Using Environmental Benefit-Cost Analysis to Improve Government Performance

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Abstract

In this paper we first describe the legal and administrative basis of mandates that variously require and eschew economic measures for environmental management. We then summarize the steps involved in benefit-cost analysis and what can and cannot be accomplished with such information. Our basic conclusion is that while the approach is not perfect, benefit-cost analysis has a solid methodological footing and provides a valuable performance measure for an important governmental function, improving the well-being of society. However, benefit-cost analysis requires analytical judgements which, if done poorly, can obfuscate an issue or worse, provide a refuge for scoundrels in the policy debate. We conclude the article with specific suggestions for both the everyday performance of benefit-cost analysis and its use in policy decision-making.

Key Words: benefit-cost analysis, environmental regulation, regulatory reform

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Scott Farrow and Michael Toman*

Improving the performance of government is now a bipartisan objective. Vice-President Gore promotes the National Performance Review and Reinventing Government. Congress passed the Governmental Results and Performance Act of 1993, and it has considered proposals like the Regulatory Improvement Act of 1997. One common theme in these activities is that performance objectives establish goals and a basis of accountability to the public, the Congress, and the Executive Office. Agencies are responding to this direction, and the EPA is no exception. For example, reinvention activities at the EPA are widely promoted and prominently displayed on their internet pages as making the EPA work better and smarter.

Of course, the substance is in the details. Among potential indicators of performance, economic indicators are often the most controversial. The standard economic indicators are cost comparisons and net benefit calculations derived from benefit-cost analysis. The level of vitriol surrounding debates over "regulatory reform," in which benefit-cost analysis has figured prominently and been the subject of much criticism by environmentalists, underscores the lack of agreement among stakeholders about economic indicators. Supporters of economic indicators argue such measures are state-of-the-art for illuminating tradeoffs inherent in environmental management and for determining whether a government action improves or reduces the well-being of the country. Critics of economic measures question both the theoretical and the empirical basis for the indicators.

In this paper we first describe the legal and administrative basis of mandates that variously require and eschew economic measures for environmental management. We then summarize the steps involved in benefit-cost analysis and what can and cannot be accomplished with such information. Our basic conclusion is that while the approach is not perfect, benefit-cost analysis has a solid methodological footing and provides a valuable performance measure for an important governmental function, improving the well-being of society. However, benefit-cost analysis requires analytical judgements which, if done poorly, can obfuscate an issue or worse, provide a refuge for scoundrels in the policy debate. We

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conclude the article with specific suggestions for both the everyday performance of benefit-cost analysis and its use in policy decision-making.

THE LEGAL AND ADMINISTRATIVE BASIS FOR ECONOMIC PERFORMANCE MEASURES

Congress has provided a variety of performance criteria in different environmental statutes and indeed, in different sections of the same statute. Congressional guidance and the adherence of the agency to those criteria can become the turning point in litigation. For example, the section of the Toxic Substances Control Act (TSCA) concerned with existing chemicals requires an assessment of benefits and costs of regulation, with some form of reasoned judgment that the latter are less significant than the former. Environmentalists were concerned that one of the three reasons for judicial rejection of Phase II of the proposed asbestos ban under TSCA was a faulty benefit-cost analysis.[1] Conversely, business groups were concerned that EPA's initial use of cost considerations in regulating toxic air pollutants was rejected in court because of inconsistency with statutory criteria. Subsequent air toxic regulations appeared to ignore costs if risks were perceived as unacceptable, and amendments to the Clean Air Act in 1990 stipulated sweeping and tough controls based on "maximum achievable control technology."[2] Similar restrictions on benefit-cost analysis are found in other major environmental statutes, such as the Clean Water Act and the Resource Conservation and Recovery Act.[3]

Congress has also changed criteria in statutes over time. The 1996 revision of the Safe Drinking Water Act includes a new requirement that proposals for maximum contaminant levels contain an analysis of "the incremental costs and benefits associated with each alternative maximum contaminant level considered." On the other hand, impatience with substance-by-substance regulation of hazardous air pollutants led to sweeping and tough requirements for "maximum available control technology" in the 1990 revision of the Clean Air Act.

In the Small Business Regulatory Fairness Act of 1996 (SBREFA), Congress recently codified its ability to review, and under extreme circumstances, reject new environmental or other rules. Under this statute, Congress can act within 60 days to pass a joint resolution of disapproval which, if signed by the President, stops the regulation from becoming law.

In addition to the mixture of statutory direction, Presidents since the 1970s have issued Executive Orders that call for analysis of the benefits and costs of major regulations. While

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[1] L. Fisher et al., *Toxic Substances and Pesticide Regulation Handbook* (Washington, DC: Environmental law Institute, 1995).

[2] See George van Houtven, "Bureaucratic Discretion in Environmental Regulations: The Air Toxics and Asbestos Ban Cases," in R. Congleton (ed.), *The Political Economy of Environmental Regulation* (Ann Arbor: University of Michigan Press, 1996).

[3] Richard Morgenstern (ed.), *Economic Analysis at EPA: Assessing Regulatory Impact* (Washington, DC: Resources for the Future, 1997).

the criteria are not currently actionable by law in the absence of statutory direction, the Executive Orders attempt to create an Executive Branch performance criteria for regulations from all agencies.

A watershed in Presidential guidance was Executive Order 12291, issued in 1981 right after President Reagan took office.[4] That Order called for Federal agencies to prepare economic analyses that to the extent practicable calculate benefits and costs of major rules on a comparable monetized footing. It further required that agencies should promulgate regulations only if benefits "outweigh" costs, unless this explicit and quantitative balancing was precluded by the underlying statute. These analyses are processed and reviewed in the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB).

Executive Order 12866, along with a guidance document issued not long after President Clinton took office, retained most of the specific analytical requirements for major rules. However, this Order stipulated that benefits should "justify" costs and that the choice among alternative regulatory approaches should "maximize net benefits unless a statute requires another regulatory approach." Analyses should take into account a variety of quantitative and qualitative factors, including distributional considerations (impacts on different groups) and factors that might be difficult to monetize. Consistent with this altered "decision criterion," the Order and the guidelines issued by OMB put increased emphasis on the calculation of distributional impacts and the assessment of qualitative as well as quantitative factors.[5] In principle, however, the agencies still are to show that regulations can meet an economic performance test.

Environmental agencies also have opportunities to select benefit-cost analysis as an economic performance indicator in other contexts. One important example is Environmental Impact Statements (EIS). However, regulations of the Council on Environmental Quality identify a broad range of social and economic impacts and provide guidance on the consideration of qualitative impacts, while emphasizing the optional nature of a monetized benefit-cost analysis.[6]

The Government Performance and Results Act of 1993 (GPRA) provides another opportunity for agencies to select criteria on which their programs will be judged for budgetary purposes. EPA has developed a strategic plan as part of its GPRA program. Benefit-cost analysis has its own chapter, but it essentially states merely that EPA will comply with the Executive Order requiring benefit-cost analysis for major rules and "may" carry out benefit cost analyses in support of new reauthorization efforts.

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[4] Detailed discussion can be found in, V. Kerry Smith (ed.), *Environmental Policy Under Reagan's Executive Order: The Role of Benefit-Cost Analysis* (Chapel Hill: University of North Carolina Press, 1984); and Administrative Conference of the United States, *A Guide to Federal Agency Rulemaking* (Washington, DC: U.S. Government Printing Office, 1991).

[5] The guidelines were issued on January 11, 1996 in a document entitled *Economic Analysis of Federal Regulation Under Executive Order 12866.* The document was not a formal OMB publication, in contrast to the guidance issued for implementing EO 12291.

[6] 40CFR 1502.23

A variety of bills have been introduced that would define economic or risk performance criteria for the development of environmental and other regulation. Many of these bills have been seen, rightly in our view, as too prescriptive in what they would require government experts to do in assessing regulations, and many paid too little attention to the underlying ability of agencies to explicitly balance benefits and costs under some of the key environmental statutes. Other bills are more consistent with modest expansions on the current Executive Order. A Senate bill (S981) proposed in the 105th Congress by Senators Thompson and Levin would require agencies to assess the economic performance of regulations and use the information to explain their decisions without compelling decisions solely or primarily on cost-benefit grounds. Congress has also proposed that it develop analytical expertise and a process for regulatory review to parallel that of the Executive Office. The proposal would create a Congressional Office of Regulatory Affairs (CORA), parallel to OIRA in the Executive Office, with CORA conducting its own analysis of major regulations.

ANATOMY OF BENEFIT-COST ANALYSIS

An anatomical exploration ultimately involves disassembling the body and examining its parts. Before doing this, we consider what the body looks like when it is whole based on accepted practices of economists (many items passing as benefit cost analysis belong to a different species.). In broad outline, the results of a benefit-cost analysis can be seen as a table in which the rows represent impacts (benefits or costs), and columns represent alternative regulatory actions. The costs and benefit entries are expressed in monetary terms wherever possible. Future costs and benefits are expressed in terms of today's monetary units through a procedure economists call discounting (discussed below). Since benefits and costs in practice are uncertain, the table entries also are adjusted for the probability of occurrence of the benefit or cost if the regulatory alternative is implemented.

In each column, monetized costs are subtracted from monetized benefits to obtain a "bottom line" measure of the (discounted) total net benefits across time and affected individuals. For economists, this bottom line is a key factor, though not the only one, in answering the question of whether society as a whole is better off with one regulatory alternative or another, or whether the alternative chosen is the least cost.

To develop the entries in the table, several steps are needed.[7] We illustrate the method in the context of the 1985 "Regulatory Impact Analysis" conducted by EPA of a regulation to sharply reduce the lead content of gasoline (see Box 1 and Table 1). We use this example because it is widely seen as a "Cadillac" among benefit-cost analyses of proposed rules, an exemplary illustration of best practice.[8] We also attempt to illustrate some of the general methodological issues that arise in environmental cost-benefit analysis.

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[7] The steps are described more fully in the OMB guidelines already referred to and in Morgenstern, *op. cit.*

[8] See the report by Albert Nichols in Richard Morgenstern (ed.), *Economic Analyses at EPA: Assessing Regulatory Impact* (Washington, DC: Resources for the Future, 1997)

Box 1. *Benefit-Cost Analysis of the Phasedown of Lead in Gasoline*

Table 1 illustrates the evaluation of benefits and costs in this case. The components of this analysis included the following elements:

Baseline: Determination of current and future gasoline use, lead releases, and lead exposure without a tightening of the lead content standard, taking into account such factors as increased gasoline use with growth in population and income and the effects of earlier regulations.

Consideration of alternatives: Both alternative lead contents and different mechanisms for phasing down lead use, including the novel idea of allowing "lead credit trading" among refineries. Under this program, refineries that made faster than required progress in reducing total lead usage could sell credits to other refiners which faced higher costs in the lead phasedown.

Identification of risk changes: A very large body of scientific study was available linking blood levels in children to adverse effects on health and learning ability, and linking lead use in gasoline to changes in blood levels. Using this evidence, analysts could determine how many more children would avoid having blood levels deemed unsafe under different regulatory standards. Additional public health information that emerged contemporaneously with the rulemaking identified the reductions in health risks and threat of premature death from adult hypertension with reduced lead exposure. Still another risk component identified in the analysis was the increase in health impacts from other pollutants (ground-level ozone and carbon monoxide) if higher lead levels in gasoline continued to foul catalytic converters. Finally, consideration was given to the potential cancer risk from increased use of benzene in fuel with lower lead levels.

Cost and benefit calculations: The cost calculations involved the use of complex models to assess increased refining costs under different lead standards, and the potential savings from lead credit trading. Modeling of vehicle performance also shed light on the potential costs of damage to older engines from lower lead levels in the fuel, as well as potential fuel economy savings. Health benefits included inferences of the willingness to pay of parents (and others) to reduce blood levels in children from the cost of avoided medical treatment and remedial education if more children had blood lead levels below the health threshold, with the understanding that this was clearly an underestimate of the value per child and that it also ignored the value of reduced blood levels for children already below the threshold. Avoided medical costs and wage losses also were used as a conservative estimate of the value of avoided adult hypertension. To assess the value of reduced threat of premature death from hypertension-induced heart attack and stroke, the analysis relied on "rule of thumb" estimates of the value of reduced mortality risk derived from evidence on how wage payments differ with occupational risk (see Box 2). Finally, to value the reductions in other pollutants from lessened catalytic converter contamination, the analysis relied on both direct estimates of the type just discussed and on assessments of avoided control costs for these pollutants.

Discounting: not a major consideration, especially given that benefits appeared to substantially exceed costs in most cases.

Sensitivity analysis: Calculated benefits substantially exceeded costs even with different assumptions about factors such as the degree of catalytic converter fouling, and net benefits were further enhanced by the innovative approach to cost-reduction embodied in the lead credit trading system. Qualitative factors (like the benefits to children with blood levels already below the health standard) further strengthened the case for the rule.

Table 1. Benefits and Costs of Lead Reduction in Gasoline

Category	*1988 Costs/Benefits (millions $1983)*	
	Low-lead policy option	*Complete lead phaseout*
Costs		
Increased refinery costs	$503	$691
Valve damage[a]	$0	C
Total costs	$503	$691 + C
Benefits		
Reduced vehicle maintenance	$660	$755
Reduced HC, NO_X, and CO emissions from misfueling		
Monetized benefits	$404	$404
Unmonetized benefits[b]	B_1	B_1
Reduced lead-related health damages		
Avoided medical costs	$41	$43
Avoided remedial education costs	$184	$193
Unmonetized[c]	B_2	B_3
Total benefits	$\$1,289+B_1+B_2$	$\$1,395+B_1+B_3$
Net benefits	$\$786+B_1+B_2$	$\$704+B_1+B_3-C$

Notes:

[a] In the complete lead phaseout option, costs include unmonetized potential damage to valve seats of older engines.

[b] Includes chronic health effects of ozone and CO, plus any effects from reduced sulfate particulates.

[c] Includes benefits other than avoided costs of medical care and compensatory schooling for children brought below 30 μg/dl blood lead, plus any benefits to children for children at lower blood-lead levels. $B_3 > B_2$ because the unleaded option would affect more children.

Source: Original information from a March 1984 U.S. EPA report. This table adapted from Richard Morgenstern (ed.), *Economic Analyses at EPA: Assessing Regulatory Impact* (Washington, DC: Resources for the Future, 1997), page 56. Note: This adaptation of the table corrects a typographical error in the source version.

The first step is the definition of a *baseline*: what will happen if there is no new regulation? The baseline must take into account the impacts of changing market conditions and other current and pending regulations.

The next step is an *identification of policy alternatives*. These include different standards, different methods of regulation--such as incentive-based policies like pollution taxes or tradable permits versus technology standards--and alternatives to regulation altogether (such as public information campaigns).

The third step is an *identification of potential changes in outcomes and risks*. This step also generates information about a variety of other performance measures that are important to stakeholders. However, a significant challenge frequently arises in using scientific studies (for example, a change in eutrophication of a water body or a change in lung function due to pollutant exposure) that do not really focus on choices that affect individuals (whether a water body is still a valuable recreation site, whether work must be missed or medication taken because of lung-related illness).

In addition, assessments of public health threats are often carried out in ways that are inconsistent with the methods of economic analysis. Economists are interested in the rate of change in health impacts with respect to environmental conditions, because this is how the *incremental* benefits of and costs of environmental improvement can be assessed (see below for further discussion of the marginal approach in economics). In contrast, public health studies often focus on a single threshold level of acceptable risk based on explicit or implicit value judgments on what degree of risk is realistic or appropriate. Examples of such judgments include basing threshold exposure levels on the most sensitive subpopulations and most serious exposure scenarios, or the extrapolation of risk information from one population group to another that may be more sensitive.

Of particular concern to economists interested in measuring the benefits of environmental improvement is the effect of compounding risk judgments. For example, the compound effect of building in a little caution in judgments about the concentration of a hazardous substance, the degree of exposure to that substance, and the sensitivity to that substance of the most vulnerable member of the exposed population can be to overstate the overall risk to the population by an order of magnitude.[9] While there is a legitimate reason to be concerned with unfavorable scenarios and sensitive subpopulations, economists generally argue that these factors should be dealt with explicitly through the characterization of distributions of risks.[10]

The fourth step is the *assessment of economic costs and benefits*. Environmental improvements can offer a variety of benefits to people--improved health and reduced

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[9] See W. K. Viscusi, J. T. Hamilton and P. C. Dockins, "Conservative versus Mean Risk Assessment: Implications for Superfund Policies," *Journal of Environmental Economics and Management*, 34 (1997): 187-205.

[10] See Raymond Kopp, Alan Krupnick, and Michael Toman, "Cost-Benefit Analysis and Regulatory Reform," *Human and Ecological Risk Assessment* 3 (1997): 787-852; and National Research Council, *Science and Judgment in Risk Assessment* (Washington, DC: National Academy Press, 1994), especially Appendices N-1 and N-2.

mortality risk, enhanced recreational opportunities and aesthetic conditions, increased crop productivity and reduced materials damage, increased genetic diversity, and preservation of spiritual values. Economists attempt to deduce the preferences of the affected populations for these attributes *relative* to other goods and services for which people show a preference. For example, saying that people put a particular economic value on improved health means that they are willing to give up that amount of other beneficial consumption opportunities (now or in the future), whether those other opportunities involve bigger cars or better schools. Economists refer to this as the *willingness to pay* for environmental improvement.

Similarly, the *opportunity cost* of providing environmental improvements is the (current or future) consumption opportunities actually given up in order to invest in improved environmental conditions. Resources used for this purpose could be used to provide other individual or collective goods that people value. Opportunity cost includes not just direct expenditures for environmental improvement, but also indirect effects such as reduced product performance. Both economic benefits broadly defined (willingness to pay) and opportunity costs are expressed in comparable monetary units, making possible the calculation of net benefits that can be compared across different environmental protection measures.

In this limited space we cannot survey all the analytical techniques used by economists to assess environmental benefits and costs, or the challenges and limitations confronted in applying them.[11] Among the major controversies surrounding cost analysis is the degree of technical innovation that should be assumed with or without regulation.[12]

Even larger controversies can arise in the valuation of benefits. All the benefits of environmental improvement must be inferred from indirect evidence, since by definition "environmental improvement benefits" are not goods that trade in markets like shirts or financial assets. Empirically, one of the most important environmental benefits appears to be reduced risks of premature mortality. However, intellectual debate and policy controversy surrounding the estimation of this benefit is especially intense (see Box 2).

Economic benefits and costs are measured as *incremental* changes relative to the baseline. Economists do not and should not try to measure the total value of environmental or ecological resources: the total value of all such resources is likely unknowable and possibly infinite, and this all or nothing value is irrelevant to any practical policy decision.[13] What is relevant instead is the amount of additional benefit secured from environmental improvement, and the additional cost.

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[11] For further discussion see A. Myrick Freeman III, *The Measurement of Environmental and Resource Values: Theory and Methods* (Washington, DC: Resources for the Future, 1993).

[12] For contrasting views see Michael Porter and Claas van der Linde, "Toward a New Conception of the Environment-Competitiveness Relationship," *Journal of Economic Perspectives* 9 (1995): 97-118; and Karen Palmer, Wallace Oates, and Paul Portney, "Tightening Environmental Standards: The Benefit-Cost or No-Cost Paradigm?," *Journal of Economic Perspectives* 9 (1995): 119-132.

[13] See Michael Toman, "Why Not to Calculate the Value of the World's Ecosystem Services and Natural Capital," *Ecological Economics* vol. 25 (1998): 57-60.

Box 2. *Economic Valuation of Reduced Mortality Risks*

Reductions in the risk of premature mortality are a major component of the benefits in many environmental measures. For instance, the value of reduced mortality risk accounts for roughly three-quarters of the monetized benefits from the Clean Air Act.† How can economists assign a monetary value to such improvements in environmental safety?

Skeptics might question whether any attempt to "put a price on human life" is possible or even appropriate. But economists assessing the value of reduced mortality risk are *not* engaged in such an effort and share the skeptics' opposition to doing so. The goal is to determine how much people are willing to give up to reduce the probability of shortened lifespan within a larger affected group (for example, the population of greater Los Angeles), not to put a price tag on a specific life.

Individuals routinely make such calculations, consciously or intuitively, as part of everyday life. For example, they decide whether to buy safer but more expensive motor vehicles (and whether or not to accept the inconvenience of using the vehicle's safety equipment). They decide whether to jaywalk or proceed to an intersection to cross a thoroughfare. They decide whether or not to purchase preventive medical care. And they make tradeoffs between monetary income and occupational hazards.

In principle, then, individual preferences (willingness to pay) for improved environmental safety can be defined as well. These preferences sometimes are expressed in a somewhat confusing shorthand, the "value of a statistical life." To illustrate this idea, suppose that an environmental policy could reduce the risk of fatality from two in a million to one in a million for each of three million people. Then the expected number of lives saved by the policy--the number of "statistical lives," since we do not know in advance which specific premature fatalities will be averted, is three. This is itself an important performance measure to many stakeholders.

The problem in economic benefits assessment arises not in the definition of the reduced mortality risk but in the measurement of its value. In the example above, if each of the three million affected individuals had a willingness to pay for the posited risk reduction of $5, then the value of statistical life in the case posed would be $5 million ($5 per person times $3 million people expressing the value divided by an expected number of lives saved of 3). In practice, a wide range of values--from $1 million to over $10 million per statistical life--is used in environmental benefits assessment, reflecting the empirical uncertainties surrounding the measure.

Economists have used two different sources of information to estimate these values: direct surveys of willingness to pay, and data on income-occupational risk tradeoffs. Applying occupational wage premium data to evaluate environmental risks is problematic because the risks are not comparable--voluntary risks of immediate death versus involuntary risks of future early death after a long latency period and potential period of debilitating illness. The populations bearing the risks (young males versus elderly individuals and children) also are not comparable. Survey methods, while controversial because of the hypothetical nature of the responses, avoid the drawbacks of extrapolation from noncomparable risks. The key problem with this approach is in asking respondents to evaluate the right risk--the threat of reduced longevity at the end of life, a number of years from now, versus an immediate mortality risk. Additional empirical research is needed to establish better estimates.‡

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† See EPA, *Final Report to Congress on Benefits and Costs of the Clean Air Act, 1970-1990*, Document EPA410-R-97-002 (Washington, DC: EPA, 1997).

‡ See Kopp *et al., op. cit.;* and Dallas Burtraw *et al.*, "Costs and Benefits of Reducing Air Pollutants Related to Acid Rain," *Contemporary Economic Policy* 26 (1998): 379-400.

The last step in a benefit-cost analysis is the *calculation of overall net benefits from different alternatives*. This step requires analysts to determine how to aggregate costs and benefits over time and across individuals. Aggregating over time in turn requires a decision about *how to discount future benefits and costs*. There is a long-established practice for the discounting and aggregation of net benefits (see Box 3), but the practice nonetheless remains controversial.[14] Along with the calculation of monetized net benefits, a thorough assessment should include *sensitivity analysis* to determine how robust the findings are given different assumptions and uncertainties, and *qualitative information on nonmonetized benefits and costs*.

Box 3. *A Primer on Discounting*

Discounting, a procedure widely used in economic analysis, is a direct counterpart to the accrual of interest in a savings account. Both concepts reflect the fact that resources have a *time value*. Given a choice between having $1 worth of added consumption opportunities today and receiving the same benefit at a specified time in the future, people generally would opt for the former. Because people are *impatient*, they would be willing to wait only if they were to receive more than $1 worth of benefit at the later time. How much more depends on how much they value present consumption over future consumption, which economists refer to as the *marginal rate of time preference*. This rate will vary from person to person and depends on individual circumstances (for example, poverty often tends to increase the preference for current benefits).

To illustrate, one dollar invested today at three percent per annum for one year will yield *$1(1.03)=$1.03* (this is a simple interest calculation, ignoring compounding during the year). An investment for two years will yield *$1(1.03)(1.03)=$1.06*. Since discounting is the reverse of interest, a dollar received one year from now can be said to have a *present value* of *$1/(1.03)=$0.97* when discounted at three percent per annum. And the present value of one dollar received two years from now is *$1/(1.03)(1.03)=$0.94*.

Investors are willing to pay savers to defer consumption because investment is productive: putting $1 today into the right investments in new plant, new training, or renewed environmental quality can yield more than $1 of benefits in the future. In principle, the rate of interest will balance the time preferences of savers with the demand for savings by investors. In practice uncertainties, taxes, and market barriers make it quite difficult to settle on the "right" discount rate for evaluating environmental or other regulations. Many economists would agree that the time preference of consumers generally is on the order of 2-3% (as reflected in the inflation-adjusted rate of return on short-term Treasury bills). But if regulatory compliance activities displace private investment as well as consumption, the "opportunity cost" is higher. In its new guidelines for economic assessment of regulations, OMB proposes a "default" rate of seven percent, while allowing for other rates if agencies can justify them.

[14] Discounting in economic analysis is intended to reflect the apparently robust human preference for getting benefits earlier than later, and for postponing costs. Controversies arise in both the determination of a discount rate and the application of the method to situations where costs and benefits arise across generations. For discussion of these issues see Robert Lind and Richard Schuler, "Equity and Discounting in Climate-Change Decisions," in William Nordhaus (ed.), *Economics and Policy Issues in Climate Change* (Washington, DC: Resources for the Future, 1998).

Finally, a complete analysis should include to the extent possible the *incidence of costs and benefits across space and time*--who benefits, who loses, and when. This information obviously is crucial to a well-informed and defensible policy decision that goes beyond an aggregate net benefits measure

WHY PERFORM BENEFIT-COST ANALYSIS?

We argued above that more routine use of environmental benefit-cost analysis can provide a disciplining element which forces all sides in a policy debate to more carefully consider, in a world of inherently limited resources, what is gained and what is given when making a decision. Benefit-cost analysis is vital as a decision tool, though economic performance as measured by net benefit should not be the sole determining factor in decisions. There are practical and methodological limits to what can be done with benefit-cost analysis. Advocates of the method must avoid hubris in their claims of what the tool can do and in their diagnoses of why benefit-cost analyses do not have more effect on actual policy decisions. Yet, without such a disciplining framework, it is that much more difficult to assess and if necessary challenge the assertions of various partisans about the benefits and costs of policies and regulations.

To illustrate the problem, a number of compilations of regulatory expenditures to reduce mortality risks suggest that the cost per unit reduction in population cancer risks varies widely across proposed and implemented regulations, with absurdly large values at the top end of the range.[15] Benefit-cost analyses can draw attention to these seemingly inconsistent expressions of environmental values and, by highlighting the highest-cost risk reductions, provide opportunities for choices that are more consistent and that improve performance.

Among the many criticisms leveled against benefit-cost analysis, three stand out:

(1) The environment as such is something whose value defies economic measurement;

(2) Estimates of benefits and costs are too imprecise and incomplete to be useful; and

(3) Benefit-cost analysis neglects equity concerns.

All three criticisms contain at least some measure of truth. However, we believe that none of them refutes the value of benefit-cost analysis for informing and guiding environmental decisions.[16]

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[15] See, for example, Tammy Tengs *et al.*, "Five Hundred Life-Saving Interventions and Their Cost-Effectiveness," *Risk Analysis* 15 (1995): 369-390; Randall Lutter and John F. Morrall III, "Health-Health Analysis: A New Way to Evaluate Health and Safety Regulation," *Journal of Risk and Uncertainty* 8 (1994): 43-66; and Robert W. Hahn, "Regulatory Reform: What Do the Numbers Tell Us?," in Robert W. Hahn (ed.), *Risks, Costs, and Lives Saved: Getting Better Results from Regulation* (New York: Oxford University Press, 1996). For a sharply critical view of these kinds of analysis, see Lisa Heinzerling, "Regulatory Costs of Mythic Proportions," *Yale Law Journal* 107 (1998): 1981-2070.

[16] Many of the points we make here are also developed in Morgenstern, *op. cit.*, Chapter 3; and Kenneth Arrow *et al.*, *Benefit-Cost Analysis in Environmental, Health, and Safety Regulation: A Statement of Principles* (Washington, DC: American Enterprise Institute, 1996).

With respect to point (1), economic evaluation of environmental benefits and risks is more difficult than choosing a flavor and brand of yogurt. Nevertheless, so long as consumer, business, and government budgets are limited, choices are inevitable and ubiquitous. Quantitative economic analysis provides valuable information on how people in society value environmental choices, in lieu of depending just on the stated preferences of interest groups. Critics of benefit-cost analysis sometimes seem to invoke argument (1) above principally to reject the notion that tradeoffs might be necessary, especially if those tradeoffs cut against the strongly held prior beliefs of those advocating a policy or regulation.

With respect to the imprecision of estimates, *not* doing benefit-cost analysis does not lessen uncertainties; it only masks them by leaving the decision-maker to integrate a larger amount of disparate pieces of information in a more subjective and unstructured way. If a benefit-cost analysis is done reasonably well it will highlight the uncertainties and provide sensitivity analyses that illustrate their significance. In addition, by providing measures of those costs and benefits that can be monetized, the analysis provides a stronger basis for making qualitative judgments about the importance of nonmonetized factors--that is, do we think these factors are important enough to outweigh an estimate of negative net benefits, or are they sufficiently important to tip the balance in a close call?[17]

Finally, with respect to equity concerns, while the calculation of aggregate net benefits ignores differences across time and space, a benefit-cost analysis also can illuminate both distributional impacts and the potential tradeoffs between cost and equity considerations. Moreover, carrying out a benefit-cost analysis in no way precludes a policy judgment that weighs equity considerations as well as aggregate net benefits. Recent interest in issue of environmental equity and sustainability is leading to suggested changes in practice that would modify benefit-cost analysis to more clearly answer whether identified subgroups also receive net benefits.[18] Consequently, we believe these shortcomings could be ameliorated over time, if there was a consistent commitment by agencies and other stakeholders to do so.

IMPROVING THE PRACTICE OF BENEFIT-COST ANALYSIS

A skeptic could write a book on "How to Lie with Benefit-Cost Analysis. Advice on how to lie would include:

- Fiddle with the definition of baselines so that benefits of regulation are enlarged or costs are diminished.[19]
- Omit impacts or costs that do not support your cause.

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[17] This process is illustrated in *President Clinton's Clean Water Initiative*, Office of Water, Document 800-R-94-002 (Washington, DC: USEPA, 1994).

[18] See Scott Farrow, "Environmental Equity and Sustainability: Rejecting the Kaldor-Hicks Criteria," *Ecological Economics* (November 1998, in press).

[19] Examples include not taking into account the effects of other policies that will reduce the benefits of new regulation, or assuming more pollution reduction in the baseline to reduce the costs of regulation.

- Use upper-bound estimates of benefits or costs.
- Omit alternatives that you don't wish to see implemented.
- Limit the monetization of benefits to make it difficult to compare benefits to costs.
- Use discounting assumptions that distort benefits or costs.
- Count some impacts like changes in employment or taxes as distinct benefits, even though any impacts of these changes on overall well-being already have been captured in the overall net benefits assessment.

For those wishing to not to do this, a substantial amount of guidance on best practice in benefit-cost analysis is available. A number of such principles have been developed as part of the ongoing concern of the past few years with "regulatory reform." Table 2 lists some of the most important recommendations for high-quality analysis. These basic principles could be used by third parties in and out of government who might not have a detailed factual knowledge of the case at hand but could still screen the benefit-cost analysis for quality.[20] We believe that assessments that do not address these issues in a coherent fashion are suspect and are less likely to provide a solid base for the promulgation of new regulation or the passage of new legislation.

Even if the everyday practice of benefit-cost analysis improves, there is no assurance that these analyses will contribute to more informed and improved public policy toward the environment. Table 3 lists several procedural steps that can increase the usefulness of an analysis.[21] But there is still no assurance that regulatory assessments will be done and used well unless agencies have incentives to use resources for analysis and use analysis in decisionmaking. If agency budgets for analysis are starved, then analysis will suffer. If assessments are done solely by the same offices that seek new regulations and will have responsibility for implementing them, then a self-serving bias is likely to exist and there will inevitably be questions about the completeness and reliability of analysis.[22] And if the requirements of Executive Order 12866 for thorough analysis *and* for reasoned justification are adhered to selectively and serve as little more than a speed bump *en route* to a foreordained destination, then there is reason to be concerned. To conclude this article, we turn to broader questions involving evidence on the usefulness of policies requiring benefit-cost analysis and suggestions for improving those policies.

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[20] More detailed guidance for those critiquing studies can be found in: California Environmental Protection Agency, *A Guide for Reviewing Environmental Policy Studies* (Sacramento: California EPA, 1994); the OMB guidance cited above, or any one of a number of standard textbooks on benefit-cost analysis.

[21] The items listed in Tables 2 and 3 are drawn in part from previously cited sources such as the OMB guidelines, Arrow et al., and Morgenstern. Some ideas also have been suggested to us in unpublished communications with OMB and GAO staff.

[22] See Linda Babcock and George Lowenstein, "Explaining Bargaining Impasse: The Role of Self-Serving Bias," *Journal of Economic Perspectives* 11 (1997):109-126.

Table 2: Suggested Improvements in the Practice of Benefit-Cost Analysis

ISSUE	Good Practice
Problem	A clear statement of the problem to be addressed by regulation.
Baseline	A logical and consistent definition of baseline conditions.
Alternatives	Identification and at least some assessment of a range of alternatives, not just one preferred or "mandatory" alternative.
Integration	Provide information on the real "drivers" of benefits and costs in their natural units of measurement such as: sickness cases avoided, recreational visits, tons of pollution emitted, etc.
Valuation	Treatment of benefits and costs with attention to direct and indirect effects and monetization of benefits and costs to the greatest extent possible using consistent valuation rules.
Equity	Some discussion of the incidence of benefits and costs and their implications for equity concerns.
Data	Evidence that data used in the analysis have been evaluated and are credible.
Uncertainty	Assessment of potential uncertainties and biases in the analysis. Uncertainties can be dealt with using sensitivity analysis. And at a minimum, implicit value judgments underlying risk assessments should be made explicit, and sensitivity analyses should be performed using other risk characterizations that account for a range of sensitivities and exposures as well as extreme cases.
Discounting	Consistent and logical procedures for discounting benefits and costs.
Communication	Presentation of the analysis in a standardized format, as transparently as possible, with a table at least summarizing categories of impacts and monetized values.

Table 3: Suggested Improvements in the Process of Benefit-Cost Analysis

ISSUE	Improved Process
Early start	Initiation of the analysis at the start of the rulemaking process or legislative deliberations to inform option development.
Value of information	Early (informal) identification of those decisions that might change as a result of benefit cost studies.
Participation	Identification of the key non-governmental stakeholders in a prospective regulation or law, with the assessment process made more transparent and accessible to them by inviting their contributions to it.
Review	Provision for an ongoing interagency process for economic analyses of major rules, to ensure consistency in basic assumptions and methodologies and an internal check on quality control. Consider external review

DOES BENEFIT-COST ANALYSIS MATTER? COULD IT MATTER MORE?

What evidence exists that economic performance measures matter in regulatory development? Evidence from a recent General Accounting Office study suggests that economic measures are primarily used to support the case for *different* regulation by highlighting options for increasing the cost-effectiveness by which environmental standards are met, as Table 4 illustrates. Morgenstern's in-depth review of economic analyses of selected EPA rules paints a somewhat more mixed picture (which could result in part from the selection of the rules studied).[23] In Morgenstern's review, the experts responsible for the analyses reported a number of contributions, ranging from strengthened environmental goals to more cost-effective implementation to some relaxation of environmental requirements seen to have high costs and limited benefits.

Table 4: Officials' Views on Usefulness of Regulatory Economic Analyses

Use of Analysis	Number of analyses
Identify the most cost-effective approach	10
Implement health based regulations cost effectively	2
Define regulation's coverage	3
Define regulation's implementation date	1
Defend/document a regulatory decision	2
Reduce health risks at feasible cost	1
Played no role in the regulatory decision	1

Source: General Accounting Office, "Regulatory Reform: Agencies could Improve Development, Documentation, and Clarity of Regulatory Economic Analyses," GAO/RCED-98-142, 26 May, 1998.

This information underscores what we see as the ambiguous and ambivalent attitude of regulatory agencies and many environmental groups toward benefit-cost analysis. When there is little controversy about the goal (or the controversy already has been resolved in the political process), benefit-cost analysis may assist in the design of policy measures. In some cases it has played some role in influencing policy goals, though that role rarely has been decisive.

Two additional studies provide evidence on the importance of economic performance in regulatory design. Statistical studies of EPA decisions regarding pesticide use and water quality regulation indicate that while cost and risk were considered by EPA, environmental damages could have been reduced at lower cost if benefit-cost criteria had been used in policy design.[24]

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[23] Morgenstern, *op. cit.*, Chapter 16, Table 1 (page 458).

[24] See Maureen Cropper et al., "The Determinants of Pesticide Regulation: A Statistical Analysis of EPA Decision Making, in Congleton, *op. cit*.; and Wesley Magat, Alan Krupnick, and Winston Harrington, *Rules in the Making: A Statistical Analysis of regulatory Agency Behavior* (Washington, DC: Resources for the Future, 1986).

Even when the design of regulations can be improved with greater use of economic performance information, our observations of regulatory assessment activities at the state and federal levels suggests that a top-down legislative approach to requiring agency use of this information will have only modest impacts on regulatory performance. Decision-makers typically compete for specific constituency favor, few are trained or appear rewarded for attention to economic performance, and benefit-cost analysis can be redefined to become whatever the agency wishes it to be in a particular application. In this situation, simply mandating benefit-cost assessments risks becoming another irrelevant, time and cost-consuming agenda item. We do favor passage of a bill like that proposed in the last Congress by Senators Thompson and Levin (105-S.981) to provide a statutory basis for benefit cost analysis. However, we believe that such an approach will add value to the current Executive Order only if there also is greater accountability in the quality of benefit-cost studies and in the use of economic performance measures by executive and legislative decisionmakers.

The creation of a Congressional Office of Regulatory Analysis, as proposed in the last Congress, is one way to enhance executive branch accountability. Review of agency analyses can be coupled with outside comment and the threat, albeit distant, of Congressional action under SBREFA against regulation Congress judges to be unwarranted.[25]

But in the final analysis, increased oversight at the final stage of regulatory development alone will not do the trick. Current regulatory philosophies and practices regarding the environment have evolved from an almost 30-year history of media specific legislation which often is quite hostile toward the use of economic performance measures for environmental management. For benefit-cost analysis to play a constructive role--as a decision tool, not a single-minded decision rule--Congress should add to existing statutes criteria for reasoned consideration and balancing of benefits and costs. Legislative changes in the substantive environmental statutes to provide more flexibility in the explicit balancing of benefits and costs is a difficult but evolutionary step in integrating our diverse environmental laws and enhancing the performance of regulation.

[25] See Heather Ross, "How Will Congress Review Rulemaking?," *Resources* Issue 126 (Winter 1997): 5-7 (available at `http://www.rff.org/resources_articles/files/rulemaking.htm`).