Reading material for Second year economics students

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Chapter Six

Valuation and cost-benefit analysis of the environmental resources

Outline

- **In this chapter, the following essential points will be discussed.**
  - Introduction: Need for environmental valuation
  - Importance of economic valuation
  - Classification of Environmental Benefits
  - Techniques for measuring the economic value of environmental resource/non-market goods
  - Environmental Cost benefit analysis

Introduction

- Measuring the economic importance of natural environmental resources become crucial soon after the Exxon Valdezoil tanker ran aground on the Bligh Reef in Prince William Sound off the coast of Alaska on March 24, 1989.
- The economic damages from spills include the loss of ;
  - valuable fisheries and tourism, and
  - individual biological species, including several endangered turtle species and hundreds of bird species

- The Exxon Corporation (now Exxon Mobil) accepted the liability for the damage caused by the leaking oil, and the liability consisted of two parts:
  1. the cost of cleaning up the spilled oil and restoring the site insofar as possible, and
  2. compensation for the damage caused to the local ecology.

- Environmental valuation is a very active and rapidly expanding field, and also somewhat controversial.
  - many non-economists regard putting prices on environmental services as totally misconceived, if not wicked, while
  - most economists accept the desirability of environmental valuation
- The basic strategy for environmental valuation is the 'commodification' of the services that the natural environment provides.

6.1 Valuation of the environment

- Why value the environment?
  - Valuation requires benefit–cost analysis for decision making to choose the most economically desirable projects
  - This can be done by comparing the potential benefits from the project and the costs associate to it
    - (loss of or endangered species, pollutions and other environmental damages must be assed in addition to project budget)
  - These analyses however, frequently fail to incorporate important nonmarket values associated with rivers.
- If the analysis does not include all the appropriate values, the results will be flawed. Have we made progress?

Dimensions of value

- Natural environment provides four categories of service for humans and their economic activities:
  - resource inputs to production by firms,
  - sinks for the assimilation of wastes generated in production and consumption,
  - amenity services to households,
  - life-support services for firms and households

1. Environmental cost–benefit analysis

- ECB analysis
  - is a project and/or policy analysis tool
  - is applied in investment/policy appraisal
  - answers whether the expected benefits of an investment (policy) justify the costs
  - includes monetary estimates of both the benefits and costs of the activity (projects/policies) over time
  - uses defined discount rate (social rate of time preference, cost of capital, others…)

Net Present Value (NPV) → $NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t}$

- CBA can be used for valuation of environmental resource…..but is week; two major causes of poor CBA in valuing environment are:
  - (a) Inclusion of externalities (both temporal and spatial) is essential for an environmental economic analysis
- However, most CBA cases fails to do so; thus, ignore externalities
  - This results in ignoring important impacts (externalities)
    - the person affected by an action is not part of the decision-making process
  - (b) Lack of market prices to signal scarcity or value: results in low or zero prices for important benefits or costs (poor valuation) of environmental resources

2. Categories of Environmental Benefits

- Environmental Economic Benefits is measured as Total Economic Value (TVE): includes Use Values and Non-Use Values

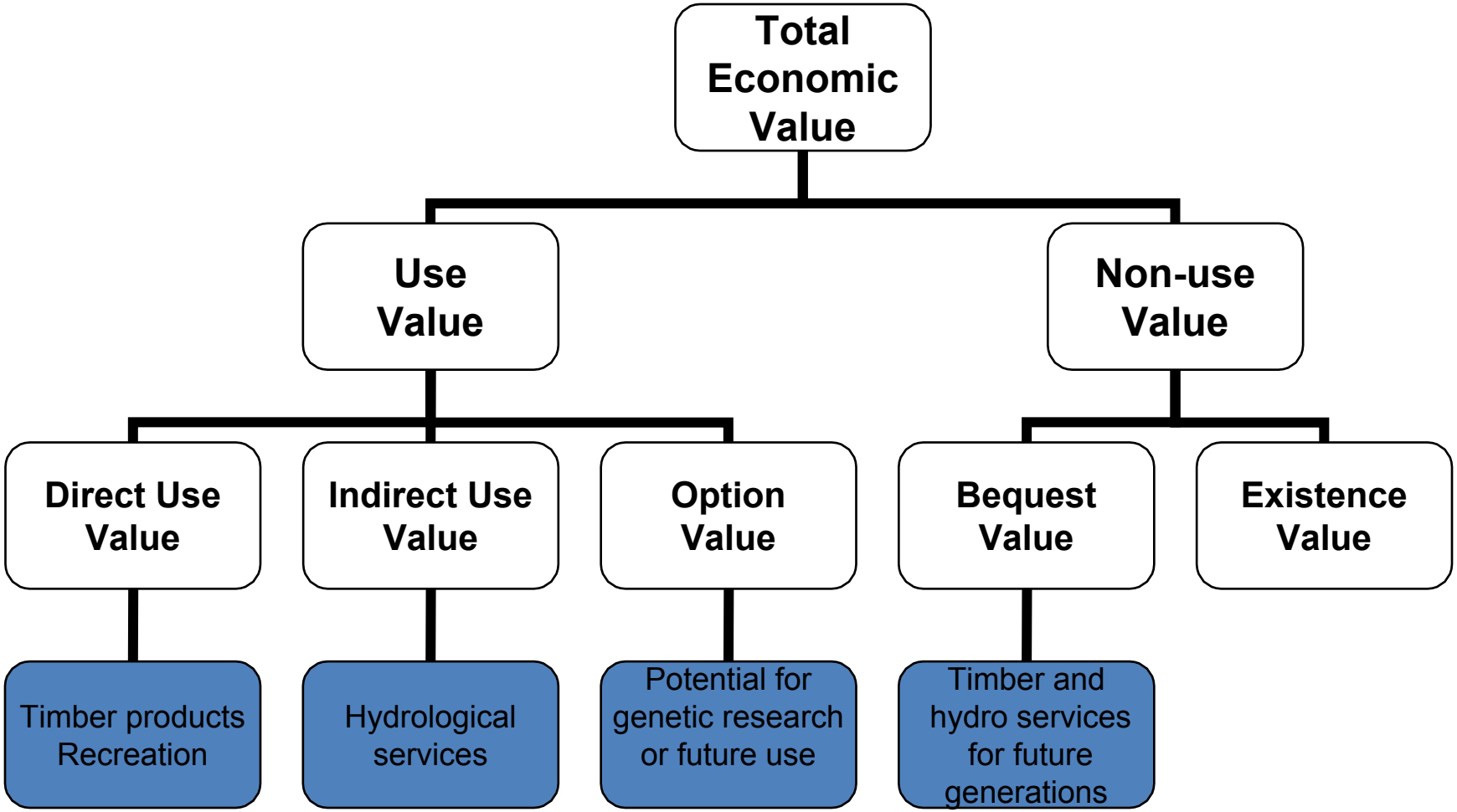
TEV = Use values + Non-use values

- Use Values (UV): benefits that are derived from the actual use of the environmental resource (timber for furniture purposes....)
  - UV - easier to measure and include Direct Use (both consumptive and non-consumptive), Indirect Use (passive use), and Option Value (OV)
  - OV: additional value placed on environmental resource by those people who want to have the option of using the goods and services in the future

Non-Use Values = Existence values + Bequest values

- Existence value: People wish to maintain or improve environmental assets out of sympathy for species and nature or from moral conviction
- Bequest value: the desire to preserve environmental assets for the enjoyment of other people of both the present generation and the future generations
  - Desire to have the resource available for children or grandchildren to experience

The TEV Table – The case of a forest



- For some environmental products, most of the value is direct use values : e.g.
  - drinking water from ground (aquifers),
  - plantation forests and furniture,
  - energy from oil deposits and production
- Indirect Use Values include, for instance, watersheds, protection of special habitats from forest
- For other environmental goods and services, most of the value is in Non-Use Values: e.g:
  - Maintaining endangered species (whales, panda,…) or preserving remote & special places (Ras Dashen, Semien mountains,)

- So, how much is an environmental resource (nature) worth?
  - Many techniques to value the 'unpriced/underpriced/non-market' environmental resources
- Non-market goods are goods that do not typically trade in markets (environmental goods and services)
  - Air quality, wildlife habitat, clean river water, biodiversity, scenic landscapes, climate,….
- Time and other opportunities (resources) are sacrificed to obtain/enjoy non-market goods
- Examining these trade-offs can serve as a basis for valuing non-market goods

Economic Valuation methods

- Many environmental goods and services are not priced correctly in normal markets
- Environmental Economic Valuation (EEV)
  - allows a fuller accounting of benefits and costs (including environmental goods and services that are often ignored)
  - improves the chance of projects passing a Net Present Value test
  - helps overcome failures in existing markets by identifying distorted prices (e.g. gasoline prices, consumption, and health and GHG impacts of increasing energy use)

- Environmental valuation methods can be separated into two broad categories:
  - stated preference, and
  - revealed preference methods
- Revealed preference: are based on actual observable choices that allow resource values to be directly inferred from those choices (prices are observable).
  - For example, in calculating how much local fishermen lost from the oil spill, the revealed preference method might calculate
    - how much the catch declined, and
    - the resulting diminished value of the catch

- The stated preference is used when the value of the resource is not directly observable; such value is obtained by using
  - a survey that elicit the respondents' willingness to pay (their "stated preference") for the preservation of the resource.
- Economic methods of measuring environmental and resource values

Methods	Revealed Preference	Stated Preference
Direct	Market Price	Contingent Valuation
	Simulated Markets	
Indirect	Travel Cost	Attribute-Based Models
	Hedonic Property Values	Conjoint Analysis
	Hedonic Wage Values	Choice Experiments
	Avoidance Expenditures	Contingent Ranking

Stated Preference Methods

- Contingent valuation: is the most direct approach, and provides a means of deriving values that cannot be obtained in more traditional ways.
  - This approach merely asks respondents what value they would place on an environmental change such as the loss of a wetlands or exposure to pollution or on preserving resource in its current state.
  - Alternative versions ask a “yes” or “no” question to reveal whether or not the respondent would pay $X to the change or to prevent change
- The answers reveal either an upper bound (in the case of a “no” answer) or a lower bound (in the case of a “yes” answer).

- The questions used in contingent valuation can take both Open-ended and Close-ended form
- Open-ended questions - respondents are asked to state their maximum willingness to pay, and the problems with open ended questions are
  - Difficulty to answer, WTP may not be typical of purchasing decisions
  - High non-response observed in samples
- Close-ended questions, respondents are asked to say whether or not they would be willing to pay a particular amount
- The questions must also specify the mechanism by which payment will be made

- This survey approach creates a hypothetical market and asks respondents to consider a willingness-to-pay question contingent on the existence of this market.
- The major concern with the use of the contingent valuation method for survey respondents to give biased answers in case of closed ended questions such as;
  - strategic bias,
  - information bias,
  - starting-point bias,
  - hypothetical bias, and
  - the observed discrepancy between willingness to pay (WTP) and willingness to accept (WTA)

Revealed Preference Methods

- Revealed preference methods are “observable” and “indirect” because they infer a value rather than estimate it directly.
- Suppose for example, a particular sport fishery is being threatened by pollution that reduce sport fishing. How is this loss to be valued when access to the fishery is free?

1. Travel Cost Method
   - One way to derive this loss is through TCM that may infer the value of a recreational resource (such as sport fishery, a park, or a wildlife preserve) by using information on how much the visitors spent in getting to the site to construct a demand curve for willingness to pay for a “visitor day.”

- The basic premise is that travel cost to a site can be regarded as the price of access to the site
- Multiple observations on travel cost and quantity of visits can be used to estimate a demand curve
- Once a demand curve has been estimated, the value of the site to an individual can be estimated by computing consumer surplus,
  - In a survey based analysis, the Travel Cost Demand Curve is often expanded to include other explanatory variables such as age, income, family size, education level, and other socioeconomic variables

- One interesting paradox that arises with the travel-cost model is that:
  - those who live closest to the site will have low travel costs; this understates the true value of the resource, but high travel cost may overstates it
  - another challenge in this model is that the degree to which the opportunity cost of time is incorporated

2. Hedonic Pricing Techniques (HPT): are based on the theory of consumer behavior that suggests people value a good because they value the characteristics of that good rather than the good itself
   - An examination of how the price of the good varies with change in the levels of these characteristics can reveal the prices (value) of the characteristics

- Example: assume that all the characteristics of houses and neighborhoods are the same in a city
- Houses with higher air quality would have higher prices
- This positive relationship can be represented by:
  - $H_p = a + bQ$,
  - where H_p is housing price, Q is air quality and 'b' tells how many units H_p will increase with each unit of air quality
- Other explanatory variables that could be included in the hedonic housing price functions
  - Characteristics of the house itself
  - Characteristics of the neighborhood

3. Hedonic Wage Approach (HWA): is based on the idea that an individual will choose the location/city in which he/she resides to maximize his/her utility
   - The individual will consider wages and a host of other positive (education, recreation…) and negative (crime, pollution…) factors
   - Wages adjust to compensate people for different location/city characteristics

- Example: Suppose a person has two job offers, one in a cold weather city and the other in a warm weather city, and also suppose each job offers the same salary
  - If the person chooses the warm weather job and others do too, the labor pool will increase in the warm weather city and wages fall,
  - the reverse happens in the cold weather city
- The difference between the wages in the warm weather city and the cold weather city compensates people for the disutility of living in the cold weather
- This compensating differential can be used to look at value placed on environmental amenities or risk

Averting Expenditures

- A final example of an indirect observable method involves examining "averting or defensive expenditures."
- Averting expenditures are those designed to reduce the damage caused by pollution by taking some kind of averting or defensive action.
- An example would be to install indoor air purifiers in response to an influx of polluted air or to rely on bottled water as a response to the pollution of local drinking water supplies

Benefit Transfer Approach (BTA)

- BTA helps to look at existing studies for value of analogous environmental change/resource
- BTA is used when the process of estimating value using revealed preferences or stated preferences approaches is expensive
- BTA - process of taking values from studies that were previously completed in other areas, and applying them to the area where the new decision must be made

- It is important to use a reference study that is congruous/similar in different aspects
- If many reference studies are available, the process becomes much easier
- The appropriate reference study can be chosen, or a weighted average of the values can be employed, where weights are chosen according to similarity between the reference study and the problem at hand

6.2 Environmental analysis

- It is practically difficult to place an accurate value on certain environmental resources or benefits
- However, failure to value them means leaving them as valueless
- Then we value environmental resources for the following reasons:

– To give an indication of the utility (satisfaction) derived from the environment
  - The greater the utility yielded by an environmental resource, the more is it valued and the more we should protect it

- To estimate the values of environmental goods and services that are not priced and/or imperfectly priced by the market
- To estimate the costs of present environmental damages (e.g. pollution effects on health) or future potential environmental damage (e.g. global warming) due to human activity
- To identify market and policy failures and propose solutions to these problems

Discussion Questions

1. Discuss the importance of environmental valuation and environmental economic analysis.
2. Are environmental valuation and cost benefit analysis similar? Why or why not?
3. Briefly explain the difference between the contingent and travel cost approaches of environmental valuation (support your explanation with examples).