A fuzzy multi-criteria approach for the ex-ante impact assessment of food safety policies

Mario Mazzocchi *, Maddalena Ragona, Agostina Zanoli

University of Bologna, Department of Statistics, Via Belle Arti, 41, 40126 Bologna, Italy

ABSTRACT

There are many obstacles hindering regulatory impact assessment (RIA) for food safety policies, mainly difficulties in the monetisation of impacts and major uncertainties in assessing some of the policy outcomes. This paper reviews these obstacles and explores how a procedure based on fuzzy methods could address them. The resulting tool (named 'Scryer') consists in the combination of an explicit scoring system with indicators of uncertainty in assessments, and the application of fuzzy logic to multi-criteria analysis. Among the desirable properties of Scryer there are the ability of aggregating a variety of different impacts without necessarily monetise them, and the flexibility to adjust to qualitative and model-based impact assessment. An illustrative application on regulating mycotoxin contents in cereals and cereal products is provided.

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Introduction

Regulations on food safety issues have greatly increased over the last years in the European Union (EU), mainly in response to recent food scares. On this regard, doubts could be raised whether such regulations are justified by a persisting real risk to human health or are rather driven by the political need of responding to short-term and possibly irrational public concerns. If the latter motivation prevails, policies may violate the rule that expected benefits should justify the costs, or that the most cost-effective intervention is chosen.

In principle, all possible consequences of a regulation should be considered and quantified before being approved. Cost-benefit analysis (CBA) is the standard approach to compare impacts of different policy options in order to identify the option with the highest benefit/cost ratio, and is usually 'recommended' – or even 'required' – as the preferable technique to be adopted in regulatory impact assessment (RIA) in the majority of countries using this process. In practice, the application of CBA in RIA faces major obstacles, especially for food policy interventions. CBA is often 'partial' (limited to a narrow group of impacts) or 'soft' (integrating qualitative and quantitative information) (OECD, 2009). The immediate alternative to CBA is multi-criteria decision analysis (MCDA, see Figueira et al., 2005), where the ranking of alternatives can be based on different measurement scales (including the

combination of quantitative and qualitative variables), while in CBA impacts are estimated in monetary terms.

Among the limitations of most RIA studies, there is an underlying pitfall associated with the inevitable uncertainty in qualitative or quantitative assessments. Such uncertainty arises from difficulties and inconsistencies in judgments or problem structuring (internal uncertainty), and from the probabilistic nature of external factors like climate (Stewart, 2005). Furthermore, the CBA goal of monetising all impacts and aggregate them to obtain the overall balance of costs and benefits is hindered by the chronic lack of adequate information. As argued by Sunstein (2005), these issues around CBA become especially serious when the safety legislation is based on the precautionary principle as in Europe, which means that legislation may be required even for risks on which there is substantial scientific uncertainty.[1] A critical review of the implications of adopting CBA for RIA by food safety authorities is provided by Irz (2008).

The extension of MCDA to consider fuzzy measurement (see e.g. Meyer and Roubens, 2005 and references therein) makes it possible to accompany discrete qualitative impact evaluations with an indication of uncertainty. In short, MCDA seems a preferable approach in case of policy areas – like food safety – where significant economic, social and environmental impacts cannot be monetised. In this regard, MCDA can be considered as a more comprehensive approach compared to CBA, and CBA could be regarded as a special

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* Corresponding author. Tel.: +39 051 2098225; fax: +39 051 232153.
E-mail addresses: m.mazzocchi@unibo.it (M. Mazzocchi), maddalena.ragona@unibo.it (M. Ragona), agostina.zanoli@unibo.it (A. Zanoli).

[1] Sunstein (2002) provides an entertaining example of the limitations of CBA with regards to food safety interventions, by looking at the range of monetised benefits from introducing an Environmental Protection Agency (EPA) regulation on arsenic content in water. With 'reasonable assumptions' these benefits range from $ 0 to $ 560 million.

case of MCDA in situations where all impacts (criteria) can be monetised. Finally, even though CBA is deemed as an objective tool (albeit biased by income), the subjectivity of MCDA (as relying on preferences of experts) can be communicated in a transparent way (Department for Communities and Local Government, 2009; Gamper and Turcanu, 2007).

In this paper, we review these obstacles with regard to food safety policies, and explore how fuzzy multi-criteria analysis could address them. Hence, our work aims to contribute to the methodological debate on the procedure to analyse the likely impacts and rank the policy options within a RIA process. Section "Background" lists the key issues in performing an adequate impact assessment for food safety regulatory interventions and reviews the current approaches and methodological developments, with a focus on MCDA. The procedure for ranking alternative policy options is described in Section "Methodology", while the technical details of the adopted multi-criteria method are provided in the appendices. In Section "Application", we show the results of a demonstrative application on a regulatory proposal setting maximum limits for two mycotoxins which can be found in cereals and cereal products. Finally, some concluding remarks and directions of further developments of the tool are given.

Background

Limits of cost-benefit analysis for food safety regulations

While there is a strong demand for the evaluation of the specific impacts of food safety regulations and a wide body of quantitative research has been proposing methods for monetisation of policy impacts (Antle, 1999; Caswell, 1998), complete and reliable cost-benefit analyses are an exception rather than the rule. There are many reasons for this, and the most apparent ones are (a) poor data availability and quality, especially for some key impacts (public health, administrative burdens, etc.); (b) difficulty in isolating confounding factors (e.g. market forces, weather, etc.); (c) probabilistic outcome of some actions, as food hazards may still occur with lower risks; (d) uncertainty in compliance levels; (e) different timing in the occurrence and discounting of costs and benefits (e.g. short-term costs for firms vs. long-term health outcomes).

These issues have been generally addressed by resorting to sophisticated quantitative models or ad hoc techniques for individual impacts (Ragona and Mazzocchi, 2008). However, the availability of time and (financial and human) resources necessary to collect data and perform quantitative analyses may also depend on the importance of the problem requiring an action (the so called 'proportionate level of analysis', European Commission, 2009). In most cases, time and resources are limited. At the European Commission (EC) level, the whole impact assessment process must be carried out within 1 year, but for urgent matters the time limit is reduced to 4–6 months.

In addition, the impacts of food policy decisions depend on outcomes that can hardly be predicted, because of external or internal uncertainty (Jauch and Kraft, 1986), where the former refers to environmental (objective) sources of uncertainty, and the latter to personal (subjective) uncertainties of those providing the judgments. For example, adverse effects on human health might be subject to external uncertainty because some toxins occur at the crop level only under certain weather conditions, or because adequate risk assessment studies are lacking and the dose–response mechanism is unclear. In other cases, evaluators may be uncertain on their own judgments, because of lack of expertise or the difficulty of capturing complex interactions among the influential factors (internal uncertainty).

Finally, a key point – often overlooked when analysing public decision making – is the relevance of public perceptions and media coverage on food-borne risks, especially when policy intervention is originated by a novel food scare or a major outbreak. This does not necessarily mean introducing an 'irrational' component, since food safety is a credence attribute, and a deficit of consumers trust in the food supply chain has real economic consequences on markets that policy makers (and firms) are keen to avoid (Bernauer and Caduff, 2004; Sjöberg, 2001). On the other hand, some authors and institutions have expressed concerns on the possible over-regulation in response to social sensitivity of risks and on the recent use of unconsolidated models which include societal perceptions and stakeholder participation (Ball and Boehmer-Christiansen, 2007; Better Regulation Commission, 2006).

These difficulties have been widely acknowledged in the literature and a valuable discussion on the advantage of MCDA over CBA is provided in Gamper and Turcanu (2007). In some instances the short-cut is to implement a *partial* CBA, where only monetisable impacts are quantified and the balance of monetary costs and benefits is compared with the qualitative assessment of other costs and benefits, with the unfortunate drawback that costs are usually easier to monetise than benefits. This has also been the practice in several impact assessment studies on food regulations by the European Commission or the Food Standards Agency.[2] Interestingly, recent RIAs from the European Commission in the food area have chosen to privilege a qualitative assessment of costs of benefits across policy options, even after major efforts in collecting data and stakeholder feedbacks.[3]

The current EC impact assessment procedure

In short, while the integrated impact assessment procedure adopted by European Commission since 2002 requires transparency, rigour, flexibility and a proportionate level of analysis (i.e. balancing the costs of ex-ante evaluation with the relevance of the regulation), a feasible method meeting all of these requisites hardly exists. Furthermore, under the current procedure[4] all likely economic, social and environmental impacts of "Commission proposals with possible regulatory effects" need to be considered, while previous IAs were not necessarily comprehensive. The impact assessment process is based on a document which is shared by all Commission services and covers any EC regulation, the Impact Assessment Guidelines (European Commission, 2009) (hereinafter referred to as the EC-IAGs).[5]

A few points from the EC-IAGs are worth mentioning for the purposes of this study. First, all policy options need to be evaluated against a benchmark which consists in the 'no policy change' (or 'do nothing') option. Second, the RIA process must follow a participatory approach through stakeholder consultation. Third, the whole assessment process should consider the 'proportionate level of analysis' (PLA), i.e. the level of detail required in terms of "data collection efforts and stakeholder consultation, the level of ambition of the objectives, options and delivery mechanisms, the type of impacts to be examined, and the arrangements for monitoring

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[2] See for example the RIA for the 2009 England Contaminants in Foods Regulation (http://www.food.gov.uk/foodindustry/regulation/betregs/ria/ria2009/iacontaminantsfoodregs09), and the 2007 RIA on the EC Regulation on classification, labelling and packaging of substances and mixtures (http://ec.europa.eu/governance/impact/ia_carried_out/docs/ia_2007/sec_2007_0854_en.pdf).

[3] See for example the 2008 'food labelling' RIA (http://ec.europa.eu/governance/impact/ia_carried_out/cia_2008_en.htm#sanco) or the 2005 legislative proposal laying down minimum rules for the protection of chickens kept for meat production (http://ec.europa.eu/governance/impact/ia_carried_out/docs/ia_2005/sec_2005_0801_en.pdf).

[4] As detailed in the EC strategy on Better Regulation (Mandelkern Group on Better Regulation, 2001, p. iii).

[5] Under transparency principles, all EC impact assessments can be accessed at http://ec.europa.eu/governance/impact/index_en.htm.