Valuing Unmarketed Goods and Environmental Amenity

We need to convert opportunity costs to dollars according to individuals' valuations, their willingness to pay.

1. General Approach

Market Goods:

$$\textbf{price} = \textbf{marginal cost}$$
$$= \textbf{marginal valuation}$$

$\therefore$ often use market prices

- **or adjust market prices $\rightarrow$ *shadow prices* [C&B Ch. 5; FP Ch. 7.2; S&W Ch8; DoF]**
- **or use the changes in consumer's and producers' surplus when prices change. [C&B Ch. 7; S&W Ch 9,10; FP Ch. 8.4; DoF]**

Other values?

but: value of convenience
value of time saved
value of new road
value of increased quietness ?
value of privacy

But: what if there are no markets?

[C&B Ch. 12; FP Ch. 11; S&W Ch 11; DoF]

Then Use Opportunity-Cost Prices

Q: what is | forgone / sacrificed / given up ?

A:

- **with over-the-counter prices: Money**
- **with going to hospital (or AGSM):**
  - **— time**
  - **— forgone income**
  - **— fees**
- **with using a road/bridge/tunnel**
  - **— time**
  - **— out-of-pocket money**

eg $2.20 Harbour Bridge v. other

Willingness to pay

Q: how can we express in $ what is given up?

A: use individual's valuation (CS) — "willingness to pay"

How? –

1. by asking (CV)
2. by revealed choice.

otherwise –

3. by opportunity-cost methods

Eight Methods of Evaluating Non-Traded Impacts.

Here we consider eight methods of evaluating non-traded impacts:

1. **The value of time saved (3)**
2. **The Travel Cost method (3.1)**
3. **Hedonic pricing: prices in an affected market (4.2)**
4. **Surveys: Contingent Valuation, or how much will people pay? (4.3)**
5. **Defensive expenditure: revealed cost of protection (4.4)**
6. **The Change-in-Cost method: benefits = costs avoided (4.5)**
7. **The Change-in-Output method: benefits = higher value of output (4.6)**
8. **The Replacement Cost method: revealed value & costs of replacement (4.7)**

2. Valuing willingness to pay (Consumer's Surplus):

1. ***(Other) markets — Hedonic pricing***

   — what is the effect of the pollution on prices in affected markets?

   e.g. *land*. — hedonic pricing

2. ***Survey***

   a. willing to *not* to have the pollution? (max) Willingness To Pay WTP

   b. minimum they'd accept to live with the pollution? Willingness To Accept WTA (min.)

3. ***Cost-based measures***

   — what is the cost of abating the pollution?

Property rights

Coase theorem — bargaining over externality

3. Value of Time Saved

Numerical example: what is the value to Joe of a faster commute home?

Joe’s wage rate is $10/hr, and

Joe would pay up to $8/hr not to work.

∴ Joe’s value of increased leisure = $10 + (–$8) = $2/hr
(= his forgone wage payments + his forgone enjoyment of working)

What if Joe can cut his commuting time and enjoy more leisure?

Say he would pay up to $3/hr to avoid commuting.

∴ Joe values his reduction in commuting time at $5/hr = $2 – (–$3),

since the value to Joe of a reduction in commuting time
= the benefit to Joe of increased leisure ($2)
– the forgone benefit to Joe of commuting (–$3)

The Value of Time Saved ...

= **max. amount of money beneficiaries would be willing to pay to obtain the saving**

e.g. a new road → less commuting time

value of reduction in commuting time V_c per time unit = benefit of increased leisure MB_L – benefit of commuting time forgone MB_c (–ve)

$V_c = MB_L - MB_c > 0$, **where** $MB_L =$ **forgone wage payments** $w +$ **forgone benefits of working** MB_w **(–ve) (work is a "bad")**

$\therefore V_c = w + MB_w - MB_c$

If $MB_w < MB_c$, **(both negative) — (if marginal disutility of working > marginal disutility of commuting) — then** $V_c < w$

e.g. (values from surveys and revealed preferences)

w **= \$10/hr**

$MB_w \equiv$ **(forgone) benefits of working = –\$8/hr**

$MB_c \equiv$ **(forgone) benefits of commuting = –\$3/hr**

($\therefore MB_L \equiv$ **(forgone) benefits of leisure = 10–8 = \$2/hr)**

$\therefore V_c = w + MB_w - MB_c$ **= 10 – 8 + 3 = \$5/hr**

The Manly Jetcat: Estimate V_c, the value of shorter commuting time.

compare Jet Cat from Manly with ordinary ferry

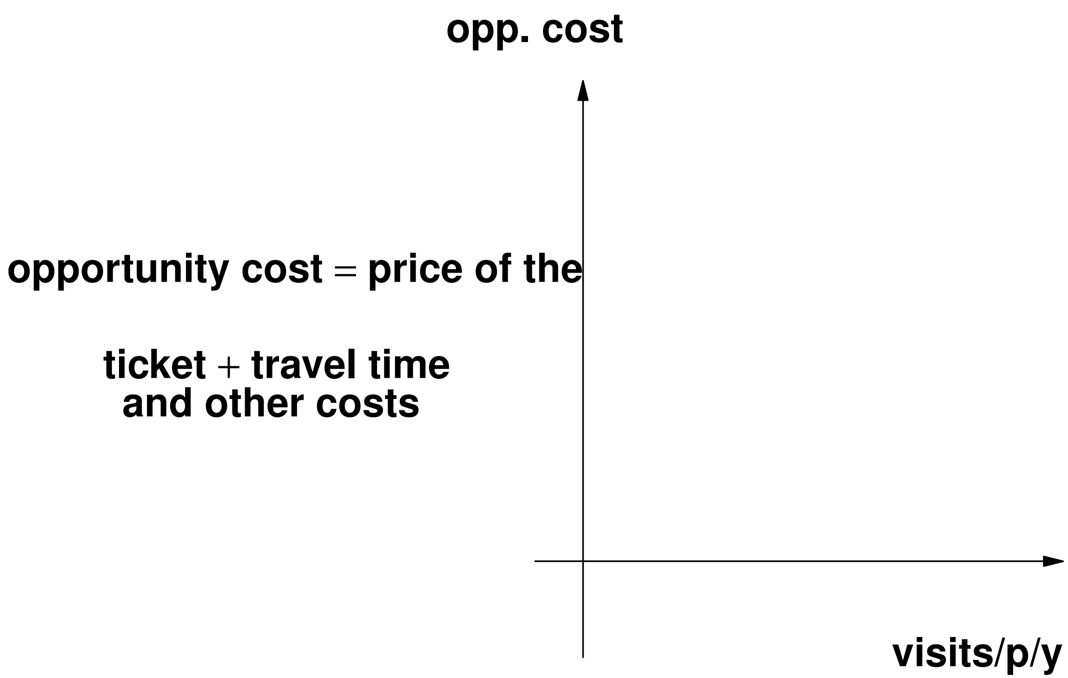
assume passengers prefer
- **lower *fares***
- **shorter *trips***

the Jet Cat is 20 minutes faster at $5.50 more expensive. (check)

The complete demand curve: Hotelling/Clawson.

travel costs ∼ individuals different costs

e.g. consumers' surplus lost if a theatre closes
the opportunity cost of going to the theatre



Observe only 1 point on each group's demand curve: assume a single curve, or estimate each separately.
– National Parks
– method used to estimate value of visiting NPs

3.1 The Travel Cost Method [C&B pp. 276, S&Th pp. 88]]

Can be applied to any activity where the quantity consumed varies in response to the (opportunity) cost of travel to undertake it, e.g. recreation.

Steps:

1. ***Define the benefit to be valued.***
   e.g. car visits to a specific park over a year
2. ***Collect data.***
   On the cost of each visit, the origin of each group; travel costs include marginal costs of the visit: wages forgone, vehicle wear & tear, food, petrol, accommodation.
3. ***Define zones of origin.***
   Based on distance (travel cost) to the park. Need average travel cost, numbers of car visits (both surveyed), and population of the zone.
4. **Calculate the visit rate per 1000 population per zone p.a.**
5. **Assume that visitors across zones respond to entrance fees and travel costs in the same way.**
6. **Simulate the number of visits with a particular entrance fee.**

Travel Cost Example

TC: Basic Data

Zone of visitor origin	Average travel cost ($/car)	Total car visits	Population of zone	Total car visits per 1000 pop.
1	2	150	5	30
2	4	64	4	16
3	6	16	2	8
4	8	8	2	4
5	10	3	1	3
6	12	0	3	0
Total		241		

TC: simulation of $2/car entry fee

				Simulated		
Zone of visitor origin ('000)	Average travel cost ($/car) visits	Entrance fee ($/car)	Total visit cost ($/car)	Pop. of zone	Total visits per 1000	Total
1	2	2	4	5	16	80
2	4	2	6	4	8	32
3	6	2	8	2	4	8
4	8	2	10	2	3	6
5	10	2	12	1	0	0
6	12	2	14	3	0	0
Total						126

Simulation of Travel Cost Method

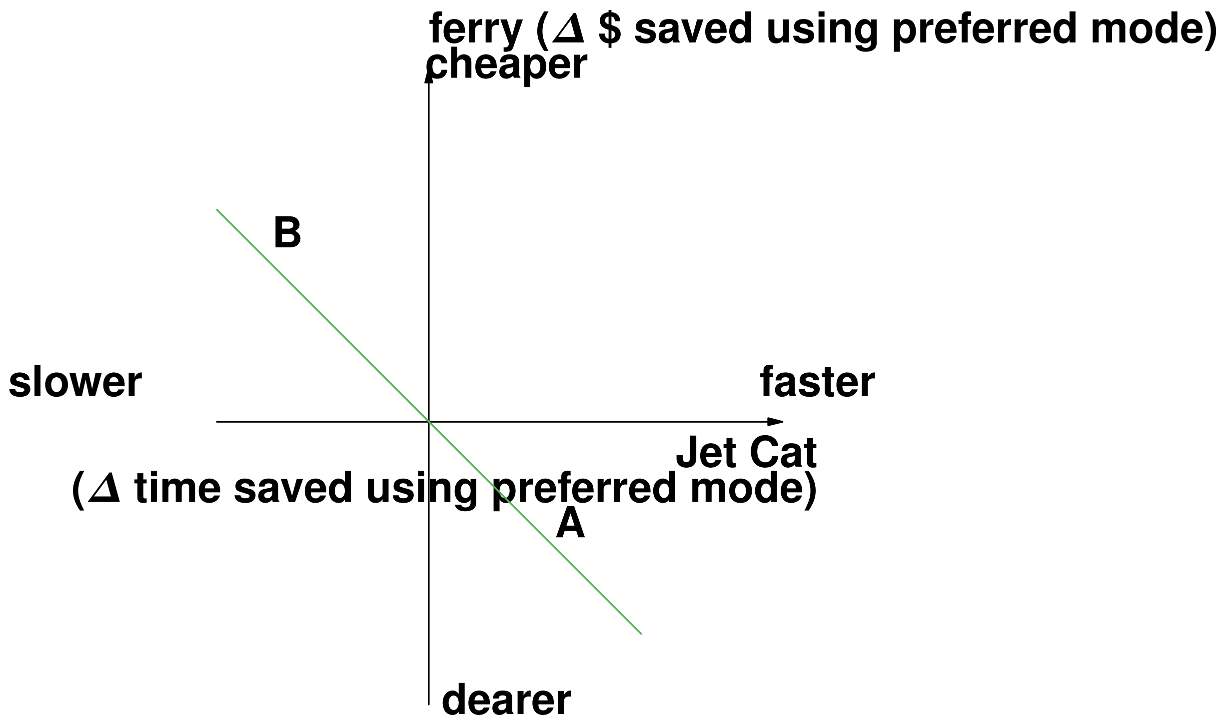
- **Zone 1 visitors now face a cost/car of \$4/visit.**
- **Before the fee, Zone 2 visitors, faced with an equal cost, came at the rate of 16visits/1000/year, so now Zone 1 $\rightarrow$ visits/year = $3 \times 16 = 80$**
- **Zone 2 visitors will come at 8/1000 $\rightarrow$ 32 visits/year**
- **Etc.**
  Note that a cost of \$12/car chokes off demand, previously from Zone 6, now from Zone 5 as well.
- **Demand schedule:**

Simulated entrance fee	*Simulated number of visits/year*
\$0	241
\$2	126
\$4	62
\$6	32
\$8	15
\$10	0

7. **Calculate the value.**
   The consumer surplus = the area above the price (\$0/visit) below the demand curve plotted from the above table = \$700 total.

Sydney Harbour Travel [S&W pp. 150–156]

Q: "how do you travel?", "what's the next best alternative?"
e.g. Manly Jet Cat ($8.00 & 15 min.) v. ferry ($2.50 & 35 min.)



Then the slope of green line → $??? per minute saved i.e. price, value of time saved. Line of indifference between slow and fast modes. Min. number of wrong responses to the SW. Assumptions: individual rationality, equal values.

Estimating the Relationship — NFX

$$C_i \quad = \quad a_i + bT_i + M_i$$

where C_i total cost of mode i

a_i intrinsic value i

T_i time spent travelling

M_i money cost (fare +)

The probability of using ferry instead of the Jet Cat p_F is (using the logit transform – NOT FOR EXAMS):

$$p_F = \frac{e^{\Delta C}}{1 + e^{\Delta C}} = f(\Delta C)$$

$$\Delta C = C_{JC} - C_F$$

$$\log \frac{p_F}{1 - p_F} = \Delta CR = a_{JC} - a_F + b\Delta T + \Delta M$$

4. Valuing the Environment

Q: Is an improvement in environmental quality an economic improvement?

A: Only to the extent that we value these improvements.

- **In what sense is:**
  - **— cleaner water**
  - **— cleaner air**
  - **— less noise pollution**
  - **— saving species — whales, etc.**

  a welfare improvement?
- **What are the rights, if any, of creatures other than human beings?**
- **Direct monetary measures of benefit:**
  - **— improved access to national parks or other areas with access charges**
  - **— improved growth and quality of crops, etc.**

A two-stage process:

1. **Evaluate the project (which will harm the environment) without environmental effects (costs)**
   - **If negative NPV, then stop.**
   - **If positive NPV, then → stage 2.**
2. **Include environmental costs:**

   Are these sufficient to reduce NPV to zero?
   - **If yes, then stop. (And renegotiate?)**
   - **If no, then → stage 3.**
     The PPIC is satisfied.

   Negotiating positions depend on the prior allocation of property rights.
3. **A decision balancing the net economic benefits against the costs to particular groups.**

   (distributional impacts)

Use, Option, and Existence Values

Total Economic Value = Actual Use Value + Option Value + Existence Value

To determine these:

1. ***Travel Cost Method*** **(see 3.1 above)**
   Uses the value of time spent to visit a park or recreation area, as well as any direct costs, to determine the community demand curve for the amenity.
   Useful when data are available.

2. ***Hedonic Pricing Method.*** **(see 4.2)**
   Uses the changes in land values as a measure of the costs or benefits imputed to changes in environmental amenity due to the project. (e.g. land near the airport)
   Can be useful when similar projects already undertaken, or ex post for damage estimation.

3. ***Contingent Valuation Method*** **(see 4.3)**
   Asks people what they are Willing To Pay for the benefit or what they are willing To Accept as compensation.
   It’s very general, but may be costly to perform, and has severe qualifications (see below).

***Indirect (monetary) benefits*, e.g.,**

- — **reduced air pollution**
- — **fewer respiratory diseases**
- — **consumer surplus gain from improved health**
- — **measured benefits will justify real expenditures on improving environmental quality.**

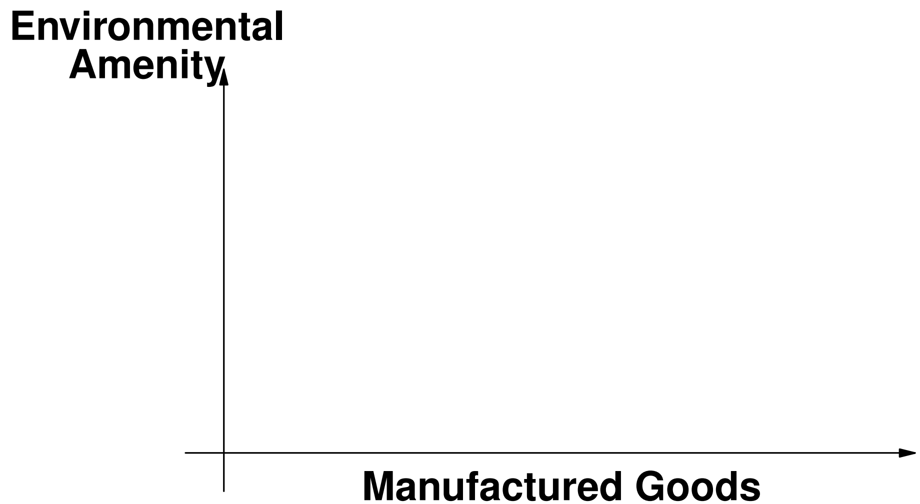
- **Total economic value:**
- **total user value = actual use value + option value + existence value**
- **intrinsic values and existence values**
  - — **irreversibility**
  - — **uncertainty**
  - — **uniqueness**

Example: Road through the Grampians

[Sinden & Thampapillai, Box 6.1, p. 93]

Benefits & costs	Alternative A	Alternative B
Benefits from recreation	40	32
Costs of construction	34	19
Loss of timber income	0	5
∴ Net benefit	6	8

4.1 Why the Environment Will Always Matter



1. technical change, inventions: more Manufactured Goods from the same Environmental Amenity reduction
2. increasing scarcity → greater value of the environment in the future. (with no change in preferences)

The lower slope at point B (new price ratio)

⇒ a higher value of environmental amenity in terms of manufactured goods.

Against this: expectations of a higher level per generation.

4.2 Hedonic Prices [C&B pp. 279, S&Th pp. 93]

(Johansson Ch 7)

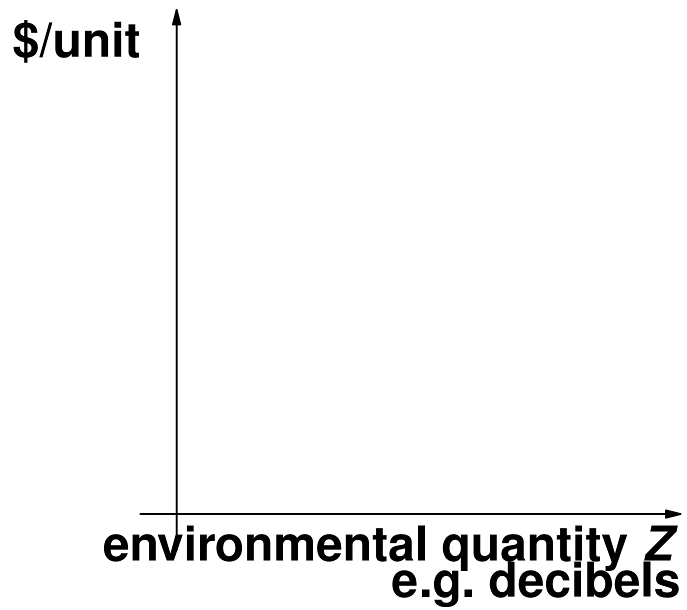
- **House prices are affected by environmental amenity e.g. effect of noise due to Third Runway on Sydney house prices**
- **Price of housing P_h is a function of:**
  - **locational L variables**
  - **neighbourhood N variables**
  - **environmental Z variables**
- **The *hedonic* or implicit price function:**

$$P_h = P_h(L, N, Z)$$

- **Utility $V(x, L, N, Z)$ s.t. $y = px + P_h(L, N, Z)$ = income and x all other goods, and P_h rental cost of housing.**
- **regress housing prices against L, N, and Z**
- **compute incremental effect of Z on price P_h**

But beware of double counting!

Graphically:



- **Represents marginal implicit price if all households have the same preferences and incomes**
- **Obtain a locus of equilibrium values**
- **Applications?**
  - **— aircraft noise (Z: decibels)**
  - **— cleaner air**
- **Comparison of survey and hedonic approaches**

4.3 Contingent Valuation Survey Data [C&B pp. 281, S&Th pp. 96]

- **Questions:**
  - **— "Provision of an environmental amenity is increased. What is the most you are willing to pay for this increase?" WTP**
  - **— "Suppose the environmental amenity is not provided. What is the minimum compensation required if you are to be as well off as with the amenity?" WTA**
- **But there may be a Free-Riding bias:**
  - **— If respondents know they will not have to pay, then will overstate their willingness to pay for the improvement.**
  - **— If respondents know that they have to pay, then they may understate their true preferences, leaving others to pay.**
- **To overcome the bias, we should ideally:**
  - **— sample those who must pay**
  - **— sample those who will not pay**

The true measure should be in between.

Contingent valuations (CV)

- **First used in Australia for Kakadu National Park, by the Resources Assessment Commission (as was)**
- **Hypothetical changes identified via photographs:**
  - **e.g. Kakadu with and without mining**
  - **how does one realistically convey this?**
- **The Farmington Experiment:**
  - **pictured conveyed information on visibility ranges**
  - **Navajo Reservation threatened by power-plant emissions**
  - **CV and EV questions**
  - **told would have to pay the average bid, not one’s own**
  - **new information (e.g. that bids are inadequate) affects behaviour**
  - **starting bids are also important**

- **Hyland and Strand study of Grenland area of Norway**
  - — **visibility the issue**
  - — **CV question asked (WTP)**
  - — **hypothetical tax of 0.6% of income**
  - — **sample of Norwegians: 56% said “yes”**
  - — **but detailed study of locals**
  - — **60% unwilling to pay at all, none over 8% of income**
  - — **Problems:**

    influenced by starting bids

    path-dependent:

A to B to C	**1.3%**
A to C	**0.9%**

Example: CV converts environmental ratings to $

[Sinden & Thampapillai, Box 6.2, p.97]

CV: value of recreational visit per group —
ranged from \$7 to \$30, they said

Then: agency scored each on 10 environmental factors
and found a correlation:
Δ 1 unit in rating $\rightarrow$ increase of \$8 per visit

4.4 Defensive Expenditure [C&B p. 272, S&Th p. 99]

Agents sometimes willing to sacrifice to defend their existing position.

When the action exactly maintains their utility, the expenditure measures the avoided loss in CS.

Examples:

- **higher flood levees**
- **moving house to avoid noise, dust, or smoke**
- **filtering river water for household use**

4.5 The Change-in-Cost Method [S&Th pp. 100]

A project may lower the costs of production.

The approximate benefit can be estimated as the savings in production cost:

Value of benefit =
Cost at present – Cost with useful change = Cost saved

Example: tollway benefits > cost of toll for those who pay it

4.6 The Change-in-Output Method [S&Th pp. 102]

Soil conservation can reduce erosion or soil salinity, neither of which are directly traded on a market (yet).

The value of a project which supplies more soil conservation can be derived from changes in the value of an associated output, such as agricultural produce.

e.g. Lower erosion or salinity should also improve the market value of the land, as in Hedonic Pricing.

So: the benefit is propoertional to the Δ output value

4.7 The Replacement-Cost Method [C&B p. 273, S&Th pp. 104]

Can obtain a range for the value of an existing benefit from the costs of replacing it.

The minimum value of an existing benefit = the cheapest cost of replacing it.

The annual amount that a rural community pays to maintain a country road against floods, fires etc. is a measure of the minimum value it places on the road.

e.g. lack of replacement of a burnt-out bridge implies that the value of the bridge is less than its replacement cost.

A range:

Minimum replacement cost	**<**	**Value of benefit**	**<**	**Maximum replacement cost**

Example: Benefits of fishing on the Ovens

[Sinden & Thampapillai, Box 6.3, p.105]

Anglers visit the Ovens River:
they spend ~ $43 and catch 1–5 trout per visit

Next best alternative would cost ~ $151/visit, they said.

⇒ the marginal cost of the best replacement = 151 – 43 = $108/trip

On average 15 visits per year to the Ovens,
and 9 visits per year to the next best.

Plot the implied demand curve.

∴ The Net Benefit of the Ovens to anglers:

= additional cost of 9 trips elsewhere = 9 × 108 = $972

+ the value of the forgone trips = ½ × 108 × 6 = $324

∴ the Annual total benefit of the Ovens = $1296/year/angler

Property Rights

a. **Do the residents have the right to current levels of environmental amenity?**
e.g. clean air, clean water, low noise.

b. **Or, does the company have the right to reduce environmental amenity? (perhaps becuase of prior occupation or exercise)**
e.g. to use up the clean air or water, to raise levels of noise, dust etc.

If (a), then the firm must pay.
If (b), then the residents pay (in cash or kind).

- **how property rights can solve conflicts**
- **saving New Zealand fishery**
- **“bubble” policy and emission credit (air pollution)**
- **special interest groups**
- **emission permits, e.g. CFCs in Australia**

Example: Proposed Gold Mine: NSW South Coast.

Environmental Impact Statement:

detail of the mine proposal
Financial Appraisal
economic appraisal
abatement undertaken
social effects—*local*
economic effects
“public” goods
water supply/pollution *
landscape
wildlife
noise
dust
prostitution/. . .

———

employment
infrastructure

———

closing down ?
moving away
rehabilitation

Summary tables:

Methods of estimating values.

Method	*What can be valued?*	*What data are required?*
Travel cost	**Net benefit**	**Quantities and costs for each visitor group**
Hedonic pricing	**Net benefit, total benefit**	**Price and characteristics of a good, from many exchanges of the good**
Contingent Valuation	**Net benefit, total benefit, total cost**	**Willingness-to-pay responses to survey questions**
Defensive expenditure	**Net benefit, total benefit**	**Change in expenditure to maintain existing level of welfare**

Methods of estimating partial values

Method	*What can be valued?*	*What data are required?*
Change in cost	**Minimum value of benefit**	**Money costs, before and after a change**
Change in output	**Total benefit**	**Money revenue, before and after change**
Replacement cost	**Range for a benefit**	**Actual and likely costs of replacement**

(Source: Sinden & Thampapillai, pp. 88–89)

e.g. airport noise

5. Criticisms of Contingent Valuation

Introduction

(Report of the NOAA Panel on Contingent Valuation, as a response to the litigation over damages from the 1989 *Exxon Valdez* disaster in King William Sound, Alaska.)

Estimation of fall in values of damaged environmental amenity.

- **for recovery of restoration costs**
- **for estimate of the fall in value of affected resources**
- **for estimate of the costs of conducting the damage assessment.**

Two kinds of values diminished:

- ***use values*, and**
- ***existence values*.**

Use Values and Existence Values

Use values:

information revealed in market transactions — out-of-pocket expenses
losses to those who make active use of the affected areas:
eg. fish kills → commercial fishermen's losses
eg. oil spills on tourism → lost incomes of tourist operators

Passive-use (or *Existence* or non-use) values:

individuals who make no active use of a particular asset but who still derive satisfaction from its mere existence, even though they never intend to make active use of it

How to evaluate passive-use values?

No direct market transactions to observe.
No indirect methods → clues to lost values?
Answer: *Contingent Valuation*.

Contingent Valuation

— the direct elicitation of these values from individuals through carefully designed and administered sample surveys.

Typically:
provide responents with information about hypothetical government programs that would reduce the likelihood of a future adverse environmental event.

Respondents given some specific information about the exact nature of the damages to be prevented.

Respondents confronted with questions that provide information about the economic sacrifice (their WTP) they would have to make to support the environmental program.

Why Not Willingness to Accept?

What is their *Willingness To Pay* (WTP)?

- **What is the maximum they'd pay for the program?**
- **A series of questions with different prices depending on previous answers**
- **"yes" or "no" to a dollar levy if the program goes ahead**

Not asked Willingness To Accept (WTA) —
because of the possibility of unrealistically high answers, and income effects.

CV is controversial:

— **answers may be inconsistent with rational choice**
— **responents may not understand the issues**
— **respondents may not take the questions seriously, since they're not binding (talk is cheap[1])**

Criticisms of the Contingent Valuation Method

(See Hausman & Diamond in Package)

First: The impossibility of *external validation* of CV results.

Experiments may provide an artificial opportunity to pay for environmental goods, including passive use.

Then compare CV WTP with “real” results.

eg. Seip & Strand:

> **CV WTP for membership in a Norwegian environmental organisation was very much greater than the actual responses when the real opportunity was offered to a similar group: only 6 of 64.**

Examples of CV WTP

eg. Duffield & Patterson:

The environment amenity was maintenance of flow of Montana rivers, with spawning grounds for two rare species of fish. Two groups of passive-use respondents polled by mail:

Group 1: hypothetical questions to elicit CV WTP to contribute to agency to maintain stream flow (6.3%), and

Group 2: actual cash contributions to the same organisation possible. (1.1%)

Results: response rates and expressed WTP higher when hypothetical (G1) than when actual (G2).

eg. Dickie et al.:

WTP for ordinary market goods (strawberries).

Compare expressed WTP with actual.
CV WTP > actual by up to 50%
(although casual design)
Still possible to conclude that CV WTP reflects actual market demand, although significantly higher.

Six Concerns With CV:

1. **CV can produce results that appear to be inconsistent with assumptions of rational choice;**
2. **responses to CV surveys sometimes seem implausibly large in view of the many programs for which individuals might be asked to contribute and possible substitutes (public and private) for the amenities in questions;**
3. **difficult in CV surveys to provide adequate information to respondents about the hypothetical program and to be sure that the information has been absorbed and accepted;**
4. **respondents in CV surveys may actually be expressing feelings about public spiritedness or the "warm glow" of giving, rather than actual WTP for the program in question.**
5. **few CV surveys have reminded respondents of the budget constraints under which all must operate;**
6. **scaling up CV survey results is questionable, given the uncertain "extent of the market";**

5.1 CV Inconsistent with Rational Choice

— What requirements are imposed by rationality?
— Why are they relevant to evaluation CV reliability?

Weakest rationality: *consistency*:

- **If prices fall, individual purchaser better off (private goods and public goods)**
- **WTP should be an increasing function of the scale of the program**
- **Falling marginal WTP (as scale of project increases) shouldn't result in very abrupt falls.**

But some studies suggest that WTP doesn’t increase with the scale:

eg. Kahneman:

WTP for cleaning up all lakes in Ontario only slightly > WTP for one region’s lakes’ cleanup.

eg. Desvouges et al.:

Average WTP for measures to prevent 2000 migratory birds (not endangered species) from dying in oil-filled ponds ≈ AWTP for 20,000 or 200,000 birds from dying.
Diminishing MWTP? Yes, but not to zero, especially when AWTP not negligible.
Rational, consistent choice?

i.e. lack of scale effect

Is rationality needed? Why not just accept values (WTP) as found? Well ...

- **How to reason about values without rationality?**
- **Give a lack of external validation → want internal consistency.**

5.2 CV: Implausibility of Responses

CV usually used to elicit values for a specific program, in which case many individuals express zero WTP, and AWTP over the whole sample of respondents often at least a few $ and frequently $20 to $50.

With, say, 7–8m households, get hundreds of million $ as aggregate WTP (see Kakadu CV by the Resources Assessment Commission).

But there are many types of possible environmental damage:

$\rightarrow$ **much for each household to pay**

$\rightarrow$ **overestimates for large numbers of environmental problems, especially when exist substitutes too.**

5.3 CV: Information Provision and Acceptance

Often programs and impacts only sketchily outlined.

eg. WTP to prevent a chemical leak into a river; details?

- **time for chemical to degrade (if at all)?**
- **ecological and human health damage**

Such information necessary, but not sufficient for rational responses.

Limits on ability to internalise and accept information. (motivation)

Pessimists $\rightarrow$ high WTP: overstated?
Optimists $\rightarrow$ low WTP: understated?

i.e. What if respondents rely on a set of heuristics, such as

- **"These environmental accidents are seldom as bad as we're led to believe."**
- **"Authorities almost always put too good a face on these things."**

— then they're answering a different set of questions.

5.4 CV: “Warm Glow” Effects

Open-ended CV questions $\rightarrow$ many “zeroes” (those who would pay nothing for the program) and a number of sizable reports.

This bimodal distribution also characterises charitable donations:

- **most of us give nothing to most charities,**
- **but give non-trivial amounts (>$10) to those we do support.**

Such responses support the charities, but also generate for the donor the so-called “warm glow” from giving.

Do such responses to CV questions also reflect a *warm glow* from expressed support of environmental protection, rather than actual WTP?

If so, that would explain the lack of scale effects mentioned in 5.1 above.

5.5 CV: Absence of a Meaningful Budget Constraint

"What current or planned expenditures would you forgo to pay for the environmental protection program?"

5.6 CV: Extent of the Market

Undersampling and zero sampling of a subgroup of the relevant population only justified if the subgroup has a predictably low WTP for protecting the resource.

Design of CV Instruments

A CV study can be seen as a self-contained referendum in which respondents vote on whether to tax themselves or not for a particular purpose.

Open-ended questions:

- **“What is the smallest sum that would compensate you for environmental damage X?”**
- **“What is the largest amount you would be willing to pay to avoid (or repair) environmental damage X?”**

Or: Willingness-to-pay question (— referendum):

- **“Would you be willing to contribute (or be taxed) D dollars to help cover the cost of avoiding or repairing environmental damage X?”**
  eg. — the $80 environmental levy by the Sydney Water Board

The latter is *the Panel’s preferred form*: realistic, no strategic reason not to answer truthfully, possible to validate with property tax referendums.

CV: Addressing the Embedding Problem

CV: Time Dimension of the Passive Use Losses

6. Irreversibility, or Forgoing Options

(From Pearce on the Gordon-below-Franklin — see Package.)

Suppose: direct costs: \$1,
benefits: \$*D* forever (a perpetuity)

$\therefore\ NPV(D) = -1 + \dfrac{D}{r}$**, where *r* is the discount rate.**

But indirect costs = preservation *benefits P forgone* in perpetuity or $PV(P) = \frac{P}{r}$**,**

$\therefore\ NPV(D) = -1 + \frac{D}{r} - \frac{P}{r}$**, and** $NPV(D) > 0$**, iff** $(D - P) > r$**.**

But *P* and *D* will not be constant: $P_t = P_0 e^{gt}$**, and** $D_t = D_0 e^{kt}$**,**

$\therefore\ NPV(D) = -1 + \frac{D}{r+k} - \frac{P}{r-g}$

and $NPV(D) > 0$ **iff** $\sqrt{D} > \sqrt{P} + \sqrt{k+g}$

If $P = 0.2$**,** $k + g = 0.01$**, then** $\sqrt{D} > 0.547$**,** $\therefore\ D = 0.299$

and $D/P > 0.299/0.2 = 1.497$**:** $\therefore$ **for NPV > 0,** $D > 150\%\ P$**.**

Let's put numbers in for the Gordon-below-Franklin:

The N.P.V. of the dam is given by

$$NPV(D) = -1 + \frac{D}{r+k} - \frac{P}{r-g}$$

where D is the benefit perpetuity discounted at r p.a., with technological decay of k p.a.

and P is the forgone, lost benefits, with a real rate of growth of g p.a.

Let r = 5% p.a., and g = 4% p.a.

The Present Value of $1 of initial-year preservation benefits = $259.80

Now: hydro instead of coal $\rightarrow$ ΔCS = $189 m

$\therefore$ if NPV(D) = 0, then $P = \frac{189{,}000{,}000}{259.8} = 727{,}483$

So that if the initial year's preservation benefit > $750,000

then NPV(D) < 0, so STOP!

7. What Is the Value of Human Life?

Life: Nature of the Valuation **[C&B pp. 284]**

Two senses:

- **value to the individual of being alive**
- **value to *other* people of his/her being alive —we focus on this.**

Value of one's life to *other* people:

from 1. *benefits to evaluator of the life*

e.g. servants, employees, slaves, children? breadwinner — protection of these

***so* death ends benefits**
∴ life valued by net benefits
e.g. Court payouts
e.g. to widows/widowers: p.v. of dead spouse's lost earnings

& from 2. *knowledge that person obtains utility while alive*

e.g. rescue strangers

Subjective values of life.

***so* subjective — not all lives equally valuable—(*is*, not *ought*)**

vary by (a) probability of dying
(b) life expectancy
(c) quality of life

a. note—we all take risks:
— voluntary
— involuntary ∴ none value our lives infinitely

e.g. { crossing road / driving car

?

but higher-risk job → higher pay (& self selection)

Value of life depends on probability of remaining alive

e.g. • educating { kids / mature age students

• rescue attempts

b. life expectancy e.g. society's efforts for kids v. elderly

c. quality of life: e.g. ?

Ethical issue — utilitarian perspective. Dread factor.

Life: Nature of the Decision

a. preventing loss of life

e.g. rescues
accident prevention
life-support
drugs
chemicals
—choice among lives: who will be saved?
—“triage”

b. possibility of causing loss of life

compare value of desired end
v. probability of causing death

Life: Rationality

Moral issues; but *not* making a decision is a decision itself

a. *Preventing loss of life*

costs usually clear → threshold problem
benefits?

voluntary donations ⇒ individual choices?

e.g. dialysis machines prolong life — clear
CAT scanners, MRI → better diagnosis → lives saved – whose?

***longer-run* decisions to prevent death**

e.g. kidney dialysis machines, CAT scanners, NMR machines
— often need *representatives* to decide

e.g. value of additional lives saved by another doctor (marginal value of a doctor)

***or* group-insurance approach**

– e.g. willingness to pay for *option* of having an ICU → voluntary HMOs
→ involuntary tax system

cultural guidelines (“women and children first”)

b. *causing possible deaths*

e.g. fire department hazardous to firemen

***probabilities* are crucial when there are risks.**

Summary of Week 5

These lectures introduced methods to evaluate unmarketed goods and services (emphasis on opportunity costs):

- **Valuing time via revealed preference, given a choice of fast and dear, versus slow and cheap.**
- **Valuing distant attractions using the Travel Cost method.**
- **Valuing the environment using Hedonic pricing: how do land values change?**
- **Using Contingent Valuation (survey) methods: strengths and weaknesses.**
- **Other methods: Defensive expenditure, Change in cost, Change in output, Replacement cost.**
- **Forgoing an option: irreversibility.**
- **Valuing life**