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The influence of individuals in forming collective household preferences for water quality

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ABSTRACT

Preference for water quality and its nonmarket valuation can be used to inform the development of pricing policies and long term supply strategies. Tap water quality is a household concern. The objective status quo of water provision varies between households and not between individuals within households, while charges are levied on households not individuals. Individual preferences differ from collective preferences. In households where there are two adults, we examine the preferences of each separately and then as a couple in collective decisions. We show the level of influence each has in developing the collective decision process. We use discrete choice experiments to model preference heterogeneity across three experiments on women, men and on both. We propose a random utility model which decomposes the error structure in the utility of alternatives so as to identify the individual influence in collective decisions. This approach to choice data analysis is new to environmental economics.

Introduction

Tap water is a typical complex good that is provided at the household level and which can be decomposed into a number of attributes. While tap water is certainly a good familiar to all members of households, each member may display substantially different tastes for its attributes. Because of the composite nature of welfare changes in household water supply, due to this intra-household heterogeneity of taste, conducting stated surveys based on a representative of the household might lead to misleading results. This is an important issue from the empirical viewpoint and motivates our study.

The theoretical and applied literature on household economics has made substantial progress in modelling joint preferences in marketing and transport (Arora and Allenby, 1999; Adamowicz et al., 2005; Hensher et al., 2008; Marcucci et al., 2010), whereas with few exceptions (Dosman and Adamowicz, 2006; Bateman and Munro, 2005; Strand 2007; Beharry et al., 2009), less progress has been made in terms of empirical applications in the field of non-market valuation. Investigating preferences from choice data coming from group decisions, rather than individual decisions, requires the ability to handle latent correlations amongst individual and joint choices in a structured manner. In the context of tap water,

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results obtained from disentangling individual preferences in group decisions have important implications for both policy and survey practice. These implications are of particular salience when preference surveys are designed to inform the process of definition or/and negotiation of water tariff between water utilities and regulatory bodies in charge of evaluating the adequacy of the tariffs and the economic management of investment by water utilities. At the time of data collection for this study this was of particular relevance in Italy, where recent legislation was intended to shift the control of water supply to newly constituted local water network utilities, with the intent of inducing water management to be more responsive to market forces. The debate over this legislation proposal has been relegated to backstage after the results of a national referendum (12–13 June 2011 on the composition of water tariffs), but the focus on cost efficiency and social benefits is still driving the debate in Italy as much as elsewhere.

In this study we use data from a widely employed form of stated preference survey for multi-attribute goods, choice experiments (Adamowicz et al., 1998). The salient feature of the data collection is that members of households have provided choice responses first as individuals, and then jointly as a family. To adequately investigate preference heterogeneity of household members for tap water one of the main issues is how to empirically measure such differences, considering that results can be quite sensitive to choice of model specification. Previous work usefully employed power function approaches based on the concept that the household's indirect utility is determined by a convex combination (a power function) of the indirect utility of man and woman (Dosman and Adamowicz, 2006). This was later extended to power functions at the single attribute level. That is, the contribution of each attribute to the household's utility function was modelled as a convex combination (Beharry et al., 2009), with the power parameter specified as a household specific random component.

Within this context, we now explore the use of an innovative modelling approach, that we call structural choice modelling (hereafter SCM). SCM is an alternative econometric framework for modelling choice data using latent variables, by combining data generated from separate but related surveys and thereby simultaneously modelling choice outcomes from several DCEs (Rungie, 2011; Rungie et al., 2011, 2012; Coote et al., 2011). With respect to previous applications in environmental economics this approach provides two advantages: (i) the incorporation of latencies and (ii) the simultaneous estimation of structural causal factors from individual and joint choice.

SCM is designed to incorporate latent variables and structural equations into the analyses of DCEs and, more generally, into choice processes (McFadden, 1974, 2001). There are indeed several important precursors to SCM. Firstly, factor analytic models have been used to study brands in a product category. This is as if "brand" is an attribute and the individual brands are levels. Factors have been applied across brands and other attributes by Elrod (1988), Elrod and Keane (1995), Keane (1997) and Walker (2001). Secondly, factor analytic models have also been applied to the characteristics of respondents by using indicator variables (Walker, 2001; Ashok et al., 2002; Morikawa et al., 2002; Temme et al., 2008; Bolduc and Alvarez-Daziano, 2010; Yáñez et al., 2010; Hess and Stathopoulos, 2011). Thirdly, methods using latent variables have been developed for the analysis of combined RP and SP data (Ben-Akiva and Morikawa, 1990; Hensher et al., 1999; Louvier et al., 1999; Ben-Akiva et al., 2002; Louviere et al., 2002; Morikawa et al., 2002). The various approaches differ in the nature of the covariates employed; in the first the covariates are the attributes of the alternatives and in the second the characteristics of the respondents. However, all approaches rely on similar mathematics.

SCM adapts this mathematics to extend the analysis of the attributes. In particular, it adds to the factor analytics the capacity to specify simultaneous equations and correlations (Jöreskog, 1970; Bollen, 1989; Jöreskog and Sörbom, 1996; Jöreskog, 1970) and it exploits the potential relationships between uses and choice outcomes (Rungie, 2011; Rungie et al., 2011, 2012; Coote et al., 2011).

In the traditional random coefficient model (e.g. Ben-Akiva et al., 1997; McFadden and Train, 2000; Dube et al., 2002; Train, 2009), the coefficients for each covariate are independent random variables with means and variances estimated from the data; i.e. the variance covariance matrix, denoted by Σ, is either diagonal or with off-diagonal elements that refer to only covariances between random coefficients. In SCM the coefficients have a multivariate distribution where, through the parsimonious use of factor analytics in the form of simultaneous equations and correlations, Σ can be significantly more complex, yet structured. Although to be practical, the number of parameters must not be excessive. In addition competing models, i.e. competing specifications for the structure of Σ, can be empirically evaluated. In other words, the factor analytics are used to bring testable correlation structures to the error component nature of mixed logit models. The contribution of SCM is in its capacity to specify and evaluate competing models for how preferences for attributes are related. Error component models, of the type explored to define flexible substitution patterns between alternatives (Brownstone and Train, 1999; Herriges and Phaneuf, 2002; Thiene and Scarpa, 2008) can also be seen as special cases of SCM specifications.

The present study adds to the existing literature in several ways. First, it is one of the few existing applications of structural choice models to investigate latency in preference heterogeneity. Second, to our knowledge this is the first empirical study using this approach in the field of environmental and resource economics. Ultimately, it is one of the few contributions using data from more than two choice experiments that are simultaneously modelled within a natural group, such as the couple.

The rest of the paper is organized as follows. The next section discusses the formation of joint preferences from the preferences of individuals. Then follows a section illustrating the methodology. Survey and data are described in Section 4, whereas Section 5 defines model specifications and provides a discussion of result estimates. The last section concludes.