19

Facilitating Regulatory Design and Stakeholder Participation

The FERET Template with an Application to the Clean Air Act

R. Scott Farrow, Eva Wong, Rafael A. Ponce, Elaine M. Faustman, and Richard O. Zerbe

The federal government requires impact and benefit–cost analyses for major regulations, as do numerous states.[1] In addition to a role in regulatory development, such analyses are important to stakeholders of all persuasions who comment on regulations and participate in the public debate. However, the high cost and slow pace of conducting customized studies are barriers to their use early in regulatory development and in later public participation. The Fast Environmental Regulatory Evaluation Tool (FERET) is designed to provide a common platform reflecting best practice, lower costs, and faster delivery time in the expectation of improving regulatory development and stakeholder involvement.

As a risk assessment and benefit–cost tool, FERET integrates impact and benefit–cost analysis while incorporating uncertainty into both. In environmental policy analysis, uncertainty usually focuses on the risk assessment of health impacts. In contrast, benefit–cost evaluation typically involves a different group of researchers. This dichotomy also appears in separate policy suggestions to improve regulation through the use of risk and benefit–cost analyses.

In this chapter, we describe a computerized template for benefit–cost analysis that integrates aspects of risk and economic analysis. We illustrate its uses by evaluating alternative health and economics assumptions in the analysis of the future benefits and costs of the Clean Air Act (U.S. EPA 1997, 1999). The complete FERET model along with supporting documentation is provided on the CD-ROM provided with this book and also is available from the authors. (FERET operates using Microsoft Excel and Decisioneering Crystal Ball for full functionality.)

Regulatory Evaluation

How and when are regulatory evaluations produced? Various environmental, health, economic, and policy analysis professionals are called upon to produce impact and benefit–cost analyses. Analyses are typically carried out for only the small fraction of federal regulations that are considered major, about 1% in 1999 (OMB 2000), and the number for states is likely to be even lower. The cost of such analyses, in the few cases publicly known, ranges from $200,000 to $8 million and can often take years to complete (Morgenstern 1997). Could regulatory development benefit from application to the 99% of regulations that are not analyzed, or from a public debate that allows expanded access to experiment with alternative designs and scientific assumptions? Could the standard practice of focusing on a mean or average value with a few variations be better informed by a broader consideration of uncertainty throughout the analysis?

Believing that the answer to these questions is "yes," we set out to design a computerized template that would

- structure the basic integration of impacts and valuation;
- provide a core survey of the literature;[2]
- incorporate uncertainty through simulation methods; and
- deliver a bottom line benefit–cost analysis that reports quantitative impacts, economics values, and qualitative elements.

The resulting program is FERET.

Benefit–Cost Analysis and the Structure of FERET

Benefit–cost analysis is a long-established technique that is the subject of numerous books that address both estimation and conceptual issues (for example, Zerbe and Dively 1994; Hanley and Spash 1993). The conceptual underpinning of the benefit–cost approach is a field called *welfare economics*, which seeks to answer whether a society's well-being is improved after some action, such as a new regulation. Such analyses are problem-specific, but a common starting point is to assess changes in one or several markets while allowing for external nonmarket effects such as pollution damages. It is typically assumed that a competitive market exists (that is, there are many buyers and sellers[3]) and that welfare is increased as long as those who gain can potentially compensate those who lose (the Kaldor–Hicks criteria, as discussed in Zerbe and Dively 1994 and Farrow 1998, among others). FERET can be consistent with a welfare theoretic analysis because it computes net benefits as the difference between reductions in external costs and the costs of compliance. For example, the dominant benefits from the reduction of conventional air pollutants are health impacts avoided—the reduction in external impacts—while industry control costs represent the typical cost.

Some distributional issues related to income also can be evaluated in FERET, even if they receive little attention in standard benefit–cost analysis. As an example, compliance costs in FERET include taxes,[4] because tax transfers net out (are equal) among gaining and losing parties. However, analysts can segregate tax payments if they wish as a gain to one party and a loss to another. Other distributional issues involve who bears the costs and who receives the benefits. For instance, although the basic structure of FERET identifies the compliance cost as those of industry, such costs are wholly or partially passed on to consumers who bear the final costs. Newly emerged concerns under the name of environmental justice or equity investigate the impacts on minority or low-income groups who may bear a disproportionate burden of external costs. FERET can be used to assess these costs or benefits as well.

How FERET Facilitates Benefit–Cost Analysis

FERET was designed to not only improve on standard practice but also move to best practice. As support to the analyst, FERET provides current guidance from government and other sources such as that by the Office of Management and Budget in the Executive Office of the President, the U.S. Environmental Protection Agency (EPA), and the state of California. Outside critics also have developed various lists of what constitutes best practice.[5] Below, we list recent suggestions for improving benefit–cost analysis developed by a distinguished group of economists (Arrow and others 1996) and explain how FERET addresses these suggestions.

"Benefits and costs of proposed policies should be quantified wherever possible. Best estimates should be presented along with a description of the uncertainties." FERET provides the template to quantify costs and benefits. Best estimates, often interpreted as either the mean or the median value, are easily available in FERET, as is the entire statistical distribution as a representation of the uncertainty.

"A core set of economic assumptions should be used in calculating benefits and costs associated with environment, health, and safety regulation. Key variables include the social discount rate, the value of reducing risks of dying and accidents, and the value associated with other improvements in health." In FERET, the analyst selects the discount rate and other economic parameters with various Help files to assist in that choice. Furthermore, instead of depending on a single economic value, FERET provides a bibliography of values. The user has the opportunity to select one or many studies as the basis of key health and economic variables. Additional guidance is provided by identifying studies chosen by EPA in its work.

"Information should be presented clearly and succinctly in a regulatory impact (benefit–cost) analysis. Transparency is necessary if benefit–cost analysis is to inform decisionmaking." FERET, while not writing the text for a benefit–cost analysis, is an openly structured template in which the effects of different benefit or cost assumptions can be investigated. Written in Excel, it is (relatively) transparent in its form and operation. Users can use the built-in capabilities of commercial software such as Excel and Crystal Ball to track changes, prepare reports, and display results graphically.

"It is important to identify the incremental benefits and costs associated with different regulatory policies." FERET is designed to assess the impact of regulations through a "with and without" kind of analysis that is the basis for assessing incremental benefits. Although guidance is provided on this topic, only the analyst can establish the sequence of regulatory designs that identify various levels of "incremental" regulation. Once defined, the regulatory design becomes the basis for an incremental analysis.

"Whereas benefit–cost analysis should focus primarily on the overall relationship between benefits and costs, a good benefit–cost analysis will identify important distributional consequences of a policy." FERET can be used in several ways to identify the distributional aspects of a regulation. For instance, modifying the "exposed population" is one way to identify subsets of the overall population, perhaps based on income or race. Health and valuation studies also can be selected that focus on subsets of the population such as children. Finally, information about the direct incidence of costs among business, consumers, and the government can be identified.

"Not all impacts of a decision can be quantified or expressed in dollar terms. Care should be taken to ensure that quantitative factors do not dominate important qualitative factors in decisionmaking." FERET provides a special area to enter qualitative factors that may affect decisions. These factors are presented with the quantitative results. Also presented is a calculation showing how large the qualitative factors need to be to change the economic value of the regulation from positive to negative or vice versa.

"The more external review regulatory analyses receive, the better they are likely to be." FERET's default assumptions are based on EPA's peer-reviewed studies of the retrospective and prospective studies of the Clean Air Act. FERET has been circulated for testing among interested users. Most important, FERET provides a common structure for stakeholder participation in regulatory debate. If one stakeholder develops an analysis, his or her assumptions are readily apparent in FERET. Other stakeholders may conduct external reviews of the original analysis with analyses of their own.

Beyond Best Practice

FERET provides several additional capabilities. For instance, the most important assumptions can be quantitatively identified through the sensitivity analysis features of Crystal Ball, analysts can pick more than one value for key parameters and use the results of several studies, the optimal level of regulation can sometimes be calculated, and graphics and statistics are provided. Perhaps of most importance, FERET reports the physical and other impacts used in the production of the benefit estimates, which are of direct interest to various stakeholders.

The Structure of FERET When Data Are Known

The structure of FERET is relatively simple. First we discuss the structure as if key parameter values are known, and then we discuss uncertainty over those parameters. The end point of FERET's calculations are estimates of the *present value of net benefits,* the difference between the present value benefits (PVB) and present value costs (PVC). In regulatory applications, PVB are typically external (third-party) costs avoided, such as health impacts. The annual benefits of an external impact j (B_j) are

$$B_j = \Delta y_j \times V_j$$

where Δy_j is the change in impact j (such as health cases), which is valued at V_j. For example, impact j could be the number of premature deaths avoided through control of airborne particulate emissions. PVB is the sum over all impacts (J) and time periods (t, up to terminal time T):

$$\text{PVB} = \sum_{t=0}^{T} \sum_{j=1}^{J} \frac{B_{jt}(1+i)^t}{(1+r)^t}$$

where i is any rate of growth in real benefits (say, due to increased population growth) and r is a real (excluding inflation) discount rate. B_{jt} may be zero in some early years if there is a latency period or a delay in implementation (the latter two delays are possible input choices for the user).

Health impacts in particular are measured (in the primary approach) through concentration–response functions, typically of the form

$$\Delta y_j = -y_j(e^{-\beta \Delta X} - 1)$$

where ΔX is the change in concentration of a pollutants and β is the concentration response (the percent change in cases caused by a unit change in concentration) estimated from epidemiological data.

On the cost side, PVC encompasses compliance costs by industry and any nonmarket costs (external costs) to consumers. These costs are context-specific to the regulatory design. Some analysts may have their own models of cost, in which case a cost distribution can be entered directly. Alternatively, FERET provides an EPA model, PROJECT, for cost estimation. PROJECT, which has been used in various forms in courts for more than a decade, computes the PVC on the basis of estimates of fixed, operating, and maintenance costs. The user is prompted for cost assumptions (with help available in documentation from EPA and provided with FERET) on the life of buildings and equipment associated with fixed costs. Taking into account the life of the project and any replacement cycle, the model computes the PVC.

Taxes also can be taken into account if the user wishes to identify some distributional impacts, such as those among industry, government, and the consumer. The basic FERET analysis sets the tax rate to zero on the basis of welfare economic results for the standard computation of social benefits and costs.

Intermediate information is obtained on all environmental impacts that are quantified. In addition, a *cost-effectiveness analysis* (that is, the least cost of achieving a given objective) can be carried out by setting the benefit to zero and studying costs of the regulatory alternative. Alternatively, benefits can be the sole focus of analysis. By finding the level of control that balances additional costs with additional benefits, the regulation can be optimized; this feature is not yet automated, but the underlying software is capable of performing the task.

Incorporating Uncertainty

Depending on the context, there can be uncertainty over several parameters, including the change in concentration, the concentration–response function, compliance costs, and the value of impacts (ΔX, β, C, and V). For concentration and cost, FERET uses a single user-defined distribution to represent the uncertainty. However, for health response and valuation, there is uncertainty as to which distribution among many should be used. Different studies report different distributions, and some studies report multiple distributions. To accommodate this surplus of information, FERET has a two-step procedure that first selects which distribution should be used in one trial and then selects a single measure from that distribution. The process is repeated so that on the next iteration, a different study (or the same one) is randomly selected and its distribution sampled. The resulting empirical "meta-distribution" takes into account the distribution over all the studies selected by the user.

FERET provides a flexible structure. For example, although the studies used by EPA (1997, 1999) are provided as a default, users can easily "turn off" any study from the bibliography so it will not be sampled; similarly, studies can be given different weights. Alternatively, users can select non-EPA studies or add their own studies. Documentation is provided for key characteristics of each study (demographics, location, peer review, source of data, and so on) as well as the full citation.

Figure 19-1 illustrates the steps to generate a single "trial" or "observation" for a single pollutant and a single impact. The first step is to sample from the change in concentration based on the user's regulatory design (Step 1). FERET then randomly selects one study from among the health studies chosen for use and samples from the distribution of the response function of that study (Steps 2 and 3). When the sample values are substituted into the concentration–response function, the number of cases changes. For most functions, the baseline number of cases is determined from information calculated using either EPA-provided incidence rates or national baseline incidence rates already integrated into FERET. Users can change the baseline if they have more local information. Valuing the change in cases follows similarly in Steps 4 and 5, in which a valuation study is randomly selected from among the potential set and then an observation is drawn from the distribution of the value from that study. When the value is multiplied times the change in the number of cases, the monetized benefits of the environmental improvement are recorded for that one trial. FERET then samples from the distribution of compliance cost.

The difference between the cost and the benefit, after putting both values in present value terms,[6] is the net present value of the action. The bottom line is a distribution of environmental and monetary impacts, including the present value of net benefits.

Output Reporting and Sensitivity

FERET provides a summary table showing the mean, 5th and 95th percentiles for the health impacts, and the present value. These are the data most

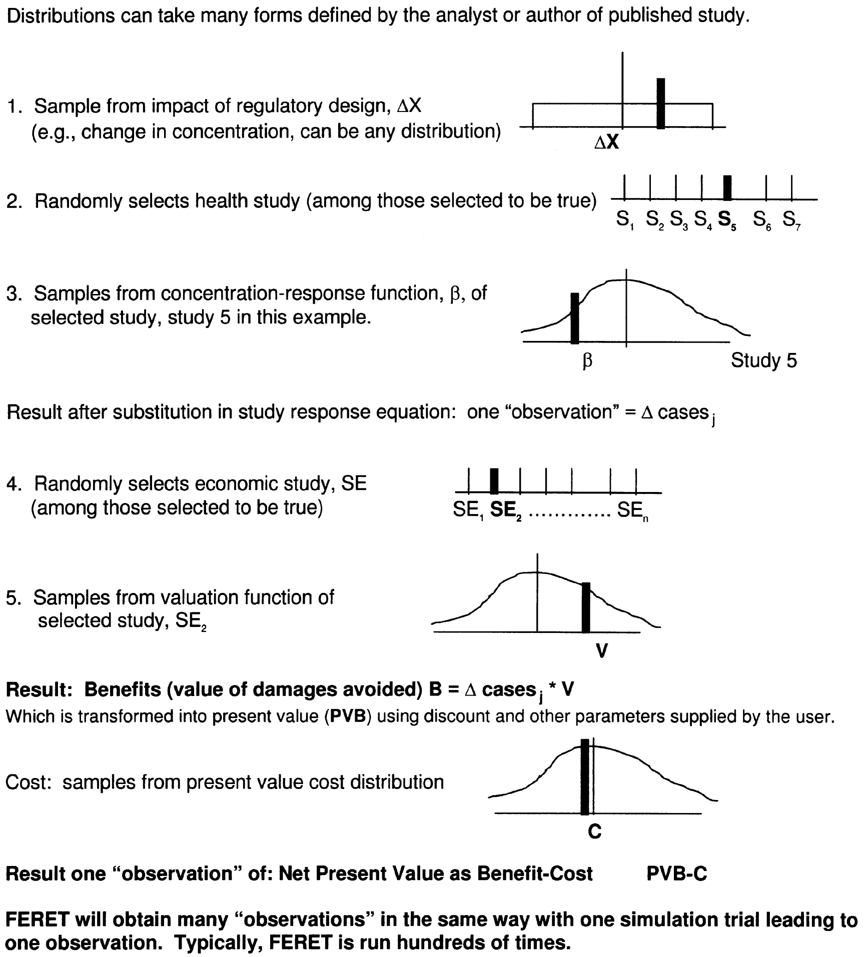

FIGURE 19-1. FERET Conceptual Flow Chart for One Impact of One Pollutant

frequently used in a benefit–cost analysis, although complete information on the statistical distribution for each intermediate and final output is available. Adjacent material provides qualitative information entered by the user from the regulatory design worksheet. Sensitivity analyses that identify the assumptions most highly correlated with a particular forecast can be automatically generated, as can sensitivity plots that show the outcome of varying a particular parameter. Data, including graphics of cumulative or frequency distributions, can be outputted in the form of a report.

At the end of an analysis, FERET produces the essentials of an economic risk assessment: a benefit–cost analysis with uncertainty, along with health and other impacts more traditionally associated with such studies. How such an analysis is used enters the territory of risk management. A decisionmaker applying standard economic analysis may suggest taking any or all of the actions whose mean (expected) present value is positive. In fact, distributional and other issues make the conclusion less clear. Typically, the analyst and the decisionmaker will want to know about the sensitivity of the results to changes in some assumptions, such as the discount rate or the exposed population, which is easily done in FERET. Others might feel that the direction of the qualitative impacts is clear and might, therefore, change a decision based on only the monetized impacts. Finally, some decisionmakers may use a modified decision criteria, perhaps due to budget constraints or some kind of precautionary principle. FERET assists in the risk and benefit–cost analysis, but it is not a risk manager or a decisionmaker.

Case Application: The Costs and Benefits of the Clean Air Act

EPA recently completed an important set of studies on the costs and benefits of the Clean Air Act (U.S. EPA 1997, 1999). EPA's analyses are based on an extensive review of the literature and the construction of elaborate air pollution, health, and valuation models that predict and value impacts on health and the environment. Numerous sensitivity and other studies were developed over the several-year period during which these studies were prepared. However, the public has little ability to investigate assumptions other than those used by EPA.

Because the structure of FERET is designed to allow analysts to follow the EPA approach but deviate from it when they wish, the EPA analyses provide a testing ground for both calibrating FERET and testing FERET's potential as a stakeholder participation tool. Consequently, in the last section, we report a calibration to EPA's results for 2010 and investigate several modifications of EPA's analysis.[7]

Calibration to EPA's Costs and Benefits

FERET is designed to follow the intent of and utilize the same statistical building blocks as EPA in its studies of the Clean Air Act. However, unavoidable differences result because the underlying EPA model is based on finer geographic resolution, and even the quite good documentation provided by EPA does not address all the technical questions that one might ask. The calibration efforts use the same health and economic studies, incidence rates, discount rate, latency periods, and so on (details are provided in the CD-

TABLE 19-1. Mean Values of Impacts, Benefits, and Costs: EPA and Calibration FERET

Comparison impact	*EPA 2010*	*FERET*
Present value net benefit (billion $)	83–86	83
Premature mortality (no. of deaths)	23,000	23,000
Total benefit (billion $)	110	110
Total cost (billion $)	27	27

ROM provided with this book). The impact of the Clean Air Act on national concentrations (the regulatory design) was calculated from EPA data to make those values consistent with key outcomes in the EPA report.

The driving factor in the costs and benefits of the Clean Air Act is the number of premature deaths avoided, which account for more than 90% of PVB. In Table 19-1, the EPA results for 2010 and a calibration result from FERET are presented for key economic and health dimensions.

Although any particular simulation can generate somewhat different outcomes, the results from FERET nearly replicated the EPA results. The benefits, costs, net present value, and premature mortality are quite accurate, but there is some ambiguity as to which present value one should calibrate. EPA variously reports the mean net present value as $83 billion (U.S. EPA 1999, iii), $86 billion (implied on p. 114), and $93 billion (p. 105). EPA tables suggest that $83 billion or $86 billion is intended. Some differences exist between EPA values and FERET predictions. For instance, FERET predicts somewhat higher incidence of respiratory and cardiovascular hospital admissions (due at least in part to a somewhat different aggregation process across studies) and a somewhat lower mean value per life saved.[8]

Figure 19-2 illustrates one of several of the visual outputs of FERET, showing a chart of the distribution of the present value of the net benefits. Because FERET's base-case calibration reasonably mimics the results of the EPA analysis, we use FERET to address several issues as if we were stakeholders interested in regulatory development or a fast turnaround and assessment of the regulatory analysis. The first question regards the importance of the mortality concentration–response study used by EPA. The second question is about the role of valuation studies that used contingent valuation survey techniques.

FERET is designed to allow the user to easily change the studies on which the analysis is based. Alternative FERET analyses were conducted that first use the short-run mortality studies considered by EPA in its draft retrospective study, followed by an alternative using two long-term studies instead of one. The use of long-term studies was advised by the EPA Clean Air Council. Two sets of changes were necessary to assess the importance of the shift from one long-term study to short-term studies. One change is the incidence rate and another the exposed population. Because the long-term study (Pope and

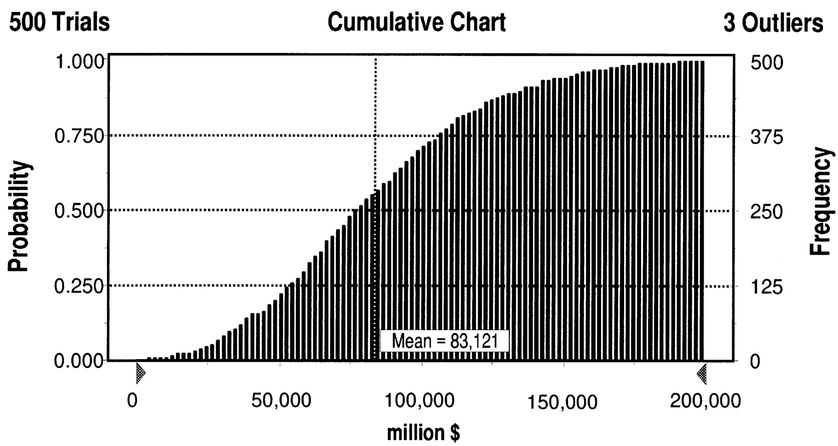

FIGURE 19-2. Cumulative Distribution of Net Present Value

others 1995) was based on premature deaths of people more than 30 years old, the incidence rate was changed from that used in the EPA study to correspond to an "all ages" incidence rate for the short-term studies, as was the exposed population. The result is presented in Table 19-2.

The difference between short and long-term studies is quite dramatic. The present value of net benefits drops by 98%, whereas deaths drop by almost 90%. There is a 50% chance that net benefits are negative using the short-term studies, with a daily improvement in concentration equal to the long-term mean. Alternatively, if a second long-term study (Dockery and others 1993) is used equally along with that of Pope and others (1995) (using the initial incidence rate and assuming the annual mean pollution change equals the median change), then net benefits increase to 136 billion and deaths averted increase to 36,000.

Does this result mean that the EPA analysis is flawed? No. It points out the importance of the decision to use the different types of studies. If long-term studies are the right choice, then the value of information is dramatic. It reveals that the reduction of pollution is much more important than previously thought, compared with short-term studies. Alternatively, it may suggest some caution in dropping one modeling approach, using short-term studies, and entirely depending on newer results.[9]

The second question investigated the importance of the method of estimating the value of a statistical life. Contingent valuation is a survey method (Farrow, Goldberg, and Small 2000) that is the subject of heated professional debate regarding its reliability and interpretation. Some analysts do not believe that such studies are consistent with sound economic science, whereas others believe that they can be consistent.

TABLE 19-2. Mean Values of Impacts, Benefits, and Costs: EPA and Calibration FERET Short- and Long-Term Studies

Comparison impact	*EPA 2010 (1 long term)*	*FERET 2010 (2 long term)*	*(short term)*
Present value net benefit (billion $)	83–86	137	2
Particulate-caused mortality (no. of deaths)	23,000	36,000	3,000

A solution as to its role in a policy debate (but not its science) is available. Within FERET, economic studies—in parallel to the health studies—can be turned on or off, and weighted in different ways. The importance of the contingent valuation studies is investigated by comparing the outcomes when they are and are not used. One other change was necessary to compare the valuation studies. EPA used a single distribution, fit to the mean estimates of the valuation studies, and drew values of a statistical life from that distribution. This method does not allow the user to delete studies selectively. When an alternative base case is estimated using individual valuation studies instead of EPA's distribution, the net benefits increase somewhat to more than $90 billion from the EPA results of $83 billion. When the contingent valuation studies are then removed from the study set, the median value per life saved changes by only $200,000 (from a mean of $4.4 million), and the net present value changes by only a few billion dollars (a few percent). This change is relatively small in the context of the broader variation of the outcome. We conclude that whether contingent valuation studies are used for the value of premature mortality is irrelevant to the overall outcome, therefore potentially removing a contentious issue from stakeholder discussions.

Finally, FERET automatically updates key data from the 1990 values used in the EPA report to more current dollars. These adjustments for the value of a dollar may have more of an effect on policy than many other modeling changes. EPA reported its basic results in 1990 dollars (as FERET does). When adjusted for inflation, as FERET can do for any year between 1990 and 2000 for key summary measures, the net benefits increase by 27%. In the perceptions of policymakers, this adjustment may be as real as any improvements in analysis.

Conclusions

FERET is a tool that integrates risk and policy analysis in a benefit–cost framework. Constructed around EPA's design and data for the costs and benefits of the Clean Air Act, FERET provides a quick tool for regulatory development and stakeholder participation. An application to the Clean Air Act illustrates its use as a stakeholder participation tool. It allows the quick investigation of alternative assumptions, such as which studies to include.

Using FERET, we found that the decision to move from short-term to long-term mortality studies is a key determinant of the benefits, whereas the distinction between economic studies that use or do not use contingent valuation is of relatively little importance. FERET appears to provide a flexible structure for use in regulatory development and stakeholder participation. Possible applications include state air quality regulations, as for older sites; screening to assess regulatory alternatives for federal regulation; support for company environmental management systems; environmental justice issues for different "exposed" populations; and health outcomes from health or safety regulation.

Notes

1. For a review of benefit–cost practice in the federal and state governments, see Farrow and Toman 1999 or Hahn 2000.

2. Morgenstern and Landy (1997, 461) state, "Contractors who conduct these studies argue that a remarkably large portion of the costs are associated with gathering information rather than from conducting actual analysis."

3. See, for instance, Varian 1992.

4. FERET includes a cost estimation program developed by the U.S. Environmental Protection Agency called PROJECT, which provides cost estimates that can remove the effect of taxation from the cost of the firm.

5. See, for example, Arrow and others 1996 and Farrow and Toman 1999.

6. The typical case will generate annual benefits that are put into present value terms using the regulatory design parameters of the timing of the action and Excel's present value formula. If the PROJECT model is used to generate costs, then the costs are already in present value terms.

7. However, FERET is being used to capture the nationwide output of the EPA analysis. The underlying EPA tools provide a finer geographic resolution, but this information has not been important to the debate, and the public is unlikely to have the ability to use the EPA model at such detail.

8. Run "FERET2010.xls" on the enclosed CD-ROM. You may wish to read calibration notes, also included.

9. For a different critique that might be quantified, see Lutter and Belzer 2000.

References

Arrow, K., M. Cropper, G. Eads, R. Hahn, L. Lave, R. Noll, P. Portney, M. Russell, R. Schmalensee, V.K. Smith, and R. Stavins. 1996. *Benefit–Cost Analysis in Environ-*

mental, Health, and Safety Regulation. AEI Press, Washington, DC. http://www.aeibrookings.org (accessed March 5, 2001).

Dockery, D.W., C. Pope, X. Xu, J. Spengler, J. Ware, M. Fay, B. Ferris, and F. Speizer. 1993. An Association between Air Pollution and Mortality in Six U.S. Cities. *New England Journal of Medicine* 329(24): 1753–1759.

Farrow, S. 1998. Environmental Equity and Sustainability: Rejecting the Kaldor Hicks Criteria. *Ecological Economics* 27(2): 183–188.

Farrow, S., and M. Toman. 1999. Using Environmental Benefit–Cost Analysis to Improve Government Performance. *Environment* 41(2): 12–15, 33–37.

Farrow, S., C. Goldburg, and M. Small (eds.). 2000. *Environmental Science and Technology* Special Edition (Economic Valuation), April 15.

Hahn, R. 2000. State and Federal Regulatory Reform: A Comparative Analysis. *The Journal of Legal Studies* 29(2): 873–912.

Hanley, N., and C. Spash. 1993. *Cost–Benefit Analysis and the Environment.* Edward Elgar: Hants, U.K.

Lutter, R., and R. Belzer. 2000. EPA Pats Itself on the Back. *Regulation* 23(3): 23–28.

Morgenstern, R. (ed). 1997. *Economic Analyses at the EPA.* Resources for the Future: Washington, DC.

Morgenstern, R., and M. Landy. 1997. Economic Analysis: Benefits, Costs, and Implications. In *Economic Analyses at the EPA,* edited by R. Morgenstern. Resources for the Future: Washington, DC, 455–478.

OMB (Office of Management and Budget). 2000. *Draft Report to Congress on the Costs and Benefits of Federal Regulations.* OMB: Washington, DC.

Pope, C.A., M. Thun, M. Namboodiri, D.W. Dockery, J. Evans, F. Speizer, and C. Heath. 1995. Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults. *American Journal of Critical Care Medicine* 151(3, Part 1): 669–674.

U.S. EPA (Environmental Protection Agency). 1997. *The Benefits and Costs of the Clean Air Act, 1970 to 1990.* U.S. EPA, Office of Air and Radiation: Washington, DC.

———. 1999. *The Benefits and Costs of the Clean Air Act, 1990 to 2010.* EPA-410-R-99-001. U.S. EPA, Office of Air and Radiation: Washington, DC.

Varian, H. 1992. *Microeconomics Analysis.* W.W. Norton and Company: New York.

Zerbe, R.O. Jr., and D.D. Dively. 1994. *Benefit–Cost Analysis in Theory and Practice.* HarperCollins College Publishers: New York.