ABSTRACT

Cost-benefit analysis is one technique for evaluating the merit of environmental regulations. There is an ongoing debate regarding the role of cost-benefit analysis in regulatory decisionmaking, particularly in the area of environmental policy, and whether there should be more or less use of such analysis of federal regulations. Currently federal agencies are required under both executive order and legislative mandate to produce cost-benefit analyses of significant regulations. This report presents a summary of these analytical requirements at the Environmental Protection Agency. It reviews the results of environmental cost-benefit analyses as well as the sensitivity of these assessments to key economic assumptions. Lastly, it discusses the potential function of environmental cost-benefit analysis in policymaking. This report will not be updated.

Summary

Since the 1970's, cost-benefit analyses of laws and regulations have been performed to evaluate a number of federal agency programs, including those relating to health, safety, and the environment. The examination of the outcomes and role of cost-benefit analysis has increased of late in the public policy arena, with the domain of environmental regulation receiving a substantial amount of this attention.

Cost-benefit analysis attempts to quantify the changes in societal well-being that result from the imposition of a regulation (or other policy, action, or decision). Federal agencies, including the Environmental Protection Agency (EPA), are required by Congressional mandate and executive order to perform cost-benefit analysis of their most significant regulatory actions.

This report presents both the monetized costs and benefits of recent EPA regulations, as well as
describes in qualitative terms the benefits of these programs that EPA was unable to quantify and/or monetize. Nonmonetized benefits can be significant but may be omitted when performing cost-benefit comparisons; however, considerable uncertainty exists surrounding some such benefits. Similarly, there are also some difficulties associated with interpreting cost estimates, particularly when making comparisons across rules.

The Office of Management and Budget (OMB) generally reviews EPA's cost-benefit analyses, and the public has an opportunity to comment on these assessments as well. The General Accounting Office (GAO) has also performed a review of some aspects of EPA's economic analyses. Both OMB and GAO emphasize the impact that changes in key assumptions can have on cost-benefit analysis results.

It is difficult to obtain completely independent estimates of the total costs and benefits of EPA regulations. While there have been some attempts by independent parties to produce comprehensive estimates of the total costs and benefits of EPA regulations, these efforts generally rely on the information provided by EPA in its analyses. OMB has estimated total quantified costs and benefits of environmental regulation; but noting the many uncertainties, OMB concluded that although the analyses can provide useful general information about existing programs, they may not be useful for evaluating individual regulations except for indicating needs for further data and analysis.

While the practice of cost-benefit analysis has become more sophisticated over the years, there is still significant debate regarding its exact role in public policy analysis. Deliberation over environmental cost-benefit analysis, in particular, continues to raise challenging issues.

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Introduction

The concept of cost-benefit analysis is familiar to most people acquainted with public policy evaluation, and this analytical philosophy has been attracting increased public interest of late. Often the cost-benefit analyses of government programs for which it is difficult to quantify and monetize all costs and benefits are the most controversial, and therefore evoke the most public consideration. The programmatic endeavors of the Environmental Protection Agency (EPA) fall into this category, as environmental protection is a clear example of a market failure regarding goods that the public values, such as clean air, water, and healthy ecosystems, but for which there exists incomplete information both about the market value of these goods and the risks imposed upon them by pollution and other human (as well as natural) by-products.

Although the concept of cost-benefit analysis may seem simple and straightforward at first blush, it is an analytical framework that raises both theoretical and methodological concerns. While many concede that cost-benefit analysis can provide important information to policymakers on the impacts and implications of programs, as well as provide for transparency in the decisionmaking process for financial obligations resulting from government requirements, some question the utilitarian philosophical underpinnings of an analytical approach that deals only with economic efficiency without considering who receives the benefits and who bears the costs. More commonly, it is often pointed out that the inputs to such comparative analysis can be extremely complex and difficult to estimate.

The field of environmental cost-benefit analysis draws upon many disciplines to a substantial degree, which can include economics, chemistry, biology, geology, meteorology, risk assessment, epidemiology and toxicology, among others. As such, these analyses can provide a wealth of information on a number of aspects of a regulatory program. Yet, as with any such attempt to comprehensively evaluate the probabilities of a labyrinth of scenarios, the unavoidable counterpart is the sometimes considerable analytical uncertainty in the end result. Such uncertainties arise to some extent throughout each step of the cost-benefit estimation process. The monetization of outcomes may be the most controversial procedural component of the cost-benefit assessment to some, yet perhaps it is this translation to a common unit of measurement that allows for interpretation of a necessarily complicated analysis and hence has contributed to the popularity of the cost-benefit analysis framework in some circles.

What Analysis of Regulations is EPA Required to Perform?

EPA is required by law and by executive order to perform a number of analyses of many of the regulations it issues. The required focus of these analyses spans a range of policy concerns, including such matters as paperwork burden reduction and the potential for small business impacts. The broadest framework of analysis employed by EPA is cost-benefit analysis, which is required under Executive Order 12866 and the Unfunded Mandates Reform Act of 1995.

Cost-Benefit Analysis

Regulatory cost-benefit analysis attempts to measure the change in societal well-being resulting from the imposition of regulations. It can provide information to decision makers both on the merits of the regulation at hand as well as provide a framework for comparing a variety of regulatory alternatives. While cost-benefit analysis may aim to present categories of costs and benefits in terms of dollars (so that the cost-benefit comparison can be performed with a common unit of measurement), often monetizing and even quantizing all categories of costs and benefits can be extremely difficult and complex. In addition, monetization of some benefits categories can be controversial because indirect methods are often employed to estimate a value for goods that are not generally traded in the marketplace. For example, to estimate the monetary value of a reduction in risk of premature mortality, economists may perform statistical examinations of the wage premiums that workers receive for jobs that entail higher health risks or conduct surveys to assess people's "willingness-to-pay" to reduce a hypothetical health risk.

In order for an agency to address the complex analytical requirements and estimation difficulties associated with cost-benefit analysis, financial resources must be devoted to these undertakings. A study often major EPA regulations indicated that, for those rules, the average cost of performing a cost-benefit
analysis was $2.5 million, and if the asbestos rule (for which the cost-benefit analysis cost $8 million) was dropped from this average, the average would be $1.6 million (1995$). An estimate of approximately $1,000,000 (1996$) per cost-benefit analysis was indicated in another study. A Congressional Budget Office study of 65 economic assessments found that EPA incurred an average cost of $662,000 and a median cost of $376,000 (1995$). This represents, generally, a one-time financial investment for a rule; this is to be compared to the cost of a major regulation, which is (generally) greater than $100 million per year, and may be billions of dollars per year.

Albeit there has not yet been a comprehensive analysis of the cost of all EPA cost-benefit analyses and any resulting rule changes/savings, some preliminary evidence suggests that the cost of analysis may be warranted. In a study of 12 EPA final regulations, the author concluded that "...the economic analyses supported specific cost-saving rule improvements." The author of this report concluded for the group of rules he studied, "...[T]he present value of the annual increase in benefits and/or decrease in costs of the rules attributable to the economic analyses clearly outweighs the one-time cost of carrying out the analyses." 8

Executive Order 12866. On September 30, 1993, President Clinton signed Executive Order 12866 on Regulatory Planning and Review (58 Federal Register 51735, October 4, 1993), which requires agencies to perform cost-benefit analysis of proposed and final regulations. This executive order applies to "significant" regulatory actions. Executive Order 12866 defines a regulation to be "significant" if it may:

1. "Have 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; (2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; (3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or (4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive order."

Executive Order 12866 revoked and replaced two executive orders issued under the Reagan Administration: Executive Order 12911 requiring Regulatory Impact Assessments and Executive Order 12498 establishing the regulatory planning process. The analyses required under the Reagan and Clinton executive orders are largely similar, though there are some differences regarding how and to what extent such analyses may affect an agency's regulatory decisions. 9

Under Executive Order 12866,

"Federal agencies should promulgate only such regulations as are required by law, and necessary to interpret the law, or are made necessary or compelling by public need... In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits should be understood to include both quantifiable measures... and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits... unless a statute requires another approach."

Unfunded Mandates Reform Act (P.L. 104-4), Title II. In addition to these analysis requirements set forth by executive directive, the legislative branch also has directed EPA to perform cost-benefit analysis. The Unfunded Mandates Reform Act (UMRA) requires that federal agencies perform cost-benefit analysis of their regulations, including effects of the regulation on health and the environment. Section 201 of this Act directs agencies to "...assess the effects of Federal regulatory actions on State, local, and tribal governments, and the private sector..." unless otherwise prohibited by law. Section 202 of UMRA directs agencies to provide quantitative and qualitative estimates of anticipated costs and benefits of a regulation if such regulation results in annual expenditures of $100 million or more, including costs and benefits to State, local, and tribal governments, or the private sector. Section 205 further directs agencies, for those regulations for which an agency prepares a statement under 202, to adopt the least costly, most cost-effective or least burdensome regulatory alternative that achieves the objective of the rule or provide an
explanation why such an approach was not adopted. In general, these provisions give statutory authority to requirements similar to those in Executive Order 12866.

Other Required Analyses

A number of other legislative mandates and executive orders also require agencies to analyze and/or consider particular areas of policy concern. Such policy areas include small business impacts, children’s health and safety risks, and environmental justice. Often these other analysis requirements are considered in the written summary of the economic cost-benefit assessment. For more detailed information regarding these other legislative mandate and executive order analysis requirements, see Appendix A.

What are the Results of Cost-Benefit Analyses of EPA Regulations?

EPA's Cost-Benefit Analyses

EPA has been performing economic analysis of its regulations since 1981, when the first executive order was issued requiring agencies to perform such analyses. Ideally, such economic analyses fulfill requirements of both Executive Order 12866 (or, prior to Executive Order 12866, the requirements of Executive Order 12911) and UMRA, as well as examine more specific areas of policy concern (see Appendix A).

Summary of Recent EPA Regulatory Impact Analyses for Economically Significant Rules.

The Office of Management Budget (OMB) has published information on the benefits and costs of individual federal regulations dating back to April 1, 1995. (For estimates of the cost of all environmental regulations, see Other Cost-Benefit Analyses of EPA Regulations). Since that date, EPA has issued 28 economically significant final regulations (generally, those with an annual effect on the economy of $100 million or more). For each of these economically significant regulations, EPA has performed an economic assessment, often referred to as a “Regulatory Impact Analysis” (RIA) (which is what such economic assessments were called under President Reagan’s Executive Order 12911).

Table 1 presents a summary of the emission reductions, costs and benefits of these regulations, and includes monetized as well as nonmonetized benefits. (Note this table does not include all EPA regulations, but only those considered economically significant. Nevertheless, OMB states that they believe that such rules, generally, represent the vast majority of the costs and benefits of new federal regulations). The information in Table 1 is essentially from EPA-supplied RIAs and other documents, although the format of some figures may have been slightly altered to reflect figures used in OMB’s 1998 Report to Congress on the Costs and Benefits of Federal Regulations.

EPA's Comprehensive Cost-Benefit Analysis of the Clean Air Act, 1970 - 1990 (Section 812 Study).

In addition to the cost-benefit analyses that EPA has performed of individual regulations, in 1997 EPA completed a comprehensive cost-benefit analysis of the Clean Air Act for the years 1970 - 1990. This report addresses the question of how the overall health, welfare, ecological, and economic benefits of Clean Air Act programs compare to the costs of these programs in the period 1970 - 1990. This final report was developed through a peer review process with the EPA Science Advisory Board (SAB) Council on Clean Air Act Compliance Analysis (Council), an independent panel of economists, scientists and public health experts chaired by Dr. Richard Schmalensee of the Massachusetts Institute of Technology. The SAB Council summarized its findings in a July 8, 1997 letter to EPA as follows: "The Council finds that the Retrospective Study Report to Congress by the Agency is a serious, careful study and employs sound methods along with the best data available. While we do not necessarily endorse all details of this study’s findings, we believe that as a general matter that they are consistent with the weight of available evidence."

In contrast to a regulatory cost-benefit analysis that attempts to estimate the effects of a regulation before
it is issued (ex ante analysis), this assessment estimates ex post the effects of numerous regulations issued in response to a piece of legislation (the Clean Air Act). It focuses on the National Ambient Air Quality "criteria" pollutants of sulfur dioxide, nitrogen oxides, carbon monoxide, particulate matter, ozone, and lead. Table 2 summarizes the results of this Section 812 Study.

Table 2. Summary of the Monetized Costs and Monetized Benefits of the Clean Air Act from 1970 - 1990 (billions of 1990$)

<table>
<thead>
<tr>
<th>Total Direct Compliance Costs (present value)</th>
<th>Total Monetized Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits Category (pollutant)</td>
<td>Mean Present Value</td>
</tr>
<tr>
<td>Mortality (particulate matter)</td>
<td>$16,632</td>
</tr>
<tr>
<td>Mortality (lead)</td>
<td>$1,339</td>
</tr>
<tr>
<td>Chronic bronchitis (particulate matter)</td>
<td>$3,313</td>
</tr>
<tr>
<td>Children's lost IQ points (lead)</td>
<td>$399</td>
</tr>
<tr>
<td>Hypertension (lead)</td>
<td>$98</td>
</tr>
<tr>
<td>Hospital admissions (particulate matter, ozone, lead, and carbon dioxide)</td>
<td>$57</td>
</tr>
<tr>
<td>Respiratory-related symptoms, restricted activity, and decreased productivity (particulate matter, ozone, nitrogen dioxide, and sulfur dioxide)</td>
<td>$182</td>
</tr>
<tr>
<td>Soiling damage (particulate matter)</td>
<td>$74</td>
</tr>
<tr>
<td>Visibility (particulates)</td>
<td>$54</td>
</tr>
<tr>
<td>Agriculture - net surplus (ozone)</td>
<td>$23</td>
</tr>
<tr>
<td><strong>Total Monetized Benefits</strong></td>
<td><strong>$22,171</strong></td>
</tr>
</tbody>
</table>

$500
EPA is now in the progress of preparing its first comprehensive report on the costs and benefits of the 1990 Clean Air Act Amendments, often referred to as the Prospective Study.

Reviews of EPA's Cost-Benefit Analyses.

GAO Review. In 1997, the U.S. General Accounting Office (GAO) produced a report to congressional committees entitled "Air Pollution: Information Contained in EPA's Regulatory Impact Analyses Can Be Made Clearer." This report describes the results of GAO's review of 23 RIAs of air quality regulations. The RIAs analyzed were prepared and issued by EPA's Office of Air and Radiation between November 1990 and December 1995.

Generally, GAO found that all 23 RIAs presented the cost of the regulation in terms of dollars. However, only 2 of the RIAs assigned dollar values to benefits.

GAO concluded in its report that EPA was not always consistent in its use of some key economic assumptions, upon which the results of the cost-benefit comparison depend heavily, nor did it always explain the rationale behind its choice of assumptions. In particular, GAO focused on EPA's use of two key economic assumptions: 14

- **Discount Rate.** The value of the discount rate chosen in a cost-benefit analysis can have a significant impact on the results of the study. Discounting is used to reflect the idea that resources (goods and services) may be worth more now than in the future. This is because resources now may be invested and hence be worth more in the future, and because people usually prefer consumption in the present over consumption in the future. As benefits and costs occur in a stream over time and may vary from year to year—for example, costs may be imposed for air pollution control equipment in year 1 while the improvement in air quality may not occur until year 3—the choice of a rate to discount costs and benefits to present values can effect the cost-benefit ratio. 15

Of the 23 RIAs reviewed, GAO found that five did not indicate whether the estimated future benefits and costs were discounted. EPA's guidance suggests that sensitivity analyses be performed to show what effects a different discount rate may have on the cost-benefit ratio. Of the 18 RIAs that did clearly indicate the discount rate used, five performed such sensitivity analysis while 13 used a single rate. 16

- **Value of a Statistical Life.** The value of a statistical life represents individuals' willingness-to-pay (WTP) for a reduction in risk of mortality, and is derived from aggregating individuals' WTP across the relevant population. For example, if a reduction in pollution in a city of one million people reduced one's risk of premature death by one in one million, one "statistical life" would be saved in that city. If a typical individual is willing to pay five dollars for a reduction in risk of premature mortality of one in one million (the five dollar value may have been derived through a contingent valuation survey or other method), the total WTP for the one "statistical life" saved in that city would be five million dollars. The value of a statistical life used in a cost-benefit analysis can have a significant impact on the results of such an assessment, and may even determine the sign of the cost-benefit comparison.

GAO reported that of the 14 RIAs that showed an expected change in mortality due to the impacts of a regulation, five did not indicate what value of a statistical life was chosen. Of the remaining nine that did indicate the value chosen, one did not perform sensitivity analysis to show how benefits estimates might be affected if different valuation assumptions were employed for that benefit category.

GAO stated that EPA has formed an Economic Analysis Consistency Task Force to address any inconsistencies in its economic analysis. Further, EPA stated that many factors affect how extensive an
RIA is, including staff, time and other resource constraints, the authorizing legislation for environmental regulations, and the significance of the regulatory action.

**OMB Review.** OMB has been overseeing cost-benefit analysis of regulations performed by agencies under the authority of executive orders since President Reagan issued Executive Order 12291 in 1981. OMB first issued preliminary guidance implementing Executive Order 12866 on October 12, 1993, and issued the most recent guidance, developed through an interagency process, on January 11, 1996, *Economic Analysis of Federal Regulations Under Executive Order 12866* (otherwise known as the *Best Practices* guidance document).

OMB has also issued two Reports to Congress (one in 1997 and one in 1998) on the costs and benefits of federal regulations issued by all federal agencies. These reports, in addition to summarizing monetized estimates of the costs and benefits of federal regulations in environmental and other program areas, also assess the general state of regulatory cost-benefit analysis as applied by agencies to evaluate their programs.

OMB concludes in its 1997 report that:

> "Although considerable progress has been made in providing micro data in advance of regulatory proposals and in developing best practice guidance, further progress is needed to continue improving regulatory decisions. Specifically, we need to ensure that the quality of data and analysis used by the agencies improves, that standardized assumptions and methodologies are applied more uniformly across regulatory programs and agencies, and that data and methodologies designed to determine whether existing regulations need to be reformed is developed and used appropriately." 18

The 1998 report further concludes that for agencies’ cost-benefit analyses, "the overall picture remains one of slow but steady progress towards the *Best Practices* standards". 19 While the OMB report acknowledges that economic assessments, even if fully adhering to *Best Practices* guidance, should not be the sole determinant regarding whether existing regulatory programs or program elements should be reformed or eliminated, the report asserts that cost-benefit analysis provides useful general information about existing regulatory programs.

OMB’s Reports to Congress highlight some methodological issues of particular concern when aggregating cost-benefit estimates from a set of individual rules. These estimation difficulties include:

- **Baseline Issues.** The baseline is the state of the world against which costs and benefits of a regulatory action should be measured, and should represent the world in which the policy under consideration was never implemented. As this requires an approximation of circumstances which never occurred, estimation problems are inevitable. OMB states that this issue becomes particularly problematic when analyzing large impacts, because, for example, "...the techniques of applied welfare economics, upon which cost-benefit analysis is based, hold only for marginal changes in economic activities." 20

- **Use of Ex Ante Versus Ex Post Estimates.** Related to (1) above is the problem that *ex ante* cost and benefits estimation techniques (which most RIAs employ) are based upon a set of preferences, technologies, and regulatory structure that may well change over time. This problem is even greater for prospective studies, as both the baseline and "counterfactual" must be predicted.

- **The "Apples and Oranges Problem."** Individual studies may vary greatly in their estimation techniques. In addition to a wide range of quality that may be found in a survey of cost-benefit analyses, different methodological and conceptual approaches (like different discount rates, assumptions underlying regarding "high", "low" and "best guess" estimates, and valuation studies chosen), can make any aggregate cost-benefit study difficult to interpret.

In addition to general comments that OMB offers on regulatory cost-benefit analysis, OMB’s 1998 Report
to Congress also offers a discussion of a few elements of analysis from EPA’s Section 812 report, *The Benefits and Costs of the Clean Air Act, 1970 - 1990*. OMB observes that the results of this cost-benefit assessment can be sensitive to certain methodological elements in particular, which include:

*Establishing a Baseline*. EPA’s Section 812 report assumes a baseline scenario from 1970 - 1990 in which no additional air pollution controls beyond 1970 requirements are implemented, either voluntarily or as a result of other government actions. (The 812 Report does assume that some technology improvements occur which lower baseline emission rates). Due to population and economic growth from 1970 - 1990, and the accompanying increase in emissions from motor vehicles and other sources, the degradation of modeled air quality in the baseline results in a large change in air quality attributed to the Clean Air Act in this study. OMB reiterates that the inherent uncertainty associated with such speculation regarding “what would have happened” is substantial.

*Significant Benefits Categories*. OMB points out that 90% of the total monetized benefits in the Section 812 Retrospective are associated with reduced exposure to particulate matter. OMB contends that the state of the science is such that there is considerable uncertainty associated with the magnitude and causation of particulate matter benefits categories.

OMB further observes that EPA assumes no time lag in the relationship between a change in exposure to particulate matter and the change in the risk of chronic health effects and mortality. OMB claims it is quite possible that there is a lag in this relationship, and that particulate matter benefits are highly sensitive to this assumption. OMB’s report states that adopting an alternative assumption of a 15-year lag, for example, would reduce the present value of mortality benefits by a factor of two.

*Benefits Transfer* Methods for Valuating Changes in Mortality Risk. The Section 812 Retrospective estimates a mean value of $4.8 million per statistical life, based on 26 studies of individuals’ willingness-to-pay (WTP) for small reductions in mortality risks. This estimate translates to a WTP of $5 for a reduction in mortality risk of one in a million. OMB states that extrapolating this marginal valuation, which is derived from small changes in mortality risk, to the changes in mortality risk as represented in the Section 812 report (which are roughly 10 to 100 times greater), results in a total WTP that is a large portion of a household’s annual budget. OMB asserts that budget constraints at this level of expenditure may reduce an individual’s WTP as compared to WTP estimates that reflect a smaller portion of a household budget. OMB highlights this difficulty associated with transferring economic benefits estimates from one situation to another.

In response to OMB’s observations regarding EPA’s economic analyses, EPA states that in developing RIAs, it strives to use the most current and scientifically defensible methods. EPA submits that where there are controversies, it relies on the advice of its Science Advisory Board (SAB) to guide its methodological decisions. During June and July 1999 meetings of the SAB, EPA sought SAB guidance regarding many of OMB’s concerns highlighted above. EPA states that it is making some revisions to its economic analyses based upon this guidance. One example of this is the revision of EPA’s assumption regarding the existence of a temporal lag between exposure to particulate matter and the resulting change in mortality risk. EPA requested that the SAB review the scientific evidence on this matter and the SAB recommended that EPA assume a 5 year distributed lag structure in its analyses, while recognizing the lack of direct scientific evidence for a specific lag in mortality effects. EPA states that it is following SAB guidance in assuming the 5 year lag structure and presenting a sensitivity analysis showing the impact of alternative lag structures, including the OMB suggestion of a 15 year lag. 21

In addition to addressing the issue of lags in health effects associated with particulate matter, EPA also requested SAB guidance on the issue of the value of a statistical life. EPA states that while the official SAB advisory letter has not been issued, oral comments indicate SAB support for EPA’s use of the $4.8 million (1990 dollars) value for a statistical life, with appropriate caveats and alternative calculations, showing the impacts of assuming different methods for calculating the value of reduced mortality risk, such as calculating life years saved instead of lives saved.
Other Cost-Benefit Analyses of EPA Regulations. While organizations and individuals outside EPA have produced a number of estimates of costs and benefits of particular environmental regulations, there are few studies that make an effort to evaluate in a comprehensive manner the total costs and benefits of such regulatory programs. Moreover, the comprehensive studies that do exist generally rely on data and analyses from EPA, though often with some adjustments.

In OMB's 1998 Report to Congress on the Costs and Benefits of Federal Regulations, OMB conducts the most thorough examination to date of the total costs and benefits of federal regulations, including those issued by EPA, as of March 31, 1998. OMB derives these estimates for EPA regulations from the following sources:

1. EPA's Environmental Investments: The Cost of a Clean Environment (December 1990), which derives cost estimates of pollution control based on the Department of Commerce's "Pollution Abatement and Control Expenditures" (PACE) reports, EPA RIAs of its major regulations (generally, those which have an effect on the economy of $100 million or more), and special EPA program analyses;
2. Other EPA RIAs of major final regulations;
3. Benefit/cost ratios as presented in a study by Robert Hahn, which derived its estimates based on EPA RIAs, with some adjustments made for purposes of consistency across analyses;

OMB modified some estimates to avoid double-counting and provide for consistency with their Best Practices guidance document.

Table 3 presents the results of OMB's effort to appraise the aggregate costs and benefits of EPA regulations as of March 31, 1998. The estimates presented below from OMB's report reflect only monetized costs and benefits: the table omits benefits that were quantified but not monetized, and also omits costs and benefits that were not quantified.

Table 3. Estimates of the Total Annual Monetized Costs and Monetized Benefits of Environmental Regulations
(billions of 1996$ as of March 31, 1998)

<table>
<thead>
<tr>
<th>Costs</th>
<th>$120-$170</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits</td>
<td>$93-$3,300</td>
</tr>
<tr>
<td>Net Benefits$</td>
<td>$-77-$3,200</td>
</tr>
</tbody>
</table>


Note: The dollar figures in this table do not reflect benefits that were quantified but not monetized. They also do not reflect benefits and costs that were not quantified.

Furthermore, as previously noted, OMB emphasizes that there are many caveats associated with aggregate cost-benefit figures. OMB explicitly says it "must underline the uncertainty of these estimates." It states that the "estimates are useful primarily for drawing general conclusions about categories of regulations that should be corroborated with additional data and analysis. As specific values," OMB goes on, "they are fraught with uncertainties.... [T]he baseline, apples and oranges, and other methodological problems significantly reduce the likelihood that these findings are robust." OMB further stresses that total (monetized) costs and benefits do not provide the information needed to make decisions about
incremental changes in regulatory programs. 24

What is the Role of Cost-Benefit Analysis of EPA Regulations?

It is important to understand that uncertainties exist throughout the cost-benefit estimation process. Each step of the analysis requires predictions and assumptions, from the estimation of the changes in emissions to the forecasts of consumer preferences. The obvious question arises: based on the current state of cost-benefit analysis in the environmental policy arena, is it a useful tool to employ in regulatory decision making?

The Current State of Cost-Benefit Analysis

The summaries of EPA’s economic assessments above illustrate the difficulties of performing cost-benefit comparisons of environmental regulations. Although it is usually considered easier to monetize costs than it is to monetize benefits, there are difficulties associated with capturing both completely and accurately.

**Costs.** One of the key interpretive and estimation difficulties regarding the cost of a regulation relates to how the notion of “cost” is defined. Economists define the cost of a good or service as the maximum value of the opportunities foregone in obtaining that good or service. The economic cost of a regulation is the opportunity cost of a reallocation of resources. Some RIAs attempt to capture this “social cost” to society; however, most RIAs estimate the cost of the rule as the expenditures for pollution control equipment. RIA cost estimates also often include other direct costs, such as administrative and legal expenses, but rarely attempt to capture “general equilibrium” effects like product substitution, discouraged investment and retarded innovation. General equilibrium effects may be significant, but are very difficult to estimate empirically.

There is a great deal of debate regarding whether there is a systematic bias in agency cost estimates of regulations. Critics posit that agencies understate costs because their incentive is to keep and grow their regulatory programs. Such incentives clearly exist, and it is indeed possible that regulatory programs on the whole become more expensive because they increase their scope beyond original legislative intention. Notwithstanding, some recent evidence suggests that agency cost estimates for individual rulemakings are not usually underestimated. In a recent study of *ex ante* cost estimates of 25 environmental and occupational safety regulations, the authors found that twelve overestimated total (direct) costs, while only six underestimated these costs. 25 The authors found that much of the overestimation could be attributed to technological innovations that were not anticipated when cost estimates were developed. In addition, some costs were found to be overestimated because they were based on rule provisions that changed (became less stringent) or erroneous assumptions about complete compliance. (Of course, in these instances emission reductions and benefits would be smaller as well). Other causes of overestimation include producing estimates of maximum (rather than expected) costs, and public pressures from the regulated community on the agency to not underestimate costs.

**Benefits.** Perhaps the most difficult interpretive issue regarding benefits estimation is what value to place on nonmonetized benefits categories. The nonmonetization of a benefits category does not equate to its insignificance, and these categories should not be ignored when performing the cost-benefit comparison. Care should be used in interpreting such qualitatively discussed categories, however. Some such benefits may be expected to occur with certainty but there is simply insufficient data or resources to quantify and/or monetize them. For other benefits categories, there may be inadequate information to conclude they will actually result from the regulation. For example, while there may be enough evidence to establish a link between a toxic air pollutant and human respiratory problems, and hence this category may be listed as a nonquantified/nonmonetized benefit of a regulation, there may not be enough information to conclude that the reduction of the air toxic due to the regulation will result in a reduction in incidence and/or severity of the respiratory problem. Such a determination may depend heavily upon expected exposures and “background” concentrations of the pollutant already present in populated areas, and this data may not be available.

The monetization of benefits introduces additional estimation challenges. Although some may hold philosophical objections to putting a dollar value on health and welfare effects, mainstream economic
theory infers that individuals do behave in such a way as to indicate that they do consider tradeoffs (costs) when considering what "basket" of goods and services they choose to acquire with their limited resources. Observations of how U.S. society values environmental goods indicate that individuals do not place an unlimited value on such goods. That said, producing a dollar estimate of the value associated with a particular regulatory action can be problematic in practice, even if one does not have a philosophical objection. Regulatory benefits estimates are virtually always derived by using values obtained from studies of a similar scenario and transferring them to the benefits category expected to result from the regulation under examination. For instance, if a regulation reduces one's risk of premature death by one in ten million, deriving the dollar value associated with this may entail utilizing studies of other health-risk scenarios that produce willingness-to-pay estimates for a reduction of risk of one in one million. Extrapolation of these estimates usually involves assumptions of linearity, (i.e., in this case, the "benefits transfer" method would involve dividing the original estimate by ten), but it is possible that such assumptions may not hold over the relevant range. Other benefits transfer methods involve using estimates (from other analyses) of a dollar benefit per ton of pollutant reduced. Such techniques have limitations due to the lack of consideration of actual human exposure under different regulatory scenarios, but may be useful when it is extremely difficult and expensive to go through an extensive risk assessment exercise.

**Making the Comparison.** Not only are there significant estimation difficulties for both costs and benefits of regulations, the interpretation of the results of cost-benefit analysis may be problematic because the quality of economic analyses varies greatly among rulemakings. Some economic assessments may quantify and/or monetize certain categories of benefits, while others may not. Some assessments estimate only costs associated with expenditures for pollution control equipment, while others attempt to estimate the true opportunity costs of a reallocation of resources. Information on adverse health and ecological effects ranges from extensive to virtually non-existent. Results may depend on the capabilities of the economist, and are not immune to analytical subjectivity and even manipulation. Certainly agency resources, as well, play an important role in how extensive an RIA is. Strict monetary cost-benefit analysis is also significantly lacking in its insensitivity to the consideration of the distribution of costs and benefits. Even if a regulation can pass the net monetary benefits test, due to the existence of diminishing marginal utility of income (i.e., an additional dollar to a millionaire, on average, is worth less than an additional dollar to a relatively poorer person), such a regulation still might not make society better off. Similarly, a regulation may not indicate net monetized benefits, yet will increase societal well-being.

**Cost-Benefit Analysis and Regulatory Decisions**

Clearly, the economic analyses summarized above indicate that no simple monetary cost-benefit comparison will illuminate the merit of many environmental regulations. Estimates of monetized benefits are, at best, incomplete. The most extensively researched RIAs still have benefits categories that cannot be quantified, and even with further development of the relevant sciences it will be all but impossible to produce cost-benefit analyses that are all-inclusive. Further complicating any straight-forward assessment is the extent to which key underlying assumptions, which often involve predictions of the unknown, can affect the final numbers.

With all its limitations, cost-benefit analysis can nonetheless provide useful information to policymakers and the public that might not be revealed otherwise. In the complicated world of regulation, such assessments have value in more or less systematically laying forth what information is available to decision makers. They can thereby reveal — if only partially — the basis for the regulation under examination, and integrate information from a variety of disciplines to assess broad implications to society of a policy in question. Economic cost-benefit analysis can also encourage consideration of alternatives and tradeoffs, which government policymakers in a single program area may not have incentives to consider.

The theory of welfare economics holds that cost-benefit analysis can be used as a means to optimize social well-being, and therefore is an appropriate framework to guide decision making on matters such as environmental protection. Critics of this theoretical approach may argue that decisions about
environmental protection involve consideration of the moral "rights" of humans and non-humans. In the consideration of marginal policy changes about the level of environmental protection, there is some agreement that the articulation of tradeoffs can, at a minimum, provide invaluable information and provide for a useful accounting framework. Environmental cost-benefit analysis is not now, nor will it possibly ever be, a precise science. But it has found use as an analytical framework and informational source in attempting to make comparisons of policy options with dissimilar units of measurement.

Conclusion

Cost-benefit analysis is now commonly performed to evaluate environmental regulations. EPA is required under both executive order and Congressional mandate to perform this type of analysis for its significant regulations. While independent parties often produce cost-benefit analysis of individual environmental regulations, a comprehensive assessment of EPA regulations is difficult to perform without significant reliance on EPA's own analyses.

The complexities and difficulties associated with cost-benefit analysis are not solely related to placing a monetary value on goods that are not generally traded in the marketplace. There may also be considerable uncertainty and data gaps associated with the inputs required to perform the economic valuation. For many regulations, an important input is the estimate of the change in incidences of health effects, and there is often incomplete information regarding the extent and severity of such health effects. Compounding these estimation difficulties are the number of factors that need to be forecasted, such as weather patterns and economic growth — variables that are inherently subject to uncertainty. Cost-benefit analysis requires that certain assumptions about these variables be employed; changes in key assumptions can impact the analytic results significantly — and, of course, real world trends may diverge from predictions for these variables, such that actual regulatory outcomes may differ substantially from projected costs and benefits. Retrospective examinations of regulatory cost-benefit assessments have been limited, though the General Accounting Office has recommended that EPA support such analyses.

Hence while cost-benefit analysis has become more sophisticated over the years, there are still limitations to its role in regulatory decision-making. Some limitations are due to the measurement difficulties associated with inputs to the cost-benefit comparison. Others involve philosophical objections to the cost-benefit analysis framework. Still others are regulatory constraints in statutory language that prohibit the consideration of costs by an agency in regulatory decision-making. While cost-benefit analysis has increased in practice, it is unclear whether there has been a corresponding increase in its actual use in policymaking.

The debate regarding the practical usage of cost-benefit analysis in environmental policy, in particular, continues to evoke fervent criticism and support amongst policymakers and analysts. The dispute involves philosophical issues such as the nature of justice, or whether cost-benefit analysis, a "rights-based" philosophy, or some alternative framework should be used to guide public decision making. Of less dispute is that, despite the sometimes extensive uncertainties associated with cost-benefit analyses, these assessments often incorporate a great deal of information relevant to regulatory decisions and can increase accountability in public policy.

Appendix A: Other Regulatory Requirements

Below is a list of regulatory requirements that are often addressed in Regulatory Impact Analyses, in addition to the cost-benefit analysis as required under Executive Order 12866 and the Unfunded Mandates Reform Act. The list is not all inclusive, but reflects the main analytical and policy considerations as required by Congressional mandate and executive orders.

Small Business Impact Analysis

The Regulatory Flexibility Act (1980) as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA) requires an agency to prepare a regulatory flexibility analysis for proposed and final rules unless the Agency can certify that the rule will not have a significant impact on a
substantial number of small entities. A regulatory flexibility analysis includes a description of the steps an agency has taken to minimize the significant economic impact on small businesses. This law requires agencies to collect input from small entities on regulations and to identify alternative regulatory approaches for small businesses, small governmental jurisdictions and non-profit organizations.

Paperwork Reduction Analysis

The Paperwork Reduction Act of 1995 requires all proposed regulations to be analyzed as to the paperwork that they require and that paperwork be reduced to a minimum. A regulation which creates a new paperwork requirement must be cleared by OMB.

Environmental Justice

Executive Order 12898 requires that each federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minorities and low-income populations.

Intergovernmental Partnerships

Under Executive Order 12875, federal agencies may not issue a regulation that is not required by statute and that creates a mandate upon a State, local or tribal government, unless the federal government provides the funds necessary to pay the direct compliance costs incurred by those governments, or the agency consults with those governments.

Children's Health and Safety

Executive Order 13045 directs federal agencies developing health and safety standards to include an evaluation of the health and safety effects of the regulations on children.

Indian Tribal Governments

Executive Order 13084 states that federal agencies may not issue a regulation that is not required by statute that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs on those communities, unless the federal government provides the funds necessary to pay the direct compliance costs incurred by the tribal governments, or EPA consults with those governments.

Voluntary Consensus Standards

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 directs federal agencies to use voluntary consensus standards in regulatory activities unless to do so would be inconsistent with applicable law or otherwise impracticable.

Footnotes


2 Some individual environmental statutes authorize or even require consideration of costs in developing regulations and many environmental statutes require consideration of risks, however, these individual legislative provisions do not mandate comprehensive cost-benefit analysis of the regulation and other regulatory alternatives. See Congressional Research Service, Risk Analysis: Background on Environmental Protection Agency Mandates, CRS Report 98-619 by Linda-Jo Schierow. June 1998.

3 A wealth of literature exists on the theoretical and practical limitations and strengths of cost-benefit analysis, particularly with respect to regulatory analysis. For example, see Raymond Kopp, et al., Cost-Benefit Analysis and Regulatory Reform: An Assessment of the Science and the Art (Washington, D.C.:


8 Ibid. p. 463.

9 For example, Reagan’s order permitted regulation only when benefits exceeded costs (unless this approach was prevented by law), and the Clinton order directs federal agencies to issue regulations only when necessary due to “compelling public need,” and after a reasoned determination that benefits justify costs, or when required by law. For a summary of the key provisions of President Reagan’s Executive Orders 12291 and 12498 and President Clinton’s Executive Order 12866, see Congressional Research Service, *Risk Analysis: Background on Environmental Protection Agency Mandates*, Report No. 98-619 by Linda-Jo Schierow, June 1998, p. 19.


15 In such a case where costs occur before benefits are realized, the choice of a lower discount rate will result in a higher value for monetized benefits; using a higher discount rate will result in a lower relative value of benefits.

16 Because the cost-benefit figures are sensitive to the choice of discount rate, OMB guidance advises that the assumption of a 7% discount rate be employed in all analyses to allow for comparison across rules. However, agencies may use other discount rates in addition to 7% if there is a compelling reason and for purposes of sensitivity analyses.


18 Ibid., p. 66.

19 Ibid., p. 83.

20 Ibid., p. 7.
21 These responses of EPA were obtained by CRS through oral and written communication with EPA economists within the Office of Air and Radiation (August 1999).

22 However, EPA's studies may rely on information produced by independent agencies, and generally undergo OMB review as well as public comment.


26 Robert Hahn, ed. Risks, Costs, and Lives Saved (Washington D.C.: The AEI Press, 1996) contains an excellent set of discussions of the use of cost-benefit analysis in regulatory policymaking. For the use of this approach, see especially the chapters by Hahn; for a critique of the approach, see the chapter "Benefit-Cost Analysis: Do the Benefits Exceed the Costs?" by Lester B. Lave.
