Ph.D. Thesis Proposal
Academic Year
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"Consumer's behavior towards extra virgin olive oil: hypothetical and non-hypothetical discrete choice experiment methods"

Thesis proposal to be submitted to the Institut de Sostenibilitat

Universitat Politècnica de Catalunya

By

Ahmed YANGUI[1]

Under the supervision of

Thesis director: Prof. José María Gil

Co-director: Dr. Montserrat Costa-Font

PhD Program: Sustainability

Main Subjects: Agricultural Economics and Applied economics

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1. Introduction

Since the introduction of discrete choice experiments by Louviere and Hensher (1982) and Louviere and Woodworth (1983) it has been used by a growing number of studies. Discrete choice experiments are appealing as value derivation techniques because they are consistent with both Lancaster's microeconomic approach (Lancaster, 1966) and Random Utility Theory (RUT) (McFadden, 1974). In the other words, Discrete choice methods assume that individuals are rational and make choices to maximize their utility taking into account budget constraint, and their utility derived from the different characteristics, or attributes, that a good possesses, rather than directly from the good per se. Accordingly, a change in the level of an attribute describing a given alternative good may cause respondent to favor that good over another that is perceived as providing an inferior combination of attributes.

In discrete choice experiments, respondents are asked to select their preferred alternative from a given set (the choice set), and are typically asked to perform a sequence of such choices giving rise to a panel of discrete choices. Experimental design theory is used to construct the alternatives, which are defined in terms of both their attributes and the levels that these attributes could take (see Louviere et al., 2000 and Street and Burgess, 2007).

Despite the widespread use of discrete choice experiments, evidences presented in numerous papers indicate the existence of related various issues based on the representative level of the sample (widely and limit sample size), preference type (stated preferences, revealed preference), empirical setting (hypothetical and non-hypothetical situation), the selected model for the estimation (regression, logit, probit, hierarchical Bayes), the type of inference estimation procedures (maximum likelihood, Markov

chain Monte Carlo) and finally the extend of the design (full factorial, fractional factorial, adaptive).

If considering the estimation modeling, the most recently adopted and reported in the literature is the one based in random utility theory and named Random Parameter Logit model (RPL). Since its introduction by Train (1998) many works noticed the great relevance of the model such as Scarpa and Giudice(2004) and Menapace et al. (2011). In fact the RPL model has evolved as a fundamentally useful tool in the analysis of discrete choice models. The RPL model in contrast to other more simple specifications such as the multinomial logit model allows for a more flexible and continuous form of preference heterogeneity. The multinomial model assumes preferences homogeneity in the sample, implying that all coefficient of the utility expression are the same across individuals, whereas the RPL model allows utility coefficients vary across individuals according to continuous probability distribution functions (Train, 1998). However, the RPL model also presents some limitations. Being the most important a potential weak heterogeneity among participants derived from the fact that individual partworth across the participants could be very similar Consistently with Akaichi et al. (2013), the random parameter logit model predicts better when sample mean partworth of the coefficients are used for model predictions than the hierarchical Bayesian multinomial logit model. Hence, the possibility of estimating deep parameters to account for new sources of heterogeneity could be having great relevance.

Individuals choices are part of a decision making process of interest to many scholars including economist, marketers, and planners. Therefore the basic RUT where individual's utility is assumed to be a function of a set of explanatory variables that define the product could be very restricted and an extension of this model will be pertinent. The extensions can be achieved by: 1) the addition of a flexible disturbance in

order to allow for a rich covariance structure and enable the estimation of unobserved heterogeneity through, random parameters or relaxing the IIA condition of the logit; 2) by developing specific models of latent psychological explanatory variable that conform the individuals decision making process such as attitudes and perceptions in order to provide a richer understanding and explanation of individuals' behavior; 3) by the inclusion of a latent segmentation of the population (latent class) captured by means of taste parameters, choice sets, and decision protocols; and finally 4) by combining revealed preferences and stated preferences so as to reduce bias and improving efficiency of the parameter estimates (Walker and Ben-Akiva, 2002). These extensions incorporated in RUT are able to provide insights into the individual's decision making analysis which are considered by the basic model as the "Black box".

A key objective of discrete choice experiment is to obtain sufficient quantity of high quality choice data to estimate the appropriate choice models to be used to explore various relevant issues. However, the basic choice experiment consist in asking respondents to choose the more preferred of various alternatives offered in choice set, thereby obtaining one choice observation per set. Generally there are two traditional ways to increase the number of observations either by increasing the sample size or increasing the number of choice sets evaluated by each respondent. The former clearly has cost implications, especially when the real incentives are used, while the latter can impose difficulties in the task of respondents (Lancsar et al., 2013).

More recently, two new ways for choice experiment question formulation were proposed named Ranking Conjoint Analysis (RCA) and Best Worst Scaling (BWS). The first ask respondent to express preferences for several alternatives existing in the choice set by ranking them from more preferred to less preferred, while the second ask respondent to choose not only the best option in each choice set, but also the worst

option respect to the remaining options (Louviere, 2008). These two methods imply an increase of questions per choice set instead of an increase of the number of choice set. In addition, it provides information about the relative preference of respondent's related to the non-chosen profiles of the basic choice experiment. It's important to highlight that the combination of these experimental methods (RK and BWS)with an appropriate experimental design for the extra choice information could be used to estimate models for single individuals providing a new way to capture heterogeneity (Caparros et al., 2008; Akaichi et al., 2013). Moreover, it allow us to obtain a ranking for the alternatives that constitute the choice showing the gradation from the most preferred and the less preferred option by individual in the BWS method (Lancsar et al., 2013). Consequently, it remains to be of great relevance to test the predictive power of the Ranking Discrete choice experiment and the Best Worst Scaling methods for individuals' real world actions adopting efficient experimental design.

This thesis try to overcome the limitations above mentioned in the literature by means of both methodological and empirical innovations in nature especially in the agro-food marketing sector. Its scientific contributions are organized in three main chapters defining three independent scientific articles. The analysis of consumer's preference heterogeneity towards traditional product such as extra virgin olive oil is the guideline of this thesis. The purpose of the first chapter consists in the possibility to identify additional behavioral information associated with consumer's preference heterogeneity by the application of an extended Random Parameter Logit Model. Following Greene el al. (2006) we explore the further impact of accounting for the mean and variance heterogeneity in the distribution of individual specific preferences. Under a widely understanding of consumer's decision making close to traditional product, the second approach incorporate several elements of cognitive process that have been identified as

important including strong dependence to the choice process. This analysis relies on the integration of latent variables that define consumer's personality trait and lifestyle orientation in their utilities function. In doing so, we cover an important research gap by the application of a flexible and practical hybrid choice model (Ben-Akiva et al., 2002. Finally, the third part represents our work plan for the last article. A brief description of each one is offered below.

2. Revealing additional preference heterogeneity with extent Random parameter logit model: The case of extra virgin olive oil for Catalan consumer's.

In the past times, different preference elicitation methods have been used by economists and market researchers to obtain the willingness to pay (WTP) for definite product attributes. Among the preference elicitation methods, discrete choice experiment has been widely used in the literature. On the other hand, methods to model preference heterogeneity in discrete choice experiment continue to receive a significant attention in the literature. These models include the Latent Class Model (LCM), Random Parameters Model, etc.

The growing popularity of RPL model to obtain estimates of WTP has focused in the relaxation of the three limitations of the conventional logit model such as multinomial logit model (MNL) or conditional logit model (CL). Firstly, it allows us to expect random preference variation across the population through the distribution of the random parameters. Secondly, the RPL relax the assumption of the independence from irrelevant alternatives (IIA). Finally, this model allows the correlation among unobserved factors over time (Train, 2003). However, the RPL present a major limitation. The partworth for ith individual (β_{ki}) is the sum between the sample-mean partworth (β_k) and the standard deviation (σ_k) of the distribution of (β_{ki}) around

(β_k), which is influenced by the individual specific heterogeneity (α_{ki}) with mean zero and standard deviation one as follow: $\beta_{ki} = \beta_k + \sigma_k\alpha_{ki}$ (Hensher and Greene, 2003). Therefore, if the quantity $\sigma_k\alpha_{ki}$ is so small so the individual partworth across respondents will be very similar.

For that reason, through the present study we enhance the RPL following (Greene et al., 2006) by estimating deep parameters to account for heterogeneity around the means and the variances of the random parameters distributions. However the possibility exists to add further behavioral information associated with the mean and the variance of the random parameter distribution, through parameterization of its heterogeneity as follow: $\beta_{ik} = \beta_k + \delta_k Z_i + \sigma_{ik}\vartheta_{ik}$. Where the vector Z_i is a set of choice invariant characteristics that produce individual heterogeneity in the means, δ_k are parameters which capture the mean shift, σ_{ik} is specified as $\sigma_{ik} = \sigma_k\exp[\omega_k hr_i]$. Where ω_k are parameters which capture variance heterogeneity of the random parameters in the systematic utility and hr_i are observed variables of the individuals.

This last aspect is the main contribution of this paper for the food marketing literature. The performance of the Greene et al. (2006)'s GHR-RPL model is evaluated against CL and RPL models. This models has been applied for assess of the preference heterogeneity of Catalan consumer towards the consumption of the extra virgin olive oil. This product has been chosen, firstly, for his economic importance, already Spain is the world leader as producer country and as exporter of olive oil. Secondly, that extra virgin olive oil is the fundamental component in the Spanish diet.

In order to achieve these objectives, a sample of 401 consumers of extra virgin olive oil was used. Data was collected via face-to-face interviews in Catalonia during September 2009, in different shopping hours and at different type of food retail store. The survey is

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divided in three blocks. The first block was designed to elicit information about socio demographic and respondents' lifestyles. The second block consists of a choice experiment, where four main attributes were identified each defined with three levels: price (3.70 €/l, 6 €/l, and 7.5 €/l), production system (conventional, protected denomination of origin (PDO), and organic), origin of the product (Spain, Catalonia, and Imported) and origin of the brand (Spanish, Catalonia, and distribution brand). Finally, the third block was focused on respondents' olive oil and organic olive oil buying and consumption habits as well as purchasing attitudes.

Finally, as principal results we can cite, taking into account the heterogeneity within the random parameters, results in a better model fit for most of cases. Obtaining similar utility distributions compared with the RPL with higher standard deviation due the new source of heterogeneity detected. Unfortunately, in line with Greene et al. (2006) this procedure is possible to produce unacceptable ranges in the behavioral outputs, including the sensible outputs in terms of sign. Despite that all the parameters estimated with the GHR-RPL have maintained their evaluated signs except the interaction factor CONV*CAT (conventional extra virgin olive oil with Catalan origin), two sample mean-partworth of the factors PDO, and interaction factor ORG*ESP (organic olive oil with Spanish origin) lost their significance although their standards deviation continue to be statistically significant.

Secondly, the most relevant attribute that determines respondents' election towards extra virgin olive oil is origin and specifically the Catalan origin of the product in contrast to the Spanish or imported origin. Results show that organic production of extra virgin olive oil is negatively valued by respondents and the protected denomination of origin characteristic positively valued although is not statistically significant. Thirdly, The GHR-RPL results reveal that the preference intensities for olive oil with PDO is

affected negatively by the terms subjective norms (NSB). In contrast, the terms environment concerns and subjective norm moderate the negative preference associated to organic production. Furthermore purchase intention, subjective norms and the higher level of study could mitigate the sensitivity of the consumers respect to price. Finally, when the purchase frequency will be more separate this will mitigate the negative preference associated with Spanish organic olive oil.

3. **The effect of food related personality traits and lifestyle orientation on consumer's behaviour related to extra virgin olive oil: estimation of an extended hybrid choice model.**

Choice models have displayed to be of high value and importance in a wide variety of applied settings such as agro food marketing, public goods valuation, transport analysis, etc. (Van Loo et al., 2011; Greene and Hensher, 2013; etc.). The employment of experimental choice models has been motivated by the combination of two principal features: (1) realism: in real markets, consumers are faced with competing products and must choose among them, and (2) experimental control (Ashok et al., 2002). Discrete choice modelling defines individuals' utility function by means of explanatory variables such as the socio-economic characteristics of respondents and product attribute levels. However, in the last decade, many works have noticed that decision makers are conditioned by their psychological factors, personality traits, attitudes, etc. (Chen, 2007; Yáñez et al., 2010). These last concepts cannot be directly measures but inferred from observed variables. Therefore, our work focuses on the incorporation of latent variables such as attitudes and perceptions as explanatory variables in discrete choice models.

Hybrid choice model (HCM) represents a promising new class of models which merge classic choice models with structural equations models (SEM) for latent variables (LV). Regardless of their conceptual appeal, up to date the application of HCM in agro food

marketing remains very scarce. The present work extends previous HCM applications by first estimating a random parameter logit model (RPL) into panel data context (taking into account the heterogeneity around the mean) and second, estimating the relationships between latent variables. Moreover, few studies have investigated the potential effect of purchase habits, food-related personality traits and lifestyle orientation on consumer's behavior (Chen, 2007; Eertmans et al., 2005). However, neither work try to understand which effect they have on the consumers' behavior related to organic olive oil and to the extra virgin olive oil (EVOO) in general as Spanish traditional product. The model pretends to better understand Catalan consumer's behaviour towards extra virgin olive oil. Therefore, in order to ascertain the role of psychological factors in consumer's behavioural process of decision towards a traditional product, variables such as food related personality traits, purchase habits and lifestyle orientation were introduced. With especial attention to the relationship between them and the factors determinant of consumer's purchase intention, based in the theory of planned behavior (TPB).

As above mentioned, the Data used here corresponds to a survey carried out on a representative sample of Catalonian population with quotas by postal code. The initial sample consisted of 425 face-to-face interviews from which 401 answered the choice experiment. Data were conducted in September 2009 at different shopping hours and different types of food retail stores. To implement CE, first, attribute and attribute levels were determined based on a three-step procedure: 1) Literature review regarding consumer behavior of extra virgin olive oil; 2) four focus groups of 8 people each to identify main consumption patterns and attitudes towards extra virgin olive oil, with special attention respect the organic attribute; and 3) observation in retails outlets to identify real prices and informal interviews about reasons of choosing a specific

product. Therefore, four main attributes were identified each defined with three levels: price (3.70 €/l, 6 €/l, and 7.5 €/l), production system (conventional, protected denomination of origin (PDO), and organic), origin of the product (Spain, Catalonia, and Imported) and origin of the brand (Spanish, Catalonia, and distribution brand).

The findings suggest that the incorporation of inferred LV for understanding individuals' food decision making constructions is needed. That is, some LV have indirect effects associated with consumer's purchase intention towards organic olive oil, and that almost all LV considered have a direct effect related to consumer's utilities associated with extra virgin olive oil. The results reveal a high and significant heterogeneity, highlighting the role of the housewife with high level school education as responsible of both household food purchases and preparation of familiar dishes. Unexpected finding proves that healthy lifestyle was not a significant explicative latent variable in forming consumers' attitude towards extra virgin organic olive oil. This can be due to cultural reasons, the extra virgin olive oil is a traditional component of the Spanish and Catalan diet and already perceived as a healthy food product. On the other hand, the health and natural content of it could explain the positive effect of food involvement.

Our result support the contention that attitudes, personality traits and lifestyle orientation are helpful in food choice and important variables to reveal the ambiguity associated with consumer's behavioral process. However, the principal limitation of this work is the lack of available software tools enable to estimate simultaneously the hybrid choice model taking into account the introduction of correlation among the individuals.

4. Ranking and Best Worst discrete choice experiment

From time to time since Thrustone (1927) developed the Random Utility Theory (RUT), many authors such as Louviere et al. (1999) have discussed various ways to collect individuals' responses consistent with RUT. They show how various response forms can be used to obtain extra choice information that can be expanded into implied choices. It is fair to say that most researchers believe that 1) one would need to observe many choice sets for each person in a survey to insure that each individual-level discrete choice model would successfully converge and yield reliable estimates, and 2) the number of choice sets required would be too large for typical survey applications (Louviere el al., 2008).

To obtain more preference information, some researchers obtained a full rank-ordering of the alternatives in particular choice sets simply asking a respondent to state provide partial rankings. Typically, this ranking was for one or a small number of sets, and the applications of a full or partial ranking of the alternatives in each choice set could be combined with an optimally efficient design for multiple choices set to provide sufficient choice observation to estimate models for individuals. Louviere et al. (2008) commented that maybe is true that asking an individual to rank a set of option is equivalent to asking her to make repeated preference choices from a set of options, such as most preferred, least preferred, next most preferred, etc. Furthermore, according to Marley and Louviere (2005), best worst tasks seem to be easier to respond for people than to complete a traditional ranking task that is it takes advantage of a person's susceptibility to identify and respond more consistently to extreme options. If that is true, normally the predictive power of sequential best worst task for individual's real action will be better that to the ranking task.

Given the importance of this topic for marketing, environmental and agriculture economics, we conducted our experiments: 1) in non-hypothetical conditions to overcome the hypothetical bias problem, and 2) to follow the estimation of partworths by an external validity analysis (holdout task) to see if the estimates parameters actually work in predicting significant real world actions. Therefore, our study stands out by the inclusion of non-hypothetical holdout choice task in both ranking (RK) and best worst (BW) discrete choice experiment methods which allowed us to assess and compare the external predictive performance of the estimated parameters in both methods.

To attend this main objective a random sample of 120 of olive oil consumers will be selected to evaluate different alternatives of the olive oil through different choice sets. The individuals will be equally assigned to two discrete choice experiment methods (60 persons per mechanism). The different alternatives were defined through the combination of the four attributes and their levels, the type of the olive oil (extra virgin, virgin, refined), the origin (Andalucía, Catalonia, any other Spanish regions), the brand (private label, manufacturer label), and the price (2.20, 3.50, and 4.80 Euro/L). Street and Burgess's (2007) D-optimally efficient design was used to identify nine choice sets with five different olive oils and "none of them" option for each.

Individuals will be asked either to rankthe alternatives from most preferred to least preferred, or to apply a sequential best worst mechanism (e.g. best from the 5 alternatives, worst from the remaining 4 alternatives, the best of the remaining 3 alternatives, and the worst of the remaining 2 alternatives) taking into account their regular purchase habit (see figure 1 and figure 2). Afterword, to finish all nine choice sets, each person we will be presented with a hold out choice set (figure 3). Each person should be chosen between 10 different olive oils and the "none of them" option. Since the data base will be collected, different models will try to estimate consumer's

preferences such as the "rank ordered logit", the "sequential best worst multinomial model", and the "Random parameter logit".

5. Work plan

The thesis is beig developing under the supervision of prof. José María Gil and Dr. Montserrat Cost-Font at CREDA-UPC-IRTA. A summary of the work done up to now and a proposed work plan for the completion of the thesis is offered below.

The first part of this thesis, which focuses in revealing additional preference heterogeneity of Catalan consumers of extra virgin olive oil with and extended Random Parameter logit model, has been already completed. A research paper (Yangui et al., 2012) derived from this part, has been recently submitted for publication consideration in the *Journal of Agriculture Economics,* a journal with ISI Impact Factor (1.551). The paper (Yangui et al., 2013) has been also presented at the "Agriculture Economic Society Annual Conference" in April 8-10, 2013.

The second scientific article of the thesis, which aims to assess the effect of food related personality traits and lifestyle orientation on consumer's behaviour related to extra virgin olive oil with the application of an extended hybrid choice model, has been already finished. A research paper (yangui et al., 2013) containing the results of this second part will be soon submitted for publication consideration in the *Journal of Agricultural and Resource Economics*, a journal with ISI Impact Factor (0.71). Also, the paper (Yangui et al., 2013) has been recently sent for consideration as a communication at the African Agriculture Economic Association conference (AAEA) which will be celebrated in Tunisia, September 22–25, 2013.

The work during this period will be devoted to prepare the third part of the thesis and to complete the whole version of this doctoral thesis. Currently, an empirical experiment is

being developed to collect the necessary data base, and forthcoming models will be estimated.

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Situación de compra 1			Número de identificación: ………			
	ACEITE 1	**ACEITE 2**	**ACEITE 3**	**ACEITE 4**	**ACEITE 5**	**OPCION "Ninguno"**
T.Aceite : Marca: Origen: Precio:	Virgen Distribuidor Andalucía 3.50	Aceite de oliva Distribuidor Andalucía 3.50	Aceite de oliva Fabricante Resto de España 4.80	Extra Virgen Fabricante Cataluña 4.80	Extra Virgen Fabricante Cataluña 2.20	Ninguno de Las cinco aceites
	M 2M ☐ P 2P	M 2M ☐ P 2P	M 2M ☐ P 2P	M 2M ☐ P 2P	M 2M ☐ P 2P	☐

Por favor de las cinco aceites indique primero la mejor opción que más le gusta (que más se adapta a su comportamiento real) (marcando el recuadro M), de los cuatro restantes indíqueme la opción que menos le gusta (Marcando el recuadro P), luego de los tres restantes indíqueme la opción que más le gusta (marcando el recuadro 2M) y de los dos restantes indíqueme la opción que menos le gusta (marcando el recuadro 2P).

En el caso que hay una(s) opción(es), aparte de su mejor opción, que no la compraría ni hoy ni en el futuro, por favor indíquelo poniendo cruz en la casilla en blanco correspondiente. Finalmente, si ninguna de las cinco opciones le satisfacen, por favor elija la opción "Ninguno"

Figure 1: Example of Best Worst discrete choice experiment method card.

	ACEITE 1	ACEITE 2	ACEITE 3	ACEITE 4	ACEITE 5	OPCION "Ninguno"
Situación de compra 1			**Número de identificación:** ………			
T.Aceite : Marca: Origen: Precio:	Virgen Distribuidor Andalucía 3.50	Aceite de oliva Distribuidor Andalucía 3.50	Aceite de oliva Fabricante Resto de España 4.80	Extra Virgen Fabricante Cataluña 4.80	Extra Virgen Fabricante Cataluña 2.20	Ninguno de Las cinco aceites
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	☐

Por favor clasifique las cinco aceites según sus preferencias (atendiendo a su comportamiento real de compra) de 1 a 5. (1= el más preferido y 5= el menos preferido).

En caso que haya una(s) opción(es), aparte de su mejor opción, que no compraría ni hoy ni en el futuro, por favor indíquelo poniendo una cruz en la casilla en blanco correspondiente. En caso que ninguno de las cinco aceites se parecen a su comportamiento habitual, por favor elija la opción "Ninguno".

Figure 2: Example of Ranking discrete choice experiment method card.

	ACEITE 1	ACEITE 2	ACEITE 3	ACEITE 4	ACEITE 5	OPCION "Ninguno"
T.Aceite : Marca: Origen: Precio:	Extra virgen Distribuidor Andalucía 3.50	Virgen Distribuidor Andalucía 2.20	Aceite de oliva Distribuidor Cataluña 4.80	Extra virgen Fabricante Cataluña 3.50	Virgen Distribuidor Resto de España 4.80	Ninguno de Las diez aceites
	☐	☐	☐	☐	☐	
	ACEITE 6	ACEITE 7	ACEITE 8	ACEITE 9	ACEITE 10	
T.Aceite : Marca: Origen: Precio:	Aceite de oliva Distribuidor Resto de España 3.50	Virgen Fabricante Cataluña 2.20	Extra virgen Fabricante Resto de España 2.20	Virgen Fabricante Andalucía 4.80	Aceite de oliva Fabricante Andalucía 3.50	
	☐	☐	☐	☐	☐	☐

Por favor indique el aceite lo más preferido para usted. Si ninguno de los cinco aceites le satisfacen, por favor elija la opción "Ninguno"

Figure 3: Example of holdout task card.