ECONOMY AND ENVIRONMENT PROGRAM
FOR SOUTHEAST ASIA

Valuing the Health Impacts of Pollution: Notes & Suggested Readings

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May 1995

EEPSEA SPECIAL PAPER

EEPSEA is supported by a consortium of donors and administered by IDRC.
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Economy and Environment Program
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VALUING THE HEALTH IMPACTS OF POLLUTION: NOTES & SUGGESTED READINGS

The readings listed below are available from the EEPSEA Secretariat. The notes provide an overview of each topic.

1. NOTES

Cost-Benefit Analysis and Valuation

The purpose of cost-benefit analysis (CBA) is to guide investment decisions. If the costs of an investment exceed the benefits it produces, the investment should not be undertaken. Environmental economics extends conventional CBA to include environmental costs & benefits. In order to do so, these costs and benefits need to be translated into units of measurement that can be compared and added to conventional costs and benefits. Conventional goods and services are traded in markets for observable prices. With the appropriate adjustments to correct for defects in those markets, market prices provide economic values. But environmental goods and services are generally not traded in markets, so other methods are needed to estimate their dollar values. This has given rise to a large literature on environmental valuation.

An investment in pollution control should reduce the damage to health caused by pollution. The damage avoided is thus one of the benefits of the investment. (In most cases, health damages avoided would be only one benefit; there may also be aesthetic improvements, increased income from tourism, reduced damage to buildings, and so on. If so, these should also be included in the CBA.)

One can imagine three uses to which a CBA, based on valuation of health damages, might be put :

a) **to assess the efficiency of a particular investment**. E.g. does a dollar invested in pollution prevention result in more than a dollar of damages avoided?

b) **to set priorities**. The cost-benefit ratios for different pollution prevention investments can be compared. If a dollar spent preventing air pollution produces $1.20 worth of health benefits, while a dollar spent to prevent water pollution produces $1.80 worth of benefits, then preventing water pollution is clearly a better investment.

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c) to **design pricing policies**. Say the application of a pesticide that costs a dollar to produce results in 10 cents worth of health damages. In a sense, the true cost of the pesticide is $1.10. The government might impose a 10 cent tax so that pesticide users pay that full cost. Users could then be expected to reduce their use of pesticide (by an amount that reflects the degree to which their demand for pesticides is sensitive to its price: the "price elasticity of demand").

Putting a dollar value on human life or health is often resisted, due to moral reservations or doubts about the reliability of valuation methods. This means that CBA is often politically unacceptable for making "yes or no" decisions of type (a). Valuation of health damages is most likely to be used in setting priorities.

Valuing Health Damages

This involves two steps: first, establishing a dose-response function (How much illness does a given dose of pollution cause?) and second, valuing the damage.

Dose-Response Functions

Establishing a dose-response function (DRF) requires measurement of exposure and measurement of damage. Measurement of exposure may require primary data collection. Often data are available about emissions from a pollution source, but these emissions may be dispersed. People will also be exposed in varying degrees depending on how much time they spend indoors, whether they drink purified water, and so on. This means correlations of emissions or even of ambient air quality with health are unlikely to be fully reliable. DRFs are frequent nonlinear and/or discontinuous and may involve thresholds below which there is no appreciable damage. Deriving a function from only a few closely-spaced observations may therefore be unreliable.

Measuring damage for the purpose of valuation requires a unit of measurement amenable to a given valuation method. For example, number of work days lost due to illness is amenable to valuation; direct physical measurements like diminished breathing capacity are less so.

Establishing a relationship between exposure and damage requires the analyst to control for various confounding factors which may also influence health. Obvious ones include diet, age and smoking habits.

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Valuation Methods

The readings in the first section describe many environmental valuation methods, only a few of which are potentially applicable to health damages. Those that are most applicable are:

a) **productivity loss** (e.g. workdays lost due to illness)

b) **cost of medical expenditures**

c) **hedonic methods**: These assess differences in the price of housing in polluted or unpolluted areas, or the difference in wages between hazardous and non-hazardous jobs. The difference gives an idea of the value of damages avoided to those individuals (more precisely, their willingness to pay to avoid damages). Differences in housing prices are likely to include some non-health damages from pollution; wage differences are more closely related to health alone.

d) **contingent valuation method (CVM)**: This involves surveys (using questionnaires or experiments) to find out how much people would be willing to pay to avoid damages (WTP), or how much compensation they would require to accept more damage (WTA).

Each of these methods has its pros and cons.

Workdays lost and **medical expenditures** involve thresholds: individuals may suffer discomfort that is serious but not severe enough to require medication or time off work. Other problems are:

* Imputing wages for workdays lost from housework, or other non-cash labour;

* Assigning an appropriate "shadow price" to wages when there are high levels of unemployment;

* Avoiding the implication that the lives or health of people who are poor, very old, or very young, (as measured by their wages) are less valuable than those of the rich.

In general, these methods are likely to give a lower bound or minimum value.

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Hedonic methods require well-functioning markets for housing or labour, with buyers and sellers who are well-informed about pollution risks; and matching pairs of housing or jobs that are similar in all respects except exposure to pollution.

CVM is a controversial method, subject to many biases. Some of these include:

* Strategic bias (respondents may indicate low or high willingness to pay because they think the survey results will lead them to pay for a service or for the government to provide one that it otherwise would not.)

* Starting point bias occurs when the respondent's WTP is influenced by the phrasing of the question or experiment (E.g. Would you be willing to pay $1? $10?)

* Hypothetical bias: Respondents find it difficult to answer questions like "How much would you pay to be healthier?"

* Very large differences have also been reported between WTP and WTA. At a minimum, the choice of a WTP vs. WTA question should reflect the actual situation.

Some of the biases in CVM can be reduced by specifying the attribute in question very precisely; by pretesting the questionnaire; and by involving a psychologist in the design of the survey. Some health CVM's require respondents to maintain a diary, to provide an accurate record of their current health to establish a DRF and against which alternative states of health could be compared.

Sometimes more than one method is used, either to include all costs (e.g. work days lost + medical costs) or to cross-check (comparing CVM to other methods). Care is necessary to avoid double counting. Surveys can sometimes be designed to provide data for more than one method.

Benefits Transfer

Careful data collection to establish dose-response functions and values can be costly and time consuming. To reduce these costs, the "benefits transfer" approach has sometimes been employed. This involves taking a value from an existing study (most commonly done in the US, where the literature is more abundant) and transferring it to a new context. This has been done for both DRF's and values. Sometimes a correction factor is included (e.g. reducing the value by the difference in per capita income).

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Transfer of DRF's may not be valid if the local context contains factors that would affect the function. (E.g. differences in baseline health or nutrition may cause a given dose of pollution to produce more damage.) Transfer of values may also neglect factors that would cause people to value health differently. For example, the concept of what constitutes full health may vary with culture, not only with income. In general, there are numerous environmental factors specific to location, culture and so on; these limit the reliability of the benefits transfer approach in assessing environmental problems.

In spite of these limitations, the cost advantages of benefits transfer will continue to encourage its use. Studies that compare original measurements to estimates derived from benefits transfer would be a useful contribution.

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May 1995

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