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Modelling individual preferences for environmental policy drivers: Empirical evidence of Italian lifestyle changes using a latent class approach

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ABSTRACT

Degraded air quality severely affects the health of citizens worldwide. The design of effective policies requires exploring public preferences for environmental and air quality policy instruments. Within the EC-FP7 SEFIRA project, using a choice experiment that stresses the trade-offs between attributes, this study investigates public preferences for environmental policy drivers in Italy. The main objective is to investigate the role played by selected policy drivers in determining policy preferences, complemented by elasticity and willingness to pay estimations. Preference heterogeneity and the role of socio-economic and attitudinal variables are explored with a latent class model over 2400 respondents sampled across Italy. The results allow identifying the different role played by the policy drivers across the classes. It emerged that most of the respondents (43%) are particularly sensitive to the cost components (cost sensitive respondents). The remaining respondents instead show an important sensitivity towards personal engagement in term of changes in the mobility and eating habits (lifestyle-change sensitive respondents). However, while 29% of them perceive these habits' changes as negatively impacting on the personal utility, the other 28% of respondents translate the potential changes in the habitual behaviour of driving and eating as environmental and health benefits. Based on the modelling results, potential policies are simulated reporting respondents' reaction to selected scenarios. It shows the crucial role played by reduction of premature deaths due to atmospheric pollution and measure cost.

1. Introduction

The use of behavioural modelling and related techniques to evaluate environmental and air quality policies is timely. Policies based on technical measures and technological solutions have been used successfully for many decades. However, there are increasing evidences that such measures are not up to the task of reducing air pollution to acceptable levels. One reason for this is the indication from health effect studies that adverse effects on human health can occur even at pollutant concentrations that meet existing legal targets. Policies involving non-technical measures are therefore likely to play an increasingly important role in the future air quality management in Europe. Such policies will inevitably take into account for behavioural and lifestyle changes, assessing also individual preferences towards the main policy drivers.

The application of the discrete choice models (DCMs) in the environmental field is not *per se* a novelty, and in the last years has exponentially increased. Furthermore, the past 15 years have seen

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considerable research based on discrete choice experiments (DCEs) and their use is continues to grow (Hoyos, 2010).

In the scientific literature, DCEs have been applied mainly in the environmental field and (marginally but now increasingly) in the air quality domain in order to: *i)* analyse individual preferences towards a set of environmental options (such as policies) (e.g. Bristow et al., 2010; Garroda et al., 2012; Jacobsen and Thorsen, 2010; Gevrek and Uyduranoglu, 2015; Tang and Zhang, 2015); *ii)* predict demand (or acceptance of) a new option and define optimum pricing (e.g. Jaensirisak et al., 2005; Shen et al., 2009; Brécarda et al., 2009; Marcucci and Gatta, 2016; Marcucci et al., 2012); *iii)* simulate the ex-ante impact of a potential policy based on attributes' changes (e.g. Scarpa and Alberini, 2005; Andreopoulos et al., 2015; Valeri and Danielis, 2015); *iv)* estimate the welfare effect and the willingness to pay (WTP) for e.g. an improvement in the service quality, a decrease of the travel time etc. (e.g. Marsh et al., 2011; Chalak et al., 2012; Andreopoulos et al., 2015); and *v)* investigate the role played by individual beliefs and attitudes toward environmental changes (e.g. Hess and Beharry-Borg, 2012; Hoyos et al., 2015; Valeri and Cherchi, 2016).

Among the most recent and interesting applications of DCMs in the environmental field, Birol et al. (2006) supported policy makers to formulate efficient and sustainable wetland management policies in accordance with the European Union Water Framework Directive (2000/60/EC). Gevrek and Uyduranoglu (2015) studied public preferences for carbon tax attributes in Turkey deriving interesting results on the acceptability of various tax systems and cost distribution. In order to support the Danish political decision to establish the first-ever national parks, Jacobsen and Thorsen (2010) investigated if people hold preferences regarding which site to be designated as national park, separate from the preferences for its environmental functions. Shen et al. (2009) investigated if natural environmental change and transport network improvements affect individuals' choices of transport mode under an extension proposed for the Osaka (Japan) monorail loop. Andreopoulos et al. (2015) estimated changes in the perceived value of different ecological and economic services in a mountain community in Greece in terms of consumer surplus and WTP measures for different scenarios. British preferences and WTP measures for reducing GHG emissions were explored by Chalak et al. (2012), who showed that the average per-unit WTP to avoid increased GHG emissions is greater than the WTP for efforts to reduce them. Estimating hybrid choice models in the context of beach visitors' WTP for improvements in water quality, Hess and Beharry-Borg (2012) demonstrated how a latent attitudinal variable (a 'pro-intervention' attitude) helps responders' sensitivity not only to the stated choice exercise but also to questions about their attitudes. Applying the same modelling approach to a DCE conducted in the Basque Country (Spain) in 2008, Hoyos et al. (2015) evaluated the environmental awareness impact in evaluating land-use policies in a Natura 2000 Network site. Valeri and Cherchi (2016) also used a hybrid choice model to establish whether (and to what extent) habitual car use, modelled as a latent variable, affects the individual's propensity to buy a specific type of engine technology.

The human sphere and the related behavioural components are playing an increasingly significant role also for institutions in the environmental understanding and contributions to the decision-making processes. Over time, the organizations and institutions responsible for decision making, policy analysis and setting priorities have shown greater interest in applying behavioural insights to policy making in various fields, including the environment. Since 2008 the European Commission (EC) has proposed innovative proposals for the Consumer Rights Directive, for the Package Retail and Insurance-based Investment Product (PRIP) legislation (EC, 2006, Ciriolo, 2011; van Bavel et al., 2013; Lourenço et al., 2016) and for the design of a Framework Contract for the provision of behavioural studies. Complementing these activities, the EC has started to fund research projects addressing the topic of the study presented in this paper such as the GLAMURS project (http://glamurs.eu/) and the CECILIA2050 project (http://cecilia2050.eu/). Also the OECD (2008, 2012a, 2012b) and the World Bank (2015) have emphasised the importance of identifying the behavioural elements and incorporating them into the design of policies. At the national level, centralised behavioural insight teams have been established in several countries (e.g. Germany, United Kingdom); in other countries (e.g. Denmark and France) ministries have taken the lead.

The type of research used to inform policy making typically asks citizen beings to rate/choose items on a list. This approach generally yields no more information than the fact that human tendency to desire the benefits but to avoid paying the costs; examples are provided by the EC Eurobarometer (2013) and Zvěřinová et al. (2013). That approach suffers also from a lack of information about the trade-offs among the considered options. In the context of the on-going EC-FP7 SEFIRA project, a DCE study was designed and implemented in seven European countries to analyse public preferences for potential air quality policies. The DCM approach has been used to obtain behavioural insights that will aid decision makers in the design of environmental policies. Country-specific preferences have been estimated for selected environmental policy drivers, and then compared across the seven European countries included in the SEFIRA study (Austria, Belgium, Germany, Italy, Poland, Sweden, and United Kingdom). Preliminary results of the DCMs for these seven countries are reported in Valeri et al. (2016). In this paper, we undertake an *in depth* analysis of the results obtained for one of the investigated countries (Italy) in order to better exploit observed and unobserved heterogeneity, WTP and elasticity measures, with special attention to the two policy drivers that entail changes in the respondents' personal engagement/lifestyle. Moving from the multinomial logit (MNL) model to a latent class (LC) modelling approach allowed to highlight the role played by socio-economic and attitudinal items (such as environmental awareness and intentions) in determining policy drivers preferences and WTP/elasticity measures. The empirical results derived from the LC model were used to simulate eight potential environmental and air quality policies, reporting their impact in term of choice probability changes and showing their contribution to the design of effective policies.

2. Methodology: choice modelling

The MNL is the base model where the linear utility function U for a generic individual i and a generic alternative j is reported below:

$$U_i(j) = \beta' x_{ij} + \varepsilon_{ij}$$

where the deterministic part of the utility is comprised of the estimated parameter β_{ij} for each explanatory variable x_{ij} (in our case, the policy driver), and the error term is represented by ε_i. The choice probability is then:

$$\mathrm{Prob}(y_i = j) = \frac{\exp(\beta' x_{ij})}{\sum_{q=1}^{J} \exp(\beta' x_{qi})}$$

where the probability Prob_i of an individual i choosing alternative j out of the set of J alternatives is equal to the ratio of the (exponential of the) observed utility index for alternative j to the sum of the exponentials of the observed utility indices for all J alternatives, including the $i-th$ alternative (Hensher et al., 2010;