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Summary:

Valuation of nonmarket goods for use in cost-benefit analyses: Methodological issues

The subject of this thesis is how to value nonmarket goods when the valuations are to be used in cost-benefit analysis (CBA). To be more specific, the aim of the thesis is to investigate i) how the Stated Choice method can be used in valuation of environmental goods, ii) how methodological problems related to Stated Choice influence the valuation results, and iii) how the choice context influences the valuations of nonmarket goods. The cases and the data are related to valuation of travel time, environmental impacts and traffic safety included in CBA of road investments, but the results and the conclusions are relevant to valuation of nonmarket goods and considerations about CBA in general.

Background and limitation of the focus on Stated Preference methods

In Norway, CBA are carried out for all road investment projects, and a benefit/cost ratio is calculated for each project. An optimal decision rule would be to rank the projects according to a decreasing benefit/cost ratio and then carry out the projects in that order, until the budget is depleted. However, several recent Scandinavian studies show very weak – if any – association between the priority ranking assigned to a given road investment project and the project's benefit/cost ratio. If doubt amongst decision makers about the accuracy of the valuation of the goods included in CBA partly can explain this weak association, improving the valuation methods could be one way to strengthen it.

If a good is to be included in a CBA, the good has to have a monetary value associated with it. However, some of the goods decision makers want to include in CBA are not directly bought and sold in actual markets. Such nonmarket goods thus have to be valued either in Stated Preference (SP) studies or in Revealed Preference (RP) studies. SP data are collected in surveys where people in a constructed market are asked hypothetical questions and/or are presented hypothetical choice tasks. RP data, on the other hand, are based on people's actual choices in real (surrogate) markets. For example, the labour or housing market can be used to indirectly value safety or environmental goods (i.e. hedonic pricing techniques).

In this dissertation the focus is on SP methods. The main reason for this focus is that SP methods in many cases are the only means to construct the relevant valuation contexts and, therefore, the only way to measure people's preferences for nonmarket goods.

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Methodological issues

Two different SP valuation methods are used in the five papers that constitute this thesis, Stated Choice and Contingent Valuation. Stated Choice is, briefly described, a method in which nonmarket goods are assessed relative to each other and not in absolute amounts as with the more common Contingent Valuation method.

Data from two different national Norwegian surveys consisting of in-person interviews are used in the papers. The first study, conducted in 1993-94, is an environmental study valuing air pollution and noise related to road traffic. The second study, conducted in 1995-96, is a so-called "value of time study" measuring travellers' willingness to pay for a reduction in travel time.

In paper 1 environmental impacts of urban traffic are valued by Stated Choice. The results from this study have been used by the Norwegian Public Roads Administration in their CBA since 1995. Paper 1 points to the fact that considerable uncertainty remains with regard to:

- the impact on the valuations of interaction effects and other general methodological problems with Stated Preference methods because the respondents in this study only had the possibility to state their preferences for environmental goods and not other goods included in the CBA; and
- problems related to the complex choice situation of Stated Choice.

Paper 2 shows that inconsistent choices (i.e. violations of the transitivity axiom) commonly occur in several Stated Choice tasks and have a significant impact on the valuation of reduced travel time. It is shown that different abilities (i.e. level of education) cause inconsistent choices. The occurrence of inconsistent choices is shown to be largest in the beginning of the choice sequence and is reduced for subsequent choices. As a conclusion to the results in paper 2 it is suggested that respondents may need more training and help to choose consistently in Stated Choice studies.

Paper 3 investigates the causes and consequences of lexicographic choices (i.e. violation of the continuity axiom) in Stated Choice studies. By lexicographic choices we mean a set of choices in which the respondent consistently chooses the alternative that is best with respect to one particular attribute. The analyses in paper 3 shows that lexicographic choices commonly occur in Stated Choice tasks and that lexicographic choices are not the same as lexicographic preferences because lexicographic choices are partly a result of:

- Study designs with too large differences between the presented alternatives. Such choices give less information about preferences, but this is normally not a serious modelling problem;
- Simplification of the choice task. Such lexicographic choices contribute to the large variance in Stated Choice data and might therefore have a significant impact on the valuation of nonmarket goods if it is not corrected in the analysis.

Paper 4 makes use of the logit scaling approach to handle variance increases caused by inconsistent choices in Stated Choice data. The scaling approach is a statistical estimation method that allows for differences in the amount of unexplained variance in different types of data, which can then be used together in the analysis. The amount of unexplained variance is shown to increase as the number of inconsistent choices increases. The main conclusion from the analyses in paper 4 is that scaling due to inconsistencies significantly improves the models and reduces the valuations of travel time. In addition, the scaling approach makes the valuations of travel time from the Stated Choice data more consistent with the valuations from Contingent Valuation data included in the same study. Another important conclusion is that scaling due to education (cf. paper 2) gives no improvement of the model.

The subject of paper 5 is possible interaction effects in valuation of nonmarket goods included in CBA. CBA for road investments includes nonmarket goods such as travel time savings, traffic safety, noise and air pollution. Traditionally, these nonmarket goods are valued through separate willingness-to-pay studies without any attention to interactions between them. Paper 5 shows that a simultaneous valuation procedure, accounting for interactions between the nonmarket goods included in CBA for road investments, significantly reduces the valuations of travel time savings, noise and air-pollution compared to a separate valuation procedure. The results presented in paper 5 show that the choice of valuation context is an important issue in the overall methodological discussion of how to value nonmarket goods for use in CBA.

Conclusions, questions and further research needs

The results in paper 5 show that when one wishes to include nonmarket goods such as travel time, traffic safety, noise and air-pollution in CBA for road investment projects, these nonmarket goods should be valued simultaneously in the same study. However, there are reasons to question whether the relevant shadow prices for use in CBA should be based on short-term valuations (as in today's valuation practice) or more long-term valuations. A more long-term valuation procedure can ensure that:

- the valuation context is in better accordance with a desired future context (i.e. the society people want) instead of today's context which may be undesired and too limited to present in a questionnaire as an acceptable choice set where people are to state their preferences; and
- the budget allocation process is completed, as is assumed in standard economic theory.

In paper 2 and 3 it is shown that Stated Choice is a valuation method that may collect so much data noise that the valuation results are affected. Therefore, it should be a goal for practitioners to make the elicitation methods sufficiently simple that people are able to state their preferences in response to the choice set they are presented.

Paper 4 shows that the scaling approach may be a way to handle variance differences due to inconsistent choices and that accounting for such heteroscedasticity may lower the estimated value of travel time. Similar results are obtained in other studies accounting for heteroscedasticity due to taste/preference variations and

heteroscedasticity due to variations connected with different elicitation methods. Accounting for variance differences in SP data seems to be a crucial issue for future research, and analyses that simultaneously correct for heteroscedasticity due to inconsistencies, taste differences and other sources are needed.