Toward Principles and Standards in the use of Benefit-Cost Analysis

A summary of work

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PART ONE: Background and History

I. Introduction

a. The Principles and Standards Project; Acknowledgements

This report is a summary and compilation of work done for the Principles and Standards for Benefit-Cost Analysis Project ("Principles and Standards Project"). The project was completed under the auspices of the Benefit-Cost Analysis Center at the Evans School of Public Affairs, University of Washington, with support from the John D. and Catherine T. MacArthur Foundation. This report draws years of scholarship and work on benefit-cost analysis into a single document intended as a starting point to establish principles and standards for benefit-cost analysis in government and non-profit decision-making, with a particular emphasis on social programs. The responsibility for this report, including errors, mistakes, and choice of standards lies with the senior author and not with the student research assistants, authors of white papers, or the scientific committee members who helped with this report.

The Benefit-Cost Analysis Center thanks the John D. and Catherine T. MacArthur Foundation for their support, particularly Michael A. Stegman, Valerie Chang, and Steven Casey. The Center also thanks the Evans School of Public Affairs for institutional support, including the efforts of Dean Sandra Archibald and Professors Alison Cullen and Joe Cook. The Center would also like to recognize its support staff, Deborah Fishler, Katie Ward, Aubri Wall, Camille French, and Kay Sterner. The Evans Communication Team, including Molly McCarthy and Joe Eastham, deserve thanks for creating the interactive sections of the Center's website to enable public comment on this project. Finally, the authors thank Nevena Lalic and Kiana Scott for their assistance reading and editing drafts.

The Principles and Standards Project commissioned white papers on various subjects from leading experts and promising younger scholars in specific fields of applied benefit-cost analysis. Each of these scholars was commissioned because of his or her experience and work in the field. The topics and commissions of these papers are as follows:

Table 1: Commissioned Papers, Authors and Reviewers

Topic	*Author*	*Reviewer*
General Equilibrium Analysis and Social Programs	H. Allen Klaiber and V. Kerry Smith	Roberton C. Williams III

Distributional Issues	John Loomis	James K. Hammitt
Behavioral Economics	Lisa A. Robinson and James K. Hammitt	Brigitte Madrian
Social Policy	Aidan R. Vining and David L. Weimer	Robert Haveman
Early Childhood Interventions	Lynn Karoly	Clive R. Belfield
Crime	John R. Lott, Jr.	Bruce H. Kobayashi
Public Safety	R. Scott Farrow and W. Kip Viscusi	Richard O. Zerbe
Public Health	Joe Cook	Lisa A. Robinson

Each of the commissioned authors' papers was subject to professional review by another scholar in the field, and comments were provided to the author. Following revisions, each commissioned paper was opened up to public comment through posting on the website of the Benefit-Cost Analysis Center. Through this site, readers could view and download these pieces of cutting-edge scholarship, and leave comments for the authors and the benefit-cost analysis community. Authors of papers responded to comments as appropriate, and the final papers have again been made available to the public. Complete final versions of these commissioned papers are included as appendices to this report.

Though this report draws heavily from both the commissioned white papers and reviews, its views are those of the authors, primarily the principle author. Blame for inevitable omissions and mistakes should not fall on the white paper authors or reviewers.

b. The Scientific Committee

The authors are greatly indebted to the following members of the Society for Benefit Cost Analysis who served as a scientific review committee. Their reviews and input served to significantly improve the report; any remaining faults, however, are the responsibility of the report authors alone. Moreover, please note that members of the Scientific Committee are not responsible for the content of the report; this document is the representation of the views of the lead project author, and membership on the scientific committee should not be seen as an endorsement of all contents herein.

Table 2: Reviewers on Scientific Committee

Reviewer	
Anton, Paul	Anton Economics
Aos, Steve	Washington State Institute for Public Policy
Burgess, David	University of Western Ontario
Cameron, Trudy	University of Oregon
Graham, John	University of Indiana
Hammitt, James K.	Harvard University

Harberger, Arnold C.	University of California, Los Angeles
Harrison, Glenn	Georgia State University
Kobayashi, Bruce H.	George Mason University
Krutilla, Kerry	Indiana University
Loomis, John	Colorado State University
Lott, John R., Jr.	University of Maryland
Robinson, Lisa A.	Independent Consultant
Schmitz, Andrew	University of Florida
Vining, Aidan	Simon Fraser University
Viscusi, W. Kip	Vanderbilt University Law School
Weimer, David	University of Wisconsin
Williams, Roberton C., III	University of Maryland

In addition Glenn Jenkins and David Burgess made very helpful suggestions. There are more citations to the principal author's work then he is comfortable with, and which in some cases could be replaced by better citations. Time constraints made this convenient but this author asks forbearance by other colleagues.

c. The Purpose and Goals of this Report

This report aims to establish principles and standards for the use of benefit-cost analysis for analyzing social programs. Most of these will apply also to benefit-cost analysis more generally. The report recognizes that these principles and standards necessarily will need to adapt to future developments and advances in economics and benefit-cost analysis scholarship; thus, we view our report as the beginning of a continuing endeavor. We hope that this ongoing project will be a collaboration of members of the field, including scholars, practitioners, policymakers, and theorists. This report is a starting place for this effort.

Finally, there are several notable omissions from this report, which we were not able to fully address due to time and resource limitations. Among these, items to be addressed in future iterations include:

- A portfolio approach justification for BCA;
- Standardized stated-preference methodology;
- The validity of separating equity and efficiency given new research findings and theoretical advances;
- The role of behavioral models in valuation and prediction.
- The relation between benefits-cost and happiness research.
- And a compilation of unit value for work in social program evaluation

Though we touch on many of these issues within our principles and standards, a fuller review of the current literature is beyond the scope of this project. We envision that future editions of the Principles and Standards Project will be able to provide more expansive and documented guidelines.

d. Report Organization

This report begins with a summary of all Foundational Principles, Theoretical Standards, and Technical Standards for benefit-cost analysis (BCA) found in the project. This is to provide a quick reference point for individual items; for further discussion, the reader should refer to the discussion of each item found in the main body. Next, we explore the history of benefit-cost analysis in the US, in terms of empirical efforts at financial analysis, theoretical economic developments, and government adoption of regulatory analysis protocols. Then, we discuss past criticisms of BCA. Part II first proposes general, fundamental principles that underlie BCA. Following this, more-specific theoretical and technical standards for BCA are organized under subheadings of Benefit and Cost Estimation, Market Extent, Discounting, Risk and Uncertainty, Equity and Distribution, and Presentation. Part III provides a glossary of terms and abbreviations, as well as appended white papers commissioned for the project.

References are provided in each section, and all white papers associated with this project are available on the Benefit-Cost Analysis Center's website at www.bcacenter.org. This report will be placed on the web site as well, with a comment section to receive feedback and suggestions.

II. Summary of Collected Principles and Standards

The introduction to Part II provides a fuller discussion of the structure and vision for our General Principles, Theoretical Standards, and Technical Standards than provided here. Briefly, principles are intended to be broad-based, fundamental concepts that define BCA. Theoretical and technical standards then apply these principles, providing more specific direction as to current best-practices involving various aspects of BCA. This summary provides a quick reference of collected principles and standards; each item is explained in detail within the report.

We have not attempted here to separate well-established standards from newer concepts and recent research advances. Given that BCA is a continually evolving discipline, we thought it most advantageous to discuss commonly practiced and state-of-the-art standards in tandem. For any particular analysis component, where there exists a well-established standard practice as well as a different, newer approach gaining traction, we include both in the standard. In some instances, the new approach or finding is currently under development or poorly codified, and thus we provide the commonly practiced standard and provide the new concept as something the analyst must consider when using the older approach. Where both a newer and older approach are in use, a standard describes both approaches, and provides the analyst with guidance as to selecting the most appropriate methodology for an analysis given resources and context. Our reasoning is that this structure will allow for standards to evolve in keeping with empirical and theoretical developments as frontier practices become better established and less resource intensive, and subsequently supplant older methods.

Thus, our standards in part represent the state of the art, in part represent commonly accepted practices, and in part represent what we think should be the state of the art based upon the expert literature, comments, and reviews generated through this project.

Summary of Principles and Standards

Foundational Principles for Benefit-Cost Analysis

Standards for the Estimation of Benefits and Costs

Standards for Determining Market Extent (Economic Standing)

Standards for Addressing Risk and Uncertainty

Standards for Selecting and Implementing Appropriate Discounting Procedures

Standards for Addressing Equity and Distributional Issues

Standards for Analysis Presentation

III. History of Benefit-Cost Analysis and its Application in the United States

Benefit-cost analysis (BCA) as currently practiced represents the culmination of more than a century of theoretical advances in economics as well as empirical improvements in the art of public policy decision-making. BCA is, at its core, an accounting framework used to evaluate the financial consequences of decisions. In this sense, it is similar to analyses that corporations sometimes conduct in order to evaluate investment decisions and calculations individuals make on a daily basis prior to engaging in an activity or making a purchase, for example. However, BCA differs from these frameworks in two significant ways. First, the objective of BCA is to increase public welfare; this increases both the technical and political complexity of the exercise, because the definition of "public welfare" is elusive. Second, because BCA often encompasses non-market goods, such as the value of a recreational visit or wildlife viewing at a park, the required data is often not found in market transactions, and instead must be generated through resource-intensive surveys or other statistical analyses.

Formalized BCA was first employed in the United States for the analysis of US Army Corps of Engineers' (hereafter 'the Corps') public works projects such as canals and dams. These projects required significant allocations of Federal expenditures to selected states or regions; as such, there was a need to justify the choice of a particular project or site objectively.

Economic theorists also spurred the growth of BCA through exploration of the concepts of efficiency and social welfare in public sector economic policy. BCA has thus developed as a means for welfare economists, government and engineers to evaluate the effect(s) of economic policy and decision-making upon social welfare. Advances largely coalesced to foster widespread governmental application of BCA in the mid-twentieth century.

The following section provides a more detailed discussion of the early implementation of BCA in the United States. Next, we provide a historical synopsis of the development of BCA theory. A final section describes the advent of BCA as formalized in Federal government policy, with particular attention to recent developments.

a. The Engineers

BCA in the US primarily arose not through academic research, but out of a need to facilitate mutual accommodation in a political climate rife with distrust and disagreement (Porter 1995). During the nineteenth century, the French were at the forefront of formalized attempts to develop analyses of public investments. Though US Treasury Secretary Albert Gallatin had advocated for the comparison of water project benefits and costs in 1808 (Hanley and Spash 1993), American efforts to analyze public investments were usually ad hoc until the Corps,

borrowing from the French model, entered the picture in the early twentieth century (Porter 1995).

The Corps' use of BCA was motivated by a Congressional desire to allay conflict and build consensus. Attempting to better govern its own massive earmark spending on contentious water projects, Congress recognized the Corps as a relatively neutral and respected arbiter in Federal water project controversies, and thus sought to use the prestige of the Corps to promote procedural regularity and give public evidence of fairness in project selection (Porter 1995). The subsequent passage of the Rivers and Harbor Act of 1902 mandated that the Board of Engineers for Rivers and Harbors, also established by the Act, certify water projects as beneficial (Hammond 1966), as Congress evidently found the ideal of efficiency sufficient to serve as a coordinating principle to facilitate tractable decision-making and curb rampant spending. A later amendment to the Act in 1920 further required Corps-recommended projects to promise benefits in excess of costs (Hammond 1966). Porter (1995) notes that this project approval process was not a mere formality: the Corps rejected more than half of proposed projects, usually on the basis of economic unfeasibility (Porter 1995).

Depression-era public works spending and ongoing flood concerns further spurred the application of BCA through the Flood Control Act of 1936. This Act stated that the Corps was to evaluate water resource project benefits and costs "to whomsoever they accrue" (Hanley and Spash 1993). The Act allowed Congressional authorization only for projects that had been approved by the Corps. However, Porter (1995) notes that the Act's explicit requirement for Corps approval on a BCA basis was already standard Corps practice. Though project approval methodology still left ample room for political influence and special interest legislation, Congressional passage of inefficient large public works bills was significantly curtailed; the Corps' economic analyses limited debate such that the approval of truly egregious projects became more rare (Porter 1995).

Initially, economic figures put forward by the Corps were accepted without reservation. However, the Flood Control Act had neglected to specify appropriate metrics for benefits and costs, which resulted in each Federal agency developing criteria biased towards its own initiatives (Quade 1971). Accordingly, rival techniques and standards for BCA were introduced. After 1940, this led to controversy regarding Corps decisions, as powerful interests including major utilities, railroads, and rival Federal agencies (especially the Bureau of Reclamation and the Department of Agriculture) called various technical figures into question and pushed for rigorous standardization (Porter 1995).

In 1945, four federal agencies—the Army Corps of Engineers, Federal Power Commission, Bureau of Reclamation, and Department of Agriculture—commissioned a "subcommittee on costs and benefits" (N.A. 1945, 315/2/1) in an attempt to resolve these differences by relying on basic economic principles. However, while the subcommittee's report served to clarify points of difference, such as project life and the degree of side effect inclusion, they could not officially resolve different principles and standards as the committee lacked formal bargaining power to develop unilateral customary procedures (Porter 1995). Thus, the committee largely left the task following their descriptive efforts, but a small USDA working group tasked by the subcommittee to prepare "an objective analysis of the problem" persisted (Porter 1995). In 1949, this

working group distributed a report titled "Objective Analysis" (Porter 1995). However, this report, known colloquially as the "Green Book," failed to reconcile cost-benefit practices and, while influential, did not gain official standing (Quade 1971).

b. The Economists

The modern economic basis for BCA builds on the early formalization (1844) of consumer surplus associated with Jules Dupuit, civil engineer and self-taught economist (Ekelund and Hébert 1999), and Vilfredo Pareto's foundational study of the distribution of income and economic efficiency (1896). Theoretical advancement of Pareto's work in the 1930s rendered economists significant actors alongside engineers in the benefit-cost field. From Pareto's work comes the concept of a "Pareto improvement" which occurs when, as the result of an allocation change, at least one person is made better off and no person is made worse off. A second term, "Pareto efficiency," is a state that is attained when no further Pareto improvements are possible. There are two forms of Pareto efficiency: In its strong form, Pareto efficiency holds that state A is preferred to state B when state A is ranked higher than state B for one person and all other persons rank A at least as high as B. In its weaker form, the utility (well-being) of each individual must be higher in state A for state A to be preferred (Boadway and Bruce 1984). In practice, the unanimity requirement of the Pareto efficiency criterion is paralyzing as an empirical decision-making tool as almost every policy decision engenders winners and losers. A more pragmatic substitute for the Pareto criterion, developed in light of this limitation, is the "Potential Pareto," or "Kaldor-Hicks", criterion.

The Kaldor-Hicks (KH) criterion arose during the late 1930s out of discussions among leading British economists about the adoption of the Corn Laws in 1815 and their repeal in 1846 (Harrod 1938; Robbins 1938; Hicks 1939). Earlier economists had generally assumed that each individual had an "equal capacity for enjoyment," and that gains and losses among different individuals could be directly compared (Mishan 1981; Hammond 1985). For example, Harrod (1938) argued that the net social benefit from a policy could be established on the assumption that the individuals affected were equal in their capacity to enjoy income. By 1939, however, leading British economists began to question the validity of making interpersonal comparisons of utility as required for such policy prescriptions (Hicks 1939). For instance, Hicks' contemporary Lionel Robbins wrote that interpersonal comparisons of utility could not rest on a scientific foundation since utility cannot be measured, and thus the justification for such comparisons is more ethical than scientific (1938). Nicholas Kaldor proffered a solution, acknowledging the inability of economists to establish a scientific basis for making interpersonal comparisons of utility, but suggesting that this difficulty could be rendered irrelevant (1939). Kaldor sought to avoid interpersonal utility comparisons by separating equity from efficiency, arguing that policies engendering an increase in aggregate real income are always

desirable because given such a change the *potential* then exists to make everyone better off:

> [T]he economist's case for the policy is quite unaffected by the question of the comparability of individual satisfaction, since in all such cases it is possible to make everybody better off than before, or at any rate to make some people better off without making anybody worse off. (Kaldor 1939)

According to Kaldor's revised criterion of economic efficiency, a hypothetical project is desirable if the money measure of gains exceeds the money measure of losses, since there is then the potential for a transfer between winners and losers that could satisfy the basic Pareto criterion. Using the change in aggregate gains as the measure of efficiency was thought to separate efficiency and distributional effects and thus avoid interpersonal utility comparisons (Kaldor 1939). Contemporary thinking held that only politicians (or at least non-economists) should make judgments and decisions about income distribution effects. Eager to separate considerations of efficiency from those of distribution so as to put economics on safe ground as an objective policy instrument, Kaldor noted that whether *actual* compensation should take place "is a political question on which the economist, qua economist, could hardly pronounce an opinion," (1939). He thus proposed that decision-makers address ethical values regarding equity outside the purview of BCA. Hicks, perhaps the most prominent economist of the time, accepted the Kaldor approach, which eventually became known as the Kaldor-Hicks (KH) criterion.

The KH criterion did not truly obviate concern about making interpersonal comparisons of utility, however. The KH assumption of equal marginal utility of income in fact embraces such comparisons in a very particular way, where all people are treated equally in terms of the value they place on changes in income. To address this, Kaldor endorsed the procedure adopted by Pigou (1920), which Kaldor describes as "dividing welfare effects into two parts: the first relating to production, and the second to distribution" (Kaldor 1939). Kaldor suggests, "the economist should not be concerned with prescriptions at all . . . For, it is quite impossible to decide on economic grounds what particular pattern of income-distribution maximizes social welfare" (Kaldor 1939). By taking this approach, BCA has been led to largely ignore the concept of moral sentiments as goods even though they may in fact fit the economic definition of goods, in that there is a willingness to pay for them.

In recent decades, BCA has continued to evolve in keeping with economic theory. Many of the current principles and standards identified in this project reflect this. For instance, growth in economic theory regarding the valuation of non-market goods and services has fostered increasingly comprehensive economic analyses. Valuation methods for non-market goods and services such as the travel-cost method (Hotelling 1949), hedonic valuation (Rosen 1974), and contingent valuation (CV) surveys (e.g. willingness-to-pay) (Mitchell and Carson 1989) have increasingly gained acceptance as means by which to estimate values for non-market resources in the absence of observable market transactions. Current work regarding stated preference methods, both

CV and conjoined analysis, is at the forefront of current BCA research and development. Other aspects of continued growth and discourse in BCA concern the use of appropriate discount rates to account explicitly for distributional issues, and the treatment of uncertainty in producing estimates. Such refinement in economic methodology has enabled broader application of BCA to analyses of all types of government expenditures and regulatory activities.

Although the KH-criterion remains the standard for BCA today, in recent years, it is of diminishing use in its restrictions. Analysts have lent increasing attention to ethical issues of distribution and intergenerational equity to the extent that KH has in practice been, if not abandoned, seriously eroded. Various approaches have been proposed to account for equity in BCA, including: (1) distributional weighting, where net benefits, expressed in dollars, are weighted by income or some other metric to express an equity viewpoint (Brent 1984); (2) using unweighted net benefits, but applying the KH-criterion separately within each income class as well as in society as a whole (Ng 1984; Farrow 1998; Graham 2008); (3) using well-being rather than money as the metric, and employing a social welfare function that captures equity viewpoints (Adler 2008); (4) use benefits and costs expressed in dollars and measure willingness to pay for ethical sentiments to capture equity (Loomis 2010; Zerbe 2001; 2007; 2009; 2010); and (5) taking a portfolio approach, whereby it is assumed that if a KH test is applied in multiple rulemakings, and that winners and losers are considerably mixed, then in the long run *most* (but not all) people will better off (Hicks 1941; Graham 2008). What is most commonly advocated though is for BCA to analyze equity issues qualitatively and separately from efficiency, by presenting policy-makers with the best distributional information possible and letting them weigh equity concerns implicitly (e.g., Jones-Lee, 1976). To date, this final approach is the most common practice throughout the world, and though we touch on these other approaches, this is our formal recommendation below in our principles and standards. Recent findings, (e.g. Cai et al. 2010) call into question the validity of the long-assumed separation between equity and efficiency, however, so future Principles and Standards revisions will need to revisit this issue.

c. Application to Broader Governance

The use of BCA at the federal level expanded beyond Army Corps applications in the 1960s, as former Defense Secretary Robert McNamara instituted BCA within the Defense Department's Planning and Programming Budgeting System (PPBS) (Fuchs and Anderson 1987). Though President Lyndon Johnson expanded the use of PPBS throughout the executive branch in 1965, the program failed due to its complexity, difficulty in implementation, and lack of sustained presidential support. The program was officially terminated in 1971 (Fuchs and Anderson 1987). Six years later, in an attempt to solidify executive branch control over federal regulatory agencies, President Richard Nixon included BCA in his "Quality of Life Review" process for agency regulations

(Fuchs and Anderson 1987). In a similar vein, numerous Executive Orders, regulatory commissions, and other executive actions pertaining to federal agency regulations undertaken by President Gerald Ford and President Jimmy Carter contain language referencing the weighing of benefits and costs to one degree or another (Fuchs and Anderson 1987).

The use of BCA in federal decision-making was formalized beyond simply referencing benefits and costs in 1981, when President Reagan issued Executive Order (EO) 12291. EO 12291 required that Regulatory Impact Analyses be conducted for major government initiatives (Reagan 1981). As noted by Philip Shabecoff in a *New York Times* article on November 7, 1981, "[President Reagan] transformed with a stroke of his pen what had been a useful economic tool into an imperative of Federal decision making" (Shabecoff 1981). Among other things, the executive order declared that: (1) Regulatory action shall not be undertaken unless the potential benefits to society for the regulation outweigh the potential costs to society; (2) Regulatory objectives shall be chosen to maximize the net benefits to society; (3) Among alternative approaches to any given regulatory objective, the alternative involving the least net cost to society shall be chosen; and (4) Agencies shall set regulatory priorities with the aim of maximizing the aggregate net benefits to society, taking into account the condition of the particular industries affected by regulations, the condition of the national economy, and other regulatory actions contemplated for the future (Reagan 1981). As a result of this order, the Office of Information and Regulatory Affairs (OIRA) within the White House Office of Management and Budget (OMB) became the central clearinghouse for all substantive agency rulemaking, at the time reviewing between 2,000 and 3,000 rules per year. President Reagan's subsequent EO 12498, issued in January 1985, furthered this commitment, requiring each federal agency to submit a regulatory plan to OMB discussing all significant current or proposed regulatory activity for yearly review (Reagan 1985).

In 1993, President Clinton introduced EO 12866, at once revoking both EO 12291 and 12498 and establishing a new format for OIRA reviews. Order 12866, titled "Regulatory Planning and Review," sought to promote four broad objectives: (1) to enhance planning and coordination with respect to both new and existing regulations; (2) to reaffirm the primary role of Federal agencies in the regulatory decision-making process; (3) to restore the integrity and legitimacy of regulatory review and oversight; and (4) to make the process more accessible and open to the public (Clinton 1993).

President Clinton's order stated that when making regulatory decisions, both qualitative and quantitative costs and benefits should be incorporated into an assessment of all alternatives, including the status quo, and that the alternative that maximizes net benefits should be clearly identified. Of particular relevance to this Principles and Standards project, EO 12866 established twelve prescriptive principles for adherence to the new regulatory philosophy. The EO specified that performance objectives of a chosen regulatory policy must be specified and that stakeholders significantly affected by a regulation must be consulted. Other sections within the EO reorganized the regulatory review structure (Section II), developed a planning mechanism (IV), and centralized regulatory review within OIRA (VI). Section III prescribed the litmus test for

determining what regulatory decisions must be subject to these review standards, stating that any regulation action that is likely to "[h]ave an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities" qualifies as "significant regulatory action" (Clinton 1993).

In compliance with EO 12866, OIRA organized an interagency review committee with representatives from every major Federal regulatory agency to examine the state of the art for the economic analysis of regulatory action. Three years later, in 1996, the group released a "Best Practices" document detailing the appropriate standards and methodology under which to conduct analysis of significant regulatory action as mandated by Clinton's Executive Order (US OMB 1996).

In 2003, the OMB under President George W. Bush issued Circular A-4 (US OMB 2003), which details methods for identifying benefits and costs as well as informs agencies what should be included in a BCA. The document replaced the 1996 "Best Practices" publication and a subsequent guidance form issued in 2000 (US OMB 2000). In Circular A-4, OMB refers to the combination of BCA and other information as "regulatory analysis". The document gives details regarding required aspects of a regulatory analysis, including a statement of need for a rulemaking, an identification of regulatory alternatives, and an identification of benefits and costs. According to Circular A-4, regulatory analysis must also establish a baseline for the comparison and must separately describe the "distributional effects" of each alternative (i.e. how both benefits and costs are distributed among sub-populations of particular concern) so that decision-makers can properly consider these distributional effects along with the effects on economic efficiency.

The George W. Bush administration also produced more formal guidelines for agencies conducting BCAs, focusing analysis on the calculation of net benefit. In 2002, EO 13258 installed "regulatory policy advisors" in place of the Vice President for duties related to regulatory oversight, OIRA, and regulatory conflict resolution (Bush 2002). EO 13422, issued in January 2007, amended Clinton's EO 12866 in five major ways: (1) it required that agencies identify the specific market failure or issue prompting regulation in writing; (2) it ordered agencies to designate a presidentially appointed intra-agency "regulatory policy officer" to control upcoming agency rulemaking; (3) it required yearly estimates summing the cumulative benefits and costs of agency rules expected to reach publication in the coming year; (4) it expanded executive influence by broadening OIRA review to include significant guidance documents, defined as "agency statement[s] of general applicability and future effect, other than . . . regulatory action[s], that set forth a policy on a statutory, regulatory, or technical issue or an interpretation of a statutory or regulatory issue;" and (5) it permitted agencies to use more formal rulemaking procedures when warranted (Bush 2007).

In January 2009, President Barack Obama issued EO 13497, which formally revoked EO 13258 and EO 12866 and installed an updated version of President Clinton's EO 12866 (Obama 2009a). The Obama Administration's October 2009 Executive Order (13514), titled "Federal Leadership in

Environmental, Energy, and Economic Performance" significantly addressed regulatory review and cost-benefit analysis. EO 13514 mandates retrospective BCA policy analysis through annual performance evaluation to enhance accountability and extend or expand projects that have net benefits and reassess or discontinue under-performing projects (Obama 2009b).

In keeping with this emphasis, a December 2009 proposal submitted by the White House Council on Environmental Quality to the National Academy of Sciences (NAS) for review seeks to update Federal principles and standards for water resources planning and decision-making. The document seeks to update and expand the established principles and guidelines in place for water resource projects, currently collected as the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (US Water Resources Council 1983). The proposed revisions aim to modernize national water resources development by increasing the role of science in decision making, incorporating both monetary and non-monetary benefits in the calculation of net benefits, and ensuring the transparency of analyses and determinations.

Most relevant for our purposes, the proposal seeks to expand the purview of these principles and standards to encompass all Federal agencies that undertake water resource projects, whereas current guidelines only pertain to the US Army Corps of Engineers, Bureau of Reclamation, Natural Resources Conservation Service and the Tennessee Valley Authority. The NAS is expected to submit commentary on the proposal in November 2010. The intent is for this new set of principles to provide overarching standardization for analyses and decision making, under which each Federal agency will draft an "Implementation Guidance" document detailing how the common principles apply to its agency-specific mandate. Though only in the review stage, this effort at honing trans-agency principles and standards for BCA represents a significant development in the effort to achieve standardization. The scale, scope, and import of water-resource related Federal projects are such that this attempt at BCA standardization represents a significant step towards a broader Federal standardization.

The Presidential budget proposed for FY2011 (Obama 2010) also affirms a move to increasingly cohesive, sophisticated Federal BCA.[1] While no specific principles and standards are outlined within the document, the budget proposal informs the development of principles and standards by addressing the underlying goals and intent of future Federal BCA. Within the Analytical Perspectives: Performance and Management section, the budget proposal states that more sophisticated evaluation methods are required to answer fundamental questions about the social, economic, or environmental impact of programs and practices by isolating the effect of Government action from other possible influencing factors (Obama 2010). Agencies seeking funding are required to

[1] The proposals in the President's Budget are also discussed in OMB's 2010 Report to Congress on the benefits and costs of Federal regulations. More generally, the OMB's annual reports to Congress provide updated information on Federal regulatory analyses and related concerns, including issues relevant to the conduct of BCA (http://www.whitehouse.gov/omb/inforeg_regpol_reports_congress/).

demonstrate that their 2011 funding priorities are based upon credible empirical evidence—or a plan to collect that evidence—and to identify impediments to rigorous program evaluation in their statutes or regulations so that these might be addressed going forward (Obama 2010). For instance, the document notes "The Administration… has made a concerted effort to increase investments in early childhood education and home-visiting programs that are backed by strong evidence—because rigorous evidence suggests that investments in those areas have especially high returns" and further calls for retrospective BCA analyses, noting: "Historically, evaluations have been an afterthought when programs are designed—and once programs have been in place for a while it can be hard to build a constituency for a rigorous evaluation" (Obama 2010).

While such comprehensive Federal legislation requiring the broad use of a formal, standardized BCA framework has yet to be approved by Congress, the presence of BCA as standard practice in governmental decision-making is nonetheless apparent within various levels of government. Since the initial expansion of BCA beyond the Army Corps, intra-agency application and development of BCA practices has mirrored Congressional and Executive Branch actions described above. Though space does not allow for a detailed discussion of each, the US Environmental Protection Agency, Department of Transportation, Federal Aviation Administration, Department of Homeland Security, Department of Justice, Department of Housing and Urban Development, Department of Education, and Department of Health and Human Services (to name several significant actors) have all developed internal guidelines and BCA protocols in response to the aforementioned Executive Orders and OMB circulars.[2] However, there currently is no overarching framework of inter-agency principles and standards beyond general guidance as provided by OMB and the Executive Branch.

Momentum is building towards increasing standardization, largely precipitated at the agency level and by the Executive Branch. In a February 2009 Memorandum to the heads of Executive Departments and Agencies (74 FR 5977), President Obama directed the head of OMB to prepare a comprehensive set of recommendations pertaining to regulatory review at the Federal level. This call for input sought to examine the role of cost-benefit analysis and related distributional concerns, disclosure and transparency, in preparation for the coming issuance of an Executive Order on Federal Regulatory Review. These documents reveal interest in and impetus for the development of a comprehensive, coherent standardization of BCA for decision analysis and implementation. Likewise, as the proposed Presidential FY2011 budget document notes, far beyond the desire for consistency and efficiency, there exists a public right to governmental accountability and a justified expectation for prudent allocation of scarce fiscal resources that increases the need for consistent, standardized BCA in practice (Obama 2010). Currently, the most comprehensive set of guidelines for conducting BCA on government projects and regulation remain OMB Circulars A-94, "Guidelines and Discount rates for

[2] The Benefit-cost analysis center at the University of Washington Evans School of Public Affairs is currently in the process of assessing these various documents. Draft reviews are available by request online at http://evans.washington.edu/research/centers/benefit-cost-analysis.

Benefit-Cost Analysis of Social Programs" (US OMB 1992) and A-4 "Regulatory Analysis" (US OMB 2003).

While there is no comparable set of standards or history of use of BCA in state and local governments, there is growing momentum to that end. For example, the State of Washington, through the Washington State Institute for Public Policy (WSIPP),[3] now performs analyses of significant new social programs, and many states have adopted regulatory review policies (though of widely varying structure, scope, and impact) (Schwartz *in press*). A forthcoming report by the Institute for Policy Integrity[4] at the New York University Law School provides a detailed discussion of the regulatory review process on a state-by-state basis (Schwartz *in press*). In addition, there is growing interest in using BCA in non-governmental settings, such as non-profit human services agencies. It is our belief that these Principles and Standards should apply to these growing areas as well.

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IV. Criticisms of BCA

Given the role of benefit-cost analysis (BCA) in governmental decision-making and the significant implications of policy decisions informed by such analysis, it is hardly surprising that both the process and application have long come under scrutiny. As noted previously, criticism has often served as the impetus for the growth and honing of BCA as a discipline and tool. Present criticism might best be divided into two categories: (1) philosophical concerns, generally broad questions of ethics, morality, and BCA usage; and (2) economic/technical issues, usually more pointed critiques involving questions such as non-market valuation and discounting. However, a more significant division is without doubt the dichotomous perspectives of BCA that inform BCA critics and proponents; much criticism of BCA has little to do with BCA, but rather with ongoing questions regarding the usage of science and expertise in decision-making.

Much of the criticism directed towards the use of BCA tackles a straw-man: BCA as a mechanistic decision-making criterion. Conversely, its best proponents present and defend a method by which to provide knowledge and inform possible outcomes. This dichotomy is by no means unique to the discipline of BCA; rather, it is one example of the debate surrounding science in many forms and across many disciplines. Sarewitz (2004) writes that scientific inquiry is inherently and unavoidably subject to politicization in a controversial decision-making environment, and thus that "political controversies with technical underpinnings are not resolved by technical means" (1). Fundamentally, most criticism of BCA stems from the pervasive and problematic notion that "science is a source of facts and theories about reality that can and should settle disputes and guide political action" (Sarewitz 2004). Science of any discipline, including BCA, will not furnish a decision without direction as to policy goals or social mores. Yet agreement can sometimes be reached about the means to reach a decision, even if not about the decision itself.

The decision to use BCA is itself an ethical decision. The way in which it is used, however, can rest in considerable part on science. Concerns of inter-generational equity, discounting, and distribution are in the end political or ethical questions with economic or scientific components. Certainly, the approach and rationale utilized for a BCA must be explicitly stated alongside the analysis. While decisions made by the analyst or policy maker are open to critique, it is illogical to condemn BCA itself on such grounds. This point, consistently emphasized in current BCA publications and analysis (as reviewed in Zerbe 2007), obviates much of the criticism levied at BCA; BCA is not a mechanistic decision *maker,* and should not be viewed or presented as such. The proper use of BCA is to furnish information and predictions. Thus, in reality, much disagreement surrounding BCA reflects democratic deliberation regarding values and usage, and does not speak to the legitimacy of BCA in and of itself.

A second overarching criticism contends that BCA is not sufficiently inclusive, encompassing, or informed. As a blanket criticism, such contention is inappropriate given that BCA is fundamentally an application of deterministic modeling. BCA is applied to complex, interrelated social, political, economic,

and ecological systems; complex systems theory holds such systems to be non-linear and intrinsically uncertain (von Bertalanffy 1968; Costanza et al. 1993), inherently limiting the potential accuracy and holism of a BCA model relative to its real-world analog. This is, however the case with any model. Thus, any particular BCA model represents a gross simplification of the real world, intended not to reflect reality in comprehensive detail, but rather to inform decision-making about the likely efficiency of alternative policies. The very premise of modeling, as famously quipped by Einstein, is "to be as simple as possible, but not too simple." As such, BCA processes of system bounding, aggregation, and reduction are not and should not be expected to be wholly definitive and complete. Sarewitz (2004) similarly notes that more information often decreases consensus, as increased information provides an ever-larger pool out of which interested actors can strike differing positions on the history leading to current circumstances, on what is presently occurring, on what needs to be done, and on what the outcome(s) will be.

Certainly, the assumptions and choices made to facilitate a particular BCA might well neglect a crucial process or fail to reflect a key value, and thus appropriately garner criticism as poorly suited for its intended purpose. Criticizing a BCA for inappropriately or insufficiently representing reality in this capacity serves a crucial place in honing BCA principles and standards and increasing the utility of future analyses. However, such criticism fails to resonate when levied as an indictment of BCA more broadly; it is axiomatic that BCA *modeling* does not fully capture the breadth and depth of complex social-economic systems.

This is not so say that all criticisms of BCA are poorly founded; in fact, discerning critics have and continue to drive constructive growth and development within the field. Zerbe (2007) provides a fuller, iterated treatment of specific points of contention regarding BCA. Perhaps the most trenchant criticisms are: First, recognition that the usage of KH and the potential compensation test (PCT) entails a value judgments in and of itself, even though the fundamental premise of practical welfare economists has been to avoid value judgments and interpersonal comparisons of utility in conducting analysis and making policy prescriptions (Chipman and Moore 1978). Second, there is widespread criticism that BCA is missing important values. This criticism reflects the valuation structure and scheme of classic KH and PCT analysis, which does not fully reflect the values and goals we hold as individuals and a society, as it often neglects equity and other moral values (Zerbe 2007).

While including moral sentiments in BCA analysis certainly cannot resolve moral issues (Zerbe 2007), critics are correct in asserting that much past BCA work has failed to incorporate existing moral sentiment into the model and output. Axiomatically, unless BCA includes values held for distributional effects and other "equity goods" (Zerbe 2007), then values will necessarily be missing. And it is missing values that lie at the heart of most legal and philosophical criticism of BCA as a technique. To address this, traditional KH criterion can be expanded to include all sentiments the realization of which there is a willingness to pay (Zerbe 2007; 2008; 2009).

The new framework proposed by Zerbe is comprised of six components as follows:

> (1) That all sentiments for which there is a WTP (willingness-to-pay) or WTA (willingness-to-accept) are included in the analysis, including those concerning distributional and moral sentiments more generally, (2) the elimination of the PCT test and its replacement with the simple requirement that the net present value of a project be positive[5], where (3) the definition of benefits and losses are grounded in reasonable psychological expectations and thus in large part in law, (4) the understanding that the proper use of BCA is to furnish information and predictions and not to furnish the decision, (5) that transactions cost economics rather than market failure is the basis for a justification that government intervention might be useful, and (6) that there is a moral basis for BCA (Zerbe 2007).

As a basic methodology for conducting BCA, these components address both the broader philosophical criticisms of BCA discussed previously as well as more specific concerns of ethics and morality, namely that (1) inter-generational equity is untreated; (2) either immoral values are included or moral values are excluded (the basis for past headline-worthy contentions that BCA fails to universally denounce slavery for instance (Dworkin 1980)); [6] and (3) that BCA does not include moral sentiments (Fried 1978).

Grounding these moral inclusions and exclusions in law ensures that the application of BCA does not project its own inherent value system in a similar manner to that of classic KH and PCT methods. For instance, a thief's valuation of ill-gotten goods would not be included given the legal prohibition against theft, unless the legality of the theft itself were the issue.[7] This exemplifies how BCA builds upon KH by fostering a more holistic, inclusive assessment of held values; it assumes from the illegality of the act that should a broader BCA be conducted, that the social value placed upon prohibiting theft would have the same compensatory effect as simply excluding stolen gains due to their illegitimacy (Zerbe 2007). Such a distinction might seem trivial, but if BCA were

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[5] The PCT should be abandoned as it is not identical to a positive net present value and historically ignores moral sentiments (Zerbe 2007; Boadway and Bruce 1984).

[6] It is important to note that this criticism is a "proof of concept" critique; in practice, clearly no modern economist would be comparing various policy options that include slavery. Nonetheless, this criticism is somewhat specious in that it belies the practical point that BCA cannot stipulate a moral framework, but rather the economic analysis only reflects the legal and moral framework to which it is applied; thus, BCA would weigh positive values associated with slavery only in a case where slavery is deemed an acceptable policy option. Where BCA is employed retroactively to past time periods, it fails to chart a moral course against segregation, torture, acts of violence, and many other actions that modern society rejects precisely because such actions were legally and socially permissible in the given time period; BCA can only reflect existing values and legal standards, not dictate them.

[7] This might seem intuitive, but it is important to note that economists (e.g. Rajkumar and French 1997) have in the past argued that property loss not be included as a cost since it merely represents a transfer of property from one party to another; by not including the thief's value for the stolen good, but still including the good's value to its rightful owner, the resultant effect is to count the lost property as a cost. Thus, the question is not actually whether a thief's value of the good should be included, since standard BCA would also likely not include this value, but rather whether the stolen good should be counted as a cost to its legal owner.

merely to instill a new valuation system (even one with seemingly positive aspects such as excluding stolen values) rather than seek to expand the purview of analysis in order to fully reflect actual values held, then it would run afoul of the same criticisms levied previously against BCA. Grounding BCA within a legal/psychological foundation draws from existing moral sentiment and thus prevents the analysis itself from being the arbiter of moral and immoral values.

In most cases, BCA as formulated here can provide a straightforward and defensible methodology for appraisal, basing the usage of willingness-to-pay (WTP) or willingness-to-accept (WTA) upon existing rights. Where a good or service is not legally possessed, WTP measures the amount one might pay to obtain it; WTA furnishes the converse estimate, assuming ownership based upon the existing legal foundation and estimating what one might accept to sell or forgo a good. This is not to say that the distinction between WTA/WTP conveys ownership, but rather that the appropriateness of using a WTP estimate versus a WTA estimate is determined by the existing legal ownership status or broad expectation of a right.

Often, using WTP/WTA methods to assign values to non-market goods and preferences is controversial. Numerous publications, including Sagoff (2008) and Anderson (1993), have excoriated BCA for misappropriating communal and other such non-market values, claiming that their WTP/WTA conversion into commodity values greatly diminishes their "true" value. The entirety of this debate is beyond the scope of this discussion, but it might be summarized succinctly as the belief that economic science utterly fails to assign "value" to spiritual, aesthetic, ethical, and historical values, especially as held communally.

Without doubt, assigning WTP/WTA values to non-market goods and preferences is inexact; given the intangible, ethereal, nature of concepts such as happiness, how could it be otherwise? BCA does not claim to definitively assign value to such goods, but rather to better recognize the values held for spiritual, ethical, and moral preferences. Moreover, it bears reminder that no policy analysis tool purports to fully include such values; they are by definition inexact.

The facilitating role of BCA cannot be overstated on this point, as in the end democratic deliberation must determine value prescriptions and decide the suitable weight lent to any BCA analysis. There remains much room for improvement in economic assessment and valuation, particularly of non-market goods, and debate over such methods and frameworks serves a crucial, constructive role in improving BCA. In the classic words of statistician George Box, "all models are wrong, but some are useful." The task is to continue to hone and improve BCA as a *useful* policy tool; the application of KHM and this Principles and Standards project represent such an endeavor. As basis for rejecting BCA outright, however, arguments about the limitations of benefit-cost analysis as a justification for its abandonment are without foundation. One would not throw away a good hammer because it failed to tighten a screw, or even because it was used to build a poorly constructed house. Similarly, BCA should not be tossed aside for failing to accomplish what it is not intended, does not purport, nor cannot logically be expected to achieve.

In this vein, we note several technical criticisms that have been levied at either BCA or more particularly at the inclusion of moral sentiments or equity

concerns in BCA. Much of this technical debate is discussed further within the following principles and standards, as these issues have driven refinement in BCA practices and methodology. One technical criticism concerning BCA at large lies in the existence of the Scitovsky reversal paradox (Scitovsky 1941). Schmitz and Zerbe (2008) have shown that the paradox is unlikely to arise in most cases. The technical criticisms of including moral sentiments are primarily twofold; first the possibility that including moral sentiments could result in a positive net present value but not pass the PCT (Milgrom 1993), and second that their inclusion could led to double counting (McConnell 1997). Zerbe et al. (2006) have shown that even if the PCT test were to be retained (and we recommend it be dropped), the inclusion of moral sentiments only results in the problematic effects discussed by Milgrom in trivial cases. Further, Zerbe et al. also show that double counting will not result from the inclusion of moral sentiments, even in the case of non-paternalistic altruism.

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PART TWO: General Principles and Standards for Benefit-Cost Analysis

I. Description of Principles and Standards

The remainder of the document sets out cohesive guidelines for performing benefit-cost analyses of social programs, to foster maximally relevant, accurate, and comprehensive implementation of BCA in social policy decision-making. Part Two first delineates general, fundamental principles that form the underlying philosophical tenets of BCA, and then provides standards for conducting BCA that apply across all social policy sectors. The general principles might be considered the "non-negotiables" that underpin all BCA. The standards present more-specific guidance regarding currently held best theory and practices for different components of BCA. Standards are further divided into theoretical standards, broadly conceived concepts to guide analyses, and technical standards, appropriate methodological techniques for practitioners.

Many aspects of BCA remain fluid and will continue to evolve in keeping with research findings and theoretical advancements; where convention is un-established or no general consensus exists, we have attempted to describe state-of-the-art practices and current research findings that indicate a way forward. These areas especially will demand revision and update in future Principles and Standards volumes. Rather than divide current and developing practices in BCA, we have attempted to combine the two as relevant; where an approach reflects a longstanding professional consensus, but recent research and theoretical advances advocate for a new methodology, we describe both and discuss what implications the new findings have for the old methodology. Many frontier findings and practices for BCA lack firmly established protocol, demand more research, or are currently cost-prohibitive, and thus cannot be codified as explicit standards. However, such issues are hugely important to BCA, and presenting them as related to the relevant established standard allows the analyst room to chart a course that both leverages the best-available research findings and is in keeping with resource demands and the scope of analysis.

The principles and standards that follow strive to further hone the way that BCA organizes knowledge and structures debate. We believe that implementation of the principles and standards presented, as gathered from a commissioned group of experts who practice and study BCA in their various disciplines, will help facilitate more-compatible cross-sector policy comparisons, engender greater transparency so as to make policy debates more tractable, and improve the relevance and comprehensiveness of benefit-cost analyses. In turn, this should foster more equitable, efficient, and beneficial social policy decision-making.

Finally, we acknowledge past publications providing principles and standards for BCA (Arrow et al. 1996), texts on BCA and applied welfare analysis

(Stokey and Zeckhauser 1978; Gramlich 1990; Hanley and Spash 1993; Brent 1998; Jones 2005; Boardman et al. 2006) and major article collections (Layard and Glaister 1994; Schmitz and Zerbe 2009) that provide the foundation upon which these principles and standards are based. Where this report and the appended white papers fail to sufficiently address or describe a concept or practice, we point the reader to these sources. Further, US Office of Management and Budget Circulars A-94 and A-4 provide similar guidance in regards to government projects and regulation (US OMB 1992; 2003); these documents also serve as common resources for BCA standards and practices.

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II. Foundational Principles for Benefit-Cost Analysis

The fundamental role of benefit-cost analysis (BCA) is to provide information that serves to improve decision-making and facilitate better policy outcomes. Graham (2008) makes a strong empirical case that despite various sources of criticism, BCA has proved efficacious in this regard. By monetizing policy outcomes, BCA produces comprehensive assessments of policy interventions that can be compared both within and between sectors. Rather than focusing on sector-specific metrics such as health outcomes, educational attainment, or crime statistics as policy end-goals, BCA takes a broader approach to improving social welfare. This allows policy-makers to weigh investment decisions more holistically and pursue alternative solutions that increase efficiency and better outcomes. This is especially true for social policy decision-making, where significant effects typically accrue outside of the primary policy focus (Vining and Weimer 2010). For instance, by rendering all outcomes in a consistent format, BCA can reveal whether increasing funding for addiction treatments or drug enforcement will likely result in greater net benefits, or alternatively, where a reduction in specific aspect of educational funding is likely to result in the smallest reduction of net benefits. The comprehensiveness and comparability of BCA fosters more efficient governance and increased social welfare.

However, these same demands of comprehensiveness and consistency make BCA a highly demanding and complex endeavor. Given resource limitations and empirical realities, achieving uniformity of analyses is extremely difficult. Models are limited by the accuracy and availability of data, as well as by time and funding constraints. A sizeable proportion of social policy outcomes are experienced as non-market benefits, forcing analysts to develop means to quantify these impacts. Future outcomes are of course uncertain, and thus the analyst must predict expected policy effects. Different policy realms demand specific, nuanced approaches that can in turn make cross-sector comparisons difficult.

BCA is as much an art as it a science, since addressing these difficulties requires creativity, expertise, and careful objectivity on the part of the analyst. Moreover, these aspects drive a great deal of the controversy surrounding BCAs, both in terms of the mechanics of performing an analysis and how the analysis is utilized in decision-making. Debate can take on an ethical component, for instance regarding the issue of intergenerational equity and discounting. Some BCA decisions are inherently "judgment calls," and unfortunately, the decisions and assumptions an analyst must make when conducting BCA can become a source of controversy that obscures the true policy debate when BCA is not presented and utilized properly.

The desire to develop a consistent basis for the large number of decisions an analyst must make motivates this project's effort to establish a common framework for BCA. Developing standardized protocols and best-practice guidelines, reflecting a consensus of expert practitioners and peer-reviewed literature, will make BCA a more effective and less-controversial policy tool,

which we believe will in turn affect social welfare decisions to good effect. The five foundation principles that follow form the basis for the more specific guidelines elaborated upon in the remainder of the document. These foundational principles provide the underlying philosophical framework for BCA work generally, and are not restricted to social policy analyses.

a. Foundational Principles for BCA

Foundational Principle One: BCA is a financial evaluation tool that seeks to calculate values for all project inputs and outputs to determine the net benefit of a given project, policy, or intervention. It seeks to provide an objective framework for discussion, amendment, and decision-making by providing an accurate representation of policy outcomes.

Benefit-cost analysis (BCA) is distinguished from other types of financial evaluations by the fact that it seeks to value inputs and outputs of all forms to derive a comprehensive summary of the net benefits associated with a policy decision (Boardman et al. 2006). Its purpose is to identify the most efficient policy option (Vining and Weimer 2010). For social policy, BCA reflects the extent to which the values that individuals place on program outcomes likely exceed program costs (Robinson and Hammitt 2010). Though a private firm might focus on financial benefits and costs to the firm, BCAs for social policy incorporate all quantifiable outcomes, private and social, direct and indirect, and tangible and intangible (Brent 1996), which are then monetized to facilitate holistic comparison of policy alternatives (Boardman et al. 2006). Valid BCA in this context comprehensively accounts for the full range of social benefits and costs (Vining and Weimer 2010); analyses that do not include significant indirect or spillover effects upon non-targeted populations or effects outside of the given policy spectrum (e.g. crime-reduction engendered by improved education policy) do not meet the standard of BCA. While not all effects can be measured or estimated, any unmeasured or poorly understood effects thought significant must be addressed qualitatively or quantitatively within the analysis. BCA can either be ex ante, when considering an intervention or choosing amongst policy options, or ex post, to gauge project efficacy in order to guide future policy decisions (Boardman et al. 2006).

Though the two terms are often used interchangeably, the term "benefit-cost analysis" rather than "cost-benefit analysis" (CBA). BCA is more closely associated with work of economists, while CBA has a stronger association with engineering disciplines and mechanistic analyses. Though the term CBA, is more widely used, CBA can have a pejorative connotation, as it is frequently utilized by critics in referring to the archetype of a deterministic, value-free calculator of human livelihood. The type of analysis in practice today and codified in this report (BCA) has little (if anything) in common with the CBA straw-man. Language plays a significant role in framing any policy discussion, and thus it is important to emphasize this distinction to increase the acceptability of BCA to policy-makers and the public. Practically, the use of "benefit-cost" instead of

"cost-benefit" helps emphasize that net benefits are the appropriate welfare measure and speaks directly to the true role of BCA.

Finally, we note that before conducting a BCA, one must first determine if BCA is the most appropriate tool to use (Zerbe and Dively 1994). For instance, in some cases benefits or costs are prohibitively difficult to determine. In other situations, the policy choice has already been made and what remains is to decide how to meet the policy objective. For example, a policy maker may decide that the quarantine and treatment of a deadly disease must be undertaken, but the method of achieving the policy goal has not been chosen. If the goal is already determined, cost-effectiveness analysis is be an acceptable alternative to BCA, because it is analyzes the least-cost option to achieve a predetermined goal. Again though, such financial analyses are not fully developed BCAs, and should be carefully distinguished from BCA in language and application. Moreover, in such situations, expanding the policy discussion to allow for BCA instead of a more limited analysis can identify alternative solutions, reveal indirect or unintended effects, and foster better policy.

Foundational Principle Two: BCA is an aid to public policy decision-making; it is not, and should not, be regarded as a substitute for democratic, legislative, and administrative decision-making. Likewise, political influence should not intrude into technical analysis decisions and the analysis process.

Properly used, BCA is not a mechanized decision-making tool, but rather a means of analysis that provides useful information to decision-makers (Zerbe and Dively 1994). BCAs organize data and information in such a way that decision-makers can readily observe the tradeoffs of various decisions (Gramlich 1990; Zerbe and Dively 1994). BCA should present clear information and use transparent methodology such that it structures constructive debate. Likewise, just as BCA should allow for policy-makers to make policy decisions, political actors should not unduly influence technical analysis components or limit the range of alternatives considered (Farrow and Viscusi 2010).

Although BCA is primarily used to provide information, at times the most appropriate action is to rely on the results of the BCA to make a decision. For example, in some situations wasteful, poor decisions are likely to be made in the absence of BCA due to the contentious or political nature of the issue. In other situations, agreement on BCA as a methodology—and on abiding by its results—may render a decision process tractable when an agreement is otherwise unlikely to be reached. In these situations, the role of discourse is confined to the decision to cement the use of BCA—or to require that any policy or project demonstrate net benefits in order to be in approved.

Foundational Principle Three: Transparency enhances the value of BCA for decision-making by facilitating a more comprehensive understanding of the analysis, and properly focuses the policy discussion upon political

issues rather than technical aspects of BCA. Thus, both the analysis process and results should be made as transparent as possible.

Given the complexity of most BCAs, and the large number of decisions that analyst must make when conducting an analysis, it is vital that both the analysis process and results be made as transparent as possible. This ensures that there is accountability for analyst decisions. More importantly, eliminating the "black box" makes BCAs more useful; allowing policy-makers to see where the data come from, what assumptions underlie the model, and what decisions were made regarding what values are included greatly enhances the value of a BCA by facilitating a more comprehensive understanding as to the meanings, implications, and uncertainty associated with final estimates. Thus, transparency is emphasized throughout our theoretical and technical standards, as relevant to that particular component of the analysis.

Foundational Principle Four: Pursuit of the "perfect" analysis should not prevent completion of a useful analysis. A BCA that meets basic acceptability requirements regarding objectivity and appropriate methodology can still be released even if it does not conform to all best practices or is data-deficient.

Different situations may call for different styles or depths of analysis. A "quick and dirty" analysis may be appropriate to determine whether different policy alternatives should be fleshed out, or to point towards a decision for an organization with limited resources. Other situations may require intricate, comprehensive analysis in order to fully reflect the details and complexities of the proposed program or policy. In these situations, the elusive "perfect" or completely comprehensive analysis should not prevent a good analysis from going forward (Farrow and Viscusi 2010).

Farrow and Viscusi identify an axiomatic practical limit to BCA, in that BCA may only provide an analysis of identified benefits and costs. In most cases these known benefits and costs will not be exhaustive, whether because of resource or limitations to quantification. For instance, there are numerous instances where we know that nonmarket goods and ethical considerations have value, but are unsure of what those values are; any BCA is likely to encounter such instances where effects cannot readily be enumerated or valued, and thus the analysis becomes highly conjectural (Gramlich 1990). Social policy analysis can prove particularly complicated, as it involves many effects that are highly difficult to predict and value (Vining and Weimer 2010). In these situations, BCA can contextualize existing information and present the known implications of policy options to decision-makers, while acknowledging and discussing the implications of unquantified and unknown effects. Incomplete knowledge and data-deficient aspects should not prevent an otherwise complete benefit-cost analysis from going forward, as long as appropriate measures for addressing and presenting uncertainty in are BCA are taken.

Foundational Principle Five: BCA should be conducted in accordance with the "Principle of Proportionality." This principle states that the allocation analytical effort should be in direct proportion to the expected value of increased information, defined in this case as the extent to which it might affect a policy decision.

Essentially, an analysis should itself be subject its own internal BCA. Additional time and resources expended towards gathering data, building more complex models, or disaggregating effects increase analysis costs. Thus, the cost of acquiring such information should at least be equaled by the expected decision-making benefit provided by the informational gain. Any expenditure should reflect the value of the information garnered, in terms of the extent to which it might change the policy decision (Farrow and Viscusi 2010). Aspects that should influence the allocation of analysis resources include: (1) the magnitude of the program; (2) the significance of particular effects to overall model outcomes; and (3) the context and relevance of affected markets. This principle applies equally to the various nested levels of analysis, including the number and types of policy options considered, types of benefits and costs, distributional impacts included, and the extent to which such impacts should be assessed (Wiener et al. 2009).

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III. Standards for the Estimation of Benefits and Costs

The aim of benefit-cost analysis (BCA) is to aggregate benefits and costs resulting from policy choices to evaluate their relative efficacy and equity. This seemingly mechanistic prescription actually entails a complex task on the part of the analyst. One challenge is that very few policy outcomes involve only goods and services traded directly on the open market where price is readily observable. Many other goods and services are not traded on the open market, yet these non-market values must be included to provide holistic economic comparisons for decision-makers.

Prices for some goods and services are available through existing research on non-market valuation. Some non-market economic values are found in published literature and established studies (for instance the marginal-excess tax burden). For other goods and services, value estimates have not been sufficiently researched, are poorly understood, require further clarification, or are as yet undeveloped; thus there is no commonly accepted figure (Vining and Weimer 2010). For instance, the value of IQ gains and the treatment of volunteer time are not yet adequately quantified (Vining and Weimer 2010). Given the need for a comprehensive accounting stance, a primary focus of BCA research is the development of better non-market value estimates.

The art of BCA is to leverage available resources so as to provide a useful analysis that reasonably addresses the base question for a given policy decision. Certainly, no BCA contains *all* benefits and costs; rather, the extent of relevant markets, available data and resources, and policy emphases serve to dictate the scope and breadth of values included in the analysis. The emphasis of this section is upon proper estimation of benefits and costs, in terms of building an accurate model and best portraying economic reality. Within this context, the rationale for governing what should be included or excluded from valuation and analysis is based solely upon relevance and significance to overall model outcomes. In a later section on market extent in BCA (Section IV), we discuss legal and ethical aspects that might constrain economic standing and thus exclude some such benefits and costs; this section, however, discusses only guidelines for data gathering, estimation, and modeling. Below are principles and standards detailing current best practices for determining project benefits and costs.

a. Theoretical Standards for the Calculation of Benefits and Costs

Benefits and Costs Theoretical Standard One: The standard theoretical measures of benefits and costs are the willingness-to-pay for gains (WTP) and the willingness-to-accept losses (WTA). However, analyses should

account for divergence between the two metrics stemming from the relative accuracy of qualifying effects as a gain or a loss.

The standard theoretical measure of benefits and costs in BCA remains willingness to pay (WTP), defined as the maximum amount of money an individual would be willing to give up in exchange for a good (or pay to avoid a harm), and willingness to accept (WTA), defined as the minimum amount an individual would require to forego a good (or accept a harm) (Robinson and Hammitt 2010). This has long been thought to correspond to the concept of compensating variation (CV) and equivalent variation (EV) introduced into economic theory by Hicks (1939).

However, research has noted an empirical divergence between WTP and WTA, a discrepancy beyond that which is expected from the income effects encompassed by the CV-EV difference. This poses a longstanding problem for estimating effects in BCA. Classical consumer theory explains divergence between WTP and WTA as a product of income effects, and Willig (1976) proved that WTP and WTA metrics should produce close-to-equivalent values where income effects are negligible, as he argued they often were. This has encouraged analysts to use the WTP, occasionally with Willig adjustments, to calculate both benefits and costs, especially as the WTA is thought to be more difficult to calculate. However, the income effect has been has been found to be an inadequate explanation for the size of the divergence. Thus the Hicksian relationship between CV and EV, which relies on income effects, no longer holds (Zhao and Kling 2004). Horowitz and McConnell (2002) empirically demonstrate substantial WTP and WTA divergence

Kahneman and Tversky (1979) introduced the concept of "Prospect Theory" as a means to further explicate the WTA-WTP divergence. Several behavioral factors explain the greater than expected discrepancy. Divergence arises from: (1) income effects (McBride 2001); (2) substitution effects (Hanemann 1991); (3) Loss-aversion (Kahneman et al. 1991, Morrison 1998); (4) endowment effects (Knetsch 2009); (5) behavior in the face of uncertainty (Viscusi et al. 1987; Zhao and Kling, 2004); (6) the magnitude of change (whereby individuals demonstrate decreasing sensitivity as the change increment becomes larger) (Kahneman and Tversky 1979); and (7) the existence of moral sentiments about the good in question (Anderson and Zerbe 2010).

Benefits and Costs Theoretical Standard Two: Benefits and costs are defined relative to their appropriate counterfactual baseline (i.e. existing policy or currently expected outcomes).

The calculation of net benefits is a relative comparison, relative to a reference point, usually the status quo. The question of causality, whether a given expenditure actually engenders an increase (or decrease) in net benefits or if it in fact has little bearing on the outcome, is central to BCA (Drake et al. 2009). By carefully evaluating the counterfactual baseline, BCA helps identify causal effects and factors that might be unobserved otherwise.

In developing an appropriate comparison, he analyst must predict future conditions, estimate likely responses to a given policy, and determine the likely extent of noncompliance or nonparticipation. The source of comparison plays a very significant role in determining how BCA regards a policy. Thus, analysts must clearly identify the counterfactual being employed and discuss how this relates to comparisons used in similar analyses (Karoly 2010). This ensures that a BCA accounts for the true benefits and costs of inaction, and more importantly evaluates the degree to which the comparative outcome accurately represents the current decision-point.

Benefits and Costs Theoretical Standard Three: As much as possible, analysts should use a consistent BCA approach across multiple public policy outcomes.

Analysts should use a consistent BCA methodology for all projects, since applying the same model to different projects best facilitates accurate comparisons. Even though the input assumptions of that particular BCA model might be biased, utilizing the same model and consistent analysis procedures at least ensures that mean values are biased in the same direction.

Similarly, the analyst should use a common source for basing shadow price estimates. For instance, when monetizing labor market outcomes, the analyst should use a common source, such as the US Department of Labor's Common Population Survey data, whether analyzing a public health project or an education program. This is not inconsistent with the need to adjust figures for the analysis' context. Rather, for an estimate such as that of labor market earnings, which is required in analyses of many different policy sectors, figures should stem from a common source and be adjusted for context using the same methodology utilizing a common method of conducting the benefit transfer. If multiple sources of shadow price information are combined, the analyst must take care to avoid the inconsistency of conflating study estimates derived using different discount rates and currency values.

Benefits and Costs Theoretical Standard Four: The fundamental summary metric of BCA is the net present value of benefits. Though other summary statistics remain prevalent in the language of policy discussion, they provide accurate values only after appropriate adjustments. If the policy-maker desires a different metric (such as the benefit-cost ratio), this should be provided along with net benefits and adjusted to provide an accurate value.

The five most widely used financial indicators are: (1) net present value (NPV); (2) the benefit-cost ratio, calculated as benefits/costs, or more rarely (benefits-costs)/costs; (3) the internal rate of return (IRR), which is the interest rate at which the NPV of investment benefits and costs are equal; (4) the modified internal rate of return, which adjust for deficiencies in the IRR; and (5)

the payback period, which is simply the time required to fully recover investment costs (Zerbe and Dively 1994).

The fundamental summary metric of policy BCA is net social benefits, also termed net-present value (NPV) or simply net benefits. NPV reflects the present value of benefits minus the present value of costs, with all future benefits and costs discounted to a present value. This is the most appropriate metric as it most accurately presents the results of an analysis. One significant advantage of NPV is that it makes no difference whether the benefits are counted as benefits or as negative costs, or whether costs are counted as costs or negative benefits. This is important, because a cost to one individual might represent a benefit to someone else, and thus the concept of benefit and cost categories proves particularly useful (Boardman et al. 2006).

While other summary metrics are popular among non-economists, they are inappropriate for use in BCA unless carefully modified. For instance, policy-makers often look to a benefit-cost ratio, where benefits are divided by costs. Though using such a ratio can identify whether a project has positive net benefits, it does not facilitate comparison amongst projects that all demonstrate positive net benefits, as the ratios do not necessarily reflect an ordering of projects based upon net present benefits. Given that metrics such as benefit-cost ratio remain significant in the language of policy discussion, it might be appropriate to provide such a metric if desired by policy-makers. However, net benefits should always be the fundamental metric of BCA, and any other figures should be provided alongside net benefits and carefully adjusted to ensure their accuracy. Zerbe and Dively (1994) provide means by which to adjust other summary metrics to provide accurate figures.

b. Technical Standards for the Calculation of Benefits and Costs

Benefits and Costs Technical Standard One: The comprehensiveness of the analysis framework should be determined by the principle of proportionate analysis. BCA should consider general-equilibrium (GE) effects where the effort required is justified by the expected importance of these effects in altering a policy decision.

How resultant policy changes are characterized is a key distinction between partial and general equilibrium analyses (Klaiber and Smith 2010). Partial-equilibrium (PE) measures select a subset of policy effects. General-equilibrium (GE) analysis, on the other hand, aims to take into account most or all effects of a policy. In practice, the framework employed by most analyses falls on a spectrum between a strict PE framework that analyzes only the targeted market and a fully computable general equilibrium (CGE) model. Resource, data, and computational limitations often serve to determine the method used. Klaiber and Smith note that the term "general equilibrium" in practice can represent several different types of analysis. A GE analysis might consider

effects through more than one market, or describe a policy's effects on prices, incomes, and non-market services affected by market decisions (Klaiber and Smith).

Most social policy analyses employ a modified PE framework that incorporates impacts in multiple (assumed-to-be) independent markets or takes account of interdependencies in several select markets, striking a compromise between practical limitations and the need for comprehensiveness. This model is much less resource-intensive than CGE models, and can provides a suitable basis for sound decision-making. Moreover, in many instances, the stakes are simply not high enough to justify building a full CGE model. Direct cost analysis might even prove more appropriate then a simple PE model for smaller social policy programs (EPA 2008). Small interventions based on quasi-experiments or field research, community-based programs, and similarly small-scale policies can be modeled efficiently and with reasonable accuracy without the complexity of even a PE framework.

The inclusion of GE effects can significantly affect the results of BCA when there are significant distorted markets (Goulder and Williams 2003; Fullerton and Heutel 2010; Klaiber and Smith 2010). A policy that proves either beneficial or inefficient when analyzed for its effect within a specific market might prove otherwise when the same policy choice is evaluated across all relevant sectors. For instance, an educational policy that fails to provide full return on investment in terms of increased graduation rate or better classroom performance might prove warranted given expected benefits accruing from decreased crime, lessened social welfare expenditures, or increased public health (Heckman 2006; 2008).

A full GE analysis is a theoretical construct; it is impossible to measure the effect of a policy on every market in the economy. The intent of a GE framework should instead be to evaluate a sufficient number markets alongside the targeted market so as to provide a reasonable approximation of the results of a theoretically complete GE analysis. Though it is somewhat counter-intuitive, Goulder and Williams (2003) demonstrate that the relative importance of including general-equilibrium effects is largely independent of the size of the *targeted* market. Rather, it is crucial to include effects related to *affected* markets that exhibit some combination of: (1) a large difference between social marginal benefit and social marginal cost of the good (highly distorted); (2) size of affected market; and (3) tight linkage to the targeted market (significant cross-elasticity). Thus, the degree to which an analysis employs a partial or general framework should be a function of: (1) data and resource availability; and (2) the presence of affected markets that are highly distorted, large-scale, or tightly linked to the targeted market, and thus are highly relevant to the analysis (Goulder and Williams).

Benefits and Costs Technical Standard Two: Where possible WTP measures should be used for gains and WTA measures for losses. Where this is not done, the analysis should include a clear discussion of the bias from this omission and the rationale for the choice between WTP and WTA.

The analyst often has to select between using WTP and WTA measures of policy effects. Though typically property rights can inform the appropriate choice, in many cases, such as that of non-market goods, property rights are poorly defined and legal definitions often prove incongruent with individual's reference points (Robinson and Hammitt 2010). Thus, the analyst should carefully describe and examine the implications of choices made regarding the use of WTP and WTA variables.

In practice BCA frequently utilizes unadulterated WTP estimates, even where WTA figures would be theoretically more appropriate. One constraint may be data limitations or the principle of proportionate analysis (see Chapter VII, Risk and Uncertainty). However, the rationale behind using such an estimate should be discussed. Where WTP and WTA figures are likely to differ significantly for BCA analysis, attention should be paid to the effect this divergence might have on the results.

The analyst can use sensitivity analysis to examine impact of potential variability (Robinson and Hammitt 2010). For example, where the concepts of the reference state and loss aversion indicate that WTA values might be most appropriate, but the BCA utilizes WTP estimates, the analyst would likely need to examine model sensitivity to possible WTA values (Robinson and Hammitt 2010).

Generally, in addressing WTP/WTA discrepancy, the analyst should avoid making a priori decisions as to whether values are rational or stable, and consider psychologically-salient attributes of behavioral research on benefit values and the effects of other physical and psychological characteristics using the best available quantitative and qualitative methodology (Robinson and Hammitt 2010).

Benefits and Costs Technical Standard Three: Values and estimates culled from secondary sources should be modified for relevancy using a benefit-transfer function (also see Chapter VII, Risk and Uncertainty).

Rather than being a specific, universally applied equation, a benefit-transfer function is a correction developed specifically for the current analysis that reflects the focal statistical population. Given finite resources and time constraints, BCA usually entails applying estimates of effects, non-market benefits, and other figures derived elsewhere in a different study or decision context (Boardman et al. 2006). The point estimate might have been developed under assumptions inappropriate for the current analysis, or else the figure might simply pertain to a project of different magnitude, temporal context, or regional physical and socioeconomic characteristics (Boardman et al. 2006). For instance, differing population incomes might need to be accounted for using relevant demand elasticities (Farrow and Viscusi 2010). Similarly, commonly used values might require adjustment for the current situation; the value of a statistical life developed in a workplace context might be different for deaths due to other occurrences (e.g. terrorism) or other demographics (e.g. the elderly), and the recreational benefits of a beachfront park would lack relevancy to a landlocked town (Farrow and Viscusi 2010).

A benefit-transfer function thus adjusts the estimate for these conditioning factors (Farrow and Viscusi 2010). Robinson and Hammitt (2009) provide five steps that comprise the benefit-transfer process:

> 1. Describe the Study Scenario. Determine the characteristics of the risks and populations to be addressed by the target study; i.e., in the case of the refinery study, the types of risks associated with air population and the characteristics of the affected Sub-Saharan African population.
>
> 2. Identify Potentially Relevant Existing Valuation Research. Search the valuation literature for primary research studies that address similar populations and types of effects.
>
> 3. Review Existing Studies for Quality and Applicability. Assess the quality of the primary research studies by determining whether they follow generally accepted best practices in terms of the data and methods used. Assess applicability in terms of: (a) the similarity of the health effects; (b) the similarity of the populations experiencing the effects; and, (c) the ability to adjust for differences between the scenarios in the primary research study and in the target study.
>
> 4. Transfer the Estimates. Conduct the transfer, making any necessary adjustments to the primary research estimates and applying them to the target scenario. This transfer may be based on the results of a single study or several studies.
>
> 5. Address Uncertainty. Address uncertainties in the estimates both qualitatively and quantitatively; e.g., by conducting sensitivity or probabilistic analysis as appropriate and discussing the implications for decision-making. (13)

Given that there are often numerous (and incongruent) estimates in use, the appropriateness of using a particular figure and of making subsequent adjustments should be discussed. Transferred values should be explicitly identified and the analyst should provide rationale for the use of each one. As stated in Step 5 of the benefit-transfer function above, such "borrowed" estimates should be included in sensitivity analyses and Monte Carlo simulations to evaluate the significance of the figure overall within the BCA.

Finally, it is not always possible to develop a benefit transfer function. In such cases, the issue of transferability must be addressed using sensitivity analysis or qualitative methods. Hammitt and Robinson (2010) and Robinson et al. (2010) provide examples of how this can be accomplished.

Benefits and Costs Technical Standard Four: Non-market benefits and costs should be estimated using the current methodology appropriate for the given context.

Non-market values, defined as values for outcomes not directly traded in markets, can often comprise a large portion of total project outcomes for social policy evaluations. Thus, non-market valuation techniques are of vast importance. Non-market outcomes are valued using either revealed- or stated-preference methods.

In revealed-preference valuation, the analyst utilizes data from market transactions or observable behavior to estimate the values of nonmarket goods associated with the observable transaction. One example of revealed-preference valuation is hedonic regression. Hedonic regression uses revealed preferences to develop proxy values that reflect the value of various component characteristics not directly monetized as stand-alone values. Essentially, the overall value of a heterogeneous commodity that can be characterized as a bundle of distinct characteristics (e.g. the market price of a house) can be regressed on the quantities of each of these characteristics to impute a marginal price for each characteristic (such as the price per unit of local air quality) (Champ et al. 2003; Boardman et al. 2006).

For instance, values related to public safety interventions might be established hedonically through real estate prices. Variation in housing prices due to heterogeneously bundled risk components such as proximity to or possibility of exposure to environmental toxicity, natural disasters, crime, and other risk factors can reflect the values related to particular factors (Loomis 2010). Hedonic regression reduces concern regarding omitted variables and self-selection bias in the calculation of such values where the analysis lacks a true null analog (the textbook example being in real estate, where no two houses represent the exact same bundle of characteristics).

Stated-preference valuation methodologies use answers generated in a hypothetical choice scenario to estimate the value of non-market goods (Champ et al. 2003). Individuals are asked how they would behave in a hypothetical market, and these responses are analyzed to produce valuation estimates. One commonly used stated-preference method is contingent valuation (CV), where survey participants are presented with a policy scenario, and asked to give a WTP value for a gain or a WTA value for a loss regarding a good or service that is not directly or indirectly reflected in an expenditure or assess (Champ et al.). This technique primarily arose in environmental project analyses as a means to quantify use and non-use values such as an improvement in air quality or the continued existence of a species. CV is typically appropriate where a project has impacts that are not directly felt or experienced by people with standing in the analysis (Zerbe and Bellas 2006).

A second stated-preference method is conjoint analysis. Rather than asking participants to give a WTP or WTA value for a single good, conjoint analysis presents individuals with a bundle of component attributes; the participant is then asked to choose their most-preferred bundle. The results of the survey can then be analyzed via multiple regression to estimate component

values, or increasingly, hierarchical Bayesian analysis, which can then build models of individual decision-making behavior (Champ et al. 2003).

Non-market valuation is a complex exercise, with a vast body of both supporting and critical literature. It is beyond the scope of this project to recommend specific non-market valuation procedures, excepting that any methodology employed be in keeping with the principles and standards stated throughout this report. Statistical and behavioral findings continue to drive growth and development in the field, and each component of non-market valuation (e.g. survey techniques) has its own associated body of literature.

Non-market valuation techniques continue to evolve and improve as the ongoing subject of extensive research. For instance, recent findings demonstrate that WTP and WTA values are greatly subject to the stated (or unstated but perceived) distributional consequences of a policy, which has significant implications for designing CV and conjoint analysis surveys going forward (Cook et al. 2007; Cai et al. 2010). Recent research also demonstrates the importance of informed preferences, showing large changes in WTP and WTA values when people are re-surveyed after having had time to process the information (e.g. Harsman and Quigley 2010). These findings are just two examples of how non-market valuation continues to swiftly evolve. Furthermore, given our resource and time constraints for this project we are unable to meet the considerable task of codifying the current state of the art. Thus, the best- practice standard for this report is to ensure that whatever non-market technique is employed be in keeping with the most up-to-date literature and expert-determined protocols. Champ et al. (2003) provides a definitive resource for practitioners conducting non-market valuation, and Boardman et al. (2006) serves as a valuable reference text. In future principles and standards updates, we hope to better codify non-market valuation and update it with new findings.

Benefits and Costs Technical Standard Five: Outcomes should be monetized to the degree necessary to facilitate faithful comparisons of economic merit. If an outcome category is monetized for one alternative, it should be monetized for all alternatives.

The utility of BCA is that it provides a comprehensive and explicit manner by which to evaluate decision alternatives on the criterion of economic efficiency (Weimer and Vining 2010). In order to furnish a truly comprehensive analysis, analysts must estimate all reasonable impacts, both tangible and intangible, market and non-market values. Values are aggregated into a single monetary metric and presented alongside key quantities and values that inform the monetized estimates to furnish the decision-maker(s) with an objective summation of the economic merit of a given policy option (Farrow and Viscusi 2010). Given that BCA is frequently utilized in social and environmental policy applications, many (if not most) policy outcomes lack an explicit, observable marketplace value (e.g. value of better dietary nutrition or of urban green space). Non-market outcomes are to be monetized through shadow prices derived using hedonic methods, WTP/WTA stated-preference, or otherwise estimated. This method should correct for distortions (e.g. subsidies, externalities), non-existent

market values, and intangible benefits (Karoly 2008). Further, the development of shadow prices allows for comparison of outcomes across sectors, demonstrating the relative economic merits of allocation amongst various policy sectors (Cook 2010).

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IV. Standards for Determining Market Extent (Economic Standing)

The traditional assumption in benefit-cost analysis (BCA) is that all values should count (Trumbull 1990; Cook 2010). No BCA, however, attempts to include or can include *all* values. Instead, the analyst is called to make decisions regarding the "extent-of-the-market" (Smith 1993) (or "economic standing" (Whittington and MacRae 1990)). The extent of the market considers whether or not a person or group's benefits and costs are counted, or, what subset of their values are counted.

The objective basis for determining market extent is in terms of the likely significance of effects with the principle of proportionate analysis. All principles and standards regarding those particular aspects of market extent can be found in Part II, Section II, The Estimation of Benefits and Costs. This present section takes the exclusion of effects based upon insignificance or proportionality as a given, and is best viewed as a guide to addressing more subjective constraints often placed upon the inclusion of significant, feasibly estimated effects. Valid BCA requires an objective accounting stance and an analysis that is explicit about values imposed on the analysis and missing from it. Analyses that narrowly define economic standing, such as a public health project evaluation that defines program success in terms of a single unit of measure (e.g. quality adjusted life years), do not represent a BCA, though they might represent part of a one.

An aim to include all significant effects raises both practical obstacles, such as resource limitations, and theoretical problems, such as the issue of "bad" values. More commonly referred to as bad utility, the issue of bad values has frequently been illustrated using Nozick's (1974) concept of utility monsters (e.g. Posner 1979). An example of such a monster is provided by Sen (1982), who poses a hypothetical situation in which, as the number of racist thugs wishing to beat up Ali increases, a point will be reached when their combined utility from the beating will exceed Ali's disutility, thereby justifying the beating on grounds of economic efficiency.[8] Scholars have raised numerous thought experiments demonstrating this conflict between efficiency and morality, such as a hypothetical action, motivated by utility theory, to hang an innocent man as a way to stop the murder of many other innocent people. These issues were brought to application in BCA especially by Whittington and Macrae's (1986) article on economic standing in BCA and the subsequent discussion (Turnbull 1990; Zerbe 1992).

This section provides an overarching theoretical principle for market extent in BCA, followed by standards that discuss how to address: (1) practical limitations to this theoretical principle; and (2) exogenous constraints that often enter into the analysis. Here we suggest an approach to these issues that is consistent with counting all values and moral considerations in so far as they are held by society.

[8] The actual situation posed by Sen is a bit more complicated, involving several other actors and touching on several notions of utilitarian and welfare theory. However, the basic premise remains the same.

a. Theoretical Standard for Determining Market Extent

Market Extent Theoretical Standard One: As a theoretical stance, BCA should value all policy effects for all parties.

In theory, BCA should include all economic outcomes (Turnbull 1990; Cook 2010). For objective analysis, all individuals should be counted and their values count equally. This is the appropriate theoretical stance, as it reflects the need for comprehensive BCA that portrays economic reality. In practice, however, the relevance of effects, constraints placed upon economic standing, resource limitations, and the inability to credibly estimate certain values all serve to limit the inclusion of policy benefits and costs. The remaining standards in this section provide guidance as to bounding BCA market extent in a pragmatic, appropriate manner.

b. Technical Standards for Determining Market Extent

Market Extent Technical Standard One: Count all values and persons affected by the policy to the extent likely to affect results. Appropriate market extent should be based upon significance to model results and the need for proportionate analysis.

Many effects are minor and their inclusion proves inconsequential to analysis results. Other effects prove impossible or prohibitively difficult to quantify. In keeping with the principle of proportionate analysis discussed in Part II, Section II, the relationship between overall model significance and estimation costs appropriately constrains the inclusion of effects in BCA.

Any geographic, political, logistical, or legal constraints placed upon market extent that exclude certain values even though they are both quantifiable and significant may render BCA invalid. No constraint is an appropriate justification for omitting significant obtainable effects; no BCA accounting stance should simply exclude or ignore other effects.

Market Extent Technical Standard Two: The analyst should discuss the implications of excluded effects and present them alongside the focal results.

Just as a logistical inability to include a certain category of benefits or costs does not mean that those effects should simply be ignored, a BCA taking a particular accounting stance should still inform decision-makers as to the implications and importance of policy effects to non-targeted populations.

Often, the analyst will be asked by the client to focus on net benefits to a particular subset of the population. Such a geographic or political accounting

stance can reflect a logical approach to policy decision-making. Stakeholders or representative agents of these principals have a right to view policy effects on a scale that reflects their interests. For example, a state government might wish to determine the effects of a state-financed transportation program to that particular state, whereas for a federally financed policy, this disaggregation might be inappropriate. It would be illogical for a state to use state tax dollars to finance a project that does not convey benefits to state residents. Similarly, a federal agency should generally consider benefits and costs from a national accounting perspective. However, a proper BCA employing a state accounting stance should provide decision-makers with estimates of *all* significant effects, including those to non-residents, alongside the summary of net benefits to state residents. Beyond ensuring an objective analysis, the inclusion or discussion of effects accruing to parties outside the given geographic boundary can prove highly useful in identifying potential feedbacks to the targeted population and fostering effective, comprehensive, and ethical policy decisions. The professional approach is to be explicit about omitted effects and policy impacts outside of the targeted population.

One policy area that frequently demonstrates the need to show benefits and costs accruing outside of the targeted accounting stance are criminal justice programs. Even though an analysis prepared for a county or state might focus on net benefits to that particular jurisdiction, presentation of crime policy options must acknowledge potential spillover and interaction effects between abutting and overlapping jurisdictions (Lott 2010). This is because a project might engender large net benefits to the targeted area through simply altering the spatial distribution of criminal behavior instead of reducing overall occurrence. Similar concerns typically arise in most policy sectors.

Thus, while a geographic or political accounting stance is appropriate for the disaggregation of benefits and costs, no constraint is an appropriate justification for omitting significant effects. Whether an effect cannot be estimated or it falls outside of the targeted accounting stance, the presentation of BCA should still inform decision-makers as to the implications and importance of these effects.

Market Extent Technical Standard Three: The law and the policy question under consideration can furnish a guide as to values that are offset by opposing values.[9] This provides an objective justification for the exclusion (or inclusion) of illegally derived benefits.

[9] Economic standing is not the same as legal standing. A litigant must have legal standing in order to be able to bring a case to court. Generally speaking, the litigant must have suffered (or be in immediate danger of suffering) a particularized injury of some sort, that injury must have been caused by the conduct of the defendant, and it must be likely that a favorable court decision will redress the injury. Three requirements are commonly referred to as "injury-in-fact," "causation," and "redressability." Certain cases may involve additional requirements of standing established by statutes or by the courts. Whereas legal standing is primarily a procedural mechanism to regulate access to the judicial system, market extent in BCA refers to the extent of the effects of an action.

While some contend that the exclusion of illegally derived benefits injects subjectivity into what is ideally an objective exercise, the use of the law should rather be seen as furnishing information, though not perfect information, about values, that is as a guide to provide rough estimates of aggregate sentiments is not particularly subjective. The implication of an act being illegal furnishes information for BCA about broader sentiments, just as if an earlier "rough" BCA were already conducted (Zerbe 2001; 2007). Thus, by recognizing the law we follow established principle.

Consider whether a BCA commissioned to evaluate policy responses to theft should include the value held by the thief towards the stolen goods. If the goods are worth more to the thief than to the victim, a decision based upon narrowly defined net benefits will recommend that the thief be allowed to retain the goods. However, if this is in fact the ruling, the end result will be an increase in theft and its attendant costs. Some of these costs are in terms of the violation of the moral sentiments of members of society that would consider such results unjust. Though these sentiments may be difficult to quantity directly, it is reasonable to infer from the present illegality of theft that the public's willingness-to-pay (WTP) to have stolen goods returned is greater than any excess value of the good to the thief compared to that of the victim.

If, however, the policy question is whether or not theft *should* be illegal, then the value to thieves should count (see ME-S4 below). Thus, the exclusion of legally proscribed values does not represent a subjective constraint. Rather, the justification for excluding illegally derived benefits is based upon the supposition that the existence a law represents the results of a prior, de facto BCA.

Finally, while this discussion takes a broad, theoretical perspective to the economic standing of illegal benefits and costs, and discusses this largely in the context of criminal law, it is important to note that there is a much more specific component not discussed herein. BCA is commonly employed by and for government agencies in regulatory decision-making. There is a vast body of literature and legal casework regarding how analyses of government agency regulations, for instance, should account for (or exclude) some values that, while not necessarily illegal, run counter to a legislative aim or agency mandate. For example, consider whether the US Environmental Protection Agency should count the benefit of pollution to the polluting firm when conducting a BCA. For issues such as pollution control (as well as crime, transportation, or public health) the optimal economic outcome is likely to never be zero pollution (or zero crime, zero traffic, or zero illness). Thus, when analyzing programs it is often necessary to count bad utility so as to more accurately determine an optimal level of regulatory enforcement.

The relationship between economic and legal standing often proves complicated. Legal standing can often provide guidance as to what (and whose) values should be included, but proper BCA should consider significant direct and indirect policy effects regardless of whether such effects are born out upon those who would have legal standing to challenge the policy in court. Likewise, legality does not necessarily bound the inclusion of benefits or costs. Not all outcomes proscribed by law should be excluded in a BCA.

The legislative or regulatory context of the policy decision in such cases can require (or prohibit) including certain benefits or costs; this is determined by administrative law, in terms of: (1) whether the appropriate legislative body has spoken directly to the question at hand; and if not (2) whether the agency's interpretation of the statue is reasonable and not arbitrary (Sunstein 2001). These issues are much more intricate and fluid, reflecting ongoing legal proceedings and legislative actions. Nonetheless, the approach recommended in this section can be applied according to administrative law as well. Sunstein's (2001) excellent discussion of default principles for regulatory BCA provides more detailed guidance as to how to proceed in a regulatory setting.

Market Extent Technical Standard Four: Where the policy question under consideration concerns a change in a point of law itself, or when the value of an illegal act is used to structure policy, effects accruing to those acting illegally should be counted.

Illegally derived benefits should be excluded in BCA, except in cases where the policy question at hand concerns a change in law, or when the illegal values serve to determine appropriate policy. A BCA for a marijuana legalization policy, for instance, should obviously relax the constraint of illegality to include benefits and costs resultant from marijuana usage within each policy alternative. This allows for the sentiments of all stakeholders to be given accurate weight. Likewise, in setting criminal penalties, the value of the illegal act is often crucial to effective policy-making. For instance, Becker's (1968) optimal penalties approach bases crime deterrence upon setting penalties such that the criminal internalizes the cost of the action; thus, when expected benefits are exceeded by these costs, the crime is deterred. In order to effectively structure penalties then, the analyst needs to incorporate benefits to the criminal resulting from the illegal action.

It is crucial to note that the change in law under consideration need not necessarily be explicit. The example is given of whether or not the time-saving value gained by a speeding motorist should be considered in a BCA analysis. If the issue if whether or not the speed limit should be changed, than the answer is unequivocally yes. If, however, the question is whether or not a fine is justified for speeders, it is reasonable to take as given that there is a social willingness to pay for fining speeders. For instance, analysis of a transportation project might find that road improvements would alleviate traffic such that cars desiring to speed would now generally be able to travel at five miles per hour greater than the posted speed limit. If local law enforcement officials will not ticket cars travelling five miles an hour over the speed limit on the road, and travel at such speed is facilitated by the new project, then implicitly part of the analysis at hand is a consideration of whether cars should be allowed to travel at this new, increased speed. Given this, the benefits and costs of this illegal act should be included in BCA, as the legality of the act is implicitly being analyzed.

Market Extent Technical Standard Five: Where legal rights are substantially controversial, they cannot be used to determine economic standing or reference points.

Using the law to inform the market extent of a BCA is not feasible in every application. For example, in estimating benefits and costs for a BCA of a potential change in abortion law, it would not be proper to consider using WTP values for those on one side of the issue and WTA for those on the other side, as the legal reference point must be regarded as fragile (Zerbe 2001). The WTP should be used for both, as neither part has ownership, and the analyst would include sentiments on both sides of this issue. Even if current policy question did not actually consider whether or not abortion should be legal, but merely altered the rate of occurrence (e.g. a public health project), one would have to include sentiments on both sides of this issue. It would not be legitimate to simply assume that current abortion law reflects the full weight of public sentiments. In such cases, two sets of results should be presented such that both sides are alternatively given full economic standing. Moreover, it should be acknowledged that the language of economic efficiency is not best suited, nor the only language to be used, for this type of constitutional discussion (Zerbe 2001).

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V. Standards for Addressing Risk and Uncertainty

Risk and uncertainty are inevitable components of BCA predictions. The treatment of risk and uncertainty is fundamental to achieving a faithful assessment of policy options and ensuring that decision-makers can base policy decisions upon a best-possible understanding of potential and/or expected outcomes and ramifications. Following a definition of risk and uncertainty as applied to BCA, this introduction summarizes the concept of risk and uncertainty to provide background for the principles and standards outlined in this section.

The precise definitions of risk and uncertainty have long been the subject of scholarly debate. In this document we assume that *risk* refers to a source of imprecision for which a probability of engendering a desired or undesired outcome can be assigned. Commonly this is summarized as an event with a known probability distribution. *Uncertainty* denotes an unknown or stochastic process for which precise quantitative description is unfeasible or unavailable. Uncertainty is often summarized as an event with an unknown probability distribution. Though we provide this distinction between risk and uncertainty, it is important to note that in the context of policy decision-making, the probabilities of adverse outcomes are treated similarly whether precisely quantified or poorly understood (Farrow and Viscusi 2010).

Risk

Fischhoff et al. (1984) cautions that the precise meaning of "risk" remains embedded in controversy, as the choice (whether conscious or not) of a particular definition greatly affects policy choices, resource allocation, and the distribution of political power. As noted below, the definition of risk in BCA is an operative question that affects how benefit-cost outcomes are presented. For example known probabilities might allow for direct incorporation within BCA, whereas uncertainty as to parameter precision and model accuracy might better be dealt with in a supplementary fashion alongside BCA output.

Though colloquially risk often implies potential for adverse outcomes and carries a negative connotation, risk is neither "good" nor "bad." Although known probabilities may be incorporated mechanistically into BCA, risk analysis and management depend upon the context of the decision-maker. Even well-quantified risks can complicate the use and interpretation of BCA. Almost three centuries ago Daniel Bernoulli demonstrated that few empirical decisions are made in a risk-neutral fashion according to the expected value criterion that multiplies the size of a payout by its probability of occurrence (Bernoulli 1954). Risk neutrality implies one to be indifferent when faced with a choice between a policy that with absolute certainty would cause one death and another policy with a one-in-a-million chance of causing one million deaths; in fact, people appear not to be indifferent.

Policy-makers tend to operate in a risk-averse setting, where more-certain outcomes are prioritized over outcomes with a greater potential gain but also a greater possibility of failure. Often, decision-makers can qualitatively evaluate

the relative merits of expected values against potential harms side by side with BCA results; in such cases where regulation mandates strict adherence to formal BCA criteria, decision-making thresholds can be inserted directly into the model to allow for the analysis to faithfully represent political or societal risk-treatment preferences.

One example of systematized risk aversion is the Precautionary Principle, whereby a proposed action or policy must demonstrate prior to its implementation, that with reasonable certainty it will not engender irreversible harm (Stewart 2002). For BCA it is key to note that risk aversion (as well as risk-seeking behavior) can be incorporated into analyses as is socially or politically desired. Analysts can employ thresholds to guide probabilistic decision-making within a BCA model so as to adhere to a desired treatment of risk rather than employ strict probability theory. If decision-makers desire precautionary management, thresholds can preclude an action holding a greater expected payoff but lacking the desired degree of certainty (Vining and Weimer 2010). In a simple example, for a policy scenario where weighted outcome values reveal that selecting "Option A" maximizes expected net benefits whenever "Option A" is has at least a 40% chance of "success," policy-makers might still desire to restrict the model to only select "Option A" where there exists a 70% chance of success.

Uncertainty

Policy decision-making requires action despite uncertainty; even a decision not to act engenders its own consequences (IRGC 2010). BCA is designed to be a decision-making aid for policy decisions in the face of uncertainty. A crucial component of BCA then is its ability to improve understanding of risks and risk perception, and provide appropriate guidance on making risk-management decisions (North 1998).

Uncertainty may be separated into different components. Morgan and Henrion (1990) detail seven aspects through which uncertainty might be introduced into quantitative analysis: (1) random error and statistical variation; (2) systematic error and subjective judgment; (3) linguistic imprecision; (4) variability across time and space engendered by aggregation; (5) inherent randomness and unpredictability; (6) disagreement; and (7) approximations. Note that these categories also refer to non-stochastic processes, such as uncertainty as to whether a policy has a causal effect on a given outcome.

Even though a precise probability distribution is unavailable, uncertainty can often be addressed quantitatively. Appropriate BCA uses sensitivity analyses, probabilistic methods such as Monte Carlo simulation, and other means to reflect uncertainties in order provide decision-makers with sufficient knowledge as to the relative significance of various sources of uncertainty and fuller picture of possible policy outcomes. For instance, a sensitivity analysis might prove a BCA model to be robust to approximation error of a certain variable, thus obviating concern (or further expense towards reducing uncertainty).

As discussed previously, risk and uncertainty are treated in much the same way in BCA. The primary importance to analysts of distinguishing between the two is that uncertainty can point to an opportunity to learn more about the

level of probabilities (Farrow and Viscusi 2010). The following theoretical standards provide a conceptual foundation for addressing risk and uncertainty in BCA. Subsequent technical standards outline empirical steps to be taken when conducting BCA.

a. Theoretical Standards for Addressing Risk and Uncertainty

Risk and Uncertainty Theoretical Standard One: The treatment of risk and uncertainty when conducting BCA is itself subject to at least an informal BCA test.

Further investment towards increased information or decreased uncertainty, in terms of both greater costs and further delay, should be in proportion to the expected benefit of the resultant improvement in decision-making ability (Wiener et al. 2009). In short, research expenditures should be commensurate with the value of the information gained. Of course, the analyst cannot know with certainty how investing resources to reduce uncertainty about a parameter will improve decision-making ability. However, the analyst can still strategically allocate resources in order to best estimate overall policy effects and improve decision-making. There are numerous ways to achieve proportionate allocation, for instance qualitatively determining that a certain aspect of a BCA is particularly important to the policy decision, or applying sensitivity analysis to different parameters in the model to identify significant relationships between parameter variability and overall model variability. In any case, careful thought must go into data gathering, and the rationale for a particular investment of resources should be carefully justified and clearly stated.

Finally, given this need for a treatment of uncertainty that is in proportion to the magnitude of policy implications, though discussing parameter uncertainty is essential, the existence of such uncertainty should not necessarily be a barrier to identifying a policy that maximizes the difference between the level of expected benefits and expected costs (Farrow and Viscusi 2010). Greater refinement of an analysis might not affect the overall policy assessment or optimal policy choice (Farrow and Viscusi 2010); in such cases, further expenditure towards data gathering is unwarranted.

Risk and Uncertainty Theoretical Standard Two: Analyses should account for multiple sources of risk and uncertainty.

Within a BCA model, there are two basic forms of uncertainty: (1) parameter uncertainty (e.g. sampling error); and (2) model uncertainty (e.g. scale-up effects) (Cook 2010). Both types should be addressed by furnishing decision-makers with a full range of decision approaches (Farrow and Viscusi 2010). Similarly, the International Risk Governance Council (IRGC) identifies two broad categories of risk governance "deficits," where (1) requisite elements (such

as sufficient and/or accurate data) are lacking or (2) actions are either untaken or unsuccessful. One instance of a deficit regarding assessing and understanding risks would be the provision of biased or selective information. A related deficit due to untaken action would be a failure to consider a suitable range of alternatives (IRGC 2010).

The means and methods for addressing risk and uncertainty will be tailored for the requirements a particular BCA. Farrow and Viscusi (2010) recommend that analysts present the full range of relevant policy options. This provides a means by which to minimize the possibility of bias by omission. Cook (2010) formalizes the way to account for the two central forms of uncertainty in addressing policy makers by both: (1) communicating the distribution of benefits at the parameter level to show the implications of parameter uncertainty; and (2) communicating the distribution of model outcomes given varied inputs and parameters to demonstrate how scaling effects and parameter uncertainty amplify model uncertainty. Together these two forms of presentation provide the policy maker with an appropriate conception of parameter and model uncertainty in the BCA model.

A crucial element of accounting for multiple sources of risk and uncertainty is to work in an iterative and recursive process (Wiener et al. 2009). Consultation with scientists, stakeholders, policy makers, and oversight bodies should not merely be an ex ante occurrence but rather a continuous dialogue so as to promote high-quality information and furnish insight into both direct and ancillary policy effects (Wiener et al. 2009).

Risk and Uncertainty Theoretical Standard Three: Assumptions of rationality may need to be modified in the face of risk or uncertainty.

Research in both neo-classical economics and behavioral economics suggests that individuals often misunderstand or misinterpret probabilities. In addition, even if probabilities are well-understood, individuals may overweight small changes in probabilities close to "0" or "1," and may be averse to ambiguity (Robinson and Hammitt 2010). These findings suggest that researchers will need to take care to ensure that probabilities are clearly communicated, and will need to consider how overweighting and ambiguity aversion affect related values. Given that BCA is the basic economic method of risk assessment and risk management (Farrow 2004), proper analysis must then strive to pragmatically represent empirical economic decision making.

North (1998) notes that understanding and managing risk involves both normative and behavioral aspects, as both risk and risk *perception* are critical to decision-making regarding uncertainty. Thus, risk assessment within BCA should be oriented towards subjective aspects of decision-making, emphasizing procedures and processes for dealing with risk (North 1998); BCA should then reflect current understanding of such behavioral responses to risk and uncertainty so as to best represent economic reality (Farrow and Viscusi 2010). Echoing this concept, a recent paper by the Committee of Past Presidents of the Society for Risk Analysis in response to the White House OMB's request for

public comment on the current Federal system of Regulatory Review stresses this need to greatly enhance the role of social and behavioral sciences in risk analysis (and thus BCA) so as to better understand how and why groups and individuals behave and act as they do in the face of risk and uncertainty (Wiener et al. 2009).

Risk and Uncertainty Theoretical Standard Four: BCA should not impose a particular form of risk-treating behavior, but should rely on empirical analysis.

The IRGC notes that sound, forward-looking policy requires a suitable mix of risk taking and risk avoidance (IRGC 2010). While the appropriate role of BCA is not to support a particular philosophy of risk management (e.g. Precautionary Principle), few empirical decisions are made on a risk-neutral basis. Zerbe (2007) argues that BCA should reflect the philosophy of risk appropriate for the policy problem, not the values of the analyst.

The treatment of risk may be dictated by agency mandate or legal constraint, or it may be dictated by the affected population. Some agencies are required to choose policy options that maximize net benefits, other agencies are required to select policy options that minimize harm or avoid certain risks. When preparing analysis in the context of such binding regulations, risk management standards are best included within the BCA model so that they are internalized within estimated net benefits. For instance, issues such as thresholds and irreversibility can be addressed a priori using a two-period (Gollier 2001) or canonical (Dixit and Pindyck 1994) model to optimize the timing of action (Farrow 2004). Essentially, such a model delays action until benefits significantly exceed costs given a predefined amount of precaution (Farrow 2004).

Decisions regarding risk management (e.g. a Precautionary Principle) can also be made post-hoc through deliberation and public process. This helps ensure that the policy selected faithfully reflects public sentiment. In other settings, a baseline BCA might appropriately be conducted in risk-neutral fashion, and an ex post facto analysis and delineation of risk factors, probability thresholds, and various risk behaviors presented alongside model outcomes. Even basic sensitivity analyses demonstrating the relative outcomes engendered by various risk-behaviors can help policy-makers manage risks more efficaciously, and varying the treatment of risk in complementary analyses helps identify current deficiencies in risk governance.

Risk and Uncertainty Theoretical Standard Five: The analyst should carefully account for the difference between predictions and estimates when transferring estimates and modeling outcomes.

BCA must recognize the statistical distinction between estimates and predictions. In most settings, parameter estimation focuses on the statistical relationship between the estimated parameter and the data set used for this estimation, evaluating to what degree the parameter accurately represents the given data. However, BCA usually entails using parameters derived in various

studies (the "study sample") to predict policy outcomes (the "policy sample"); the issue for BCA then is not the representativeness of the parameter relative to its underlying data set, but rather the degree to which the study sample is appropriate for application to the policy sample (Vining and Weimer 2010).

Often, this transfer of WTP/WTA functions and parameter estimates from the study sample to a policy context proves problematic. Statistical literature recognizes that best estimates often do not facilitate accurate predictions (Efron and Morris 1977). Predictions generated using said estimates tend to be overly optimistic given the stochastic nature of real world events and the powerful force of regression to the mean, producing values that prove too large in absolute value terms (Vining and Weimer 2010). Thus, analysis should account for regression to the mean (the statistical tendency that given an extreme sample from a data set, a second sample from that same set will tend to be closer in value to the mean value of the set) and optimism biases (that individuals tend to be overly optimistic about the potential outcomes of policies they generate or advocate (Vining and Weimer 2010)), as research demonstrates that small, systematically selected, and carefully controlled programs typically demonstrate better outcomes relative to when the program is subsequently employed in empirical settings (Drake et al. 2009).

A related issue to optimism bias and regression to the mean is that of scale-up effects. Scale-up effects are of particular concern for social policy BCA, as analyses generally extrapolate findings derived on smaller, more manageable scales to make decisions regarding wide-scale policy implementation. Often there is little basis for knowing the direction or magnitude of the scaling factor for parameter estimates when such an action or policy is applied at large (Karoly 2010).

Risk and Uncertainty Theoretical Standard Six: Statistical significance levels for program and policy effect size are not relevant to BCA. Regardless of the associated level of significance, all estimated effects should included in the BCA model with the appropriate standard error.

Statistical significance is not the same as economic significance (McCloskey and Ziliak 1996). The decision to use a variable in a BCA model should be based upon economic theory instead of statistical significance. Given the importance of comprehensiveness in BCA of social policies, all effects, including those that might not achieve conventional levels of statistical significance in particular studies, should be included. The heightened uncertainty associated with using a statistically insignificant parameter will be internalized within the BCA model by the larger standard error value (relative to statistically significant parameters) accompanying the probability distribution of that parameter within a Monte Carlo simulation (Vining and Weimer 2010). The distribution of benefits to costs modeled by the Monte Carlo simulation or other simulation approach will reflect the increased degree of risk resultant from the use of statistically insignificant estimates. While this increases the degree of comprehensiveness, it also underscores the necessity of conducting a Monte Carlo simulation to account for the resultant increase in uncertainty (Vining and

Weimer 2010). For a fuller discussion of Monte Carlo simulations and the treatment of uncertainty related to estimated effects, see Vining and Weimer (2010).

b. Technical Standards for Addressing Risk and Uncertainty

Risk and Uncertainty Technical Standard One: Clearly delineate the accuracy and precision of numerical values and identify sources of uncertainty.

To denote modeling assumptions and report numerical values, the analysis should convey information about the accuracy of the estimates. Explanation should be provided as to the resource limitations or inherent uncertainties currently unresolved (Farrow and Viscusi 2010).

The presence of uncertainty represents a potential for acquiring information that fosters more precise understanding (Farrow and Viscusi 2010). Along with explicitly accounting for uncertainty, analyses should identify priorities for further characterization, denoting highly consequential areas of uncertainty whereby adherence to the principle of proportionate analysis mandates increased and/or better information (Wiener et al. 2009). These sources of uncertainty that are of great significance to model outcomes are a priority for further research expenditure.

Risk and Uncertainty Technical Standard Two: Explicitly define the concept of risk used in the analysis

Fischhoff et al. (1984) write that the definition of risk is a political decision. This includes: (1) the degree of objectivity in defining a risk, for instance the attribution of deaths to predisposing causes such as poor nutrition instead of immediate causes such as disease; (2) a risk's dimensionality, in terms of the spate of consequences included in characterizing the risk; (3) the choice of summary statistic, such as deaths per ton of coal mined versus deaths per thousands of coal miners; and (4) risk bounding, which includes the attribution of partial consequences and the relevant time scale. All of these decisions play a significant role in determining the outcome(s) of BCA, as even a slight shift in the characterization of a risk might dramatically change model results and the decision context. For instance, Herbert et al. (1979) describes how a significant source of discrepancy and controversy in the debate over various energy technologies is predicated upon choices made regarding the inclusion (or lack thereof) of back-up energy sources. Thus, the analysis should carefully denote the operative definition of risk and provide justification for the choices made regarding characterization.

Risk and Uncertainty Technical Standard Three: Use sensitivity analyses to evaluate implications of estimates and modeling assumptions.

Conduct sensitivity analyses to examine implications of choices made regarding valuation and methodology, so as to reveal the impact of such decisions hold in the model. Such evaluation should include, but not be limited to different discount rates, the subject age to which policies are discounted, shadow price estimates, methods of future outcome projection, and scaling factors (Karoly 2010). Though risk traditionally connotes the potential for negative impact and/or costs, sensitivity analyses and other statistical approaches to the characterization of risk apply equally to questions of beneficial impact and positive values (Farrow 2004).

Risk and Uncertainty Technical Standard Four: Utilize probabilistic techniques to calculate net benefits so as to account for multiple uncertainties.

BCA typically entails a number of uncertain precisions multiplied by uncertain shadow prices, requiring a probabilistic framework to accurately predict the value and precision of net benefits. Generally, the point estimate of net benefits should be the mean net benefits across all *simulations*, as opposed to the net benefit predicted from a calculation using the mean value of each *parameter*. Where the mean is unduly influenced by a small number of trials with large net benefits, it is appropriate to utilize a trimmed mean (Vining and Weimer 2010); when doing so, justification for ignoring extreme results must be made. Monte Carlo simulation is the most frequently employed, but not the only, means by which to address these multiple sources of uncertainty, including imprecision in effect predictions, uncertainty regarding monetized shadow price estimates, and potential interaction effects (Vining and Weimer 2010).[10] The results of a Monte Carlo simulation can also be presented to policy-makers using a histogram that shows the distribution of net benefits across all simulations, accompanied by appropriate summary statistics (e.g. mean, inter-quartile range). This supplements point estimates and provides greater analysis transparency.

Risk and Uncertainty Technical Standard Five: Analyze every value as a random variable, unless given evidence to the contrary.

Assume statistical randomness: If a numerical value is considered important and not analyzed as a random variable, one should explain why not (Farrow and Viscusi 2010). When there is only one source of data, and thus a single probability distribution, for a variable, this distribution can be incorporated directly in the simulation. However, when numerous studies are applicable, the analyst can pool these studies. On such approach is for each model iteration to

[10] For a more detailed overview of conducting a Monte Carlo simulation for BCA, see Vining and Weimer (2010).

first randomly select a particular study and then sample from that particular parameter distribution; the resulting meta-distribution accounts for uncertainty across studies (Farrow 2004). Justification should be provided for studies and data sources used or not used in analysis (Farrow and Viscusi 2010).

Risk and Uncertainty Technical Standard Six: Account for the legislatively mandated or desired stance towards risk at different agencies and levels of government.

Decisions regarding risk management (e.g. a Precautionary Principle) can be made post-hoc through deliberation and public process. In cases where legislation mandates strict adherence to BCA outcomes, issues of uncertainty, thresholds, and irreversibility are to be addressed a priori using a two period (Gollier 2001) or canonical (Dixit and Pindyck 1994) model to optimize the timing of action (Farrow 2004). Essentially, such a model delays action until benefits significantly exceed costs given a predefined amount of precaution (Farrow 2004).

Risk and Uncertainty Technical Standard Seven: Address potential for regression to mean, publication bias, and optimism bias when necessary by adjusting estimates.

Though no definitive consensus exists as to the appropriate way account for regression to the mean and optimism bias in predictions, often it is appropriate to downwardly adjust estimates to account for regression to the mean, optimism bias, and sample size issues in light of the incongruous nature of estimates and predictions (Vining and Weimer 2010). For example, the Washington State Institute for Public Policy often discounts effects engendered outside of an empirical setting by as much as 50% when evaluating educational projects (Drake et al. 2009). Selection bias can be either positive or negative, however, thus in some cases an upward adjustment of effect estimates might be necessary.

Sample size is also a concern. Vining and Weimer (2010) discuss the danger of using too few (especially single) estimates of a parameter. Parameters estimates are a single value in a distribution of possibilities, and large numbers of estimates will regress to the mean value of the distribution. Thus, a mean value of a distribution is more likely to be accurate than a single observation from a distribution. The optimal method then is to incorporate as many parameter estimates as are available to identify a range of possible parameters through meta-analysis. Estimates gathered from meta-analyses, utilizing multiple studies, likely require less reduction given the benefit of increased sample size and differing methodologies (Vining and Weimer 2010).

Finally, publication bias, the tendency for researchers and editors to submit and accept manuscripts for publication based ufselepon the strength or direction of research findings, might influence meta-analyses of related studies (Dickersin 1990). Even optimism bias, that people tend to be overly optimistic

about policies they develop or advocate, can hinder accurate representation (Vining and Weimer 2010). To determine the appropriateness of adjusting an estimate, the analyst should carefully evaluate differences in the context from which the data stem and the empirical environment in which the program will be enacted; in turn, this should inform a clear, pointed justification of the analyst's actions to downgrade (or upgrade) an estimate of effects.

Risk and Uncertainty Technical Standard Eight: Low-probability, high consequence (i.e. catastrophic) risks should be treated with special attention according to contemporary protocol.

High-consequence/low-probability events demand special attention within BCA because of the magnitude of economic damages resulting from catastrophic events (Kunreuther and Michel-Kerjan 2009). For an overview of current discussion and protocol for dealing with catastrophic events, see Kunreuther and Michel-Kurjan (2009). Analysis of such events should also be a priority of the iterative discussion process, with an eye towards priority-setting and further research (Wiener et al. 2009).

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VI. Standards for Discounting in Social Policy BCA

There is perhaps no economic topic as difficult and contentious as choosing a discount rate. Similarly, within benefit-cost analysis (BCA) perhaps no methodological question has been so widely debated as the discounting of future benefits and costs. Policy analysts generally agree that future impacts should be discounted at a given social discount rate (SDR) to convert these benefits and costs to present values (Boardman et al. 2010). However, though the body of literature regarding this subject is vast, the value of the SDR, is unresolved. Little consensus exists on philosophical or technical issues related to discounting, including what should be discounted, intergenerational discounting methodology, and the very choice of a discount rate.

These issues are of major significance (Burgess 2008). The practical importance of this issue for BCA is noted by Moore et al. (2004, 789):

> "Evidence abounds that the quality of governmental CBA [cost-benefit analysis] varies widely, and that a major reason for this variability is lack of consistency in the use of the SDR [social discount rate] (DeAlessi, 1996; GAO, 1998; Hahn et al., 2000). Many governmental CBAs employ SDRs without any well-specified rationale (Hahn et al., 2000; Morrison, 1998), and some governments, especially at the sub-state level, do not discount at all" (Zerbe and Dively, 1994, p. 289).

Weitzman (2001) echoes this point, noting that "the most critical single problem with discounting future benefits and costs is that no consensus exists today, or, for that matter has ever existed, about what rate of interest to use" (260). Given the central role discounting plays in determining the financial worthiness of public projects and social initiatives, there is a real need for greater consensus, or at least consistency, in project evaluations.

A significant part of the problem lies in the fact that proponents of different approaches to discounting are frequently unclear about what function the discount rate is supposed to perform. Thus, it is often difficult to parse out the fundamental distinctions between approaches. The end result in many cases is that "intergenerational welfare economics raises more questions than it is able to answer satisfactorily" (Dasgupta 2008, 167).

This is no small matter, as the discount rate more often than not has a powerful impact on what is deemed an acceptable project. Brennan (2007) writes that much of the discounting literature fails "to draw relevant distinctions… and to ask the right questions" (260). This in part explains the unresolved nature of the discounting debate, given that a convincing choice of an appropriate discount rate and discounting methodology can only be made by first carefully defining what we expect discounting to do and second by simplifying the discussion by focusing on acceptable assumptions. Otherwise, the widely divergent assumptions about the role of the discount rate will make agreement about its numerical value or range impossible. The further advantages of furthering consensus regarding the proper range of discount rates are that doing

so enhances the acceptability of BCA and allows for comparisons among analyses of different projects.

Finally, it is important to note that in many –if not most- cases, much of the theoretical and philosophical debates that make the issue of discounting so contentious are not particularly salient to typical social policy BCAs. For instance, much of the numerous controversial issues that arise in the context of discounting pertain to very long time periods (e.g. the Department of Energy's studies of nuclear waste repositories, which employ time horizons of 10,000 or even 1 million years, or Stern's (2007) climate change report, which estimates effects occurring centuries in the future due to actions taken today). Most social policy BCAs employ time horizons best measured in decades. Further, Summers and Zeckhauser (2008) properly note that issues such as "reaction functions (the impact of choices made today upon choices made in the future) are particularly important considerations when positing a discount rate for long-term projects.

Similarly, as is often discussed in relation to economic analyses of climate change impacts, deep structural scientific uncertainty, coupled with a non-negligible probability of a potential catastrophic occurrence (i.e. a "fat-tailed"distribution), challenges our present ability to conduct a meaningful economic evaluation (see Posner 2004; Sunstein 2007; Weitzman 2009).[11]

The aforementioned sources of disagreement, both philosophical and technical, make discounting a heady process. Given the wide range of opinions and findings on discounting espoused by highly educated, well-reasoned scholars at the top of their respective fields, how are analysts tasked with conducting BCAs to appropriately proceed? We attempt to chart a suitable course for discounting within BCA that is both theoretically and empirically appropriate, not to mention feasible given typically available time and resources.

The application of standard benefit-cost procedures in thought exercises regarding such things as 10,000-year projects and wholesale catastrophes are not typically relevant to most social policy BCA. A homelessness intervention policy undertaken at the municipal level or a new state secondary education initiative would be expected to have a more tractable time-horizon, a relatively finite target population, and likely not face deep structural uncertainty as to a potential catastrophic event. Moreover, one would not expect the analysis of such a project to be concerned with changing preferences in future generations, the chain of future decisions resultant from the policy, or the broad intergenerational equity debate.

We believe that it is possible to codify consistent, tenable standards for discounting within most social-policy BCA applications. The following standards should be viewed through this lens, and are not intended to be a definitive voice (though still a voice) on appropriate discounting for more experimental or novel applications (e.g. such as nuclear waste internment policy or global climate change mitigation).

In the theoretical standards below, we outline the theoretical tenets that underlie appropriate discounting in social policy BCA. Subsequent technical

[11] For instance, Weitzman (2009) describes how in such "fat-tailed" scenarios, where an inability to sufficiently bound overall damages resultant from a potential catastrophe can outweigh any discounting of effects.

standards describe appropriate technical methodology. Where multiple approaches to a given issue have traction in the literature and prove empirically appropriate, we posit what we find to be the most appropriate approach, but note as well where this cannot meet general consensus where general consensus does not yet exist. To reiterate the purpose of this paper is to suggest how one might make a theoretically appropriate, empirically reasonable, and politically tractable choice of a discount rate within the context of social policy BCA. This document might certainly form a baseline for more theoretically or philosophically demanding applications in other sectors, but is not, for instance, intended to present ironclad standards for discounting in climate change mitigation policy analysis.

c. Theoretical Standards for Social Policy Discounting

Discounting Theoretical Standard One: All benefits and costs expected to accrue in the future should be discounted at a standard rate.

The manner in which BCA addresses intertemporal comparison is highly significant to project outcomes, as well as highly controversial philosophically. Though it is commonly accepted that *monetary returns* should be discounted, both due to time preference and the investment value of money, the discounting of life and health (as is done in many social policy BCAs) is disputed (as reviewed by Portney and Weyant 1999; Sunstein 2007). Philosophers and legal scholars often question such discounting (or even discounting monetary returns) on ethical or legal grounds (e.g. Cowen and Parfit 1992; Revesz 1999; Shapiro and Glicksman 2003, Ackerman and Heinzerling 2002; 2004). This concern is addressed by an extension of the Principle of Intergenerational Neutrality (IGN) (Sunstein 2007). The Principle holds that members of any particular generation should not be favored over members of any other. By extension the Principle of Equal Economic Valuation (EEV) holds that all values should be treated equally. (This Principle is treated by Zerbe (2009), though not by name.) This principle supports discounting life and health values. In fact, the justification for discounting adheres to the idea of intergenerational neutrality, as a failure to discount can often injure, instead of promote, the interests of future generations (Sunstein 2007; Viscusi 2007), and similarly the EEV principle requires that all valuations are discounted equally. For this reason, Brennan (2007) writes that the IGN principle requires discounting in all but highly specialized cases.

A number of scholars have suggested it is immoral to discount the utility of future generations more than our own, implying that a zero discount rate should be used (e.g. Ackerman and Heinzerling 2002; Brown 1990; Parfit 1992; 1994; Plater et al. 1989). However, failing to discount future effects raises several significant anomalies than can in fact harm future generations. Viscusi (2007) points out that without discounting, a permanent (but miniscule) yearly benefit or cost flow becomes infinite and cannot be outweighed; assuming a positive interest rate, it will always be superior to delay a policy so long as the same

opportunity remains available. Thus, any future technological change rendering a policy more effective (e.g. the ability to save 34 lives in 100 years for the same cost of saving 33 lives this year) will dominate the analysis (Viscusi 2007, 217). Given these issues, it is clear that a zero discount rate can prove hugely detrimental to future generations by inhibiting policy action or even causing harm. Discounting can lead to an increase in investment, which in turn engenders long-term benefits to future generations, whereas a refusal to discount can delay action or protective program implementation (since a zero discount rate always favors program delay) and result in future generations being worse off (Sunstein 2007).

Discounting Theoretical Standard Two: Recognize that lower discount rates are not inherently more inter-temporally equitable, nor are higher discount rates inherently less inter-temporally equitable.

Brennan (2007) correctly states that the discount rate itself is not an ethical issue, but rather the intertemporal distribution is the only fundamental ethical concern. In this vein, it is important to acknowledge that while we typically associate future inequities that might result from a project, such as environmental harm, with using too high a discount rate, low discount rates are not always beneficial in this regard either. For instance, Viscusi (2007) poses the example of a potential dam that has a low, but very long-term, flow of benefits and a very high up-front cost; in this instance, a zero (or low) discount rate could make the dam project pass a benefit-cost test and increase environmental harm (2007, 215). Similarly, the US Office of Management and Budget (OMB) (1992) holds that, "[I]f one expects future generations to be better off, then giving them the advantage of a lower discount rate would in effect transfer resources from poorer people today to richer people tomorrow." This in part gives rise to Theoretical Standard Three below:

Discounting Theoretical Standard Three: The moral and philosophical implications of discounting should be addressed directly through consideration of the value of the benefits and costs; given the goal of increased efficiency (as reflected by increase net benefits), all future effects should be appropriately discounted in BCA.

This Standard is a statement of the EVV principle. As Just et al. (2004, 579) note, the choice of a discount rate affects income distribution, particularly the change in income distribution across generations, so that choosing a discount rate is not dissimilar to that of making equity judgments about income distribution. This in part explains the considerable sensitivity to the discount rate issue. Emphasis on the equity effects of the discount rate has driven much of the discussion and much of the disagreement about the appropriate rate.

Accounting for individual preferences regarding intergenerational equity and distribution is very difficult. Ideally, where the current generation has moral

values that apply to the interests of future generations, these should be counted in terms of willingness-to-pay (WTP) at present (and not incorporated into the discount rate). An argument and example is shown by Zerbe (2004). Admittedly however, measuring WTP for equity is an empirically difficult task (though this would be equally true for determining an appropriate equity-motivated adjustment to the discount rate). Both intra- and intergenerational distributional preferences have been shown to vary according to race, religion, income level, and societal characteristics (Beckerman and Hepburn 2007; Frederick et al. 2002; Miller 1992; Sunstein 2005).

For standard BCAs then, most appropriate means by which to fully account for project equity concerns is to present disaggregated results and address distributional concerns directly in the same manner that intragenerational equity concerns are currently addressed. This provides an effective means to address equity concerns without having to adjust the discount rate used in the analysis. Further ethical considerations are then included as cost or benefit values within the analysis (or at least discussed separately) so as to carefully distinguish between different choices and estimations made in the analysis. This approach is conceptually appropriate, as scholars (e.g. Viscusi 2007) have pointed out that intra- and intergenerational effects should be accounted for in exactly the same fashion within groups subject to a single BCA.

Finally, it is important to note that including effects on future generations represents an altruistic leap in and of itself, as not everyone shares (nor does behavior demonstrate the existence of) such sentiment (Viscusi 2007). It should not be overlooked that the fact that effects on future generations are included and treated in the same fashion as effects on current generations represents the expression of ethical sentiments.

Theoretical Standard Four: Where future valuations are expected to change, the discount rate should be also be separated semantically from measures to take into account the full expected value of future benefits and costs.

Predicted changes in future valuations should be accounted for by directly adjusting these values instead of altering the discount rate. Often, the discount rate incorporates estimated future values such that the rate used is lower than might otherwise be expected (i.e. one might assign a uniform valuation for a given benefit across all generations but lower the discount rate, which in essence serves to increase the estimated value to future generations). For example, Summers and Zeckhauser (2011), echoing the recommendations of many environmental economists and environmental lawyers, give a low discount rate to amenity goods on the grounds that such goods will become especially valuable in the future. Benefit cost analysis is compatible with arguments that attempt to take account future values through adjustment to the discount rate, but this is not the preferred method as it conflates two different values.

For example, if the real value of amenity goods increases at 2.5% per year and the discount rate for income is 6%, one could use a discount rate for

amenity goods of 6% minus 2.5%, or 3.5%. This approach is reasonable as long as one is clear about the assumption for the growth rate of the real value of equity goods. Thus we could have for the present value of an annuity that grows at the rate g and is discounted by *r*:

$$PV = A + A(1+g)/(1+r) + A(1+g)^2/(1+r)^2 \ldots A(1+g)^n/(1+r)^n \quad (1)$$

Where A the current value of the amenity good. Equation (1) may be expressed as:

$$PV = A + A/(1+k) + A/(1+k)^2 + \ldots A(1+k)^n \quad (2)$$

where $k = (1+r)/(1+g)-1$, which is approximately $r-g$.[12] Thus, if the growth rate is 4% and the discount rate is 7%, k would be about 3%. Some may refer to k as the discount rate but it is better to refer to the discount rate as 7% and the growth rate of 4% separately.

Summers and Zeckhauser would reduce the discount rate by the rate of population growth for the future, say 1%, on similar grounds to the argument for amenity goods, that is that the population growth rate will result in greater future values. But such adjustments should be done separately from those to the discount rate. The advantage of keeping the discount and growth rates separate, shown by the fast that increased value due to populations growth may be problematical. Increased population will likely reduce the quantity of amenity goods so it is not clear that increased population will increase total values. In any event, this process of accounting for the growth (or diminution) of values applies to any goods and not just to amenity goods. This is obviously equivalent to a two step process in which the future values are estimated and then discounted by the normal discount rate. Thus we can talk about k as the amenity discount rate or about future values of amenity goods and the discount rate remains at 6%. Obviously, the difficulty here is the estimation of future values but this difficulty exists under any approach to discount rates.

What is most relevant and readily apparent from this discussion is that major differences about the proper discount rate arise because some are using estimates of future values to reduce the rate and others separate the two calculations, estimating future values independent of the discount rate. In so far as the equity rate is simply accounting for future values, it does not differ from the usual procedure. However, accounting for estimated changes in future valuation using the discount rate is not ideal for BCA because it muddles the assumptions and choices made in the analysis.

Separating future value estimates from the discount rate is much more transparent and easily interpretable for policy makers, as it better highlights the implications and choices made regarding each aspect. Thus, this is the most appropriate method for BCA.

[12] Note that if g>r, this leads to infinite values.

Theoretical Standard Five: The discount rate used in BCA should have an empirical basis (either observed, estimated, or derived). Expert opinion by itself is not sufficient justification for a given rate.

For all but the simplest financial evaluations, the appropriate discount rate cannot be directly observed and instead must be derived by economists. Moreover, it may not be feasible to survey all affected classes of individuals regarding their time preferences, let alone suitably aggregate these individual preferences. Given this, one might suppose that the use of trained economists represents a way to make a tractable decision about the discount rate, essentially deferring to these experts for the appropriate discount rate for public projects instead of basing a rate on the observed market behavior of individuals.[13]

In this vein, Weitzman (2001) undertakes a survey of over of 2,160 Ph.D.-level economists asking them to provide their "professionally considered gut feeling" (266) as to the proper discount rate for a proposed project intending to mitigate global climate change effects (and receives a range of estimates from -3% to 27% (268). Weitzman argues that is sensible to assume that each "expert" has an equal chance of knowing the "correct" social discount rate, in the absence of further knowledge. He suggests also that instead of using an average of these discount rates one should use an average of discount *factors*, where the discount factor is $1/(1+r)^t$. After all it is the discount factor that is actually used to weigh future values. As the discount rate (r) gets smaller and the time period (t) shorter, the discount factor grows. This amounts to computing the present value of a public project using the discount factors connected with these rates, and then recovering the discount rate from the average of the present values so that the numerical value of the discount factor will be different for every time period (Long et al. 2010). The discount rate for any time period can then be backed out. As Weitzman notes:

> "What is the expected value today of an extra expected dollar at time *t*? It should be the expected present discounted value of a dollar at time *t*, weighted by the 'probability of correctness' or the 'probability of actuality' of the rate at which it is being discounted" (264).(13)

Rather than taking the rate from the average of present values, Weitzman finds that the distribution of the preferred discount rates roughly corresponds to a gamma distribution with a mean of 3.96% and standard deviation of 2.94%. Assuming a gamma distribution, Weitzman derives an implied effective discount rate of $\mu/(1+t\sigma^2/\mu)$, where μ is the mean, σ^2 is the variance, and t is the number of years in the future when the benefit is to be received (or costs paid). A consequence of using a range of discount factors representing a range of rates is that the effective discount rate declines hyperbolically to the lowest value over time (2001, 264) (In the survey three discount rates given are negative; Weitzman truncates the rates at zero).

[13] Though of course even trained economists have not special claim on "knowing" that correct answer to question that is at its base normative.

There are several difficulties that suggest against using Weitzman's results to choose the discount rates: First, the gamma distribution does not in fact fit the data all that well. Long et al. (2010) have used Weitzman's data to directly derive discount rates from the discount factors rather than trying to fit a distribution. This shows that low rates are underestimated by the gamma function so that the rates derived from the discount factors are too low. This is crucial for longer lived projects as the lower rates dominate the results. Thus Weitzman's estimates from his own data are too low especially for longer time periods. Other critiques include that of Moore et al. (2004) and Newell and Pizer (2003), which find Newell and Pizer's random-walk model, based upon the US treasury bond rate, to be a better estimation method than that of Weitzman, though we don't recommend treasury rates as the appropriate estimate either. Finally, the wide range of values given to Weitzman appears to evidence that most economists are not in fact experts on discount-rate issues and that even amongst economists there is significant fundamental disagreement. The significant disparity of rates observed seems to demonstrate either that there is no consensus as to the conceptual foundations of the SDR or that there broad misunderstanding as to what social BCA is intended to achieve (Burgess 2008). Either way, it is clear that it is not sufficient to simply base the discount rate on the opinions of supposed experts.

d. Technical Standards for Social Policy Discounting

Discounting Technical Standard One: As an initial basis for developing a range of discount rates for social policy BCA, consult relevant published literature and standard government recommendations (such as that from the White House OMB).

Published academic literature and government analysis standards should form the initial basis choosing a discount rate for use in BCA. For instance, the US OMB Circular A-94 (1992), which states that a real discount rate of 7% should be used as a base-case for regulatory analysis, provides a convincing initial standard. This is a reasonable recommendation. However, the Circular goes on to say, "[I]f we take the rate that the average saver uses to discount future consumption as our measure of the social rate of time preference, then the real rate of return on long-term government debt may provide a fair approximation. Over the last thirty years, this rate has averaged around 3% in real terms on a pre-tax basis" (OMB 1992). Thus, the OMB also recommends conducting a second model run using a 3% discount rate for the sake of comparison. However, the danger of using this low rate is that one may choose a project at the expense of a higher yielding project (or the purchase of higher yielding bonds). The bond rate represents a measure of the riskless rate of return (Viscusi 2007), and most government projects are not riskless. Certainly no project should be recommended at a rate lower than this.

Table 2, taken from Harrison (2010), summarizes discount rates as employed throughout the world for BCA:

Table 2: Current Real Discount Rates in Practice Internationally[14]

Country/Organization	Agency	Discount rate (percent)
Philippines		15%[a]
India		12%[a]
Pakistan		12%[a]
International Multi-lateral Development Banks	World Bank	10-12%[a]
	Asia Development Bank	10-12%[a]
	Inter-American Development Bank	12%[a]
	European Bank for Recon. & Development	10%[a]
	African Development Bank	10-12%[a]
New Zealand	Treasury and Finance Ministry	8-9%. From 1982 to 2008 it was 10[abf]
Canada	Treasury Board	8%c. From 1976-2007 was 10 (and test 8-12%)[ab]
China (People's Republic)		8%[a]
South Africa		8% (and test 3 and 12 %)[d]
United States	Office of Management and Budget	7% (and test 3%). Used 10% until 1992.[a]
European Union	European Commission	5 % From 2001-2006 was 6% a
Italy	Central Guidance to Regional Authorities	5%[a]
The Netherlands	Ministry of Finance	4% (risk free rate).[e]
France	Commissariat General du Plan	4%. From 1985-2005 used 8%[ab]
United Kingdom	HM Treasury	3.5% (declining to 1% for benefits and costs

[14] Original table found in Harrison, M. 2010 Valuing the future: The social discount rate in cost-benefit analysis. Visiting Researcher Paper, Australian Government Productivity Commission. Canberra, Australia. http://www.pc.gov.au/__data/assets/pdf_file/0012/96699/cost-benefit-discount.pdf. pp. 10.

		received more than 300 years in the future) from 2003. From1969-78 used 10%[a].
Norway		From 1978-98 used 7%.[ab]
Germany	Federal Finance Ministry	3%. From 1999-2004 used 4%[ab]
United States	Environmental Protection Agency	2-3% (and test 7%)

*a- Zhuang et al. (2007 table 4, pp 17-18,20); b- Spackman (2006, Table A1, p.31); c- Treasury Board of Canada (2007, p.37, 1998, p. 45); d- South African Department of Environmental Affairs and Tourism (2004, p.8); e- van Ewijk and Tang (2003, p. 1); f- Use of 10% rate by New Zealand Government is confirmed by Young (2002, p. 12; Abusah and de Bruyn (2007, p. 4); g- New Zealand Treasury (2008) recommends a default rate of 8% (after adjusting the market risk premium of 7% for gearing).

Technical Standard Three: Based upon its relative straightforwardness as compared to the shadow price of capital (SPC) approach, the social opportunity cost (SOC) approach to discounting is preferred. However, both methods are theoretically appropriate, thus the working standard is that the analyst must explain the implications of the chosen approach and justify her choice should the analyst derive a discount rate for use in BCA.

Disagreement exists as to the proper methodology by which to actually derive the discount rate for the cash flows of a given project or investment. Generally, this need not hinder social policy BCA, as in the majority of cases the analyst can select an appropriate discount rate from the range of rates derived by government and academic sources. Nonetheless, we outline the two primary approaches to deriving a rate to provide a brief reference as to the mechanics and rationale underlying the various discount rates in practice and highlight what we find to be the strongest method.

In categorizing approaches, it is helpful regard the various discounting methodologies as being either *investment-based* or *consumption-based* or, more appropriately the weighted average of both. Most methods either equate the discount rate to the rate of return expected from different investments of equal risk or else regard the discount rate as the change in value of consumption over time (Young 2002). In a perfect market scenario (i.e. all markets clear, all goods and services are marketed, perfect information, and a single market interest rate), a market clears at a rate where the consumption time preference and the opportunity cost of capital are equivalent; this rate is the discount rate.

Empirical markets are, however, of course imperfect. Since a given individual's investor and consumer preferences do not then equate, the analyst seems to feel forced to choose which of the two preferences (investor or consumer) to utilize in a given analysis. Much of the debate around discounting in financial analyses concerns which approach, if either, should be used to estimate a discount rate (Young 2002). Moreover, many parameters needed to

furnish a discount rate, such as the shadow price of capital, are not directly observable but instead must be estimated. These issues give rise to the numerous discount rate estimation techniques in use.

Investment-Based Discounting

Based upon its relative simplicity, the BCA Center prefers the social opportunity cost (SOC) approach (which is a weighted average of investment-based and consumption approach) (see Harberger 1986; 1987; Sandmo and Dreze 1971; Sjasstad and Wisecarver 1977; Burgess 2010a; 2010c). The social opportunity cost of capital (SOC) approach determines the discount rate on the basis of consumption and capital displaced; the weighted SOC is a weighted average of the pre-tax and post-tax rates of return weighted based upon the proportion of funding stemming from different sources. The fundamental premise of the SOC approach is that an investment should not be made at the expense of another investment that has a higher yield for the same budget, and thus the discount rate should reflect the opportunity cost of funds (Harberger 1973; Sandmo-Dreze 1971) as well as the consumption rate of return, each weighted by there significance. (Contrary to some assertions the SOC is not equivalent to Bradford's two stage approach (Burgess and Zerbe, 2011.)

Burgess (2011) suggests that if a project produces benefits that the private sector treats as equivalent to income a straightforward application of the SOC criterion is appropriate; benefits and costs should be discounted at the social (economic) opportunity cost of capital, which is a weighted average of the pre-tax and post tax rates of return where the weights reflect the proportions of funding that displace private investment and consumption respectively when the government borrows to finance the project. For any project whose benefits are not treated as income there will be "indirect revenue effects", but they can be incorporated by adding to (or subtracting from) the project's benefits, not by adjusting the discount rate.

Though Liu (2003) claims that the SOC approach requires a different rate for each project (as he interprets the SOC as the internal rate of return on a project), if we follow Harberger (1973) and define the SOC as the "social opportunity cost of borrowed funds", i.e. the rate of return foregone when the government borrows to finance a project, the SOC rate will be unique and thereby common to all projects. If there are indirect revenue effects they should be added to or subtracted from the project's benefits, not incorporated by adjusting the discount rate. In this regard, we follow the standard suggested earlier in which the discount rate is separated from determining future values to discount.

The "debt" incurred through displacing investment and stimulating savings comes from the extraction of funds (resources) from the economy, not from the nature of their use. Thus, the shadow price of investible funds (SPIF) and the SOC should properly apply to policemen's and teachers' salaries and soldiers' meals as well as to investments in public roads and dams.[15] The SOC

[15] As noted by a personal communication from Arnold Harberger, 2010

discount rate would apply to these sorts of government expenditures as well as traditional investments.

The SOC takes into account both the displacement of capital and foregone consumption, and in an open economy the use of foreign funds. Its use is simpler than other similarly derived rates. This rate associated with the SOC is:

$$SDR = \Sigma\beta_i r_i + \Sigma\theta_j p_j + \alpha f \quad (3)^{16}$$

While the SOC is conceptually straightforward, it is empirically challenging to arrive at a reliable estimate; not only must rates of return on alternative sources of funds be estimated, so must the proportions of funding drawn from each source.[17] Nevertheless it is less challenging than deriving rates from the other main approaches, and conveys several other significant benefits. According to the SOC approach, the marginal source of funding for all projects is the capital market. This ensures a level playing field for all projects and avoids situations where a project is judged to be worthwhile because it is proposed to fund it using an efficient tax. If a particular tax is being proposed to finance a particular project, the revenue from the tax could be used to pay down the debt instead of funding the project so the alternative use of funds for any project is to pay down the government debt. Using the SOC approach, Burgess and Zerbe (2011) posit that the appropriate discount rate for social policy initiatives undertaken in the US and Canada lies between 6% and 8%. This is consistent with the base OMB recommendation of a 7% discount rate. The reason that this recommended range of rates is significantly higher than that proposed

[16] Where $\Sigma\beta_i + \Sigma\theta_j + \alpha = 1$, β_i is the proportion of funds from increased savings of group *i*, r_i is the marginal rate of time preference for group *i* (often the after-tax real rate of return), θ_j is the proportion of funds from displaced investment in sector *j*, p_j is the marginal rate of capital productivity in domestic sector *j*, α is the proportion of funds from foreign funding, and *f* is the marginal cost of foreign funding.

[17] A reasonable estimate of the opportunity cost of displaced investment is the pre-tax rate of return on capital in place. Accounting rates of return calculated using either national accounts or company accounts tend to be fairly stable over time. Jorgenson and others have estimated these rates of return for the U.S. economy over many years (see Jorgenson and Yin 1996). Poterba (1999) estimated an average pre-tax rate of return in the U.S. non-financial corporate sector of 8.5%. Under certain conditions the average cost of foreign funding can be approximated as the rate of return that foreign investors earn on the capital invested in the country net of all taxes paid to the host government. If the supply price of foreign funding is upward sloping, the average cost will understate the marginal cost. If the withholding tax corrects the divergence between average and marginal cost, the marginal cost of foreign funding will be the rate of return to capital net of corporate and property taxes but gross of withholding taxes. Assuming a pre-tax rate of return of 8.5% and a combined corporate and property tax rate of 35%, the implied marginal cost of foreign funding is approximately 5.5%. The consumer rate of interest is usually calculated as a group's after-tax rate of return, but for some groups (e.g. negative savers) it is the real interest rate on credit cards and other debt. Since the aggregate household sector is a net saver, a reasonable estimate of the marginal cost of incremental saving (foregone consumption) is the pre-tax rate of return to capital net of all taxes on income from capital. Applying the corporate, property and personal tax rates to Poterba's 8.5% estimate of the pre-tax rate of return gives an after tax rate of return of approximately 3.5%.

elsewhere[18] is because other researchers do not base their SDR estimates on the null alternative use of funds being down the debt. We feel that this is the most appropriate basis on which to calculate opportunity cost, and thus support the 6-8% SDR range that this assumption gives rise to.[19]

Consumption-Based Discounting

Other economists prefer to employ consumption-based discounting for social policy BCA, on the grounds that social welfare ultimately is based upon utility from consumption of both private and public goods (Arrow (1995), Cline (1992), Marglin (1963), Mirlees and Stern (1972), and Stern (2007; 2008) among others). However, these authors generally recognize that adjustments must be made to account for the opportunity cost of investment funds (Burgess and Zerbe, 2011). A consumption-based discount rate is then based upon society's willingness to exchange present and future consumption (Boardman et al. 2010). This rate is the consumption rate of interest (CRI), usually associated with the post tax rate of return for individuals. When using a CRI-based rate, analysts must account for the fact that society might select less-efficient public projects over more-efficient private projects if the CRI is less than the marginal return on investment (Boardman et al. 2010). Thus, project impacts upon private-sector investment are multiplied by the shadow price of capital (SPC) to generate consumption equivalent flows, which are then discounted at the CRI. This method is commonly referred to as the CRI-SPC approach (see Boardman et al. 2010 for further detail).

The social discount rate in this approach has two components: (1) the pure rate of time preference; and (2) the preference for increasing equality in per capita consumption over time than would occur in the null (i.e. "consumption smoothing"). This second component is product of the future growth rate of aggregate per capita consumption multiplied by the elasticity of the marginal utility of consumption with respect to increasing per capita consumption. Stated or revealed preference methods are typically used to estimate the time preference and the marginal utility of increasing per capita consumption parameters, and the future growth rate is estimated using historical data. That is, the fundamental equity approach to discounting is:

$$\rho = \delta + g\eta \tag{4}$$

Where δ is the pure rate of time preference, g is the growth rate of per capita income, ρ is the discount rate to be applied in valuing future per-capita

[18] For example, while Boardman et al. 2010 utilize a consumption-based approach in their analysis, they conduct a parallel investment-based approach and derive 5% rate for Canada based upon the SOC method.

[19] Note that this rate range, since it is derived using national accounts data, does in fact contain a risk premium, which is contrary to the standard put forth in this document. However, this premium reflects non-diversifiable risk, as opposed to an added risk penalty tacked on to the discount rate used in an analysis; unless a given project contributes less risk to the aggregate portfolio than the foregone risk from displaced private investment, it is appropriate to include this embedded premium.

consumption dollars, and η is minus the elasticity of marginal utility with respect to consumption. The equation holds that a dollar in the future is worth less than a present dollar for two reasons. First, the future increments to consumption are discounted because of pure impatience. By extension, the δ term would also capture a desire to give less weight to future individuals than we give to ourselves in the model (Beckerman and Hepburn 2007). The second term (given a positive growth rates) shows that increments to future consumption are reduced in value (i.e. the declining marginal utility of income) because we expect that the future will be richer than the present. This implies that an increment to consumption will be worth less in terms of marginal utility.

There has been much discussion of the appropriate assumptions to make regarding each of these parameters, and of consequences of uncertainty regarding them. Weitzman (2007) suggests as an easy-to remember triad of values $\delta = .02$, $g = .02$, and $\eta = 2$ which together imply a discount rate of 6 percent a year. Stern uses different values to arrive a discount rate of 1.4%, a rate lower by 77% than the Weitzman triad suggests, which gives some idea of the range of opinion even among those ascribe to this approach. Stern assumes a point estimate of the growth rate in consumption of 1.3% and assumes the elasticity of marginal utility with respect to consumption to be 1. Stern sets the pure rate of time preference at zero, following Ramsey's (1928) argument that a non-zero time preference rate is unethical for social policy.

A recent time-preference based approach by Boardman et al. (2010) (intended to derive the appropriate social discount rate for Canada) posits a base discount rate of 3.5%, with a range of 2.5% to 7%. This approach further adjusts for projects that crowd out of private investment (multiplying consumption equivalent flows by the SPC) and that are intergenerational (employing lower rates in successive time periods, down to a 1.5% rate for effects beyond 200 years) (Boardman et al. 2010).

Boardman's analysis represents the state-of-the-art for a consumption-based discount rate; however, the BCA Center disagrees with the underlying methodology and finds as a consequence the suggested rate to be too low. While the SPC approach is commonly used, it is not without flaws. For instance, estimates of the current marginal utility of income, let alone for future generations, are few, varied and contentious. An additional problem is that there is little agreement on what the social rate of time preference should be (as discussed above, currently the CRI is typically employed in this capacity). Moreover, the adjustments necessary for the SPC to take into account the value of capital displaced, make it similar to the SOC. Due to these issues, as well as the theoretical and empirical strengths of the SOC method, we recommend discounting using the SOC approach (and thus using the 6-8% SDR rate derived by Burgess and Zerbe (2011). This investment-based approach is also supported by the US OMB (1992) (who derive a similar 7% SDR rate).

Discounting Technical Standard Two: The discount rate period should match the period of the cash flow stream being analyzed.

The selected discount rate should be applied according to the same time interval as the project cash flow stream. For example, if the cash flow is allocated monthly, a monthly discount rate should be used. In reality, receiving one hundred dollars once a year is not the same as receiving fifty dollars twice a year. This can be accounted for by matching the period discount rate with the cash flow period. It can also be accounted for by using effective rate of yearly interest. The effective yearly interest rate is:

$$(1 + r/h)^h - 1 \tag{5}$$

where h is the number of cash flow periods in the year, and r is the nominal yearly rate.

Discounting Technical Standard Three: Use real rates of discount with real benefits and costs.

Real rates of discount based on calculations of the past will produce less volatility than using nominal rates with nominal values. Real rates will be based on the analysis of past rates. Errors can occur where past expected inflation differed from actual inflation, but at least for OECD countries real rates are fairly stable for long periods. Though this standard might seem obvious, there are past examples where real and nominal rates have been confounded in government agency analyses.

Discounting Technical Standard Four: Health and mortality risks should be discounted.

This directly accords with Theoretical Standard One. OMB Circular A-4 (US OMB 2003) notes that although some have questioned whether health or lives should be discounted, resources that used to save lives today could instead be invested to save more lives in the future, thus justifying discounting. The Circular states, "For such reasons there is a professional consensus that future health, both benefits and costs, should be discounted at the same rate" (US OMB 2003).

Discounting Technical Standard Five: Project-specific adjustments for risk should not be built into the discount rate; depending on the data and approach used in deriving a discount rate, however, it is appropriate for the discount rate to carry an embedded risk premium accounting for non-diversifiable systematic risk.

Generally speaking, for both conceptual and pragmatic reasons, the treatment of risk and time discounting should be undertaken separately in BCA (Boardman et al. 2011); that is, a risk premium should not be incorporated into the discount rate. The one exception is for non-diversifiable, or systemic risk.

While it has long been standard practice to employ a risk-free rate for government projects (i.e. government investment risk is lower than private investment risk), Crowley (2000) notes that there are equally defensible positions which might hold government investment risk to be equal to or even higher than private sector investment risk. In any case, assuming that asset returns to public investment are influenced by the business cycle and correlated with national income, it is certainly appropriate for the discount rate to include an adjustment for systematic risk as does private sector discounting (Brean and Burgess 2010). For this reason, Gray et al. (2010) suggest employing a standard Capital Asset Pricing Model (CAPM) as used in the private sector to discount public investments at a discount rate adjusted to reflect systematic risk.[20] Based upon these factors, we advocate for the SOC rate estimation approach: The SOC approach produces rates with an embedded premium for non-diversifiable risk (since these rates are derived using national accounts data) (see Boardman et al. 2010 for a discussion of this upward bias).[21]

Diversifiable risk, however, should not be incorporated into the discount rate unless it is deemed feasible to apply rate adjustments that would require the estimation of separate beta's for each project. More problematically, discounting net benefits at an increased rate so as to compensate for the presence of diversifiable risk can result in overcorrected NPV (Boardman et al. 2011; Brealey et al. 2011). Thus uncertainty associated with benefit and cost figures should be incorporated directly into the estimation of such values rather than factored into the discount rate used within the analysis. This can be accomplished deriving certainty equivalents for the estimated cash flows and then discounting these certainty equivalents.[22] Boardman et al. (2011) note that analysts typically cannot derive certainty equivalents or option prices in practice, since doing so requires

[20] Additionally, since systematic risk is of course factored into private investment decisions, competitive neutrality demands that the public opportunity cost of capital reflect this as well (Brean and Burgess 2010).

[21] Again, Crowley (2000) demonstrates that there is no basis for definitively concluding whether government investment risk is lower, equal to, or even higher than private investment risk; given this, it stands to reason that the best current course of action is to use discount rate that reflects a comparable degree of systemic risk. Similarly, Klein (1997) shows that government does not truly face a lower cost of capital, as were taxpayers to be remunerated for the risk borne by tax-financed projects, the cost of capital to the government would be the same as that faced in the private sector.

[22] A certainty equivalent represents the guaranteed amount at which an individual would be indifferent between the certain payoff and a risky asset. This is different from an expected value, which simply represents a weighted average of possible outcomes.

resource-intensive contingent valuation surveys. Thus, while expected values, which can be derived from observable market transactions, are not theoretically certain to be of the same magnitude or sign as certainty equivalents in the absence of very strong assumptions about individual utility (Boardman et al.), they are the standard pragmatic standard method of accounting for risk in NPV estimates.

Finally, disassociating risk and discounting is important from a standpoint of transparency and presentation as well. Using a probabilistic technique to explicitly adjust estimates of benefits and costs serves to improve the informational value of a BCA relative to using discounting to reflect uncertainty. It is preferable over factoring diversifiable risk into the discount rate since it better compartmentalizes decisions regarding reasons to adjust benefits and costs and decisions made regarding time preference.

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VII. Standards for Addressing Equity and Distributional Issues

Benefit-cost analysis (BCA) inevitably faces concerns about how to appropriately deal with issues of equity. Early BCA economists feared that should BCA engage in the more subjective issues of distribution, it would be labeled as unscientific (Zerbe 2007). Partially to avoid problematic interpersonal utility comparisons, the original Kaldor-Hicks (KH) model and the potential compensation test separate equity and efficiency by asserting that as long as beneficiaries could potentially compensate the "losers" from a program, the project was overall beneficial and thereby justified in benefit-cost terms (Zerbe 2007).

Many have been critical of the reliance on potential compensation, instead arguing that equity and distributional effects deserve consideration or valuation within the model (e.g. Zerbe 2007; 2009). Economists have pointed out that the existence of significant charitable giving makes the notion of individuals acting solely to maximize their personal utility somewhat dubious (Sugden 1984). For this reason, moral sentiments should not be ignored in BCA, and recent development in BCA has focused on expanding analyses to better include and address equity effects (Zerbe 2007; Loomis 2009). Empirically, politicians, decision-makers, and those affected by a policy care a great deal about the distributed effects of a potential decision; simply put, it matters who wins and who loses.

For instance, the environmental justice movement represents one aspect of this, where there is concern that decisions regarding the distribution of industrial activities, toxic pollution, and hazardous waste management unduly harm the poor and disadvantaged, subsequently further amplifying a cycle of poor health and low quality of life (EPA 2010). To address this issue of environmental justice Farrow (1998) proposes a modified criterion wherein a project is deemed to pass a benefit-cost test if the identified group either receives net benefits or is at least fully compensated for its losses (and similarly for environmental sustainability, if the compensation is larger than the net value of the resource, and the net value of the resource is reinvested). Krutilla (2005) proposes the KH Tableau framework, which disaggregates the benefits and costs of an intervention among stakeholders and records all between-stakeholder financial transfers. Though this can prove highly complex, a fully implemented KH-Tableau can provide a comprehensive understanding of economic effects at the chosen level of stakeholder grouping.

Typically BCAs present data on equity and distribution effects, for example, potentially differential effects by race, socioeconomic level, or geographical distribution, however these elements have traditionally been an afterthought in BCA (Loomis 2010). Some government agencies require this analysis, and explicitly disfavor programs that have disproportionate effects on certain populations. However, generally analyses have not employed a full accounting framework for benefit distribution such as the KH Tableau method.

Further, once a decision-making party decides to pay attention to a particular disaggregation, the methodology of weighting is at issue as well. For instance, willingness-to-pay (WTP) (see Section II, Costs and Benefits) for a given benefit is often employed to reflect the relative utility of a good or service to different people or populations and thus guide weighting. If WTP is found to be strongly linked to income based upon empirical findings, however, it is preferable to measure WTP as a percentage of income to adequately consider equity with respect to low-income residents (Loomis 2010). The use of willingness-to-accept (WTA) values instead of WTP values also has the potential to increase equity, as values for WTA are affected by income or present wealth, but not bounded by these metrics. Moreover, weighting can prove highly problematic, and thus it is the formal recommendation of this report that distributional weights not be used. We discuss them herein nonetheless however, in acknowledgement of the fact that this issue is far from settled.

In the section that follows, we provide theoretical standards aimed at improving the ability of BCA to address equity and distributional concerns. The technical standards that follow then provide more specific action-items for practitioners when conducting a BCA.

a. Theoretical Standards for Addressing Equity and Distributional Issues

Equity and Distribution Theoretical Standard One: Explicitly include the distribution of net benefits in the discussion and presentation of BCA results.

This is consistent with principles of completeness and transparency. Ideally, BCA efforts should fully detail the equity effects of a proposed project, such that the analysis provides a basis for constructive debate. Comprehensive presentation of project equity effects serves to make the true decision-making tradeoffs readily apparent. Equity effects should be presented clearly and discussed coherently so that the policy discussion centers on political questions and not scientific or methodological issues. Thus, BCA should strive to present equity effects in such a manner that frames the policy debate clearly in terms of the fundamental political, social, or ethical question rather than allowing the scientific mechanics of the analysis to be a point of controversy and thus obfuscate the true nature of the policy decision.

Finally, it is important to note that an "equity effect" does not simply refer to an unequal distribution of benefits and costs, and that personal losses do not necessarily represent a "fairness" issue. If equity considerations become to diffuse, policy decision-making degenerates into a battle for special interest favors (Graham 2008). A pollution policy, for instance, that aims to make polluters pay a greater share of pollution mitigation costs might unequally distribute net benefits, but would certainly not be considered unequal in an analytical or philosophical sense. Careful distinction between an unequal distribution of net benefits and true equity effects is crucial, as otherwise the

concept of equity and distribution merely serves as a political vehicle for interested parties.

This document does not provide a rigorous definition of what constitutes an "equity effect," as the particular issue of equality facing a BCA will differ given the policy realm and context. However, broadly conceived, a true "equity effect" is likely to entail a disproportionate allocation of costs upon a population lacking the means to exert their political interests upon the policy decision, for instance those living in poverty, lacking English proficiency, or possessing a disability. Graham (2008) posits equity concerns to pertain primarily to those who lack basic capabilities to pursue a good life, primary goods, or access to the central entitlements that define humanity in a modern, civilized society. Protecting or advancing the interests of such groups is a significant policy concern (and sometimes a legal mandate, as with government agencies forced to consider environmental justice), and thus it is important to provide information regarding net benefit distribution to underrepresented populations.

Equity and Distribution Theoretical Standard Two: Present differentiated policy effects either implicitly or explicitly, but do not explicitly weight disaggregated benefits and costs (if effects are weighted, the analyst should take extreme care so that weighting does not distort estimates such that it fosters sub-optimal policy decisions).

The issue of distributional weighting remains highly contentious, and future principles and standards updates will require revisiting this issue. Harberger (1978), Loomis (2010) and others recommend *not* weighting differentiated benefits and costs (i.e. explicit weighting), since such weighting can undermine the utility-theoretic foundation of the estimated benefits and costs (Loomis 2010). Instead, implicit weighting, where un-weighted values are presented in a disaggregated fashion (e.g. by income bracket, ethnicity, or other relevant factor), is usually most appropriate (Zerbe and Dively 1994). If weights are used, weighting methodology must utilize an appropriate source. For instance, the Federal income tax rate is progressive, and the respective rates per income bracket reflect a comparison of marginal utilities of income as approved by Congress and the President of the United States (Loomis 2010). This representative authority lends justification for use of such figures.

Harberger (1978) cautions that limits must be put in place when considering distribution of benefits to individuals as a function of a proposed project. Weighting should not be used to produce a benefit estimate that exceeds the most cost-efficient way of achieving that same benefit. For example, a project that has an estimated real cost of $2 million and a real benefit of $1.6 million, but when weighted for an equity concern a net benefit figure that exceeds the $2 million project cost, is not justified, as it would be more efficient to simply transfer $1.6 million to the intended recipients. Essentially, distributional weighting should not cause an inefficient project to "pass" a BCA when the same effects could have been achieved via a less costly project.

Equity and Distribution Theoretical Standard Three: Beyond displaying the distributed effects of a policy, BCA should aim to provide decision-makers with information as to how the current distribution of net benefits could be altered if so desired.

Loomis (2010) notes the importance of providing feedback such that analysts and planners can modify a project to more equitably distribute benefits if that is a policy concern. For instance, a Lorenz curve, reflecting the cumulative percentage of income as a function of cumulative percentage of population, can be compared to a Lorenz curve demonstrating the cumulative distribution of project benefits against the cumulative population of beneficiaries to examine the distributional effects of a project relative to the existing distribution of income (Farrow and Viscusi 2010). Also, for very large-scale policies, before-project and after-project Lorenz curves of the focal population can be contrasted to demonstrate the how a given policy alters the distribution of income (Loomis 2010). The Gini coefficient, a summary statistic for a Lorenz curve, is the ratio of the area between the line of complete equity (a straight-line Lorenz curve that would result from a one-to-one relationship between cumulative income and population) and the actual Lorenz curve of the given population, over the total area underneath the equality line. Comparing the project-specific Gini coefficient against the societal figure similarly addresses concerns as to whether a project improves or worsens the present income distribution (Loomis 2010). An empirical example of how a policy maker might use such information would be to then alter the project funding mechanism within the BCA model, for instance an income tax instead of a sales tax, and again use the Gini coefficient to evaluate whether a project betters or worsens present income distribution (Loomis 2010).

b. Technical Standards for Addressing Equity and Distributional Issues

Equity and Distribution Technical Standard One: Disaggregate benefits and costs according to policy relevance and data availability.

At minimum, net benefits should be disggregated by broad stakeholder type, in terms of government (i.e. taxpayers), participants, and the "rest of society" (Karoly 2010). The degree to which disaggregated net benefits should be estimated differs given project context. For instance, a comparison of educational policies might be concerned with increasing opportunities for currently underrepresented groups by income, ethnicity, and gender, whereas health policy might require disaggregation by age as well. Subject specific guidance, for instance US Environmental Protection Agency (EPA) publications regarding environmental justice, can provide practitioners with tools and information such as appropriate disaggregations and indicators.

Data availability can also constrain disaggregation. Though poverty is to some extent endogenous, it represents a reasonable surrogate for more-difficult-to-quantify disadvantages, and thus presenting net benefits to the affected

population below the official US poverty line can help address equity concerns in data-limited situations (Graham 2008). Where a stakeholder of concern is identified by a very specific combination of multiple characteristics (e.g. low-income, single-parent, urban ESL households), and data limitations render such disaggregation effectively impossible, the analyst might present side-by-side disaggregations of what information is available (e.g. by income, by geographic location, or by number of adults in household) to at the very least allow decision-makers to better infer benefit distribution.

There are multiple ways to appropriately disaggregate net benefits, some much more complex than others. For instance, if project costs are borne by taxes or user fees, it will be relatively straightforward to determine the distribution of costs. However, estimating benefits in such a case proves more difficult. One commonly employed method is to utilize accompanying population data from a contingent valuation survey to indicate how individual benefits might vary with respect to income, demographic, or other factor. Loomis (2010) suggests disaggregating total economic values by income brackets and examining the pattern of benefit distribution. Using multiple regression analysis, demographic characteristics can be coded as factors and subsequently tested against individual benefits for model "fit", in terms of whether there is s significant difference in response to price or consumer surplus by factor. Given that BCA is concerned with economic significance and not statistical significance, when using multiple regression it is also to determine percentage change in value or absolute change in net benefits (Loomis 2010).

Equity and Distribution Technical Standard: When comparing projects, use congruent benefit and cost disaggregations.

Often, projects are weighted according to the aims and/or needs of a particular locality or jurisdiction. This proves problematic when comparing projects across political boundaries, as different weighting frameworks produce benefit and cost estimates that are relevant only to that particular context; for instance, a city mayor might be concerned about the effects of a capital improvement project on underrepresented groups, whereas another official convening a different analysis might have desired weighting to address potential effects on the poor.

Loomis (2010) notes that utilizing Federal tax figures allows for standardization of weighting for valid comparisons across states and other nested jurisdictions. Thus in the absence of another metric, these figures should be used for standardization when distributional weighting, against the recommendation of this report, is used. However, even if both studies weight using progressive tax rates as proxy for marginal utility of income, discrepancies in bounding can make comparisons problematic. Unless weight groupings are congruent across projects, disaggregated net benefit estimates do not necessarily provide a valid means of project comparison. Given such concerns, it is typically preferable simply to present unweighted net benefits, which already include to the degree possible the WTP for realization of moral sentiments, and let

decision-maker implicitly weight distributional concerns when comparing projects.

Equity and Distribution Technical Standard Six: Address potential relationship between distributional effects and policy valuation.

Though typically BCAs proceed on the assumption that distributional concerns are separable from efficiency concerns, and thus that project equity issues can be addressed subsequent to conducting the BCA, recent findings suggest that equity issues can in fact greatly affect policy valuation. Cai et al. (2010) demonstrates for climate policy that the distributional consequences of a given policy option can greatly affect an individual's WTP value. This calls into question the validity of the assumption that it is possible to produce a single WTP value without specifying the distribution of benefits and costs to those being surveyed. Without specification of policy effects, each individual is likely to impute what consequences seem most likely to them and these perceptions can differ across individuals in unobserved ways (Cai et al. 2010). More research is required make such findings operational for BCA, but it is important to note that distribution of net benefits likely plays a more significant role in policy valuation than has generally been assumed. Thus, when an analysis relies significantly on contingent valuation, the distribution of net benefits might need to be incorporated into the valuation process instead of addressed post analysis. This will be an area of future BCA refinement, however, and will require further addressment as these principles and standards are updated.

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VIII. Standards for Analysis Presentation

The presentation of benefit-cost analysis (BCA) findings is critical to the useful application of BCA in policy-making. In many cases, the consequences of a policy decision result directly from the quality of methods used to display and assess quantitative data (Tufte 1997). Benefit-cost analysis (BCA) has been criticized in the past for combining a huge amount of data into a figure that gives a "thumbs-up" or "thumbs-down" to a project, with little transparency as to how the analysts arrived at that ratio. Opaque presentation hinders decision-making, and often serves to delegitimize BCA in the eyes of non-practitioners; if BCA is to be used most effectively in policy-making, there is a need for analysts to make models and outcomes available and accessible to the larger public (Caulkins 2002).

Greater transparency as to how analysts arrived at specific values enables decision-makers to make better-informed use of BCAs and provides a basis for constructive debate about the true tradeoffs of a policy decision. Clear presentation of assumptions about parameter values, modeling choices, discount rates, time horizons, and other choices made by the analyst allows policy-makers to verify that the researchers' choices are consistent with those of the policy-maker. Openness and clarity regarding the decisions made by the analyst indicates responsibility and increases accountability (Tufte 1997). Moreover, providing model and process details, rather than simply a single estimate of net benefits, enables others to replicate or conduct comparative analyses. Efforts increasing BCA transparency will likely also foster a greater acceptability to the public of BCA employed in social policy decision-making.

The following theoretical standards outline broad concepts as to how BCA should be implemented and incorporated into policy decision-making, as well as how modeling results should be presented. More pointed standards then detail best practices for meeting such principles in conducting BCA.

a. Theoretical Standards for Analysis Presentation

Presentation Theoretical Standard One: Presentations of benefit-cost analyses must be understandable, meaningful, and accountable to the audience.

Presentations of BCA results should avoid overwhelming the audience with technical details that obscure the data or make the results difficult to understand. However, overly simple presentations can belie the complex, uncertain nature of BCA estimates. Thus, BCA should be presented in a manner that is accessible and yet still reflects the true meaning and implications of analysis results. Depending on the audience and feasibility, a presentation of a BCA should include—or at least make available to those interested— each element discussed in the technical standards below.

Presentation Theoretical Standard Two: Analysis presentation should not overly emphasize the final estimate of net benefits. Each component of the analysis, from data gathering to modeling processes, potentially generates highly relevant policy information that deserves equal footing alongside model results in presentation.

Generating estimates of net benefits for different policy options is the fundamental output of BCA. Without context, however, net benefit estimates lack meaning and can result in ill-informed decision-making. Information and findings garnered throughout the analysis, such as model distributions, sensitivity analyses, and current data deficiencies, provide context and depth to model outputs that greatly enhance the overall usefulness of BCA for policy decision-making.

Communicating probabilistic results to policy makers who tend to seek a final, numerical figure proves to be a significant challenge for BCA (Caulkins 2002). Though there is an understandable tendency for policy-makers to simply look for a final net benefit summation, BCA practitioners should resist this pressure to "just provide a number". A single numerical BCA output can unhealthily dominate thinking and discussion, and moreover focusing on a single number belies the uncertainty associated with BCA model results. Morgan and Henrion (1990) and Krupnick et al. (2006) provide guidance as to presenting probabilistic information to decision-makers.

Similarly, unquantified effects must be purposefully presented so that they are not "lost" to the policy process. "Hard" data tends to drive out "soft" data, and so analysis presentation must ensure that unquantified effects are not ignored. The presentation of BCA should strive to provide the best information possible to policy-makers regarding the risks, implications, and assumptions underlying estimates so that they can be fully understood and utilized; this includes whatever quantitative or qualitative information is relevant to the decision.

b. Technical Standards for Analysis Presentation

Presentation Technical Standard One: Provide a brief (~10 page) summary for decision-makers describing analysis process, results, and implications.

Though the actual analysis report might be longer, especially given technical appendixes, a project summary should also be composed that concisely details the analysis process, results, and implications. The summary should not over-simplify the analysis or over-generalize findings, but it should be worded in non-technical language that makes the report accessible to non-experts and policy-makers lacking economic expertise. This document should include, but not be limited to:

- A step-by-step discussion of how the analysis was conducted
- Visual or graphic displays of quantitative data such as Monte Carlo simulation results.
- Explicit statements regarding model assumptions, baseline for comparison, and selection of parameter values, and other analyst-defined aspects.
- Description of the subset of outcomes that are measured, and which are observed versus projected.
- Qualitative analysis of elements not included in the model.
- Tables or graphs of relevant figures, such as net benefit disaggregations.
- Discussion of policy alternatives

Presentation Technical Standard Two: Design models to allow replication and future revision. If possible, create models with accessible user-interfaces so policy makers can explore scenarios interactively.

Data and model information should be made available to facilitate replication, revision, and refinement of the analysis. Whether provided in a technical appendix, supporting documents, or made available digitally. This is in keeping with best practices for scientific research overall, and greatly contributes to the legitimacy of BCA and development and growth in the field.

One method that can help demonstrate the implications of analysis decisions and communicate policy risks is to create interactive models that are accessible to policy makers (Cook 2010). For instance, models may be designed so that policy makers may change point estimates of parameters to observe the impact on the BCA outcome. This method can be used to improve communication of estimates with individuals less familiar with probabilistic statistical modeling techniques.

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PART THREE: Appendixes

IX. Glossary of Terms and Abbreviations

Term	Abbreviation	Definition
Benefit-Cost Analysis	BCA	Benefit-cost analysis (BCA) is an accounting framework that is used to evaluate the financial and the social consequences of decisions and to compare alternatives in financial terms. BCA attempts to furnish data about the gains and losses from a decision that are often missing from market data. Benefit-cost analysis and cost-benefit analysis are equivalent terms.
Benefit-Cost Ratio		The ratio of benefits to costs (total present value of benefits divided by total present value of costs)
Benefits		Benefits are the positive effects of a policy or program, and are measured by the willingness to pay (WTP) for gains or the WTA for a loss restored. This is a proxy for the price people would pay for the goods were the market to provide them.
Contingent Valuation Method	CVM	A survey-based method for valuing non-market resources. The survey typically asks people how much they would be willing to pay to maintain the existence of a certain feature (or willing to accept to be compensated for its loss) in a scenario given in the survey. Also called a "stated preference" model.
Cost-Benefit Analysis	CBA	See benefit-cost analysis above. Benefit-cost analysis and cost-benefit analysis are equivalent terms.
Cost-Effectiveness Analysis	CEA	Type of economic analysis that compares relative costs given a certain pre-decided outcome.
Costs		Costs are the actual social costs and the value of negative effects of a policy or program. Costs are determined by the amount those bearing the costs would be willing to accept (WTA) to bear the burden of the project or decision.
Disability-Adjusted Life-Years	DALY	Disability-Adjusted Life Years is a metric that combines mortality and morbidity by incorporating equivalent years of healthy life lost as a result of poor health and/or disability along with years lost due to premature death. It is derived using the formula DALY = Years of Life Lost + Years Lived with Disability.
Discount Rate		Typically represented as a percentage. The rate at which future values are reduced by time period to reflect present value. This is done according to personal time preference and/or market interest rates.
Expected Value		Savings or costs over time multiplied by the probability of those savings or costs being realized.

Term	Abbreviation	Definition
Externality		A cost or benefit, not reflected by the transaction price, incurring/accruing to an individual not party to the actual market transaction. From a societal perspective, externalities cause too little or too much production/consumption, as prices do not reflect true costs/benefits of a good or service and producers/consumers do not incur all costs or accrue all benefits
General Equilibrium Analysis	GE	An analysis in which many markets are taken into account, in contrast with Partial Equilibrium Analysis.
Least-Cost Alternative	LCA	The policy option that requires the lowest input of net present costs out of all alternatives. See cost-effectiveness analysis
Least-Cost Planning	LCP	Least cost planning (LCP) is a sub-division of BCA. In LCP the benefits are taken as given in the form of some objective to be obtained. For example one might wish to reduce the high school dropout rate by 20%. LCP would seek to discover the least expensive method of achieving this goal. See cost-effectiveness analysis.
Multi-Criteria Decision Analysis	MCDA	A disciplinary term describing various methodological tools designed to facilitate tractable decision-making in the face of numerous, conflicting analyses. Such methods aim to highlight and alleviate conflicts that cause different decision methods to produce conflicting answers.
Net Present Value	NPV	The present value of benefits minus the present value of costs.
Nominal Interest Rates		Market rates, which include expected inflation. .
Non-Market Values		Values for items not always counted in business accounting, e.g. the recreational value of a visit to a national park.
Office of Information and Regulatory Affairs	OIRA	The Office of Information and Regulatory Affairs (OIRA) is located within the Office of Management and Budget. OIRA's functions include reducing paperwork burdens, reviewing Federal regulations, and overseeing policies relating to privacy, information quality, and statistical programs.
Office of Management and Budget	OMB	The Office of Management and Budget (OMB) is a federal executive branch agency whose predominant mission is to assist the President in overseeing the preparation of the federal budget and to supervise its administration in Executive Branch agencies. As part of this, OMB evaluates the effectiveness of agency programs, policies, and procedures, assesses competing funding demands among agencies, and sets funding priorities. OMB also helps develop better performance measures.

Term	Abbreviation	Definition
Partial Equilibrium Analysis	PE	An analysis which is limited in its inclusion of markets. Contrast with General Equilibrium Analysis.
Present Value	PV	The value, in today's dollars, of a future benefit or cost. Also can be described as the amount of money you would have to invest today at N% to yield X value a given number of years in the future.
Quality-Adjusted Life-Years	QALY	Statistical metric designed to measure disease burden, in terms of quality and length of life added by a given policy intervention (or the converse). This can then be used to most efficiently allocate funds in terms of maximizing the marginal benefit of a policy intervention (in QALYs).
Real Interest Rate		Rate with inflationary expectations eliminated. Real rates show less variability than nominal rates.
Risk		Technically defined as the likelihood (probability) of an occurrence (positive or negative) adjusted by the magnitude of said event.
Risk-Informed Decision Framework		Decision-making approach that incorporates probabilistic risk assessment techniques into regulatory decision-making.
Shadow Prices		Prices used to value non-market goods.
Standing, Economic		A person or group has economic standing in an analysis if the effects of the program or policy on that group are included in the analysis.
Standing, Legal		Whether or not an individual or group is able to bring a lawsuit in court over a certain matter or against a specific defendant. In order to have standing, the plaintiffs must show (1) specific individualized injury (2) caused by the conduct of the defendant (4) of the type a favorable court decision can redress.
Travel Cost Method	TCM	A non-market valuation method, typically applied to recreational values, that derives a proxy value for a recreational site based upon actual market transactions (i.e. travel expenditures) incurred in order to access the site.
Uncertainty		Typically, an uncertain outcome that is not/cannot be described probabilistically, where either the current state or future outcomes cannot be precisely described.
Value of a Statistical Life	VSL	A misleading term referring to statistical value used to reflect the marginal cost of reducing deaths within a certain set of circumstances (e.g. worker deaths on a bridge building project). Essentially, VSL represents an equilibrium value between wealth and a reduction the probability of death. Where the cost of a statistical death reduction is lower than the VSL, such expenditure is then warranted. Values are adjusted to reflect demographics and characteristics of affected population, in terms of income level and life cycle.

Term	Abbreviation	Definition
Willingness to Accept Payment	WTA	The price someone who has a good would accept to sell it. Also can be expressed as the minimum amount of money one would accept to forgo some good or to bear some harm.
Willingness to Pay	WTP	The price someone would pay to acquire a good or benefit. The willingness to pay is bounded by the ability to pay.

X. Commissioned White Papers

This appendix provides a summary or abstract from each of the commissioned project white papers. Due to length, each paper is not appended in full. All papers are available at http://evans.washington.edu/research/centers/benefit-cost-analysis/principles-and-standards-draft-papers.

a. Analysis Components

An Assessment of Important Issues Concerning the Application of Benefit-Cost Analysis to Social Policy

Aidan R. Vining, Centre for North American Business Studies Professor of Business and Government Relations in the Segal Graduate School of Business, Simon Fraser University

David L. Weimer, Professor of Public Affairs and Political Science, Robert M. La Follette School of Public Affairs, University of Wisconsin – Madison

Reviewer: Robert Haveman, Professor Emeritus of Public Affairs and Economics, Faculty Affiliate, Institute for Research on Poverty, Robert M. La Follette School of Public Affairs, University of Wisconsin - Madison

"Social policy can be defined as the laws, rules, directives, programs, and other instruments employed by government to increase investments in human capital, encourage behaviors with positive externalities, discourage behaviors with negative externalities, or reduce wealth, income or consumption disparities. Social policy includes a range of substantive policy areas including early childhood development, education, physical and mental health, juvenile justice, crime and corrections, housing, income support and employment…

Because it is always valuable and important to understand the efficiency consequences of government interventions, including social policy interventions, there is no normative reason why these fundamental principles of BCA (and more generally welfare economics) should not apply to social policy. Therefore, we argue that *the standard principles of BCA should apply to social policy*. However, the application of BCA to social policy does raise a number of issues that deserve special attention in any effort to develop standards for benefit-cost analysts. Our specific charge from the BCA Society was to 'address general considerations in conducting a BCA of social programs, the need for principles and standards for social programs and addiction in particular and point out any special problems facing those doing BCA in the field of addiction. An ideal methodology will be suggested in so far as this is possible.' "

Behavioral Economics and Benefit-Cost Analysis

Lisa A. Robinson, Independent Consultant
James K. Hammitt, Professor of Economics and Decision Sciences, Department of Health Policy and Management, Harvard University

Reviewer: Brigitte Madrian, Aetna Professor of Public Policy and Corporate Management, John F. Kennedy School of Government, Harvard University.

"As traditionally conducted, benefit-cost analysis is rooted in neoclassical welfare economics, which assumes that individuals act rationally and are primarily motivated by self-interest, making decisions that maximize their own well-being. Its conduct is now evolving to reflect recent work in behavioral economics, which integrates psychological aspects of decision-making. We consider several implications for analyses of social programs. First, benefit-cost analysis often involves valuing nonmarket outcomes such as reductions in health and environmental risks. Behavioral research emphasizes the need to recognize that these values are affected by psychological as well as physical attributes. Second, benefit-cost analysis traditionally uses exponential discounting to reflect time preferences, while behavioral research suggests that individuals' discounting may be hyperbolic. However, steep near-term rates may largely reflect impulsive behavior and self-control problems. Third, behavioral research emphasizes the influence of social preferences on valuation. In addition to acting altruistically, individuals may act reciprocally to reward or punish others, or use the status of others as the baseline against which to assess their own well-being. Fourth, behavioral economics identifies factors that can help develop valuation studies that provide well-informed, thoughtful preferences. Finally, while behavioral research has led some to argue for a more paternalistic approach to policy analysis, an alternative is to continue to focus on describing the preferences of those affected by the policy options while working to ensure that these preferences are based on knowledge and careful reflection. Benefit-cost analysis can be best viewed as a pragmatic framework for collecting, organizing, and evaluating relevant information."

General Equilibrium Benefit Analyses for Social Programs

Allen H. Klaiber, Assistant Professor of Agricultural Economics, the Pennsylvania State University
V. Kerry Smith, W. P. Carey Professor of Economics, Arizona State University

Reviewer: Roberton C. Williams III, Visiting Associate Professor, Department of Agricultural and Resource Economics, University of Maryland–College Park, Senior Fellow, Resources For the Future

"[This paper] describes the conceptual framework for incorporating general equilibrium effects into benefit-cost analyses of social programs. To make our description tangible we selected a specific example, the evaluation of reductions in the resources available for public primary education. We use a policy change that has been common in local public education, due to the economic downturn-reductions in the teaching staff. To highlight the general equilibrium effects of exogenous reductions in the resources used to produce education and its effect on common measures of the quality of education, we use a locational sorting model applied to school districts in Maricopa County, AZ. Several of these districts experienced teacher cuts in the 2009-2010 school year and we use these cuts to illustrate how the model would work. Our approach provides an illustration of how the general equilibrium effects influence our understanding of both the severity and distribution of changes in household well-being arising as a result of changes to local social programs."

Importance of Incorporating Distributional Issues in Benefit-Cost Analysis

John B. Loomis, Department of Agricultural and Resource Economics, Colorado State University

Reviewer: James K. Hammitt, Professor of Economics and Decision Sciences, Department of Health Policy and Management, Harvard University

"…[An] important part of a policy decision is who gains and who loses. The distribution of benefits and costs is certainly important to politicians as well as economists, but of course for different reasons. Traditionally, few BCA explicitly analyze or provide a detailed discussion of equity. Historically, when equity was discussed it was in the context of a policy induced change in market prices, taxes or incomes, not changes in utility from publicly provided non-market goods like human health and environmental quality. This chapter addresses that gap. After first reviewing the importance of including equity in BCA, and the metrics to quantify distributional concerns, two case studies illustrating how to empirically evaluate distributional effects of non market goods are presented."

b. Social Policy Sectors

Principles and Standards for the Benefit-Cost Analysis of Public Safety

Scott Farrow, Professor and Chair, Department of Economics, University of Maryland, Baltimore County
W. Kip Viscusi, University Distinguished Professor of Law, Economics, and Management, Vanderbilt University Law School

Reviewer: Richard O. Zerbe, Daniel J. Evans Distinguished Professor, Director, Center for Benefit-Cost Analysis, Daniel J. Evans School of Public Affairs, University of Washington.

"This monograph provides an initial compilation of proposed principles and standards for benefit-cost analysis (BCA) of public safety policies. Public safety issues cover a wide range of governmental activities in general categories such as security, physical safety, health, natural hazards, and consumption of goods. Each of these areas of potential risk exposure has specific components such as crime, terrorism, food products, water, floods, and transportation accidents. Fundamental to each component is the element of risk of a bad outcome, including risks arising from nature as well as those that are the result of actions of people. Typically, there are also decisions that affect one's exposure to the risk as well as possibilities to either alter the risk or its consequences, such as through the purchase of insurance…

The applications of benefit-cost analysis to policy decisions involving public safety are diverse. The different contexts for BCA are associated with different literatures, communities of practice, and outlets for publication. What is similar across the applications in public safety is that there is an element of risk involving a probability of some negative outcome. An antonym for safety is danger and in modern parlance, the likelihood of a bad outcome or risk. Notwithstanding the systematic policy concern with risk, it's not surprising that we don't have Departments of Public Danger or Public Risk, both because of the broad scope associated with such names and the fact that agency names tend to be cast in positive advocacy terms. Designating an agency as promoting environmental protection stresses the constructive function of the agency in a way that designations such as the environmental hazard agency does not. Nevertheless, attending to general concepts such as public danger and public risk provides an important clue to the principles and standards that may be common across areas of public safety. Consequently, this monograph focuses on principles and standards for applying BCA where the unifying theme is that public safety directed at reducing risk to the public. How risks should be incorporated theoretically and empirically into BCA is the focus of the proposed principles and standards."

Principles and Standards for Benefit-Cost Analysis of Public Health Preparedness and Pandemic Mitigation Programs

Joseph Cook, Assistant Professor of Public Affairs, Evans School of Public Affairs, University of Washington

Reviewer: Lisa A. Robinson, Independent Consultant

"There are a number of policies and programs that can be implemented in both the private and public sector at the local, state and federal level to either contain the spread of epidemic or pandemic influenza or mitigate its effects once it is

already widespread. These containment and mitigation strategies have been studied extensively in the public health and epidemiology literature, often with state-of-the-art mathematical modeling approaches, to find "optimal" strategies. These analysts typically had a clear objective in mind when defining optimality: reduce the number of cases or deaths.

Many of these policies, however, imply large costs and benefits outside the health sector. For example, school closures are thought by many epidemiologists to be effective at slowing the spread of a pandemic or at least reducing peak caseloads, and are widely used. They may impose few costs on the healthcare system, but may involve large costs to families. Parents may need to miss work or arrange alternative childcare. These effects may differ by socioeconomic status (i.e. one-adult vs. two-adult households, availability of paid leave policies). On the other hand, the benefits of containment and mitigation programs (i.e. avoiding widespread morbidity and mortality by controlling the disease) may have very large macroeconomic effects which have only recently begun to motivate careful research. These types of economic costs and benefits have not been widely incorporated into existing economic analyses. "

Principles and Standards for Benefit-Cost Analysis of Early Childhood Interventions

Lynn A. Karoly, Director, Office of Research Quality Assurance; Senior Economist, RAND Corporation

Reviewer: Clive R. Belfield, Associate Professor, Department of Economics, Queens College, City University of New York, Co-Director, Center for Benefit-Cost Studies in Education, Teachers College, Columbia University.

"While the BCAs of early childhood programs serve to make such investments more compelling, there are limitations in the current state of the art. Most importantly, there are a number of methodological choices required when implementing a BCA—from discount rates to shadow prices—and analysts typically do not follow a standardized approach. Moreover, there are a number of other challenges in applying the BCA approach to early childhood programs that further introduce potential differences in methodology. These challenges include the economic values to attached to observed program outcomes, many of which do not have readily available economic values, and valuing potential benefits beyond the last observed outcomes. At present, most BCAs of early childhood programs provide proof of the principle that the economic returns can be positive for a given program, but they do not support decision-makers who may want to use the results to choose between alternative approaches to early intervention or to assess the difference in the economic returns obtained from investing in early childhood versus investing later in childhood or versus investing in some other type of social program.

In this context, the objective of this paper is to delineate a set of principles and standards for conducting BCAs of early childhood programs. Such principles and standards can guide the methodological choices that analysts need

to make when performing BCAs for one or more early childhood programs and they can support greater transparency in the results the analysts provide. The principles and standards can also support consumers of the BCA results in their need to understand the methods employed and the comparability across different studies."

Principles and Standards for the Benefit-Cost Analysis of Crime

John. R. Lott, Senior Research Scientist, University of Maryland, College Park

Reviewer: Bruce H. Kobayashi, Professor of Law, George Mason University Law School

"Criminal justice involves many trade-offs. Are we spending enough on police? What are the levels of penalties for different crimes? Are there trade-offs between different types of penalties? For example, does greater reliance on criminal penalties reduce the reliance on reputational penalties? There are many possible alternative methods of deterring crime. Longer prison terms are just one option. There are also issues of increasing the probability of arrest or conviction for those who are arrested. There are also private actions that can deter crime. Private reputations are one example. Take also putting locks on doors, car alarms, or people owning guns. Some of these actions involve possible externalities and we will discuss how those externalities might be measured and evaluated…

Though the range of possible estimates for many of these actions will be too large to definitively say whether the actions pass a cost-benefits test, that is not an unusual result. It is still useful to know what actions can be said to pay for themselves and which ones don't.

Cost benefit analysis is a technique designed to determine the feasibility of a project or plan by quantifying its costs and benefits. Below is a brief rough outline of what is involved with measuring and calculating these costs and benefits."