A multi-level cost benefit approach for regulatory decision support in food safety and quality assurance scenarios

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Abstract— **In complex policy decision situations where policy objectives can only be reached through appropriate activities of individual actors with own decision authority and individual objectives, the classical approaches for measuring the effects of regulatory initiatives through cost-benefit or related types of analysis do not provide the appropriate information for decision support. This paper discusses a framework for a multi-level analysis approach that could provide decision support in multi-level policy decision situations.**

Keywords— **cost-benefit analysis, multi-level analysis, policy decision support, impact assessment**

INTRODUCTION

Decisions on the formulation and possible implementation of policy regulations depend on appropriate information on the possible effects of decisions regarding costs, benefits, impacts and similar indicators (Bartlett, 1989, Ruan et al., 2008). The analysis of effects would need to focus on those domains that are of interest to policy involving broad subjects like, e.g., public welfare, the environment, public services or the economy but may also focus on effects related to specific groups like, e.g. enterprise or consumer groups (Adler, Posner, 2001). For the analysis, approaches like cost-benefit analysis (Tevfik, 1996, Boardman, 2006, Brent, 2006), impact assessment (Jacobs, 2007, de Vries, 1999, OECD, 2001, Rau and Wooten, 1980) and others, all of them in the following generally referred to as 'cost-benefit type' of approaches, have been developed and discussed extensively in literature. The variety of approaches signals difficulties in the analysis and in the provision of information for policy decision support.

However, irrespective of the intensive discussion in literature and the need for policy decision analysis, there is little use of cost-benefit-analysis type of approaches for ex-ante but more for ex-post policy decision support (Kornhauser, 2000, Graves, 2007). A recent international expert workshop (Bonn, 2007) suggested as reasons the lack of objectivity, simplicity, transparency, and reliability. Deficiencies in reliability are not just related to data quality but might be due to structural deficiencies in cost-benefit approaches. They usually compare present with future possible scenarios but disregard possible development paths or development barriers that might prohibit a future scenario to materialize even in cases where the cost-benefit analysis suggests its general attractiveness.

This paper intends to design a framework for a cost-benefit-type of approach that improves the decision support capability of cost-benefit-type of analysis initiatives and provides a tool that might better serve the needs of policy in the analysis of potential effects of its decision alternatives. The focus on decision support will require to first specifying the principal modelling approach and, secondly, its integration into a decision support framework.

THE MODELLING FRAMEWORK

OVERVIEW

A decision model consists principally of 3 modules (Qudrat-Ullah et al., 2008),

a) the **objectives** of the decision authority,

b) the space of available policy activities (**regulatory framework**), and

c) a '**cause-and-effects model**' that allows to identify the effects of policy interventions.

A cause and effects model could be based on a cost-benefit-type of analysis approach if the underlying model represents the cause and effects relationships in an appropriate manner.

A cause and effects model builds on data, a calculation model that specifies possible effects in selected domains and a decision table that allows the analysis of effects in the selected domains for decision support. These elements characterize possible difficulties not just in cost-benefit-analysis but also in any other cause-and-effects modelling approach. They involve a.o. (Edwards et al., 2007, Merkhofer 1997)

a) the selection and use of methodologies for the **collection and analysis** of data (1),

b) the **integration** of different dimensions of non-monetary positive and negative

effects into monetary terms or into indicators like utilities and others (3), or

c) the identification of **boundaries for the analysis** or the identification of effects

being named as, e.g., costs, benefits or impacts (2).

This approach models a scenario, where one can capture appropriate data from a variety of sources including statistical data, case studies, or even expert knowledge for the analysis of effects of policy regulations in domains that are of policy interest. However, this model does not cover a complexity where the outcome of any policy initiative might be partly beyond the control of the policy decision maker but be influenced by decisions of other groups.

THE MULTI-LEVEL APPROACH

If past developments do not allow the analysis of their expected behaviour through statistical analysis, the model has to be complemented by models that provide information of the effects of policy initiatives on these groups and their potential reactions. Of specific relevance in this context is the differentiation between different levels of analysis, e.g., between the levels of society (and policy), the level of individual actors which might include enterprises, consumers, and others, and the levels of the sector identified as the relevant groups of individual actors (figure 1).

Critical points are relationships between levels. On the lower (e.g., enterprise) level the focus is usually on individual enterprises, on the level of society on impact domains or impact areas. The necessary transformation in information exchange has to consider theses issues. Cases in point are activities in food safety and food quality where enterprises are responsible for food safety and quality, but where consumers expect policy to guarantee food safety and at least a baseline quality.

Each of the levels has different objectives and requires a different modelling of cause-and-effects relationships. The level of society builds on the classical analysis of monetary and non-monetary costs and benefits. Monetary costs might be matched by non-monetary benefits if they suit the objectives of policy which, in turn might be able to cover monetary costs through taxation and similar means. At the level of enterprises, the main focus is on monetary costs and benefits. In the long run, monetary benefits have to exceed monetary costs in any case.

The different views may have consequences for development paths. A classical cost-benefit study disregards the path towards the realization of policy objectives or the obstacles that might prevent their realization.

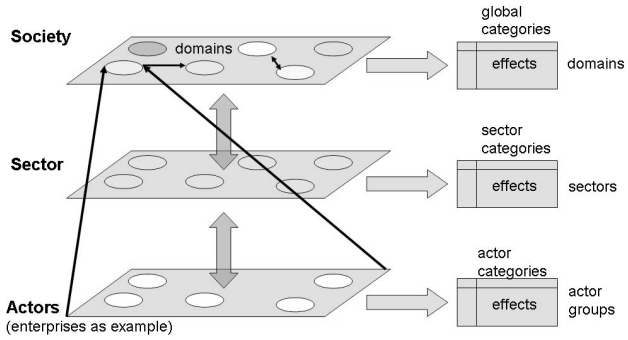

Figure 1: Multi-level analysis approach, level relationships and tables of effects.

The discussion of effects on these different levels is aggravated by the fact that the analysis on the different levels is rooted in different areas of research which differ in vocabulary. While the focus on both levels is on positive and negative effects with relevance for objectives and decision activities, they are referred to, e.g., at the level of society as 'cost-benefit analysis' (Mishan, Quah, 2007, Nas, 1996) or 'impact assessment' (Kirkpatrick, 2007, Mandelkern Group, 2001, European Commission, 2005) and at the level of enterprises as an analysis of turnover, expenditures or profits.

The sector level (intermediate level) is more complex and requires a more detailed discussion. It serves as a link between the levels of society and enterprises or consumers. One might view the sector as an aggregate of enterprise activities and without own personality. In this case, a separate sector analysis does not provide additional information. However, the interest of the sector's enterprises as a group might be different from the interest of individual enterprises. In this case, the sector's interests and possible reactions need to be analyzed separately.

Consider the case of tracking and tracing for better control in food safety activities (Poignée, 2008). The society with policy as its representative actor is interested to assure tracking and tracing capability. For the individual enterprise, major benefits from investment in tracking and tracing capability depend on the simultaneous realization of this capability by its suppliers and customers. Furthermore, it might consider potential benefits as low if it assumes that the probability of food safety failures in its own value chain is also low. Both arguments together create an investment barrier for individual initiatives. However, at the sector level the view might be different. The probability of a food safety failure somewhere in the sector and in consequence, a reaction of consumers that reach beyond the enterprises involved is much higher that that for an individual chain. For the sector as a whole the cost-benefit relationship is, therefore, different. If the sector as a whole is not able to actively act according to its interests, the individual investment barriers will prevent the sector to reach its objectives.

The mutual interdependence of different levels is exemplified in food safety control where a failure at enterprise level might initiate a sequence of effects and containment activities.

THE DECISION SUPPORT ENVIRONMENT

OVERVIEW

The integration of the multi-level decision framework into a decision support environment must deal with the deficiencies mentioned for traditional cost benefit type of analysis, including the lack of objectivity, simplicity, transparency, and reliability.

Of specific relevance, especially for improvements towards simplicity and transparency, is the reduction of complexities as far as possible without compromising other issues like, e.g., reliability. A core approach involves the utilization of filter technologies (see Alter, 2002). With filter technologies, the complexity of a cost-benefit type of approach is stepwise reduced through an elimination of possible individual actors, activities of actors, and of impact domains that are, according to the decision maker, of minor relevance to the outcome in a certain decision situation. The filters (or checklists) contain, in themselves, certain expert knowledge on the relevance of actor activities and impact domains for different decision scenarios.

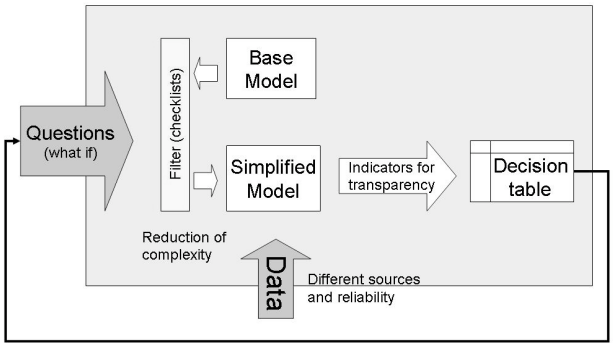

Figure 2: The reduction of complexities through filter approaches that allow the transfer of a base model into a simplified decision support model.

DATA COLLECTION SCHEMES

In cost-benefit-type of approaches, data collection usually builds on statistical data collection schemes (Dompere, 2004, Ray, 1990). However with a focus on the analysis of individual actors, data collection needs to build, in addition, on expert knowledge, case studies, and enterprise decision models.

The data should describe the actual situation and allow an identification of expected behaviour through expert knowledge or enterprise decision models. As an example, if the analysis shows positive monetary effects of new developments but identifies necessary initial high investments which enterprises might have difficulties to realize because of, e.g., restrictions in the accessibility of monetary funds, one might be able to conclude from experience (expert knowledge) that this constitutes an investment and development barrier. The same conclusion could come from a model that describes enterprise behaviour.

With the different types of data, the analysis has to clarify differences in reliability and communicate this information as part of its analysis. One might start with a rather low but cheap reliability level e.g., from a very first expert judgement and then move towards a more elaborate level of data collection with a higher level of reliability.

INDICATORS ON EFFECTS AND DATA RELIABILITY

In a multi-level decision framework, different types of monetary and non-monetary effects are to be represented by suitable indicators. For the support of transparency, these indicators should be directly linked to certain types of effects and characterized by an indicator for reliability. The mapping of individual indicators provides the basis for decision support and could deliver certain patterns of effects which, in turn, could be related to certain types of policy initiatives.

Further support could be reached through the aggregation of different types of monetary and non-monetary effects into a monetary or non-monetary (e.g. utility) aggregate (Krieger et al., 2008). This aggregation needs to build on aggregation vectors that characterize the actors' preferences on the different levels of analysis. As objectives might include interest in certain effects and as preferences might change over time, the specification of the aggregation vector needs to be open for analysis. In cost-benefit type of analysis approaches, the specification of the vector is one of the critical issues that might challenge the value and objectivity of the resulting indicator.

The decision tables on the different levels serve different purposes. On the higher level (the society/policy level) it supports decision on the need for regulatory activities. On the enterprise and sector level, it serves policy to better understand the decision scenario the enterprises are in and the probable reaction to changes in the economic and regulatory environment.

CONCLUSION

The multi-level decision framework supports the capturing of positive and negative effects of policy regulations on different levels of the economy. This is especially relevant in scenarios, where effects on the society/policy level depends on the activities of individual actors (as, e.g. enterprises) with own interests and decision authority as reflected in scenarios where policy intends to promote improvements in food safety and food quality. Knowledge on the effects of policy initiatives on different levels of society might signal policy a range of opportunities to reach its objectives involving, e.g., regulations, incentives, taxes, financial support or, even leaving developments taking its course.

The development of the multi-level decision framework is challenged by the well-known problems that are encountered by traditional approaches for the analysis of effects through cost-benefit and similar approaches on the level of society but delivers, through its multi-level view, better information on expected effects. For using in a policy decision situation, the framework needs to find a feasible approach of dealing with the problems that allows its utilization in decision support without compromising its inherent strength. Transparency in analysis, simplicity in use, and transparency in reliability are key requirements in this respect. The framework employs filters to reduce complexity, reliability indicators to signal the reliability of results, and presents effects through clusters of (disaggregated) indicators that provide transparency in quantitative and qualitative effects on each level of analysis and could serve as 'decision tables' for policy decision support. If captured in appropriate calculation tools it could provide a simulation platform for 'what-if' type of analysis.

To keep this approach feasible, it will need to concentrate on the lower level on the actors (e.g. enterprises) with major relevance for reaching policy objectives. This involves prior knowledge as is the case in cost-benefit types of analysis where one needs to identify the impact areas that are relevant at the level of society.

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