ECONOMIC VALUATION AND COST-BENEFIT ANALYSIS

K.G. Willis
University of Newcastle upon Tyne, UK

Keywords: economic valuation, public goods, externalities, opportunity cost, travel-cost, hedonic price, contingent valuation methods, benefit transfer, meta-analysis, cost benefit analysis.

Contents

Summary

Environmental and cultural goods produce a variety of benefits that can be measured with economic valuation methods. These benefits comprise use or consumption benefits; and non-use benefits from knowing that particular goods will be conserved even if the individual never sees the good. Methods of valuing or 'costing' public goods include the benefits society foregoes by conserving the good rather than undertaking some alternative economic activity.

The cost of an environmental externality can be measured by the effect or damage caused to other productive processes, or to human health and welfare. Methods to assess the benefits provided by public goods including observing what people are prepared to spend on a complementary good e.g. transport, to enable them consume the public good e.g. recreation; or the amount they are prepared to pay in terms of a house price premium to acquire a public good such 'peace and quiet'. Other methods include asking people directly the maximum amount that they would be prepared to pay for the good rather than go without it. These direct or contingent valuation methods are now used extensively to value public goods, and are likely to become increasingly important in the future.

Differences in value estimates of a specific public good between studies can be analyzed through the use of meta-analysis; whilst benefit transfer methods can impute value estimates to other sites or policy scenarios. Valuation estimates can be directly entered into a cost-benefit analysis of a project or policy.

1. Introduction

When people make decisions, they weigh up the expected benefits from their choice against the costs of this action. The benefits gained from adopting *A*, involves the loss of benefits from some alternative *B* that is precluded. Thus the benefits of conserving old redwood forest in Oregon are the preservation of a number of Northern Spotted Owls (an endangered species). The benefits foregone, or in economic terms the (opportunity) cost of preserving the Northern Spotted Owl, is the value of lost timber production. Opportunity cost is often easy to quantify in monetary terms. The use of the environment, for timber production, agriculture, water resources, or urban use, has clear benefits that are usually valued in market terms. However, the preservation of a particular area for biodiversity, or the preservation of a particular species, is not expressed in market terms, because there is no conventional market for these goods. This lack of a conventional market characterizes a whole series of goods, including some UNESCO activities, under the World Heritage and Cultural Conservation programs.

The chief characteristic of non-market goods is their 'public good' nature. A 'public good' in economic terms is one that is non-rival in consumption (its use by one person in no way detracts from its availability to others, i.e. it has zero opportunity cost of consumption); and non-excludable (consumers cannot be excluded from consuming the good, i.e. producers have no property rights over it). Environmental valuation derives values for non-marketed 'public' goods, so that they can be appraised in a commensurate way with market goods and services in benefit-cost analysis, as a means of improving decision making, and ensuring an optimal provision of 'public goods'.

2. Benefits provided by 'public goods'

The benefits of public goods can be classified as *use benefits* (comprising current use values; the value of the 'option' to use the good in the future even if an individual does not currently consume it; anticipatory value; and external amenity value); and *non-use benefits* (the value of knowing the good exists even if the individual never intends to consume it; and the benefits individuals derive from passing on the good to future generations).

Table 1 outlines some goods with different types of use and non-use benefits. For example, open access non-priced recreation in a Scottish Sitka spruce forest has use value and visitors might be willing to pay for the option to visit the forest again. However, Sitka spruce forests have negative, rather than positive external amenity benefits on landscape values, and limited existence and bequest values: indeed individuals are often willing to pay to see sitka spruce plantations replaced by more diverse conifer and broad-leaved woodlands. Purely private goods, such as the UNESCO collection of Traditional Music of the World, or productions by the Bolshoi Ballet, have use value for listeners, audiences, and purchasers of CDs; and people may derive *ex ante* anticipatory value for productions attended. People may also be willing to pay something for the option to hear pieces from such a music collection in the future, even if they do not currently listen to this type of music. Because some cultural goods, especially those with an oral tradition such as the cultural music of minority

groups, are at risk of being lost, people might in addition be willing to pay to conserve examples of this music just to know they exist, or will be available for future generations.

	Recreation in a Scottish Sitka spruce forest	**UNESCO: Traditional Music of the World**	**Edinburgh Castle: (visitor)**	**Edinburgh Castle (non-visitor; but visitor to town)**	**Edinburgh World Heritage Site (non-visitor)**	**British Museum (non-visitor)**
Use values						
Current	✓	✓	✓			
Option	✓	✓	✓	✓	✓	✓
Anticipatory		✓	✓			
External amenity			✓	✓		
Non-use values						
Existence		✓	✓	✓	✓	✓
Bequest		✓	✓	✓	✓	✓

Table 1: Benefits provided by some cultural goods

Buildings of architectural and historic interest provide a variety of public good features which encompass both use and non-use values. Use values, for example for visitors to Edinburgh, a World Heritage Site, include the value of visiting the Castle and other buildings, and the external visual amenity of the buildings. Potential visitors might also derive benefit from the option to visit the Castle in the future, and for the anticipation from such a visit. Non-use values might comprise existence value (the benefits derived from knowing the Castle exists, even though the individual has no intention of entering it nor even viewing its exterior) and bequest value (from knowing that it is part of a stock of historical capital which will be passed on to future generations). As Table 1 shows, visitors to Edinburgh Castle derive different benefits than those who only visit Edinburgh as a World Heritage Site.

Existence and use value may characterize some cultural goods. Non-visitors to a World Heritage Site, or say the British Museum in London, may value the option to visit it in the future, plus benefit from their existence in helping to maintain the stock of cultural goods, and passing these on to future generations. Buildings of historic and architectural interest in some World Heritage Sites such as Edinburgh, are extremely expensive to maintain, a cost which is principally borne by their occupants. Moreover, visitors to Edinburgh can enjoy the ambience of the Old and New Towns free of charge, in an uncongested walk around the area. The fact that residents cannot charge visitors for entry to the Old and New Town areas means that buildings attract a lower rate of return from their private use, compared with their total value to society, and that owners will spend too little on their maintenance.

It is possible to charge for some "public goods", such as the entrance to a historic building. However, whether it is optimal to do so is questionable. In the absence of

congestion, it may cost no more to admit X+1 visitors to the Sequoia National Park in California as X visitors, in which case the marginal cost of the additional visitor is zero. Any entrance charge greater than zero might deter consumers with a positive valuation whilst making no off-setting cost saving. The optimal price to the US National Parks Service, as the organization responsible for the park and the quality of facilities, is positive; whilst the optimal price for consumers is zero. Obviously no price can simultaneously be zero and non-zero: the conventional price system is inherently incapable of producing an efficient outcome. If the price is zero (as in the case of access to the Edinburgh World Heritage Site, and the British Museum, London) the question then arises who will supply, and pay for, these public goods.

These combinations of 'public good' and 'private good' features are common to many types of environmental and cultural goods. In designing any environmental valuation study it is incumbent on the researcher to specify in detail the set(s) of benefits that the good provides, those that should be measured, and then to apply the most appropriate technique or combination of techniques to value them. The choice of benefit estimation technique to be adopted in any study depends upon a number of criteria. Such criteria comprise: the purpose of the study (e.g. whether opportunity cost estimates, or direct benefit estimates are required); the particular economic values required (use and/or non-use values, or a sub-set); the type of values required (*ex ante* or *ex post*); whether particular assumptions are deemed acceptable or not; the importance attached to particular errors (e.g. statistical errors in the technique, possible cognitive psychological biases, etc.); the conformity of the technique with theory in particular applications (e.g. whether the model proposed deals with substitution and complementary effects, or addresses the issue of valuing the individual elements of a program); robustness of the benefit estimates (e.g. in terms of statistical, content, (Content validity refers to the appropriate framing of the study (e.g. do people accept the willingness-to-pay format for the change in the environmental good; is the payment vehicle realistic?); and the questions asked in relation to the good being valued (e.g. have respondents been given adequate time to think; are there substitute goods, and have they been included in determining the value of the good?)).criterion, (Criterion validity refers to a comparison of estimates of the value of a public good from one valuation method with actual market or simulated market behaviour of the demand or value for that public good. Criterion validity has the greatest potential for offering a definitive test of the reliability and accuracy of a method, not only in terms of estimating the value of a good, but also in terms of estimating how many people will actually demand and purchase the good at that price.) and construct validity (Construct validity refers to the correspondence or convergence between estimates from different methods of measuring the value of the same public good (e.g. between hedonic price method, travel-cost method, contingent valuation method, or the effect on production estimates); and the extent to which the findings of one method are consistent with theoretical expectations.)); whether the population of relevance can be identified with enough precision; and whether the benefit estimates per individual can be easily aggregated over this population.

Methods to value the environmental goods are either based upon (1) assessing the market impact of environmental changes through 'effect on production' or 'mitigating expenditure', or replacement cost' measures; or (2) individuals' preferences, either revealed or expressed, for the environmental change. Market based measures are used

to estimate the value of an environmental good, such as air pollution, through changes in the price and quantity of marketed outputs affected by the pollution. Clearly not all environmental nor cultural goods are marketed. In these situations, values need to be determined through revealed and expressed preference techniques. However, only expressed preference methods can be used to determine the non-use value of environmental and cultural goods.

-
-
-

Bibliography

Arrow, Kenneth J., R. Solow, P.R. Portney, E.E. Leamer, R. Radner and H. Schuman (1993). Report of the National Oceanic and Atmospheric Administration (NOAA) Panel on Contingent Valuation. *Federal Register* 58(10), 4016-4614. [Lists the general recommendations, subsequently adopted by the NOAA in the USA, for conducting contingent valuation studies to estimate non-use values of natural resources damages. General guidelines cover sample type and size, non-response, type of survey, pre-testing questionnaire, and reporting data. Specific recommendations for CV surveys include the monetary elicitation method, type of CV to adopt, description of the good, use of follow-up questions, adequate time lapse from accident, and alternative expenditure possibilities and substitute commodities available.]
Cropper, Maureen L. and Wallace E. Oates (1992). Environmental Economics: a survey. *Journal of Economic Literature* 30, 675-740. [Documents the environmental policy and legislation background to the need for environmental economics; the theory of environmental regulation; choice of policy instruments; design of environmental policy, including legal liability, command-and-control mechanisms, etc.; measurement of benefits and costs of pollution control; indirect methods for measuring benefits; hedonic price models; contingent valuation methods; applications of valuation techniques to various issues; and the distribution of costs and benefits.]

Garrod, G.D. and K.G. Willis (1999). *Economic Valuation of the Environment.* Edward Elgar, Cheltenham. ISBN 1-85898-684-2. [The book includes detailed examinations of the theory and practice of a wide range of contingent valuation, hedonic price, choice experiments, and travel-cost methods. Complementing the theory are cases studies on various policy areas such as recreation, landscape, biodiversity, water quality, and amenity values. The book also assesses whether the transfer of benefit values are possible; that is, whether values derived for one good can be accurately and reliably applied to a similar good elsewhere.]

Hanemann, W. Michael and Barbara Kanninen (1999). The statistical analysis of discrete-response CV data, in I.J. Bateman and K.G. Willis (eds.) *Valuing Environmental preferences: theory and practice of the contingent valuation method in the US, EU, and developing countries* Oxford University Press, Oxford. [Addresses a range of statistical issues in discrete response contingent valuation (CV), including the dual statistical and economic requirements of an adequate analytical model, the integration of CV analysis with random utility models, the question of positive and negative preferences, efficient statistical design of CV experiments, and problems in estimating welfare measure from CV data.]

Hoehn, John P. and Alan Randall (1989), 'Too many proposals pass the benefit cost test', *American Economic Review* 79, 544–51. [This article explains why the conventional application of cost-benefit analysis (CBA), may result in the over-estimation of net benefits and in too many proposals passing the CBA test. It illustrates the general error introduced by the independent analysis of a large number of

proposals put forward by the public sector. The paper goes on to define a valid CBA approach that involves either employing a simultaneous or holistic valuation of citizens' values, or a sequential evaluation of public policy changes.]

Mitchell R.C. and R.T. Carson (1989). *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Resources for the Future, Washington D.C. [Shows how contingent valuation (CV) can be used to determine the public's willingness-to-pay for many public goods. The book documents the theoretical basis for CV; outlines the different benefits public goods provide; explores different CV designs. Much of the book is devoted to developing procedures to permit respondents to answer honestly and meaningfully, and avoiding strategic behaviour in responses. It also deals with assessing the validity of CV studies; avoiding measurement bias; sample survey sizes; and survey methods. The book provides the standard reference text for CV researchers.]

Montgomery, Claire A., Gardner M. Brown and Darius M. Adams (1994). The marginal cost of species preservation: the northern spotted owl. *Journal of Environmental Economics and Management* 26, 111-128. [This article illustrates the use of a market based cost approach to valuing an environmental good, by estimating the value of a marketed commodity (timber) being foregone to conserve an endangered species. Because species survival is not certain, the decision to 'save' a species is not an all-or-nothing choice, but rather a marginal one. How much additional production (of timber) foregone will increase the probability of survival by a certain percentage? Estimates are derived for the increasing marginal cost associated with increasing the probability of the survival of the northern spotted owl in Oregon.]

Smith, V. Kerry and Ju-Chin Huang (1995). Can market value air quality? A meta-analysis of hedonic property models. *Journal of Political Economy* 103, 209-227. [This paper illustrates the procedures required to develop an accurate meta-analysis model to summarise the results of marginal willingness-to-pay for reducing particulate matter from a number of studies across different cities. The results demonstrate the variability of estimates across methods, and the sensitivity of estimates to local conditions.]

Ward, Frank A. and Diana Beal (2000). *Valuing Nature with Travel Cost Models: a manual*. Edward Elgar, Cheltenham. [This book presents a comprehensive treatment of travel-cost models (TCMs), along with a wide range of applications to natural and environmental policy questions, for readers with little formal background in economic theory or statistics. It provides insights into the theory and application of TCMs gained over the last half century on the development and use of this important methodology.]

Willis, K.G., K. Button, and Peter Nijkamp (eds.) (1999). *Environmental Valuation: Volume 1: methods and anomalies & Volume 2: multi-attribute programmes, validity, allocation issues, and case studies***.** Edward Elgar, Cheltenham. [These two volumes provide a collection of seminal papers on environmental valuation, by a variety eminent authors. Volume 1 covers opportunity cost and preventative expenditure, travel-cost, hedonic price, contingent valuation, discrete choice, non-use values, willingness-to-pay versus willingness-to-accept compensation controversy, with contributions from cognitive psychologists on anomalies in economic theory and the effect of perceptions on values. Volume 2 addresses the problem of valuation when there are multi-attribute goods and programs, and considers how the validity of results can be assessed. Allocative mechanisms for environmental resources are also illustrated with the analysis of some property rights issues surrounding damage to natural resources. A series of case studies evaluate major issues: biodiversity; wetlands; landscape; noise; safety; and air pollution. The volume concludes with the transfer of benefit estimates between sites, the usefulness of meta-analysis, and two thought provoking articles concerning the meaning of valuation.]

Biographical sketch

Ken Willis is Professor of Environmental Economics in the School of Architecture, Planning and Landscape at the University of Newcastle. After initially undertaking research on migration and labour mobility, and regional development policies, his interest moved to environmental issues in the 1980s. Since then he has undertaken extensive research on the appraisal and valuation of environmental projects and policies. His expertise embraces environmental benefit estimation techniques (travel-cost models, hedonic price models, contingent valuation methods, stated preference or conjoint analysis methods, and contingent ranking techniques); and environmental cost assessment studies (averting and preventative

expenditure, and replacement cost techniques). He has directed and worked upon numerous research projects using these techniques for government organizations, international development agencies, and various private companies. This research has encompassed environmental projects and policies covering a wide variety of issues from air pollution, bathing water, biodiversity, architectural conservation areas, cultural and archaeological heritage, earthquake risk mitigation, electricity supply interruptions, environmentally sensitive areas, fishing, forests, green belts, historic buildings, recreation values of canals, rivers, etc., landscape, low flow alleviation in rivers, property attributes, quarries, sites of special scientific interest, various town planning policies, traffic calming schemes, utility networks, waiting time for social housing, waste disposal, water quality, and wildlife conservation. Although most of his research has been concentrated in Europe, he has experience working on a number of environmental economics projects in Ghana, India, Iran and Malaysia.

He has published a large number of articles in a variety of economic and environmental journals; and is the author of *Economic Valuation of the Environment* (with Guy Garrod) and the editor of a two volume set on *Environmental Valuation* (with Ken Button and Peter Nijkamp) both published in 1999 by Edward Elgar in Cheltenham.