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Article

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Analysis of heterogeneity in the preferences of wine consumption

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Abstract

The general decline in per capita consumption of wine worldwide over recent decades reveals the need to apply effective marketing strategies to capture segments of the population, such as young people or women, who tend to consume wine sporadically and in small amounts, even among traditional wine-producing countries. However, until now these strategies have been designed considering these segments as homogeneous groups, when in fact they are not. In this paper, several discrete choice models are used to incorporate the unobserved heterogeneity present in individuals' decisions, such as mixed or latent class models, with the aim of identify the socio-demographics profiles of individuals who consume a certain amount of wine per week. The results highlights the superiority of these models and the variability individuals' characteristics due to heterogeneity.

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Keywords: Preferences; Wine; Heterogeneity; Latent class; Mixed logit

1. Introduction

In the last two decades, there has been a steady decline in per capita wine consumption worldwide. This was especially noticeable in the early years of the economic crisis. It even occurred in countries such as Italy, France and Spain, which not only dominate global wine production and trade with a joint market share of more than 50%, but are also considered important references for wine consumption linked to gastronomy. However, in recent years, a recovery in consumption has begun to be observed in some countries, although this has not yet become fully-fledged in the main wine-producing countries.

The reasons for the downward trend in wine consumption are very diverse, and are mainly related to changes in consumption habits,¹ greater health concerns, increasing

competition from other alcoholic beverages or the scarce attention paid to certain social strata such as young people and women.² Despite greater variety in supply, greater marketing efforts by wineries and appellations of origin, more careful labelling or making more information available to consumers, the truth is that there has been an aging of wine consumers. Therefore, it is necessary to attract younger generations. However, in the case of young consumers, higher beer consumption due to its comparative price advantage, as well as, greater demand for non-alcoholic beverages targeting urban and younger consumers have not contributed to creating a greater predisposition among young people towards the culture of wine. Nevertheless, the different emotional responses this population segment has to wine could be used to guide the

(footnote continued)

indication, is one of the causes of the decline, although, in recent years, the latter has also seen reduced consumption (MERCASA, 2014).

²In this respect, see the works of Albisu and Zeballos (2014); Atkin and Thach (2012); Bruwer et al. (2011); Marinelli et al. (2014); Martínez-Carrión and Medina-Albadalejo (2010); Pomarici and Vecchio (2014); Seller-Rubio and Nicolau-Gonzalbez (2016); Vecchio et al. (2017).

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¹The decrease in the consumption of table wine in favour of higher quality wine, whether with designation of origin (DO) or protected geographical

development of new products (Mora et al., 2018). Yet another reason is that wine has gone from being a regular product in people's diets to becoming one of moderate consumption by the majority of the population. Indeed, high frequency and/or high quantity consumption are scarce, and are usually linked to a specific occasion, and mainly during the weekends.

This drop in consumption has been quite substantial in countries like Spain. Spain ranks third among wine-producing countries, has the largest surface area devoted to vine cultivation and is one of the main wine export countries in the world. As regards wine consumption, Spain represented approximately 4% of world wine consumption in 2016, which places the country in seventh place in the ranking, however, its per capita consumption has fallen by more than 13 l since 2002, standing at around 21 l in 2016.

The Canary Islands and, specifically, the island of Tenerife, is one of the Spanish regions with the oldest traditions in vine cultivation and wine production. The Islands' greatest period of splendour, although distant in time (16th century), was when the famous Canarian wine, Malvasia, put the Islands on the international wine map. Indeed, recognizing the quality of its wines, the Canary Islands were given the name of "the Islands of Wine". Moreover, Canary Island viticulture has always had an export vocation, and up until the mid-nineteenth century, wine was the main export product from the islands (Macías, 2005) and their main source of wealth. This has led to the development of a unique landscape of significant ecological value, the presence of a rich variety of grapes and some of the best preserved examples of Europe's oldest varietal heritage. In recent decades, the renovation of the sector through the creation of D.O.³ and the restructuring of cultivation areas, along with modernization, innovation and commitment to quality have guided the island's producers in an attempt to achieve better positioning of Tenerife's wines in the international market. However, all these efforts do not seem to be sufficient given the current world situation, which is aggravated by other problems of a local nature such as the generational change in the Canarian wine sector, high production costs, market insularity and urban development pressures in rural areas (Scherrer et al., 2009).

Given this context, and considering the importance that knowledge of wine consumers' behaviour has for the design of marketing strategies to facilitate the recovery of consumption, the objective of this paper is to identify, through discrete choice models, socio-demographic profiles that define individuals that consume certain amounts of wine per week. Special emphasis is placed on whether the profiles detected differ or not when considering unobserved heterogeneity in consumption decisions.

In general, research into wine consumption decisions, regardless of the model used, explicitly ignore the unobserved heterogeneity that could capture interindividual differences that are not included in a model's regressors. Not taking this heterogeneity into account can lead to erroneous conclusions. In fact, sometimes, these studies can wrongly be considered as appropriate, when using standard measures of goodness of fit that yield adequate values and these measures do not allow a diagnosis to be made about the possible presence of unobserved heterogeneity. This can lead to biased estimates of model parameters and inaccurate inferences that may have an impact on decision-making and marketing strategies.

On the whole, unobserved heterogeneity has not been sufficiently addressed in the wine literature even though its analysis would contribute to a more precise knowledge of consumers' behaviour. It would, for example, provide a better description of variations in the consumption preferences of individuals with the same socio-demographic characteristics, and thus, identify the most appropriate market segments to direct new marketing strategies. In addition, most of the research that analyzes the preferences of wine consumers tries to identify segments of consumers based on wine attributes of the wine, such as price or knowledge the individual has about the product, thus different results are obtained according to the context and/or geographical area analyzed. A review of this can be found in Rodríguez-Donate et al. (2017).

As mentioned, unobserved heterogeneity in the socio-demographic profiles of individuals has not been studied in depth. Another aspect to note is that when identifying consumer profiles for the design of specific marketing strategies socio-demographic variables (objective variables) are considered more appropriate than subjective variables, such as wine knowledge, motivational or cultural variables. The reasons for this are that the latter can be difficult to quantify due to the subjective nature of respondents' motivations, and the difficulty to incorporate them into marketing strategies (Molina et al., 2015).

Consequently, this paper not only aims to identify socio-demographic profiles of individuals who consume certain amounts of wine per week, but also investigates the unobserved heterogeneity of individuals' decision-making, quantifying the variability in individuals' characteristics due to heterogeneity. That is, it seeks to cover two aspects. On the one hand, the identification of the socio-demographic characteristics of wine consumers according to the quantity consumed. And, on the other hand, it highlights the importance of considering unobserved heterogeneity by comparing alternative models. In addition, although the analysis is carried out for a specific geographical area (Tenerife), the results could be compared to those of other territories that also have a tradition of producing and consuming wine and even those areas with emerging wine sectors.

To carry out this objective, data from a survey carried out on Tenerife (Canary Islands) at the end of 2014 have been used. In the following sections, the data are described and different estimated discrete choice models are explained. Subsequently, the most relevant results are presented, showing individuals'

³In spite of territorial limitations, in relative terms, the Canary Islands have a substantial number of wine brands and Designations of Origin that promote a high quality and differentiated product in an increasingly saturated global wine marketplace. Specifically, on the island of Tenerife there are six Designations of Origin, which produce over one hundred brands of wine and the surface area devoted to wine production represents 54.3% of the total of the Canarian archipelago (Agricultural Statistics of the Canary Islands, 2012).

characteristics that lead to a greater or lesser propensity to consume higher or lower quantities of wine per week. Finally, the main conclusions, limitations and future research are discussed.

2. Material and methods

2.1. Data

The data used in this study come from a survey conducted on individuals of legal age residing on the island of Tenerife in 2014 aimed at identifying their wine consumption habits and preferences. For the selection of the individuals surveyed, the island was divided into three large geographical areas: the northern area, the southern area and the metropolitan area. In each of them, stratified proportional sampling was carried out, stratified according to municipalities, gender and age groups, with the maximum admitted error being less than 3.2%. The survey, which was conducted through a personal interview at street level, consisted of 47 questions of both a socio-demographic type (gender, age, area of residence, family situation, occupation, educational level and income level), and about their attitudes toward the wine consumption in general, and Tenerife wine in particular. Of the initial sample, composed of 1119 individuals, only 1028 contributed information on all the variables of interest in this study and have been considered.

The univariate analysis of the socio-demographic variables shows that in the sample, there is the same proportion of men and women. In addition, the most frequent age intervals are those from 30–39 years old and 40–49 years old, with percentages above 20%, the representation of the youngest (18–29 years old) is 16.5% and that of the oldest (70 or over) 10.3%. There are 39% of respondents residing in the metropolitan area, 35.9% in the north and the rest in the south. Most of them are married or in a couple (65.4%) and those who state they work do so mainly in the private sector, especially as employees. Students and homemakers represent 19.5% of the total of individuals, unemployed 14.9% and retired 16.7% (representing 98.8% of the "other" category of the survey). Regarding educational level, the most frequent level is that of secondary studies, vocational training or similar (43.9%), followed by primary (25.1%) and university/higher education (23.1%). Finally, in relation to income, more than 50% of individuals state their family income is less than or equal to 1000 euros per month.

Regarding weekly quantities of wine consumed, the intervals established are a maximum of a quarter of a litre, between a quarter and one litre maximum, between one and two litres maximum and more than two litres. It is found that 38.8% of the respondents opt for the lowest consumption interval and 18.1% consume between a quarter and one litre as a maximum, which means that over half the respondents consume less than a litre a week. Likewise, practically half the respondents declare spending a maximum of 6 euros on the weekly purchase of wine.

When the quantity consumed is analysed according to respondents' socio-demographic characteristics (see Table 1),

Table 1

Weekly consumption according to socio-demographic characteristics (%).

	0–1/4	1/4–1	1–2	> 2
Gender				
Male	47.1	23.5	19.1	10.3
Female	82.7	12.6	3.7	1.0
Age				
18–29	86.1	9.8	3.5	0.6
30–39	68.3	21.7	6.3	3.8
40–49	61.2	19.6	12.8	6.4
50–59	50.3	21.7	19.7	8.3
60–69	53.4	18.0	17.3	11.3
70 or over	66.0	15.1	13.2	5.7
Area				
North	63.1	17.1	9.5	10.3
South	62.8	18.6	16.3	2.3
Metropolitan	67.8	18.7	10.0	3.5
Marital Status				
Married/In a couple	59.2	20.7	14.0	6.1
Single	75.9	14.0	6.6	3.5
Widowed/Separated	75.0	11.7	6.3	7.0
Occupation				
Student/Homemaker	87.2	6.9	5.4	0.5
Civil servants/Employees	60.6	23.6	10.4	5.4
Professionals/Entrepreneurs/Self-employed	55.8	19.4	17.6	7.3
Unemployed/Others	60.0	18.8	12.9	8.3
Educational Level				
Primary	59.3	17.8	14.0	8.9
Secondary	65.9	18.4	10.4	5.3
University	70.0	19.0	9.7	1.3
No studies	62.2	14.6	13.4	9.8
Income				
Under €600	71.9	13.1	8.8	6.3
€600–1000	66.0	14.9	11.6	7.5
€1000–2000	61.4	23.1	12.1	3.4
Over €2000	62.6	19.2	12.1	6.1

it is observed that, in the case of gender, there is a clearly differentiated behaviour between men and women, since it is men who usually consume the largest amounts (29.4% of men consume more than 1 l a week compared to 4.7% of women) and women consume smaller amounts more often (82.7% of women consume less than 1/4 litre versus 47.1% of men).

In relation to age, although in all age segments a high percentage of respondents state they consume a maximum of 1/4 l of wine per week, especially the youngest (86.1%), those who consume more than 1 l usually have an intermediate age (50–69 years old). This age range is extended for those who consume between 1/4 l and a litre at most a week (30–69 years old).

Regarding the area of residence, in all areas the consumption of small amounts predominates, however, it is worth noting the percentage of residents in the south of the island that consumes between 1 and 2 litres maximum is 16.3% while those in the north who consume more of 2 l is 10.3%.

As for the marital status of respondents, again the consumption of the lowest quantity predominates in all the categories.

However, among those who are married this has a lower percentage weight, and, this situation is inverted in the consumption of ¼–2 l maximum.

Regarding respondents' occupation, totally different patterns are observed between the student-homemaker category and the rest of the occupation categories, specifically, 87.2% of the former report consuming ¼ l or less per week, while in the rest of the categories this percentage is below 61%. Moderate consumption (from ¼ to 1 l maximum) is especially frequent among employees and civil servants, while, the highest consumption is registered mainly among self-employed and entrepreneurs (1–2 l maximum) and unemployed/others (over 2 l).

When analyzing education level, there are no significant differences in the behaviour of respondents, except for the lower percentage of those with university/higher education who consume more than 1 l a week compared to those who do not have studies or have primary studies. Finally, lower consumption tends to be more frequent among respondents with lower incomes (71.9%). Those who have higher incomes (above €1000) most often consume between ¼ l and 2 l at most, while those with intermediate incomes (€600–1000) consume more than the 2 l.

2.2. Methods

In the analysis of consumption decisions, in which the individual chooses from a set of alternatives, discrete choice or qualitative response models are an adequate methodology, insofar as they take into account the nature of the dependent variable and try to analyze the effects of each of the explanatory variables on the probability of choice of each alternative among a set of finite options, instead of predicting individuals' average behaviour. Depending on whether the available alternatives are two or more than two, we resort to binomial or multinomial models, respectively. In the latter case, the set of options may or may not have an implicit order, thus proposing ordered or unordered models, respectively.

In this paper, given the ordered nature of the variable of interest, the weekly amount of wine consumed, some ordered models can be used to identify the determinants of the probability that the individual consumes a certain amount of wine. Once the standard specification has been formulated, and considering that apparently identical individuals with the same vector of characteristics choose different alternatives, two of the specifications that allow the incorporation of heterogeneity in individuals' decisions are defined, that is, models that explain the variation in the preferences of individuals with the same characteristics (mixed and latent class models).

2.2.1. Standard ordered specifications

Standard ordered specifications were initially developed by Aitchison and Silvey (1957) and Snell (1964), and later formulated by Mckelvey and Zavoina (1975) and McCullagh (1980), who adapted them to applications in social sciences. Ordered models are adequate when the choice alternatives imply a natural order (a more recent detailed review can be

found in Greene and Hensher, 2010). One way to interpret this process of choice is to consider that individuals hold a specific assessment or opinion on the issue that determines their choice (focus of the index function or latent variable).

In formal terms, this assessment can be expressed as a non-observable or latent variable, Y_i^* , whose range can be subdivided into ordered intervals such that if the assessment of individual i , is in interval j , the individual chooses option j , that is, $Y_i = j$, $j = 0, \dots, J$. The latent variable, Y_i^* , is assumed to depend on a set of explanatory variables that determine the choice by individual i , that is:

$$Y_i^* = x_i' \beta + \varepsilon_i$$

where ε_i is a random disturbance term. The choice of the individual from among the alternatives $0, \dots, J$ is a reflection of the value Y_i^* in relation to the thresholds μ_j , $j = 1, \dots, J$, that is:

$$Y_i = \begin{cases} 0, & \text{if } Y_i^* \leq 0 \\ 1, & \text{if } 0 < Y_i^* \leq \mu_1 \\ 2, & \text{if } \mu_1 < Y_i^* \leq \mu_2 \\ \vdots & \\ J, & \text{if } \mu_{J-1} < Y_i^* \end{cases}$$

These thresholds are unknown and would be $0 < \mu_1 < \mu_2 < \dots < \mu_{J-1}$. In this formulation, the first threshold is considered null and it is assumed that the index function $x_i' \beta$ contains an intercept term. Another equivalent formulation consists of introducing a threshold μ_0 and eliminating the independent term of the index function.

From this point of view, linking the individual's choice to the value of the latent variable implies assuming that there is a linear function for the explanatory variables of choice, such that, if this function takes values between μ_{j-1} and μ_j , the alternative j is the one that provides maximum utility.

Adopting this approach and considering that the distribution function of the random variable ε_i is logistic (denoted as Λ), the probabilistic model that determines the choice is an ordered logit model and is defined as follows:

$$P(Y_i = 0) = P(Y_i^* \leq 0) = P(\varepsilon_i \leq -x_i' \beta) = \Lambda(-x_i' \beta)$$

$$P(Y_i = j) = P(\mu_{j-1} < Y_i^* \leq \mu_j) = P(\mu_{j-1} - x_i' \beta < \varepsilon_i \leq \mu_j - x_i' \beta) = \Lambda(\mu_j - x_i' \beta) - \Lambda(\mu_{j-1} - x_i' \beta), \\ j = 1, \dots, J-1$$

$$P(Y_i = J) = P(Y_i^* > \mu_{J-1}) = P(\varepsilon_i > \mu_{J-1} - x_i' \beta) \\ = 1 - \Lambda(\mu_{J-1} - x_i' \beta)$$

The vector parameters β (common for all alternatives) and the thresholds are estimated jointly by the maximum likelihood method.

Although the specification of these models is relatively simple, incorporating the multitude of factors that are involved in individuals' decision-making processes is a complex task. The random component of the specification aims to collect unobserved variables that influence the decision, such as errors of measurement, differences between individuals, incorrect

perceptions of attributes or the inherent randomness of human nature (Munizaga and Álvarez, 2002). To incorporate heterogeneity in individual preferences, we can use mixed specifications or latent class models, whose main difference resides in assuming that the distribution function for the parameters is continuous or discrete, respectively.

2.2.2. Mixed models

One way to capture heterogeneity in individual responses is to admit the stochastic nature of the parameters that determine these responses. This idea is what gives rise to the so-called mixed models. These models have been widely used, since they can approximate any model of random utility (McFadden and Train, 2000).

From the random utility approach, which assumes that the individual is rational and chooses the alternative, from the set of available options, which provides maximum utility, the utility that individual i obtains from alternative j can be expressed through the function:

$$U_{ij} = x'_{ij} \beta_{ij} + \varepsilon_{ij}$$

where β_{ij} is a parameter vector that reflects the preferences of the individual i and can change from one individual to another. If the values of these parameters were known for each individual, the probabilities of choice could be derived using a conventional logit model. However, since these parameters are unknown, it is not possible to determine the probability of each of the alternatives for each of the individuals at given values of vector. However, the probability of choice corresponding to the different possible values of the previous vector can be calculated as an integral of L_{ij} (defined below) on the possible values of β_j .

The probability of choice of each alternative is a function of a multidimensional random variable and the probabilities defined by the mixed logit model are mathematical expectations of these functions, that is:

$$P(Y_i = j) = \int L_{ij}(\beta) f(\beta) d\beta$$

where:

$$L_{ij}(\beta) = \exp(x'_{ij} \beta_j) / \sum_{j=0}^J \exp(x'_{ij} \beta_j)$$

and β is a vector that contains vectors β_j that intervene in the deterministic component of the utility of alternative j , while x_{ij} represents the vector of characteristics of individual i or of attributes of alternative j that intervene in said component. In most applications, it is assumed β follows a normal or lognormal distribution (Algers et al., 1998; Ben-Akiva and Bolduc, 1996; Bhat, 1998, 2000; Revelt and Train 1998, 2000). If you want to ensure that the coefficients for all individuals remain within a certain range, you can use the uniform distribution, the triangular (Glasgow, 2001; Hensher and Greene, 2003; Revelt and Train, 2000; Train, 2001) or the normal truncated one (Revelt, 1999), and even discrete uniform distributions are often considered (Andrews et al., 2002; Kamakura and Russell, 1989; Wedel and Kamakura, 2000).

The distribution of β depends on a vector of parameters θ that will need to be estimated, so that the probabilities derived through the mixed logit can be written as:

$$P(Y_i = j) = \int L_{ij}(\beta) f(\beta/\theta) d\beta$$

Once the distribution of the parameter vector for the entire population is obtained, it is worth asking in which area of the distribution a particular individual is situated. Given that the choice of the individual provides information in this sense, the question can be addressed from the distinction between the distribution of the vector of random parameters for the whole population $f(\beta/\theta)$, and the distribution of the same vector in the subpopulation of individuals who chose the alternative j when faced with a choice process described by a vector of variables x_i , $h(\beta/j, x_i, \theta)$.

The derivation of the conditioned density functions and the respective means for the indicated subpopulations can be found in Train (2003, 298–301). Since probability does not have a closed mathematical expression, it is necessary to simulate the value of the integral. In this paper, we have used the Halton sequences that show greater efficiency than random extractions (Bhat, 2003; Halton, 1960).

Mixed models and some of their extensions have been used previously to analyze wine consumers' preferences, mainly in relation to wine attributes and price (see Escobar et al., 2017; Kallas et al., 2012, 2013; Lai et al., 2008; Stasi et al., 2014).

2.3. Latent class or finite mixture models

Latent class or finite mixture models represent an alternative to the ones described above. Unlike mixed models that presume a continuous distribution for the vector of random parameters, in these models a finite distribution is assumed. In this way, individual heterogeneity is captured by each individual belonging to a group or class. Within each class, preferences are homogenous but heterogeneous between different classes (Hensher and Greene, 2003; Kamakura and Russell, 1989; Vermunt and Magidson, 2005).

The specification of an ordered latent class model assumes that the vector of parameters is distributed among individuals with a discrete distribution, so that in the population there is a finite number of Q classes or groups of individuals, not knowing a priori which individual belongs to each class. Therefore, "the model assumes that individuals are distributed heterogeneously with a discrete distribution in a population" (Greene and Hensher, 2010: 248).

The random utility of alternative j for individual i , is defined as:

$$U_{ij} = x'_{ij} \beta_q + \varepsilon_{ij}$$

where β_q is the vector of parameters of each class and in which a nonparametric specification is assumed. Thus:

$P(\beta_i = \beta_q) = \pi_q$, $\sum_{q=1}^Q \pi_q = 1$, $\pi_q \geq 0$, $q = 1, \dots, Q$ - with π_q being the probability that an individual i belongs to the class q . Also, the probability that individual i chooses alternative

j can be expressed as follows based on the logistical specification:

$$P(Y_i = j/x_i) = \sum_{q=1}^Q \pi_q [\Lambda(\mu_{j,q} - x_i' \beta_q) - \Lambda(\mu_{j-1,q} - x_i' \beta_q)]$$

The estimation of the model by maximum likelihood provides the values of the parameters of the characteristics vector, as well as the probability of belonging to each of the (π_q).

Latent class or finite mixture models, despite having a long history in varied areas, have also received increasing attention in the analysis of consumer preferences and, specifically, in the analysis of wine consumers' profiles (De Magistris et al., 2011; Jarvis et al., 2010; Lockshin et al., 2009; Mueller et al., 2010; Mueller and Sxolnoki, 2010; Rémaud et al., 2008; Scarpa et al., 2006). As indicated by Mueller et al. (2010: 24), and according to Hynes et al. (2008) "[...] broad classes of consumers exist with similar preferences to each other, but different preferences to everyone else, thus the latent class approach is more appropriate. [...] For food in general and wine specifically, the assumption that every consumer has individually unique preferences seems less adequate than the notion of a certain number of consumer groups with similar preferences". Gázquez and Sánchez (2007) point out the importance of considering consumers' heterogeneity in choice models.

3. Results and discussion

The results of the estimation of ordered standard, mixed and latent class models for weekly amounts of wine consumed are presented in Table 2. The dependent variable in the three estimated specifications is the decision on weekly amount of wine to consume classified according to the intervals defined in Section 2.1. The vector of explanatory variables is the set of socio-demographic characteristics of the individuals included in the survey: gender, age, area of residence, marital status, occupation and income level.⁴ For each of the traits considered, dichotomous variables have been defined that take the value 1 if the individual presents the characteristic in question and 0 otherwise. The reference categories of said variables being in all the estimated models: male, 18–29 years old, metropolitan area, married/in a couple, student or homemaker and income less than 600 euros.

In the mixed logit model, the random parameters detected, whose standard deviations were significant at 1% significance, are those that correspond to the variables: gender, age (except the 60 to 69 years old group), living in the north, occupation and two of the income levels (€600–1000, €1000–2000). For all random parameters, normal distributions are assumed.

In the literature on latent class models, there is no test that allows the determination of the number of classes that should

be considered, but rather, a test procedure is used, in which, we start estimating the model with the largest number of classes and the estimated models are compared using the Akaike information criterion (AIC). However, if the model is estimated with an excessive number of classes, the estimates can show high variations with respect to the estimated parameters with fewer classes, leading to instability in the model. Following this procedure, we have selected two groups or classes in which differences in the parameters are observed, with the probability of belonging to class 1 being 42.1% and 57.9% in class 2.

It has been considered appropriate to analyse the results obtained with the simplest specification and then comment on the differences found with the other specifications. In the ordered logit model, the discrete changes are defined as the change experienced in an individual's probability of choosing each of the alternatives when the individual shows the characteristic in question and when they do not. These changes, which have been calculated for each individual and then averaged for the whole sample (see Table 3), indicate that women are 35.7% more likely to consume ¼ l of wine or less per week than men. While they are less likely than men to consume more than that amount, with the greatest differences in the case of gender being between ¼ l and 1 l maximum per week.

Regarding age, the youngest individuals are those who have the highest probability of consuming ¼ litre or less per week, since, the sign of the discrete changes of the other age intervals for this amount is negative. Moreover, this probability decreases with increasing age (up to 69 years old). Likewise, individuals with ages between 50 and 59 are those who have the greatest probability of consuming between a ¼ litre and a litre at most (13.1%), and those between the ages of 60 and 69 have a higher probability of consuming more than one litre a week with respect to the youngest individuals.

As for the area of residence, individuals residing in the north and south of the island have, respectively, 7.3% and 3.9% less probability of consuming a maximum of ¼ litre per week than residents in the metropolitan area. Above this amount, the highest probabilities correspond to individuals from the north.

In the case of the marital status, married individuals or ones living in a couple have a clearly differentiated behaviour from that of single, widowed or separated individuals, since the former are more likely to consume more than a ¼ litre a week. The discrete changes for single and widowed or separated individuals have a negative sign for amounts greater than a ¼ litre a week.

With respect to individuals' occupations, students and homemakers (reference category) are those who are most likely to consume less, that is, the discrete changes for the other occupations are negative. Additionally, these other occupations have higher probabilities than those of the reference category for higher consumption alternatives (note that the discrete changes, in this case, are positive).

Finally, in relation to income, individuals who obtain less than €600 per month (reference category) are more likely to consume a ¼ litre or less per week compared to those with

⁴The educational level, although it is available in the survey, was not introduced as an explanatory variable given that it is not significant in most of the estimated specifications or, as in the case of estimated latent class models, it does not allow the maximization of the likelihood function when this variable is included in the specification together with the income level, given its high correlation.

Table 2Estimations of standard, latent class and mixed ordered logit models for weekly amounts of wine consumed ^a.

	ORDERED	LATENT CLASS		MIXED
		LC1	LC2	
Constant	-1.847***	-4.266	-1.441**	-2.469***
Gender				
Male (reference category)				
Female	-1.730***	-3.093***	-1.731***	-3.330*** (1.774***) ^b
Age				
18–29 (reference category)				
30–39	0.830***	1.088	0.997**	1.104*** (1.029***)
40–49	1.382***	1.618	1.657***	1.881*** (1.784***)
50–59	1.846***	1.884*	2.322***	2.835*** (0.871***)
60–69	1.918***	2.656**	2.172***	3.040***
Over 70	1.288***	1.873	1.532***	1.700*** (0.980***)
Area				
Metropolitan (reference category)				
North	0.336**	1.407**	-0.244	0.232 (1.748***)
South	0.180	-0.494	0.360	0.356*
Marital Status				
Married/In a couple (reference category)				
Single	-0.208	0.294	-0.275	-0.520**
Widowed/Separated	-0.499**	0.164	-0.946**	-0.791***
Occupation				
Students/Homemakers (reference category)				
Civil servants/Employees	0.629**	1.845	0.528	0.852*** (0.925***)
Professionals/Entrepreneurs/Self-employed	0.550*	1.786	0.666*	0.451 (1.921***)
Unemployed/Others	0.540**	1.865	0.366	0.609* (1.766***)
Income				
Under €600 (reference category)				
€600–1000	0.565	-0.145	0.557	0.449 (1.164***)
€1000–2000	0.305	-1.033	0.884*	0.630** (0.645***)
Over €2000	0.248	-0.288	0.518	0.530
Mu(1)	1.208***	-0.067	2.081***	2.109***
Mu (2)	2.603***	0.509	6.349	4.471***
Estimated probability class 1		0.421***		
Estimated probability class 2		0.579***		
Ln L	-891.536	-866.034		-882.724
AIC	1802.072	1771.077		1795.448
N = 1028				

Significance levels: * = $p < 0.1$; ** = $p < 0.05$; *** = $p < 0.01$.^aThe mixed logit model has been estimated considering 125 sequences Halton.^bStandard deviation of random parameters.

higher incomes. These results have some agreement with those obtained in the univariate analysis, although, in the latter, the joint effect of the variables on the probability of each alternative is not taken into account.

When comparing the values of discrete changes of the mixed logit model with those obtained from the ordered logit model, no differences are observed with respect to the sign, although there are differences with respect to their amounts. Specifically, in the case of gender, the magnitude of the change in the alternative of wine consumption between a ¼ l and 1 l at most a week is 21.1 percentage points higher in the mixed specification (38% vs. 16.9%). Moreover, the difference is not

negligible in the case of consuming ¼ l at most per week (almost 15 percentage points higher).

There are also significant differences in relation to age, especially for the segments between the ages of 50 and 69 in the alternative of lower consumption and above 40 years old for the next highest consumption alternative. In addition, for consumption alternatives above 1 litre per week, the magnitude of the discrete changes of the mixed model is lower for practically all socio-demographic characteristics.

If the density of the distribution of some of the random parameters considered in the mixed logit is analyzed, in the case of occupation, it is observed that professionals/

Table 3

Discrete changes of standard and mixed ordered logit models for weekly amounts of wine consumed.

	Ordered				Mixed			
	0–¼	¼–1	1–2	> 2	0–¼	¼–1	1–2	> 2
Gender								
Male (reference category)								
Female	0.357	-0.169	-0.129	-0.059	0.500	-0.380	-0.107	-0.013
Age								
18–29 (reference category)								
30–39	-0.189	0.086	0.070	0.032	-0.195	0.156	0.035	0.004
40–49	-0.320	0.127	0.128	0.063	-0.365	0.276	0.079	0.099
50–59	-0.429	0.131	0.186	0.112	-0.585	0.372	0.187	0.026
60–69	-0.445	0.124	0.197	0.125	-0.628	0.370	0.225	0.033
over70	-0.305	0.112	0.126	0.067	-0.348	0.260	0.079	0.029
Area								
Metropolitan (reference category)								
North	-0.073	0.037	0.025	0.011	-0.055	0.045	0.009	0.001
South	-0.039	0.020	0.014	0.006	-0.036	0.030	0.006	0.001
Marital Status								
Married/In a couple (reference category)								
Single	0.044	-0.023	-0.015	-0.006	0.071	-0.059	-0.011	-0.001
Widowed/Separated	0.098	-0.053	-0.032	-0.013	0.097	-0.081	-0.014	-0.002
Occupation								
Students/Homemakers (reference category)								
Civil Servants/Employees	-0.139	0.068	0.050	0.022	-0.139	0.113	0.023	0.003
Professionals/Entrepreneur/Self-employed	-0.125	0.059	0.046	0.021	-0.074	0.060	0.012	0.001
Unemployed/Other	-0.119	0.058	0.042	0.019	-0.097	0.080	0.016	0.002
Income								
Under €600 (reference category)								
€600–1000	-0.057	0.029	0.020	0.009	-0.070	0.057	0.011	0.001
€1000–2000	-0.066	0.033	0.023	0.010	-0.099	0.081	0.016	0.002
Over €2000	-0.055	0.027	0.019	0.009	-0.091	0.074	0.015	0.002

entrepreneurs/self-employed are those with the lowest average value compared to the rest of the categories, this effect is also seen in the lower magnitude of discrete change. However, the highest concentration of density around the average, that is, the one with smallest standard deviation, is reached in the case of civil servants/employees. In relation to income, there is a shift to the right of the curve corresponding to income between €1000–2000 compared to that of lower incomes, with the former showing a greater effect on the probability of consuming more than one ¼ of a litre per week and a smaller effect for lesser amounts. Regarding age, a higher value of the mean of the random parameter is observed as individuals' ages increase, with those over 70 presenting a differentiated behaviour. It is also noteworthy that there is less kurtosis of the density (greater variance) in the case of individuals between the ages of 40 and 49, who show greater dispersion with respect to the other age segments.

Another relevant aspect in this model is to observe how the discrete change varies depending on the different values of the range of each of the random parameters, since this approximation provides the differentiated effects of the probabilities of choice of each consumption alternative for each of the variables. Specifically, considering the probability of the

alternative of lower consumption, evaluated in the values of the first and third quarter of the random parameter of the gender variable and in the average value of the rest of the random parameters, the discrete change varies from 0.45 to 0.16, respectively. This indicates, therefore, that the effect of unobserved heterogeneity in gender on the probability of consuming a maximum of ¼ litre per week moves within a range of values with an amplitude equivalent to approximately 30 percentage points. In this way, the consideration of unobserved heterogeneity shows that within the group of women who choose the same consumption alternative, there are differentiated behaviours.

The variability in discrete changes is also observed for the intermediate ages, residing in the north, different occupations and two of the lower income intervals. Specifically, in the case of individuals aged between 30 and 49, the effect on the probability of consuming a ¼ litre or less per week varies by more than 25 percentage points with respect to the youngest. In the case of the highest consumption alternative, the greatest variability in discrete changes is found for individuals between the ages of 40 and 59, as well as for the unemployed.

On the other hand, if the discrete changes are calculated over the entire range of values of all the random parameters of

the model, it is observed that the interquartile range of these changes takes the value 0.38 for gender, confirming, again, the dispersion present. In addition, there are women whose probability of consuming a maximum of ¼ litre per week barely exceeds that of men's (10.5%), while others have a probability 65% higher than that of men (see that the average discrete change for gender was 50% in Table 3). Likewise, 25% of women have the least effect on the probability of consuming a maximum of ¼ litre per week, the amount of this effect is less than or equal to 20% compared to men.

The results of the estimated latent class model show, as commented above, differences in the estimated parameters of the two classes. Although the model assumes a flexible and parsimonious specification of data representation, in this paper, it is clear, both in the significance, and in the value of parameters for both classes that, indeed, there is unobserved heterogeneity present in decisions on wine consumption regarded weekly amounts consumed.

Specifically, the difference in the amount of the estimated parameter for the gender variable in both classes (higher in class 1), as well as for those from the north of the island, the widowed/separated category and all the occupation categories is noteworthy. Likewise, parameters of different signs are observed in both classes for all the categories of the area of residence, marital status and income level.

Even though it is not easy to make a natural interpretation of the two classes, based on the results obtained, individuals belonging to class 1 could be identified with those who have more sporadic consumption of small amounts, compared to the individuals of class 2, who are associated with more frequent and larger amounts of wine consumption.⁵ In this case, considering two classes does not try to separate individuals with different socio-demographic characteristics, but rather, to characterize individuals who, even with similar characteristics, present differentiated consumption patterns.

Some additional results that can be obtained from this model are, on the one hand, the probabilities, estimated *a posteriori* of each of the individuals belonging to each class, which would roughly discriminate between the two classes. For instance, the probability of individuals of class 1 consuming a maximum of ¼ litre per week is 66.7%, compared to 61.9% of those in class 2, while the probability that the latter consume more than one litre per week is 5 percentage points higher than that of individuals of class 1. On the other hand, using posterior probability, the number of members of each class can be estimated by assigning each individual to the class in which he/she obtained the highest predicted probability, resulting in 721 individuals in class 1 and 307 in class 2. Likewise, calculating the conditional average as an average of the parameter estimates for each of the classes weighted by the estimated probability of belonging to each class, it is observed that their values are comparable to those derived from the mixed model. Thus, for the majority of variables greater similarity is obtained between these two models than with the ordered specification that does not incorporate heterogeneity.

Table 4

Discrete changes of latent class model.

	0-¼	¼-1	1-2	> 2
Gender				
Male (reference category)				
Female	0.307	-0.090	-0.134	-0.083
Age				
18–29 (reference category)				
30–39	-0.143	0.028	0.073	0.042
40–49	-0.231	0.038	0.126	0.067
50–59	-0.304	0.026	0.191	0.087
60–69	-0.328	0.023	0.180	0.126
Over 70	-0.231	0.026	0.124	0.081
Area				
Metropolitan (reference category)				
North	-0.035	-0.011	-0.004	0.050
South	-0.019	0.014	0.020	-0.014
Marital status				
Married/In a couple (reference category)				
Single	0.017	-0.012	-0.014	0.009
Widowed/Separated	0.090	-0.046	-0.048	0.004
Occupation				
Students/Homemakers (reference category)				
Civil servant/Employees	-0.127	0.018	0.043	0.065
Professionals/Entrepreneurs /Self-employed	-0.147	0.021	0.056	0.070
Unemployed/Others	-0.114	0.012	0.036	0.065
Income				
Under €600 (reference category)				
€600–1000	-0.051	0.020	0.034	-0.003
€1000–2000	-0.053	0.033	0.049	-0.030
Over €2000	-0.042	0.017	0.033	-0.008

With respect to the discrete changes of the latent class model, calculated as the weighted average of the effects by the weight of the classes considered (42.1% and 57.9%, respectively), differences are observed compared to the other two estimated models, both in relation to the amount for each of the consumption alternatives in all the variables as well as the sign for some variables (see Table 4). In addition, it should be noted that in this model, the discrete change in alternatives for consumption of a litre at most per week, for most variables, is lower than that recorded in the case of the ordered standard and mixed models.

On the other hand, if an approximation is used for the calculation of the discrete change for each of the classes, differences between the classes would also be obtained. This approximation has been made using the vector of estimated coefficients of each of the classes for each individual and then averaging for the total sample. Thus, it should be noted that in the case of women, who, in general, have a lower weekly consumption than men, the discrete change in class 1 for the alternative of lower consumption is almost 7 percentage points higher than that of class 2.

The comparison of the three estimated models has been made by using information criteria. First, the model that does not incorporate heterogeneity was compared to each of the models that do incorporate it and then these with each other.

⁵The frequency of consumption and the weekly amount of wine consumed have a high positive correlation.

The mixed model has turned out to be superior to the standard ordered model, taking into account both the individual significance of the deviations of the random parameters and because of its lower value for the Akaike information criterion. In this case, when dealing with nested models, a comparison of the likelihood ratio has also been carried out, reaching the same conclusion. When comparing the standard ordered model with the latent class model, the value of the Akaike information criterion leads to selecting the latter. Finally, we have compared the two specifications that consider heterogeneity in consumer decisions. In this case, both the Akaike information criterion and the test proposed by Ben-Akiva and Swait (1986) provide evidence of the slight superiority of the latent class model versus the mixed model.⁶ In short, the models that consider heterogeneity better also explain individuals' decision regarding the weekly amounts of wine consumed.

4. Conclusions

In this paper, different discrete choice models have been used to identify the effects of certain socio-demographic features of individuals on the probability of choosing a weekly amount of wine to be consumed. From the estimation of a standard model that takes into account the ordered nature of the modalities of the dependent variable, the unobserved heterogeneity present in consumption decisions is incorporated, using two additional specifications: mixed and latent class models.

Based on criteria often used in the comparison of models, the superiority of the specifications that consider unobserved heterogeneity is verified. They, thus, allow the identification of differentiated behaviours for individuals with the same vector of explanatory variables. In addition, between the mixed and latent class models there are fewer differences in the extent of the impacts of individuals' characteristics on the decision to consume a certain amount of wine than with those of the simplest specification. Specifically, the most notable differences between the models that take into account heterogeneity compared to those that do not consider it are the effects of gender, age, mainly for individuals between the ages of 50 and 70 and the area of residence.

Thus, the most characteristic features of individuals who tend to consume smaller amounts of wine are: being a woman, young, resident in the metropolitan area, not married, homemaker or student and with a low income. On the other hand, the features of consumers of greater amounts of wine are: being a man, of intermediate ages, resident outside the metropolitan area, civil servant or professional and with intermediate income levels.

In the latent class model, the consideration of two differentiated classes, in terms of their consumption preferences, could be attributed to the fact that there are individuals who partake in sporadic consumption, and therefore of lesser amounts, compared to others who consume larger amounts.

However, the interpretation or association of each class to these types of consumption cannot be directly verified from the estimation of the model, given the complexity inherent in the choice of weekly amount consumed by individuals with identical observable characteristics.

In the mixed model, the densities of the parameters considered to be random reflect the unobservable heterogeneity of individuals, showing greater or lesser dispersion depending on the characteristic of the variable considered, for example, in the case of occupation or income levels. Indeed, an additional contribution of this paper is obtaining the discrete changes for different values of the random parameters, from which variability is observed and is a reflection of the heterogeneity present. This makes it possible to demonstrate that individuals who have the same modality of a specific characteristic may choose different alternatives. And even, when they choose the same alternative, the effect on the probability of their choice may be different. Moreover, the model allows the characterisation of different groups of individuals that present the same socio-demographic characteristics and yet show differentiated potential patterns in relation to the weekly amounts of wine consumed.

That is, the results obtained indicate that it is not appropriate to consider individuals who have the same traits as if they form a homogeneous group. In addition, these results provide a more accurate and realistic knowledge of individuals' consumption behaviour. Therefore, there is a clear need to use models that take into account unobserved heterogeneity when identifying consumption profiles, especially from socio-demographic variables.

Until now, advertising campaigns and/or marketing strategies have not been effective or, at least, have not been as effective as one would like, because they have been designed under the premise that the individuals to whom they are directed form a homogeneous group in terms of socio-demographic features. However, individuals of the same group can exhibit differentiated consumption patterns. In short, it is important to identify specific profiles, within the same population group, as is the case of women or the youngest consumers. Thus, directing advertising campaigns and/or personalized marketing strategies that are more effective is a matter of great importance if the declining trend of wine consumption per capita is to be reversed.

As for future lines of research, from a methodological point of view, in the case of the estimated latent class model, it would be interesting to study more thoroughly the interpretation of the results and the characteristics of the individuals belonging to each of the classes. In the mixed specification, given the variability detected in the effects on the probability of choosing a consumption alternative for individuals with the same characteristic, it would also be interesting to delve into the different socio-demographic profiles that would result in that case. Moreover, the analysis could also be extended considering non-socio-demographic variables that influence individuals' consumption patterns, as well as other alternative specifications that include the unobserved heterogeneity in consumers' decisions.

⁶See Cameron and Trivedi (2005) for a discussion on the criteria for comparing non-nested models.

In addition, given the scarcity of studies that address unobserved heterogeneity in socio-demographic characteristics of wine consumers, the sample could be extended to other geographical areas and comparisons made of the results obtained.

Finally, although the main wine consumers in Tenerife are residents, non-residents could also be analyzed. Not only, because for a popular tourist destination like Tenerife, there are millions of non-resident visitors, but also because this segment has not been sufficiently analyzed in the literature. Therefore, it could be a key segment on which to focus future marketing strategies that could help increase consumption and revitalize the island's wine sector.

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