CHAPTER

1 INTRODUCTION TO COST-BENEFIT ANALYSIS

In the Affair of so much Importance to you, wherein you ask my Advice, I cannot for want of sufficient Premises, advise you what *to determine, but if you please I will tell you* how. *When those difficult Cases occur, they are difficult, chiefly because while we have them under Consideration, all the Reasons* pro and con *are not present to the Mind at the same time; but sometimes one Set present themselves, and at other times another, the first being out of Sight. Hence the various Purposes or Inclinations that alternately prevail, and the Uncertainty that perplexes us.*

To get over this, my Way is, to divide half a Sheet of Paper by a Line into two Columns; writing over the one Pro, *and over the other* Con. *Then during three or four Days Consideration, I put down under the different Heads short Hints of the different Motives, that at different Times occur to me,* for *or* against *the Measure. When I have thus got them all together in one View, I endeavor to estimate their respective Weights; and where I find two, one on each side, that seem equal, I strike them both out. If I find a Reason* pro *equal to some two Reasons* con, *I strike out the three. If I judge some* two *Reasons* con, *equal to some three Reasons* pro, *I strike out the five; and thus proceeding I find at length where the Balance lies; and if after a Day or two of farther consideration, nothing new that is of Importance occurs on either side, I come to a Determination accordingly. And, tho' the Weight of Reasons cannot be taken with the Precision of Algebraic Quantities, yet, when each is thus considered, separately and comparatively, and the whole lies before me, I think I can judge better, and am less liable to make a rash Step; and in fact I have found great Advantage from this kind of Equation, in what may be* called Moral or Prudential Algebra.

—B. FRANKLIN, London, September 19, 1772.[1]

INDIVIDUAL VERSUS SOCIAL COSTS AND BENEFITS

Benjamin Franklin's advice about how to make a personal decision illustrates many of the features of cost-benefit analysis (CBA). These include a systematic cataloguing of impacts as benefits (pros) and costs (cons), valuing in dollars (assigning weights), and

then determining the *net benefits* of the proposal relative to the status quo (net benefits equal benefits minus costs).

When we as individuals talk of costs and benefits, we naturally tend to consider only our *own* costs and benefits. To oversimplify, we choose between alternative courses of action according to which has the largest individual net benefits. Similarly, in evaluating various investment alternatives, firms tend to consider only those costs (expenditures) and benefits (revenues) that flow to them. In cost-benefit analysis we try to consider *all of the costs and benefits to society as a whole*. For this reason, some people refer to CBA as *social* cost-benefit analysis.

Cost-benefit analysis is a policy assessment method that quantifies in monetary terms the value of all policy consequences to all members of society. The net social benefits measure the value of the policy. Social benefits (B) minus social costs (C) equals net social benefits (NSB):

$$NSB = B - C \tag{1.1}$$

Throughout this book we will use the terms *policy* and *project* interchangeably. CBA applies to policies, programs, projects, regulations, demonstrations, and other government interventions.

Stated at this level of abstraction, it is unlikely that many people would disagree with doing CBA. In practice, however, there are two types of disagreements. First, social critics including some political economists, philosophers, libertarians, and socialists have disputed the fundamental utilitarian assumptions of CBA that the sum of individual utilities should be maximized and that it is possible to trade off utility gains for some against utility losses for others. These critics are not prepared to make trade-offs between one person's benefits and another person's costs. Second, participants in the public policy-making process (analysts, bureaucrats, and politicians) may disagree about such practical issues as whether certain given impacts are costs or benefits, what those impacts will be over time, how to monetize (attach a dollar value to them), and how to make trade-offs between the present and the future.

Our purpose in this chapter is to provide a nontechnical but reasonably comprehensive overview of CBA. Though we introduce a number of key concepts, we do so informally, returning to discuss them thoroughly in subsequent chapters. Therefore, this chapter is best read without great concern about definitions and technical details.

THE PURPOSE AND USES OF CBA

The broad purpose of CBA is to help social decision making. More specifically, the objective is to facilitate more efficient allocation of society's resources. As we will see, where markets work well, individual self-interest leads to an efficient allocation of resources. Consequently, government analysts and politicians bear the burden of providing a rationale for any governmental interference with private choice. Economists lump these rationales under the general heading of *market failures*. Where markets fail, there is a prima facie rationale for government intervention. But, and this is important to emphasize, it is no more than that. One must be able to demonstrate the superior effi-

ciency of a particular intervention relative to the alternatives, including the status quo. For this purpose, we use CBA.

There are two major types of cost-benefit analysis. *Ex ante* CBA, which is just standard CBA as the term is commonly used, is conducted while a project or policy is under consideration, before it is started or implemented. *Ex ante* CBA assists in the decision about whether scarce resources should be allocated by government to a specific project or policy. Thus, its contribution to public policy decision making is direct, immediate, and bureau specific. *Ex post* analysis is conducted at the end of a project. At this time, all of the costs are "sunk" in the sense that they have already been given up to do the project. The value of *ex post* analyses is broader but less immediate as they provide information not only about the particular intervention but also about the "class" of such interventions. In other words, they contribute to "learning" by government managers, politicians, and academics about whether particular classes of projects are worthwhile.

Some CBA studies are performed during the course of the life of a project, that is, *in medias res*. Some elements of such studies are similar to an *ex ante* analysis, whereas others are similar to an *ex post* analysis.

There is also a fourth type of CBA—one that compares an *ex ante* CBA with an *ex post* (or *in medias res*) CBA *of the same project*. This comparative type of CBA is most useful to policymakers for learning about the efficacy of CBA as a decision-making and evaluative tool. Unfortunately, there are almost no disinterested published examples of this type of CBA.[2] (In Chapter 19 we provide an example of such a comparison.) The paucity of this type of CBA is not as surprising as it may appear because the constituencies for *ex ante* CBA are frequently different from those for *ex post* or *in medias res* CBA.

It is useful to elaborate on the values of these four types of CBAs. Table 1.1 summarizes the important ways in which the different types of analysis aid government decision making.

Project-Specific Decision Making

Ex ante analysis is most useful for deciding whether resources should be allocated to a particular project that is under consideration. For ongoing projects an *in medias res* analysis can also be used for decision-making purposes when it is potentially feasible to shift resources to alternative uses. It is rare that such analysis will lead to termination of an investment project nearing completion because a large share of the costs will have been incurred, and benefits subsequent to the analysis will usually exceed the remaining costs. However, it can happen. For example, a Canadian Environmental Assessment Panel recently recommended the decommissioning of a just completed dam on the basis of an *in medias res* analysis that showed that, with use, future environmental costs would exceed future benefits.[3] Because *ex post* analysis is conducted at the end of the project, it is obviously too late to reverse resource allocation decisions with respect to that particular project.

Learning about the Net Social Benefits of a Specific Project

In the early stages of a project there is considerable uncertainty about the project's actual impacts and, consequently, about the true net social benefits. As time goes by, more is known about the impacts, and CBA studies conducted later can estimate the

TABLE 1.1 Value of Different Classes of CBA

	Class of Analysis			
Value	***Ex Ante***	***In Medias Res***	***Ex Post***	***Ex Ante/Ex Post or Ex Ante/In Medias Res Comparison***
Resource allocation decision for this project	Yes—helps to select best project or make "go" versus "no-go" decisions, if accurate	If low sunk costs, can still shift resources If high sunk costs, usually recommends continuation	Too late—the project is over	Same as *in medias res* or *ex post* analysis
Learning about actual value of specific project	Poor estimate—high uncertainty about future benefits and costs	Better—reduced uncertainty	Excellent—although some errors may remain. May have to wait long for study	Same as *in medias res* or *ex post* analysis
Contributing to learning about actual value of similar projects	Unlikely to add much	Good—contribution increases as performed later. Need to adjust for uniqueness.	Very useful—although may be some errors and need to adjust for uniqueness. May have to wait long for project completion.	Same as *in medias res* or *ex post* analysis
Learning about omission, forecasting, measurement and evaluation errors in CBA	No	No	No	Yes, provides information about these errors and about the accuracy of CBA for similar projects

Source: Anthony E. Boardman, Wendy L. Mallery, and Aidan R. Vining, "Learning from *Ex Ante/Ex Post* Cost-Benefit Comparisons: The Coquihalla Highway Example," *Socio-Economic Planning Sciences*, 28, no. 2 (1994), 69–84, Table 1, p. 71. Reprinted with kind permission from Elsevier Science Ltd., The Boulevard, Langford Lane, Kidlington OX5 1GB, UK.

net benefits of the project more accurately. In general, *ex post* studies are more accurate than *in medias res* studies, which are more accurate than *ex ante* studies.

Learning about the Potential Benefits of Similar Projects

Ex post analyses not only provide information about a particular policy intervention but, more importantly, about similar interventions as well. They help analysts who are currently conducting *ex ante* CBAs of similar policies. Furthermore, *ex post* analyses (and *in medias res* analyses) potentially contribute to learning by political and bureaucratic decision makers, as well as policy researchers, about whether particular kinds of projects are worthwhile. The U.S. federal government has explicitly induced learning by sponsoring and requiring evaluation of a variety of "pilot tests," "demonstration projects," and "social experiments" including, for example, various welfare reform demonstrations that were conducted by different states during the 1980s.[4] Eventually the weight of evidence may lead to a policy change; these welfare demonstrations con-

tributed to the passage of a new federal welfare law, the Family Support Act of 1988.[5] Similarly, a whole range of CBAs in the 1960s and 1970s of industry-specific economic regulations showed that the costs of regulation often exceeded the benefits, thereby paving the way for deregulation initiatives in the 1980s in the trucking, airline, and telecommunications industries.[6]

The amount of societal learning from *in medias res* and *ex post* analyses depends on the *generalizability* of a particular project. This is crucial for realistic assessment of the usefulness of CBA.[7] For example, CBAs of experiments involving the efficacy of new surgical procedures or new pharmaceutical products are usually generalizable to larger populations. Lessons from many experiments, however, are not as generalizable as they appear.[8] For example, if the proposed intervention is several orders of magnitude larger than the experiment, there may be unknown nonlinear scale effects.[9] Also, if the proposed program has a more extended time frame than the experiment, this may increase the incentives for behavioral changes that increase costs or reduce benefits unpredictably.

Learning about the Efficacy of CBA

Comparison of an *ex ante* with either an *in medias res* or an *ex post* analysis is most useful for learning about the value of CBA itself. Most importantly, a comparison CBA provides information about the accuracy of the earlier *ex ante* CBA, which, in turn, provides guidance about the accuracy of subsequent similar *ex ante* CBAs. Information about the predictive capability of CBA is useful for decision-making purposes. Comparison studies also help analysts understand the reasons for any divergence between predicted and actual benefits or costs. In Chapter 19 we discuss four important potential types of errors: omission errors, forecasting errors, measurement errors, and valuation errors. Understanding the reasons for these errors helps to reduce them in the future.

THE DEMAND FOR CBA

The U.S. federal government first mandated the general use of CBA in Executive Order 12291, issued by President Reagan in early 1981. This order requires a regulatory impact analysis (RIA) for every major regulatory initiative. (An RIA is essentially a cost-benefit analysis that also takes into account distributional and fairness considerations.) President Clinton confirmed the federal government's commitment to CBA in Executive Order No. 12866, 3 C.F.R. 638 (1994).

Although Congress, in spite of many recent attempts, has failed to pass a comprehensive act requiring the application of cost-benefit analysis, there are several pieces of legislation that mandate *ex ante* CBA. The Unfunded Mandates Reform Act of 1995 passed by the 104th Congress requires agencies, except for independent regulatory boards and commissions, to prepare cost-benefit analyses for any regulation likely to result in costs of $100 million or more in any year. The CBA must also consider reasonable alternatives and select the least costly, most cost-effective, or least burdensome of the alternatives, or explain why such alternatives were not selected. The Treasury and General Government Appropriations Act of FY 2000 (HR 2000), which President Clinton signed into law in September 1999, requires the Office of Management and

Budget to issue a report providing information on the costs and benefits of federal regulations and to issue guidelines to standardize measures of costs and benefits. Previous appropriation acts have contained identical provisions.

Nearly all other Western industrialized countries have similar protocols covering broad ranges of programs or specific program areas. For example, Canada's Federal-Provincial Fraser River Flood Control Agreement recognizes that before any dike construction can take place projects have to be determined to have sound engineering and be economically viable. Economic viability is determined by CBA.

The demand for *ex post* analysis is not so explicit; there are no mandatory requirements that it be done. Nonetheless, resource allocation decisions often draw heavily on such analyses. For example, President Clinton's State of the Union Address on February 17, 1993, emphasized the relationship between *ex post* CBAs of specific Head Start programs (i.e., educational programs for low-income preschool children) and his intention to increase funding and expand the scope of such programs.

As public officials face citizen resistance to raising taxes or pressure to reduce taxes, they are increasingly forced to ensure that government works more efficiently and effectively. In practice, this provides an impetus toward the increased use of CBA and related methods to make more efficient resource allocation decisions. Such trends are contemporaneous with greater concern for the environment, which calls for the valuation of environmental and other social impacts, in addition to consideration of government expenditures.

THE COST OF CBA

Although the demand for CBA is increasing, we should keep in mind that it takes many resources (time, skill, and money) to do CBA well, especially when the projects are large, complex, and have unique features. The costs of conducting CBAs can be very large. For example, Thomas Hopkins reported in 1992 that a CBA of reducing lead in gasoline cost the Environmental Protection Agency (EPA) roughly $1 million.[10] On average, the EPA spends approximately $700,000 for a major CBA, that is, for the analysis of projects with compliance costs in excess of $100 million annually.[11] Large-scale evaluations of training programs, of which CBA is one component, often run into the millions of dollars.

READERS OF THIS BOOK

This book is primarily for people who want to know how to do CBA. Second, it is for people who want to know how to interpret CBAs—in other words, clients of CBAs. Clients can be helped in two ways. In the narrow sense, clients should be well enough informed to evaluate a specific CBA and to judge whether it has been conducted well. In the broad sense, clients may need to evaluate CBA studies well enough to have a sense of the conclusions of the literature in a specific area, such as employment training or environmental regulation. In order to do this well, one has to understand the basic principles of CBA.

THE BASIC STEPS OF CBA: COQUIHALLA HIGHWAY EXAMPLE

CBA may look intimidating and complex. To help make the process of conducting a CBA more manageable, we break it down into nine basic steps, which are listed in Table 1.2. We describe and illustrate these steps using a relatively straightforward highway example. For each step, we also point out some practical difficulties of performing CBA. The conceptual and practical issues that we broach are the focus of the rest of this book. Do not worry if the concepts are unfamiliar to you; this is a dry run. Subsequent chapters fully explain them.

Imagine that in 1986 a cost-benefit analyst, who works for the Province of British Columbia, Canada, has been asked to perform a CBA of a proposed highway between the town of Hope in the south-central part of the province and Merritt, which is more or less due north. This highway would be called the Coquihalla Highway. The analyst's CBA is presented in Table 1.3.[12] How did she get these results? What were the difficulties? We will go through the nine steps, one at a time. One factor that helps us identify the difficulties is the fact that the Coquihalla Highway was actually built in 1987.

1. **Specify the set of alternative projects.** Step 1 requires the analyst to specify the set of alternative projects. In this example, the provincial government required the analyst to consider only two alternative highways, one with tolls and one without. The provincial Department of Transportation decided that the toll, if applied, would be $40 for large trucks and $8 for cars. Thus, the analyst has a tractable set of alternatives to analyze.

In practice, however, there are often difficulties even at this stage. For many projects, including this one, the number of potential alternatives is huge. This highway could vary on many dimensions including:[13]

Road surface: It could be surfaced in bitumen or concrete.
Routing: It could take different routes.
Size: It could have two, four, or six lanes.
Tolls: The tolls could be higher or lower.
Wild animal friendliness: The highway could be built with or without "elk tunnels."
Timing: It could be delayed until a later date.

TABLE 1.2 Conceptually CBA Is Simple

1. Specify the set of alternative projects.
2. Decide whose benefits and costs count (standing).
3. Catalogue the impacts and select measurement indicators (units).
4. Predict the impacts quantitatively over the life of the project.
5. Monetize (attach dollar values to) all impacts.
6. Discount benefits and costs to obtain present values.
7. Compute the net present value (*NPV*) of each alternative.
8. Perform sensitivity analysis.
9. Make a recommendation based on the *NPV* and sensitivity analysis.

TABLE 1.3 Coquihalla Highway CBA (1986 $ Million)

	No Tolls		*With Tolls*	
	A	***B***	***C***	***D***
	Global Perspective	***Provincial Perspective***	***Global Perspective***	***Provincial Perspective***
Project Benefits:				
Time and Operating Cost Savings	389.8	292.3	290.4	217.8
Terminal Value of Highway	53.3	53.3	53.3	53.3
Safety Benefits (Lives)	36.0	27.0	25.2	18.9
Alternative Routes Benefits	14.6	10.9	9.4	7.1
Toll Revenues	—	—	—	37.4
New Users	0.8	0.6	0.3	0.2
Total Benefits	494.5	384.1	378.6	334.7
Project Costs:				
Construction	338.1	338.1	338.1	338.1
Maintenance	7.6	7.6	7.6	7.6
Toll Collection	—	—	8.4	8.4
Toll Booth Construction	—	—	0.3	0.3
Total Costs	345.7	345.7	354.4	354.4
Net Social Benefits	148.8	38.4	24.2	−19.7

Source: Adapted from Anthony Boardman, Aidan Vining, and W. G. Waters II, "Costs and Benefits through Bureaucratic Lenses: Example of a Highway Project," *Journal of Policy Analysis and Management,* 12, no. 3 (Summer 1993), 532–555, Table 1, p. 537.

Changing the highway on just one of these dimensions would generate at least one new alternative. Changing two or three simultaneously greatly increases the number of alternatives. In general, if there were n dimensions, each with k possible values, there would be k^n alternatives. For example, if there were three dimensions, each with three possible values, there would be 27 mutually exclusive alternatives. With four dimensions, each with three possible values, there would be 81 alternatives! Neither decision makers nor analysts can cognitively handle comparisons among such a large number of alternatives.[14]

CBA compares the net social benefits of investing resources in a particular project with the net social benefits of a hypothetical project that would be displaced if the project under evaluation were to proceed. The displaced hypothetical project is sometimes called the *counterfactual.* Usually, the counterfactual is the status quo, which means there is no change in government policy. In Table 1.3 the analyst compares the net social benefits if the highway were built either with or without tolls to the net social benefits under the status quo—if the highway were not built.

Sometimes the status quo is not a viable alternative. *If a project would displace a specific alternative rather than a hypothetical one, it should be evaluated relative to the specific alternative.* Thus, if government has committed resources to either the highway project or a health care project, without any prospect of reconsideration, then the highway project should be compared with the health care project, not the status quo.

This CBA pertains to a specific highway between Hope and Merritt. There is no attempt to compare this highway project to alternative highway projects in British Columbia, although one could do so. Rarely does the analyst compare a highway project more broadly to completely different types of projects, such as health care, antipoverty, or national defense projects. As a practical matter, full optimization is impossible. The limited nature of the comparisons sometimes frustrates politicians and decision makers who imagine that CBA is a *deus ex machina* that will rank *all* policy alternatives. On the other hand, as we mentioned earlier, the weight of CBA evidence can and does help in making broad social choices across policy areas.

2. **Decide whose benefits and costs count (standing).** Next, the analyst must decide who has standing, that is, whose benefits and costs should be counted. In this example, she was not in a position to decide this; her superiors in the provincial government were. They wanted the analysis done from the provincial perspective but also asked her to take a global perspective. The provincial perspective measures only the benefits and costs that affect British Columbian residents, including costs and benefits borne by the British Columbian government. The global perspective includes the benefits and costs that affect everyone, irrespective of where they reside. Thus, it includes benefits and costs to Albertans, U.S. residents, and even tourists from the United Kingdom. Combining these two perspectives on standing with the no-tolls and with-tolls alternatives gives the four columns in Table 1.3 labeled A through D.

It is often contentious whether an analysis should be performed from the global, national, state (provincial), or local perspective. Although the federal government usually performs analyses taking only national costs and benefits into account, critics argue that many issues should be analyzed from a global perspective. Recent environmental issues that fall into this category include ozone depletion, global climate change, and acid rain. At the other extreme, local governments typically want to ignore costs and benefits that occur in adjacent municipalities or are borne by higher levels of government. Our highway example deals with this issue by analyzing costs and benefits from both the global and the British Columbian perspectives.

3. **Catalogue the impacts and select measurement indicators (units).** Step 3 requires the analyst to list the physical impacts of the alternatives as benefits or costs and to specify the impacts' measurement units. We use the term *impacts* broadly to include inputs (required resources) and outputs. For this proposed highway, the anticipated beneficial impacts are time saved and reduced vehicle operating costs for travelers on the new highway ("Time and Operating Cost Savings" in Table 1.3); the residual value after the discounting period of 20 years ("Terminal Value of Highway"); accidents avoided (including lives saved) due to drivers switching to the shorter, safer new highway ("Safety Benefits"); reduced congestion on the existing alternative routes—the old road ("Alternative Routes Benefits"); revenues collected from tolls ("Toll Revenues"); and benefits accruing to new travelers ("New Users"). The anticipated cost impacts are construction costs ("Construction"); additional maintenance and snow removal ("Maintenance"); toll collection ("Toll Collection"); and toll booth construction and maintenance ("Toll Booth Construction").

Specification of impact category measurement indicators usually occurs at the same time as specification of the impact categories. There are no particular difficulties

in specifying measurement indicators of each impact category in this illustration. For example, number of lives saved per year, person-hours of travel time saved, and dollar value of gasoline saved are reasonably natural.

In this example, identifying most impacts is relatively straightforward, although critics might argue that some relevant impacts were omitted. Health impacts from automobile emissions, impacts on the elk population and other wildlife, and changes in scenic beauty were not considered.

From a CBA perspective, analysts are only interested in project impacts that affect the utility of individuals with standing. In CBA, so-called impacts that do not have any value to human beings are not counted. (The big caveat is that this applies only when human beings have the relevant knowledge and information to make rational valuations.) Politicians often state the purported impacts of projects in very general terms. For example, they might say that a project will promote "community capacity building." CBA requires analysts to identify explicitly the ways in which the project would make some individuals better off through, for example, improved skills and better education. Similarly, politicians have a strong tendency to regard "growth" and "regional development" as beneficial impacts. In CBA analysts should identify the people who may have higher incomes or may consume more goods and services. Of course, analysts should also include the negative environmental and congestion impacts of growth.

Put another way, in order to treat something as an impact, we have to know there is a cause-and-effect relationship between some physical outcome of the project and the utility of human beings with standing. For some impacts, this relationship is so obvious that we do not think about it explicitly. For example, we do not question the existence of a causal relationship between motor vehicle usage and accidents involving human morbidity and mortality. For other impacts, the causal relationships may not be so obvious. What about the impact of exhaust fumes from vehicle usage of the highway on residents' blood pressure? Or the impact of more airborne lead on blood pressure? Demonstrating such cause-and-effect relationships often requires an extensive review of scientific research.

Some potentially very important impacts may depend on unresearched, preliminary, or contradictory scientific or biological knowledge. For example, controversy surrounds the effect of chlorinated organic compounds in bleached pulp mill effluent on wildlife. Although an earlier Swedish study found such a link, a more recent Canadian study found none.[15] The highly publicized controversy surrounding the northern spotted owl demonstrates how widely opinions can vary. Although some experts feel the social costs of logging that eliminate the owl from some areas are relatively minor, Jonathan Rubin and his colleagues have argued the costs may be very large:

> Biologically, the owl is an indicator for old-growth temperate ecosystems: the trees, associated plant communities, and wildlife species that find their optimal habitat in these forests. If the spotted owl cannot survive, its extinction could represent a lack of viability for old-growth habitat itself. Elimination of an ecosystem, itself a unique resource, clearly has greater costs for society than mere extinction of the owl.[16]

Watch out for impacts where different groups of people view what is apparently the same impact in opposite ways. Consider, for example, "flooded land" as a potential impact category. Residents of a flood plain generally view floods as a cost because flood

waters damage homes, whereas duck hunters regard floods as a benefit because ducks like them. Even though opposing valuations of the same impact could be aggregated in one category, it is usually more useful to have two impact categories—one for damaged homes, another for recreation benefits.

Due to data limitations, it may not be feasible to measure some impacts using natural measurement units. For example, an analyst may wish to measure the number of crimes avoided due to a policy intervention but may not have such estimates. Instead, the analyst may have access to some indicators, such as changes in arrest rates or changes in conviction rates. The analyst can use one of these surrogates or some combination of them. Remember that valuation of the impact at step 5 should be consistent with the chosen measurement indicator. For example, the valuation of an arrest would be lower than the valuation of a conviction so that the analyst would obtain similar estimates of the benefits of reduced crime from using either indicator. Also, bear in mind that all indicators involve some loss of information.

4. **Predict the impacts quantitatively over the life of the project.** The proposed highway project, like almost all projects, has impacts that extend over time. The fourth task is to quantify all impacts for each alternative over the life of the project. The analyst needs to predict for the no-tolls and with-tolls alternatives, for each year, and for each category of vehicle (trucks, passenger cars on business, passenger cars on vacation):

- the number of vehicle-trips on the new highway
- the number of vehicle-trips on the old roads
- the proportion of travelers from British Columbia

With estimates of these impacts, knowing the highway is 195 kilometers, and with other information the analyst can estimate:

- the total vehicle operating costs that users save
- the number of accidents avoided
- the number of lives saved

For example, the analyst estimated the new highway would save 6.5 lives each year:

SHORTER DISTANCE:

130 vkm $\times$ 0.027 lives lost per vkm $= 3.5$ lives/year

SAFER (4-LANE VERSUS 2-LANE):

313 vkm $\times$ 0.027 lives lost per vkm $\times$ 0.33 $= 3.0$ lives/year

Total lives saved.[17] $= 6.5$ lives/year

Lives would be saved for two reasons. First, the new highway is shorter than existing alternative routes. It is expected that travelers will avoid 130 million vehicle-kilometers (vkm) of driving and evidence suggests that, on average, there are 0.027 deaths per million vehicle-kilometers. The shorter distance is expected, therefore, to save 3.5 lives per year. The new highway is also predicted to be safer per kilometer driven. It is expected that 313 million vehicle-kilometers will be driven each year on the new highway. Based on previous traffic engineering evidence, the analyst estimated that the new highway would lower the fatal accident rate by one-third. Consequently, the new highway is expected to save 3.0 lives per year due to being safer. Combining the two components, 6.5 lives are saved per year.

Now we turn to difficulties of predicting impacts. One odd feature of the cost-benefit literature is that hardly anybody discusses the fact that prediction is both essential and very difficult! Most textbooks focus on theoretical issues, assuming that market demand and supply curves are known. But often they are not. Surprisingly, as we discussed earlier, there are almost no published examples of CBA comparison studies that provide information about the predictive accuracy of CBAs. This issue is so important that Chapter 19 is devoted largely to it. As discussed there, the actual usage levels of the Coquihalla Highway and, therefore, the benefits are considerably higher than predicted, and so are costs. Even this understates the problem as there are errors within benefit categories, which do not show up in the aggregate dollar benefit figure because they offset each other. Prediction is especially difficult when projects are unique, have long time horizons, or relationships among variables are complex.

Many of the realities associated with actually doing steps 3 and 4 are brilliantly summarized by Kenneth Boulding's poem on dam building in the Third World, presented in Exhibit 1.1. Many of his points deal with omission of impact categories due to misunderstanding or ignorance of cause-and-effect relationships and to prediction errors. He also makes points about the distribution of costs and benefits, which we discuss later.

EXHIBIT 1.1 CBA Seeks A Ballad of Ecological Awareness

The cost of building dams is always underestimated,
There's erosion of the delta that the river has created,
There's fertile soil below the dam that's likely to be looted,
And the tangled mat of forest that has got to be uprooted.

There's the breaking up of cultures with old haunts' and habits' loss,
There's the education programme that just doesn't come across,
And the wasted fruits of progress that are seldom much enjoyed
By expelled subsistence farmers who are urban unemployed.

There's disappointing yield of fish, beyond the first explosion;
There's silting up, and drawing down, and watershed erosion.
Above the dam the water's lost by sheer evaporation;
Below, the river scours, and suffers dangerous alteration.

For engineers, however good, are likely to be guilty
Of quietly forgetting that a river can be silty,
While the irrigation people too are frequently forgetting
That water poured upon the land is likely to be wetting.

Then the water in the lake, and what the lake releases,
Is crawling with infected snails and water-borne diseases.
There's a hideous locust breeding ground when water level's low,
And a million ecologic facts we really do not know.

There are benefits, of course, which may be countable, but which
Have a tendency to fall into the pockets of the rich,
While the costs are apt to fall upon the shoulders of the poor.
So cost-benefit analysis is nearly always sure
To justify the building of a solid concrete fact,
While the Ecologic Truth is left behind in the Abstract.

—Kenneth E. Boulding

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5. **Monetize (attach dollar values to) all impacts.** The analyst next has to monetize each of the impacts. *Monetization* means assigning value in dollars. Specifically, the analyst has to monetize time saved, lives saved, and accidents avoided. For this, the analyst needs the monetary value of an hour saved by each type of traveler, the value of a statistical life saved, and the value of an avoided accident. Ideally, these estimates should be specific to British Columbia in 1986. Some of the dollar values used in this CBA are:

- leisure time saved per vehicle (25 percent of gross wage times the average number of passengers) = $6.68 per vehicle-hour
- business time saved per vehicle = $12 per vehicle-hour
- truck drivers' time saved per vehicle = $14 per vehicle-hour
- value of a life saved = $500,000 per life

These estimates are based on studies conducted prior to 1986. Recent estimates of the value of a life saved are much higher, closer to $2 million in 1986 dollars.[18]

Sometimes the most intuitively important impacts are very difficult to value in monetary terms. The value of environmental impacts is especially contentious. In CBA, value is measured in terms of willingness-to-pay. As we discuss in Chapter 4, when markets exist and work well (they don't "fail"), willingness-to-pay can be determined from the appropriate demand curve. Naturally, problems arise when markets do not exist or do not work well. Obtaining values for such impact categories can be a life's work. Scholars have spent many person-years trying to determine the appropriate value of a saved life. In practice, most CBA analysts do not reinvent these wheels but instead draw on previous research: They use plug-in values whenever possible. Although catalogues of impact values are not comprehensive, considerable progress has been made in this regard, as we show in Chapter 15.

If no person is willing to pay a strictly positive amount for some impact, then that impact would have zero value in a CBA. Thus, for example, if construction of a dam would lead to the extermination of a species of small fish, but if no one with standing was willing to pay a positive amount to save that species, then the extermination of this fish would have zero value in a CBA of the dam.

Some government agencies and critics of CBA are unwilling to attach a monetary value to life. This forces them to use an alternative method of analysis, such as *cost-effectiveness analysis* or *multigoal analysis*, which we discuss in Chapters 2 and 17.

6. **Discount benefits and costs to obtain present values.** For a project that has costs or benefits that arise over extended periods (years), we need a way to aggregate the benefits and costs that occur in different years. Usually, future benefits and costs are *discounted* relative to present benefits and costs in order to obtain their *present values*, *PV*. The need to discount arises due to most people's preference to consume now rather than later and because if we consume now we usually give up the opportunity to consume more in the future. Discounting has nothing to do with inflation per se, although inflation must be taken into account.

A cost or benefit that occurs in year t is converted to its present value by dividing it by $(1 + s)^t$, where s is the social discount rate. Suppose a project has a life of n years and let B_t and C_t denote the benefits and costs in year t, respectively. The present value

of the benefits, $PV(B)$, and the present value of the costs, $PV(C)$, of the project are, respectively:

$$PV(B) = \sum_{t=0}^{n} \frac{B_t}{(1+s)^t} \quad \textbf{(1.2)}$$

$$PV(C) = \sum_{t=0}^{n} \frac{C_t}{(1+s)^t} \quad \textbf{(1.3)}$$

In the highway example the analyst used a real (inflation-adjusted) social discount rate of 7.5 percent.

As we discuss in Chapter 10, the choice of the appropriate social discount rate is still contentious. Different theories suggest different values. Unfortunately for the practically oriented analyst, there is still some theoretical disagreement. The value of the social discount rate is, thus, a good candidate for sensitivity analysis. For government analysts the discount rate is usually mandated by a government agency with authority (e.g., the Office of Management and Budget, the General Accounting Office, Ministry of Finance, or Treasury Board). Often, for example, the specified real (inflation-adjusted) discount rate is 7 percent. But most economists regard this rate as too high.

7. **Compute the net present value of each alternative.** The *net present value* of an alternative, *NPV*, equals the difference between the present value of the benefits and the present value of the costs:

$$NPV = PV(B) - PB(C) \quad \textbf{(1.4)}$$

The basic decision rule for a single alternative (relative to the status quo) is simple: *Adopt the project if its NPV is positive.* In short, the analyst should recommend proceeding with the project if its $NPV = PV(B) - PV(C) > 0$; that is, $PV(B) > PV(C)$.

When there is more than one alternative to the status quo, the rule is slightly more complicated: *Select the project with the largest NPV.* This rule assumes implicitly that at least one *NPV* is positive. If no *NPV* is positive, then none of the specified alternatives are superior to the status quo, which should remain in place.

Earlier we emphasized the net social benefits of a project. We show in Chapter 6 that the *NPV* of a project or policy is identical to the present value of the net social benefits (*NSB*):

$$NPV = PV(NSB) \quad \textbf{(1.5)}$$

Thus, selecting the project with the largest *NPV* is equivalent to selecting the project with the largest present value of the net social benefits.

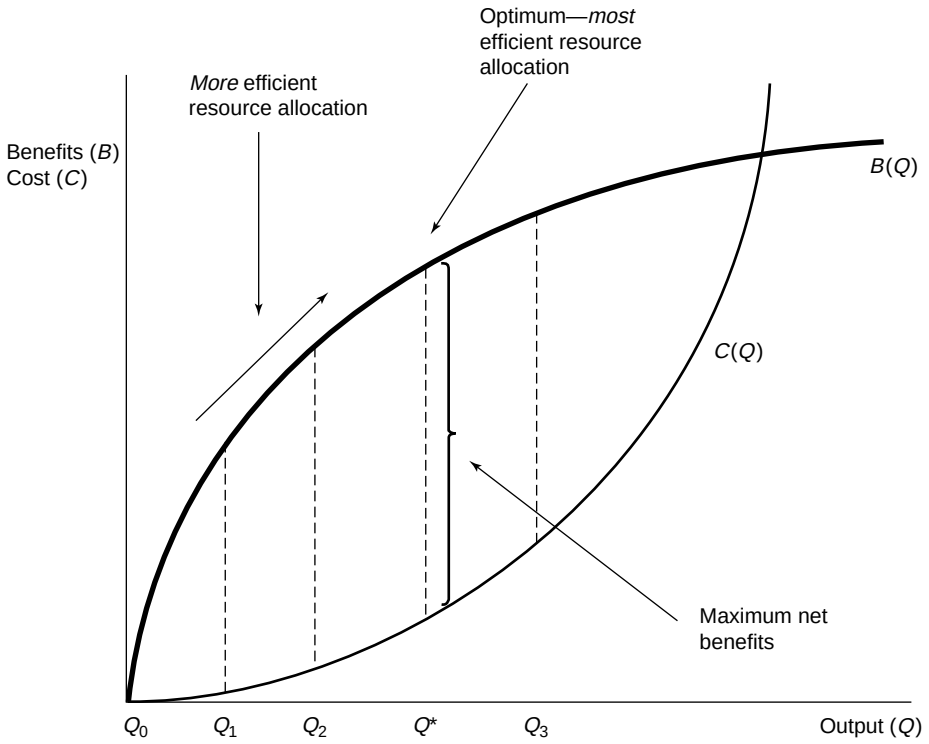
In the highway example, the no-tolls alternative has a higher net present value than the with-tolls alternative. Thus, the analyst is inclined to recommend the highway should be constructed without tolls. However, the *NPV* of the no-tolls alternative from the provincial perspective is quite small, although positive. Earlier, we emphasized that conducting CBA requires prediction and monetization, which are not always completely accurate. It is important to remember that the net present values presented in Table 1.3 are estimates and that sensitivity analysis should be conducted before mak-

ing a final recommendation. However, before turning to sensitivity analysis (step 8), we discuss decision making in a bit more detail.

In fact, there is some confusion about the appropriate decision rule. Both the *internal rate of return*, which is discussed in Chapter 6, and the *benefit-cost ratio*, which is discussed in Chapter 2, have both been proposed as decision rules. The appropriate criterion to use is the *NPV* rule. Other methods may give incorrect answers; the *NPV* rule does not.

An obvious caveat about the *NPV* criterion is that it is only applies to the actual alternatives specified. Other alternatives might conceivably be better. Although the *NPV* criterion results in a *more efficient* allocation of resources, it does not necessarily recommend *the most efficient* allocation of resources. This point is illustrated in Figure 1.1. Consider a project for which the alternatives vary along an output scale (Q). The benefits and costs associated with alternative scales are represented by the functions $B(Q)$ and $C(Q)$, respectively. The benefits increase as the scale increases but at a decreasing rate. In contrast, costs increase at an increasing rate. A small-scale project

FIGURE 1.1 CBA Seeks More Efficient Resource Allocation



Moving from Q_0 toward Q^* increases efficiency; that is: $NPV(Q^*) > NPV(Q_2) > NPV(Q_1) > NPV(Q_0)$

Moving beyond Q^* reduces efficiency, but Q_3 is more efficient than Q_0: $NPV(Q^*) > NPV(Q_3) > NPV(Q_0)$

(for example, Q_1) has positive net benefits relative to the status quo, Q_0. As the scale increases, the net benefits increase up to the optimal scale, Q^*.[19] As the scale increases beyond Q^*, the net benefits decrease. Net benefits are positive as long as the benefit curve is above the cost curve, they are zero where the cost curve and benefit curve intersect and are negative for larger-scale projects.

Suppose that the analyst evaluates only two alternative output levels, Q_1 and Q_2, relative to the status quo. Clearly, output level Q_2 is preferred to output level Q_1, which, in turn, is preferred to the status quo, Q_0. The analyst would, therefore, recommend Q_2. However, as the figure shows, net social benefits are maximized at output level Q^*. This optimal output level was not recommended because it was not among the set evaluated. In this example, use of the *NPV* criterion leads to a more efficient alternative to the status quo but not to the most efficient alternative.

The analyst may not have included the optimum output level in the set of alternatives for a number of reasons. The analyst may have not known the optimum output level, even approximately, until after performing the analysis. Cognitive capacity limitations, often summarized as *bounded rationality* problems, may hinder the analyst from considering the optimal alternative.[20] Additionally, budgetary or political constraints may limit the choice set.

8. **Perform sensitivity analysis.** As the foregoing discussion emphasizes, there may be considerable uncertainty about both the predicted impacts and the appropriate monetary valuation of each unit of the impact. For example, the analyst may be uncertain about the predicted number of lives saved and about the appropriate dollar value to place on a statistical life saved. The analyst may also be uncertain about the appropriate social discount rate and about the appropriate level of standing. Sensitivity analysis, which we discuss in Chapter 7, attempts to deal with these uncertainties. As shown in Table 1.3, the analyst performed sensitivity analysis on the standing issue by computing the net present values from both the global perspective and the provincial perspective.

There are practical limits to the amount of sensitivity analysis that is feasible. Potentially, every assumption in a CBA can be varied infinitely. In practice, one has to use judgment and focus on the potentially most important assumptions. Although this can mean that CBA is vulnerable to the judgment biases of the analyst, carefully thought-out scenarios are usually more informative than a mindless varying of assumptions.

9. **Make a recommendation based on the *NPV* and sensitivity analysis.** Generally, the analyst should recommend adoption of the project with the largest *NPV*. In the highway example, of the alternative projects has a negative *NPV*, from a British Columbian perspective, suggesting that from this perspective it would be more efficient to not build the Coquihalla Highway at this time than to build it and charge tolls. Sometimes the status quo is the best alternative. Here, however, from a global perspective both the with-tolls and no-tolls alternatives are preferable to the status quo. Based on selecting the alternative with the largest *NPV*, the analyst would recommend the selection of A above C, and B above D. In short, the no-tolls alternatives are superior. This result gives a flavor of the possibly counterintuitive recommendations that CBA can support. In this case, tolls lower the *NPV* because they deter people from using the highway, and so fewer people enjoy the benefits.[21]

As we have emphasized, however, the net present values are expected values. Sensitivity analysis, which we have not shown in detail, might suggest that the alternative with the largest expected *NPV* is not necessarily the best alternative under all circumstances.

Finally, it is important to note that analysts make recommendations, not decisions. CBA concerns how resources *should* be allocated; it is *normative*. It does not claim to be a *positive* (i.e., descriptive) theory of how resource allocation decisions are actually made. Such decisions are made in political and bureaucratic arenas. CBA is only one input to this political decision-making process—one that attempts to push it toward more efficient resource allocation. CBA does not always succeed. Politicians are often reluctant to be upstaged by economic arguments. Indeed, the highway was built with tolls!

BUREAUCRATIC AND POLITICAL "LENSES"[22]

Thus far, we have assumed that CBA is not influenced by bureaucratic or political processes. This approach is reasonable given that CBA concerns how resource allocation decisions should be made. In practice, however, CBA frequently gets distorted when bureaucrats and politicians get their hands on it. Government bureaucrats have a tendency to see costs and benefits differently depending on their position and their agency. A bureaucrat's role has a strong influence on what he or she thinks CBA is, or should be, about. Specifically, their perception of what constitutes benefits and costs are based on whether they are "analysts," "spenders," or "guardians."[23] These labels are indicative of three different perspectives bureaucrats bring to project evaluation in government. The analysts' perspective is standard CBA, which we have already presented in Table 1.3. Guardians and spenders have quite different perspectives.

Most students of CBA and most government employees have not taken, and will not take, formal courses in CBA analysis. They believe that what they think is CBA is, in fact, CBA, even if it is not. This section describes the perspectives of guardians and spenders and shows how these perspectives differ from CBA. This helps clarify what CBA actually is in contrast to what one may think it is. This section also identifies many of the common mistakes in CBA. These mistakes often vary systematically according to one's background and experiences. Even those trained in CBA may modify their orientation toward those of guardians or spenders as a consequence of the immediacy of their daily bureaucratic roles. When you are in a government job, you should make sure you are not unconsciously adopting a guardian or spender perspective. We also hope that by understanding these different perspectives, analysts may be better able to communicate with guardians and spenders, and guardians and spenders may be better able to communicate with each other. Finally, this section helps students understand better why decisions are often not consistent with CBA—they are often made by guardians or spenders, not analysts.

We recognize that the following *bureaucratic lenses* are caricatures. In practice, a bureaucrat may not exhibit all of the characteristics associated with a particular lens. From time to time, bureaucrats exhibit schizophrenic tendencies—sometimes they adopt one perspective, sometimes another. In particular, guardians in line agencies are

prone to cognitive dissonance because they have dual allegiances. They are quite likely to describe themselves as being unsure of whether they are guardians, spenders, or both. In practice, though, most bureaucrats with whom we have discussed this recognize that they have a tendency to frequently adopt a guardian or spender perspective.

Guardians

Guardians are often found in central budgetary agencies, such as the U.S. Office of Management and Budget, and in controllership or accounting functions within line agencies. They tend to have a bottom-line budgetary orientation. Their natural tendency is to equate benefits with revenue inflows to their agency or other governmental coffers and to equate costs with revenue outflows from their agency or other governmental coffers. Thus, they engage in *revenue-expenditure analysis*.[24] Guardians have a natural tendency to regard CBA as naive, impractical, and, worst of all in their eyes, a tool whereby spenders can justify whatever it is they want to do.

The conceptual lens of "pure" guardians can be illustrated by the way they tend to look at the costs and benefits of the Coquihalla Highway. Table 1.4 summarizes how a provincially based guardian would evaluate the no-tolls highway alternative and the corresponding with-tolls alternative. These evaluations can be compared to the analyst's evaluations, which appear in columns B and D of Table 1.3, respectively.

To guardians, all toll revenues are regarded as benefits, whether paid by provincial residents or by nonresidents. Construction costs are a cost because they are an outlay by provincial government. Because guardians seek to minimize net budgetary expenditures, their preference, not surprisingly, is for the with-tolls alternative. Indeed, their gut reaction is to consider raising tolls, irrespective of its effect on levels of use or its impact on social benefits.

How does the guardians' perspective differ from CBA? Most importantly, guardians ignore nonfinancial social benefits, in this case $384.1 million for the no-tolls al-

TABLE 1.4 Coquihalla Highway from a State Guardian's Perspective (1986 $ Million)

	No Tolls	*With Tolls*
Revenues ("Benefits"):		
Toll revenues from British Columbia residents	0	112.1
Toll revenues from non–British Columbia residents	0	37.4
	0	149.5
Expenditures ("Costs"):		
Construction	338.1	338.1
Maintenance	7.6	7.6
Toll collection	—	8.4
Toll booth construction	—	0.3
	345.7	354.4
Net Revenue-Expenditure "Benefits"	−345.7	−204.9

Source: Adapted from Anthony Boardman, Aidan Vining, and W. G. Waters II, "Costs and Benefits through Bureaucratic Lenses: Example of a Highway Project," *Journal of Policy Analysis and Management*, 12, no. 3 (1993), 532–555, Table 2, p. 539.

ternative and $297.3 million for the with-tolls alternative. In general, they ignore impacts valued by consumers and producers such as time saved and lives saved. When guardians are in control of a government service, it is easy to understand why one has to wait so long for the service. Neither your time nor anyone else's figures into their calculations. Similarly, guardians tend to ignore nonfinancial social costs, such as congestion and pollution.

In the Coquihalla Highway example, all social costs happen to represent governmental budgetary costs and so there is no difference between the CBA cost figures and the guardians' cost figures. In other situations, however, there might be considerable differences between correct social costs and guardians' costs. Consider, for example, the cost of labor in job-creation programs. Guardians would treat the full financial remuneration to labor as a cost, whereas CBA analysts would consider only the loss of other opportunities (such as lost leisure time). Another manifestation of the same mistake concerns the treatment of resources currently owned by the government, such as offices or land. Guardians tend to treat these resources as free because using them for a project does not entail additional budgetary outlay. They ignore the value of these resources in other uses.

Guardians ignore costs not borne by their level of government. Thus, they ignore the loss suffered by British Columbians from paying tolls and treat toll revenues as a benefit. In CBA tolls are a transfer from travelers to the government: Offsetting costs and benefits results in net benefits of zero. On the other hand, guardians automatically treat subsidies from the federal government as a benefit because they are revenue inflows. However, if the federal government has earmarked a certain amount of money to transfer to British Columbia and if funds used for one purpose reduce the amount available for other purposes, then federal funds for this highway should not be treated as a benefit from the provincial perspective.

Finally, guardians generally want to use a high social discount rate. Because of their financial background or their agency's culture, they naturally prefer to use a financial market discount rate, which is generally higher than the appropriate social discount rate. They also know that using a high discount rate will make it more difficult to justify most projects because costs usually occur before benefits. Thus, it is easier to limit spenders who, in their view, overestimate benefits, underestimate costs, and generally use money less efficiently than the private sector.

Spenders

Spenders are usually in service or line departments. Some service departments, such as transportation, may be involved with physical projects, whereas social service departments, such as health, welfare, or recreation, make human capital investments. Some service departments, such as housing, make both types of expenditures. The views of spenders are somewhat more variegated than those of guardians because the constituencies of particular agencies are more varied. Nevertheless, there are several major commonalities.

Most importantly, spenders have a natural tendency to regard expenditures on constituents as benefits rather than as costs. Thus, for example, they typically see expenditures on labor as a benefit rather than a cost. Spenders regard themselves as builders or professional deliverers of government-mandated services. As spenders focus on providing projects or services to particular groups in society, we characterize them as

engaging in *constituency-support analysis*. Table 1.5 summarizes how spenders in the provincial highway department view the no-tolls and with-tolls alternatives.

Spenders treat social benefits received by and monetary payments to their constituents (residents of British Columbia in this example) as benefits. Thus, time saved, lives saved, and vehicle operating costs saved by British Columbians are benefits. However, they also treat money received by construction workers who build the highway as a benefit. Thus, spenders think of both project benefits *and* project costs as benefits. With this method of accounting, both the with-tolls and no-tolls highway alternatives generate huge net constituency benefits. In general, spenders tend to support *any* alternative rather than the status quo (no project). Thus, the mistrust of spenders by guardians is perfectly understandable. Guardians and spenders almost always oppose one another.

Spenders view monetary outlays by British Columbian highway users (also their constituents) as costs; for example, they treat tolls paid by British Columbians as costs. Table 1.5 shows that spenders favor the no-tolls alternative primarily because a toll is a cost for some of their constituents. Indeed, spenders normally do not favor "user pay" fees unless their agency keeps the toll revenue within its own budget or the payers are nonconstituents. If spenders could collect and keep the tolls, they would face a dilemma: Tolls would reduce constituency benefits but would increase the agency's budget. Thus, they would face a trade-off between constituency-support maximization and budget maximization.[25]

In general, as Robert Haveman and others have pointed out, politicians prefer projects that concentrate benefits on particular interest groups and camouflage costs or diffuse them widely over the population.[26] Spenders are similar. They tend to weight each impact category by the strength of the connection that constituents make between the impact and their agency. They focus on impacts that their constituents will give them a lot of credit for and will ignore others. Because people almost always notice expenditures on themselves, such "benefits" are invariably weighted more heavily than social benefits.[27] Thus, for example, construction jobs are more heavily weighted than diffuse social benefits.

TABLE 1.5 Coquihalla Highway from a State Spender's Perspective (1986 $ Million)

	No Tolls	***With Tolls***
Constituency "Benefits":		
Project Costs (from CBA)	345.7	354.4
Project Benefits (from CBA)	384.1	334.7
	729.8	689.1
Constituency "Costs":		
Toll Revenues from British Columbia Residents	—	112.1
Net Constituency "Benefits"	729.8	577.0

Source: Adapted from Anthony Boardman, Aidan Vining, and W. G. Waters II, "Costs and Benefits through Bureaucratic Lenses: Example of a Highway Project," *Journal of Policy Analysis and Management,* 12, no. 3 (1993), 532–555, Table 3, p. 542.

Spenders are also similar to politicians in their determination to complete partially completed projects. Congress, for example, decided to complete the Tellico Dam when it was 90 percent complete, even though the incremental costs exceeded the incremental benefits.[28]

Presumably, the politicians believed that continuation of the project bought ongoing political support. Even though sunk costs are, by definition, sunk, and it may not be efficient to finish a partially completed project, spenders tend to believe that there are positive constituency-support benefits from completion of projects.

Spenders treat some inputs as neither benefits nor costs. Currently owned government assets may simply be ignored. In support of the Tellico Dam, for example, the Tennessee Valley Authority (TVA) argued that "since the farmland behind the dam had already been purchased, the value of this land should be considered a sunk cost, even though the land has yet to be flooded and could be resold as farmland if the project was not completed."[29]

Spenders tend to favor large, irreversible, capital-intensive projects. For example, spenders tend to favor urban rail systems over buses. Once the infrastructure is in place, it cannot be easily redeployed to other uses so the system will almost certainly remain in operation and constituents are guaranteed to receive some benefits. Furthermore, the normally lower operating costs for such projects allow for lower prices and relatively high usage levels, thereby further increasing constituency support.

The perspective of spenders concerning market efficiency has a bearing on the way they view many aspects of CBA. To spenders, markets are almost always inefficient. Spenders act as if unemployment is high in all labor markets. They believe that unemployment will be reduced by the number of people used on a government project. Even if some workers switch from other employment, these workers' vacated jobs will be filled by an unemployed worker. Thus, even if the job created did not go directly to an unemployed worker, there would eventually be a job "created" for an unemployed worker. Spenders do not recognize that project resources are diverted from other potentially productive uses that would also involve jobs.

Furthermore, spenders believe there are indirect benefits of creating jobs and making other project expenditures—there is a multiplier effect.[30] In the extreme, spenders have a "Midas touch" view of project evaluation: First declare the expenditures (costs) to be a "benefit," and then multiply these expenditures by a multiplier. As a result, any government project would be seen as producing "benefits" greater than "costs."

Spenders generally favor using a low (even zero) social discount rate. For some, this is because they are not familiar with the concept of discounting. For others, they know this tends to raise the project's *NPV* and, therefore, the probability of its adoption. Other ways spenders generate support for their projects is to choose a poorly performing counterfactual (a straw man) or to overestimate project usage levels and, therefore, benefits.[31]

CONCLUSION

This chapter provides a broad overview of many of the most important issues in CBA. We deal with these issues in detail in subsequent chapters. At this point, do not worry if you can only see CBA "through the glass, darkly." Do not worry if you cannot entirely

follow the highway analysis. Our aim was to give you a taste of the practical realities. We think that it is important to provide readers with a sense of these realities before dealing with the technical issues.

CBA is often taught in a way that is completely divorced from political reality. We wish to avoid this mistake. CBA is a normative tool, not a description of how political and bureaucratic decision makers actually make decisions. Because CBA disregards the demands of politicians, spenders, guardians, and interest groups, it is not surprising that there are tremendous pressures to ignore it or, alternatively, to adapt it to the desires of various constituencies or interest groups. In practice, correct CBA is no more than a voice for rational decision making.

Exercises for Chapter 1

1. Imagine that you live in a city that currently does not require bicycle riders to wear helmets. Furthermore, imagine that you enjoy riding your bicycle without wearing a helmet.
   a. From your perspective, what are the major costs and benefits of a proposed city ordinance that would require all bicycle riders to wear helmets?
   b. What are the costs and benefits from society's perspective?
2. The effects of a tariff on imported kumquats can be divided into the following categories: tariff revenues received by the treasury ($8 million); increased use of resources to produce more kumquats domestically ($6 million); the value of reduced consumption by domestic consumers ($4 million); and increased profits received by domestic kumquat growers ($5 million). A CBA from the national perspective would find costs of the tariff equal to $10 million—the sum of the costs of increased domestic production and forgone domestic consumption ($6 million + $4 million = $10 million). The increased profits received by domestic kumquat growers and the tariff revenues received by the treasury simply reflect higher prices paid by domestic consumers on the kumquats that they continue to consume and, hence, count as neither benefits nor costs. Thus, the net benefits of the tariff are negative (−$10 million). Consequently, the CBA would recommend against adoption of the tariff.
   a. Assuming the agriculture department views kumquat growers as its primary constituency, how would it calculate net benefits if it behaves as if it is a spender?
   b. Assuming the treasury department behaves as if it is a guardian, how would it calculate net benefits if it believes that domestic growers pay profit taxes at an average rate of 20 percent?

Notes

1. "Letter to Joseph Priestley," in *Benjamin Franklin: Representative Selections, with Introduction, Bibliography and Notes,* Frank Luther Mott and Chester E. Jorgenson, eds., (New York: American Book Company, 1936), pp. 348–349. We would like to thank Ken MacCrimmon for bringing this quote to our attention.
2. But see Linda R. Cohen and Roger G. Noll, eds., *The Technology Pork Barrel* (Washington, DC: The Brookings Institution, 1991). We do not include CBAs by the World Bank of its own projects because they are neither disinterested nor published. In fact, evidence suggests that the World Bank does not actually use CBA much; see Nathaniel H. Leff, "The Use of Policy-Science Tools in Public-Sector Decision Making: Social Benefit-Cost Analysis in the World Bank," *Kyklos,* 38, no. 1 (1985), 60–76.

3. Federal Environmental Assessment Review Office, *Oldman River Dam: Report of the Environmental Assessment Panel*, Ottawa, Ontario, May 1992.
4. For summaries of the workfare evaluations, see Judith M. Gueron and Edward Pauly, *From Work to Welfare* (New York: Russell Sage Foundation, 1991), and Daniel Friedlander, David H. Greenberg, and Philip K. Robins, "Evaluating Government Training Programs for the Economically Disadvantaged," *Journal of Economic Literature*, 35, no. 4 (1997), 1089–1855.
5. See Martha Derthick and Paul J. Quirk, *The Politics of Deregulation* (Washington, DC: The Brookings Institution, 1985), and Carol H. Weiss, "Evaluation for Decisions: Is Anybody There? Does Anybody Care?" *Evaluation Practice*, 9, no. 1 (1988), 5–20.
6. See Robert Hahn and John A. Hird, "The Costs and Benefits of Regulation: Review and Synthesis," *Yale Journal of Regulation*, 8, no. 1 (1991), 233–278.
7. Of course, other criteria may determine whether evaluative research actually gets used; see the preceding paragraph. For a review of evaluative research utilization in policy analysis, see David H. Greenberg and Marvin B. Mandell, "Research Utilization in Policymaking: A Tale of Two Series of Social Experiments," *Journal of Policy Analysis and Management*, 10, no. 4 (1991), 633–656.
8. Robinson G. Hollister, Peter Kemper, and Rebecca A. Maynard, eds., *The National Supported Work Demonstration* (Madison, WI: University of Wisconsin, 1984).
9. See Thomas K. Glennan, Jr., "Evaluating Federal Manpower Programs: Notes and Observations," in *Evaluating Social Programs: Theory, Practice and Politics*, Peter H. Rossi and Walter Williams, eds. (New York: Seminar Press, 1972).
10. Thomas D. Hopkins, "Economic Analysis Requirements as a Tool of Regulatory Reform: Experience in the United States," Statement presented to the Sub-Committee on Regulations and Competitiveness Standing Committee on Finance, House of Commons, Ottawa, September 15, 1992, p. 10.
11. U.S. Environmental Protection Agency, *EPA's Use of Benefit-Cost Analysis: 1981–1986*, EPA-230-05-87-028, Office of Policy, Planning and Evaluation, August 1987, pp. 1–3.
12. This example is based on W. G. Waters II and Shane Myers, "Benefit-Cost Analysis of a Toll Highway: British Columbia's Coquihalla," *Journal of Transportation Research Forum*, 28, no. 1 (1987), 434–443.
13. In fact, the divided highway was made of concrete with four lanes, and with tunnels for animals to be able to safely reach the other side.
14. G. A. Miller, "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information," *Psychological Review*, 65, no. 1 (1956), 81–97.
15. These studies are discussed by Robert Williamson, "Pulp Cleanup May Be Waste of Money," *Toronto Globe and Mail*, December 23, 1992, pp. A1, A6.
16. Jonathan Rubin, Gloria Helfand, and John Loomis, "A Benefit-Cost Analysis of the Northern Spotted Owl," *Journal of Forestry*, 89, no. 12 (1991), 25–30, at p. 26.
17. Of course, some additional deaths will occur as a result of more people traveling by road. This additional cost is netted out against the generated traffic benefits.
18. Ted R. Miller, "The Plausible Range for the Value of Life—Red Herrings Among the Mackerel," *Journal of Forensic Economics*, 3, no. 3, (1990), 17–39.
19. Note that at the optimum output level, marginal benefits equal marginal costs: $dB/dQ = dC/dQ$. One can see that the slope of the benefit curve at Q^* equals the slope of the cost curve at Q^*.
20. For the seminal writing on this topic, see Herbert A. Simon, *Models of Man* (New York: Wiley, 1957). Although this problem is unlikely to be of major importance in situations similar to that depicted in Figure 1.1, cognitive factors become an increasingly important issue when (1) project benefits and costs vary simultaneously on many dimensions, (2) the benefit and cost functions are discontinuous or complex (e.g., with interaction terms), or (3) there is uncertainty about the interactions or the functional forms.
21. As we will discuss in Chapter 4, tolls on congested highways generally increase net social benefits.
22. This section draws heavily on Anthony Boardman, Aidan Vining, and W. G. Waters II, "Costs and Benefits through Bureaucratic Lenses: Example of a Highway Project," *Journal of Policy Analysis and Management*, 12, no. 3 (1993), 532–555.

23. This terminology was introduced by Sanford Borins and David A. Good, "Spenders, Guardians and Policy Analysts: A Game of Budgeting Under the Policy and Expenditure Management System," Toronto, Case Program in Canadian Administration, Institute of Public Administration of Canada, 1987 (revised 1989).
24. In practice, revenue-expenditure analysis is similar to *cash flow analysis* and *budget impact analysis*. For certain purposes cash flow analysis and budget impact analysis are very helpful. A problem arises when an analyst does this type of analysis while thinking or maintaining that he or she is performing CBA.
25. See, for example, William A. Niskanen, "Bureaucrats and Politicians," *Journal of Law and Economics,* 18, no. 3 (1975), 617–643, and André Blais and Stéphane Dion, eds., *The Budget-Maximizing Bureaucrat: Appraisals and Evidence* (Pittsburgh, PA: University of Pittsburgh Press, 1991). For various reasons, senior spenders may be more interested in the discretionary budget or "budget shaping" than in budget maximizing; see Patrick Dunleavy, *Democracy, Bureaucracy and Public Choice* (Englewood Cliffs, NJ: Prentice Hall, 1992). They may, therefore, be willing to support projects that involve considerable "contracting out" and other activities that may not be budget maximizing per se.
26. Robert H. Haveman, "Policy Analysis and the Congress: An Economist's View," *Policy Analysis,* 2, no. 2 (1976), 235–250.
27. Barry R. Weingast et al. refer to this phenomenon as the "Robert Moses effect" after the "famous New Yorker who appreciated it and exploited it so effectively." See Barry R. Weingast, Kenneth A. Shepsle, and Christopher Johnsen, "The Political Economy of Benefits and Costs: A Neoclassical Approach to Distributive Politics," *Journal of Political Economy,* 89, no. 4 (1981), 642–664, at p. 648.
28. R. K. Davis, "Lessons in Politics and Economics from the Snail Darter," in *Environmental Resources and Applied Welfare Economics: Essays in Honor of John V. Krutilla,* Vernon K. Smith, ed., (Washington, DC: Resources for the Future, 1988), pp. 211–236.
29. Robert D. Behn, "Policy Analysis and Policy Politics," *Policy Analysis*, 7, no. 2 (1981), 199–226, at p. 213, n. 27.
30. One reason some bureaucrats attach so much importance to multipliers is because they have a basic grounding in input-output analysis, but they do not clearly understand the fundamental distinction between impact analysis and evaluation analysis; see W. G. Waters II, "Impact Studies and the Evaluation of Public Projects," *Annals of Regional Science,* 10, no. 1 (1976), 98–103.
31. See, for example, John F. Kain, "The Use of Straw Men in the Economic Evaluation of Rail Transport Projects," *American Economic Review, AEA Papers and Proceedings,* 82, no. 2 (1992), 487–493, and Linda R. Cohen and Roger G. Noll, eds., *The Technology Pork Barrel* (Washington, DC: The Brookings Institution, 1991).