PRICING THE PRICELESS:

Cost-Benefit Analysis of Environmental Protection

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EXECUTIVE SUMMARY

In recent years the use of "cost-benefit" analysis to set environmental standards has attracted a large and high-profile group of supporters. According to its advocates, cost-benefit analysis offers a way of achieving superior environmental results at a lower overall cost to society than other available approaches.

This view is mistaken. Cost-benefit analysis is a deeply flawed method that repeatedly leads to biased and misleading results. Far from providing a panacea, cost-benefit analysis offers no clear advantages in making regulatory policy decisions and often produces inferior results, in terms of both environmental protection and overall social welfare, compared to other approaches.

In order to assess the pros and cons of any particular regulatory standard, cost-benefit analysis seeks to translate all relevant considerations into monetary terms. In cost-benefit analysis, therefore, both the costs of, say, putting a scrubber on a power plant to reduce air pollution and the benefits of doing so, including the saving of human lives and the prevention of debilitating and painful diseases, are presented in terms of dollars. The costs and (particularly) the benefits of regulation often will be realized in the future; in such cases the numeric estimates of costs and benefits are "discounted," i.e. treated as equivalent to smaller amounts of money today.

Proponents of cost-benefit analysis make two basic arguments in its favor. First, use of cost-benefit analysis ostensibly leads to more "efficient" allocation of society's resources by better identifying which potential regulatory actions are worth undertaking and in what fashion. Advocates of cost-benefit analysis also contend that this method produces more objective and more transparent government decision-making by making more explicit the assumptions and methods underlying regulatory actions.

In fact, cost-benefit analysis is incapable of delivering what it promises. First, cost-benefit analysis cannot produce more efficient decisions because the process of reducing life, health, and the natural world to monetary values is inherently flawed.

Efforts to value life illustrate the basic problems. Cost-benefit analysis implicitly equates the risk of death with death itself, when in fact they are quite different and should be accounted for separately in considering the benefits of regulatory actions. Cost-benefit analysis also ignores the fact that citizens are concerned about risks to their families and others as well as themselves, ignores the fact that market decisions are generally very different from political decisions, and ignores the incomparability of many different types of risks to human life. The kinds of problems which arise in attempting to define the value of human life in monetary terms also arise in evaluating the benefits of protecting human health and the environment in general.

Second, the use of discounting systematically and improperly downgrades the importance of environmental regulation. While discounting makes sense in comparing alternative *financial*

investments, it cannot reasonably be used to make a choice between preventing noneconomic harms to present generations and preventing similar harms to future generations. Nor can discounting reasonably be used even to make a choice between harms to the current generation; the choice between preventing an automobile fatality and a cancer death should not turn on prevailing rates of return on financial investments. In addition, discounting tends to trivialize long-term environmental risks, minimizing the very real threat our society faces from potential catastrophes and irreversible environmental harms, such as those posed by global warming and nuclear waste.

Third, cost-benefit analysis ignores the question of *who* suffers as a result of environmental problems and, therefore, threatens to reinforce existing patterns of economic and social inequality. Cost-benefit analysis treats questions about equity as, at best, side issues, contradicting the widely shared view that equity should count in public policy. Poor countries, communities, and individuals are likely to express less "willingness to pay" to avoid environmental harms simply because they have fewer resources. Therefore, cost-benefit analysis would justify imposing greater environmental burdens on them than on their wealthier counterparts. With this kind of analysis, the poor get poorer.

Finally, cost-benefit analysis fails to produce the greater objectivity and transparency promised by its proponents. For the reasons described above, cost-benefit analysis rests on a series of assumptions and value judgments that cannot remotely be described as objective. Moreover, the highly complex, resource-intensive, and expert-driven nature of this method makes it extremely difficult for the public to understand and participate in the process. Thus, in practice, cost-benefit analysis is anything but transparent.

Beyond these inherent flaws, cost-benefit analysis suffers from serious defects in practical implementation. Many benefits of public health and environmental protection have not been quantified and cannot easily be quantified given the limits on time and resources; thus, in practice, cost-benefit analysis is often akin to shooting in the dark. Even when the data gaps are supposedly acknowledged, public discussion tends to focus on the misleading numeric values produced by cost-benefit analysis while relevant but non-monetized factors are simply ignored. Finally, the cost side of cost-benefit analysis is frequently exaggerated, because analysts routinely fail to account for the economies that can be achieved through innovative efforts to meet new environmental standards.

Real-world examples of cost-benefit analysis demonstrate the strange lengths to which this flawed method can be taken. For example, the consulting group Arthur D. Little, in a study for the Czech Republic, concluded that encouraging smoking among Czech citizens was beneficial to the government because it caused citizens to die earlier and thus reduced government expenditures on pensions, housing, and health care. In another study, analysts calculated the value of children's lives saved by car seats by estimating the amount of time required to fasten the seats correctly and then assigning a value to the time based on the mothers' actual or imputed hourly wage. These studies are not the work of some lunatic fringe; on the contrary, they apply methodologies that are perfectly conventional within the cost-benefit framework.

Fortunately, there are many good alternatives to the use of cost-benefit analysis. In fact, virtually all of the environmental protections adopted in the United States over the last several decades were developed without the use of cost-benefit analysis. Technology-based regulation, market-based regulation such as pollution trading, and environmental right-to-know programs all have reduced pollution and protected the environment without relying on the problematic method of cost-benefit analysis.

Given the deep and varied flaws in cost-benefit analysis, given the fact that a lot of time and money are required to generate cost-benefit studies, and given that superior, time-tested regulatory alternatives are available, cost-benefit analysis should be rejected as a tool for evaluating environmentally protective regulation.

1. Introduction

How strictly should we regulate arsenic in drinking water? Or carbon dioxide in the atmosphere? Or pesticides in our food? Or oil drilling in scenic places? The list of environmental harms and potential regulatory remedies often appears to be endless.

Is there an objective way to decide how to proceed? Cost-benefit analysis promises to provide the solution. The sad fact is that cost-benefit analysis is fundamentally unable to fulfill this promise.

This paper aims to demonstrate that the case for cost-benefit analysis of environmental protection is, at best, wildly optimistic and, at worst, demonstrably wrong. For a variety of reasons intrinsic to the methodology, cost-benefit analysis simply does not offer the policy-making panacea its adherents promise. Moreover, in practice, cost-benefit analysis frequently produces false and misleading results.

Section 2 of this paper introduces cost-benefit analysis and describes its methods of evaluating costs and benefits. Section 3 summarizes the leading arguments for the use of cost-benefit analysis. Section 4 lays out the fundamental problems with cost-benefit analysis, and Section 5 dissects some of the most prominent and disturbing examples of the use of cost-benefit analysis. Section 6 argues that there are better alternatives for establishing and evaluating public policy. Section 7 offers brief conclusions.

2. What Is Cost-Benefit Analysis?

Cost-benefit analysis tries to mimic a basic function of markets by setting an economic standard for measuring the success of the government's projects and programs. That is, cost-benefit analysis seeks to perform, for public policy, a calculation that markets perform for the private sector. In evaluating a proposed new initiative, how do we know if it is worth doing or not? The answer, it turns out, is much simpler in business than in government.

Private businesses, striving to make money, only produce things that they believe someone is willing to pay for. That is, firms only produce things for which the benefits to consumers, measured by consumers' willingness to pay for them, are expected to be greater than the costs of production. It is technologically possible to produce men's business suits in brightly colored polka dots. Successful producers suspect that no one is willing to pay for such products, and usually stick to at most minor variations on suits in somber, traditional hues. If some firm *did* happen to produce a polka-dotted business suit, no one would be forced to buy it; the producer would bear the entire loss resulting from the mistaken decision.

Government, in the view of many critics, is in constant danger of drifting toward producing polka dot suits – and making people pay for them. Policies, regulations, and public spending do not face the test of the marketplace; there are no consumers who can withhold their dollars from the government until it produces the regulatory equivalent of navy blue and charcoal gray. There is no single quantitative objective for

the public sector comparable to profit maximization for businesses. Even with the best of intentions, critics suggest, government programs can easily go astray for lack of an objective standard by which to judge whether or not they are meeting citizens' needs.

Cost-benefit analysis sets out to do for government what the market does for business: add up the benefits of a public policy and compare them to the costs. The two sides of the ledger raise very different issues.

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Estimating Costs

The first step in a cost-benefit analysis is to calculate the costs of a public policy. For example, the government may require a certain kind of pollution control equipment, which businesses must pay for. Even if a regulation only sets a ceiling on emissions, it results in costs that can be at least roughly estimated through research into available technologies and business strategies for compliance.

The costs of protecting human health and the environment through the use of pollution control devices and other approaches are, by their very nature, measured in dollars. Thus, at least in theory, the cost side of cost-benefit analysis is relatively straightforward. (In practice, as we shall see, it is not quite that simple.)

The consideration of the costs of environmental protection is not unique to cost-benefit analysis. Development of environmental regulations has almost always involved consideration of economic costs, with or without formal cost-benefit techniques. What is unique to cost-benefit analysis, and far more problematic, is the other side of the balance, the monetary valuation of the benefits of life, health, and nature itself.

Monetizing Benefits

Since there are no natural prices for a healthy environment, cost-benefit analysis requires the creation of artificial ones. This is the hardest part of the process. Economists create artificial prices for health and environmental benefits by studying what people would be willing to pay for them. One popular method, called "contingent valuation," is essentially a form of opinion poll. Researchers ask a cross-section of the affected population how much they would be willing to pay to preserve or protect something that can't be bought in a store.

Many surveys of this sort have been done, producing prices for things that appear to be priceless. For example, the average American household is supposedly willing to pay $257 to prevent the extinction of bald eagles, $208 to protect humpback whales, and $80 to protect gray wolves.[1] These numbers are quite large: since there are about 100 million households in the country, the nation's total willingness to pay for the preservation of bald eagles alone is ostensibly more than $25 billion.

An alternative method of attaching prices to unpriced things infers what people are willing to pay from observation of their behavior in other markets. To assign a dollar value to risks to human life, for example, economists usually calculate the extra wage - or "wage premium" - that is paid to workers who accept more risky jobs. Suppose that two jobs are comparable, except that one is more dangerous and better paid. If workers understand the risk and voluntarily accept the more dangerous job, then they are implicitly setting a price on risk by accepting the increased risk of death in exchange for increased wages.

What does this indirect inference from wage rates have to say about the value of a life? A common estimate in recent cost-benefit analyses is that avoiding a risk that would lead, on average, to one death is worth roughly $6.3 million.[2] This number, in particular, is of great importance in cost-benefit analyses because avoided deaths are the most thoroughly studied benefits of environmental regulations.

Discounting the Future

One more step requires explanation to complete this quick sketch of cost-benefit analysis. Costs and benefits of a policy frequently occur at different times. Often, costs are incurred today, or in the near future, to prevent harm in the more remote future. When the analysis spans a number of years, future costs and benefits are *discounted*, or treated as equivalent to smaller amounts of money in today's dollars.

Discounting is a procedure developed by economists in order to evaluate investments that produce future income. The case for discounting begins with the observation that $100, say, received today is worth more than $100 received next year, even in the absence of inflation. For one thing, you could put your money in the bank today and earn a little interest by next year. Suppose that your bank account earns 3 percent interest. In that case, if you received the $100 today rather than next year, you would earn $3 in interest, giving you a total of $103 next year. Likewise, in order to get $100 next year you only need to deposit $97 today.[3] So, at a 3% *discount rate*, economists would say that $100 next year has a *present value* of $97 in today's dollars.

For longer periods of time, the effect is magnified: at a 3% discount rate, $100 twenty years from now has a present value of only $55. The larger the discount rate, and the longer the time intervals involved, the smaller the present value: at a 5% discount rate, for example, $100 twenty years from now has a present value of only $38.

Cost-benefit analysis routinely uses the present value of future benefits. That is, it compares current costs, not to the actual dollar value of future benefits, but to the smaller amount you would have to put into a hypothetical savings account today to obtain those benefits in the future. This application of discounting is essential, and indeed commonplace, for many practical financial decisions. If offered a choice of investment opportunities with payoffs at different times in the future, you can (and should) discount the future payoffs to the present in order to compare them to each other. The important issue for environmental policy, as we shall see, is whether this logic also applies to outcomes far in the future, and to opportunities – like long life and good health – that are not naturally stated in dollar terms.

WHAT IS THE DIFFERENCE BETWEEN COST-BENEFIT ANALYSIS AND OTHER ANALYTICAL METHODS?

There are several similar-sounding decision-making frameworks that may be confused with cost-benefit analysis; it is important to understand the ways in which they are different. The basic difference is simple to state: no other analytical method requires the translation of the benefits of regulation – long life, good health, clean air – into dollars.

"Risk assessment" is a scientific method for estimating, often in quantitative terms, the human-health consequences of a particular threat. A risk assessment concerning benzene in the workplace, for example, might conclude that an individual worker faces an increased lifetime risk of cancer of 1 in 1,000 from exposures to this substance. Combined with figures on the total population of workers exposed to benzene, this probabilistic estimate might be used to generate an estimate of the total number of workers expected to get cancer from occupational exposures to benzene. Risk assessment is a building block of many cost-benefit analyses, but it is far more limited than cost-benefit analysis itself. Risk assessment does not, for example, attempt to attach a monetary value to the health outcomes it predicts, nor does it purport to make any judgment about the relative worth of lives saved today and lives saved in the future.

A similar phrase, *"comparative risk analysis,"* is used to describe yet another method. Comparative risk analysis, in basic terms, attempts to consider the many different ways risk might be reduced in our society and to identify those risks that might be most effectively reduced with the resources we have. In colloquial terms, this analysis tries to get the "biggest bang" for our risk-reducing "buck." (The same is true of a similar method, *"cost-effectiveness analysis."*)

Comparative risk analysis does not entail translation of lives and health into dollars. In other respects, however, it often replicates the most basic shortcomings of cost-benefit analysis; comparative risk analysis tends, for example, to consider only risks to humans, and only fatal risks at that, in assessing the results of environmental protection; it tends to treat all numerical risks – whether posed by arsenic in drinking water or snowboarding in the Rockies – as equivalent; and it generally incorporates the technique of discounting human lives saved in the future.

"Risk-benefit analysis" is usually a mirror-image of cost-benefit analysis: in risk-benefit analysis, the "benefits" are the economic advantages of maintaining the current level of environmentally damaging activity, and "risks" are the disadvantages of doing so.

Finally, *any* simultaneous consideration of economic costs and health or other benefits is sometimes referred to as "cost-benefit analysis." For our purposes, this usage is imprecise and misleading. As we discuss in section 6, many environmental statutes require agencies to take into account both the economic consequences and the human-health and environmental results of regulatory standards. But only one federal environmental statute (the Safe Drinking Water Act) expressly permits an agency to translate life, health, and nature into dollars, and no statute expressly permits or requires any agency to discount the lives of those saved in the future. The cost-benefit analysis we discuss in this paper embraces both of these analytical techniques.

3. What Are the Arguments in Favor of Cost-Benefit Analysis?

Before describing the problems with cost-benefit analysis, it will be useful to set forth the arguments in favor of this type of analysis. Many different arguments for cost-benefit analysis have been offered over the years. Most of the arguments fall into one of two broad categories. First, there are economic assertions that better results can be achieved with cost-benefit analysis. Second, there are legal and political claims that a more objective and more open government process can emerge through this kind of analysis.

Better Results

Economics frequently focuses on increasing efficiency – on getting the most desirable results from the fewest resources. How do we know that greater regulatory efficiency is needed? For many economists, this is an article of faith: greater efficiency is always a top priority, in regulation or elsewhere. Cost-benefit analysis supposedly furthers efficiency by ensuring that regulations are only adopted when benefits exceed costs and by helping direct regulators' attention to those problems for which regulatory intervention will yield the greatest net benefits.

But many advocates also raise a more specific argument, imbued with a greater sense of urgency. The government, it is said, often issues rules that are insanely expensive, out of all proportion to their benefits – a problem that could be solved by the use of cost-benefit analysis to screen proposed regulations. Thus much of the case *for* cost-benefit analysis depends on the case *against* current regulation.

One does not have to read very far into the literature on risk regulation before running across lengthy tables listing the costs per life saved of various federal regulations. The numbers on such tables are fantastic: according to these lists, we are often spending hundreds of millions, and sometimes billions, of dollars for every single human life, or even year of life, we save through regulation.[4]

These estimates of regulatory costs and benefits have become ubiquitous in political debates on environmental law. Scarcely a congressional hearing on this subject occurs in which these kinds of numbers do not figure prominently. Economists routinely cite these estimates as proof of the need for more economic analysis. Browse the web sites of any of a variety of think tanks, and you will find numerous references to the extravagant costs of regulation.

One widely cited study claims that the cost per year of life saved by life-saving interventions varies from zero or negative (some life-saving measures impose no new costs, and may even save money) up to *$99 billion*. The table on the following page is excerpted from that study. (Note, however, that not one of the pollution control measures listed in this table has ever been proposed by the government, much less implemented.)

COSTS PER LIFE-YEAR SAVED OF HYPOTHETICAL POLLUTION CONTROLS AT PAPER MILLS[6]

POLLUTION CONTROL MEASURE	COST PER LIFE-YEAR
Chloroform emission standard at 17 low cost pulp mills	Zero or Negative
Chloroform private well emission standard at 7 papergrade sulfite mills	$25,000
Chloroform private well emission standard at 7 pulp mills	$620,000
Chloroform reduction by replacing hypochlorite with chlorine dioxide at 1 mill	$990,000
Dioxin emission standard of 5 lbs/air dried ton at pulp mills	$4,500,000
Dioxin emission standard of 3 (vs. 5) lbs/air dried ton at paper mills	$7,500,000
Chloroform emission standard of 0.001 (vs. 0.01) risk level at pulp mills	$7,700,000
Chloroform reduction by replacing hypochlorite with chlorine dioxide at 70 mills	$8,700,000
Chloroform reduction at 70 (vs. 33 worst) pulp and paper mills	$15,000,000
Chloroform reduction at 33 worst pulp and paper mills	$57,000,000
Chloroform private well emission standard at 48 pulp mills	$99,000,000,000

Source: Tammy O. Tengs, et al., Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness, 15 Risk Analysis 369(1995).

Numbers like these have been used to argue that current regulatory costs are not only chaotically variable but also unacceptably high. They have even been relied upon to claim that the existing regulatory system actually *kills people* by imposing some very costly life-saving requirements while other, less expensive and more effective life-saving possibilities remain untouched. Indeed, a study drawing upon these data concluded that we could save as many as 60,000 more lives every year with no increase in costs if we simply spent our money on the least rather than most expensive opportunities for saving lives. Relying on this research, John Graham, the current head of the Office of Information and Regulatory Affairs in the Office of Management and Budget and a prominent proponent of cost-benefit analysis, has called the existing state of affairs "statistical murder."[5]

From this perspective, cost-benefit analysis emerges as both a money-saver *and* a life-saver. By subjecting regulations to a cost-benefit test, we would not only stop spending hundreds of millions or billions of dollars to save a single life, we could also take that money and spend it on saving even more lives through different life-saving measures.

That, at least, is the theory. We will argue in the following sections that there are good reasons to question both the theory and the facts it rests on. Nevertheless, the notion that the current system produces crazy, even deadly, rules, and that better economic analysis would avert

this terrible result, remains one of the most persistent arguments offered on behalf of cost-benefit analysis.

Objectivity and Transparency

A second important set of arguments holds that cost-benefit analysis would produce a better regulatory process – more objective and more transparent, and thus more accountable to the public.

The holy grail of administrative law is agency decision making based on objective standards. The idea is to prevent an agency either from just doing anything it wants or, more invidiously, from benefiting politically favored groups through its decisions. Cost-benefit analysis has been offered as a means of constraining agency discretion to avoid these kinds of results.

Another important goal said to be promoted by cost-benefit analysis is transparency of administrative procedures. Decisions about environmental protection are notoriously complex. They reflect the input of biologists, toxicologists, epidemiologists, economists, engineers, lawyers, and other experts whose work is complicated and arcane. The technical details of these decisions often raise important questions about how much scientific uncertainty is too much, which human populations should be protected from illness and even death, and how important the future is relative to the present.

In order for the public to be part of the process of decision making about the environment, these judgments must be offered and debated in language accessible to people who are not biologists, toxicologists, or other kinds of experts. Many advocates of cost-benefit analysis believe that their methodology provides such a language. They also assert that cost-benefit analysis renders decision-making transparent insofar as it requires decision-makers to reveal all of the assumptions and uncertainties reflected in their decisions.

4. Why It Doesn't Work: Fundamental Flaws

As we have seen, cost-benefit analysis involves the creation of artificial markets for things - like good health, long life, and clean air - that are not bought and sold. It also involves the devaluation of future events through discounting.

So described, the mind-set of the cost-benefit analyst is likely to seem quite foreign. The translation of all good things into dollars and the devaluation of the future are inconsistent with the way many people view the world. Most of us believe that money doesn't buy happiness. Most religions tell us that every human life is sacred; it is obviously illegal, as well as immoral, to buy and sell human lives. Most parents tell their children to eat their vegetables and do their homework, even though the rewards of these onerous activities lie far in the future. Monetizing human lives and discounting future benefits seem at odds with these common perspectives.

The cost-benefit approach also is inconsistent with the way many of us make daily decisions. Imagine performing a new cost-benefit analysis to decide whether to get up and go to work every morning, whether to exercise or eat right on any given day, whether to wash the dishes or leave them in the sink, and so on. Inaction would win far too often – and an absurd amount of effort would be spent on analysis. Most people have long-run goals, commitments, and habits that make such daily balancing exercises either redundant or counterproductive. The same might be true of society as a whole undertaking individual steps in the pursuit of any goal, set for the long haul, that cannot be reached overnight - including, for example, the achievement of a clean environment.

Moving beyond these intuitive responses, we offer in this section a detailed explanation of why cost-benefit analysis of environmental protection fails to live up to the hopes and claims of its advocates. There is no quick fix, because these failures are intrinsic to the methodology, appearing whenever it is applied to any complex environmental problem. In our view, cost-benefit analysis suffers from four fundamental flaws, addressed in each of the next four subsections:

- *The standard economic approaches to valuation are inaccurate and implausible.*
- *The use of discounting improperly trivializes future harms and the irreversibility of some environmental problems.*
- *The reliance on aggregate, monetized benefits excludes questions of fairness and morality.*
- *The value-laden and complex cost-benefit process is neither objective nor transparent.*

Dollars Without Sense

Recall that cost-benefit analysis requires the creation of artificial prices for all relevant health and environmental impacts. To weigh the benefits of regulation against the costs, we need to know the monetary value of preventing

the extinction of species, preserving many different ecosystems, avoiding all manner of serious health impacts, and even saving human lives. Without such numbers, cost-benefit analysis cannot be conducted.

Artificial prices have been estimated for many, though by no means all, benefits of regulation. As discussed, preventing the extinction of bald eagles reportedly goes for somewhat more than $250 per household. Preventing retardation due to childhood lead poisoning comes in at about $9,000 per lost IQ point (although, as we will see in Section 5, a much lower price has recently been proposed). Saving a life is ostensibly worth $6.3 million.

This quantitative precision, achieved through a variety of indirect techniques for valuation, comes at the expense of accuracy and even common sense. Though problems arise in many areas of valuation, we will focus primarily on the efforts to attach a monetary value to human life, both because of its importance in cost-benefit analysis and because of its glaring contradictions.

There Are No "Statistical" People

What can it mean to say that saving one life is worth $6.3 million? Human life is the ultimate example of a value that is not a commodity, and does not have a price. You cannot buy the right to kill someone for $6.3 million, nor for any other price. Most systems of ethical and religious belief maintain that every life is sacred. If analysts calculated the value of life itself by asking people what it is worth to them (the most common method of valuation of other environmental benefits), the answer would be infinite, as "no finite amount of money could compensate a person for the loss of his life, simply because money is no good to him when he is dead."[6]

The standard response is that a value like $6.3 million is not actually a price on an individual's life or death. Rather, it is a way of expressing the value of small risks of death; for example, it is one million times the value of a one in a million risk. If people are willing to pay $6.30 to avoid a one in a million increase in the risk of death, then the "value of a statistical life" is $6.3 million.

Unfortunately, this explanation fails to resolve the dilemma. It is true that risk (or "statistical life") and life itself are distinct concepts. But if human life is too sacred to buy and sell, why is it permissible to trade small risks of losing that ultimate value? One-millionth of an immeasurable or infinite value is still immeasurable or infinite, not $6.30.[7]

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In practice, moreover, analysts often ignore the distinction between valuing risk and valuing life.[8] Many regulations reduce risk for a large number of people, and avoid actual death for a much smaller number. A complete cost-benefit analysis should, therefore, include valuation of both of these benefits. However, the standard practice is to calculate a value only for "statistical" life and to ignore life itself.

The confusion between the valuation of risk and the valuation of life itself is embedded in current regulatory practice in another way as well. The Office of Management and Budget – which reviews cost-benefit analyses prepared by federal

agencies pursuant to executive order – instructs agencies to discount the benefits of life-saving regulations from the moment of avoided death, rather than from the time when the *risk* of death is reduced.[9]

Most spiritual beliefs call on us to value the lives of others - not only those closest to us, but also those whom we have never met.

This approach to discounting is plainly inconsistent with the claim that cost-benefit analysis seeks to evaluate risk. When a life-threatening disease – such as cancer – has a long latency period, many years may pass between the time when a risk is imposed and the time of death. If monetary valuations of statistical life represented risk, and not life, then the value of statistical life would be discounted from the date of a change in risk (typically, when a new regulation is enforced) rather than from the much later date of avoided actual death.[10]

In acknowledging the monetary value of reducing risk, economic analysts have contributed to our growing awareness that life-threatening risk itself – and not just the end result of such risk, death – is an injury. But they have blurred the line between risks and actual deaths, by calculating the value of reduced risk while pretending that they have produced a valuation of life itself. The paradox of monetizing the infinite or immeasurable value of human life has not been resolved; it has only been glossed over.

People Care About Other People

Another large problem with this approach to valuation of life is that it asks individuals (either directly through surveys, or indirectly through observing wage and job choices) only about their attitudes toward risks to themselves.

A recurring theme in literature suggests that our deepest and noblest sentiments involve valuing someone else's life more highly than our own: think of parents' devotion to their children, soldiers' commitment to those whom they are protecting, lovers' concern for each other. Most spiritual beliefs call on us to value the lives of others - not only those closest to us, but also those whom we have never met.

This point echoes a procedure that has become familiar in other areas of environmental valuation. Economists often ask about existence values: how much is the existence of a wilderness area or an endangered species worth to you, even if you will never personally experience it? If this question makes sense for bald eagles and national parks, it must be at least as important when applied to safe drinking water and working conditions for people we don't know.

The difficulty is that the answer to this type of question cannot be deduced solely from your attitudes toward risks to yourself. We are not aware of any attempts to quantify the existence value of the life of a stranger, let alone a relative or a friend, but we are sure that most belief systems affirm that this value is substantial (assuming, of course, that the value of life is a number in the first place).

Voting Is Different From Buying

Cost-benefit analysis, which relies on estimates of individuals' preferences as consumers, also fails to address the collective choice presented to society by most public health and environmental problems.

Under the cost-benefit approach, valuation of environmental benefits is based on individuals' private decisions as consumers or workers, not on their public values as citizens. However, policies that protect the environment are often public goods, and are not available for purchase in individual portions. In a classic example of this distinction, the philosopher Mark Sagoff found that his students, in their role as citizens, opposed commercial ski development in a nearby wilderness area, but, in their role as consumers, would plan to go skiing there if the development was built.[11] There is no contradiction between these two views: as individual consumers, the students would have no way to express their collective preference for wilderness preservation. Their individual willingness to pay for skiing would send a misleading signal about their views as citizens.

It is often impossible to arrive at a meaningful social valuation by adding up the willingness to pay expressed by individuals. What could it mean to ask how much you personally are willing to pay to clean up a major oil spill? If no one else contributes, the clean-up won't happen regardless of your decision. As the Nobel Prize-winning economist Amartya Sen has pointed out, if your willingness to pay for a large-scale public initiative is independent of what others are paying, then you probably have not understood the nature of the problem.[12] Instead, a *collective* decision about collective resources is required.

In a similar vein, the philosopher Henry Richardson argues that reliance on the cost-benefit standard forecloses the process of democratic deliberation that is necessary for intelligent decision-making. In his view, attempts to make decisions based on monetary valuation of benefits freeze preferences in advance, leaving no room for the changes in response to new information, rethinking of the issues, and negotiated compromises that lie at the heart of the deliberative process.[13]

Cost-benefit analysis turns public citizens into selfish consumers, and interconnected communities into atomized individuals. In this way, it distorts the question it sets out to answer: how much do we, *as a society*, value health and the environment?

Numbers Don't Tell Us Everything

A few simple examples illustrate another problem – that numerically equal risks are not always equally deserving of regulatory response. The death rate is roughly the same (somewhat less than one in a million) from a day of downhill skiing, from a day of working in the construction industry, or from drinking about 20 liters of water containing 50 parts per billion of arsenic, the old regulatory limit that was recently revised by the Bush administration. This does not mean that society's responsibility to reduce risks is the same in each case.

Most people view risks imposed by others, without an individual's consent, as more worthy of government intervention than risks that an individual knowingly accepts. On that basis, the highest priority among our three examples is to reduce drinking water contamination, a hazard to which

no one has consented. The acceptance of a risky occupation such as construction is at best quasi-voluntary–it involves somewhat more individual discretion than the "choice" of public drinking water supplies, but many people go to work under great economic pressure, and with little information about occupational hazards. In contrast, the choice of risky recreational pursuits such as skiing is entirely discretionary; obviously no one is forced to ski. Safety regulation in construction work is thus more urgent than regulation of skiing, despite the equality of numerical risk.

In short, even for ultimate values such as life and death, the social context is decisive in our evaluation of risks. Cost-benefit analysis assumes the existence of generic, acontextual risk, and thereby ignores the contextual information that determines how many of us, in practice, think about real risks to real people.

Artificial Prices Are Expensive

Finally, the economic valuation called for by cost-benefit analysis is fundamentally flawed because it demands an enormous volume of consistently updated information, which is beyond the practical capacity of our society to generate.

All attempts at valuation of the environment begin with a problem: the goal is to assign monetary prices to things that have no prices, because they are not for sale. One of the great strengths of the market is that it provides so much information about real prices. For any commodity that is actually bought and sold, prices are communicated automatically, almost costlessly, and with constant updates as needed. To create artificial prices for environmental values, economists have to find some way to mimic the operation of the market. Unfortunately the process is far from automatic, it is certainly not costless, and it has to be repeated every time an updated price is needed.

As a result, there is constant pressure to use outdated or inappropriate valuations. Indeed, there are sound economic reasons for doing so: no one can afford constant updates, and significant savings can be achieved by using valuations created for other cases. In the EPA's original cost-benefit analysis of arsenic (see the arsenic case study, starting at page 17), the estimated value of a case of chronic bronchitis was used to represent the value of a case of nonfatal bladder cancer.

This is not, we hope and believe, because anyone thinks that bronchitis and bladder cancer are the same disease. The reason is more mundane: no one has performed an analysis of the cost of bladder cancer, and even the extensive analysis of arsenic regulations did not include enough time and money to do so. Therefore, the investigators used an estimated value for a very different disease. The only explanation offered for this procedure was that it had been done before, and nothing better was available.

Use of the bronchitis valuation to represent bladder cancer can charitably be described as grasping at straws. Lacking the time and money to fill in the blank carefully, the economists simply picked a number. This is not remotely close to the level of rigor that is seen throughout the natural science, engineering, and public health portions of the arsenic analysis. Yet it will happen again, for exactly the same reason. It is not a failure of will or intellect, but rather the inescapable limitations of

time and budget, that lead to reliance on dated, inappropriate, and incomplete information to fill in the gaps on the benefit side of a cost-benefit analysis.

Summing Up

There are, in short, a host of problems with the process of valuation. On a philosophical level, human life may belong in the category of things that are too valuable to buy and sell. Most ethical and religious beliefs place the protection of human life in the same category as love, family, religion, democracy, and other ultimate values, which are not and cannot be priced.

Absent a credible monetary metric for calculating the benefits of regulation, cost-benefit analysis is inherently unreliable.

It is a biased and misleading premise to assume that individuals' willingness to pay to avoid certain risks can be aggregated to arrive at a figure for what society should pay to protect human life. Risk of death is not the same as death itself, and not all risks can reasonably be compared one to the other. Moreover, the value to society of protecting human life cannot be arrived at simply by toting up individual consumer preferences.

The same kind of problems affect other valuation issues raised by cost-benefit analysis, such as estimating the value of clean water, biodiversity, or entire ecosystems. The upshot is that cost-benefit analysis is fundamentally incapable of delivering on its promise of more economically efficient decisions about protecting human life, health, and the environment. Absent a credible monetary metric for calculating the benefits of regulation, cost-benefit analysis is inherently unreliable.

(main text continued on page 21)

Cost-benefit analysis in practice: Arsenic in drinking water

One thing is certain: arsenic is bad for you. It causes cancers of the bladder, lungs, skin, kidneys, nasal passages, liver, and prostate, as well as other cardiovascular, pulmonary, neurological, immunological, and endocrine problems. It is found naturally in rock formations and dissolves into drinking water supplies, the principal source of exposure.

Until the Bush administration issued a new standard for arsenic, federal law limited arsenic in drinking water to 50 parts per billion (ppb), a standard set in 1942. Almost forty years ago, in 1962, the U.S. Public Health Service recommended that drinking water should not contain more than 10 ppb.[a]

On three occasions in the past thirty years, Congress has directed EPA to update the 50 ppb standard. A 1999 report by the National Academy of Sciences concluded that the 50 ppb standard "requires downward revision as promptly as possible."[b] At last, in January 2001, EPA announced a new standard of 10 ppb (the standard recommended by the World Health Organization and adopted by many European countries). Less than two months later, the Bush administration withdrew this standard – only to accept it again after eight months of further review and debate.

The Safe Drinking Water Act, as amended in 1996, is the only federal environmental statute that explicitly sanctions cost-benefit analysis based on consumers' willingness to pay for environmental protection. The controversy that has erupted over the arsenic rule well illustrates the inability of cost-benefit analysis to answer important questions of social policy. It also shows how the controversial and value-laden assumptions of cost-benefit analysis become invisible in public debates based on such analysis.

EPA's Analysis

In developing the new standard, EPA considered four possible standards: 3, 5, 10, and 20 ppb.[c] Testing and monitoring are not reliable below 3 ppb, so it is the lowest possible level for regulation.

On the cost side, detailed engineering descriptions are available for an array of possible technologies for water treatment and disposal of resulting residues. The choice of technology depends on the size and circumstances of community water systems. EPA's estimates express only a narrow range of uncertainty about costs, as shown in the table on page 18. Note that if these pollution control technologies become cheaper once the arsenic rule is implemented – as often happens when environmental rules are enforced – the estimated costs will prove too high.

EPA'S ESTIMATES OF COSTS AND BENEFITS OF DIFFERENT ARSENIC STANDARDS

ARSENIC STANDARD (PPB)	COMPLIANCE COSTS (MILLIONS)	HEALTH BENEFITS (MILLIONS)	BLADDER AND LUNG CANCER CASES AVOIDED
3	$700-790	$210-490	57-140
5	$420-470	$190-360	51-100
10	$180-210	$140-200	37-56
20	$67-77	$66-75	19-20

Source: EPA, National Primary Drinking Water Regulations; Arsenic and Clarifications to Compliance and New Source Contaminants Monitoring; Final Rules, 66 Fed. Reg. 6976, 7009, 7017 (Jan. 22, 2001) (rounded to two significant figures). Costs and benefits are in 1999 dollars.

On the benefit side, reduction in arsenic in drinking water has many health advantages. As noted, arsenic causes many different cancers and other neurological, immunological, and endocrine problems. However, EPA's analysts were only able to produce quantitative estimates of the health effects for bladder and lung cancer; all numerical analysis of benefits refers to preventing these two cancers alone.

Even with this narrow focus, EPA faced difficult challenges in monetizing the health effects of arsenic. In the U.S., death occurs within five years of diagnosis for 88% of lung cancer cases, but only 26% of bladder cancer cases. Thus the monetization of these cancers requires estimates of both the value of avoided deaths, and the value of avoided nonfatal cancers, particularly bladder cancers. EPA set the value of an avoided death at $6.1 million in 1999 dollars, based on "wage-risk" studies measuring the wage premium required to attract workers to dangerous jobs - a procedure discussed in Section 3 of the text. For other health effects, EPA found that there was no "willingness-to-pay" value available for nonfatal cancers – so it used the value of reducing chronic bronchitis instead![d] For health effects other than cancers, EPA did not provide a dollar equivalent.

The gap between the upper and lower estimates of monetized health benefits (shown in the table above) reflects solely the uncertainty about the number of avoided cancers; the valuations of fatal and non-fatal cancers are provided in precise dollar amounts. As seen in the table, costs and benefits are comparable

for 20 ppb and 10 ppb. At 5 ppb and 3 ppb, the monetized benefits are below the costs.

AEI-Brookings Analysis

The AEI-Brookings Joint Center for Regulatory Studies has been a vocal proponent of cost-benefit analysis of environmental rules. Nevertheless, when EPA first issued its new rule, AEI-Brookings produced a study authored by Robert Hahn and Jason Burnett, highly critical of the rule.[e] This rival study is worth focusing on both because it achieved high visibility in the media, and because its methods reveal the extent to which the devil is in the details of cost-benefit analysis.

EPA had erred in two ways, the AEI-Brookings study concluded, which led to overestimates of the benefits of arsenic reduction. First, the study criticized EPA for failing to discount the lives saved by the arsenic rule. Because exposure to arsenic leads to cancer only after a latency period, Hahn and Burnett thought EPA should have discounted the benefits of the rule.

EPA had rejected discounting because it was unable, given current scientific knowledge, to identify the latency period for the cancers associated with arsenic. Hahn and Burnett were not deterred by this lack of knowledge. They simply picked a latency period (without citing any arsenic-related scientific evidence) of 30 years for their "best estimate" scenario. This guess at the latency period, combined with a 7 percent discount rate, had the effect of reducing the present value of a life saved from $6.1 million to $1.1 million.

Second, the AEI-Brookings study criticized EPA for using a linear dose-response curve in estimating the cancer risks of arsenic. That is, EPA assumed that the number of cancer cases is proportional to total exposure, a long-established assumption that is routinely used in the absence of evidence to the contrary. Making up a different dose-response relationship, Hahn and Burnett, neither of whom is a scientist, offered their "best estimate" (again, on an almost evidence-free basis) that there were only one-fifth as many cases of cancer due to arsenic as EPA had projected.

With these and other adjustments, Hahn and Burnett found the costs to be roughly ten times the benefits of arsenic reduction, costing a shocking $65 million per life saved. They speculated that even 50 ppb might be too strict a standard, in light of the low benefits.

When the National Academy of Sciences (NAS) reviewed the arsenic standard yet again, in 2001, it found exactly the opposite of Hahn and Burnett's "best estimate." That is, NAS concluded that arsenic would cause more cancer cases than EPA had projected. This finding, no doubt combined with the public outcry over the issue, helped persuade the Bush administration to relent and accept the 10 ppb standard.

Public Debate

Once the rival EPA and Hahn-Burnett numbers made their way into the public forum, the assumptions, qualifications, and uncertainties surrounding them were forgotten. Also ignored were the benefits of the rule that EPA had been unable to quantify, and the value-laden assumptions undergirding the very different analyses offered by EPA and AEI-Brookings.

One way to gauge the misunderstanding that ensued is to look at press accounts of the arsenic rule. The Washington Post, for example, ran a series of opinion pieces criticizing EPA's 10ppb standard when originally issued in early 2001 (before the latest NAS study appeared).[f] These pieces made a variety of mistakes, all stemming from a failure to distinguish precision from accuracy.

First, these opinion pieces assumed that the Clinton-era rule was not justified unless quantified and monetized benefits were higher than the costs. Because the rule (at 10 ppb) was predicted to cost $210 billion and the benefits were valued at $170 billion, these essays concluded that the rule was not worth it. Completely ignored were the many unquantified and unmonetized benefits EPA had felt certain would flow from the rule.

Second, these essays referred to the Hahn-Burnett analysis without once even mentioning the discounting and dubious scientific adjustments that so influenced its results. Journalist Michael Kinsley noted the $65 million price tag per life saved according to Hahn and Burnett's analysis, and opined, without dwelling on the details, that its assumptions seemed to him "reasonable."[g]

The public dialogue in the aftermath of the Bush administration's initial withdrawal of the new arsenic rule was not about discounting future life-saving, or cancer risk assessment, or the value of a life. Yet the numerical estimates of the benefits turn almost entirely on these issues, and the theories on which they rest. Cost-benefit analysis has not enriched the public dialogue; it has impoverished it, covering the topic with poorly understood numbers rather than clarifying the underlying clash of values.

Footnotes

a. National Resources Defense Council, *Arsenic and Old Laws* (2000), http://www.nrdc.org.

b. National Research Council, *Arsenic in Drinking Water* 9 (National Academy Press 1999).

c. EPA, National Primary Drinking Water Regulations; Arsenic and Clarifications to Compliance and New Source Contaminants Monitoring; Final Rules, 66 Fed. Reg. 6976 (Jan. 22, 2001).

d. *Id.* at 7012.

e. Jason K. Burnett and Robert W. Hahn, "EPA's Arsenic Rule: The Benefits of the Standard Do Not Justify the Costs," AEI-Brookings Joint Center for Regulatory Studies, Regulatory Analysis 01-02 (Jan. 2001).

f. Sebastian Mallaby, "Saving Statistical Lives," *The Washington Post* A19 (Mar. 5, 2001); Michael Kinsley, "Bush Is Right On Arsenic. Darn!," *The Washington Post* A23 (Apr. 13, 2001); George F. Will, "The Costs of Moral Exhibitionism," *The Washington Post* B7 (Apr. 15, 2001).

g. Michael Kinsley, "Bush Is Right On Arsenic. Darn!," *The Washington Post* A23 (Apr. 13, 2001).

Trivializing the Future

One of the great triumphs of environmental law is its focus on the future: it seeks to avert harms to people and to natural resources in the future, and not only within this generation, but within future generations as well. Indeed, one of the primary objectives of the National Environmental Policy Act, which has been called our basic charter of environmental protection, is to nudge the nation into "fulfill[ing] the responsibilities of each generation as trustee of the environment for succeeding generations."[14]

Protection of endangered species and ecosystems, reduction of pollution from persistent chemicals such as dioxin and DDT, prevention of long-latency diseases such as cancer, protection of the unborn against the health hazards from exposure to toxins in the womb – all of these protections are afforded by environmental law, and all of them look to the future as well as to the present. Environmental law seeks, moreover, to avoid the unpleasant surprises that come with discontinuities and irreversibility – the kinds of events that outstrip our powers of quantitative prediction. Here, too, environmental law tries to protect the future in addition to the present.

At a discount rate of 5 percent the death of a billion people 500 years from now becomes less serious than the death of one person today.

Cost-benefit analysis systematically downgrades the importance of the future in two ways: through the technique of discounting, and through predictive methodologies that take inadequate account of the possibility of catastrophic and irreversible events.

The most common, and commonsense, argument in favor of discounting future human lives saved, illnesses averted, and ecological disasters prevented is that it is better to suffer a harm later rather than sooner. What's wrong with this argument? A lot, as it turns out.

Do Future Generations Count?

The first problem with the later-is-better argument for discounting is that it assumes that one person is deciding between dying or falling ill now, or dying or falling ill later. In that case, virtually everyone would prefer later. But many environmental programs protect the far future, beyond the lifetime of today's decision-makers. Thus the choice implicit in discounting is between preventing harms to the current generation and preventing similar harms to future generations. Seen in this way, discounting looks like a fancy justification for foisting our problems off onto the people who come after us.

The time periods involved in protecting the environment are often enormous – many decades for a wide range of problems, and even many centuries, in the case of climate change, radioactive waste, and other persistent toxins. With time spans this long, discounting at any positive rate will make even global catastrophes seem trivial. At a discount rate of 5 percent, for example, the death of a billion people 500 years from now becomes less serious than the death of one person today.

Does Haste Prevent Waste?

The argument for discounting also assumes that environmental problems won't get any worse if we wait to address them. In the market paradigm, buying environmental protection is just like buying any other commodity. You can buy a new computer now or later – and if you don't need it this year, you should probably wait. The technology will undoubtedly keep improving, so next year's models will do more yet cost less. An exactly parallel argument has been made about climate change (and other environmental problems) by some economists: if we wait for further technological progress, we will get more for our climate change mitigation dollars in the future.

If environmental protection was mass-produced by the computer industry, and if environmental problems would agree to stand still indefinitely and wait for us to respond, this might be a reasonable approach. In the real world, however, it is a ludicrous and dangerous strategy.

Too many years of delay may mean that the polar ice cap melts, the spent uranium leaks out of the containment ponds, the hazardous waste seeps into groundwater and basements and backyards – at which point we can't put the genie back in the bottle at any reasonable cost (or perhaps not at all).

Environmentalists often talk of potential "crises," of threats that problems will become suddenly and irreversibly worse. In response to such threats, environmentalists and some governments advocate the so-called "precautionary principle," which calls upon regulators to err on the side of caution and protection when risks are uncertain.

Cost-benefit analysts, for the most part, do not assume the possibility of crisis. Their worldview assumes stable problems, with control costs that are stable or declining over time, and thus finds precautionary investment in environmental protection to be a needless expense. Discounting is part of this non-crisis perspective. By implying that the present cost of future environmental harms declines, lockstep, with every year that we look ahead, discounting ignores the possibility of catastrophic and irreversible harms. For this very reason, some prominent economists have rejected the discounting of intangibles. As William Baumol wrote in an important early article on discounting the benefits of public projects:

There are important externalities and investments of the public goods variety which cry for special attention. Irreversibilities constitute a prime example. If we poison our soil so that never again will it be the same, if we destroy the Grand Canyon and turn it into a hydroelectric plant, we give up assets which like Goldsmith's bold peasantry, "their country's pride, when once destroy'd can never be supplied." All the wealth and resources of future generations will not suffice to restore them.[15]

Most cost-benefit analysts do not exhibit this kind of humility about what the future might hold in store for us.

Begging the Question

Extensive discounting of future environmental problems lies at the heart of many recent studies of regulatory costs and benefits that charge "statistical murder." When the costs and benefits of environmental protection are compared to those of safety rules (like requiring fire extinguishers for airplanes) or medical procedures (like vaccinating children

against disease), environmental protection almost always comes out the loser. Why is this so?[16]

These studies all discount future environmental benefits by at least 5 percent per year. This has little effect on the evaluation of programs, like auto safety rules requiring seat belts and fire safety rules requiring smoke alarms, that could start saving lives right away. However, for environmental programs like hazardous waste cleanups and control of persistent toxins that save lives in the future, discounting matters a great deal – especially since, as explained above, the benefits are assumed to occur in the future when deaths are avoided, rather than in the near term when risks are reduced.

By using discounting, analysts *assume* the answer to the question they purport to be addressing, that is, which programs are most worthwhile. The researchers begin with premises that guarantee that programs designed for the long haul – like environmental protection – are not as important as programs that look to the shorter term. When repeated without discounting (or with benefits assumed to occur when risks are reduced), these studies support many more environmental programs, and the cry of "statistical murder" rings hollow.

Citizens and Consumers – Reprise

The issue of discounting illustrates once again the failure of cost-benefit analysis to take into account the difference between citizens and consumers. Many people advocate discounting on the ground that it reflects people's preferences, as expressed in market decisions concerning risk. But again, this omits the possibility that people will have different preferences when they take on a different role. The future seems to matter much more to American citizens than to American consumers, even though they are of course the same people.

For example, Americans are notoriously bad at saving money on their own, apparently expressing a disinterest in the future. But Social Security is arguably the most popular entitlement program in the United States. The tension between Americans' personal saving habits and their enthusiasm for Social Security implies a sharp divergence between the temporal preferences of people as consumers and as citizens. Thus private preferences for current over future consumption should not be used to subvert public judgments that future harms are as important as immediate ones.

Exacerbating Inequality

The third fundamental defect of cost-benefit analysis is that it tends to ignore, and therefore to reinforce, patterns of economic and social inequality. Cost-benefit analysis consists of adding up all the costs of a policy, adding up all the benefits, and comparing the totals. Implicit in this innocuous-sounding procedure is the controversial assumption that it doesn't matter who gets the benefits and who pays the costs. Both benefits and costs are measured simply as dollar totals; those totals are silent on questions of equity and distribution of resources.

Yet in our society, concerns about equity frequently do and should enter into debates over public policy. There is an important difference between spending state tax revenues to improve the parks in rich communities, and spending the same revenues to clean up pollution in poor communities. The dollar value of these

two initiatives, measured using cost-benefit analysis, might be the same in both cases, but this does not mean that the two policies are equally urgent or desirable.

The problem of equity runs even deeper. Benefits are typically measured by willingness to pay for environmental improvement, and the rich are able and willing to pay for more than the poor. Imagine a cost-benefit analysis of siting an undesirable facility, such as a landfill or incinerator. Wealthy communities are willing to pay more for the benefit of not having the facility in their backyards; thus the net benefits to society as a whole will be maximized by putting the facility in a low-income area. (Note that wealthy communities do not actually have to pay for the benefit of avoiding the facility; the analysis depends only on the fact that they are *willing* to pay.)

This kind of logic was made (in)famous in a 1991 memo circulated by Lawrence Summers (former Secretary of the Treasury, now President of Harvard University) when he was the chief economist at the World Bank. Discussing the migration of "dirty industries" to developing countries, Summers' memo explained:

The measurements of the costs of health impairing pollution depend[] on the foregone earnings from increased morbidity and mortality. From this point of view a given amount of health impairing pollution should be done in the country with the lowest cost, which will be the country with the lowest wages. I think the economic logic behind dumping a load of toxic waste in the lowest wage country is impeccable and we should face up to that.[17]

After this memo became public, Brazil's then-Secretary of the Environment Jose Lutzenburger wrote to Summers:

Your reasoning is perfectly logical but totally insane… Your thoughts [provide] a concrete example of the unbelievable alienation, reductionist thinking, social ruthlessness and the arrogant ignorance of many conventional 'economists' concerning the nature of the world we live in.[18]

If decisions are based strictly on cost-benefit analysis and willingness to pay, most environmental burdens will end up being imposed on the countries, communities, and individuals with the least resources. This theoretical pattern bears an uncomfortably close resemblance to reality. Cost-benefit methods should not be blamed for existing patterns of environmental injustice; we suspect that pollution is typically dumped on the poor without waiting for formal analysis.

If decisions are based strictly on cost-benefit analysis and willingness to pay, most environmental burdens will end up being imposed on the countries, communities, and individuals with the least resources.

Still, cost-benefit analysis rationalizes and reinforces the problem, allowing environmental burdens to flow downhill along the income gradients of an unequal world. It is hard to see this as part of an economically optimal or politically objective method of decision-making.

In short, equity is an important criterion for evaluation of public policy, but it does not fit into the cost-benefit framework.

The same is true of questions of rights and morality, principles that are not reducible to monetary terms. Calculations that are acceptable, even common sense, for financial matters can prove absurd or objectionable when applied to moral issues, as shown by the following example.

A financial investment with benefits worth five times its costs would seem like an obviously attractive bargain. Compare this to one study's estimate that front airbags on the passenger side of automobiles may cause one death, usually of a child, for every five lives saved. If we really believed that lives – even statistical lives – were worth $6 million, or any other finite dollar amount, endorsing the airbags should be no more complicated than accepting the financial investment. However, many people do find the airbag tradeoff troubling or unacceptable, implying that there is a different, non-quantitative value of a life that is at stake here. If a public policy brought some people five dollars of benefits for every one dollar it cost to others, the winners could in theory compensate the losers. No such compensation is possible if winning and losing are measured in deaths rather than dollars.[19]

In comparing the deaths of adults prevented by airbags with the deaths of children caused by airbags, or in exploring countless other harms that might be mitigated through regulation, the real debate is not between rival cost-benefit analyses. Rather, it is between environmental advocates who frame the issue as a matter of rights and ethics, and others who see it as an acceptable area for economic calculation. That debate is inescapable, and is logically prior to the details of evaluating costs and benefits.

Less Objectivity and Transparency

A fourth fundamental flaw of cost-benefit analysis is that it is unable to deliver on the promise of more objective and more transparent decision-making. In fact, in most cases, the use of cost-benefit analysis is likely to deliver less objectivity and less transparency.

Because value-laden premises permeate cost-benefit analysis, the claim that cost-benefit analysis offers an "objective" way to make government decisions is simply bogus.

For the reasons we have discussed, there is nothing objective about the basic premises of cost-benefit analysis. Treating individuals solely as consumers, rather than as citizens with a sense of moral responsibility to the larger society, represents a distinct and highly contestable worldview. Likewise, the use of discounting reflects judgments about the nature of environmental risks and citizens' responsibilities toward future generations which are, at a minimum, debatable. Because value-laden premises permeate cost-benefit analysis, the claim that cost-benefit analysis offers an "objective" way to make government decisions is simply bogus.

Furthermore, as we have seen, cost-benefit analysis relies on a byzantine array of approximations, simplifications, and counterfactual hypotheses. Thus, the actual use of cost-benefit analysis inevitably involves countless judgment calls. People with strong, and clashing, partisan positions will naturally advocate that discretion in

the application of this methodology be exercised in favor of their positions, further undermining the claim that cost-benefit analysis is objective.

Perhaps the best way to illustrate how little economic analysis has to contribute, objectively, to the fundamental question of how clean and safe we want our environment to be is to refer again to the controversy over cost-benefit analysis of EPA's regulation of arsenic in drinking water. As legal scholar Cass Sunstein has recently argued, the available information on the benefits of arsenic reduction supports estimates of net benefits from regulation ranging from less than zero, up to $560 million or more. The number of deaths avoided annually by regulation is, according to Sunstein, between 0 and 112.[20] A procedure that allows such an enormous range of different evaluations of a single rule is certainly not the objective, transparent decision rule that its advocates have advertised.

These uncertainties arise both from the limited knowledge of the epidemiology and toxicology of exposure to arsenic, and from the controversial series of assumptions required for valuation and discounting of costs and (particularly) benefits. As Sunstein explains, a number of different positions, including most of those heard in the recent controversy over arsenic regulation, could be supported by one or another reading of the evidence.[21]

Some analysts might respond that this enormous range of outcomes is not possible if the proper economic assumptions are used; if, for example, human lives are valued at $6 million apiece and discounted at a 5 percent yearly rate (or, depending on the analyst, other favorite numbers). But these assumptions beg fundamental questions about ethics and equity, and one cannot decide whether to embrace them without thinking through the whole range of moral issues they raise. Yet once one has thought through these issues, there is no need then to collapse the complex moral inquiry into a series of numbers. Pricing the priceless merely translates our inquiry into a different, and foreign, language, one with a painfully impoverished vocabulary.

For many of the same reasons, cost-benefit analysis also generally fails to achieve the goal of transparency. Cost-benefit analysis is a complex, resource-intensive, and expert-driven process. It requires a great deal of time and effort to attempt to unpack even the simplest cost-benefit analysis. Few community groups, for example, have access to the kind of scientific and technical expertise that would allow them to evaluate whether, intentionally or unintentionally, the authors of a cost-benefit analysis have unfairly slighted the interests of the community or some of its members. Few members of the public can meaningfully participate in the debates about the use of particular regression analyses or discount rates which are central to the cost-benefit method.

The translation of lives, health, and nature into dollars also renders decision-making about the underlying social values less rather than more transparent. As we have discussed, all of the various steps required to reduce a human life to a dollar value are open to debate and subject to uncertainty. However, the specific dollar values kicked out by cost-benefit analysis tend to obscure these underlying issues rather than encourage full public debate about them.

5. Why It Doesn't Work: Practical Problems

The last section showed that there are deep, inherent problems with cost-benefit analysis. In practice, these problems only get worse; leading examples of cost-benefit analysis fall far short of the theoretical model. The existence of these practical problems further undercuts the utility and wisdom of using cost-benefit analysis to evaluate environmental policy.

The Limits of Quantification

Cost-benefit studies of regulations focus on quantified benefits of the proposed action and generally ignore other, non-quantified health and environmental benefits. This raises a serious problem because many benefits of environmental programs - including the prevention of many nonfatal diseases and harms to the ecosystem - either have not been quantified or are not capable of being quantified at this time. Indeed, for many environmental regulations, the only benefit that can be quantified is the prevention of cancer deaths. On the other hand, one can virtually always come up with *some* number for the total costs of an environmental regulation. Thus, in practice, cost-benefit analysis tends to skew decision-making against protecting public health and the environment.

For example, regulation of workers' exposure to formaldehyde is often presented as the extreme of inefficiency, supposedly costing $72 billion per life saved. This figure is based on the finding that the regulation prevents cancers, which occur only in minute numbers but which have been thoroughly evaluated in numerical terms. But the formaldehyde regulation also prevents many painful but nonfatal illnesses, excluded from the $72 billion figure. If described solely as a means of reducing cancer, the regulation would indeed be very expensive. But if described as a means of reducing cancer *and* other diseases, the regulation makes a good deal of sense. Workplace regulation of formaldehyde is not a bad answer, but it does happen to be an answer to a different question.

The formaldehyde case is by no means unique: often the only regulatory benefit that can be quantified is the prevention of cancer. Yet cancer has a latency period of between 5 and 40 years. When discounted at 5 percent, a cancer death 40 years from now has a "present value" of only one-seventh of a death today. Thus, one of the benefits that can most often be quantified – allowing it to be folded into cost-benefit analysis – is also one that is heavily discounted, making the benefits of preventive regulation seem trivial.

Ignoring What Cannot Be Counted

A related practical problem is that, even when the existence of unquantified or unquantifiable benefits is recognized, their importance is frequently ignored. Many advocates of cost-benefit analysis concede that the decision-making process must make some room for non-quantitative

considerations. Some environmental benefits have never been subjected to rigorous economic evaluation. Other important considerations in environmental protection - such as the fairness of the distribution of environmental risks - cannot be quantified and priced. Even if these factors cannot be quantified, they are surely relevant.

In practice, however, unquantified values are often forgotten, or even denigrated, once all the numbers have been crunched. No matter how many times the Environmental Protection Agency, for example, says that one of its rules will produce many benefits – like the prevention of illness or the protection of ecosystems – that cannot be quantified, the non-quantitative aspects of its analyses are almost invariably ignored in public discussions of its policies.

When the Clinton Administration's EPA proposed, for example, strengthening the standard for arsenic in drinking water, it cited many human illnesses that would be prevented by the new standard but that could not be expressed in numerical terms. Subsequent public discussion of EPA's cost-benefit analysis of this standard, however, inevitably referred only to EPA's numerical analysis and forgot about the cases of avoided illness that could not be quantified.

Overstated Costs

There is also a tendency, as a matter of practice, to overestimate the costs of regulations in advance of their implementation. This happens in part because regulations often encourage new technologies and more efficient ways of doing business; these innovations reduce the cost of compliance. It is also important to keep in mind, when reviewing cost estimates, that they are usually provided by the regulated industries themselves, which have an obvious incentive to offer high estimates of costs as a way of warding off new regulatory requirements.

One study found that costs estimated in advance of regulation were more than twice actual costs in 11 out of 12 cases.[22] Another study found that advance cost estimates were more than 25 percent higher than actual costs for 14 out of 28 regulations; advance estimates were more than 25 percent too low in only 3 of the 28 cases.[23] Before the 1990 Clean Air Act Amendments took effect, industry anticipated that the cost of sulfur reduction under the amendments would be $1,500 per ton. In 2000, the actual cost was under $150 per ton.

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Of course, not all cost-benefit analyses overstate the actual costs of regulation. But given the technology-forcing character of environmental regulations, it is not surprising to find a marked propensity to overestimate the costs of such rules. In a related vein, many companies have begun to discover that environmental

protection can actually be *good* for business in some respects. Increased energy efficiency, profitable products made from waste, and decreased use of raw materials are just a few of the cost-saving or even profit-making results of turning more corporate attention to environmentally protective business practices.[24] Cost-benefit analyses typically do not take such money-saving possibilities into account in evaluating the costs of regulation.

Should We Laugh – or Cry?

Each of these problems with cost-benefit analysis as practiced – the inability to quantify all relevant values, the tendency to ignore non-quantified benefits, and the overstatement of compliance costs – describes, in a way, the trees rather than the forest of cost-benefit analysis. It is also worthwhile to look at some of the products of this method and ask, more generally, does the method make sense?

Consider the following examples, which we are not making up. They are not the work of a lunatic fringe, but on the contrary, they reflect the work products of some of the most influential and reputable of today's cost-benefit practitioners. We are not sure whether to laugh or cry; we find it impossible to treat these studies as serious contributions to a rational discussion.

Several years ago, states were in the middle of their litigation against tobacco companies, seeking to recoup the medical expenditures they had incurred as a result of smoking. At that time, W. Kip Viscusi – a professor of law and economics at Harvard and the primary source of the current $6.3 million estimate for the value of a statistical life – undertook research concluding that states, in fact, *saved* money as the result of smoking by their citizens. Why? Because they died early! They thus saved their states the trouble and expense of providing nursing home care and other services associated with an aging population.

Arthur D. Little found that smoking was a financial boon for the Czech government – in part because it caused citizens to die earlier and thus reduced government expenditure on pensions, housing, and health care.

Viscusi didn't stop there. So great, under Viscusi's assumptions, were the financial benefits to the states of their citizens' premature deaths that, he suggested, "*cigarette smoking should be subsidized rather than taxed*."[25]

Amazingly, this cynical conclusion has not been swept into the dustbin where it belongs, but instead has recently been revived: the tobacco company Philip Morris commissioned the well-known consulting group Arthur D. Little to examine the financial benefits, to the Czech Republic, of smoking among Czech citizens. Arthur D. Little found that smoking was a financial boon for the government – in part because it caused citizens to die earlier and thus reduced government expenditure on pensions, housing, and health care.[26] This conclusion relies, so far as we can determine, on perfectly conventional cost-benefit analysis.

There is more. In recent years, much has been learned about the special risks children face due to pesticides in their food, contaminants in their drinking water, ozone in the air, and so on. As a result of the

increasing prominence of cost-benefit analysis, there is now a budding industry in valuing children's health. Its products are often bizarre.

Take the problem of lead poisoning in children. One of the most serious and disturbing effects of lead is the neurological damage it can cause in young children, including permanently lowered mental ability. Putting a dollar value on the (avoidable, environmentally caused) retardation of children is a daunting task, but economic analysts have not been daunted.

Randall Lutter, a frequent regulatory critic and a scholar at the AEI-Brookings Joint Center for Regulatory Studies, argues that the way to value the damage lead causes in children is to look at how much parents of affected children spend on chelation therapy, a chemical treatment that is supposed to cause excretion of lead from the body. Parental spending on chelation supports an estimated valuation of only about $1,500 per IQ point lost due to lead poisoning. Previous economic analyses by EPA, based on the children's loss of expected future earnings, have estimated the value to be much higher – up to $9,000 per IQ point. Based on his lower figure, Lutter claims to have discovered that too much effort is going into controlling lead:

Hazard standards that protect children far more than their parents think is appropriate may make little sense. The agencies should consider relaxing their lead standards.[27]

In fact, Lutter presents no evidence about what parents think, only about what they spend on one rare variety of private medical treatments (which, as it turns out, has not been proven medically effective for chronic, low-level lead poisoning).

Why should environmental standards be based on what individuals are now spending on desperate personal efforts to overcome social problems?

For sheer analytical audacity, Lutter's study faces some stiff competition from another study concerning children – this one concerning the value, not of children's health, but of their lives. In this second study, researchers examined mothers' car-seat fastening practices.[28] They calculated the difference between the time required to fasten the seats correctly and the time mothers actually spent fastening their children into their seats. Then they assigned a monetary value to this interval of time based on the mothers' hourly wage rate (or, in the case of non-working moms, based on a guess at the wages they might have earned). When mothers saved time – and, by hypothesis, money – by fastening their children's car seats incorrectly, they were, according to the researchers, implicitly placing a finite monetary value on the life-threatening risks to their children posed by car accidents.

Building on this calculation, the researchers were able to answer the vexing question of how much a statistical child's life is worth to its mother. (As the mother of a statistical child, she is naturally adept at complex calculations comparing the value of saving a few seconds versus the slightly increased risk to her child!) The answer parallels Lutter's finding that we are valuing our children too highly: in car-seat-land, a child's life is worth only $500,000.

6. The Many Alternatives to Cost-Benefit Analysis

A common response to the criticisms of cost-benefit analysis is a simple question: what's the alternative? The implication is that despite its flaws, cost-benefit analysis is really the only tool we have for figuring out how much environmental protection to provide.

This is just not true. For thirty years, the federal government has been protecting human health and the environment without relying on cost-benefit analysis. The menu of regulatory options that has emerged from this experience is large and varied. Choosing among these possibilities depends on a variety of case-specific circumstances, such as the nature of the pollution involved, the degree of scientific knowledge about it, and the conditions under which people are exposed to it. As the following brief sketch of alternatives reveals, cost-benefit analysis - a "one-size-fits-all" approach to regulation - just can't be squared with the multiplicity of circumstances surrounding different environmental problems.

For the most part, environmental programs rely on a form of "technology-based" regulation, the essence of which is to require the best available methods for controlling pollution. This avoids the massive research effort needed to quantify and monetize the precise harms caused by specific amounts of pollution, which is required by cost-benefit analysis. In contrast, the technology-based approach allows regulators to proceed directly to controlling emissions. Simply put, the idea is that we should do the best we can to mitigate pollution we believe to be harmful.

Over the years, EPA has learned that flexibility is a good idea when it comes to technology-based regulation, and thus has tended to avoid specifying particular technologies or processes for use by regulated firms; instead, the agency has increasingly relied on "performance-based" regulation, which tells firms to clean up to a certain, specified extent, but doesn't tell them precisely how to do it. Technology-based regulation generally takes costs into account in determining the required level of pollution control, but does not demand the kind of precisely quantified and monetized balancing process that is needed for cost-benefit analysis.

Another regulatory strategy that has gained a large following in recent years is the use of "pollution trading," as in the sulfur dioxide emissions trading program created for power plants under the 1990 Clean Air Act Amendments. That program grants firms a limited number of permits for pollution, but allows them to buy permits from other firms. Thus firms with high pollution control costs can save money by buying permits, while those with low control costs can save money by controlling emissions and selling their permits.

The fixed supply of permits, created by law, sets the cap on total emissions; the trading process allows industry to decide where and how it is most economical to reduce emissions to fit under the cap. Trading programs have become an important part of the federal program for controlling pollution. These programs,

too, have not used cost-benefit analysis in their implementation. Congress, the EPA, or other officials set the emissions cap, and the market does the rest.

It is theoretically possible that cost-benefit analysis could be used to choose the overall limit on pollution that guides both performance-based and market-based regulatory programs. However, this has not been standard practice in the past; the limit on sulfur emissions in the 1990 Clean Air Act Amendments, for example, was set by a process of political compromise. Given the problems with cost-benefit analysis, political compromise cannot be viewed as an inferior way to set a cap on emissions. Many regulatory programs have been a terrific success without using cost-benefit analysis to set pollution limits.

One last example (a desire for reasonable brevity prevents us from listing more) is informational regulation, which requires disclosures to the public and/or to consumers about risks they face from exposures to chemicals. These "right-to-know" regimes allow citizens and consumers not only to know about the risks they face, but also empower them to do something about those risks. The Toxic Release Inventory created by the Emergency Planning and Community Right-to-Know Act, the product warning labels required by California's "Proposition 65," and the consumer notices now required regarding drinking water that contains hazardous chemicals, are all variants of this type of information-based regulation. Not one of these popular and effective programs relies on cost-benefit analysis.

The arguments for flexible technology-based regulation and for incentive-based programs like pollution trading and disclosure requirements are sometimes confused with the arguments for cost-benefit analysis. But both technology-based and incentive-based regulation take their *goals* from elected representatives rather than from economic analysts, even though the *means* adopted by these regulatory strategies are strongly influenced by attention to costs. The current style of cost-benefit analysis, however, purports to set the *ends*, not just the means, of environmental policy, and that is where its aspirations amount to arrogance.

Economic analysis has had its successes and made its contributions; it has taught us a great deal over the years about how we can most efficiently and cheaply reach a given environmental goal. It has taught us relatively little, however, about what our environmental goals should be. Indeed, while economists have spent three decades wrangling about how much a human life, or a bald eagle, or a beautiful stretch of river, is worth in dollars, ecologists, engineers, and other specialists have gone about the business of saving lives and eagles and rivers, without waiting for formal, quantitative analysis proving that saving these things is worthwhile.

7. Conclusion

While economists have spent three decades wrangling about how much a human life, or a bald eagle, or a beautiful stretch of river, is worth in dollars, ecologists, engineers, and other specialists have gone about the business of saving lives and eagles and rivers, without waiting for formal, quantitative analysis proving that saving these things is worthwhile.

Two features of cost-benefit analysis distinguish it from other approaches to evaluating the advantages and disadvantages of environmentally protective regulations: the translation of lives, health, and the natural environment into monetary terms, and the discounting of harms to human health and the environment that are expected to occur in the future. These features of cost-benefit analysis make it a terrible way to make decisions about environmental protection, for both intrinsic and practical reasons.

Nor is it useful to keep cost-benefit analysis around as a kind of regulatory tag-along, providing information that regulators may find "interesting" even if not decisive. Cost-benefit analysis is exceedingly time- and resource-intensive, and its flaws are so deep and so large that this time and these resources are wasted on it. Moreover, given the intrinsic conflict between cost-benefit analysis and the principles of fairness that animate, or should animate, our national policy toward protecting people from being hurt by other people, the results of cost-benefit analysis cannot simply be "given some weight" along with other factors without undermining the fundamental equality of all citizens – rich and poor, young and old, healthy and sick.

Cost-benefit analysis cannot overcome its fatal flaw: it is completely reliant on the impossible attempt to price the priceless values of life, health, nature, and the future. Better public policy decisions can be made without cost-benefit analysis, by combining the successes of traditional regulation with the best of the innovative and flexible approaches that have gained ground in recent years.

Footnotes

1. John B. Loomis and Douglas S. White, "Economic Benefits of Rare and Endangered Species: Summary and Meta-analysis," 18 *Ecological Economics* 197, 199 Table 1(1996) (converted to year 2000 dollars using the consumer price index).

2. The original calculation, based on research by W. Kip Viscusi, can be found in EPA, *The Benefits and Costs of the Clean Air Act, 1970 to 1990*, Appendix I (1997). For an example of a subsequent analysis citing the Clean Air Act analysis and adjusting only for inflation, see EPA, *Arsenic in Drinking Water Rule: Economic Analysis*, EPA Document 815-R-00-026, 5-23 (December 2000). The arsenic study used $6.1 million in 1999 dollars, which is equivalent to $6.3 million in 2000 dollars.

3. The examples in the text are rounded off to the nearest dollar.

4. See, for example, John F. Morrall III, "A Review of the Record," *Regulation*, Nov./Dec. 1986, at 25, 30 Table 4, relied upon in, among others, Stephen Breyer, *Breaking the Vicious Circle: Toward Effective Risk Regulation* 24-27 (1993); W. Kip Viscusi, *Fatal Tradeoffs: Public and Private Responsibilities for Risk* 264 (1992); OMB, Regulatory Program of the United States Government, April 1, 1991-March 31, 1992, at 12 (1991) (reproducing version of Morrall's table); Kenneth J. Arrow et al., "Is There a Role for Benefit-Cost Analysis in Environmental, Health, and Safety Regulation?," 272 *Science* 221 (April 1996).

5. *Risk Assessment and Cost-benefit Analysis: Hearings Before the Comm. on Science, United States House of Representatives*, 104th Cong., 1st Sess. 1124 (1995) (written testimony of John D. Graham).

6. John Broome, "Trying to Value a Life," 9 *J. Pub. Econ.* 91, 92 (1978).

7. E.g., Elizabeth Anderson, *Value in Ethics and Economics* (Harvard University Press, 1993).

8. For further elaboration, see Lisa Heinzerling, "The Rights of Statistical People," 24 *Harv. Envtl. L. Rev.* 189, 203-06 (2000).

9. Economic Analysis of Federal Regulations Under Executive Order 12, 866, at pt. III.B.5(a) (Report of Interagency Group Chaired by a Member of the Council of Economic Advisors) (Jan. 11, 1996).

10. Lisa Heinzerling, "Discounting Our Future," 34 *Land & Water L. Rev.* 39, 71 (1999); Lisa Heinzerling, "Discounting Life," 108 *Yale L.J.* 1911, 1913 (1999).

11. Mark Sagoff, *The Economy of the Earth: Philosophy, Law, and the Environment* 50-52 (Cambridge University Press, 1988).

12. Amartya Sen, "The Discipline of Cost-Benefit Analysis," 29 *Journal of Legal Studies* 931-952 (June 2000).

13. Henry S. Richardson, "The Stupidity of the Cost-Benefit Standard," 29 *Journal of Legal Studies* 971-1003 (2000). On the importance of allowing preference change in response to deliberation, see also Cass R. Sunstein, "Preferences and Politics," 1 *Philosophy and Public Affairs* 20 (1991).

14. 42 U.S.C. 4331(b)(1).

15. William J. Baumol, "On the Social Rate of Discount," 58 *Am. Econ. Rev.* 788, 801 (1968).

16. This discussion is based on Lisa Heinzerling, "Regulatory Costs of Mythic Proportions," 107 *Yale L.J.* 1981 (1998), and on Lisa Heinzerling's written testimony on John Graham's nomination to be head of OIRA: *Nomination of John D. Graham as Adm'r of the Office of Info. and Regulatory Affairs at the Office of Mgmt. and Budget: Hearing Before the Comm. on Governmental Affairs,* U.S. Senate 107th Cong. 1st Sess. (2001).

17. Available at http://www.whirledbank.org/ourwords/summers.html.

18. Available at http://www.whirledbank.org/ourwords/summers.html.

19. Fred Kuchler and Elise Golan, "Assigning Values to Life: Comparing Methods for Valuing Health Risks," Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report No. 784, 52 (1999).

20. Cass R. Sunstein, "The Arithmetic of Arsenic," AEI-Brookings Joint Center for Regulatory Studies, Working Paper 01-10, (August 2001).

21. Given this enormous range of uncertainty, it is hard to understand Sunstein's belief (expressed in the same working paper) that cost-benefit analysis is still useful for screening regulatory options. This could only be true if a significant number of serious proposals had costs that were many orders of magnitude greater than their benefits. As we have discussed, this is a widely held, but empirically false, view of environmental regulation.

22. Eban Goodstein, "Polluted Data," *American Prospect* 8, November-December 1997 (http://www.prospect.org); Hart Hodges, "Falling Prices: Cost of Complying With Environmental Regulations Almost Always Less Than Advertised," Economic Policy Institute, 1997 (http://epinet.org). Both publications report on the same study.

23. Winston Harrington, Richard D. Morgenstern, and Peter Nelson, "On the Accuracy of Regulatory Cost Estimates," 19 *Journal of Policy Analysis and Management* 297-322 (Spring 2000).

24. For a recent report on this phenomenon, see Claudia H. Deutsch, "Together at Last: Cutting Pollution and Making Money," *The New York Times* (Sept. 9, 2001).

25. W. Kip Viscusi, "Cigarette Taxation and the Social Consequences of Smoking," Working Paper No. 4891, 33 (National Bureau of Economic Research October 1994).

26. "Public Finance Balance of Smoking in the Czech Republic," available at http://europe.com/2001/BUSINESS/07/16/czech.morris./index.html.

27. Randall Lutter, "Valuing Children's Health: A Reassessment of the Benefits of Lower Lead Levels," AEI-Brookings Joint Center for Regulatory Studies Working Paper 00-02, at 3 (March 2000).

28. Paul S. Carlin and Robert Sandy, "Estimating the Implicit Value of a Young Child's Life," 58 *So. Econ. J.* 186 (1991).