Environmental Cost-Benefit Analysis and Anomalous Behavior – A Review

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Abstract –**Through its various links to natural resources the agriculture and forestry sector is frequently confronted with questions of environmental protection. Trade offs between agricultural production and resource conservation or environmental protection have to be evaluated by adequate methods. Cost-Benefit Analysis (CBA) is one of the most utilized procedures in this respect. Despite its theoretical applicability to non-market goods such analyses are affected by severe obstacles, which can be divided into three categories: externalities and public goods, mistakes/anomalies in decision making, and tastes ("preference coherence"). This paper reviews impediments for environmental cost-benefit analysis (ECBA) which are rooted in the empirical evidence of anomalous behaviour of individuals. Based on the likely consequences for ECBA the main directions of future research requirements are elaborated.**

INTRODUCTION

Efficient decision-making based on economic analysis in many instances relies on CBA. Since its first forms in the 19th Century in France CBA has been has been substantially refined, and recently in particular the challenges which environmental issues (and environmental policies) pose for cost-benefit analysis have contributed to this progress.

ECBA is an application of CBA to evaluate projects where market failures (e.g. externalities) are taken into account. It is needed for allocating public goods (such as environmental quality), yet the assumptions of the first theorem of welfare economics which are necessary that the outcome of a market process to leads to an efficient allocation, are not fulfilled. Thus, ECBA informs about efficient (and theoretically also optimal) allocation which would occur if market forces were in place.

This paper briefly reviews the empirical evidence of behavioural anomalies which may influence the theory and practice of ECBA.

THEORETICAL FOUNDATIONS OF ECBA

The theoretical foundations of ECBA rest in the standard economic model (SEM), which assumes rationally behaving agents which maximize an objective like utility or profits under given constraints. Based on these behavioural assumptions, the SEM allows to predict the behaviour of agents if prices, quality or income change, given preferences do not change. The benefits and costs of changes in environmental quality can then be predicted by integrating over the changes of the aggregated demand and cost curves. Estimation of the demand curve for public goods is one of the major tasks in ECBA. For a public good, the demand curve is theoretically constructed as aggregated Willingness to Pay/Accept (WTP/WTA). In order to identify WTP/WTA, it is assumed – as in neoclassical consumer theory - that it is possible to derive people's preferences from their monetary valuations of environmental changes. In ECBA practice this is either done by *revealed* preference valuation (travel cost method, hedonic pricing) or by *stated* preference valuation (contingent valuation method or choice modelling in the form of choice experiments).

Environmental quality changes often last over long time periods, and consequently benefits and costs must be discounted. In the SEM utility is discounted exponentially which is logically consistent over time. Knowing the benefits and costs of a change in environmental quality for all individuals affected allows the calculation of net benefits. If it is impossible to increase net benefits without making someone worse off, the allocation of resources is considered as *efficient*. Unfortunately, many efficient allocations exist. To know the *optimal* distribution of resources a social welfare function is required, which is unknown. Alternatively potential compensation tests, such as the Kaldor-Hicks test, are applied to compare different allocations of resources.

From a standard economic viewpoint there is a long tradition of criticizing CBA for various shortcomings, e.g. whether individuals' preferences can be a reliable guiding principle for social decisions, or the tension between economic efficiency and the distributional incidence. Recently, behavioural economics has added to this list:

Empirical evidence suggests that key assumptions of this model are in some circumstances not in accordance with individual behaviour (e.g. stable, context-independent, and internally consistent preferences). Consequently, the key assumption of maximizing behaviour has to be dropped. But then the calculated "optima" are not valid anymore, because there is no more reliable relationship between market equilibrium and welfare optimum, and between externalities and environmental policy instruments. If people no longer respond predictably to prices in comparing them with marginal values, fundamental problems for economic valuation arise.

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ANOMALOUS BEHAVIOUR AND ECONOMIC VALUATION

One of the most disturbing puzzles for ECBA is the reported wide gap between WTP and WTA, which seems to be empirically robust (Horowitz and McConnell, 2000). Besides large income effects or lack of substitute goods (Hanemann, 1991) another group of explaining factors is provided by behavioural economics. The *Endowment Effect* refers to situations where the subjective valuation of an object depends on whether the object is being acquired or given up. However, this effect may not apply to public goods because here consumers do not have exclusive property rights, and consequently the utility from "owning" publicly provided goods respectively the disutility from parting with them will likely be (much) smaller than for private goods.

The *status-quo bias* implies that the utility of consuming a good at time t will vary in relation to what was consumed in previous periods (x_{t-1}). Consequently it becomes necessary to distinguish between gains and losses when evaluating the net benefits of a policy proposal. With respect to an ECBA the existence of this effect implies, that e.g. the Kaldor-Hicks test becomes more stringent as a larger transfer of benefits is required to make losers feel indifferent.

Loss Aversion characterizes preferences that are risk-loving over losses, and risk-averse over gains. Empirical evidence in fact suggests that consumers behave this way (Berg, 2002). Drawing on prospect theory with its asymmetric value function Tversky and Kahneman (1991) argues that a substantial part of the disparity between WTP and WTA is caused by loss aversion.

Preference reversal exists when the rankings of two bundles differ according to whether people rank on the basis of strict *preference* or on the basis of *value* (Lichtenstein and Slovic, 1971). Preference reversals call into question the empirical validity of economic theory because they provide support for the conclusion that the preferences subjects reveal vary with the response mode (choice or valuation) that is used to elicit the preferences. This matters for ECBA, because if people state values that are inconsistent with their underlying preferences, it becomes impossible to judge the relative net benefits of alternate policies.

In contrast to the SEM which assumes that people discount future benefits/costs by a fixed percentage for each unit of time they must wait, in practice people often become more impatient when the consumption activity is imminent: they discount hyperbolically. The discount rate therefore becomes sensitive to the period in which it is measured. Cost-benefit decisions with immediate benefits and deferred costs are the most likely to be reversed through time.

RESEARCHING POSSIBLE SOLUTIONS

There are diverging opinions with respect to the possibilities to solve the problems of ECBA. One view is that some anomalies observed in valuations are a consequence of complexity. Helping individuals to become consistent can be done through exchange institutions penalising irrationality via an arbitrage mechanism which links private choice to social pressures. Unfortunately, this is only possible in hypothetical settings as such strong institutional pressures usually do not exists for environmental goods. Another way to help individuals becoming consistent assumes that people can transfer rationality acquired in market-like settings into a nonmarket choice setting ("rationality spillover", Shogren, 2002). Also sticking to the idea of rational behaviour but allowing the explanation of many anomalies, are the approaches of Bernheim and Rangel (2009) and Smith and Moor (2009). The latter propose that all anomalies could be explained by including further restrictions such as cognitive capacity. The former try to exploit coherent aspects of choice by replacing the standard revealed preference relation with unambiguous choice relations, which are constructed as a constraint set of objects with characteristics and ancillary conditions.

Another approach replaces the problem of utility measurement by replacing utility with the concept of happiness, which is empirically better treatable (Welsch, 2009).

CONCLUSIONS

Some of the anomalies described in the behavioural literature are relevant for ECBA if their robustness and non-triviality in the case of public goods can be established. Dependent on the specific effect, widely diverging approaches to explain the anomalies and adoptions of the ECBA methods are discussed in the literature. The current status of research does not provide unanimous prescriptions for improving ECBA with respect to the challenges of anomalous behaviour.

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