Advanced Training Program on Ecosystem Conservation

ECONOMIC EVALUATION OF NATURAL RESOURCES
Theory and application

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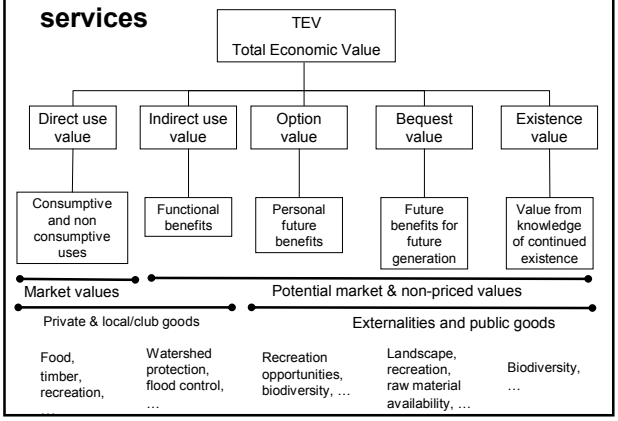
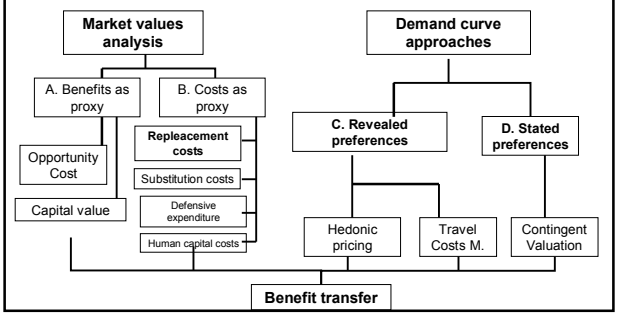
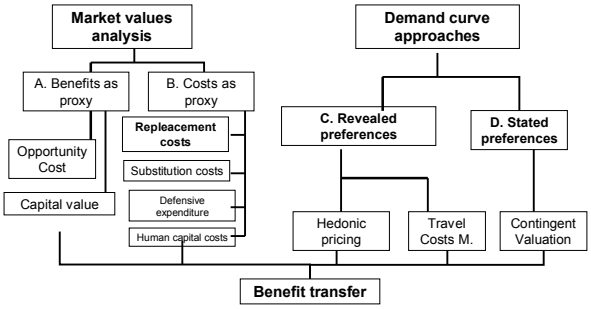
1. Economic values of environmental services



2. Methods for the valuation of non-priced goods





A. Benefits as proxy
A.1 - "Opportunity costs"

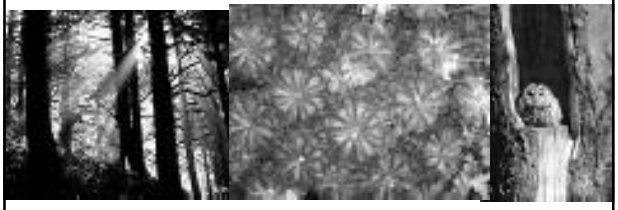
Ratio: if we use a resource, we miss an alternative use

→ the loss of revenues from the best alternative use of a resource can be considered a proxy of the value of that resource

Note: non-use values are sometimes non considered in the alternative taken as a proxy

Example:

A forest area managed for biodiversity protection



Proxy value: crop cultivation (e.g. profit loss connected to rice production in the same area)

A2. Capital value

Ratio: the value of an asset is connected to its capability of producing products and services

→

$$V_0 = \frac{a}{r}$$

Annual production

$$V_0 = \frac{P_t}{(r+1)^t - 1}$$

periodic production

Vo = asset value
r = interest rate
a and Pt: annual and periodic net benefits
t = period (years)

Note: reference only to products and services with price market.
Non-use values are non considered

Example:

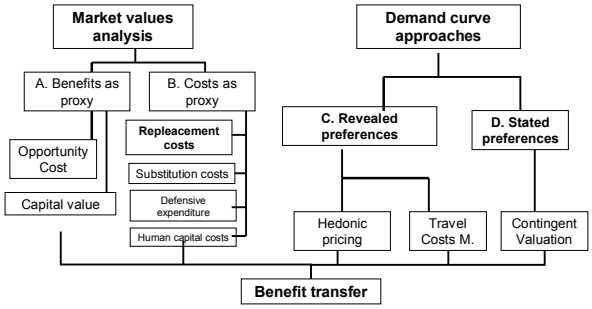
(1) Annual revenues from sales of entry permit in a recreational area (net of management costs) → value of the protected area

Annual revenues = 300,000 Euro

Resource value? (*r* = 3%)

$$V_0 = \frac{300{,}000}{0.03} = 10{,}000{,}000 \text{ Euro}$$

(a capital of 10 M E, invested @ 3%, is providing an annual interest of 300,000 E)



B. Costs as proxy

Much used methods.
Market costs are analyzed to deduct values of non-priced goods.

2 sources of errors:

- Underestimation: in real life an investment is carried out only when expected revenues are larger than expected costs
- Overestimation, if costs used as proxy are not related to efficient investments

B1. Replacement costs

Ratio: the value of a resource is connected with its production costs

→ The value of a resource can be estimated looking at:

- the past investments costs needed to supply the resource or
- the actual costs for supplying it

Example:

The value of a forests destroyed by fire is valuated looking at the plantation costs and management costs

Note: the most used and broadly accepted method (e.g. environmental damages).

Problem:

It cannot be used for non-replaceable goods or for goods that are replaceable only in the long run

Example: destruction of a site of high archeological, cultural value; destruction (extinction) of a rare species

B2. Substitution costs

Ratio: a service can be provided through different methods/technologies

→ Resources may be valuated looking at good and efficient substitutes

Example: watershed services related to drinkable water supply ← alternative systems of water provision (water pipe, mineral water provision, …).

B3. Impacts on human capital

Ratio: some environmental damages have direct impact on human life which can be valuated making reference to labor productivity or costs for health treatments

→

- cost of illness and human capital approach or
- loss of earnings approach

Also with this approaches there is a risk of underestimates

Examples: environmental disasters (Chernobyl, Bhopal, ICMESA-Seveso), water and food pollution

B4. Defensive expenditures

Ratio: for avoiding or mitigating environmental damages private and public organizations are supporting some costs

→

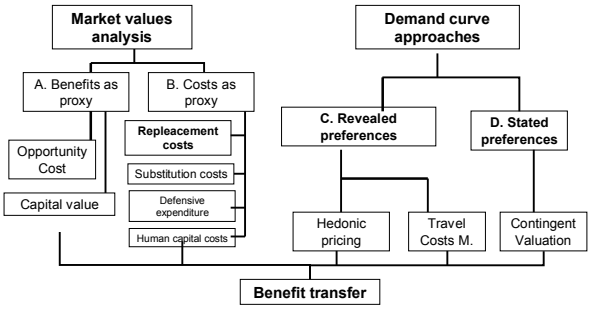
the costs supported ("*defensive expenditures*") can be a proxy of the value of the benefit connected to the maintenance of some services

Note:

Advantages of this approach: it is often easier to measure defensive expenditures than benefits' value

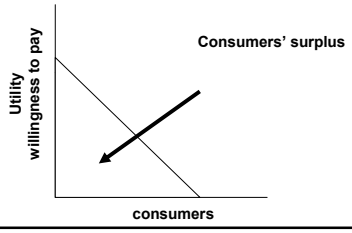
Also with this approaches there is a risk of underestimates (no evaluation of the non-use and option values)

Examples: noise, global warming, wind erosion valuated in relation to the costs normally supported to reduce their negative effects of this



C. Demand curve approaches

Methods aimed at evaluating the social utility of the consumers, i.e. their willingness to pay for products and services, even when a proper market does not exit



Two groups of methods:

- those based on revealed preferences by consumers through their behavior in the normal life:

1. Hedonic Price Method (HPM) *or Hedonic Pricing (HP)*

2. Travel Cost Method (TCM)

- Those based on stated preferences by consumers who are interviewed to understand their willingness to pay (or to compensated) to benefit for some product or services (or for not taking advantage of some product or service)

3. Contingent Valuation Method (CVM)

C1. Hedonic Pricing Method (HPM)

Ratio: if a relevant land use change occurs, price of land will change

→

positive and negative impacts (externalities) of a land use change can be evaluated making reverence to (real or foreseen) changes of prices of land and/or infrastructures

Example:

The construction of a waste disposal site has effects in the prices of land and houses in the nearby area

The same (but with opposite effects) for an urban park.

A simple approach:

$V_{externality}$ = Value with externality – Value of the good without externality

Results (positive or negative) are referred to some measure of the externality (e.g.: square meters of green area)

Normally an approach based on multiple regression is used

$P_i = f(C_{i1}…C_{in}, V_{i1}…V_{in}, A_{i1}…A_{in})$

with:

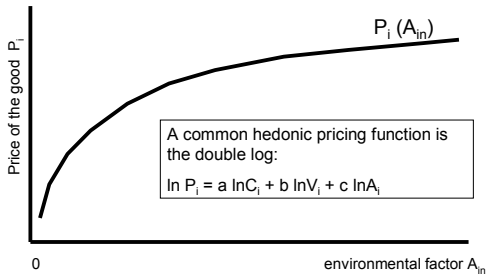
P_i = price of the good I (e.g.: a residential building)

$C_{i1}…C_{in}$ = variables connected with intrinsic aspects of the good (surface, cm, age, no. of rooms, car park, …)

$V_{i1}…V_{in}$ = variables connected with aspects of nearby goods (cm of building/sq.m, residents' density, stores, transport services, …)

$A_{i1}…A_{in}$ = variables connected with environmental aspects of the site (traffic, noise, air pollution, …)

Normally, *ceteris paribus*, when positive externalities are involved hedonic pricing function has this shape: (Freeman, 1993)

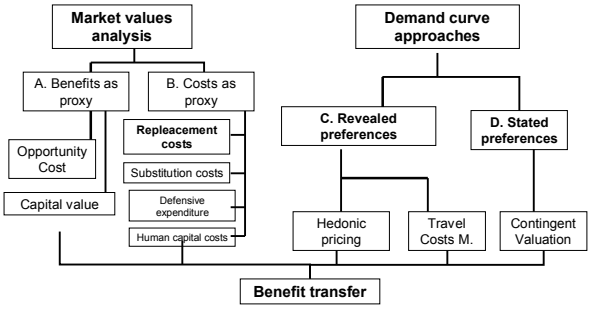


Disadvantages:

- many data are needed, not previously recorded → new survey
- an active and transparent land market for the goods taken into examination is needed
- HPM is not able to include non use value (e.g. benefits occurring to consumers that are not involved in land transaction): possible underestimation

Advantages:

- Land market is clearly influenced by externalities and private operators perceive and express preferences in connection with real word changes



C2. Travel Cost Method (TCM)

(Clawson, 1959)

Ratio:
There is a logical connection between the value of a good and the willingness to pay for the travel to visit it →
From the data related to the travel costs by consumers the demand for a good can be derived and, from the demand function, the value of the good

Some examples of TCM implementation:

The recreational value of a National Park can be derived from the travel costs of the visitors

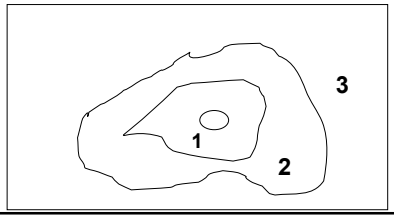
The same for hunting, fishing, cultural events, historical sites, …

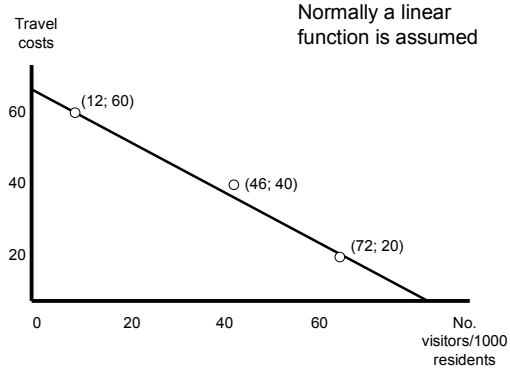
Two main approaches:

- Zonal Travel Costs Method (ZTCM)
- Individual Travel Costs Method (ITCM)

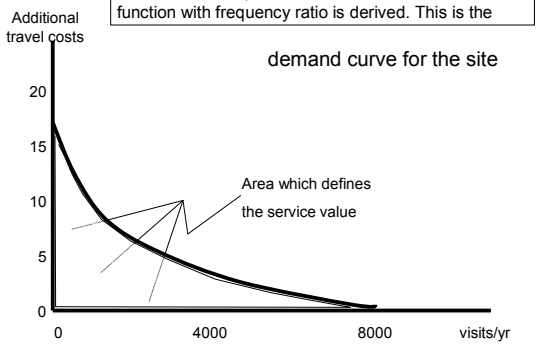
In ZTCM different areas of origin (approx. 5-10) of the visitors with similar travel costs are defined; for each area of origin, number of visitors per year are estimated and compared to the local number of residents

Area of origin	No visitators	Residents in the area	No visits/ 1000 residents	Travel costs (Euro/visit)
1	1.300	18.000	72	20
2	3.800	83.000	46	40
3	3.000	250.000	12	60
	8.100			





Once defined the relationship between travel costs and rate of visitors on the total residents for each area of origin, travel costs are assumed to be higher (e.g.: + 5, 10, 15, …Euro) and from the former function a new function with frequency ratio is derived. This is the



ZTCM applications are based on the following function:

$V_j / P_j = f (C_j, X_j)$

with:

V_j = No. visitors from area j

Pj = residents in area j

C_j = travel costs in area j

X_j = socio-economic aspects of area j (i.e.: *pro-capita* income, age, time and money available for recreational activities, presence of alternative sites, …)

In ITCM applications the basic function used is:

$V_i = f (C_i, X_i)$

with:

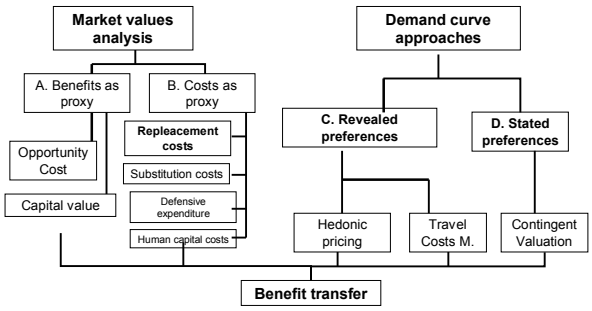
V_i = No. visitors

C_i = travel costs for each visitor i

X_j = socio-economic characteristics of the single visitors i

Disadvantages:

- Many data are needed, not previously recorded → new survey
- Consumers may include a visit in a longer recreational activity: it is not easy to make a distinction on the travel costs
- Travel is a cost: this assumption is sometimes weak (risk of overestimate if the travel is a recreational experience)
- Time spent during the travel is valuated with reference to individual salary
- As in the case of HPM, TCM is not able to include non use value (e.g. benefits occurring to consumers that are not involved in land transaction): possible underestimation



D1. Contingent Valuation Method – CVM

Ratio (a very simple one!): let's ask people directly what they think about the value of goods
→
The values of a non-priced good is derived from a survey made to a representative set of consumers who are asked to express their willingness to pay - WTP (or willingness to accept a compensation - WTA) for maintaining (or not maintaining, in the case of WTA) a good

Some examples of CVM implementation:

Environmental services of a protected area, landscape, environmental damages, new large infrastructures,…

Two main approaches

a. *Open ended survey*

"Which is your max WTP in terms of income tax for protecting 50 rare species in site X?"

Data on WTP (or WTA) are summed up and referred to the total number of consumers.

b. Dichotomous choices

"Have you a WTP of Y Euro in your income tax to maintain 50 rare species in site X?"

Data are collected asking questions with different threshold values of WTP and results are referred to the total number of consumers.

- Dichotomous choices approach is closer to real market conditions, where consumers have normally to choose between buying/refusing to buy a product
- More risks of strategic answers ("*yea saying*")

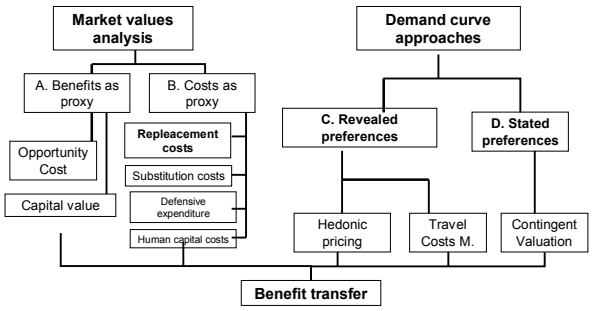
Disadvantages:

- Risk of strategic answers → clear procedures in carrying out surveys (questionnaires preparation, interviews techniques, data statistical elaboration,…)
- Information bias
- Starting point-bias
- Some disparities between results from WTP and WTA

Advantages

- Non use (existence) values may be evaluated
- Starting from the '80 in USA la CVM is employed also in legal procedures for valuating environmental damages, with the formal acknowledgment that non use values can be compensated

- Large implementation of the same approach in to evaluate the WTP for commercial goods (marketing analysis)
- Findings obtained with CVM are substantially coherent with those obtained with TCM and HPM
- CVM is the most employed method in evaluating non price goods



Benefit transfer

= results of the evaluation made (with other methods) are transferred, under defined rules, to other context.

Constraint:

- Need for a relative large number of surveys of similar products and services in similar envir., social and economic context

Advantages:

- Reduced time and costs in relation to TCM, CV, … application

Disadvantages:

- Uncertain results

Similarity principle: 3 aspects to be taken into consideration:

- Product/service must be similar (e.g. public good)
- Population: similar size of the potential consumers group
- Market: similar prices ← similar demand and supply condition

2 approaches in benefit transfer:

a. Transfer of a value
   - Unity value
   - Average value
   - Adapted value

b. Transfer of one or more functions

Files can be downloaded from the web site:
www.tesaf.unipd.it/pettenella/index.html