Monetary Valuation of the Environmental Impacts of Transport.

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Abstract:

Although it is recognised that the environmental impacts of transport are often adverse, the impacts are not always considered objectively and transparently in project evaluation and transport investment decision-making. The paper argues that a useful approach to making and understanding (environmental) trade-offs in transport is through monetary valuation of environmental impacts, as it allows project impacts to be quantified in a common unit of dollars. The principal argument is that *monetary valuation is* needed in order to improve overall *evaluation* of transport proposals

The paper examines current project evaluation procedures including the treatment of environmental impacts. Then the value of monetary valuation of environmental impacts is discussed. The paper reviews methods for monetary valuation including revealed preference and hypothetical market methods and compares the different methods. The paper concludes that increased monetary valuation of environmental impacts would be a valuable contribution to decision-making. The hypothetical market valuation methods offer great promise and deserve further research into their application to valuation of the urban environment.

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ATRF94

1. INTRODUCTION

Although it is recognised that the environmental impacts of transport are often adverse, the impacts are not always considered objectively and transparently in project evaluation and transport investment decision-making. It is increasingly important for the environmental impacts of transport to be included in project analysis and decision-making. The paper argues that a useful approach to making and understanding (environmental) trade-offs in transport is through monetary valuation of impacts, as it allows project impacts to be quantified in a common unit of dollars. The principal argument is that *monetary valuation*, putting a dollar value on the environmental impacts of transport projects, is needed in order to improve overall *evaluation* of transport proposals.

The paper is organised as follows: first, the paper examines current project evaluation procedures including the treatment of environmental impacts. Then the value of monetary valuation of environmental impacts is discussed including reasons for monetary valuation, applications, and criticisms of monetary valuation. The paper reviews methods for monetary valuation including revealed preference and hypothetical market methods and compares the different methods. Practical difficulties in monetary valuation are also identified. The paper concludes with the value of monetary valuation of the environmental impacts of transport in decision-making, and the use of hypothetical market valuation methods to achieve this.

2. PROJECT EVALUATION

Current practice

The general aim of project evaluation is "to enable a choice to be made as to the best option available, bearing in mind the broad range of government policy objectives (such as economic efficiency, social welfare, social equity and protection of the environment) and the relevant resource constraints in operation" (Lane 1978:9). Lane (1978) describes several approaches that have been developed towards overall project evaluation incorporating environmental impacts including cost-benefit analysis, planning balance sheet, cost-benefit matrix, goals achievement matrix, and other methodologies such as the environmental model and the environmental evaluation index. Other techniques which are potentially significant in the comparison of specific impacts include cost-effectiveness ("what you get for your money"), trade-off analysis (also known as bartering or planning games, in which community groups trade-off the outputs of transport projects in selecting their preferred alternative), factor profiles and incidence analysis.

The most common method for project evaluation in current use is cost-benefit analysis, in which the stream of benefits to be derived from the project over time is weighed up against the project costs which will be incurred over the life of the project. The traditional benefits from transport projects usually include travel time savings, vehicle

erating cost savings, and accident reductions. These benefits are valued in dollars often ad though there is controversy over valuation of travel time and the value of human life y in p d injury to be used in valuing accident reductions) and included in the cost-benefit mporta alysis. Project costs usually include land acquisition, construction and maintenance.

nd dec *eatment of environmental impacts*

derstan verse impacts on the environment are not usually valued in dollar terms and summed mpacts with other costs, rather they are identified and described separately from the other he prin sts and benefits. The process by which environmental impacts are weighed up against vironm e cost-benefit ratio, particularly when there are several options under consideration, is *aluatio* ot clear to the community. In regard to the UK process, but equally applicable in ustralia, Bateman, Turner and Bateman (1993) noted that "it is not clear how, recisely, the diverse impacts are weighted and/or rank ordered, so that trade-offs can : evalu e systematically addressed .... no formal multi-criteria assessment methods are used". e valu he cost-benefit method of project evaluation means that unless a monetary value can easons e placed on non-market goods, they tend to be ignored in the evaluation procedure. The p ishop, Heberlein and Kealy (1983) note that "things with unknown economic values ypothe nd to be assigned zero or very low economic values in public decision processes". ı mon imilarly, Brookshire, Ives and Schulze (1976) note aesthetic damages are usually r valua escribed as "intangibles" in benefit-cost studies, and "their consideration by decision- ıe us akers has been on a strictly judgmental or political basis".

ssessment of current practice

ateman et al. (1993) examined the current application of CBA to trunk road ssessment in the UK and identified major criticisms of current practice, particularly hat environmental and non-market impacts of roads are inadequately incorporated vithin present CBA appraisal practice.

the Nash (1990:13) regards "the current practice of quoting Net Present Values which bjecti nclude monetary valuation of some, but not all, non-financial costs and benefits, as n of eing positively misleading". Project economists have much experience and expertise 9). L n calculating transport benefits in terms of travel time savings, vehicle operating costs l pro nd accident reductions, but are not so good on the disbenefits (or costs) of proposed naly rojects.

d o There is need for improvement to current methods of project evaluation, and the role of luat nvironmental impacts within the evaluation and decision-making processes. Any spec mpacts, whether environmental or social impacts, which are not easily amenable to nal monetary valuation are difficult to include in the evaluation process. It is important to -off make a distinction between impacts which are relatively easily valued in monetary les terms such as travel time savings, and those which traditionally have been more difficult to value but not necessarily impossible, such as air quality, noise and green space impacts.

aly There is a general community feeling that environmental impacts have not been fully ıed aken into account and considered in decisions about transport infrastructure. This ehi erception has primarily arisen because environmental impacts are more difficult to

value in the same way as the traditional benefits of transport infrastructure projects such as travel time savings, vehicle operating cost savings and accident reductions. It is important to condition the existing dominant role of traditional user benefits in project evaluation which arises primarily due to the lack of quantification of other, often equally important, costs and benefits.

The importance of environmental impacts

The many competing land uses in urban areas place heavy demands on the environment. There is growing recognition of the importance and significance of the environmental impacts of transport, particularly in urban areas. Environmental impacts may include air pollution, noise and vibration, loss of green space (whether open space, parks or bushland), loss of habitats and associated flora and fauna, and loss of sunlight. Whitelegg (1993), for instance, has summarised many of the wide-ranging environmental impacts of transport in Europe, which are also applicable in Australia, focusing particularly on air and noise pollution. Note that in the paper the emphasis is on impacts arising from the presence and use of transport infrastructure, rather than lifecycle impacts or issues such as the source of raw materials and disposal of wastes.

Non-monetary assessment of environmental impacts

Attempts have been made to account for and assess the significance of the environmental impacts of transport in project analysis through non-monetary evaluation methods ranging from simple techniques such as checklists to more data intensive methods such as multi-criteria analysis.

Simple measures

Several simple techniques for assessment are described by Rogers (1993) such as:

- qualitative scales, in which impacts may be classified, for instance, as substantially negative/positive, noticeably negative/positive, slight, or none;
- scaled checklists, on which impacts are rated on a scale from say +5 to -5, or 0 to 10;
- synoptic tables, descriptive checklists allowing the evaluation of impacts to be brought together so that their relative value can be evaluated qualitatively without the use of scoring and aggregation.

In qualitative scales, the impacts may be described or ranked in terms of significance: for instance, the impact on vegetation may be "significant", while the impact on some other aspect of the environment, say water quality, may be described as "negligible". However the difficulty lies in comparing one "significant" impact with another "significant" impact. And are two "significant" impacts jointly more important than one "very significant" impact?

If environmental impacts only are assessed using non-monetary methods such as these, it is difficult to compare the assessments with other traditional project costs and benefits. Even if all project impacts are described thus, it is difficult to compare a "significant" impact (reduction) on traffic congestion with a "significant" impact on green space.

teria analysis

iteria analysis helps overcome some of the problems with the very simple ation and measurement methods by weighting different criteria. Multi-criteria involves an evaluation or effectiveness matrix (showing what the project will and a priority matrix (showing how important different objectives are) which ematically combined to produce an appraisal matrix. In an application of multi- analysis to transport, Bonsall, Pearman and Cobbett (1993) have developed a r decision support system, MASCOT, which uses multi-criteria analysis s to help in the preparation and appraisal of transport scheme options.

t mathematical techniques for combining the matrices to produce an appraisal an produce different assessments on an individual's ranking of options. For , Whelan (1994) has demonstrated that the choice of technique can have an nt influence upon the results obtained in multi-criteria analysis of anisation schemes: "a different ordering of preferable options can be obtained rent techniques using exactly the same data". Another key issue in multi-criteria is the derivation of the weights used in the priority matrix.

mental impact assessment

mental impact assessment (EIA) or environmental impact statements (EISs) are quired and produced in the process of planning, evaluating and approving large frastructure projects. However, the main focus of EIA is the measurement or cation of the physical impacts on the environment, rather than attempting to he environmental impacts in units which can then be compared to other project nd benefits. There is little monetary valuation of environmental impacts ted and reported as part of EIA. EIA is done in relative isolation from other , both positive and negative, of the project.

eral, the non-monetary methods of including the environment in project ion tend to examine the environmental impacts in isolation from the traditional costs and benefits. It is difficult to integrate the results of the non-monetary ion methods into other evaluation and assessment procedures, particularly cost- analysis.

VALUE OF MONETARY VALUATION

ntribution to decision-making of the monetary valuation of environmental s of transport projects which are not currently valued or included in project sal is discussed and examples of applications where monetary valuation would be are presented. Commonly raised criticisms of monetary valuation are also ed.

Contribution to decision-making

Common unit

Ideally, all costs and benefits should be expressed in terms of a common unit to enable different impacts to be compared. Rather than just identifying and measuring impacts individually, there is a need for a method of quantifying them in such a way that they can be compared with other impacts. In a review of valuation methods, the Resource Assessment Commission (1992) noted that "the task of decision making is made easier as more and more of the consequences of actions become measurable in a common unit: comparisons between alternatives are then facilitated". From a theoretical perspective, an ideal unit of measurement and comparison would be "utilities" or "satisfaction units", in which all costs and benefits would be converted to "utilities", measuring people's degree of satisfaction, happiness or welfare. However, in reality this is very difficult (as is calculation of the economists' social welfare function), and the best practical common unit appears to be the dollar. Other commonly measured impacts of projects are quantified in terms of dollars and the dollar is easily understood, as people are used to expressing their preferences for many goods in dollar units and making decisions based on a good's dollar value.

Consistency in decision-making

For the sake of consistency, both costs and benefits should be demand-driven. However, at present in cost-benefit analysis, the benefit side of the equation is demand-driven but not the cost side (most environmental impacts are costs). Dargay and Goodwin (1994) argue that if a value is ascribed to human health when assessing accident reduction schemes, then we should do the same for environmental effects which have a negative effect on health or life. Note that there is uncertainty in determining the health effects of environmental change. Thus, Pearce (1991) argues, consistency alone requires that better efforts be made to elicit economic values for environmental quality.

Without CBA, it is difficult to determine if the political process is in fact working properly. Decision-makers could make decisions subjectively, and there would be no check on them. The cost-benefit approach and monetary valuation encourage consistency in decision-making. By not valuing impacts, there is no test of consistency between projects. Valuation procedures measure preferences in contrast to public consultation processes which reflect pressure group opinion. Although economic values elicited by valuation methods are only one set of values, they are important because allocating goods and services according to "market power" is a widely acknowledged and accepted procedure. Most goods and services are traded in the marketplace.

Explicit trade-offs

Nash (1990) believes that "monetary valuation of environmental effects can contribute to appropriate decision-making by giving information on the degree to which the affected parties are willing to give up environmental benefits to save time or money". Valuation allows any trade-offs which are made between different environmental impacts to be more explicitly stated. However, an important issue to note is that the beneficiaries of a project and the people adversely affected by the same project may not

be the same group of people. Monetary valuation can determine the value of benefits and losses to different groups, but the decision-makers must still decide the equity and distributional issues (as discussed below).

Valuation and decision-making

It is important to note that putting dollar values on environmental impacts and including them in cost-benefit analysis will not necessarily correct market failures and produce socially desirable urban environments. For instance, if the benefits are greater than the costs in a cost-benefit analysis, a project is considered "good", regardless of who gets the benefits and who suffers the costs. Monetary valuation of environmental costs will not overcome that distributional problem. But is still useful to have better information on environmental costs. Monetary valuation will never be a substitute for political decision-making. It is an aid to the decision process. The decision-makers, as representatives of the community, have to make decisions on the distributional and equity issues of who benefits and who loses.

Hundloe and Blamey (1992) cite Pearce (1983) who says that CBA makes no claim to produce morally correct decisions. What CBA produces and what is morally correct, may coincide if and only if we adopt a further rule, namely that some aggregated set of preferences of individuals is the morally correct way of making decisions. In some circumstances, the two may well coincide. In others, government will often reserve the right to overrule group preferences. In others, most likely the majority, governments will at least wish to know what the preferences of the individuals who make up society are. It is in this sense that cost-benefit analysis, and monetary valuation, is an input, an aid, an ingredient of decision-making. It does not supplant political judgement.

Applications of monetary valuation

Subsidies

There is much debate about subsidy within transport, and who in fact subsidises whom. There is need for a full account of the costs associated with transport so that discussions with pressure groups with vested interests such as the motor vehicle industry, oil industry, construction industry and motoring organisations about subsidy and who subsidises whom, take place against a background of full information (Whitelegg 1993:130). For instance, motoring organisations often argue that road users more than cover the costs of road use while other groups argue that road users don't pay enough. And similarly, the government subsidises public transport, but are the environmental benefits worth the subsidy? The extent to which lower prices or improvements in public transport will reap wider gains for society as a whole depends very much on the thorough accounting of transport benefits and disbenefits (Whitelegg 1993:130). The true net benefits of transport are not known if all the costs are not identified. Monetary valuation of environmental costs would assist in discussions about subsidies in transport.

Consequences of infrastructure investment

Transport infrastructure requires enormous sums of money, and brings many benefits, but there is not as much recognition of the costs in terms of the environmental impacts.

Whitelegg (1993:130) argues that "it is important that the political debate is informed about the wide ranging and costly consequences" of implementing a large program of infrastructure investment. There is a need to know the environmental costs of large capital investment.

Alleviating environmental damage

Ecological tax reform, in which economic activities are taxed according to their environmental impact, has been discussed in Europe as one way to reduce and alleviate environmental damage. Fiscal reform proposals such as this are more easily discussed against a background of reasonably accurate assessments of the monetary value of damage currently caused by the use of transport (Whitelegg 1993:130-131). One step in the process of implementing tax reform to reduce environmental damage is to produce valuations of environmental damage, so that taxes can be set at efficient levels.

Or, as expressed by Dargay and Goodwin (1994) it is likely that economic levers will be used to achieve environmental objectives and it will be necessary to calculate the effects of these levers. Implementing "levers" has a monetary cost — it is important to determine if it is less than the value of the damage caused by the effect it is supposed to be reducing. Is it worth installing scrubbers on power plants in the southwest USA at a cost of $1 billion to reduce air pollution in a sparsely populated area? (Carson et al. 1992).

The "clearing up the mess" argument for valuation has also been advocated by Dargay and Goodwin (1994) who argue that since some environmental impacts impose real measurable financial costs on individuals or companies or other agencies and somebody has to pay to clear up the damage, then these costs should be included in a cost-benefit analysis.

Avoiding environmental damage

Dargay and Goodwin (1994) also argue that in other cases where there is no financial payment, but there is some loss or gain in satisfaction experienced by the community, and the community is prepared to pay to avoid that loss, then it should be valued, in the same way that we place a value on leisure time savings. If people are prepared to pay to avoid a loss in "amenity" or decrease in the "feeling of satisfaction", then that amenity should be valued. The degree of amenity may not be able to be valued directly using an existing market, but it still has a value.

Criticisms of monetary valuation

Special characteristics

An argument proposed against monetary valuation of some environmental goods is that some things are too special or important to be valued. As Sagoff (1988:69) notes "the things we are unwilling to pay for are not worthless to us. We simply think we ought not to pay for them. These things have a dignity rather than a price". The existence of legislation in America prohibiting cost-benefit and interest balancing tests shows that Americans value the idea that some policy should result from ethical deliberation and the rule of law. The American Endangered Species Act is not cost-beneficial in terms of

currently easily valued costs and benefits, which is the point of the law, and much other environmental legislation. However, the reason the policy may not be cost-beneficial is because existing, narrowly based evaluation methods do not take into account the full costs and benefits such as the interests of future generations, and the non-use values of environmental goods (that is, the value people place on goods which they do not actually use themselves). As De Lacy and Lockwood (1992:12) maintain in regard to natural areas (but equally in urban environments), "economic valuation of natural areas ... can provide useful information for decision-makers, without in any way denying that some components of natural area value cannot be assessed by such valuation".

Producing "correct" decisions

Critics of monetary valuation fear it will be a substitute for decision-making and the political process, as Whitelegg (1993:128) indicates: monetarisation "cannot be a substitute for clear decisions emerging from the political process about the kinds of cities and environments we wish to have". And similarly, "the monetarisation of environmental factors does not resolve important political and distributional issues". Whitelegg (1993:129) does not accept the notion that "building these costs into decision-making will fundamentally alter the present situation. It may even make things worse as it assumes that no other kind of state action is needed to produce sustainability other than actions related to prices, taxes and charges."

Strategic issues

Another criticism of monetary valuation is that it is limited by the extent to which it can take into account the larger *strategic issues*. For instance, Whitelegg (1993:128) argues that even if peace and quiet achieved by a proposed bypass is "worth more" than the decrease in landscape attractiveness, monetary valuation does not take into account encouragement of the use of roads, and increased emissions, global warming, car dependence and discrimination against cyclists and pedestrians. However, there is no reason these wider impacts could not also be valued using the range of valuation techniques currently used to value the more localised impacts.

The "money is right" argument

Sagoff (1988) is critical of the use of cost-benefit analysis (CBA), with its valuation of benefits and costs, for project evaluation, because CBA does not judge opinions and beliefs on their merits but asks instead how much might be paid for them. But monetary valuation can still be useful despite this caveat. Sagoff (1988:41) is also wary of monetary valuation because "the reasons people give for their views are not to be counted; what counts is how much individuals will pay to satisfy their wants. Those willing to pay the most, have the right view; theirs is the better judgement, the deeper insight, and the more informed opinion". "The soundness of an ethical argument does not depend on willingness to pay, although economic information may be relevant" (Sagoff 1988:37). Some people fear that monetary valuation will result in decisions being based solely on ability to pay, rather than what is morally or ethically desirable.

4. REVIEW OF METHODS FOR MONETARY VALUATION

There are a number of methods available to determine monetary values for non-market goods such as the environmental impacts of transport, and different ways of classifying or grouping the techniques. In this review, three general classes of methods, direct costing, revealed preference and stated preference/hypothetical market methods, are discussed.

Direct costing methods

The direct costing method is based on actual expenditures incurred or revenues lost as a result of an external impact. Costs and benefits are based on observed monetary values such as prices (Dess et al. 1992). As the method uses prices from real markets, its values are firmly grounded in observed market prices. However it is generally applicable to only some components of total external cost. Examples of applications of direct costing given by Dess et al. (1992) include the medical expenses associated with the adverse impact of vehicle emissions on health, and the damage caused to crops by air pollution.

A related valuation method is the control costs technique which uses the costs of controlling an external impact as a proxy for the damage caused by the impact. Typically, the engineering based costs of eliminating or reducing an external impact at its source are calculated. However, as Dess et al. (1992) note, there is unlikely to be much relationship between the costs of controlling an externality and the damage caused by the externality. Thus control costs should not be used as a proxy for damage costs, but may be useful when the interest is in control costs for their own sake.

As the focus of the paper is on non-market environmental impacts which are not currently incorporated into project appraisal, the direct costing approach, which directly costs impacts using existing markets, is not discussed further.

Revealed preference methods

Revealed preference methods for determining monetary values for the environment derive values from people's observed behaviour in the marketplace, that is their revealed preference. These methods may also be called "indirect methods" because values for *non-market* goods are derived indirectly from *market* goods. The methods rely on the general concept of weak complementarity where changes in environmental quality are valued by making use of the complementarity of environmental quality with a purchased good. The price of a market good which is a complement for some aspect of environmental quality is used to determine the environmental good's value.

Mitigating costs

The difference between the direct costing approach and the revealed preference mitigating costs approach is not always clear. With mitigating costs, the relationship between environmental quality and a market good is generally less direct and more complicated than in direct costing. The mitigating costs approach is similar to control costs but it refers to the costs of mitigating the effects of an externality rather than

eliminating the externality. The usefulness of mitigating costs is limited to cases where other inputs can be substituted for an impact such as pollution, as the approach exploits the substitutability between the impact and other inputs into production. Mitigating costs are used to measure the value of changes in the collective environment by examining costs incurred in using inputs to make the personal environment different from the collective environment. For instance, people's preference for low levels of noise is revealed by their decision to buy normal market goods such as double glazing windows facing a busy street, wall insulation, or building high fences and garden mounds. Preference for clean air is revealed by expenditure on air filters, visits to a doctor to treat health complaints caused by air pollution, and the cost of medicines to relieve the adverse health impacts. However, it is often difficult to determine what proportion of the expenditure on a market good is related to the effects of the non-market environmental good.

Hedonic price methods

A commonly used revealed preference method is hedonic pricing. In the hedonic price method, a good (usually property such as houses or undeveloped land) is viewed as a bundle of attributes (such as land size, number of bedrooms, distance to transport, shops...), with the market price of the good reflecting the combination of different levels of attributes in the good. With data on many properties including sale price and characteristics of the property and its location, the market price of a property can be statistically analysed to derive prices for individual attributes. Transport applications of the hedonic method using house prices include valuing accessibility to freeways or public transport routes and the impact of road noise and aircraft noise on property values (eg Nelson 1979, 1982). Reynolds (1992) demonstrated evaluation of different noise attenuation measures using hedonically derived values to value noise reductions.

In a review of valuation methods, Nash (1990:9) notes that the hedonic price method has "a number of short comings" such as: it assumes householders have full information about the market, and have accurately perceived the attributes of the available options to make a satisfactory decision; there is often multi-collinearity (strong statistical relationships) between the attributes of a property; and specification of the econometric model to statistically explain prices may be difficult. Additionally, most hedonic studies examine current levels of a good, although it is recognised that the price of a commodity depends on the present and expected future levels of the characteristics of which it is composed.

Travel costs

Another revealed preference approach which has been used extensively to value aspects of the natural environment is the travel cost method, which is based on the concept that the value of a site (usually a natural recreational site) can be determined by the cost of obtaining the site, that is the cost of travelling to the site. In practice, the definition of the "cost" of gaining access is subject to much debate. Unlike other techniques which were originally applied to valuation of natural areas, the travel cost method appears to have limited application for valuing environmental impacts of transport in urban areas.

Value of time and contributions

A related revealed preference approach is using the value of time and contributions to community lobbying efforts as a measure of the value of environmental amenity. For instance, Carson and Martin (1991) have suggested that lobbying efforts for the Alaskan Wilderness Bill could be used to value the wilderness. In the urban context, perhaps the time and effort devoted by community and residents action groups for and against freeways, airports and noise attenuation measures (eg re-surfacing of roads, noise barriers, landscaping) could be used as an indicator of the value of urban environmental amenity. However, there have been few, if any, reported examples of applications of this method for urban environmental valuation.

Hypothetical market methods

Hypothetical market methods of valuation ask people directly for their values, usually with the aid of hypothetical markets, rather than inferring values from observations of their behaviour in existing markets. The hypothetical market methods are thus sometimes called direct methods of valuation, but this term may be confused with "direct costing methods" which in contrast rely on existing markets. Two hypothetical market methods include contingent valuation (CV) and stated preference (SP) or conjoint methods. Both methods require experimental designs. Although both contingent valuation and stated preference are hypothetical questioning techniques, CV asks respondents to state values directly, while SP asks respondents to state their preferences, from which values are derived. The two methods have been developed quite separately with different applications, and thus are discussed separately.

Contingent valuation

Contingent valuation (CV) is a technique for eliciting values for goods which are not or cannot be bought and sold in a normal market. People are asked for their value of a good, *contingent* on a market existing for that good. A hypothetical market is created and described to the respondent, who is then asked to make a market (purchase) decision. Contingent markets define the good or amenity of interest, the existing level of provision, possible increments or decrements, the institutional structure under which the good is to be provided, and the method of payment. Mitchell and Carson (1989) provide a comprehensive explanation of the theoretical foundations of the technique, methodological issues and practical application.

Contingent valuation questions can ask for people's willingness to pay (WTP) value or for their willingness to accept compensation values (WTA). WTP value is the income (or amount of money) an individual would give up to achieve an increase in the level of a good and remain at the same level of utility as before the increase. WTA (also called willingness to sell) is the income required to compensate an individual for the loss (or decrease) of a good to remain at the same level of utility as before the decrease. WTP assumes that the consumer does not have the right to the good and must therefore buy it, while WTA assumes that the consumer has the right to the good and can sell it. WTP is most commonly used because it resembles familiar consumer purchase decisions.

Methods of eliciting contingent values include:

- open ended questions (respondents are asked how much they would be willing to pay for a good);
- iterative questions (respondents are asked whether they would be willing to pay a given amount for a good (say $10); if they answer yes, the question is repeated with small increments (say $1) in the cost until they say no, then the cost is reduced by smaller decrements (say 50 cents) until a final value is ascertained); and
- referendum questions which require a yes or no answer (would you be willing to pay $10 for this good?) (also known as "take-it-or-leave-it" or dichotomous choice CV questions).

The payment mechanisms for actually buying or selling the good can include property taxes, income or sales taxes, utility bills, community charges, fares, entry fees, special funds, subscription schemes or an abstract instrument.

Since its early applications in visibility studies in the early 1970s, the technique has been used to value a wide range of non-market goods. Aspects of natural resources and the environment which have been valued include: visibility, air quality and aesthetic damage; water quality and water based recreation; hunting and fishing permits; conservation and wilderness; and species preservation. Carson et al.'s (1993) bibliography of CV studies with 1,400 references indicates the wide applicability of the method. Contingent valuation does not appear to have been used often to value aspects of urban environmental amenity. Apart from valuation of safety features in automobiles, transport applications include valuation of the non-use benefits of local public transport (Bonsall, Wardman, Nash and Hopkinson 1992). Hopkinson, Nash and Sheehy (1992) do not mention the phrase "contingent valuation" in their study, but asked respondents for their willingness to pay to secure the benefits of preferred road schemes in their local village area.

Stated preference/conjoint methods

In stated preference or conjoint experiments, as they are known in the marketing literature, respondents are presented with profiles of products with different levels of attributes and asked to rate, rank or choose which profile they prefer, after weighing up the trade-offs between characteristics and price implicit in each profile. Each profile includes a price in $, so that based on the evaluation of the profiles (either a ranking, rating or choice), individual valuations for attributes can be determined.

Nash, Preston and Hopkinson (1991) discuss transport applications of stated preference analysis. However, the technique has not been used widely in the valuation of the environmental goods associated with transport. To value changes associated with transport projects, profiles of different transport solutions to a particular problem could be developed, each with different environmental impacts, transport benefits, and price tags (representing construction costs), perhaps expressed as a levy on petrol (if a road project) or fare increases. Nash (1990) believes there remains considerable unexploited potential for the use of stated preference techniques in the monetary valuation of environmental impacts. Nash (1990:9) notes that "stated preference, although widely used in the UK [and Australia] for demand forecasting and valuing travel time savings, has been little used in the area of environmental valuation".

The key criticism made of contingent valuation and stated preference methods is their hypothetical nature and the incentive for strategic behaviour by respondents to influence outcomes. However the evidence from many studies appears to be that people do give carefully considered, rational responses to valuation questions, despite their hypothetical nature, and do not behave strategically. Other possible sources of bias in contingent valuation have been detailed by Mitchell and Carson (1989) and in stated preference by Nash, Preston and Hopkinson (1991).

Comparison of methods of valuation

The market based approaches which rely on observed behaviour can only be used to value changes which are currently experienced in the market. They cannot value changes which are beyond current experience. However, because the direct questioning methods use hypothetical markets, they can obtain values about future projects and changes in goods, especially those beyond the range of existing experience. Hypothetical methods can be used to value future changes in attribute levels and environments which may not exist now. Although respondents may not have experienced particular situations, contingent valuation presents a contingent market to people and gives them much information on which to base their decision. The hypothetical techniques provide richer data than is obtainable through other methods as they enable a number of scenarios to be presented to one person and values obtained for different levels of a resource, perhaps reflecting the different options available for a proposed project. Stated preference experiments have an inherent dynamism which is not present in revealed preference which relies on past behaviour (Dargay and Goodwin (1994:22). The characteristic of dynamism is important when valuing changes which will occur in the future.

Because the direct questioning methods are hypothetical, they are applicable to a wide range of environmental resources and can be used where other techniques are not appropriate or feasible. They have great flexibility and can be applied to many different scenarios.

In addition, the direct questioning methods can value non-use values, that component of value arising not from actual use of a resource, but from knowing it exists (existence value), that it is there for others to use, for future generations (bequest value), or the possibility of use in the future (option value).

Hypothetical methods are appropriate to use where there is uncertainty over a project's impact on the environment. Different impact scenarios can be presented to respondents to value, and the degree of uncertainty can be presented and explained in the description of the contingent market.

Different methods are useful in different contexts and applications. Revealed preference methods may be appropriate for some environmental costs, whereas contingent valuation or stated preference may be necessary to derive individual values for major environmental changes, particularly for projects with an element of "user pays". Methods may also be combined. For instance, Nash, Preston and Hopkinson (1991:65) propose a stated preference application which has elements of the hedonic approach

(originally cited in Pearce et al. 1989): "an approach based on hypothetical choices between alternative houses in locations known and described by the interviewee would be a fruitful way forward on this issue [environmental disamenity caused by transport]". However overall, the hypothetical, direct methods have more strengths and offer greater promise than the revealed preference methods for valuation of currently unvalued environmental goods.

Comparison of hypothetical methods of monetary valuation

In order to value goods beyond the range of most people's experience, or with which people are relatively unfamiliar, much information about the good must be provided to respondents. To date, practical applications of contingent valuation have placed more emphasis on setting the context for valuation and providing this information than stated preference experiments. There is no reason this could not also be done in a SP experiment, it just does not appear to have been done so far. Stated preference experiments may not be as appropriate as CV for doing this. People may require more information than is usually available in SP profiles. Contingent valuation may be a more appropriate method for providing the information that people need in order to make valuations about goods they do not usually think about in a market context.

It may be easier for respondents to complete SP experiments more accurately than CV, as respondents do not actually have to state their values (because they are inferred from their ranking of different alternatives). It may be easier than asking respondents for values for items which they do not usually value in dollars and for which they have to articulate values "on the spot". The difficulty of stating a precise value has been recognised by researchers in the field and new forms of questions and analytical techniques have been developed, particularly referendum style, "take-it-or-leave-it" questions requiring only yes or no answers to given values.

Recently, there has been recognition of the possibility of combining the two hypothetical methods of contingent valuation and stated preference experiments for some valuation applications.

5. PRACTICAL ISSUES IN MONETARY VALUATION

A number of practical difficulties associated with monetary valuation, including some common to all survey methods of data collection, are discussed below.

What exactly is being valued? It is very important to fully define and describe the environmental goods that are being valued, particularly those with which people have little or no direct market experience. In hypothetical methods of monetary valuation, the definition of the scenario is vital. In revealed preference methods, there may be doubt about which goods preferences are being revealed for. Construction of high fences on busy roads may also improve privacy and security as well as reduce traffic noise.

Sagoff (1988) has proposed that people make decisions both as "consumers", thinking only about their own welfare, and as "citizens", concerned for the greater good of the

community. Blamey and Common (1993) note that any values used in cost-benefit analysis have to be "consumer" values, rather than "citizen" values. A carefully designed survey instrument would be required to ensure respondents state values from the intended perspective.

There may be difficulties in deciding how to expand up from a sample to obtain community wide or national values which may be required in cost-benefit analysis. There may also be difficulties in aggregating responses to produce meaningful estimates of averages, including handling non-responses and distinguishing between genuinely zero values and protest values.

The role of time in cost-benefit analysis, particularly the rate at which future costs and benefits should be discounted, has been much debated. For instance, Dargay and Goodwin (1994:16) note that "the nature of global environmental problems is such that the time scale of appraisal must be longer than is consistent with conventional discount rates". With valuation, it is often not clear over what time scale people are expressing values.

6. CONCLUSION

There is little doubt of the need for better and improved methods for taking the environmental impacts of projects, particularly those of transport projects in urban areas, into account in the decision-making process. Monetary valuation is one approach to improving the way in which environmental impacts are taken into account. Increased monetary valuation of environmental impacts would be worthwhile: it is not a substitute for value judgements, but is a contribution to the decision-making process. The hypothetical market methods of monetary valuation, contingent valuation and stated preference methods, offer great promise. There is need for research comparing contingent valuation and stated preference methods for valuation of environmental impacts. Although both techniques are well developed for particular uses, contingent valuation for natural resource valuation and stated preference for behavioural demand and forecasting work, they are not widely used for the application discussed in this paper. Contingent valuation has been little used to value the environmental impacts of transport projects in urban areas, while stated preference techniques have not been widely used for valuation of the environment.

NOTE

Sections of this paper are based on a paper presented at the 14th CAITR (Conference of Australian Institutes of Transport Research), 9-10 December 1993.

Extensive comments were made by the paper's referee, most of which have been incorporated, to some degree, in the revision of the paper.

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