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Substitution patterns across alternatives as a source of preference heterogeneity in recreation demand models

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ABSTRACT

Recent stated choice studies have shown that, in a context of inter-alternative correlation, individuals can assess alternatives differently. This asymmetry in perception between alternatives with different levels of substitutability becomes one additional, but usually overlooked, source of observed preference heterogeneity. In the context of beach recreation in Mallorca, Spain, this paper extends the investigation on this source of heterogeneity to a revealed preference setting. While the substitution pattern existent across sites is accounted for by means of a nested logit model, nest-specific coefficients are estimated to evaluate the utilities associated with different groups of sites. The results provide empirical evidence to suggest that substitution patterns across alternatives are a statistically significant source of influence on preference heterogeneity leading to different marginal sensitivities for a number of site attributes.

1. Introduction

The investigation of preference heterogeneity has become increasingly popular in the economic valuation domain since Train (1998) showed the presence of substantial taste variation among natural resource users. After initial applications capturing systematic variations in preferences between individuals arising due to personal or decision-context characteristics, researchers turned their attention to the analysis of the stochastic variations that may nonetheless persist after systematic differences have been accounted for. As a result, sophisticated model specifications have been developed in recent years to account for different representations of this stochastic or unobserved heterogeneity (see, for instance, Greene et al., 2006; Greene and Hensher, 2007; Hess and Rose, 2009b).

Among these approaches, the mixed logit model has become one of the most popular specifications to accommodate unobserved heterogeneity via the use of random terms (Hess and Rose, 2009b; Cherchi and de Dios Ortúzar, 2010). However, in spite of the powerful and flexible structure provided by the mixed logit model, recent studies have raised concerns about the risk of reaching confounding or even false results when arbitrary accounting for random heterogeneity without acknowledging other potential phenomena present in the data. In this line, Swait and Bernardino (2000) and Hess et al. (2005b) demonstrate in two different studies that random variations in tastes across decision-makers can be erroneously found in the presence of correlated alternatives. On the basis of their findings, these authors illustrate different approaches to separate taste variation and error heterogeneity while exploring additional sources of preferences heterogeneity.

In a choice setting where certain options are more similar than others and some of their characteristics cannot be measured and included in the model, their unobserved stochastic components will be correlated (Schwabe et al., 2001; Carrasco and de Dios Ortúzar, 2002). As a result of the heightened substitution between some alternatives, individuals can assess them differently and, at the same time, they may react differently to attributes present in one group of alternatives than to attributes present in other groups. Therefore, these systematic taste differences for attributes at different alternatives become one additional, but usually overlooked, source of observed preference heterogeneity.

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This asymmetry in perception between alternatives has already been identified in different stated choice settings. In an application involving airline choice, Swait and Bernardino (2000) estimate route-specific coefficients and identify certain taste similarities and differences between routes at the same time that they control for correlation across alternatives. In a study of domestic tourism choices, Huybers (2003) investigated how the effects of several attributes differ among tourism destinations by using destination-specific coefficients. In two choice experiment applications, Greene and Hensher (2007) and Hess and Rose (2009a) use alternative-specific coefficients to explore the existence of different substitution effects between the status quo and the experimentally designed alternatives. Overall, these studies find empirical evidence of the existence of differences in the marginal sensitivities between alternatives and, consequently, they show that respondents may treat differently one alternative from the others (Scarpa et al., 2007).

Beyond stated choice data, these results have an straightforward extension to other settings also characterized by correlated error terms across alternatives. This is the case of recreation demand modeling where the degree of substitutability across sites often vary due to their geographical settings, natural features, recreation experiences, landscape quality, etc. As a result, recreation sites can be usually divided into groups with higher substitutability within each group than across groups. In this context, the rational behind preference heterogeneity specific to sites or groups of sites can be found in the different attributes that are available to visitors in each setting and/or the different perception that recreationists can have of these attributes depending on the site they have visited or the kind of recreational experience they were looking for. However, except some applications using constants for specific sites or groups of sites (see, for instance, Hanley et al., 2001; Scarpa and Thiene, 2005; Hynes et al., 2008), few attempts have been made within the recreation demand literature to investigate how individuals' preferences change across different sites or groups of sites.

The purpose of this paper is to add additional behavioral dimensions to recreation demand models by investigating the presence of preferences specific to different groups of recreation sites when these alternatives are potentially correlated. In this way, instead of considering the existence of random heterogeneity using a mixed logit model, this paper seeks regularities in the process of choosing among different groups of alternatives. Following Swait and Bernardino (2000), the traditional Nested Logit (NL) model is implemented to explore preference heterogeneity while accounting for the substitution pattern existent across recreation sites.[1] The NL model relaxes the assumption of independence between all alternatives and, hence, allows the researcher to identify groups of alternatives offering a similar kind of recreational experience. Beach recreation in Mallorca (Spain) provides a convenient setting for the analysis. While the 73 beaches considered in the application share many characteristics, the level of substitutability across them is expected to differ generating several nests of sites. On the basis of these nests, nest-specific coefficients will be estimated to investigate preference heterogeneity for observed site attributes.

The remainder of the paper is organized as follows. Next section presents the NL model. This is followed by Section 3 where the data on beach recreation in Mallorca is presented. Section 4 shows the estimated results and discusses the empirical findings. Finally, Section 5 provides some conclusions and directions for future research.

2. Methods

In the most basic random utility model, the indirect utility of a given individual i choosing alternative j, where $j = 1, \ldots,J$, is assumed to be a function of a set of observable site attributes and a random component of utility know only to the individual. In this simple formulation, the stochastic component, ε_{ij}, is identically and independently distributed (iid) across alternatives and observations implying proportional substitution patterns amongst alternatives (Train, 2003).

However, quite often, the errors for some alternatives are correlated with each other, leading to heightened substitution between those alternatives. Such correlation can be accommodated quite easily through more flexible models with a Generalized Extreme Value (GEV) distribution for the unobservable error component overcoming the restrictive independence of irrelevant alternatives (IIA) property illustrated in McFadden (1981). Among the GEV specifications, the most frequently employed are those of the NL model where the correlations imposed are similar within nests, but for alternatives in different nests are uncorrelated and independent (Scarpa et al., 2007). In this case, the unobserved components of utility have the following cumulative distribution:

$$exp\left[-\sum_{k=1}^{K}\left(\sum_{j\in K} exp(-\varepsilon_{ij}/\mu_k)\right)^{\mu_k}\right] \quad (1)$$

where K is the number of nests in the model and μ_k is the dissimilarity coefficient of each specific nest k that reveals the degree of dissimilarity between sites within the nest and other sites in other nests.[2] McFadden (1981) shows that $0 < \mu < 1$ is a necessary and sufficient condition for the NL model to be consistent with utility maximization.

The NL model allows decomposing the recreational decision-making process in two sequential stages according to the expected substitution patterns existent across sites. In this way, the model assumes that individuals first choose a nest of alternatives for their trip and, contingent upon that choice, they select a site. In this context, the indirect utility of individual i visiting site j in nest k, $V_{ij|k}$, can be represented as a function of a set of observable site attributes $x_{ij|k}$, respondents socio-economic characteristics zi and a random component of utility $\varepsilon_{ij|k}$[3]:

$$V_{ij|k} = v_{ij|k}\left(x_{ij|k}, z_i; \beta, \gamma\right) + \varepsilon_{ij|k} \quad (2)$$

where β and γ are unknown coefficients to be estimated. In addition, given the existence of different nests of alternatives acknowledging potential similarities across certain options, respondents may react differently to the attributes of alternatives in one nest that to attributes of alternatives in a different nest. In these situations, Hess and Rose (2009a) argue that there is no reason to

[1] Different models handling inter-alternative correlation (e.g. the mixed logit – error component model) have been considered and compared to the NL presented in the paper. In all cases the NL has become the preferred model due to the poor results obtained by the other specifications in terms of statistically significant coefficients. No empirical evidence of random heterogeneity has been found in the data. These results are available from the author upon request.

[2] Hauber and Parsons (2000) suggest to use the dissimilarity coefficient to approximate the degree of correlation among alternatives within the same nest by $(1 - \mu^2)$.

[3] Following Louviere et al. (2000), individual specific characteristics that do not vary across alternatives for each sampled observation can only enter in utility expressions for up to J – 1 alternatives. In this NL application, socio-economic characteristics have been included in the utility specifications for up to K – 1 nests.