Benefit-Cost Analysis for Environmentalists:

How to Play Within the "Rules of the Game" and Win

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Part I: Economics Background–Why Economists Like Benefit-Cost Analysis

Chapter 1. Introductory Matters of Logic and Philosophy

Scarcity implies choice–doing nothing is still a choice (Figure 1.1).
Should environmental quality be a matter of choice or a moral/ethical imperative?
Federal Register 1981 ruling: play within the "rules of the game" or be ignored!
Morality and ethics do, however, inform choices since they affect demands.
Zero pollution implies zero production implies zero people, a too-costly extreme.
But uncontrolled pollution is clearly too much...where to go between these extremes?
Who decides?
Humans are, inevitably, the decision-makers–no other species makes such decisions.
The very concept of a "good environment" is inherently human.
How to decide?
Wise choices have advantages (benefits) greater than disadvantages (costs).
The nature of environmental choices (discrete and continuous environmental goods).
Added advantages get smaller as we do more, while added costs get larger (Figure 1.2).
Is information adequate to decide or do we do such a bad job of deciding, that we would be better off not even trying to do it?
But scarcity requires that we prioritize the wide range projects environmentalists want.
Useful parallels between ordinary goods and environmental goods.

Chapter 2. Why Economists Like Market Outcomes for Ordinary Goods

Values: use, option to use, bequest, preservation.
The nature of private goods (rivalrous and excludable).
Do we care about *why* people like the private goods they like?
Dollars as mere units of account, with no moral or ethical significance.
Marginal willingness-to-pay and the Demand Curve.
Marginal cost and the Supply Curve.
The market equilibrium (Figure 2.1).
Desirable features of markets when there are no "missing markets" (Figure 2.2).
Consumer surplus and producer surplus (Figure 2.3).
The Invisible Hand of the market and optimal relative amounts of ordinary goods (Figures 2.4 and 2.5).
The role of prices: ration, provide information, and provide incentives.
What about equity?
International trade and environmental quality when there are no "missing markets."
Setting marginal benefit equal to marginal cost for environmental goods is the analog to supply and demand for private goods at a point in time.
Many projects require capital investments with benefits and costs occurring over time.

Chapter 3. Benefit-Cost Analysis when Information is "Perfect"

How do economists decide?–the role of time in environmental economic decision-making.
Environmental benefit-cost analysis as the analog to ordinary project evaluation.
"The" interest rate: what is it? (price of current consumption in terms of foregone future consumption, many interest rates–but they move together).
Where does the interest rate come from? (interaction between productivity and thrift...Figure 3.1).
Discounting and compounding–flip sides of the same coin.
Do projects if present value of benefits exceeds present value of costs (NPV > 0).
Illustrative numerical example.
Decision rules (if budget-constrained, max NPV, if mutually-exclusive projects max NPV).
Other methods require the same information, yet sometimes err (B/C ratio and IRR can be higher for inferior projects; implication for bias against the environment Figure 3.2).
Summary: benefit-cost analysis has the same desirable features, for projects with an important time dimension, as ordinary supply and demand does at a point in time.
Perfect information would imply perfect decisions, cross-sectionally and intertemporally.
Intergenerational equity as one source of contention.
Other reasons environmentalists revile benefit-cost analysis–problems with its practical implementation ("Is it progress if a cannibal uses knife and fork?"–Lec).

Part II: "Missing Markets": Externalities, Public Goods, and Property Rights

Chapter 4. Externalities As "Missing Markets."

In perfect markets, Price = Marginal Social Cost = Marginal Social Benefit.
When will the wrong amounts be produced and consumed at a point in time (Case 1)?
Prices are used as information and provide incentives, but what if the prices are "wrong?"
Externalities defined as a missing market–not really "market failure," but rather "failure to have markets."
If demanders impose costs on others when consuming, they will over-consume. (Congestion, noise, smoke from fireplace. Figure 4.1)
Positive externalities result in under-provision of a good (Figure 4.2).
Environmental problems: if suppliers do not pay all of the costs of supplying, they will over-supply. (Steel, pesticide examples. Figure 4.3)
Negative externalities result in over-provision of a good.
Are negative externalities synonymous with environmental problems? (Economist versus biologist/environmentalist...philosophy revisited)
Policy implication: Eliminate the "missing market" by internalizing the externality. (Policy alternatives: regulations, taxes, subsidies, and salable emission rights)

But how do we know how big the externality is?

Chapter 5. Public Goods as "Missing Markets"

When will the wrong amounts be produced and consumed (Case 2)?
Pure public goods are non-rivalrous and non-excludable.
Pure public goods are non-profitable to produce (non-excludable) hence under-provided (Figure 5.1).
Impure public goods of environmental concern: rivalrous but non-excludable. (Tragedy of the commons discussion. Prairie dog example.)
Most externalities tend to occur in "public good media." (Dumping trash onto *my* land versus into *my* air...what is "mine?")
Policy implication: Act "as if" the resource in question were a private good. (Vertical addition of individual values.)
Equity and public goods–additional problems, since we can't *individually* choose.
But how do we know what the marginal benefits and marginal costs are?

Chapter 6. Property Rights as a Potential Solution to Environmental Problems

Owned resources will be cared for properly because of ownership incentives. (Graffiti in public restrooms versus private homes, owner/renter examples, etc.)
Coase Theorem: a major reason why environmental problems are not more pervasive. (Important policy example: CITES ivory bans versus effective property rights; not "human greed" that is problem–cows, pigs, chickens don't go extinct, while elephants, whales, rhinos do...the role of effective property rights)
Sports draft, air quality, and water allocation examples (Figure 6.1)
Property rights must be clearly assigned, with assignment known to economic agents. (Mudsplashes example...who is liable?)
Transactions costs limit range of applicability of Coase Theorem in environmental context.
Assignment of property rights *does* matter on equity grounds. (Oil tanker spills and wealth effects dependent on property rights assignment)
But will assigning property rights solve environmental problems?

Part III: Important Theoretical Problems with Implementing Benefit-Cost Analysis

Chapter 7. A Well-Known "Demand Revelation" Problem

Public goods revisited: non-excludability and "free-riding" behavior. (Light from lighthouse as example of efficiency, equity and financing problems).
"Free-riding" as a "missing market" problem–a near infinite price is seen for *increments* to the public good while a price of zero is seen for whatever happens to be provided.

Policy implication: Create proper individual incentives, or do some projects that seem to have C > B. (Correct incentives unlikely as a practical matter)

Applied approaches to indirectly infer individual values, in light of this problem. (Lead-in to Part IV)

Chapter 8. A Less-Well-Known "Supply Revelation" Problem

First observation: increases in the public good will result in greater work effort, more income and more marginal willingness-to-pay than assumed in applied benefit-cost analysis with given income.
(Only 2nd-order effect if projects evaluated frequently in small increments, unlikely)

Second observation: we work to get the goods that we desire.

If we work and *do* generate the income we *can* increment ordinary private goods.

To the extent that we care about public goods, we have no incentive to expend work effort (we will "free ride" in input markets), because we will get the collectively determined amount regardless of our individual efforts.
(Extreme case of "hippie dropouts." Analog to inefficiencies of Soviet system)

Thus, all benefit-cost analysis of public goods, uses the wrong income levels for both reasons; the "supply revelation" problem, in particular, suggests that nearly all of the ungenerated income would have been spent on the public good (Figure 8.1).

Policy implication: some projects should be done that *appear* to have C > B.

We *will* buy the private good substitutes for unprovided public goods.
(Over-suburbanization discussion...failure to properly provide central city public goods such as safety, school quality, parks, etc. results in non-optimal sprawl)

Much ado about nothing?
(WTA-WTP gap as evidence of importance, small percentage changes in income result in huge percentage changes in public goods because of their smaller base)

The broader relevance of problems in these two chapters for impure public goods, and even some private goods.

Part IV: Practical Problems With the Implementation of Benefit-Cost Analysis

Chapter 9. Approaches to Estimating the Costs of Environmental Control Policies

Explicit and implicit costs.

Types of environmental policy costs:
required add-on controls.
required input or output changes (process changes).
spatial or temporal relocation of emissions costs.

The economic incentive approach (illustration, Figure 9.1).

Chapter 10. Overview of Approaches to the Valuation of Benefits of Environmental Policies

Emissions, *per se*, are not of importance, environmental quality is.
Given environmental quality damages depend on how many damage receptors exist.
The goal reiterated: equating true marginal costs to true marginal benefits.
Valuing the benefits of environmental policies–Overview of coming chapters.
(Referenda. Surveys, interviews, and experiments. Sum of specific damages. Hedonic methods)

Chapter 11. Voting As a Way to Infer Environmental Benefits

Goal: having policies with true net marginal benefits (B > C) adopted.
Central Problem: voting doesn't reflect intensity of wants (missing markets again).
(Discrete choice mechanism allows only "for" or "against")
Environmental benefits are often highly concentrated, going to the sick and rich.
(Emphasize: "Special interests" are still interests.)
Voting paradoxes and the role of the agenda-setter.
Rational voter ignorance and complex environmental referenda.
"Marginal" voter power leads to unknown efficiency bias.
(Implication for those caring about environment–join environmental groups)
Policy implication: voting unlikely to be a good way of inferring net benefits of a policy.

Chapter 12. Constructed Markets: Stated Preferences and Experiments to Infer Environmental Benefits

Goal: eliciting true marginal willingness-to-pay from individuals, aggregating to compare to costs (contingent valuation, conjoint analysis, laboratory experiments).
Does a "constructed market" have the potential to replicate a "missing market?"
(Do we elicit true WTP or merely "environmental attitudes")
Laundry list of potential problems (strategic bias, starting point bias, selectivity bias, interviewer bias, position bias, question wording bias, many more).
Is it "Art" or is it "Science?"
(How replicable are these approaches?)
Use values versus non-use values revisited–do we have any viable alternative to these approaches to get at measures of non-use values?
(Economists are better at inferring use values, from methods in the next chapters)

Chapter 13. The Sum of Specific Damages Approach

Approach: benefits of environmental policy equal damage reduction from that policy.
Intuition: multiply all of the reduced physical damages by their values, add up (Figure 13.1).
(Problems: All of the damages, not just some. Uncertain physical damages and

uncertain values to assign to those damages. Discussion of "value of statistical life")

Information sources are diverse and not equally convincing.
(cellular studies, laboratory experiments, human laboratory experiments with volunteers, case or retrospective studies, epidemiological statistical investigations, acute versus chronic damages)

A big issue: Those damaged are implicitly presumed in this approach to not perceive damages from pollution and not perceive where pollutant levels are high versus low.

If perceptions of damages from various pollutants are good *and* perceptions of where it is polluted are also good, people would be expected to mitigate those damages, incurring expenses–not captured by this approach–to lower those damages.

Policy implication: Sum of specific damages approach understates damages.

Chapter 14. Hedonic Methods of Valuing Environmental Amenities

Consider now a polar opposite assumption, that households *perfectly* perceive damages from pollution and where it is clean and dirty.

Approach: Examine how much households are willing-to-pay in land and/or labor markets to live in cleaner locations, other things equal.

The notion is most easily seen by thinking about a freeway, with "fast lanes" and "slow lanes,"drivers picking whichever they want. During rush hour, the lower average speeds make the "fast lanes" more appealing to all drivers. Drivers will move to the fast lanes until they are no longer faster than the slow lanes–the speeds will be equalized among the lanes...drivers are then indifferent among lanes.

Similarly, people would, other things equal, prefer to locate in cleaner parts of an urban area, and would be expected to move to clean areas from dirty areas until the clean areas rent or sell for an amount that completely offsets the benefits of cleanness. The rent or price differential is a direct measure, in convenient WTP dollars, of the value of cleaner areas.

Further, people would, other things equal, prefer to work in a cleaner city than in a dirtier city, hence firms would have to offer more to lure labor to the dirtier city. Again, the wage differential provides a handy direct measure of the value of cleaner areas.

Problems: 1) perceptions (if households don't perceive damages or the spatial variation in pollution, they will not require compensation in lower rents or higher wages, understating pollution damages. 2) bias if other "bads" are positively correlated with pollution, but omitted in the estimating equation, leading to overstatement of pollution damages. 3) Wage compensation and rent compensation *should* be added together, but almost never are (Roback, Rosen, Blomquist, et al.); Figures 14.1-4, Table 14.1.

Policy implication: Hedonic methods understate pollution damages, both because rent compensation and wage compensation are seldom added in practice and because many damages (those picked up in the SSD approach) are not perceived. Adding the two might lead to some unknown amount of double-counting, however.

Chapter 15. Travel Cost Method of Valuing Environmental Amenities

The notion underlying this method is that the value of a "destination" amenity must be at least as great as the cost of visiting or people would not visit.

Adding up the time and out-of-pocket costs of a trip provides a lower bound to the value of a trip.

Those with lower trip costs (living closer to the destination amenity) should take more frequent trips, enabling estimation of a trip-taking demand curve.

Only captures use value, and overstates that value relative to non-use values, distorting preservation decisions.

Chapter 16. Political and Jurisdictional Problems.

Prior chapters presume that politicians *care* about the welfare of their constituents.
(But what are their real-world incentives?)

Implications of special interest power in the environmental context.
(Role of the nature of "concentration" of benefits and costs; rational voter ignorance)

A different sort of "crowding out."
(Government does so many things it should not be doing *at all*, that it fails to do the more limited range of things that it should be doing)

Jurisdictional issues.
(Prairie dog, Chinese panda, CO_2 examples. Local, regional, national, and transnational externalities do not correspond to political boundaries)

Environmental policy implication: understatement of benefits (jurisdictional omissions) and overstatement of costs (special interests) by decision-makers.

Part V: Epilog

Visions of the future–doomsters versus boomsters on the role of income/population growth, and technology.

Income is growing but some measures of environmental quality are falling.
(Can this be optimal? Environmental quality as a normal/superior good.)

Even in cases where measures of environmental quality are rising, are they rising optimally given income and population growth?
(Two steps forward for every misstep versus an optimal three or four steps forward for every step back)

Population as both benefit and cost.

A reason for long-run optimism, if humans can survive the next century.