

THE DISCIPLINE OF IMPERFECT BEAN COUNTING

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INTRODUCTION

Despite decades of debate about the use of cost-benefit analysis (CBA) to inform the design of environmental policy and regulations, the discussion seems only to grow more heated. Environmental activists fear and loathe CBA. They fear it when they see it being used by the regulated community as the “paralysis by analysis” strategy for endless delay of regulations that “obviously” would serve the public interest. They loathe it when they see it being used by narrow minded technocrats as a single criterion decision rule to force policy decisions to be made on the basis of efficiency considerations alone.

Some economists, weary from the battle, fall into the trap of defending CBA by arguing that with improved measurement methods, and a suitable set of welfare weights, it could be used to aggregate all social concerns relevant to a proposed policy and serve as a simple decision making method. These misguided souls do not credit to the grand discipline of economics. Instead, they lend credibility to the professional generalists who argue that those of us with specialized degrees have lost the breadth of perspective needed in the public policy realm. Economists need to admit the limits of CBA while encouraging its use as a framework for good decision making.

The ideas offered here are simple and not original, but might be useful to keep in mind when we in government find ourselves arguing about the proper role of CBA. There are at least three general limitations to the use of CBA. First, CBA is designed to measure only the efficiency effects of policies. Therefore it cannot be used as the sole criterion for making decisions. Considerations of equity, institutional and legal feasibility, and many other concerns must be factored into all but the most trivial decisions. Second, we do not now, nor will we have in the foreseeable future, credible methods for measuring, in dollar terms, all the efficiency effects of most public policies. Third, some of the basic assumptions of the economic model regarding the substitutability of goods, the nature of production and cost functions and the reversibility of decisions do not always

hold in the context of environmental damages or services. As a result, even the efficiency effects cannot be completely accounted for or aggregated together with costs into a comprehensive net benefit measure.

But these limitations do not imply that CBA has no role in the regulatory process. I support the view that CBA is a useful strategy for collecting and organizing information. It helps the analyst to ensure that all the efficiency effects of proposed policies are considered without double counting. In addition, it is a mechanism that imposes discipline on the decision making process. Without the organization and discipline provided by CBA, the policy process would, even more than usual, be driven by personal as opposed to public objectives, be subject to the fads, phobias and fears of the day, and draw upon subjective opinions instead of objective analyses. The following sections provide a few details and illustrations of these assertions drawn from my peripatetic observation of the environmental policymaking process.

SIX REASONS TO HATE COST BENEFIT ANALYSIS

Reason 1: CBA Represents an Anthropocentric Value System

Many ecologists and environmental activists correctly point out that the word “value” as used in economics refers only to the utility gained by human beings from the consumption of goods and services. In some models, people are thought to gain utility from the knowledge that others are able to consume (altruistic value) or from the knowledge that a resource exists (existence value). In any case value is understood as value to humans. As a result, it is argued that cost benefit analysis ignores the intrinsic value of ecosystem structures or functions.

There are at least two possible interpretations of the concept of an intrinsic value of nature. The first is grounded in the ethical and legal idea that non-human species possess property rights or some more generally defined rights to life, liberty and the pursuit of happiness. Following this line of reasoning we must consider the welfare of all species when debating policies affecting

human behavior. The second interpretation of the phrase “intrinsic value of nature” involves recognition of the role that nature plays in supporting human life. Under this interpretation, we recognize that ecosystem structures and functions provide services that are useful to humans even though they may not be consumed directly by humans. Such services are similar to factor inputs in traditional economic models. Purification of water, cycling of nutrients, fertilization of soil and similar functions eventually lead to goods and services that are consumed by humans and so should be valued in economic models. The first interpretation is useless in the sense that it leads to no practical advice for human behavior. The second interpretation is very useful and I argue that it is already included within the framework of cost-benefit analysis and so does not indicate an omission of important values.

With respect to the first interpretation, suppose we accept the idea that trees have rights that are the source of their intrinsic value. What should we do to ensure that these rights are protected? First, we would need to know what the trees prefer. Lacking communication with them, we could imagine what they would want if they were selfish. Presumably they would prefer that people not cut them down, or even trim one branch. Flowers would prefer not to be cut. Wheat would prefer not to be harvested. Expanding this thought experiment to include all other non-human species would no doubt imply that the rest of the world would be better off without any humans in it, not one. After all as the ultimate predator, we are probably not very important in the food webs supporting any species. And considering our history of abuse and destruction of other species, I doubt that we could expect much consideration from them based on an altruistic motive.

Moreover, if trees have rights so do gypsy moths. And how then do we reconcile the caterpillar’s right to dine with the tree’s right to be left unmolested? Even with a vast knowledge of ecology, economics and ethics a person would be unprepared to arbitrate this dispute. We humans would probably not even be able to sell our services as consultants or mediators to other species. We are useless to them. A democratic process, which included universal species suffrage, would lead inexorably to a vote in favor of the annihilation of the human race.

The second interpretation, that nature is the basis of human life, is the only useful way to talk about intrinsic value. Clearly the cost benefit framework includes and requires consideration of this definition of intrinsic value. When evaluating policies or projects that affect ecosystem form, structure or function, it is absolutely essential that we include the value of nature’s production machinery.

No economist would argue that automobiles have value because consumers demand them but that computer controlled welding machines do not have value. The factor inputs derive their value from the product they help produce and although some humans may not realize the relationship between the factors and the final products, the factors still have value.

Although there should not be many disputes about the theoretical correctness of including ecosystem values in cost benefit analysis, there remains the practical difficulty of estimating those values. I think that viewing nature as a production process is an appropriate framework for valuing its components. Recent work conducted within the field of ecological economics has developed the concept of natural capital. Although some of the valuation attempts have been fairly crude, they have tried to capture the spirit of measuring the relation between ecosystem function on the one hand and goods and services directly useful to humans on the other. In my opinion, this approach has more potential than any attempt to capture the value of nature through inquiries about existence value.

Reason 2: A Digression on Contingent Valuation

A potentially important criticism of CBA is that, in a desperate attempt to estimate dollar denominated values for the environment, it encourages use of inappropriate valuation methods. In particular, there is reason to be wary of the increasing use of the contingent valuation method to measure the value of the ecosystem or its various components. The primary argument here is that people may be able to imagine market-like conditions for goods and services that they consume directly and be able to reveal a willingness to pay that reflects closely the value that would be revealed in actual markets. But most parts of the ecosystem are not consumed directly by humans. Therefore I suspect that most people lack sufficient information to allow them to realize the importance and value of ecosystem structures.

This problem is closely related to the points made in the preceding section. Much of the structures and functions of nature are best described in economic terms as factor inputs rather than final consumption goods or services. So as an analogy, we might ask how values are derived for manufactured factor inputs. We all understand the attributes and utility associated with food, clothing and shelter. In contrast, very few people are familiar with factor inputs such as welding machines, tractors and pumps. In the case of manufactured capital, markets exist; but specialists inhabit them.

Engineers of various types are the designers and users of manufactured capital and they are the specialists who know about production capacity, quality control and substitute production strategies. When they interact in market institutions, information is exchanged and meaningful prices emerge from the process. If we wanted to know something about the value of a computer controlled spot welding machine, but could not observe prices directly, we might get a reasonable estimate by asking the appropriate type of engineer. But I would not be comfortable with an estimate of the value of the same machine elicited from a randomly selected citizen.

Suppose we carry this analogy over to the case of natural capital. The components of nature are like factor inputs to a production process. In some cases the factor inputs are not far removed from the final consumption goods they produce and in other cases there is a long and complicated chain of events separating the two. For example, birds and bees provide pollination services that contribute to the production of commercial food crops. This represents a fairly close and immediate production relationship. In this case, agricultural experts might be able to derive the value of the factors from the value of the products and from the cost of artificial pollination services. But in other cases, we have little or no market data to work with and a complicated relationship between the factors and the products. Humans don't consume the saline content of seawater directly. But salt concentrations influence ocean currents which moderate regional temperature and weather patterns that underlie agricultural productivity. In this case, there are no markets for several stages of related factor inputs and complicated physical processes linking them to the final consumption goods. Finally there are the most difficult cases where there are no markets for either factors or final goods.

In each of these cases, we might ask the ecologists to cooperate with production specialists to estimate values for natural factor inputs. In the simpler cases there has been some success. The ecologists, however are neither the designers of nature nor do they fully understand its operations. As a result, they are hesitant to say much about the relative value of individual components of any ecosystem. There is so much complexity, such as nonlinear relationships and long, variable lags between action and result, that ecologists generally limit themselves to statements of caution rather than statements of value. And in the more difficult and more common case where neither product nor factor markets exist, the valuation task is hopeless even for the expert.

So if we cannot turn to the specialists to assess the value of nature, responses to survey questions directed to the general public are bound to be inaccurate. For a number of years, I have argued that the contingent valuation method may provide credible and useful information about willingness to pay for services that are consumed directly by people. Days at the beach, an afternoon fly-fishing or even a beautiful vista are all familiar enough so that people can reasonably assess their value and state a credible willingness to pay. We cannot rely on this technique to value the large part of nature that is in fact more like the factory than the consumer good. The ecologists and certainly the general population simply do not have the requisite information to make such an assessment. Some advocates of CVM have argued that we need only convey sufficient information to respondents to allow them to form credible values in their minds. I don't think that sufficient information is available and I don't think we could convey it to respondents without essentially telling them what response we wanted. Moreover I don't think that ecosystem values can be fully reflected in responses to questions about existence value, because respondents will not be aware of all the ways that nature produces goods and services for them. Hence existence values, if correctly revealed, will always understate the full value of nature including its role as natural capital. Even though CVM seems to be "the only method available", it still should not be used for ecosystem valuation.

As a solution, those cells in the cost-benefit table that represent ecosystem values will often contain only physical quantities or descriptions of the functions and interconnections of natural capital in its role as a collection of factor inputs. For analyses of long-term events, we will have to make do with descriptive scenarios of how nature might react under different courses of human action. Let the ecologists provide their best descriptive analysis and quit demanding dollar values from them unless they can identify a clear production linkage to the final consumption unit.

Reason 3: CBA Obscures the Complexity of Environmental Problems

Activists and generalists love to characterize economists as narrow-minded technocrats incapable of appreciating the complexity of public policy issues. We philistines are said to think only in terms of numbers and to ignore all that cannot be quantified. Once during my teaching career, I overheard an English professor in class exhorting his students to pay attention to the beauty of objects. Pointing to a wooden chair, he proclaimed that the chair had been hand made and possessed a form and

style that might only be expressed with a poem. An economist, he scornfully noted, would only count the chair along with all others and sum the numbers as a measure of the value of production, brutishly ignoring the true value of the object. Now at the EPA, I frequently find myself similarly reviled. "Nature is God's realm and cannot be valued." "Nature is priceless and must be protected from all abuse." "For the right price, I suppose you would poison your own children." "It is not a matter of money, it is an issue of right and wrong." No wonder they call it the dismal science.

When besieged by such criticisms the good economist will begin chanting the mantra: "cost-benefit analysis is not a decision rule, efficiency is not the sole criterion for public policy decisions, non-monetary information is important too". Recognizing that decisions are complex, that uncertainty is great and that multiple objectives cannot always be aggregated into one index does not however mean that policy makers should have no framework for considering relevant information. In fact, the existence of multiple objectives and complexity is exactly the reason why decisions should be made within a well-defined and transparent organizing framework.

In the absence of such a framework, there are two possible undesirable outcomes. One possibility is that well intentioned but overwhelmed risk managers may become so confused by the wealth of information and tradeoffs that they make a bad decision unwittingly. In a biography of Richard Feynman, there is a description of how the great physicist solved problems: First he writes down the problem. Then he thinks for a long time. Then he writes down the solution. That strategy may have been appropriate for Feynman, but there are not very many people who I would trust to make decisions in this manner.

The second possibility, which no doubt happens with extreme rarity in government, is that unscrupulous individuals use the situation of complexity to hide their actual motives while purposely serving private rather than public interests. In an ideal world where government and stakeholders are objective, honest, brave and motivated only by a desire to improve public welfare, we might be confident that unstructured discussion would lead to the best public policy. But in the world as it is we should admit the possible existence of alternative motivations. The worlds of bureaucracy and politics are inhabited by a strange collection of species: the green winged vote buyer, the crested empire builder, the red breasted favor trader and of course the silver throated righteous preacher. For all these birds, the discipline conveyed by cost-benefit analysis can help to ensure that the criteria for decisions is made clear, the decision

process is transparent, the information basis is publicly available for review and that logic is the driver of the process.

Reason 4: CBA Assumes Convexity, Substitutability and Reversibility

It is true that most economic models are built from production and consumption functions characterized by smooth continuous shapes and representing exchange possibilities among a multitude of substitute goods and factors of production. Moreover, the values inferred from these models represent substitution possibilities at the margin of some particular allocation. Under these conditions, economists expect that growing scarcity will be foreshadowed by rising prices, which in turn cause substitutions away from the relatively scarce factors of production or consumption goods. Price signals inducing adaptive behavior is an elegant benefit of a market system.

In contrast, physical and biological systems do not always behave in such a docile fashion. Ecosystems may show little stress until certain equilibrium conditions are violated and then the system may collapse suddenly and irreversibly. Manufactured capital may serve as a substitute for natural capital only over a limited range. In teaching economics 101, we used to make jokes about producing the world's food supply in a flowerpot. A similar abuse of clear thinking that has come into vogue recently is that "knowledge has become a more important factor of production than either labor or capital". Knowledge has always been recognized as the elixir that transforms factors into products; but no one should imply that thought alone, or even with just a pinch of Minnesota soil, can produce a bushel of wheat. Similarly no economist is suggesting that computers can regulate the nitrogen cycle, while pumps irrigate the Amazon jungle.

We always need to keep in mind that price information and estimated values reflect marginal changes in the system under study. When policy analysts are studying the effects of a large project or a long time frame chain of events, then marginal values are not sufficient guides for decisions. However there is nothing inherent in CBA that requires use of marginal analysis alone. There is every reason in these cases to incorporate in CBA scenarios of the future, forecasts based on econometrics or on dynamic simulation models and other techniques to capture the important non-marginal effects that might drive the decision. Once again, just because we can't predict future conditions as an incremental change from the present, does not give us justification to abandon reason, discipline and clarity in the decision process.

Reason 5: CBA De-emphasizes the Importance of Non-Monetary Information

It is human nature to wish for simple rules to guide behavior and decision making. Thinking is hard work and it is very difficult to search for an optimal solution to a complicated problem, especially one involving multiple objectives, outcomes and constraints. So there is always the temptation to seize upon cost benefit analysis as a decision rule. If all costs and benefits could be expressed in monetary terms, aggregated and reduced to present values, the lives of the managers at EPA would be so much more pleasant.

But of course not all results of a decision can be valued in dollar terms. Further, in the case of environmental and health protection programs, it is far easier to estimate the dollar value of costs than benefits. This gives rise to the fear that lazy managers will quietly hope that at least the most important results are represented by dollars and that the decision can still be made by reference to net present value.

There is a clear potential bias in such an approach when only a small part of total suspected or known benefits can be valued in dollar terms. Yet again, I don't think that the appropriate response to this problem is to throw out the whole idea of cost benefit analysis. Recall the mantra, "cost-benefit analysis is not a decision rule, efficiency is not the sole criterion for public policy decisions, non-monetary information is important too". In practice, decision makers are probably more likely to make errors by focusing too much on one aspect of a problem that is of particular interest to them or their constituency. Alternatively they may be confused by the multiplicity of objectives with little structure for setting priorities. Careful use of CBA can help put order and transparency in a potentially chaotic decision process even when some results are not quantified or expressed in monetary terms.

Reason 6: Discounting Penalizes Future Generations

This argument is typically raised in the context of analyzing long-term effects, whether environmental or other. If damages from some present consumption activity extend far into the future, discounting will result in a relatively low present value of these damages. In fact even with fairly low discount rates values occurring more than thirty years in the future result in near zero present values. In this case, discounting leads us to de-emphasize the effects placed on future populations. This argument however is not as simple as it appears.

Since discounting is designed in part to reflect the time value of money, we might argue that without discounting we would be likely to leave a less valuable world to our successors. Without discounting we would no doubt promote some projects that have a lower present value than some alternatives that might have been funded. As a result, the set of resources and infrastructure that we pass on through time would be less valuable than it could have been; and the consumption stream available to future populations would be lower than it could have been. In this sense, the process of discounting in public policy analysis mimics the decision process used in the private sector and leads to the most profitable set of actions with maximum returns earned over time. So we should discount in order to protect the interests of the future.

Yet there may be certain types of decisions with effects in the distant future where discounting to present value should not be attempted. There are two reasons that might argue against discounting. The first is the inability of future populations to participate in financial markets and help determine the time value of money. The second is the great uncertainty associated with forecasts of economic and social conditions in the far future.

The first argument is basically an ethical one. Discount rates used in policy analysis are derived from observations of market rates of interest or from observations of the behavior of consumers that reveals their time preference for consumption. Market rates and consumer behavior reflect the preferences of the population of people alive at the present. Unborn future generations have no opportunity to influence markets through their saving and consumption behavior and so have no vote in the determination of discount rates. Therefore it is unfair to impose the current generation's time preferences on effects that will be felt in the future.

An economic argument can be made, along the lines noted above, that succeeding generations will be made better off if the current generation makes efficient investment decisions today. But from an ethical standpoint, we cannot deny that the future population cannot be consulted and so we cannot be sure what tradeoffs they might want, especially between manufactured capital and goods versus natural capital, goods and services.

The second argument hinges on our inability to predict the future. Models of economic output, investment and growth can be used to forecast future wealth and income. On the basis of these forecasts the efficiency proponents will support discounting even when considering the welfare of future populations. Economic forecasting, though, is only an extrapolation of current trends. The

important differences between the present and the future are almost always attributable to shocks, innovations and non-linear relations in the physical world. The current attempt to forecast the potential effects of climate change due to global warming provides a number of illustrations. Suppose we had been conducting an analysis of climate change effects eighty or one hundred years ago. What kind of damages might we have anticipated? We probably would have predicted that mud would paralyze domestic transportation. Narrow tires and dirt roads and increased rainfall would cause havoc. How could we have predicted the paving over of highways all across the country? Clearly, predictions based on extrapolation of existing trends become increasingly inaccurate, as the time frame grows longer. As a result it is not appropriate to assume smooth economic growth based on efficient current investment rules.

Either of these two arguments can be used to suggest that we should employ future scenarios in cost benefit analysis rather than attempting to compress values across years into a single present value metric. The ethical case is that we cannot know the correct discount rate. Concern with the accuracy of forecasting suggests that we should not perform an additional transformation on predicted results if that transformation might obscure the wide range of dissimilar, potential outcomes that are possible. In practice, the construction of future scenarios is mainly a qualitative or descriptive exercise that does not lend itself to discounting. In these cases it is best to lay out on a time line the projected effects, costs and benefits in the years in which they are expected to occur and not make any attempt to add them up across the years to a present value.

I should note that this practice of not discounting is not the same thing as using a zero discount rate. Various arguments have been advanced to support the calculation of present values by use of a zero discount rate. The danger of that approach is that the results can be manipulated to achieve just about any desired result. Suppose an initial investment is being considered that will generate a continuing stream of benefits. No matter how small the annual benefits might be, the analyst can produce a present value benefit greater than the initial investment just by extending the time frame of the analysis sufficiently far into the future. Since future benefits are counted at their face value, those occurring two hundred years out add just as much to present value benefits as those occurring in two years. Instead, long time frame analyses should include construction of future scenarios without discounting. In this way we preserve the discipline imposed by CBA while avoiding the distortion that might be caused by discounting.

IN PRAISE OF COST BENEFIT ANALYSIS

Cost Benefit Analysis provides a framework for decision analysis. In a complicated world of conflicting urgencies, a calm reasoned approach to decision-making is the first order of business. CBA brings a discipline to the analysis that helps to ensure that all relevant effects pro and con are enumerated. Activists often point emphatically to the benefits of environmental protection as if that were sufficient reason for governmental action. The economist must ask if the benefit is worth the cost. CBA forces the participants to distinguish between costs and benefits. For example, it has become convenient to defend environmental regulations by pointing out that they create jobs. Regardless of the impact of regulations on the employment rate, it is the duty of the economist to point out that jobs belong on the cost side of the ledger not the benefit side. CBA helps to bring transparency to the decision process. Power brokers of all stripes prefer to conduct business behind closed doors. Sometimes the doors are not physical but rather consist of vague statements, unfounded assertions, non-sequiturs and other logical tricks. Anything the analyst can do to clarify the objectives, motives and reasoning behind a decision will improve public welfare. CBA provides one tool useful in this effort.

In addition to supporting the goals of completeness, clarity and use of logic, CBA also pushes us to value costs and benefits as much as possible in dollar terms. I argue that this is a good direction. We need to aggregate across multiple outcomes, and to compare different programs that cannot all be financed at once. We need to compare public uses of scarce resources with private uses. Translating benefits into dollars helps us to address these problems of scarcity. But when necessary we will have to incorporate into the analysis physical indicators, descriptive scenarios and other non-monetary information. In summary, let us repeat the mantra, "cost-benefit analysis is not a decision rule, efficiency is not the sole criterion for public policy decisions, non-monetary information is important too".

ENDNOTE

1. Disclaimer: This paper reflects the views of the author alone and should not be construed as the policy of the U.S. EPA or the views of EPA officials.

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