Valuing Externalities and Public Health Impacts

Anna Alberini
AREC, University of Maryland

Presentation at the True Costs of Food Workshop, Institute of Medicine, Washington, DC, 23-24 April 2012
Many externalities...

• Water pollution
• Ecosystem and biodiversity effects
• GHG emissions (climate change), conventional air pollution emissions
• ...
• Health risks
Health Effects

- Consumers, farm workers
- Children, persons of other ages
- Sensitive groups (e.g., chemo patients; children; infants; other persons in compromised health)
- Immediate (microbial) v. delayed (cancer, other long-term effects, endocrine system effects, reproductive system effects)
- Risks associated with prevalent dietary habits (obesity, diabetes, cardiovascular risks)
- Direct v. indirect
  - Increased vulnerability to infections due to antibiotics resistance
  - Health effects of climate change (mortality/morbidity linked with temperatures, vector-borne illnesses, allergies, etc.)
  - Health risks from drinking water
What does it mean to “value” these effects?

- If something is important to you, you should be prepared to pay to get it or get rid of it.
- Willingness to Pay (WTP) to eliminate/reduce a specified adverse outcome or health risk.
- Based on economic theory:

\[ U(y - WTP, Q_1) = U(y, Q_0) \]
Valuation (cont’d)

• Benefits of program that reduces health or environmental risks = sum of beneficiaries’ WTPs for it

• How do we pay?
  – Via higher taxes
  – Via higher food prices
  – By incurring costs/efforts to protect ourselves from (health) risks
  – ...

WTP to Reduce Health Risks

• Acute, minor illness (e.g., food poisoning or “something that disagreed with me”)

• WTP to avoid it =
  = Medical expenditure to mitigate the symptoms +
  + income lost to illness +
  + cost of averting the illness +
  + value of the discomfort from being ill
Mortality Risks

• What is the WTP to reduce mortality risks?

• What is the appropriate metric?
  – The Value of a Statistical Life (VSL)
  – The Value of a Statistical Life Year (VOLY)

• Using one or the other may lead to different policy decisions, depending on age and (remaining) life expectancy of the beneficiaries
The Value of a Statistical Life (VSL)

- Benefits = VSL × L, where L is the number of lives saved by the policy
- VSL = WTP for a marginal change in the risk of dying

\[ VSL = \frac{\partial y}{\partial R} \]

- A summary measure of the willingness to pay for mortality risk reductions
Example

- If each person in a group of N people is prepared to pay $20 to reduce their risk of dying by $1/N$, then the VSL is $20*N$
The Value of a Statistical Life Year (VOLY)

- Benefits = \( VOLY \times \text{Life Years gained} \)

- \( VOLY \) usually inferred from \( VSL \):
  \[
  VSL = \sum_{t}^{T} VOLY(1 + \delta)^{-t}
  \]

- Only two studies that have elicited WTP for a gain in life expectancy directly (Chilton et al., 2004; NEEDS project, DATE?)
The VOLY (cont’d)

Advantage:
• Best suited for “chronic” mortality due to air pollution (proportional hazard models, life expectancy losses/gains)

Issues:
• Theory?
• Is VOLY constant with respect to age?
• When valuing life expectancy gains, do people understand what they are valuing?
How is the VSL estimated?

• Compensating wage studies (e.g., Viscusi, 1993; Viscusi and Aldy, 2003)
• Consumer behavior studies (Blomquist, 2003; Jenkins et al., 2001)
• Hedonics (Gayer et al., 2000, 2002; Davis, 2004)*
• Stated preference methods (Krupnick et al., 2002; Tsuge et al., 2006; Alberini et al., 2007)

*: Housing Price Hedonics; Value of a Statistical Case of Cancer
Compensating Wage Studies

\[ \ln w_i = x_i \beta + FR_i \cdot \gamma + NFR_i \cdot \delta + \varepsilon_i \]

- The VSL is inferred from \( \gamma \)
- Assumes that workers must be paid more when they face higher workplace risks – really?
- Assumes that workers know perfectly the risks, and that the researcher is measuring these risks correctly
Housing Price Hedonics
(i.e., your realtor’s comps—sort of)

\[ \ln P_i = \mathbf{x}_i \beta + \mathbf{N}_i \gamma + \mathbf{R}_i \cdot \delta + \epsilon_i \]

- Confounding/spatially collinearity
- Assumes that risks are known, and that the researcher is measuring them correctly
- May work better in contexts other than food safety
Can the hedonic pricing approach be applied to food risks?

- In principle, yes, because healthier and safer foods (organic, free range, local) are more expensive

\[ \ln P_j = x_j \beta + R_{j1} \gamma_1 + R_{j2} \gamma_2 + \ldots + \varepsilon_i \]

- Immediate mortality risks
- Risk of cancer
- Other health risks
- Envir. Effects
- Climate change effects

- But \( R_1, R_2, \ldots \) not known to the consumer and/or too correlated to disentangle the contribution of each
## Example SP method

The interventions below refer to **Paolo/yours**elf.

<table>
<thead>
<tr>
<th></th>
<th><strong>Alternative A</strong></th>
<th><strong>Alternative B</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Context (cause of death)</strong></td>
<td>Road traffic accidents</td>
<td>Cancer</td>
</tr>
<tr>
<td><strong>Other beneficiaries?</strong></td>
<td>Yes (nationwide public program)</td>
<td>No (private action)</td>
</tr>
<tr>
<td><strong>Risk reduction</strong></td>
<td>3 in 10,000 over 5 years</td>
<td>2 in 10,000 over 5 years</td>
</tr>
<tr>
<td><strong>The risk reduction begins</strong></td>
<td>In 2 years</td>
<td>in 2 years</td>
</tr>
<tr>
<td><strong>One-time cost to your household (to be paid now)</strong></td>
<td>300 euro</td>
<td>200 euro</td>
</tr>
</tbody>
</table>

Which do you prefer, A or B? And which do you prefer, A, B or neither?
Example of a conjoint choice question
Risk Communication

-- Grid of squares (10,000 squares)
-- Corso et al. (2001)
Probabilità di morire nei prossimi 5 anni

Causa principale: tumore e malattie cardiovascolari e circolatorie

Causa principale: incidenti (stradali, domestici, sul lavoro)

Cause principali: cause neonatali, traumatici e avvelenamenti

Numero di morti su 10,000 nei prossimi 5 anni

Classi di età

0-4 5 a 9 10 a 14 15-19 20-24 25-29 30-34 35-39 40-44 45-49 50-54 55-59 60-64
56 14 14 20 30 32 39 57 91 153 236 338 511

Risk Communication -- 2
Valuation of Environment-Related Health Impacts with a Particular Focus on Children

Background

The lack of empirical surveys and associated lack of data in this area is a barrier to the provision of sound policy advice. Indeed, existing values used in representations of environmental related health impacts focus on adult populations and use scenarios that often do not match well with environmental scenarios. As such, there is concern that the continued use of existing estimates from unaltered contexts that do not take these factors into account may result in a misguided benefit-cost analysis, and in a possible misallocation of resources, especially when environmental policies with significant implications for children are under consideration.

Objectives

This three-year project (2006-2009) funded under the FP6 Framework by the European Commission’s Directorate General for Research aims to improve the incorporation of environment-related health impacts in policy-making. An original survey instrument will be applied in three OECD countries (United Kingdom, Italy and the Czech Republic) that have disparities in terms of important factors, such as social insurance systems, healthcare systems, social concern about the environment, etc.

The survey will be developed in such a way that it is applicable to comparable values for adults and children for similar risks, and will also seek to outline the cost of the risk reduction, and on society as a whole. Finally, the project will examine the potential for benefit to occur across situations with different socioeconomic characteristics.

Timeline

In the first stage, methodological and policy makers will be undertaken to pilot the research framework using the selection of the appropriate valuation framework to apply in the context of the valuation of environmental health risks to children, and in the preparation of the scenario design. Based upon the findings from these exercises, different survey designs will be tested to determine which valuation methodology and which environmental risk metric is the most appropriate for this very specific context.

The second phase of the project on the valuation of children’s health will consist in implementing surveys in the three OECD countries identified in the project in order to develop estimates of the health benefits associated with a reduction of a specific environmental risk factor. The project results will be presented at an international conference to be held at the end of 2009.

VERHI-Children

• funded by the European Commission, DG-Environment

• 2006-2009

• focus on child VSL and comparison with adult VSL
Qs:

• Can we transfer the VSL from other contexts to the food safety/food production externalities context?

• What factors affect the WTP for a mortality risk reduction?
• Are the beneficiaries comparable?
• Nature of the risk
  – Cancer
• Timing (pay now, get risk reduction later)
  – latency and discounting
• Competing risks (Eeckhoudt and Hammitt, 2001; Evans and Smith, 2006)
• Other sources of similar risks (cardiovascular risks due to pollution v. diet)

• Are private behaviors substitutes or complements with public programs that reduce risks?
  – Which is more effective (has the higher productivity in reducing risks)?
  – Which is more efficient, given the price of inputs (Shogren, 1990)

• The psychometric paradigm (Slovic, 1987)
<table>
<thead>
<tr>
<th>characteristic</th>
<th>definition</th>
<th>rating scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voluntariness</td>
<td>Do people become exposed to this risk voluntarily?</td>
<td>Risks assumed voluntarily/involuntarily</td>
</tr>
<tr>
<td>Immediacy of effect</td>
<td>To what extent is the risk of death immediate—or is death likely to occur at some later time?</td>
<td>Effect immediate/delayed</td>
</tr>
<tr>
<td>Newness</td>
<td>Is this risk new and novel or old and familiar?</td>
<td>New/old</td>
</tr>
<tr>
<td>Catastrophe</td>
<td>Is this a risk that kills people one at a time (individual risk) or a risk that kills large numbers of people at once (catastrophic risk)?</td>
<td>Individual/catastrophic</td>
</tr>
<tr>
<td>Equity</td>
<td>To what extent are those who are exposed to the risks the same people as those who receive the benefits?</td>
<td>Risks and benefits match/mismatched</td>
</tr>
<tr>
<td>Future generations</td>
<td>To what extent does present pursuit of this activity or technology pose risks to future generations?</td>
<td>Very little threat/great threat</td>
</tr>
<tr>
<td>Economic benefits</td>
<td>Economic benefits include the contribution of the activity, product, or technology toward providing jobs, income, and increased personal or national productivity of goods and services</td>
<td>No benefits/very great benefits</td>
</tr>
<tr>
<td>Pleasure benefits</td>
<td>Pleasure benefits include intellectual stimulation, entertainment (fun), aesthetic enjoyment, relaxation, novelty, and camaraderie</td>
<td>No benefits/very great benefits</td>
</tr>
<tr>
<td>Dread</td>
<td>Is this a risk that people have learned to live with and can think about reasonably calmly, or is it one that people have great dread for—on the level of a gut reaction?</td>
<td>No dread/dread</td>
</tr>
<tr>
<td>Perceived risk</td>
<td>What is the risk of dying (across all U.S. society as a whole) as a consequence of this activity, technology, or product?</td>
<td>Low risk/high risk</td>
</tr>
<tr>
<td>Expected mortality</td>
<td>Number of deaths if next year is average</td>
<td>Number</td>
</tr>
</tbody>
</table>
Empirical Evidence

• Risk perceptions literature
  – Fischhoff et al. (1978), Slovic (1987)

• ...but little evidence relating attributes of risk perceptions to WTP for them
  – McDaniels et al. (1992), Savage (1993)

• Magat et al. (1996), Van Houtven et al. (2008)

• Hammitt and Liu (2004), Hammitt and Haninger (2010)

• Tsuge et al. (2005)
Effectiveness/controllability of cancer risks

- Not effective at all: 0.58%
- Little effective: 2.33%
- Somewhat effective: 4.22%
- Effective: 27.32%
- Very effective: 28.38%

H4 (private behaviors for cancer) / H5 (public programs for cancer)
## Respondents’ Dread Ratings for Selected Causes of Death

<table>
<thead>
<tr>
<th></th>
<th>no dread</th>
<th>medium dread</th>
<th>high dread</th>
</tr>
</thead>
<tbody>
<tr>
<td>road traffic accident</td>
<td>3.47%</td>
<td>9.63%</td>
<td>27.37%</td>
</tr>
<tr>
<td>cardiovascular disease</td>
<td>3.59%</td>
<td>12.99%</td>
<td>31.31%</td>
</tr>
<tr>
<td>chronic respiratory illnesses</td>
<td>7.07%</td>
<td>20.15%</td>
<td>31.96%</td>
</tr>
<tr>
<td>cancer</td>
<td>2.27%</td>
<td>4.28%</td>
<td>12.89%</td>
</tr>
<tr>
<td>fire</td>
<td>14.32%</td>
<td>26.74%</td>
<td>21.99%</td>
</tr>
</tbody>
</table>
Understudied Topics

• WTP to reduce dietary cardiovascular risks, diabetes
• WTP to reduce endocrine disruption (linked with certain pesticides)
• WTP to reduce effects on reproductive system
• Antibiotics resistance
Valuing Effects on Water & Environment

• Different approaches possible
  – Damage function approach – quantifies physical effects, then attaches a value to the physical effects
  – Ask people to value directly a change in pollution concentrations, etc.

• Travel cost method
  – natural resources/ecosystems with recreational value

• Hedonic housing price method

• Contingent Valuation, Stated Preference Methods
  – Can capture “existence” or “non-use” values
Final Thoughts

• Should we attach values to the public health and environmental effects of food production?
  – Yes

• Can we do that in a single valuation “exercise?”
  – Probably not
  – Break down into different effects and value separately
  – Careful with double counting
  – Will have to accept that different techniques/methods are required to value different effects