Monetary Valuation

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MAXIMA and the ExternE Method:
Stakeholder Reactions & Reservations

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Overview of the presentation

- Health
- Buildings
- Visibility
- Crops
- Ecosystems
  - Acidification
  - Eutrophication
  - Global warming
- Energy security

Valuation of health impacts of air pollution: Mortality

- Health impacts comprise 98% of the external costs from SO_2 and 100% of those from particulates (European Commission, 1999), with mortality impacts accounting for at least 80% of these health impacts.

- Exposure to a number of pollutants, including particulates, nitrates, sulphates and ozone, (e.g. European Commission, 1999), can lead to cases of immediate (acute) or delayed (chronic) premature death within a given population.

Methodology

- Compensating wage method
- Averting behaviour
- Willingness to Pay (WTP) => Contingent Valuation Method (CVM)

Example of CVM question

- Suppose that a new product becomes available that, when used over the next ten years, would reduce your chance of dying from a disease or illness. This product would reduce your total chance of dying over the next ten years from X to Y.
- If you were to take this product you would have to pay the full amount of the cost out of your own pocket each year for the next ten years. For the product to have its full effect, you would need to use it every year for all ten years.
- We realise that most people will not simply accept the idea that this product is guaranteed to work without some proof. In answering the next questions, please assume that the product has been demonstrated to be safe and effective in tests required by the UK Government.
- Keeping in mind that you would have less money to spend on other things, would you be willing to pay €Z per year (10 times Z total) to purchase this product?

Value of Life Years

- Value of Life Years (VOLY) correct measure to value mortality due to air pollution
- VOLY is calculated from the Value of Statistical Life (VSL)
- VSL: Suppose each member of a group of 10,000 is willing to pay €30 for a 1 in 10,000 (0.0001) reduction in the risk of death (=1 life saved in this group). Then, the VSL is €30/0.0001= €300,000.
- VOLY = Convert Value of Statistical Life (VSL) estimate to discounted stream of annual life year values over remaining lifetime (based on population survival probabilities) $\Rightarrow$ ExternE

Results of CVM Studies in Europe

- CVM surveys in France, UK, Italy
- WTP for a risk reduction of 5 in 1,000 to be incurred over the next ten years, with respect to the baseline
- Median WTP €4,650 (s.e. 333) for a life expectancy gain of one month
- VOLY €50,000 (NewExt)
- However, only 3 countries

Valuation of health impacts of air pollution: Morbidity

- *Resource costs* i.e. medical costs paid by the health service in a given country or covered by insurance, and any other personal out-of-pocket expenses made by the individual (or family). **=> market prices**
- *Opportunity costs* i.e. the cost in terms of lost productivity (work time loss (or performing at less than full capacity)) and the opportunity cost of leisure (leisure time loss) including non-paid work. **=> market prices**
- *Dis-utility* i.e. other social and economic costs including any restrictions on or reduced enjoyment of desired leisure activities, discomfort or inconvenience (pain or suffering), anxiety about the future, and concern and inconvenience to family members and others. **=> WTP**

Monetary valuation: Morbidity (€ price year 2000)

Hospital admissions	2,000/admission
ERV for respiratory illness	670/visit
Respiratory symptoms in asthmatics (event): Adults Children	 130/event 280/event
Respiratory medication use – adults and children (day)	1/day
Restricted activity days (day)	130/day
Cough day	38/day
Symptom day	38/day
Work loss day	82/day
Chronic bronchitis	190,000/case

Source: NewExt, forthcoming

Valuation of air pollution impacts on Cultural monuments

Study and nature of the asset	**WTP (€) annuity**
Pollicino and Maddison (2002) Lincoln Cathedral, UK	1 – 2
Morey *et al.* (2002) Monuments, Washington, DC	1 – low impact 1.5 – medium impact 2.1 – high impact
Navrud and Strand (2002) Nidaros Cathedral, Norway	51 – originality preserved 45 – restoration losing originality
Grosclaude and Soguel (1994) Historical buildings, Neuchatel	77 – 86

Impacts of air pollution: Visibility

- ‘Visibility’ here relates to a reduction in visual range through the presence of air pollutants, especially particles and NO_2, in the atmosphere.

- No new valuation studies have been undertaken in Europe since the previous ExternE report in 1998. New work has been undertaken in the US, most notably by ABT Associates (2000).

Visibility externalities

Visibility improvement (% of visual range)	US$ (1999)		US$ (1997)	
	Recreational		Residential	
	Minimum	Maximum	Minimum	Maximum
10%	7	10	---	---
20%	11	19	24	278
100%	42	69	---	---

Source: Adapted from ABT (2000).

We should be careful in transferring the values estimated in USA to Europe (AEAT, 2001)

=> Further research is needed in Europe

Monetary valuation of crop losses

Comparison of prices from Ecosense and current prices of major crops				
	Old Value Prices per tonne	ExternE	New Value Prices per tonne	Source
sunflower	235	ECU (1994)	273	FAOSTAT Euro (2001)
wheat	**96**	**ECU (1991)**	**137**	**IFS Euro (2003)**
potato	**82**	**ECU (1991)**	**113**	**FAOSTAT Euro (2001)**
rye	156	ECU (1991)	99	FAOSTAT Euro (2001)
oats	56	ECU (1991)	132	FAOSTAT Euro (2001)
tobacco	39020	US$ (1991)	2895	IFS Euro (2003)
barley	54	ECU (1991)	93	IFS Euro (2003)
Sugar beet	48	ECU (1991)	64	FAO (2002)

Monetary valuation of ecosystems: acidification and eutrophication

- Acidification is mainly caused by emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_X) and ammonia (NH_3)

- Eutrophication by airborne pollutants is mainly caused by NO_X and NH_3.

- The external costs accounting framework does not properly address the environmental impact categories which are the main driving force for some of the most important international energy and environmental policy actions (EU acidification strategy, EU NEC directive, UN-ECE LRTAP protocols).

Acidification and eutrophication: a Second-best Methodology

- *Standard price*, based on the implicit values of policy makers.
- It calculates the benefits of emission reduction – as perceived by policy makers - based on the abatement costs to reach a well-defined emission reduction target.
- It cannot be used for cost-benefit analysis or policy advices related to these emission reduction policies.
- This *second-best* method gives useful data for comparison of energy technology and fuels because it gives us ‘shadow prices’ for a non-market scarcity, i.e. protected ecosystems from acidification and eutrophication.

Estimating the shadow prices

- Step 1: the impact pathway approach is used to estimate impacts in physical terms
- Step 2: impacts are valued following a careful analysis of international agreements of emission reductions in Europe
  - Protocol of Gothenburg on the Convention on Long-range Transboundary Air Pollution (1999) (PRO): reduction by 50% of the number of hectares of ecosystems facing an exceeding of their 'critical loads' for eutrophication and acidification for the year 2010 (UN-ECE, 1999).
  - European directive 2001/81/EC on National Emission Ceilings for some air pollutants (NEC): same policy targets of PRO, but emission levels are slightly stricter for NEC
- Step 3: on this basis, we can estimate the shadow price per tonne of emissions

Acidification and eutrophication: Results

- As the policy makers have reached an agreement on the Gothenburg protocol and NEC, we take these emission reduction programs as the basis for our best estimate, for which we use a rounded number of **100 €/ha** for the ‘marginal’ WTP per hectare of ecosystems protected in Europe.

- (We assume that policy makers of the EU have the same WTP for improving ecosystems health all over Europe.)

Global Warming

- The main target at EU level is the Kyoto protocol of 1997, which has been ratified by the EU and its member states in 2002.
- The Kyoto protocol defines the target for the EU to reduce greenhouse gas emissions by 8% by 2008-2012 compared to 1990 emissions, for the EU 15 as a whole.
- The European Climate Change Program of 2000 elaborates a roadmap to translate this target into proposals.

A shadow price for CO_2 emissions in Europe

- The latest studies for the EU suggest that under a full flexibility EU-wide allocation of least cost sectoral objectives, the marginal abatement cost will be **20 €/ton CO_2**.
- From a theoretical point of view, there are reasons to argue for higher or lower numbers, but our analysis shows that they are no better estimates then the range of **5-20 €/ton CO_2**.
- As a number of countries accepted stricter emission reduction targets and took earlier unilateral actions to limit CO_2 emissions, and as studies indicated that they would also require the more costly emission reductions, one can argue that the WTP in some countries may be higher.
- Although the marginal abatement costs for reaching the objectives are available per country, these cannot be taken as a proxy for society's WTP per country, unless more evidence to support such values is available.

Monetary Valuation of Energy Security (ES)

- ES is “a state in which consumers and their governments believe, and have reason to believe, that there are adequate reserves and production and distribution facilities available to meet their requirements in the foreseeable futures, from sources at home and abroad, at costs which do not put them at a competitive disadvantage or otherwise threaten their well-being.
- Insecurity arises as a result of **physical failure of supplies** or as a result of **sudden and major price changes**” [Belgrave 1987 cited in Lockwood 1997].

Importance of ES

- The European Commission Green Paper of 2002 concentrates on the need for reduced energy import dependence in order to reduce energy insecurity.
- Private decisions on energy use do not fully take into account the costs of energy insecurity. Disruptions in supply and dramatic price increases have macroeconomic impacts that individuals/firms do not take into account.
- Agents tend to underestimate the risks of disruption and subsequent price adjustments, and there are other less tangible effects such as the psychological costs of people feeling insecure about their energy supplies
- We focus on **Macroeconomic externalities**
- Further research will use survey instruments to estimate willingness to pay for economic agents to avoid energy insecurity risks.

Costs associated with electricity supply disruptions (Costantini & Gracceva, 2004)

- Expenditure for military, policy and emergency services
- Expenditure on public transport e.g. costs of subway interruptions and increased delays with flights etc
- Health care expenditure e.g. costs relating to reduced refrigerating capacity
- Sanitation and waste disposal e.g. interruption in sanitation services
- Other public services e.g. interruption of schools
- Human life values i.e. costs relating to mortality and ill health, as well as lost leisure time and fear.
- Factors that influence the extent of social costs include:
  - the area affected;
  - existence of alternative energy sources;
  - duration of disruption;
  - time of day and season;
  - availability of advance warning and information.

The monetary value of ES

- The literature estimates the costs of supply disruptions by multiplying the energy not served by a factor called the **Value of Lost Load (VOLL).**
- The official VOLL used until recently by the Pool in England and Wales is a function of the duration of an outage, averaged across different kinds of customers. It ranged between **€3.8/kWh** for a one-hour outage to **€1.8/kWh** for an outage of longer than 24 hours [Egenhofer et al 2004].
- Blackout in 2003 in New York City, where the estimated direct cost (e.g. lost production and wages) was **€0.66/kWh**, with indirect costs amounting to about **€3.45/kWh**.

Conclusions

- 15 years of ExternE have given a relevant contribution to the monetary valuation of external costs due to electricity production
- Policy makers are becoming more and more aware of external costs
- The latest research has provided new evidence of the importance of external costs
- The latest research has reduced uncertainties regarding WTP values
- Further research is needed to better estimate the monetary value of externalities in
  - Eutrophication
  - Acidification
  - Global warming
  - Energy security
  - Visibility