept estimates were not included).
35 The SAB agrees that contingent valuation studies of WTA often yield results that differ
36 substantially from estimates of WTP, that the reasons for this divergence are not clear, and
37 that contingent valuation estimates of WTA should not be used.
38
- 39 (8) Provides estimates for willingness to pay for risk reductions to adults (estimates for risk
40 reductions to children are not included).
41 The SAB agrees that estimates of VRR for adults should be based on estimates of WTP
42 for risk reductions to adults. For valuing mortality-risk changes to children, this criterion
43 is not applicable.

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1

2 Additional Comments:

3 The SAB felt that an additional criterion that the stated preference survey passes some form of a
4 scope test should be added.

5

6 *Hedonic Wage Studies*

7 With respect to hedonic studies, the White Paper indicates eight selection criteria, of which four
8 are based on a recently published meta-analysis by Bellavance et al. (2009). The four based on
9 Bellavance et al. are listed below as criteria (5) through (8). The criteria, and the SAB's
10 recommendation regarding each criterion, are described in turn below.

11 (1) Use a sample size of greater than 100.

12 Sample size is not a significant concerns for most wage-differential studies that rely on large
13 data sets of workers and actuarial risk estimates based on comprehensive fatality data.

14 Studies based on other sources (e.g., an original survey of workers) should be evaluated on a
15 case-by-case basis for both sample size and quality.

16

17 (2) Limit selected studies to those conducted in high income countries as defined by the World
18 Bank.

19 The SAB recommends that the EPA base its analysis only on studies conducted on U.S.
20 populations. Because hedonic wage equations estimate an equilibrium outcome based on
21 preferences, demographic distribution and technologies, they will be unique to each country.
22 Even if incomes are similar across countries, similarity in other conditions that affect the
23 revealed marginal rates of substitution between risk and wages are not assured.

24 (3) Omit studies based on the Society of Actuaries risk data.

25 The SAB agrees with this criterion. Charge Question 4a.ii. relates to this criterion and so
26 further comments are given in response to that charge question.

27 (4) Omit studies that focused on extremely dangerous jobs (e.g., police).

28 The SAB agrees this is a reasonable criterion because the population included in these studies
29 is not representative of the population affected by EPA regulations.

30 (5) Retain only studies which employ a model specification "similar to that given" ($\ln w_i = X_i\beta +$
31 $\varphi\rho_i + \mu_i$).

32 The SAB disagrees with this criterion if it is applied exactly as the White Paper suggests (that
33 only cross-section OLS regressions are included in the database). For example, the criteria
34 would imply that estimates based on panel data, instrumental variable, or quasi-experimental
35 methods would be excluded. The SAB recommends that all estimates arising from
36 conceptually sound methods be included.

37 (6) Exclude studies based on specific cause of death.

38 This criterion is appropriate when the goal is to provide an estimate of the value of reducing
39 risks of instantaneous workplace accidental deaths. The SAB notes, however, that the EPA
40 should recognize that even within the context of accidental deaths, there is a great deal of
41 heterogeneity (e.g., falls versus electrocution). The literature often aggregates these into a
42 single measure of "risk of death". The SAB has little evidence regarding its appropriateness.

43 (7) Exclude studies which use the same underlying sample of workers as other studies.

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

**This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.
Do not cite or quote. Updated 3-1-11**

1 In other words, if multiple VSL estimates are reported based on the same underlying survey
2 sample for stated preference studies or the same worker sample for hedonic wage studies,
3 prior recommendations suggest that only one VSL estimate from a given sample be
4 incorporated into the meta-analysis.

5 The SAB agrees that this approach is desirable when conducting meta-analyses of clinical
6 trials to describe efficacy of a treatment on a health endpoint, but it is not a desirable
7 approach for meta-analyses applied to economic research. In economic research, multiple
8 estimates for an outcome of interest (in this case, a point estimate of the VSL) are often
9 reported which are based partially or wholly on overlapping samples. Model uncertainty,
10 covariate measurement uncertainty, and interest in heterogeneity of impacts across
11 subpopulations all lead to varying outcome estimates. Rather than apply a zero weight to the
12 information contained in multiple estimates, the SAB recommends that the EPA select
13 observations for inclusion in the meta-data set based on its set of criteria and take all
14 estimates that meet these criteria. For instance, if the EPA sets forth criteria indicating that
15 hedonic wage regressions must include injury risks as a covariate in order for the point-
16 estimate of the VSL to be included in the meta-dataset, then all regressions that meet this
17 criterion in a study (or across studies) should be included in the meta-data, regardless of
18 whether the underlying sample of workers is partially or wholly the same. Regression
19 estimates that do not meet the full set of criteria should not be included.

- 20 (8) Exclude studies failing to report enough information to calculate the value of mortality risk
21 reductions and/or the average probability of death.

22 The SAB agrees with this criterion.

23
24 Additional comments:

25 The EPA should consider adding the following criterion:

- 26 (a) The regression should include a measure for injury risk, or at least provide evidence
27 concerning the sensitivity of the estimated value of mortality risk to inclusion/exclusion of
28 injury risks.
- 29 (b) Regressions should include an appropriate level of industry and occupational control
30 variables to address the problem of unobserved job characteristics that often exists in these
31 studies. Panel models which control for unobserved worker characteristics do little to
32 alleviate this problem when the risk variable is constructed in such a way that it varies only
33 by occupation and industry of the worker. Estimates should arise from models which
34 convincingly address unobserved job and worker characteristics with the best methods
35 available and appropriate for the data.
- 36 (c) Eliminate any study that relies on risk measures constructed at the industry-level only (not by
37 occupation within an industry), even if the source of the risk data is the CFOI. For example,
38 Smith, et al 2004 (*Review of Economics and Statistics*) use risks that vary only by industry of
39 the worker. While there has not been direct evidence of the degree to which this practice
40 introduces measurement error of the type discussed by Black and Kneisner (2003) and Black,
41 Galdo and Liu (2003), it would seem likely to introduce important measurement error.
- 42 (d) Include only estimates that are based on an appropriate sample frame for the policy context.
43 This criterion follows the suggestion for criterion (2) for stated preference surveys.

- 1 **ii. Section 4.2.2 of the white paper discusses problems of measurement error**
2 **associated with some common sources of occupational risk information**
3 **among other concerns with the hedonic wage approach. Should EPA limit its**
4 **selection of hedonic wage studies by the source of occupational risk**
5 **information? For instance, studies relying on data from the Society of**
6 **Actuaries (SOA) have been omitted from the described data set. Should the**
7 **SOA studies be excluded? Should other sources be excluded as well?**
8

9 Yes to all three questions. Prior to 1992, BLS workplace fatalities were survey estimates, which
10 the National Academy of Sciences had questioned due to the high rate of sampling errors. For
11 instance, in 1990, the BLS estimated there to be 2,900 workplace fatalities. The National Safety
12 Council estimated 10,500 workplace fatalities. NIOSH estimated 5,500 fatalities (not including
13 Connecticut and NY – note NIOSH only used death certificates, and as Drudi reports, as little as
14 35% of workplace deaths are documented as such on death certificates).

15
16 Three sources of information provide additional details on the difficulty of using past data:

- 17
18 (1) Drudi, “A century-long quest for meaningful and accurate occupational injury and
19 illness statistics,” *Compensation and Working Conditions*, Bureau of Labor Statistics,
20 Winter 1997.
21
22 (2) Black, Galdo and Liu, 2003 and Black and Kneisner, 2003 provide a critique of the
23 previous risk measures and illustrate the unreliability of study estimates based on
24 these historical data.
25
26 (3) Leigh, 1995 (*Journal of Environmental Economics and Management*) highlights the
27 further issue of measurement error in using risk data that vary only by industry or
28 occupation of the worker. Viscusi (*Economic Inquiry* 42: 29-48, 2004) finds that
29 estimates of the value of mortality risk using estimates of risk by industry and
30 occupation are roughly half as large as estimates using estimates of risk by industry.
31 Scotton and Taylor (2010) also report this difficulty as it relates to measures of injury
32 risks (which to date have only been available by industry or occupation of the worker,
33 but not by occupation and industry of the worker). In Scotton and Taylor, inclusion
34 of industry control variables leads to a negative injury risk coefficient.

35 Lastly, there has been a steady decline in overall numbers of workplace deaths since 1970. The
36 labor force has transitioned from manufacturing to service-oriented industries and exposures in
37 the workplace have changed over time. Currently up to 15% of workplace deaths are homicides.
38 The reliance on flawed data that is not representative of current conditions is not defensible.

39
40 In summary, all studies that rely on data other than the Census of Fatal Occupational Injuries
41 (CFOI) should be excluded.
42

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

3
4 Stated Preference Studies: *Committee didn't discuss – Trudy, Maureen, Jim and others are better*
5 *suited to proposing an answer here. Perhaps an answer that says: Look at the guidelines for the*
6 *criteria, adjust your criteria, and re-review your database in light of these new criteria. I think I*
7 *would prefer this statement, since our approach has been not to “look at the results and then*
8 *describe the criteria” – but to give genuine guidance on the criteria and then let the cards fall*
9 *where they may. If the latter is the case, then we shouldn't answer 4.b. directly. We should*
10 *indicate that they re-review every study based on the new criteria and then include/exclude as*
11 *appropriate.*
12 *Thoughts?*

13
14 Hedonic Wage Studies: *See answer in italics above. If specific language is preferred, then I*
15 *would propose: All studies not based on the U.S. workforce, the CFOI risk data, and not*
16 *adhering to the criteria discussed above should be eliminated. The first two criteria eliminate all*
17 *studies prior to Viscusi (2003). Additional criteria as discussed for 4.a. should be developed and*
18 *studies after 2003 should be evaluated on these terms.*

19
20 **c. Is the committee aware of relevant empirical studies in the stated preference and**
21 **hedonic wage literatures that are not adequately captured in this review? If so,**
22 **please provide citations.**

23
24 It is important the EPA include the “grey literature” in its assembly of the two databases.
25 Unpublished manuscripts, reports, dissertations, and other non-refereed materials should be
26 evaluated based on the same criteria as the peer-reviewed publications. Meta-analytic methods
27 specifically encourage inclusion of the grey literature to avoid “publication bias” (see Bergstrom
28 and Taylor, "Using meta-analysis for benefits transfer: Theory and practice," *Ecological*
29 *Economics*, 60(2), pages 351-360, 2006.). Should the EPA wish to go further than simply
30 applying the criteria developed for the published literature, the EPA could develop a two-stage
31 process in which it first solicits peer review of unpublished manuscripts and then apply its
32 criteria to those studies that peer reviewers suggest are consistent with the quality of similar
33 published work.

34
35 Other studies to consider:

36 Stated Preference Studies:

37 Cameron, T.A., J.R. DeShazo, and P. Stiffler (2010) “Demand for health risk reductions: A
38 cross-national comparison between the U.S. and Canada,” *Journal of Risk and Uncertainty*
39 41(3) 245-273 (December)

40
41 Cameron T.A., J.R. DeShazo, and E.H. Johnson (2010) “The effect of children on adult
42 demands for health-risk reductions,” *Journal of Health Economics* 29(3): 364-376, (May)

1 Cameron, T.A. and J.R. DeShazo (2010) "Demand for Health Risk Reductions," Trudy Ann
2 Cameron and J.R. DeShazo (revise-and-resubmit)

3
4 Cameron T.A., J.R. DeShazo, and E.H. Johnson (2010) "Willingness to pay for health risk
5 reductions: Differences by type of illness," (under review; presented at 2008 AERE
6 Workshop)

7
8 Bosworth, R.D., T.A. Cameron, and J.R. DeShazo (2010) "Willingness to pay for public
9 health policies to treat illnesses" (under review; presented ASHEcon biennial conference,
10 Cornell University 2010)

11
12 J.R. DeShazo and T.A. Cameron (2005) "The effect of health status on willingness to pay for
13 morbidity and mortality risk reductions," (manuscript)

14
15 J.R. DeShazo and T.A. Cameron (2005) "Two types of age effects in the demand for
16 reductions in mortality risks with differing latencies," (manuscript)

17
18 Hedonic Wage Studies:

19 Evans, Mary F. and V. Kerry Smith, Do We Really Understand the Age-VSL Relationship?,
20 *Resource and Energy Economics*, 28: 242-261, 2006.

21
22 Evans and Schaur, A quantile estimation approach to identify income and age variation in the
23 value of a statistical life, *Journal of Environmental Economics and Management*, 59:260-
24 270, 2010.

25
26 "The Value of a Statistical Life: Evidence from Panel Data." Thomas J. Kniesner, W. Kip
27 Viscusi, Christopher Woock and James P. Ziliak. March 2010. 41pp. Available at:
28 http://www1.maxwell.syr.edu/cpr/publications/CPR_Working_Paper_Series/

29
30 Ikuho Kochi, "Endogeneity and the value of a statistical life," working paper available from
31 the author.

32
33 Carol Scotton, "Evidence on the Sensitivity of Value of a Statistical Life Estimates to
34 Fatality Risk Measures," working paper available from the author.

35
36 Kochi, Ikuho and Laura Taylor, "Risk Heterogeneity and the Value of a Statistical Life:
37 Further Market-Based Evidence," working paper available at
38 <http://www.ncsu.edu/cenrep/research/working-papers.php>.

1 Charge Question 5

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

9
10 The question of how to adjust estimates of VRR for use in a meta-analysis is distinct from the
11 question of how to adjust for use in policy analysis (discussed below). For meta-analysis, the
12 SAB suggests that EPA not adjust VRR estimates for income growth but explore more flexible
13 methods for understanding the effect of study year and average sample income on VRR.

14
15 **Does the Committee believe the Agency should adjust its value of income elasticity for use**
16 **in policy analysis in light of recent findings in the literature?**

17
18 The literature on VSL income elasticity has employed several approaches, including cross-
19 section analysis of within-sample variation in CV data, meta-analysis of hedonic-wage studies,
20 longitudinal analysis of hedonic-wage data for a particular population, and quantile analysis of
21 hedonic-wage data. Unfortunately, stated-preference estimates that are most closely matched to
22 the policy context may lack the necessary information to derive a utility-theoretic elasticity
23 estimate. Estimates obtained from cross-section analysis of CV data range between 0.1 and 1.0,
24 while longitudinal-study estimates range between 1.3 and 3.0. Elasticity estimates generally
25 vary with age and income, with the inverse relationship with income being the stronger effect.
26 Quantile analysis yields estimates of 2.2 for the lowest decile and 1.2 for the highest decile.
27 Thus smaller elasticity values may be biased against lower-income groups.

28
29 Consistent with its recommendations on VRR, the SAB recommends that EPA develop an
30 elasticity transfer function that accounts for changes in age and income distributions over time.
31 Policy impacts that affect particular regions or populations should account for differences in the
32 age and income distributions of the affected populations relative to the national distribution.

33
34 **If so, what value or range of values does the Committee believe should be used?**

35
36 As indicated in the SAB response to the other charge questions, the SAB does not believe EPA's
37 focus on a single value or range of values is appropriate. Both VRR and income-elasticity values
38 should be context specific. Where policy-relevant estimates are lacking, EPA should develop
39 income-elasticity transfer functions that make transparent any necessary assumptions for
40 interpolating or extrapolating the available evidence and that facilitate appropriate sensitivity and
41 uncertainty analysis.

42

1 Charge Question 6

2 **The white paper describes a simplified approach for updating the Agency’s recommended**
3 **mortality risk value estimate(s) (see section 5.1.1). This approach involves fitting a**
4 **parametric distribution to the set of estimates from selected studies. This is similar to the**
5 **approach used for EPA’s current default VSL estimate.**

6
7 Individuation of net benefits: The correct measure of aggregate net benefits is the sum across the
8 population of individual net benefits. Individual net benefits involve a measure of individual
9 costs and a measure of individual benefits. Individual benefits are the product of individual
10 marginal WTP for a unit of risk reduction, times the number of units of risk reduction. If
11 individual marginal WTP is statistically independent of the size of the individual risk reduction,
12 it is possible to first calculate the average of marginal WTP across the population and then to
13 multiply this average by the aggregate risk reduction to get aggregate benefits. However, there
14 may be a correlation between individual marginal WTP amounts and the sizes of individual risk
15 reductions. In that case, the strategy of first calculating an average MWTP and the aggregate
16 risk reduction, then multiplying these two amounts, will give a different answer from the correct
17 strategy. This is true for the same reason that $E[XY]=E[X]E[Y]$ only if X and Y are independent.
18 **Implication:** For the “average/aggregate, then multiply” approach (typical of VSL-based
19 calculations), it is necessary that individual WTP per unit and individual risk reductions be
20 approximately independent. The decision to use this strategy requires that the analyst defend this
21 (typically implicit) maintained hypothesis.

22
23 **a. Should EPA pursue this approach for updating its mortality risk valuation guidance**
24 **in the near term (until a more detailed analysis can be conducted)?**

25
26 To start, it is important to recognize that there is not one “true” number for VRR (VMR, or
27 whatever terminology is adopted) which is the inference that is invited by the current approach to
28 combining the results from different studies.

29
30 The current approach involves calculation of a measure of central tendency for the marginal
31 distribution of a variety of different WTP measures. Each of these measures comes from a study
32 that considers a different type of risk reduction and/or a different affected population. These are
33 demands for different goods by different groups of people. There can be no a priori assumption
34 that these numbers measure the same thing, so the current process involves an averaging of
35 “apples and oranges.” The constituent WTP measures differ for good reasons. They are not all
36 measures of the same underlying fundamental constant. The goal should be to use WTP
37 estimates that are matched as closely as possible to the policy context in question. For the EPA’s
38 needs, it is particularly important to note that the types of risks which are most relevant are often
39 not the case of “sudden death in the current period” that is the focus of most wage-risk studies.
40 Many health threats addressed by environmental policies consist of illness profiles with long
41 latencies and substantial periods of morbidity prior to death. Lost life-years are not the sole
42 determinant of WTP for health risk reductions.

43

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

**This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.
Do not cite or quote. Updated 3-1-11**

1 As a practical matter, however, the need for specially tailored WTP estimates requires that the
2 inventory of WTP measures be sufficiently “thick” in the necessary domain so that values are not
3 driven by idiosyncratic between-study variation. If the policy context corresponds to a gap
4 among available WTP estimates, there will have to be some sort of benefits transfer.
5 Alternatively, placeholder estimates and sensitivity analysis may have to be used, but if this is
6 done, it should be made *very clear* how the policy context differs from the contexts within which
7 the available WTP estimates have been measured. Only if these mismatches are clearly identified
8 will researchers be able to identify where further research will be most useful. Full disclosure to
9 the public also requires that shortcomings in the fit of WTP estimates used in policy evaluation
10 be acknowledged explicitly. It also requires that sensitivity analyses be conducted to reveal the
11 extent to which the outcome of any benefit-cost analysis depends upon the size of the
12 placeholder estimate being used.

13
14 **b. If so, should the databases on which values are based be created using only one
15 estimate drawn from each study or multiple estimates from each study?**

16
17 The answer to this depends upon the reasons for different estimates produced by a study.
18 Sometimes, these different point estimates are all, ostensibly, measures of the same thing. These
19 estimates differ because of model uncertainty (or specification searching), or the use of different
20 exclusion criteria. In this case, the research may report the sensitivity of WTP estimates to
21 assumptions about the specification, but the researcher may ultimately identify the most-
22 preferred model. In these cases, where one model clearly dominates others on a priori or
23 statistical criteria, there is an argument for using only the “best” estimate from such a paper.

24
25 However, across alternative specifications that cannot be rejected by the data, or across
26 alternative exclusion restrictions where it is not obvious which set is most appropriate, it is
27 essential to reflect the degree of “model uncertainty” in the estimates from this study, rather than
28 to consider only the interval estimates of WTP stemming from just the preferred specification of
29 the study author(s) or of the policy analyst. Comprehensive error bars are needed, and these need
30 to subsume both (a) model uncertainty and (b) parameter precision conditional on the choice of
31 model.

32
33 In other cases, however, a paper will produce a variety of different point and interval estimates of
34 WTP but this is because of heterogeneity in both the type of risk and the affected population.
35 The white paper seems to imply that different estimates from the same paper can be used only if
36 they are derived using separate models for separate samples. However, it is possible that the data
37 can be pooled across separate subsamples with indicators for differences in the type of risk or the
38 affected population, and one would *expect* different estimates. In such a case, the agency should
39 choose those estimates from the study that correspond as closely as possible to the policy-
40 relevant context, rather than averaging all estimates indiscriminately.

41
42
43 **c. If only one estimate per study should be used, what criteria should the Agency apply
44 in selecting the appropriate estimate? How would these criteria vary from one**

1 **segment of the literature to the other? The paper describes the methods used to**
2 **select independent estimates from each study. Does the Committee agree with the**
3 **methods used?**
4

5 The most appropriate estimate from a study is the one most closely aligned with the policy
6 context, across studies of “sufficient quality.” Sometimes, unfortunately, there will be no study
7 that is closely aligned with the estimate of interest. When the selection criteria cause the Agency
8 to come up empty, it will be necessary to forge ahead with the closest available estimates, yet to
9 acknowledge why they are inappropriate and to specify exactly what type of risk and what type
10 of population constitute the relevant context. Any benefit-cost analysis should be qualified by
11 the caveat that it was necessary to use a WTP estimate that was not really a good fit. As a
12 practical matter, nothing more can be done until additional research has been completed
13 concerning the appropriate context. But the Agency should persist in pointing out the theoretical
14 ideal in each case, and the extent to which the available data fall short of this ideal.
15 The Agency certainly needs to identify and publicize its “most wanted” archetypical WTP
16 estimates, to set the research agenda for subsequent empirical work.
17

18 **d. How important is it that estimates be drawn from non-overlapping subsamples? If**
19 **multiple estimates per study are recommended in the construction of the meta-**
20 **datasets, should the estimates be selected to avoid overlapping sub-samples?**
21

22 Again, it depends upon the reasons for multiple estimates from the same study (or from different
23 studies, or different authors based on the same data sets). Perhaps one study ignores
24 heterogeneity and estimates a central tendency only for some marginal distribution across the
25 studied risk and population, and another study differentiates WTP estimates according to
26 statistically significant heterogeneity. In that case, it is more appropriate to seek out the best fit
27 of the study context to the policy context, rather than to focus on non-overlapping subsamples, a
28 strategy which seems to presume that the identical underlying constant is being measured in all
29 cases.
30

31 **e. Does the Committee still favor analyzing the stated preference and hedonic wage**
32 **estimates separately? If so, how should the separate results of these analyses be used**
33 **in evaluating new policies? If not, how should they be combined in a single analysis?**
34

35 The distinction between illness profiles may be more important than the distinction between
36 stated preference (SP) and revealed preference (RP) studies. Most RP mortality-oriented wage-
37 risk studies are limited to an illness profile consisting of “sudden death in the current period.”
38 Stated preference studies can produce WTP estimates for much more general illness profiles. If
39 the range of study scenarios has been appropriately designed, an SP study can include as a
40 special case an estimate of WTP to reduce the risk of sudden death in the current period. If the
41 agency desired an estimate of WTP for this particular context, it is appropriate to use all
42 information for WTP for the *same* type of risk reduction and the *same* affected populations.
43 However, revealed preference studies are less suited to illness profiles involving latency and long
44 periods of morbidity in addition to premature mortality. It may be inappropriate to combine SP

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1 and RP studies in many cases, not because of the differences in the quality or reliability of RP
2 and SP data, but because the “good” for which WTP is being measured is fundamentally
3 different (and possibly the affected population as well).
4

5 Even though many wage-risk RP studies may not address the types of illness profiles that are
6 relevant for many of the policy contexts that are relevant to the Agency, these studies are still
7 vitally important because validation of relevant SP studies may be benchmarked against the “sudden
8 death in the current period” illness profile when this particular profile is covered by both types of
9 studies. Consistency between SP implications and best-practices RP studies, for *comparable*
10 types of risks and populations (e.g. working age males) will remain an important criterion for
11 cross-validation of the estimates from SP studies. Validation is less easy for domains of SP
12 studies which are not overlapped by any available RP studies.
13

14 That said, it is still important to acknowledge that poorly designed SP studies will continue to be
15 plagued by all of the potential problems with SP research that have been identified over the
16 years. As a generalization, many economists who have not invested in reading the stated
17 preference literature are skeptical about SP as a class of research, preferring to reject all research
18 in this class rather than to make the effort to learn how to discriminate between better and worse
19 SP evidence. Those familiar with the literature are more likely to be of the opinion that a noisier
20 estimate of the right construct will be preferable to a more precise estimate of the wrong
21 construct—this is the familiar trade-off between bias and efficiency. The Agency should help
22 researchers identify the specific types of policy contexts for which better WTP estimates are
23 most needed. Then researchers can focus on developing WTP estimates that are both more
24 precise and less biased. The Agency can continue to encourage useful research by being very
25 clear about the nature of the particular illness profiles that are most relevant to important
26 environmental policy contexts and by persistently pointing out the deficiencies in the available
27 WTP estimates.
28

29 Additional data fusion opportunities may also be available. There is likely some scope for using
30 studies of risk-risk tradeoffs, despite the absence of WTP estimates in these studies, to translate
31 RP estimates of WTP to reduce the risk of “sudden death in the current period” into WTP to
32 reduce other types of risks. Of course, estimation errors would have to be compounded across
33 these two stages.
34

35 As for expert elicitation, the SAB acknowledges that the nature of the evidence in this context
36 makes it less likely that individual experts will have significant private knowledge about WTP
37 beyond that contained in available empirical studies. However, expert elicitation could be useful
38 when it comes to the Agency’s decisions about which estimates, for a specified risk and
39 population, are a sufficiently good match and of sufficient quality to include in a tailored
40 analysis. The SAB also acknowledges that the public will need to be carefully prepared to hear
41 that the Agency will use different WTP estimates for different risks and different affected
42 groups. Transparency in the process of how different studies are selected will be very important.
43

- 1 **f. Would the Committee support the development and application of separate means**
2 **or ranges generated from the two segments of the literature? Given separate means**
3 **and/or ranges from each segment, should the results be weighted and combined to**
4 **produce a single point estimate or range? If so, how? Are other presentations of the**
5 **results preferable? More generally, how should uncertainty in the estimated value(s)**
6 **of mortality risk reductions be handled in benefits analyses?**
7

8 The use of weighted averages of individual point estimates is only appropriate if these point
9 estimates measure the same thing. Recent research certainly highlights extensive heterogeneity
10 in WTP for risk reductions, both as a function of the type of risk to be reduced and the
11 characteristics of the relevant affected population. If multiple estimates are available for the
12 same context, then these can be averaged, and it is appropriate to consider some sort of
13 weighting scheme that reflects the relative precision of the different point estimates.
14

15 The SAB acknowledges that heterogeneity in WTP across types of risks will be more palatable
16 to some audiences than heterogeneity across affected subpopulations. In the past, for example,
17 the Agency has been taken to task for the “senior death discount.” This is, however, a failure of
18 communication with the general public, rather than any theoretical ambiguity about whether
19 economics admits for different demands by different types of people. There is a clear need for
20 some very accessible explanations as to why it is inappropriate to force people to bear higher
21 costs for regulation than they would be willing to pay for themselves. It is true that it is
22 somewhat difficult to convey the distinction between “the intrinsic value of different human
23 beings” and the “different WTP of people in different circumstances.” However, this difficulty
24 does not constitute an excuse for using the wrong benefits measures for proposed policies. In the
25 case of policies which represent unfunded mandates, there is an obvious need for a clear and
26 widely accessible (and regularly repeated) explanation for why economists seek to respect
27 consumer sovereignty where possible, rather than forcing costly regulations upon people who are
28 not willing to bear the costs that will be imposed by these regulations.
29

30 Uncertainty in the estimated value(s) of mortality risk reductions should certainly be reflected in
31 any benefit-cost analysis of policies. It is misleading to overstate the precision of the evidence.
32 As mentioned above, model uncertainty is relevant, not just parameter uncertainty in the most-
33 preferred specification. If multiple estimates of WTP happen to be available for the *same* type of
34 risk reduction for the *same* population, then it is appropriate in any averaging process to
35 acknowledge different degrees of precision associated with different estimates. Whether this is
36 accomplish via Bayesian methods or by more conventional techniques is probably less important
37 than whether it is done at all.
38

1 Charge Question 7

2 **We are interested in developing a standardized protocol for updating the Agency’s**
3 **recommended mortality risk value estimates on a regular basis—for example, every 5 years**
4 **or so—to incorporate new estimates from relevant economic valuation studies as they**
5 **appear in the literature. Such a protocol might be based on the approach outlined in**
6 **Section 5.1.1 or something similar. This approach, combined with a set of rigorous criteria**
7 **for determining which new studies and value estimates are suitable for inclusion in the pool**
8 **for meta-analysis, would allow the Agency to update its guidance in a more timely and**
9 **transparent manner. (After a working protocol was put in place, it then could be modified**
10 **over time to match changes in the Agency’s general mortality risk valuation approach and**
11 **meta-analysis methods, as necessary. See charge question 8.) Does the committee believe**
12 **that developing such a protocol is feasible and desirable? Please explain.**
13

14 The SAB believes that the Agency should establish a protocol for updating the value of risk
15 reduction (VRR) estimates on a regular basis. The estimate that the agency currently uses to
16 value reductions in mortality risk is based on studies that are at least 20 years old and at most just
17 over 35 years old. Several of the studies included in the current pool would likely be disqualified
18 from consideration in the future as a result of the criteria for qualifying studies recommended by
19 the Agency in the White Paper and further criteria recommended by the SAB in response to
20 charge question 4. Moreover, the current estimate does not take into consideration the wealth of
21 new studies that make use of better techniques and better data that have been published over the
22 last 20 years. To avoid using VRR estimates based on decades-old research in the future, the
23 Agency should establish a protocol for updating regularly the estimates of the value of risk
24 reduction that it uses in its work.
25

26 The protocol should include a procedure for updating all of the information needed to construct
27 the value of risk reduction. This should include the following:

- 28 • Identification of recent additions to the literature on valuing risk reductions,
29 particularly related to mortality risk, as well as studies that provide new estimates
30 of the income elasticity of the value of risk reduction.
- 31 • Assessment of the quality of those studies and the estimates contained therein
32 according to the criteria established by the agency augmented by those
33 recommended by the SAB. Studies that do not meet the best practice criteria
34 should be excluded from consideration.
- 35 • The estimates of risk reduction gleaned from the set of qualified studies should be
36 put into comparable real dollar terms using appropriate income elasticity
37 estimates.
- 38 • The procedure for combining estimates should be in line with the
39 recommendations in response to charge questions 6 and 8.
- 40 • All of these procedures should be adaptable to take account of new information
41 and the results of new research that might enable the Agency to employ a new
42 methodology for updating its VRR estimates, such as through developing and
43 parameterizing a structural benefit transfer model.
44

**For discussion on the March 14, 2011 teleconference of the Environmental Economics Advisory Committee
Augmented for Valuing Mortality Risk Reduction.**

This is a deliberate draft. It does not represent consensus SAB advice or EPA policy.

Do not cite or quote. Updated 3-1-11

1 Updates of the Agency's estimates should be performed on a regular schedule in order to take
2 advantage of new research as it becomes available. The exact timing of these updates will
3 depend on the supply of new studies, the availability of Agency resources to devote to the task
4 and the nature of the review process for new estimates that the agency develops. The supply of
5 research on valuing risk reductions has been growing in recent years as has the pace with which
6 new studies are appearing and the Agency can have some influence on that supply through its
7 research funding activities. While the supply of new research on this topic may be growing
8 sufficiently fast to warrant annual updates of the VRR estimate, the requirements for review of
9 new estimates produced by the Agency by the Scientific Advisory Board may make it desirable
10 from the Agency's perspective to update on a less frequent basis, say every 2 or 3 years, or even
11 5 years at the outside. All of these update schedules are a vast improvement over prior practice.
12

13 Regular updates of the value of risk reduction will require an education process to make
14 legislators, administration officials and the general public aware that estimates of the values of
15 risk reductions are not static. They can be expected to evolve over time to differ across types of
16 risk and affected populations. They can also be expected to evolve over time for the same risk
17 and the same affected population as data are improved and methods are refined. Change in the
18 terminology used should assist in this regard, but in conjunction with its efforts to educate the
19 public about the change in terminology it should also take care to inform people about its plans
20 for updating these values and provide information on why this is necessary and important.

1 Charge Question 8

2 **In addition to the short-term issues that underlie charge questions 1-7, we are interested in**
3 **supporting and conducting additional research to further develop EPA’s health risk**
4 **valuation methods over the longer-term. In particular, we would like to begin the**
5 **transition from the point value transfer approach to a benefit function transfer approach.**
6 **With this longer-term research and guidance development objective in mind, please answer**
7 **the following questions:**

- 8 **a. Should EPA continue to use its current approach—that is, a point value or range**
9 **of values, possibly with an adjustment for cancer risks—or is there now a**
10 **sufficient body of empirical research to support the development of a more**
11 **detailed form of functional benefit transfer?**

12
13 EPA’s current approach is to use a baseline estimate of the VRR, one that reflects the
14 value of reducing risk of accidental death. We believe that EPA should aim to
15 distinguish the VRR according to population and risk characteristics that are relevant
16 for policy analysis. However, in the near term this baseline estimate of the VRR
17 should be revised to reflect advances in the literature and new criteria for selecting
18 acceptable studies set forth in the White Paper. This baseline estimate would reflect
19 the VRR for immediate risk of accidental death to adults, based on wage-risk and
20 stated preference studies. Fitting an appropriate distribution to this new group of
21 studies, selected according to approved criteria, would be a significant improvement
22 over the VSL estimate currently used.

23
24 To determine whether it is currently possible to distinguish the VRR according to
25 population and risk characteristics, these characteristics must be specified. Based on
26 the studies that meet the revised criteria suggested by the EPA in its White Paper, it
27 may be possible to distinguish the VRR for cancer and, possibly, heart disease.

28
29 There are two ways that the VRR could be adjusted to reflect cause of death. One is
30 to adjust the baseline estimate of the VRR (described above) using results from risk-
31 risk tradeoff studies. These studies measure the rate at which respondents substitute
32 risk of accidental death for risk of death due to other causes (e.g., due to cancer). A
33 second approach would be to conduct a meta-regression of VSL results from
34 acceptable stated and revealed preference studies, including stated preference studies
35 that value mortality risks associated with cancer and heart disease. This meta-
36 regression would include risk characteristics as covariates. It would be also desirable
37 to include a variable indicating whether the VSL estimate comes from a stated or a
38 revealed preference study to avoid confounding effects of study type (that are not
39 well understood) with effects of cause of death.

- 40
41 **b. If a functional transfer approach is feasible given the existing body of empirical**
42 **results, should this be based on a meta-analysis or a calibrated structural**
43 **preference function or perhaps some hybrid of these?**
44

1 EPA should aim to calibrate a structural preference function (e.g., an indirect utility
2 function) rather than rely on a meta-regression to combine study results. As pointed
3 out by the EEAC in 2006, a meta-regression does not represent a structural equation.
4 We view the use of a meta-regression including population and risk (but not study)
5 characteristics as a reduced-form approach to estimating a structural preference
6 function.

7
8 Moving toward a structural preference function is highly desirable. It would provide
9 an integrated, consistent framework for understanding how individuals trade off risks
10 against consumption and income. By doing so, it would provide a stronger
11 theoretical foundation for the benefit transfer task commonly faced by EPA: using
12 data on relatively familiar risks, such as sudden accidental death, to infer willingness
13 to pay for reductions in novel or complex risks. Moreover, as noted by Smith (2006),
14 a structural approach may allow additional data on other aspects of individual choice
15 to be brought to bear on the problem. It may also provide a rigorous means for
16 incorporating the results of risk-risk studies which provide valuable information but
17 are difficult to include in traditional calculations of willingness to pay for risk
18 abatement. Finally, estimating the parameters of a structural model would allow the
19 construction of confidence intervals for willingness to pay results.

20
21 Although a structural approach would provide many benefits, much additional
22 research is needed. For example, the existing literature has used a small number of
23 restrictive functional forms. Before the structural approach will be ready for routine
24 use, the effect of these restrictions must be investigated and the restrictions
25 themselves relaxed where possible. EPA should regard the structural approach as a
26 high priority for research and an important long term goal, but not yet as a
27 replacement for traditional methods.

- 28
29 **c. If the body of empirical literature is sufficient to estimate or calibrate some form**
30 **of structural preference function, what are the key variables that should be**
31 **included in such a function? That is, based on a priori theoretical considerations**
32 **and previous empirical findings, which attributes of the affected individuals and**
33 **the policy scenario should be included? What specifications are feasible given**
34 **data availability?**

35
36 As noted above, the theoretical and empirical literature on the structural approach is
37 promising, but still at an early stage of development. The literature is not yet
38 sufficient to estimate an authoritative model. As a research matter, however, a key
39 initial consideration will be whether to formulate the model in terms of the attributes
40 of risk (latency, dread, etc.) or in terms of specific risks (cancer, heart disease). The
41 former approach would be more versatile but the latter approach is likely to be more
42 tractable in the short run.

43

- 1 **d. Have the econometric issues we identified (unobserved heterogeneity,**
2 **heteroskedasticity, and small sample size) been adequately addressed by the**
3 **recent meta-analyses reviewed in Sections 4.1.1 and 4.2.3? Would the classical**
4 **approaches that we suggest for overcoming these data limitations improve upon**
5 **previous work? If a new meta-analysis is conducted, what statistical**
6 **approach(es) would be preferred?**
7

8 The econometric techniques that should be used in a meta-analysis will depend on the
9 number of VRR estimates to be drawn from each study and the total number of
10 observations available in the meta-analysis. For example, to be feasible, fixed effects
11 estimators require a sufficient number of observations from each study. Random
12 effects estimators assume that covariates in the model are uncorrelated with the error
13 term, which may be reasonable under some circumstances but not others.
14

- 15 **e. What role, if any, does the Committee believe that the life-cycle consumption**
16 **and mortality risk framework could play in evaluating health risk reductions?**
17 **In particular, does the Committee believe that this framework could be used as a**
18 **foundation for some form of structural benefit transfer function?**
19

20 Using data from stated preference and hedonic wage studies to parameterize a life-
21 cycle model is an ambitious task. It faces all of the difficulties noted above for
22 structural preference approach but in an even more complex form. Allowing utility
23 functions to be age-dependent and to depend on risk characteristics in a manner than
24 varies with age will be difficult. It is also true that the standard life-cycle model
25 assumes people are expected utility maximizers, which may not be a valid
26 assumption. Before pursuing this approach EPA should look at the literature that has
27 estimated life cycle models for the purpose of understanding savings and retirement
28 decisions. An important question is how well these models have worked in that
29 context.