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## RESEARCH IN ECONOMICS AND RURAL SOCIOLOGY

**CONSUMER BEHAVIOUR AND PRODUCT CHARACTERISTICS: CURRENT RESEARCH  
AND FUTURE STAKES**

*The quantitative saturation of food demand in developed countries compels firms to adopt qualitative differentiation policies and to multiply variants of food products supplied on markets. It is therefore important to understand how choices are made between products with very close characteristics, the difficulty being to predict consumers' reactions (to a modification in price or characteristic, to the introduction of a new product etc.). Consumers are rarely able to know and identify all the characteristics of a product, and their perception is influenced by the available information. This text presents modelling approaches used to take into account product characteristics in individual choice analysis by granting particular attention to the stakes underlying recent developments in this field.*

**Introduction**

The objective of individual choice analysis is to find the means of observation and measurement of choice determiners and their variability. For that purpose, one must have a conceptual framework that allows identification of individual choice determiners. Economics and psychology provide this framework, assuming that individuals act in such a way that their choice is the one that gives them either the highest utility (economics) or the highest satisfaction (psychology) out of the set of possible choices. To identify, from observed choices, the product characteristics that influence consumers' choices and characterize the socio-demographic attributes that explain choice variability, a non-observable variable, or latent variable, called "utility" is introduced. The model-maker makes it depend on observed characteristics of goods and consumers. They rely on the characteristic theory which stipulates that single or combined products are consumed not for themselves but for the characteristics they have (for instance, a meal is a particular combination of nutritional and gustatory attributes). The other factors affecting utility but unobserved by the model-maker are taken into account via the introduction of error terms. Then, this "structural" part of the model is completed assuming that the observed choice of a product by consumers means that the utility they get from this choice is higher than the utility they would get from any other product.

This framework sums up the underlying modelling approach to two broad families of models generally used to analyse individual choices of differentiated products: hedonic and discrete choice models. The following two

sections illustrate these two types of modelling by researches conducted within the SAE2 Department. A last section sheds some light on current areas of research in the domain of choice modelling.

**Objective characteristics and sensory characteristics**

The characteristic theory rationalizes an older empirical practice, hedonic regression, which allows measurement of the contribution of the characteristics of a product to its price. It consists in regressing the price of an item on some of its attributes. Then the attribute's implicit price, or hidden price, is defined as the derivative of the price of the product with respect to this attribute. In the context of a perfect competitive market, it is interpreted as the value attributed by consumers to an additional unit of the characteristic. If the estimated implicit price is non-significantly different from zero, either the characteristic is not perceived or it is not considered as an important characteristic and is not valued by consumers.

Although the hedonic price method has mainly been applied to durable goods because their attributes can be easily identified and measured, it may also be used for food products. The pertinent characteristics are not limited to physical or informational properties in this case. For wine, for instance, although the label of the bottle provides information on vintage, property, ranking of the wine, and so on, the most important characteristics are unknown. Indeed, the label gives no information on sensory wine characteristics (appearance, smell and taste). But as they generally are essential factors of acceptability or rejection of food by consumers, sensory properties must also be

considered. On that basis, Combris, Lecocq and Visser (1997 and 2000) estimate hedonic price equations for Bordeaux and Burgundy wines, considering not only objective wine characteristics (that is to say those appearing on the label: vintage, appellation, ranking) but also sensory characteristics, in order to find out the implicit value given by consumers to both types of characteristics. They use data collected from two issues of a French review called *50 millions de consommateurs* presenting the results of a tasting of a sample of 519 Bordeaux wines and 613 Burgundy wines by panels of experts. Wines were selected at random among those with a selling price, ex-cellar, was between 3 and 30 Euros per bottle. Moreover, the sample was representative of the main Protected Denominations of Origin (PDO).

The experts blind-tasted the wines. For each wine, the review publishes a report on the olfactory assessment (aromatic intensity, finesse, complexity of aromas), gustatory assessment (firmness of attack, suppleness, flesh, concentration, harmony between components, length of finish etc.) and on some general remarks (alcohol degree, ageing potential etc.). In what follows, these variables are called sensory variables. An average grade (between 0 and 20) is also given to each wine. The review gives information on the name of the château or domain, ranking, colour, vintage and appellation. These variables are called objective variables. Lastly, the review provides the price at which each bottle was purchased.

The dependent variable in the hedonic price equations is the logarithm of the price of a bottle of wine. The explicative variables are all the bottle attributes, represented by the objective and sensory variables defined above. Results show that if prices depend on objective attributes, they much less depend on sensory attributes and, for example, are more weakly correlated with experts' grades than with ranking.

### **Valuation of a quality label**

Another way to account for the influence of goods' characteristics on individual choices consists in using discrete choice models. These allow us to assess the effect of a characteristic on the probability of choosing a product. All are based on random utility models, where utility is broken down into a "systematic" part, depending on product characteristics and individuals' attributes, and a random part representing not only "pure" hazard but also unobserved heterogeneity in preferences, that is to say consumers' experience and information on product characteristics. Parameterizing the utility function enables us to obtain expressions for choice probabilities depending on product characteristics and individuals' attributes. If some models are known to impose a lot of structure on preferences (in the multinomial logit, for instance, they are identical for all consumers), others, like the mixed logit, provide a flexible representation of preferences allowing them to vary within the population.

A field of application for discrete choice models is quality labels. Consumers are confronted, specifically for food, with a large number of informational signs: PDO (Protected Denomination of Origin), labels etc. These intend to give better information to consumers. But the

conveyed information must be correctly perceived; all the more so in that label proliferation may lead consumers to some confusion about their meaning. Some researchers have tried to characterize consumers' demand for this type of attributes and assess the way quality labels are valued by market.

Bonnet and Simioni (2001) use a mixed logit model to represent consumers' choices between several brands of Camembert and identify their willingness-to-pay for the "Normandy Camembert" PDO label. They use data from the 1998 SECODIP database, which records the purchases of a representative panel of 4,267 French households. For each purchase, data provides the unit price and some of the characteristics of the purchased camembert (brand, PDO label or not), as well as information on the socio-demographic attributes of the buyer.

Although the data provides information on the purchased item, it does not give any on the goods that were present at the moment of the purchase but which were not bought. In other words, the consumer's set of choices is unknown. To get round that problem, the authors assume that all the brands faced by a household on a given date and in a given group of shops correspond to the whole set of purchased (and registered in the data) brands at the same date and in the same group of shops.

The estimation of the model gives a demand curve for the PDO label and characterizes the willingness-to-pay for that label according to individuals' income and age. Results show that the quality sign provided by the PDO label is not valued by the large majority of consumers: for the same price, only 16% of them would choose a PDO Camembert rather than a non-labelled one. On this market, the brand seems to be a more relevant signal. Results also show the importance of income in willingness-to-pay, well-off consumers being inclined to pay more than others for PDO labels.

### **Individual choice-modelling**

#### *Accounting for unobserved characteristics*

The models considered in the previous sections assume that all the product characteristics are observed by the econometrician. But this hypothesis is specifically strong when choices are studied on the basis of purchase data. Indeed, in that type of data, only the brand bought by the consumer, the price paid for it and some of the physical characteristics of the item (un-pasteurized milk or pasteurized milk camembert, for instance) are generally observed. Other characteristics may intervene in the consumer's choice and may not be observed, either because they are difficult to quantify (style etc.) or because they are differently perceived from one consumer to the next (quality, durability etc.). Moreover, it is not unusual to observe a positive demand for a product which is no better than another one in terms of physical characteristics and which is more expensive. In such a case, the variable making the product more attractive for some consumers is probably not observed.

Discrete choice models and, more recently, hedonic models take into account the possible existence of characteristics that are unobserved by the econometrician.

This introduction allows the model-maker to solve the problem of price endogeneity. Indeed, many papers on consumer choices neglect the fact that certain variables affecting utility, such as price, presence of a promotion or advertising operation, are set by the supplier (producer or retailer) on the basis of the information relating to the situation of the market under study, which is not observable by the econometrician but which, nevertheless, has an influence on the consumer's choice. Thus, these variables may be correlated with the error term introduced into the consumer utility and may lead to serious biases when parameters are estimated, implying recourse to more elaborated techniques and, sometimes, to other data sources. Bonnet, Dubois and Simioni (2005) illustrate this approach by estimating a nested logit choice model to study the demand for bottled water in France from the SECODIP database. Recent studies also generalize hedonic models for modelling cases where characteristics are unobserved.

#### *A generalized model of choices approach*

In the domain of consumer choice modelling, the main stakes can be illustrated from Figure 1. Usual choice models such as those described above are depicted in the central part. The opening of the "black box" that represents the formation of individuals' preferences is then suggested, following two complementary entrances:

(1) The first is described by full arrows. It consists in replacing consumers' choices in a temporal perspective and introducing economics modelling concepts derived from psychology: memory which depends on past consumption experiments, perceptions and beliefs which depend on available information etc. Then, choices are the result of a process in which consumers first collect information on products. This information is converted into "attributes perceived" by individuals, memory playing a role in the revision of their perceptions and beliefs. The choice process consists in aggregating these perceptions into a utility index which is then maximised.

(2) The second entrance, summed up by dashed arrows, complicates the previous diagram by introducing "constructs" (motivations, attitudes etc.) also derived from psychology.

In order to incorporate some of these elements from an operational point of view, it has been proposed in the literature to generalize the discrete choice models framework by adding two types of models already used in psychometrics and marketing: a latent variable model and a latent class model. The interactions between these models are presented in Figure 2. Reading this graph calls for the following comments:

(1) The central part of a generalized choice model is composed of the usual structure of discrete choice models. It is the "kernel" of the model. This framework may be enriched by taking into account the existing heterogeneity in individuals' preferences, using the mixed logit model for instance.

(2) Some authors thought of adding a latent variable model to this central framework. Its purpose is to explain certain

economically irrational choices by introducing into the modelling of utility psychological factors unobserved by the econometrician (thus, latent) such as attitudes or perceptions. This modelling thus propose to capture the heterogeneity observed in individuals' choices by combining some "hard" information on these choices, measured by socio-demographic characteristics, with "softer" information on some of their psychological characteristics such as risk perception or impatience, which are difficult to measure. The model-maker must, then, have recourse to indicators, constructed from answers to subjective questions, for instance.

(3) In parallel with mixed models or latent psychological variable models, latent class modelling may also be used to capture a part of the unobserved heterogeneity between individuals. The idea is that consumers may be divided into classes that cannot be directly identified from the data. To each of these classes corresponds a utility function and, thus, proper parameters. This type of modelling is used by Etilé (2005) to study some risky consumptions determiners (cannabis and alcohol). He brings to the fore three classes of consumers and studies each one's membership probability according to latent variables such as hyperactivity or risk aversion for which different indicators are available in his data.

#### *Observed choices and stated choices*

Many papers on individual choice analysis use data from the observation of real choice situations. For example, Bonnet and Simioni (2001) use data from the SECODIP consumer panel. This data records all the consumers' purchases and enters the "observed choice" category. It informs us on the choices realized in concrete situations, that is to say integrating real constraints on individuals' decisions, specifically the budget constraint. On the other hand, it raises several problems. For instance, the set of choices faced by consumers who buy goods is not observed by the model-maker. The latter must make assumptions on this choice set or have recourse to rather complex estimation techniques. Furthermore, few characteristics are observed in this type of data.

To overcome observed choice data drawbacks, one may resort to experiments where individuals have to choose between different alternatives (Combris and Ruffieux, 2005). This data belongs to the "stated choice" category. The idea is to place people in a situation of choice between different price levels and characteristic combinations. One advantage of this data is that it allows us to deal with characteristics that are not always present in the products supplied to consumers on the market (GMO presence or not, for instance). The main drawback is that the choice situation proposed to the individual is totally hypothetical, the latter facing none of the constraints he would face in a real-life choice situation.

The literature on individual choices suggests using both types of data categories so that the strength of some overcomes the weaknesses of others. For example, observed choice data may be used to describe consumers' choices in the case of equilibrium on the considered market. Then, little attention is given to choices made by consumers, on the one hand between the characteristic

levels of the products present on the market, which are not usually much differentiated in this type of data, and on the other hand when a new characteristic or a new product is

introduced on the market. In contrast, stated choice data may be used to shed some light on these choices.

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#### **For further information**

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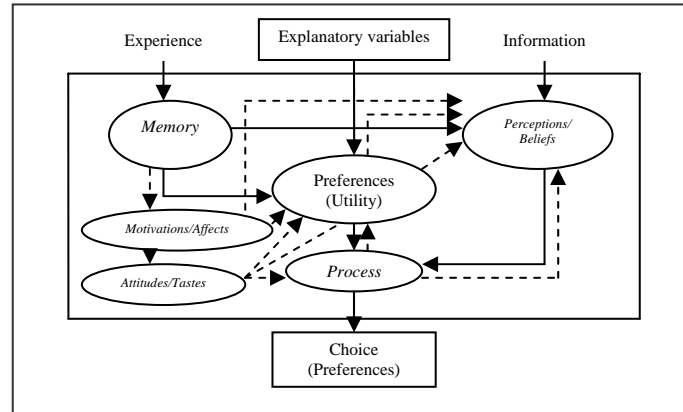
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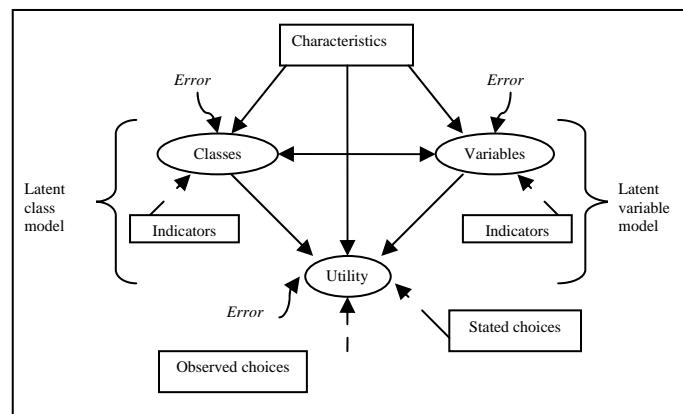
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**Figure 1: A general vision of the choice process**



Source: **McFadden** (2001). Economic choices, Nobel Lecture. *American Economic Review*, vol. 91, pp. 351-378.

**Figure 2: Structure of a generalized choice model**



Source: **Walker and Ben-Akiva** (2002). Generalized random utility model. *Mathematical Social Sciences*, vol. 43, pp. 303-343