An Introduction to Economic Valuation of the Environment using Practical Examples

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ESPA Summer School

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1. Why economic valuation?
2. What is economic valuation?
3. How do we measure economic value?
4. Why and how do economic values vary?
5. How do we use economic value evidence in decision making?
6. What can economic valuation do / cannot do?
Why economic valuation?
Better decisions

- Resources are limited
- Choices are inevitable
- Understand the relative value of different choices

- Financial
- Economic
- Social
- Cultural
- Environmental
Ecosystem Services (flows) → natural capital (stocks)
Thinking broader

- Economic value ≠ financial value
  - Not ‘the cheapest’ way but ‘the highest net benefit’
  - Not just commercial gain but social welfare

- Welfare
  - Wellbeing, happiness
  - ‘Net’ changes in wellbeing
  - Not only monetary income but total economic value
  - ‘Market’ vs ‘Non-market’
  - ‘Internal’ vs ‘External’
What is economic valuation?
Total Economic Value

- Use value
  - Option value
  - Actual use
    - Direct use
    - Indirect use
- Non-use value
  - For others
  - Existence
    - Bequest
    - Altruism
Three stages of economic valuation

1. Qualitative assessment: Understand what ecosystem services are provided.
2. Quantitative assessment: Measure the change in the provision of ecosystem services.
4. Ecosystem services assessment: Input in decision making.
Valuing Changes

How much does the individual wellbeing change?
How do we measure economic value?
Measuring total economic value

- Willingness to pay (WTP) an amount to:
  - Ensure an improvement happens
  - Avoid a decline

- Willingness to accept (WTA) compensation to:
  - Forgo an improvement
  - Tolerate a decline

- An improvement = Benefit
- A decline = Cost
- Avoided Cost = Benefit
Measuring total economic value

- Why in monetary terms?
  - Familiar
  - Comparable (especially to financial values)
  - Continuous

- In some cases we use non-monetary units too but if environmental gains (of conservation) are to be compared to the financial gains (of development), monetary measure helps
Valuation data

- **Market prices**
  - Markets exist and prices reflect opportunity costs

- **Revealed (and stated) preference methods**
  - Market prices do not exist but ‘surrogate’ markets and prices can be observed

- **Stated preference methods**
  - Market prices and surrogate markets do not exist
  - No previous experience of the change (so consumer behaviour cannot be observed)
Relative value of change

Non-Market Goods (Q)
- Water
- Clean air
- Biodiversity
- Natural Areas
- Peace & Quiet
- Health & Safety

Market Goods (X)
- Property
- Car
- Double glazing
- Helmet
- Fuel
- Bottled water

WELLBEING
- Q
- M
- SALE
  UP TO 40% OFF

eftec
Economic valuation methods

- Wellbeing generated from:

1. **Substitutes**
   - Water
   - Bottled water
   - Avertive behaviour
   - Defensive expenditure

2. **Complements**
   - Natural Areas
   - Fuel
   - Travel cost model

3. **Characteristic**
   - Peace & Quiet
   - Property
   - Hedonic pricing
   - Discrete choice models

**NO MARKET DATA?**
- Hypothetical market
  - Contingent valuation
  - Choice modelling

**Revealed preference: relationship between market and non-market good**
Different types of value / valuation

Improving Green Infrastructure

Direct observed value
- Property value impacts
- Local visitor spending

Direct (but not easily observed)
- Enhanced visitor experience

Indirect value
- Physical health
- Mental health benefits
Why and how economic values vary?
Factors affecting economic value estimates

- **The resource:**
  - Characteristics
  - Scarcity and substitutability

- **The change:**
  - Direction of change
  - The scale of change
  - The timing of change

- **Individuals – all who are affected**
  - Socio-economic characteristics (e.g. income, education, gender, age etc.)
  - Uses of the resource
  - Tastes etc.
Further information

- Defra (2007) *An Introductory Guide to Valuing Ecosystem Services*

- Defra (2010) Value Transfer Guidelines


- Accounting for Environmental Impacts – Supplementary Green Book guidance
  - Valuation of energy use and greenhouse gas emissions
  - Valuing impacts in air quality

- Assessing environmental impact guidance
  - Noise
Example 1 – avertive expenditure (water quality)

- Aesthetic quality: taste, smell and appearance of tap water
  - Substitutes include water filters (e.g. a jug/kettle, tap/under sink filter), bottled water, squash and cordial
  - Difficulty – expenditures can be substantial, but no objective measure of quality, need to rely on self-reported assessment

- Hardness
  - Hard water can damage and reduce lifetime of appliances
  - Characteristic of the raw water source and determined by the geology (presence of calcium and magnesium in aquifers)
  - Possible to mitigate through investments at water treatment plants or at the individual household level
Example 1 – avertive expenditure (water quality)

- Sample size approx. 4,500 households, representative of England and Wales, covering a wide geographical area and spanning different water services suppliers

- Online survey

- Survey data augmented with sub-region data (water supply zone)
  - Customer complaints concerning the taste, smell, appearance and hardness of tap water
  - Water hardness (mg CaCO3/l)

- Exploit regional variations in the level of service to identify impact on avertive expenditure
Example 1 – avertive expenditure (water quality)
Example 2 – Revealed & Stated Preference (bathing water)

**Total visits**

‘Best estimate’ based on available data sources:

- Local: surveys, car park income/capacities, accommodation stocks
- Regional: GBTS
- National: MENE

Assumption: current visitor patterns are reasonable representation of situation where site attains ‘sufficient’

**Reduction in visits**

Local and national survey responses to advisory signs:

- Travel cost (expenditure)
- Stated response (reduced no. visits)
- Predicted reduction – estimated by ‘trip generating function’

Two approaches: provides an estimated range for use in CBA
Example 2 – Revealed & Stated Preference (bathing water)

Supporting data

1. Best estimate of annual visitors to ‘at risk’ site

2. Expenditure per visitor per day

3. Estimated visitor spend per year

The Cambridge Model

4a. Business turnover

4b. Gross Value Added (GVA)

4c. Employment supported by expenditure (FTE)

Local survey responses
## Expenditure (aggregated)

<table>
<thead>
<tr>
<th>Category</th>
<th>Peak</th>
<th>Off-peak</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodation (today only)</td>
<td>£13.00</td>
<td>£16.57</td>
<td>£11.01</td>
</tr>
<tr>
<td>Eating and drinking in cafes, pubs, restaurants and hotels</td>
<td>£5.72</td>
<td>£4.68</td>
<td>£5.31</td>
</tr>
<tr>
<td>Buying food, drinks or snacks from shops</td>
<td>£2.19</td>
<td>£1.94</td>
<td>£2.14</td>
</tr>
<tr>
<td>Shopping such as souvenirs and items for the beach</td>
<td>£0.95</td>
<td>£0.71</td>
<td>£1.22</td>
</tr>
<tr>
<td>Activities (e.g. local attractions or water sports lessons)</td>
<td>£0.72</td>
<td>£0.31</td>
<td>£0.47</td>
</tr>
<tr>
<td>Travel and transport (e.g. fuel or train tickets)</td>
<td>£1.89</td>
<td>£2.04</td>
<td>£1.48</td>
</tr>
<tr>
<td>Car parking</td>
<td>£0.51</td>
<td>£0.25</td>
<td>£0.33</td>
</tr>
<tr>
<td>Other</td>
<td>£0.37</td>
<td>£1.08</td>
<td>£0.77</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>£26</td>
<td>£25</td>
<td>£25</td>
</tr>
</tbody>
</table>

- Overall total expenditure approx. £25 per person per visit (day) (rounded)
  - Peak and off-peak expenditure fairly similar
Example 2 – Revealed & Stated Preference (bathing water)

Impact of signs: local vs. national survey

Q. Thinking about your next visit, if you saw a sign that advises you not to go into the water because of poor water quality, what would you be likely to do?

<table>
<thead>
<tr>
<th>Locally</th>
<th>Nationally</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>14%</td>
</tr>
<tr>
<td>81%</td>
<td>50%</td>
</tr>
<tr>
<td>9%</td>
<td>12%</td>
</tr>
</tbody>
</table>

- 10% would still go in the water
- 81% would stay on the beach
- 9% would go to another beach

Q. If signs like this were displayed at that beach you visit most often, how often would you visit?

<table>
<thead>
<tr>
<th>Locally</th>
<th>Nationally</th>
</tr>
</thead>
<tbody>
<tr>
<td>84%</td>
<td>60%</td>
</tr>
<tr>
<td>7%</td>
<td>27%</td>
</tr>
<tr>
<td>10%</td>
<td>13%</td>
</tr>
</tbody>
</table>

- 84% would visit as often as now
- 7% would visit less often
- 10% would no longer visit
Example 2 – Revealed & Stated Preference (bathing water)

Which of the following options do you prefer the most?

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sign displayed at the beach you visit most often</strong></td>
<td><img src="#" alt="Good" /></td>
<td><img src="#" alt="Sufficient" /></td>
<td><img src="#" alt="Advice against bathing" /></td>
</tr>
<tr>
<td><strong>The proportion of English beaches which fail to meet water quality standards</strong></td>
<td><img src="#" alt="1/7 at risk beaches fail" /> This is 2% of all bathing waters (10 of 500)</td>
<td><img src="#" alt="1/2 at risk beaches fail" /> This is 7% of all bathing waters (35 of 500)</td>
<td><img src="#" alt="All at risk beaches fail" /> This is 14% of all bathing waters (70 of 500)</td>
</tr>
<tr>
<td><strong>The amount of litter at the beach you visit most often</strong></td>
<td><img src="#" alt="Litter remaining: 75% of current levels" /> Litter removed: 25% of current levels</td>
<td><img src="#" alt="Litter remaining: 10% of current levels" /> Litter removed: 90% of current levels</td>
<td><img src="#" alt="Litter remaining: 100% of current levels" /> Litter removed: 0% of current levels</td>
</tr>
<tr>
<td><strong>Cost to your household in terms of increased annual water bill</strong></td>
<td>£45</td>
<td>£35</td>
<td>£0</td>
</tr>
</tbody>
</table>
## Value of improvements (WTP)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>£/hh/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bathing water status – beach visited most often attains ‘sufficient’</td>
<td>24.0</td>
</tr>
<tr>
<td>Bathing water status – beach visited most often attains ‘good’</td>
<td>27.0</td>
</tr>
<tr>
<td>Bathing water status – beach visited most often attains ‘excellent’</td>
<td>33.0</td>
</tr>
<tr>
<td>Litter - 1% of litter removed at beach visited most often</td>
<td>0.3</td>
</tr>
<tr>
<td>National - 1% of all bathing water fail to meet ‘sufficient’</td>
<td>-1.5</td>
</tr>
</tbody>
</table>

![Graph showing WTP (£/hh/yr) for different water quality levels](chart.png)
### Example 2 – Revealed & Stated Preference (bathing water)

<table>
<thead>
<tr>
<th>Results (PV, 25 years)</th>
<th>Benefits</th>
<th>Costs</th>
<th>NPV</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local economic impact (GVA)</td>
<td>£</td>
<td>£</td>
<td>+£</td>
<td>20:1</td>
</tr>
<tr>
<td>National level (recreation value)</td>
<td>£</td>
<td>£</td>
<td>+£</td>
<td>13:1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivity testing – risk of failure</th>
<th>Benefits</th>
<th>Costs</th>
<th>NPV</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local economic impact (GVA)</td>
<td>£</td>
<td>£</td>
<td>+£</td>
<td>14:1</td>
</tr>
<tr>
<td>National level (recreation value)</td>
<td>£</td>
<td>£</td>
<td>+£</td>
<td>9:1</td>
</tr>
</tbody>
</table>
## Example 2 – Revealed & Stated Preference (bathing water)

<table>
<thead>
<tr>
<th>Results (PV, 25 years)</th>
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<th>Costs</th>
<th>NPV</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local economic impact (GVA)</td>
<td>£</td>
<td>£</td>
<td>-£</td>
<td>0.2:1</td>
</tr>
<tr>
<td>National level (recreation value)</td>
<td>£</td>
<td>£</td>
<td>-£</td>
<td>0.3:1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivity testing – risk of failure</th>
<th>Benefits</th>
<th>Costs</th>
<th>NPV</th>
<th>BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local economic impact (GVA)</td>
<td>£</td>
<td>£</td>
<td>-£</td>
<td>0.05:1</td>
</tr>
<tr>
<td>National level (recreation value)</td>
<td>£</td>
<td>£</td>
<td>-£</td>
<td>0.1:1</td>
</tr>
</tbody>
</table>
Example 3 - Value Transfer (tidal power)

**STEP 1**
Establish decision context

**STEP 2**
Define policy good & affected population

**STEP 3**
Measure change in policy good

**STEP 4**
Select economic value evidence

**STEP 5**
Transfer evidence & estimate value

**STEP 6**
Aggregation

**STEP 7**
Sensitivity analysis

**STEP 8**
Reporting
### Example 3 - Value Transfer (tidal power)

<table>
<thead>
<tr>
<th>Ecosystem services</th>
<th>FW Wetlands</th>
<th>FW Rivers &amp; Streams</th>
<th>Intertidal</th>
<th>Salt marsh</th>
<th>Sub-tidal</th>
<th>Terrestrial</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROVISIONING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial fish catch (F)</td>
<td>-</td>
<td>●</td>
<td>o</td>
<td>-</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Shellfish catch (F)</td>
<td>-</td>
<td>-</td>
<td>o</td>
<td>-</td>
<td>o</td>
<td>-</td>
</tr>
<tr>
<td>Grazing for cattle and sheep</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>●</td>
<td>-</td>
<td>o</td>
</tr>
<tr>
<td>Subsistence level fishing &amp; cropping (F)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Wildfowling</td>
<td>-</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>-</td>
<td>●</td>
</tr>
<tr>
<td>Fibre/materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibre and construction prods (e.g. reeds, wood, leather, aggregates)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>●</td>
<td>o</td>
</tr>
<tr>
<td>Developed Land</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>●</td>
</tr>
<tr>
<td>Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable energy (F)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water for industrial usage</td>
<td>-</td>
<td>o</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Water for agricultural usage</td>
<td>o</td>
<td>●</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Regenerative services</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>●</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance of surface FW stores</td>
<td>o</td>
<td>o</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Groundwater replenishment</td>
<td>o</td>
<td>o</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Natural medicines</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Biochemicals</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Ornamental resources</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td><strong>REGULATING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climate/climate change</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Air quality</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Water reg.</td>
<td>o</td>
<td>o</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Water purification &amp; waste management</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

* FW = Fresh Water, FWW = Freshwater Wetlands, FWRS = Freshwater Rivers & Streams, INT = Intertidal, SLT = Salt Marsh, STL = Sub-tidal, TRL = Terrestrial
Example 4 – Natural Capital Accounting (The Crown Estate)

1. What do you have?  
   Stocks of natural assets

2. What does it produce?  
   Flows of ecosystem services

3. What is that worth?  
   Natural capital benefits

4. What does it cost?  
   Natural capital maintenance
Example 4 – Natural Capital Accounting (The Crown Estate)

**Natural capital**

- Ecological communities
- Soils
- Freshwaters
- Land
- Minerals
- Atmosphere
- Subsoil assets
- Oceans

**Natural capital benefits**

- Food
- Fibre (e.g. timber)
- Energy
- Fresh water
- Clean air
- Climate regulation
- Recreation
- Amenity
- Biodiversity/conservation

**Ecosystem Service Flows**

Inputs from other capital
### Example 4 – Natural Capital Accounting (The Crown Estate)

<table>
<thead>
<tr>
<th>Conventional physical assets</th>
<th>Natural capital assets</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram of Conventional Physical Assets" /></td>
<td><img src="image2" alt="Diagram of Natural Capital Assets" /></td>
</tr>
<tr>
<td><strong>Benefits to the company (revenue streams)</strong></td>
<td><strong>Benefits to the company and wider society</strong></td>
</tr>
<tr>
<td><strong>Benefits at a single, local, scale</strong></td>
<td><strong>Benefits at multiple scales (local, regional, global)</strong></td>
</tr>
<tr>
<td><strong>Depreciate in value over finite lifetime</strong></td>
<td><strong>Without intervention value may decline or remain stable</strong></td>
</tr>
<tr>
<td><strong>Exclusively owned and controlled by the organisation for entirety of useful life</strong></td>
<td><strong>Value may tend to appreciate over an infinite lifetime</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Often only partially 'owned' or controlled (e.g. certain use rights) for a defined period of time</strong></td>
</tr>
</tbody>
</table>
Key issue: financial accounting does not reflect the wider value generated by the Park (esp. benefits from natural capital)

- Reporting to the Treasury shows cross subsidy of property income to maintain natural capital assets
### Example 4 – Natural Capital Accounting

#### Ecosystem services

<table>
<thead>
<tr>
<th>Aesthetics</th>
<th>Clean Air</th>
<th>Clean Water</th>
<th>Energy</th>
<th>Equable climate</th>
<th>Fibre</th>
<th>Food</th>
<th>Hazard protection</th>
<th>Recreation</th>
<th>Wildlife</th>
</tr>
</thead>
</table>

#### Scope of financial account

- **Gardens**
  - ●
  - ○
  - ○
  - ○
  - ○
  - ○
  - ○
  - ●
  - ○

- **Agriculture**
  - –
  - –
  - ○
  - ○
  - ○
  - ○
  - ●
  - –
  - –

- **Parkland**
  - ●
  - –
  - ○
  - ○
  - ○
  - ●
  - ○
  - ●
  - ●

- **Woodland**
  - ●
  - ●
  - ●
  - ●
  - ●
  - ●
  - ●
  - ●
  - ●

#### Scope of natural capital account

- **Gardens**
  - ●
  - ○
  - ○
  - ○
  - ○
  - ○
  - ○
  - ●
  - ○

- **Agriculture**
  - –
  - –
  - ○
  - ○
  - ○
  - ●
  - –
  - –
  - ○

- **Parkland**
  - ●
  - –
  - ○
  - ○
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  - ●

- **Woodland**
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  - ●
  - ●
  - ○
  - ●
  - ●
  - ●
  - ●
  - ●

**Key:**
- ● Significant ecosystem service flow by habitat
- ○ Potential but not significant ecosystem service flow
- – No ecosystem service flow by habitat

**Legend:**
- Included in account
- Partly included in account
- Not included in account
What can economic value do and cannot do?
Economic valuation is not a replacement for scientific and social analysis. It builds on these.

Monetary estimates are not essential. The process is what matters most.

Economic valuation is from the perspective of humans. It’s not about ‘intrinsic value’.

Economic values vary with context – and that’s as it should be.
When communicating economic value evidence....
- Be clear about what’s included in the estimate and what’s not
- Engage with decision makers and stakeholders from the start → process just as important as £
- Be specific about what the evidence can be used for and what not
- Minimise jargon
- Choose the method appropriate for the use of the value evidence
- Agree the appropriate level of effort
- Research all options before concluding economic valuation is not necessary or too expensive
- Present economic value evidence as part of the three-stage process that it is (ql, qn, £)
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