Evidence on the Value of EU Quality Certification Schemes. The Case of Dry-cured Ham in Spain

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Abstract. Consumer's preferences for cured ham are investigated with conjoint analysis. A mixed rank-ordered logit model which allows the investigation for heterogeneous preferences and its sources is estimated. In particular, we analyse to what extent consumers' socio-demographic traits affect their price-sensitiveness and whether consumer's sensory (hedonic) valuations and attitudes towards ham with a Protected Designation of Origin (PDO) affect the preferences for specific attributes. The results show that consumers with a low-medium age and income are more price sensitive. Consumers more leaned sensorially towards the own regional product (with or without PDO), are more inclined to purchase this product, and consumers with a more favourable attitude towards PDO ham, are also more prone to purchase cured ham with quality certification in comparison with a product without PDO. Accordingly, the PDO scheme attracts a segment of consumers, but still the origin by itself is a more powerful signal of quality.

Keywords: Mixed rank-ordered logit, Conjoint analysis**,** Heterogeneous preferences, Consumers, Cured ham.

1. Introduction

An important pillar of the EU policy on food quality is based on typical food products. In 1992, the European Commission provided a common legislative framework through Regulations EEC 2071/92 and 2082/92 (recently modified by EEC 510/2006 and 509/2006), to protect and promote those food products whose quality or reputation is linked to the specific territory where they are produced, or to the specific raw ingredients or technical processes traditionally developed in a specific area, through three schemes for identification and registry: Protected Designation of Origin (PDO), Protected Geographical Indication (PGI) and Traditional Speciality Guaranteed (TSG). This new legislation inherited definitions, requirements and procedures from national legislations, especially from countries like France, Italy or Spain, where similar figures had been in place since the 30's.

More than a decade has passed, and still the knowledge about the role of these Quality Certifications in consumers' preferences constitutes a big avenue of empirical research. Recent applications include van Ittersum *et al.* (2007) [1], who develop and test a model that explains consumers' intentional behaviour (willingness to purchase and to pay a premium), as a function of their relative attitude towards the certification and its perceived quality, which in turn is influenced by the image of the region and the label (in terms of quality warranty and economic support). Other authors who have studied consumer's preferences towards food products with PDO or PGI label are Platania and Privitera (2006) [2], and Supekova *et al.* (2009) [3].

The mechanisms through which the region of origin affects consumers' attitudes and preferences are well documented in the literature (see for instance Verlegh and Steenkamp (1999) [4] for a comprehensive review). The region of origin in food products as a cue to help consumers to infer quality has been investigated, among other authors by Schamel (2003) [5], and Dekhili and d'Hauteville (2009) [6]. The affective or normative components of the region of origin have also been reported and investigated (Tregear *et al.*, 1998[7]; Philippidis and Sanjuán, 2002[8]; Luomala, 2007[9]). From an affective point of view, the region of origin may evoke emotions and develop an affective attachment of the consumer to the particular origin of food, which can be stronger the narrower geographical delimitation (van Ittersum *et al.*, 2003[10]); while from a normative perspective, the consumer may be compelled to purchase food from a specific origin as a way to comply with his/her own ethical commitment (van der Lans *et al.*, 2001[11]), as in the case of an ethnocentric purchase behaviour (Shim and Sharma, 1982[12]).

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In this paper, we run a conjoint experiment to evaluate consumers' preferences towards a food product characterized by large degree of heterogeneity in quality, cured ham, and in a country which counts with a long tradition on protecting the origin as a way to identify food products, as it is Spain. Since 1985, origin certification schemes have been in place in Spain in the cured ham sector in order to avoid the misuse of origin claims, to inform consumers about the true origin of the products they buy, and guarantee the compliance with specific production rules and quality controls. Currently, a total of six quality labels on Spanish cured ham have achieved European protection, one TSG, one PGI and four PDO. Notwithstanding, the eldest PDO is PDO Teruel ham, produced in the region where the study is conducted. Conjoint analysis has been broadly used also for this purpose, but we introduce two refinements: first, a full ranking of alternative combination of attributes is used; and second, heterogeneous preferences are allowed.

Besides, the paper aims at testing if the influence of PDO/PGI certification is homogeneous across consumers, or alternatively, origin certification becomes relevant only for a niche of highly demanding consumers. In particular, we investigate alternative sources that explain heterogeneous preferences, such socio-demographic traits and attitudes towards certification. A novelty of the paper is the introduction of hedonic valuations or perceived sensory quality of ham as an explanatory factor of stated preferences. Only a few studies combine hedonic and consumer choice behaviour, which is mainly investigated through experimental auctions (eg. Lange *et al.*, 2002[13]; Noussair *et al.*, 2004[14]; Poole *et al.*, 2007[15]), and the study of the EU certification schemes using this approach is still very incipient.

In this paper, we apply an internal preference mapping to consumers' hedonic valuations of a number of cured ham samples, in order to detect a possible segment of consumers more prone to some specific origin and/or certification.

The rest of the article is organized as follows: Section 2 explains the main method of analysis; Section 3 describes the data; Section 4 presents and discusses the results; and in Section 5 the main conclusions are drawn.

2. The Conjoint Analysis: theoretical and empirical considerations

2.1. The theoretical approach

Conjoint analysis is based on Lancaster's theory of the demand of characteristics (1966) [16]. The main objective of this technique is to infer the marginal utility of each attribute that composes a product from the respondent's overall evaluation of the multi-attribute product (Green *et al.*, 1988[17]). Conjoint analysis has become well known in the marketing area since its origin in the late sixties (Green and Rao, 1971[18]). Some recent applications that analyse consumer's preferences towards food products have been presented by Hollebeek *et al.*, (2007) [19], Darby *et al.* (2008) [20], and Veale and Quester (2009) [21].

Consumer's preferences can be analysed using different response formats: rating or ranking of all the alternatives; ranking of only a few of the most preferred alternatives; or choice of the most preferred alternative. The latter case it is known as *choice modelling* (CM). A discussion about the benefits and drawbacks of every format can be found in Lusk (2002) [22].

In this paper, a ranking format is used, which is subsequently transformed into pseudo-choices, which allows accounting for more information than a CM or strict ranking (Train, 2003[23]). Stated preferences based on consumer's preference ordering have been commonly estimated using a rank-ordered logit (Ahn *et al.*, 2006[24]; Mark *et al.*, 2004[25]), being Beggs, *et al.* (1981[26]) the pioneer paper.

However, the estimated parameters can be still biased or/and inconsistent (Calfee *et al.*, 2001[27]) and this model is less flexible than a mixed rank-ordered logit. The latter is an extension of the mixed logit or random parameters model and therefore, it allows consumer's differences in taste, it does not exhibit the property of independence from irrelevant alternatives (IIA), as occurs with the conditional logit, and the random component of utility can be correlated over time (Train, 2003[23]).

In comparison with the mixed logit, which has been widely applied in the agro-food field (Scarpa *et al.*, 2008[28]; Alfnes *et al.*, 2006[29]; Bonnet and Simioni, 2001[30]), and to the best of the author's knowledge, there are not many applications in this field for the mixed rank-ordered logit (Hu *et al.*, 2007[31]). Nevertheless, this econometric model has been successfully used in other fields such as transport economics (Srinivasan *et al.*, 2006[32]; Calfee *et al.*, 2001[27]).

2.2. The econometrical model

In the common theoretical framework defined by the random utility model (RUM), each individual *n* faces a choice among *J* alternatives (*J* = 9 in our application), and he/she obtains utility from choosing alternative *i* ($i = 1, \ldots, J$) $U_{n,i}$:

$$U_{n,i} = V_{n,i} + \varepsilon_{n,i} \qquad i = 1, \ldots, J \quad n = 1, \ldots, N \tag{1}$$

where $V_{n,i}$ is the observed component of the utility that is a function of the specific features of the alternative *i* ($\mathbf{X_i}$) (additionally, characteristics of the individual *n*, $\mathbf{S}_n$, can be included) and $\varepsilon_{n,i}$ is the unobserved and random component of utility. The standard conditional logit model (CL) assumes that $\varepsilon_{n,i}$ is independently and identically distributed extreme value (also referred as *iid* Gumbel). Under this assumption, the probability for individual *n* of choosing alternative *i* is:

$$\text{Prob}_{n,i} = \text{Prob}[U_i > U_j \quad \forall i \neq j] = \frac{e^{V_{n,i}}}{\sum_{j=1}^{J} e^{V_{n,j}}} \tag{2}$$

In the current application, a full ranking of the nine alternatives is obtained. In order to apply the CL model, the alternative ranked first, can be interpreted as the chosen option, and the remaining eight alternatives collapse into the no-choice value of the dependent variable. However, this procedure would imply a considerable loss of information as only one observation per consumer would be available, and therefore would compromise the efficiency of the estimates (Hu *et al.*, 2007[31]). Alternatively, a rank-ordered logit (RL), also known as 'exploded logit', is preferable, as this model makes use of the more complete information provided by the ranking data.

Briefly, the ranking of *J* alternatives can be represented by *J-1* successive choices or 'pseudo-observations': for the first 'pseudo-observation' the choice set includes *J* alternatives, and the dependent variable (choice) identifies the alternative ranked as most preferred; for the second 'pseudo observation', the alternative ranked first is discarded, leading to a choice set composed by *J-1* alternatives, and the option ranked second, becomes the chosen alternative identified by the dependent variable. The process continues until the choice set is comprised only by two alternatives (Train, 2003[23]). Therefore, the ranking of *J* alternatives can be represented as *J-1* independent choices, and the new dataset will include *J-1* choices for each individual.

Under the assumptions of a standard logit, the probability of individual *n* ranking *J* alternatives from best to worst as j_1, ..., j_m, ..., j_J, where j_m represents the alternative chosen at the ranking order *m*, can be expressed as the product of logit choice probabilities:

$$\text{Prob (ranking } j_1, \ldots, j_m, \ldots, j_J) = \text{Prob}\left(U_{j_1} > \ldots > U_{j_m} > \ldots > U_{j_J}\right) = \prod_{m=1}^{J-1} \frac{e^{V_{n,j_m}}}{\sum_{k=1, k \neq j_{m-1}}^{J-m+1} e^{V_{n,k}}} \tag{3}$$

In the previous models (CL and RL), the deterministic or observed component of utility for individual *n*, $V_{n,i}$ can be specified as a linear function of the specific characteristics of alternative i: $V_{n,i} = \boldsymbol{\beta}' \mathbf{X}_i$, where $\boldsymbol{\beta}$ is a vector of parameters to estimate, unique and common for all individuals. A more flexible approach consists of assuming heterogeneous preferences across individuals, such that the coefficients or taste parameters in $\boldsymbol{\beta}$ can vary across individuals ($\boldsymbol{\beta}_n$). A mixed rank-ordered logit model (MRL) accommodates both, the full ranking of preference data, and heterogeneity in preferences, whilst also deals with the correlation of the 'pseudo-observations' that emerge because the individual's entire ranking is affected by the individual's coefficients (Train, 2003[23]). In a mixed logit, the vector of parameters $\boldsymbol{\beta}$ is random with a density $g(\boldsymbol{\beta} \mid \boldsymbol{\theta})$, where $\boldsymbol{\theta}$ are the parameters of the distribution (eg. if g is the normal distribution, $\boldsymbol{\theta}$ will include the mean and the standard deviation). Expression (3) still provides the probability for an individual *n* of choosing a specific ranking, but conditional on $\boldsymbol{\beta}$. The unconditional probability is the integral of that product of probabilities over the density of $\boldsymbol{\beta}$:

$$\text{Prob (ranking } j_1,\ ...,\ j_m,\ ...,\ j_J\text{)} = \int \prod_{m=1}^{J-1} \frac{e^{V_{n,jm}}}{\sum_{k=1,k\neq j_{m-1}}^{J-m+1} e^{V_{n,k}}} \times g(\boldsymbol{\beta}\,|\,\boldsymbol{\theta})d\boldsymbol{\theta} \qquad (4)$$

The model provides the estimated parameters of the density function. The applied literature usually chooses the Normal distribution for the coefficients, which allows for the possibility that individuals show opposite preferences towards a particular attribute. The estimation makes use of simulation methods, and we redirect the interested reader to Train (2003) [23] for details.

3. The Data

A survey addressed to Spanish citizens, was carried out at the end of 2004, in Zaragoza, main city in the region where the eldest (Spanish and European) PDO of cured ham exists, PDO 'Jamón de Teruel'. This is a medium size city, around 660.000 inhabitants, that concentrates about 70% of the regional population.

The survey contained three big blocks: the conjoint experiment, sensory or acceptability tests of dry-cured ham samples, and a questionnaire, with questions related to the socio-demographic profile, purchase and consumption habits, and the perception and awareness about quality certified labels, such as PDO, PGI and STG.

3.1. Consumers' profile

The sample is conformed by 202 regular purchasers and consumers of dry-cured ham, with the socio-demographics profile described in Table 1[1]. Respondents are mainly men (67%), currently working (64%), between 37 and 65 years old (77%), with primary or secondary studies (74%), and with net households net incomes located in the low-medium interval (74%).

Table 1. Consumers' descriptive characteristics

Variable	N=202 % of consumers
Socio-demographics	
Gender	
Male	67
Female	33
Age	
Less than 36 years old	11
Between 36 and 65 years old	77
More than 65 years old	12
Working status	
Housewife/pensioner/unemployed/student	36
Currently working	64
Education	
No studies	6
Primary or secondary studies	74
University degree	20
Net monthly household income	
Less or equals to 2100€	74
More than 2100€	26

3.2. Design of the conjoint experiment

A critical step in the design of the conjoint experiment is the selection of attributes and levels that enter the definition of alternative and hypothetical food products presented to consumers for evaluation. To inform the researchers about this point, two sources of information were combined: a focus group

[1] For further information on the recruitment process is provided in Resano *et al.* (2007) [33].

discussion and a previous market research study (Aguelo *et al.*, 2003[34]), on the same product and location, based on questionnaires addressed to a representative sample of consumers.

Among the set of attributes identified at this stage as relevant in the depiction of preferences towards dry-cured ham, experience attributes related to sensory characteristics, such as salt contents, fat infiltration or texture, were discarded as they are not observable, either in a real choice situation at the retail outlet, or in the market situation simulated through the conjoint experiment. Besides, to some extent, we would expect that the observable characteristics are been used by the consumer as cues for the intrinsic quality defined by sensorial parameters, and the study of the latter go beyond the scope of this paper.

The attributes and levels used in the conjoint design are shown in Table 2. The design includes four attributes: one credence attribute, 'Geographical Origin' (OR), with three alternatives: Spain (Sp), without a specific regional location; Teruel (Ter), located in the same region where the study takes place; and Bayonne (Bay), a French region located next to the Spanish border. The two regional origins, Teruel and Bayonne, count with registered EU origin certifications, PDO 'Jamón de Teruel' and PGI 'Jambon de Bayonne', respectively. Besides, the name 'Jamón Serrano' is also protected with a TSG, and this term can be applied to Spanish production of cured ham that comply with the specified rules. The second attribute is 'EU Quality Certification Label' (QC), with levels accounting for its presence (PDO, PGI or TSG) or absence. Note however, that the specific certification schemes are not included as levels to simplify the experiment and to avoid unrealistic combinations with the geographical origin. The third attribute is 'Type of Brand' (BR), with levels covering either 'Owned by the Producer' (Prod) or 'by the Distributor' (Dist). The distributor's brand has experienced a continuous increase in food distribution, and currently, it accounts for 26% of market share in both, food in general and the category of 'cooked pork products and cheeses' in particular (BICE, 2008[35]). Finally, 'Price' (PR) is included as the fourth attribute, with levels selected following an inspection of the main distribution chains, either *in situ* or through the internet, and taking into account the alternative possible combinations of origins, certifications and brands, leading to average prices of 18€, 24€ and 32€.

Table 2. Attributes and levels in the conjoint analysis

Attribute	Levels		
Origin (OR)	Teruel (Ter)	Bayonne (Bay)	Spain non-specified (Sp)
Quality Certification (QC)	Presence	Absence	
Type of Brand (BR)	Producer's brand (Prod)	Distributor's brand (Dist)	
Price (PR)	18 €/kg	24 €/kg	32€/kg

An orthogonal fractional factorial design for main effects[2] was applied that resulted in 9 alternatives to evaluate. Each consumer received a set of nine cards and a page with the nine options printed and on which the consumer assigned the ranking position. A common setting for all participants was defined. Consumers were asked to imagine that they were buying sliced ham for regular consumption at home, either carved on request at the delicatessen/specialized shop or section in the supermarket, or pre-packed. Then, participants were asked to rank the cards from best to worst, according to their preferences and the order in which they would buy them. If the total number of alternatives is very high, it is difficult for respondents to discriminate, especially among the least preferred ones. Some empirical applications have used a full rank of a number of alternatives larger than 9 (eg. Hu *et al.*, 2007 [31]; Scarpa and Del Guidice, 2004[36]). However, in this study, we followed the recommendation by Chapman and Staelin (1982) [37] who consider that consumers are only able to discriminate easily up to four alternatives, while for a larger number, the consistency in ordering the least preferred can suffer, leading to a loss of predictive power of the empirical model. Accordingly, we asked participants to select first, the three most and the three least preferred cards; and second, within each of the three groups of cards, to rank them from most to least preferred options. This is a compromise between easing the ranking task to consumers and getting the maximum possible information.

3.3. Hedonic scores and the internal preference map

[2] The SPSS 12.0 package was used for the orthogonal design

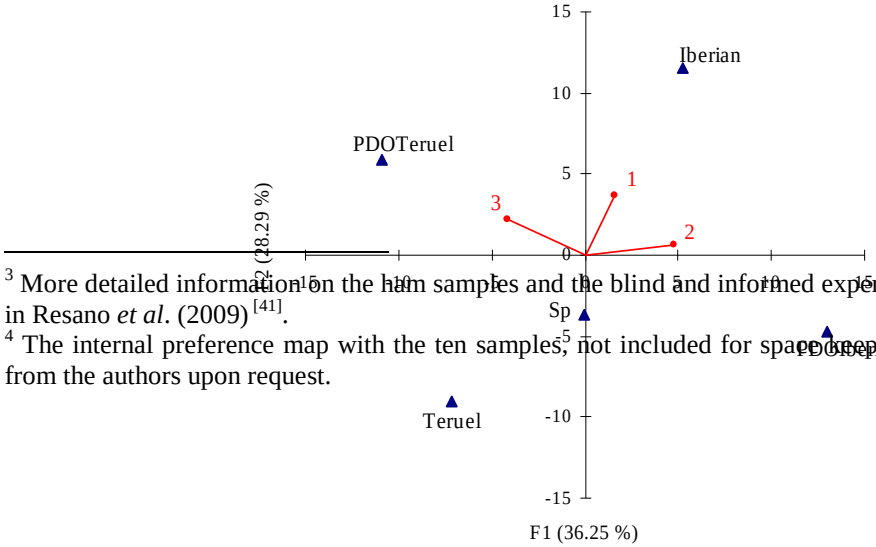
The same group of participants in the conjoint experiment provided acceptability scores on ten samples of dry-cured ham, in two experimental conditions, blind and informed, although only informed rates are used for the purpose of this paper.

The samples differed by country of origin, seven were Spanish and three French; breed, Iberian or white; type of brand, either owned by the producer or the distributor; the presence (absence) of a Quality Certification Label: PDO'Jamón de Teruel', Traditional Speciality Guaranteed (TSG) 'Jamón Serrano', or Protected Geographical Indication (PGI) 'Bayonne'; and the region of origin: Bayonne, Aveyron and Auvergne in France, and Teruel, Huelva (for Iberian ham) or any other undetermined Spanish origin[3]. Acceptability was measured on an unstructured continuous scale (0-100mm) with hedonic references ranging from "I do not like it at all" to "I like it very much", which was later converted into a scale from 0 to 10.

The standardized 'informed' scores were then analyzed with the internal preference mapping technique (MDPREF), which informs about which products are preferred by consumers, allows to visually identify clusters of consumers with similar preference patterns (Jaeger *et al.*, 1998[38]; Guinard *et al.*, 2001[39]), whilst accommodating heterogeneous 'sensory' preferences or acceptability (Jaeger *et al.*, 1998[38]; Guinard *et al.*, 2001[39]). The technique integrates three types of analysis: first a Principal Component Analysis (PCA) is applied, and the coordinates of each ham sample on the preference space determined by the first two PCA factors are kept; second, consumers' hedonic ratings are regressed on these coordinates, and the location of each consumer is plotted onto the map; and third, cluster analysis is carried out in order to classify consumers according to their liking patterns. For this purpose, an Agglomerative Hierarchical Clustering (AHC) technique is applied in order to obtain the most suitable number of segments. This number is then supplied as an input to the K-means cluster technique in order to classify the individuals into each acceptability segment.

First, and internal preference map conducted on the full set of ham samples analyzed, led to a clear distribution of samples along the first PCA according to the country of origin, while the density of consumers was significantly higher in the direction of the Iberian, Teruel and one of the Spanish producers' brands, and minimum in the direction of the French samples, and the Spanish distributor's brand[4].

Second, a new internal preference map was carried out, but this time with only those five samples that are clearly favoured by a higher proportion of consumers. This is a common practice in the application of this method in order to gain a more detailed insight into heterogeneous preferences (Labbe *et al.*, 2007[40]). The map is shown in Figure 1. The clusters are identified on the map as a vector. The first factor explains 36% of the variability in data, and clearly opposes the Iberian and Teruel samples; and the second factor explains 28% of total variance. Acceptability varies across consumers, while most of them are positioned on the top right quadrant, in the direction of Iberian hams. Although three clusters are identified with the AHC and subsequent K-means cluster technique, it is one in particular (cluster 3 on the map) which is of specific interest for the purpose of this paper. This cluster is named as 'Sensory favourable towards PDO Teruel ', as its members (29% of the sample) show a distinctive taste in favour of hams coming from Teruel, and more specifically, of PDO 'Jamón de Teruel'.



[3] More detailed information on the ham samples and the blind and informed experiments can be consulted in Resano *et al*. (2009) [41].

[4] The internal preference map with the ten samples, not included for space keeping reasons, is available from the authors upon request.

Figure 1. Internal preference map based on consumers' informed hedonic rates

3.4. The attitudes towards PDO

Finally, the same sample of consumers were asked to value in a 5-point Likert scale their degree of agreement or disagreement with a set of statements in relation to their attitudes towards dry-cured ham with PDO, defined as in van Ittersum *et al.* (2003) [10] as a learned predisposition to respond to the PDO in a consistently more favourable or unfavourable way than to equivalent un-labelled products. For simplicity, the array of statements covering cognitive, affective and normative components, have been classified into five dimensions designated as: 'Authenticity', 'Quality and safety', 'Tradition', 'Social image', and 'Taste' (Table 3). For each dimension, an aggregated score was obtained, on which a cluster analysis was carried out in order to find segments of consumers with different attitudinal profile. Two segments were selected by AHC, and K-means split individuals into relatively more and less in favour of each of the five dimensions evaluated, formed by 87% and 13%, respectively, of the respondents (Table 3).

Table 3. Consumers' attitudes towards PDO ham

Dimensions	A ham with Protected Designation of Origin (PDO) in comparison with a ham without PDO is a product...	'Relatively less favourable' (13% of the consumers)	'Relatively more favourable' (87% of the consumers)
		Relative scores over the mean of the sample	
Authenticity	more authentic which is protected against imitations	0.65	1.04
Quality/safety	which guarantees traceability with more quality controls more trustworthy safer for health	0.69	1.07
Tradition	which preserves the traditions of the region which favours the rural economy of the production area	0.77	1.03
Social image	consumed at special occasions an attractive present considered as a prestige symbol	0.70	1.54
Taste	which possess an original taste which offers a better taste	0.78	1.04

4. Estimation Results: The marginal utility of the attributes

First, a mixed logit is applied to the rank preference data, allowing for random parameters, so that, different consumers are allowed to manifest different preferences for each characteristic (Price, Quality Certification, Origin, Type of Brand). A Normal distribution is assumed for each random parameter, what

implies that we allow the possibility that preferences for specific characteristics are opposed (eg. some respondents may like and some others dislike Bayonne ham). Although it is frequent in the literature to find a negative effect of price on preferences revealing a normal demand, it is not unheard off the argument that price can act as a quality signal (Georgaud and Livat, 2007[42]) in which case, a positive impact of price on utility can be expected. The random mixed logit *Model A* allows to contemplate the possibility that price can be a significant quality cue for some consumers while can deter preferences for other segment of consumers.

Formally, the utility obtained by individual *n* from alternative *i* ($U_{i,n}$, $i = 1,\ldots,9$) is:

$$U_{i,n} = \beta_{Pr,n} \cdot Pr_i + \beta_{Ter,n} \cdot Ter_i + \beta_{Sp,n} \cdot Sp_i + \beta_{Qc,n} \cdot Qc + \beta_{Firm,n} \cdot Firm_i + \varepsilon_{i,n} \qquad [7]$$

where:

Ter_i	= 1 if origin in alternative *i* is Teruel; = 0 if Spain non-specified; = -1 if Bayonne
Sp_i	= 1 if origin in alternative *i* is Spain non-specified = 0 if Teruel = -1 if Bayonne
Qc_i	= 1 if alternative *i* carries a Quality Certification (either PDO, PGI or STG); = -1 if no Quality Certification is attached
$Firm_i$	= 1 if Type of Brand in alternative *i* is owned by the producer = -1 if owned by the distributor
Pr_i	: price in alternative *i*
$\varepsilon_{i,n}$	: residuals

Price (Pr_i) enters the model as linear [5] and the rest of attributes as effect codes. Therefore, with the exception of the coefficient on price, the rest of estimated (mean) parameters $\beta_{k,n}$, accounts for the utility difference between one level and the reference level. For instance, β_{Qc} measures the impact on utility when ham carries the Quality Certification, and $-\beta_{Qc}$ measures the impact of the lack of Quality Certification. In the case of Origin, where three levels are present, two effect codes are defined, with estimated coefficients β_{Ter} and β_{Sp}. The former measures the impact on utility of ham coming from Teruel instead of Bayonne and the latter of ham coming from any other place of Spain instead of Bayonne. The impact on utility of the origin Bayonne is can be obtained as $-(\beta_{Ter} + \beta_{Sp})$ [6].

Results of the estimation of *Model A* are shown in Table 4[7]. For each random coefficient, a mean and a standard deviation are estimated. The model shows a good overall fit (Adjusted pseudo-R^2 is 0.449) and superior to the equivalent non-random version of the (non-reported) rank-ordered logit (Adjusted pseudo-R^2: 0.432). All the standard errors apart from one (on the *Sp* variable) are significant, pointing out at the heterogeneity in preferences. Besides, the mean coefficients for Ter_i, Sp_i and Qc_i are highly significant and positive, indicating that, on average, Spanish origin, and more specifically Teruel, is clearly preferred over Bayonne; and the presence of a Quality Certification is preferred over the lack of such label. The distributor's brand provides a similar or even a higher marginal utility to the consumers. Probably because this brand is associated with the own-distributor's brand, whose owner is the chain of hypermarkets where the experiment was carried out.

Non-significant deviations around the mean are found for the coefficients on Sp_i and $Firm_i$.

[5] Including Price as categorical through two effect-codes, and running a Wald test on the equality of coefficients, led to non-significant differences, and accordingly, a linear effect of price on utility is supported by the data.

[6] The design of the experiment precludes the inclusion of specific constants for each alternative, as these would be confounded with the specific characteristics that define each alternative in a unique form.

[7] GAUSS software is first used in the screening, organization and description of data and NLOGIT 4.0. is applied in estimation.

Hensher *et al.*, (2005) [43] recommend the use of constrained distribution functions, in order to rule out the possibility that the un-constrained version (such as *Model A*) is actually hiding existing heterogeneity in the data. Accordingly, in *Model A-Restricted*, we restrict the normal distribution by imposing the equality of the mean and standard deviation for the variables *Sp* and *Firm*. Although the overall fit of the model does not improve, results now indicate that consumers' preferences are also heterogeneous with respect to these two variables.

Note that in *Model A*, the mean effect of Price is not significant while the standard error is. Given the normality assumption, this result implies that half of the population places a positive value on Price and half a negative value. Using the estimated parameters in *Model A-Restricted*, we calculate the proportion of consumers who attach a positive and negative value to each of the characteristics[8]. With respect to origin, 84% of consumers prefer the Spanish origin to French-Bayonne. This percentage increases to 87.5% when the regional origin Teruel is specified instead. With respect to the Quality Certification, 82% of consumers prefer that the product carries an origin certification, while the remaining 18% would rather to purchase ham without Quality Certification. Finally, only 16% of consumers prefer the Producer's Brand over the Distributor's Brand.

Table 4. Results of the Mixed rank-ordered logit model [a]

		Model A		*Model A- Restricted Distribution*	
Variable		Coeff.	Std. Err.	Coeff.	Std. Err.
Pr_i	mean	-0.010	0.010	-0.006	0.011
	st. devi.	0.252***	0.030	0.254***	0.031
Ter_i	mean	1.856***	0.142	2.351***	0.261
	st. devi.	1.506***	0.269	2.040***	0.355
Sp_i	mean	0.837***	0.107	1.003***	0.154
	st. devi.	0.083	0.137	1.003***	0.154
Qc_i	mean	0.913***	0.102	1.045***	0.175
	st. devi.	0.935***	0.174	1.141***	0.318
$Firm_i$	mean	-0.010**	0.010	-0.118**	0.055
	st. devi.	0.013	0.118	0.118**	0.055
Adj. pseudo-$R^{2\,(CL)\,b}$	0.432	Adj. pseudo-R^2	0.449	Adj. pseudo-R^2	0.449
LL (θ^{CL})[c]	-2010.728	LL (θ^{A})[c]	-1955.250	LL (θ^{ARest})[c]	-1958.040
N.obs.	1616				

[a] ** and *** indicate significance at 5% and 1%, respectively.
[b] Adjusted pseudo-R^2 in a conditional logit (CL) model with the same explanatory variables as *Model A*.
[c] LL(θ^j): Value of the Log-likelihood function in models j= *CL, A, A-Restricted*

5. Exploring the sources of preference heterogeneity

5.1. Socio-demographic profile and the preferences for Price

Results of the two variants of *Model A* show heterogeneous preferences towards Price, but they do not inform about explanatory sources of this heterogeneity. Therefore, we investigate next the influence of two socio-demographic characteristics, age and income, on price-sensitiveness. For this purpose, *Model A* is expanded to include the interactions denoted as $Pr\_LowInc_{i,n}$ (*Model B)*, and $Pr\_Young_{i,n}$ and $Pr\_MidAge_{i,n}$ (*Model* C*)*, defined as:

$Pr_i\_LowInc_n$ = Price of alternative *i*, faced by consumers with monthly household net income of 2100€ or less; 0 otherwise.

[8] Taking the coefficients on the variable Ter_i as an example:
$Prob(\beta_{Ter} > 0) = Prob\left[z > \frac{0 - (2.351)}{2.040} \right] = 1 - \Phi(-1.152) = 0.875$ where Φ (.) is the cumulative distribution function of the standard normal distribution, and z the standardized variable.

$Pr_i\_Young_n$ = Price of alternative *i*, faced by consumers with age lower than 36 years old; 0 otherwise

$Pr_i\_MidAge_n$ = Price of alternative i, faced by consumers with age between 36 and 65; 0 otherwise

Results of *Model B* and C are shown in Table 5. The interaction variables in both models are individually significant (except for middle age). However, the standard deviation of Price is still significant, and accordingly, these socio-demographic variables only contribute partially to explain heterogeneous preferences towards price.

Interestingly, the income interaction contributes to improve the overall fit of the model with respect to *Model A*, while age interaction only improves the fit with respect to the non-random parameters CL model.

Those consumers with lower income (74% of the sample) and younger (11%) are more price-sensitive and get disutility from higher prices ($Pr_i\_Inc_n$ and $Pr_i\_Young_n$ coefficients are negative). This result is in accordance with Bonnet and Simioni (2001[30]), who also find an inverse relationship between price sensitiveness and both, age and income. Within the segment of consumers with higher income and age between 36 and 65 years old, preferences towards price are equally split (the mean coefficient is non-significant and therefore can be replaced by zero), with half the segment preferring higher prices and the other half, lower prices. The estimated results for the rest of attributes are quite similar to the ones obtained from *Model A*.

Table 5. Results of the Mixed rank-ordered logit model: exploring preference heterogeneity around the mean of parameters on Price, Regional Origin and Quality Certification

		Model B		*Model C*		*Model D*	
Variable		Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Pr_i	Mean	0.014	0.017	0.004	0.012	-0.013	0.013
	St. dev.	0.308***	0.048	0.205***	0.023	0.327***	0.048
$Pr_i\_LowInc_n$	Mean	-0.062**	0.028	-	-		
$Pr_i\_Young_n$	Mean	-	-	-0.067*	0.037		
$Pr_i\_MidAge_n$	Mean	-	-	-0.024	0.020		
Ter_i	Mean	2.859***	0.407	1.754***	0.131	2.779***	0.411
	St. dev.	3.215***	0.618	1.451***	0.230	2.954***	0.598
$Ter_i\_FavSens_n$	Mean	-	-	-	-	0.882***	0.343
Sp_i	Mean	1.513***	0.259	0.749***	0.093	1.401***	0.251
	St. dev.	0.252	0.242	0.126	0.164	0.677***	0.247
Qc_i	Mean	1.467***	0.235	0.741***	0.069	0.970***	0.267
	St. dev.	1.730***	0.326	0.395***	0.127	1.357***	0.305
$Qc_i\_FavSens_n$						-0.041	0.189
$Qc_i\_FavAtt_n$	Mean	-	-	-	-	0.402*	0.242
$Firm_i$	Mean	-0.090	0.072	-0.064	0.047	-0.063	0.074
	St. dev.	0.408*	0.226	0.055	0.109	0.762***	0.264
Adj. pseudo-R^2		0.451		0.446		0.455	
LL (θ)[b]		-1945.135		-1962.795		-1936.140	
LLR (vs Model A)		20.230	(0.000)	---		38.220	(0.000)
N.obs		1616					

[a] *, ** and *** indicate significance at 10%, 5% and 1%, respectively

[b] LL(θ): Value of the Log-likelihood function

[c] LLR: Log-likelihood ratio to test the joint significance of interaction variables in *Model j (j= B,C,D*) with respect to *Model A;* p-value in parentheses

5.2. Sensory and attitudinal profile and the preferences for Origin and Quality Certification

Results of both variants of *Model A*, also showed that preferences towards the regional origin Teruel and the presence of a Quality Certification, are not homogeneous across individuals. There is a small although significant segment of consumers who would rather purchase ham from Bayonne instead of Teruel, and without any certification. Therefore, we investigate next the role of sensory preferences and attitudes towards the PDO as possible explanatory sources for these heterogeneity, and if there is congruence between stated preferences and both, hedonic sensory valuations and attitudes. In particular, we investigate first, if those consumers more leaned towards those ham samples coming from Teruel and that carry a PDO certification, also manifest a more intense preference towards these attributes; and second, if those consumers who show a more favourable attitude towards ham with PDO get also a higher utility from the presence of the certification.

To accommodate both sources of heterogeneity, *Model A* is expanded to include the interactions denoted as $Ter_i\_FavSens_n$, $Qc_i\_FavSens_n$ and $Qd_i\_FavAtt_n$, defined as:

$Ter_i\_FavSens_n = Ter_i \times FavSens_n$ = 1 if origin in alternative *i* is Teruel and is faced by consumers who belong to the segment 'Sensory favourable towards PDO Teruel' defined from sensory hedonic scores; = 0 otherwise

$Qc_i\_FavSens_n = Qc_i \times FavSens_n$ = 1 if alternative *i* carries a Quality Certification and is faced by consumers who belong to the segment 'Sensory favourable towards PDO Teruel' defined from sensory hedonic scores; = 0 otherwise

$Qc_i\_FavAtt_n = Qc_i \times FavAtt_n$ = 1 if alternative *i* carries a Quality Certification and is faced by consumers who belong to the segment with a 'Relatively more favourable attitude towards PDO' defined from the attitudinal scales; = 0 otherwise.

This is *Model D*, and results are shown in Table 5. The interaction defined by the sensory segment membership and the attribute Teruel is highly significant, although we fail to find a significant association between sensory and stated preferences with respect to the Certification. A relatively more favourable attitude towards ham with PDO, on the other hand, helps to explain preferences heterogeneity towards the Quality Certification (at 10% significance level). Consequently, both acceptability and attitudes contribute to explain, at least partially, the diversity of preferences with respect to the regional origin and the certification.

Interestingly, there is consistency between sensory and stated preferences. Thus, the utility provided by the regional origin Teruel, and accordingly, the probability of choosing a product with this origin, is higher for those consumers who show a higher degree of acceptability of Teruel ham. Likewise, those consumers who attach more intense connotations of authenticity, tradition, quality, safety, taste and social projection to the PDO, also manifest a more intense preference towards the Quality Certification label.

The overall fit of the model improves significantly when introducing the attitudinal interaction with respect to any variant of *Model A*, while the estimates for the non-interaction attributes remain similar.

4. Conclusions

The Regulatory Bodies of the six cured ham that have achieved European protection in Spain have always committed themselves to control the quality and to guarantee the origin of the product. However, it is necessary to study if this effort has been communicated effectively to the consumer, and, accordingly, to investigate the role of the quality certification and the origin of the ham in consumers' preferences. This information is especially relevant for PDO Teruel, which is the eldest PDO of ham in Spain, and it is produced close to the city where the experiment took place (Zaragoza).

A conjoint ranking experiment has been carried out to investigate consumer's preferences for dry-cured ham. The current paper aims at testing if the influence of the quality certification and the origin of the ham is heterogeneous across consumers. This information allows detecting what is the most attractive segment of consumers to sell a ham with quality certification. Besides, different sources for consumer's heterogeneity are analysed, including socio-demographic traits, sensorial preferences and attitudes.

The results obtained from the modelization of preferences indicate that the quality certification is considered as a quality cue on consumer choice, as it contributed to increase consumer's utility. However, this label is not considered as a signal of quality for all the consumers, as there was heterogeneity in their preferences. The same occurs with the origin of the ham. The majority of participants in the conjoint analysis prefer crearly Spanish hams over Bayonne hams, and also Teruel hams versus Bayonne hams. However, there is a small percentage of consumers who prefer Bayonne ham over Teruel ham.

Nevertheless, for the majority of consumers the regional origin was more powerful than the country of origin Teruel, which is in good agreement with the result of a previous study carried out by van Ittersum *et al.* (2003[10]). This result could be explained, at least partly, because Teruel has a long-term tradition and reputation for producing quality white cured hams in the area were the study was carried out.

The sources of the heterogeneity of the consumer's preferences are investigated through a mixed rank-ordered logit. Two different sources have been analysed in this paper:

First, consumer's heterogeneity around the price is evaluated trying to identify which consumers are willing to pay more for a particular attribute, according to their socio-demographic characteristics. More specifically, it is investigated if consumer's sensitivity to price depends on the age and income of the participant. This information may be more valuable for the agro-food producers of ham with quality certification, such as PDO Teruel or other Spanish ham with PDO, as they can target its products to a specific segment of consumers.

In this way, both the income and the age affect consumers' willingness to pay.

The low-medium income consumers, whose net income of the household is lower than 2100€, are more price sensitive than the rest of consumers, and the same occurs with the youngest consumer (who are not older than 36 years old). Therefore, consumers older than 36 years old with a medium-high income should be the more suitable segment to target a high–quality product, such as a Spanish or Teruel ham with PDO.

Second, consumer's heterogeneity around the cured ham attributes is investigated in order to ascertain if consumer's hedonic valuations and attitudes affect their marginal utility attached to the quality certification and the origin of the ham.

The results show that those consumers belonging to a cluster based on their hedonic valuations, with a clear preferences towards Teruel ham in general, and PDO Teruel ham in particular (denoted as the 'Hedonically PDO Teruel prone'cluster), obtain a relatively higher utility purchasing cured ham coming from Teruel. This is an interesting market for PDO Teruel, as these consumers not only show a strong hedonic preference for this product, but also are more inclined to purchase this product.

In the case of consumers who show the highest agreement with a set of statements with regard to a PDO ham in the attitudinal survey, they are more prone to purchase cured ham with quality certification in comparison with a product without PDO.

However, it is also important to combine this information with the one obtained previously about the socio-demographic individual's characteristics, in order to obtain a more accurate predictor of a final purchase.

Therefore, consumers with a medium-high age and income, a revealed hedonic preference for Teruel ham (with or without certification) or a high agreement with some statements about PDO ham, appear to be the most interesting segment to target PDO Teruel ham and PDO Spanish ham, respectively.

Finally, we conclude that the results obtained show that there is clear consistency between attitudes and stated preferences, whist the linkage between sensory and stated in terms of quality certification requires further investigation. Nevertheless, regarding the origin, the sensory preference towards a specific origin triggers a higher intention to purchase a ham with this origin.

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