Demand for Pharmaceutical Drugs: a Choice Modelling Experiment*

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Abstract

Despite the importance of supplier inducement and brand loyalty in the drug purchasing process, little empirical evidence is to be found with regard to the influence that these factors exert on patients' decisions. Under the new scenario of easier access to information, patients are becoming more demanding and even go as far as questioning their physicians' prescription. Furthermore, new regulation also encourages patients to adopt an active role in the decision between brand-name and generic drugs. Using a stated preference model based on a choice survey, I have found evidence of how significant physicians' prescription and pharmacists' recommendation become throughout the drug purchase process and, to what extent, brand loyalty influences the final decision. As far as we are aware, this paper is the first to explicitly take consumers' preferences into account rather than focusing on the behavior of health professionals.

Keywords: Brand loyalty, demand inducement, drug price elasticity, discrete choice experiment.

JEL codes: I11, D12, C28, C93.

1 Introduction

The purchase of pharmaceutical drugs is more than a "purchasing act in itself" because it involves a multi-stage process in which, firstly, a physician writes a drug prescription, secondly, a pharmacist dispenses and substitutes and, finally, a patient consumes. The existence of *information asymmetries* between physicians and patients and *uncertainty* about drug effectiveness generate supplier inducement and brand loyalty respectively.

In this traditional framework, physicians are the core of the system, however, under the new scenario of easier access to information, patients are becoming more demanding and even go as far as questioning their physicians' prescription. Furthermore, new regulation also encourages patients to adopt an active role in the decision between brand-name and generic drugs. In this sense, healthcare systems are going through a transition from a physician-directed system to a patient-directed one (Section 2).

The new pharmaceutical framework makes the analysis of patient preferences interesting, however the empirical literature on pharmaceuticals demand is very limited and has always been focused on the behavior of either physicians or pharmacists. Furthermore, all these studies use revealed preference data to estimate the objective utility function. On the contrary, this paper directly focuses on consumers' preferences using stated preference data (Section 3).

As far as we are aware, this paper is the first to explore consumers' preferences for commercial drugs using stated preference data obtained from a choice survey. This method is based on the premise that consumers evaluate the convenience of a product by combining the separate amounts of utility provided by each attribute. In our case, a representative sample of 439 individuals are surveyed and asked to rank a set of commercial drug alternatives according to their preferences (Section 4).

The parameters of our utility function are estimated using a *rank ordered logit* -a generalization of McFadden's conditional logit- and will determine the significance of brand loyalty, laboratory reputation and reliance upon healthcare experts throughout the decision-making process (Section 5).

The remainder of the paper is organized as follows. The nature of pharmaceutical demand and the role of consumer preferences is described in depth in Section 2. Section 3 introduces the most recent methodologies used in the estimation of consumer preferences. Section 4 describes the stages involved in an experimental design from the identification of attributes and levels to

the collection of data. Section 5 summarizes the results and, finally, Section 6 brings together the conclusions.

2 The Nature of Pharmaceutical Demand

Demand for pharmaceutical drugs is unusual in the sense that the consumer is typically not the one deciding which product to consume and often not the one paying for it. Indeed, the purchase of pharmaceutical products is more than a "purchasing act in itself" because it involves a multistage process: firstly, a physician writes a drug prescription, secondly, a pharmacist dispenses and substitutes whenever possible (*diagnosis and treatment*) and, finally, a patient pays and consumes (*drug consumption*).[1] Therefore, we can not disconnect the drug purchase act from the visit to health experts.[2] Figure 2.4 displays two different levels of bilateral relationships: those between experts -physicians and pharmacists- and patients and those between each of the agents and the drugs.

[1]The role of the pharmacist at the dispensing stage is determined by the nature of *national substitution laws* and the amount to be paid by the patient depends on the *pharmaceuticals reimbursement mechanism* that applies to each country.

[2]This is not the case for OTC drugs, available at drugstores without a physician's prescription.

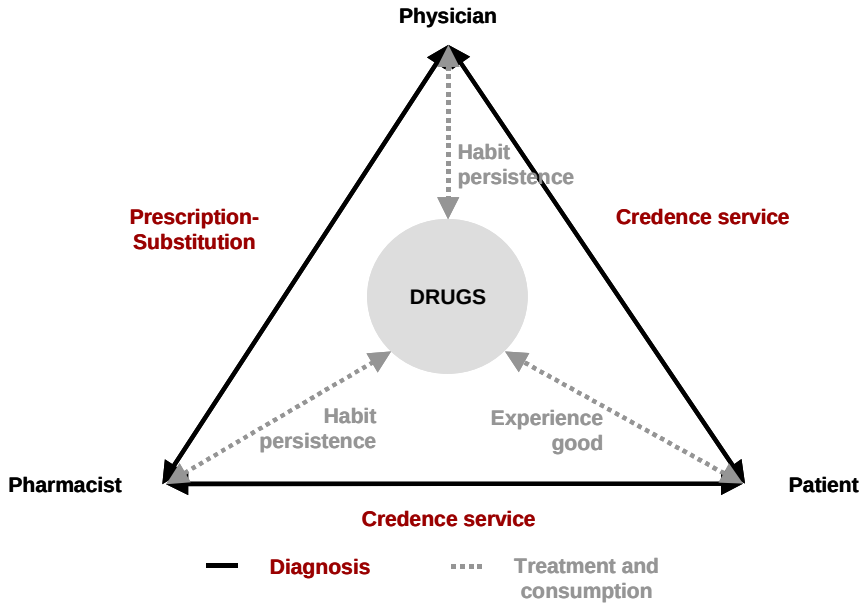

Figure 2.4. Bilateral Relationships in the Pharmaceutical Market

The drug purchasing process is characterized by the existence of *information asymmetries* between physicians and patients and *uncertainty* about drug effectiveness. Because medical knowledge is so complicated, the information hold by the physician regarding the consequences and possibilities of treatment is necessarily very much greater than that of the patient, or at least, so it is believed by both parties. On the other hand, since most drugs differ both in their effectiveness and their incidence of side effects across patients, uncertainty is also an important and long-recognized component of drug consumption (Arrow, 1963). Diagnosis and treatment services provided by heath professionals fulfil the definition of *credence service* and generates supplier inducement. On the other hand, drug consumption satisfies the characteristics of an *experience good* and raises brand loyalty among consumers.

2.1 Supplier Inducement

Credence goods have the characteristics that, even when consumers can observe the utility they derive from the product/service *ex-post*, they cannot

judge whether the quality they received corresponds to their *ex-ante* requirements. Therefore, sellers act as experts determining customers' needs. This information asymmetry between buyer and seller obviously creates strong incentives for opportunistic seller behavior (Edmons, 1997). If this expert also supplies the customer with the treatment then the "expert fraudulent" problem can emerge, that is, the expert prescribes excessive use of the product to the consumer. This is usually the case between health professionals and patients. Under the new regulatory framework, pharmacists are allowed to substitute a therapeutically equivalent drug for the one written on the physician's prescription.[3] Therefore, pharmacists play a new role in the treatment process and also become experts. As consumers are aware of the expert fraudulent problem, they face a *psychological switching cost* of changing from an expert they believe they can rely on (Klemperer, 1995).[4] As a consequence, trust becomes a key element in the relationship between the consumer and the expert. Patients firmly trust their doctors' and pharmacists' opinions and are reluctant to switch to other treatment if experts do not advise them to do so.

Two problems have been the focus of research in the literature on credence goods: (i) provision of an inefficient treatment and (ii) charging for a more expensive treatment than that provided. The first problem can be of two types: on the one hand, it is inefficient if a consumer receives a cheap treatment, when he actually needs an expensive one. This inefficiency is labelled *undertreatment*. On the other hand, it is inefficient if a consumer receives an expensive treatment when a cheap one would be enough to solve their problem. This inefficiency is labelled *overtreatment*. The second potential problem is that an expert might claim to have supplied an expensive treatment even if they have only provided a cheap one. This kind of fraud is labelled *overcharging* (Dulleck and Kerschbamer, 2001). In Health Eco-

[3]Most of the American states have adopted "permissive substitution laws" that allow a pharmacist to substitute a therapeutically equivalent drug for the one written on the prescription. In Europe, several countries have also approved mandatory substitution laws. These countries are: Denmark, Finland, France, Iceland, Italy, Luxembourg, The Netherlands, Norway and Spain (NERA, 2001).

[4]Psychological switching costs appear when the use of a product can induce a person to change their tastes so that they prefer a certain product to a functionally identical one. Psychological switching costs can also arise when the good in question is a credence good, that is, a product or service whose uselfulness or necessity is not directly measurable by the consumer, even after consumption, and may only be known by the expert seller. One example of credence goods is the medical services.

nomics, the phenomenon of overtreatment is commonly known as *supplier-induced demand*.[5] Professional ethics encourages supplier inducement in the interest of the patient, because the latter often has insufficient information to judge what treatment will improve their health.

2.2 Brand Loyalty

As previously mentioned, drug consumption shares the characteristics of experience goods. An experience good is a product whose quality or suitability for the buyer is only discoverable after consumption. When the buyer knows more about the quality of one good the longer he has consumed it, the option to switch is not an attractive one because of the risk it involves. Consequently, in order to switch, buyers may have to be compensated for this uncertainty. As stated by Klemperer (1995), consumers tend to re-use those medicines that have already worked for them, in preference to taking the gamble of trying drugs that they have not tested before and that may not suit them. In pharmaceutical markets, a consumer behaves as if they faced a switching cost equal to the maximum premium that they would be willing to pay to be guaranteed a product of the same value as the one they have previously purchased.

As noted by Klemperer (1987), the existence of *switching costs* can mean that ex-ante identical and homogeneous products become ex-post heterogenous. Consequently, switching costs lead to a form of *"artificial" product differentiation*, which has implications for firms' strategy and consumer behavior.

2.3 The New Role of Consumers Preferences

Several recent studies have stated that patients are becoming active participants in the drug decision-making process, with the confidence to question and even override doctors' decisions. This is mainly due to the fact that patients have greater access to information than before. Under these conditions, healthcare systems are going through a transition from a physician-directed system to a patient-directed one (Matthews, 2001). The drug decision-making process consists of two stages: first, the physician chooses the active

[5] Demand inducement exists when a healthcare provider, usually a physician, influences a patient's demand for care against his own interpretation of the best interest of the patient (McGuire, 2000).

ingredient and afterwards the commercial name -either a brand-name or a generic version- is prescribed and dispensed. Although it would be rare that patients influence the choice of the chemical compound, it is getting more common for patients to participate in decisions on commercial products.

Evidence of this transition process is the recent phenomenon of the increasing importance of *Direct-To-Consumers Advertising* (DTCA) in those countries where legislation allows it. Advertising is a vehicle for getting information to customers and telling them about product availability, quality and cost. This spending on DTCA reflects a widespread belief within the pharmaceutical industry that patients may influence the choice of prescription drugs (Coscelli, 2000).

The wedge between the interests and preferences of the patient and the actual behavior of the physician raises the concept of *patient compliance or non-compliance*. After receiving a drug prescription from a physician, patients choose whether or not to fill the prescription (purchase compliance), whether or not to consume the drug in accordance with the doctor's prescription (use compliance) and whether or not to maintain the prescription over the life of refills and follow-up (sustained compliance). Ellickson et al (1999) reviewed evidence that non-compliance rates are astonishingly high, reaching up to 70%, and found that there is substantial variation in the compliance rate, depending on the type of drug and disease being treated.

Armantier and Namoro (2002) examined the prescription behavior of doctors and compliance on the part of patients in an agency model that accounts for the interplay between patient non-compliance, direct-to-consumer advertising and drug promotion toward doctors. They found that doctors' prescriptions are directly influenced by the probability of patients' noncompliance as well as by advertising aimed at doctors and patients.

Finally, another factor that stimulates the patient to become a decision-maker at the chemist's shop is the implementation of substitution laws. In some sense, this legal framework encourages the *use non-compliance*, that is, although patients are not able to choose between active ingredients, they can indeed decide between the generic or the branded version of the same drug.

In several European countries, governments have introduced the *reference price system*, a reimbursement mechanism aimed at motivating those price-sensitive consumers to replace expensive brand-name drugs with their corresponding lower-cost generic versions. The aim of the Health Ministries is then to mitigate the habit persistence and brand loyalty of consumers providing economic incentives through a cost reduction in the purchase of

pharmaceutical drugs.

In conclusion, under the scenario of easier access to information, patients become more demanding and may even reject their physicians' prescription. Furthermore, new regulation also encourages patients to adopt an active role in the decision-making process between brand-name and generic drugs.

3 Estimation of Consumers Preferences

The aim of this paper is to estimate consumer preferences for commercial drugs using a choice modeling experiment. As mentioned before, the new pharmaceutical framework makes the analysis of patient preferences interesting, however, the empirical literature on pharmaceuticals demand is very limited and has always been focused on the behavior of either physicians or pharmacists. Moreover, all of them use revealed preference data to estimate the degree of supplier inducement in the drug purchasing process; that is, these models use historical data on the choices effectively made by physicians or pharmacists.[6]

As far as we are aware, this paper is the first to explore consumer preferences throughout the drug purchasing process using stated preference data obtained from a choice survey.[7] In this special type of surveys, customers are asked to respond a list of socio-economic questions and rank, according to their preferences, a series of alternatives that represent real or hypothetical products. Although economists typically display sckepticism about relying on what consumers say they will do compared with observing what they actually do, there are many situations in which one has little alternative but to take consumers at their word. The premise of this article is that stated preference surveys can produce data consistent with economic theory, and from this it is possible to estimate econometric models which are indistinguishable from their revealed preference data counterparts.

[6]The empirical work by Ellison et al (1997) analyzed the prescription and dispensing process and therefore the preferences of physicians and pharmacists. Using micro-data, Hellerstein (1998) examined physicians' prescription behavior and found evidence of persistence , even after controlling for observable characteristics of physicians and patients. Lundin (2001) found the existence of moral hazard in the physician prescription behavior. Coscelli (2000) used a panel daa on both doctors and patients so as to analyze the importance of their preferences in the prescription decision.

[7]By choice survey we mean any form of data collection involving the elicitation of preferences.

Traditionally, the majority of econometric models have used revealed preferences (RP) to estimate consumers preferences, however, stated preference (SP) data have been extensively used in market research and, more recently, in discrete choice modeling techniques. In some cases, the use of SP has important advantages: (i) SP allows the estimation of consumer preferences in those situations where information on the choices made by individuals is not available; (ii) in addition to this, it is possible to estimate the preferences of individuals for attributes or characteristics of products that are currently non-existent; (iii) SP solves the problem of collinearity that exist between product characteristics when RP is used. This is probably the most common limitation of RP data and one might well wonder why many economists would argue that severely ill-conditioned RP data are superior to SP data just because they reflect "true" market choices and (iv) SP allows the range of possible values in product characteristics to be extended. In many cases, RP is limited by the low variability of some product characteristics (such as price) that prevent the parameters of the utility function from being estimated efficiently.

In our case, all conditions are satisfied up to a certain extent. For example, in Spain, there is not enough market information about the choice made by patients at the chemist's shop. Moreover, we include non-existent alternatives (i.e. generic drugs which are more expensive than branded products) in the experiment to be able to capture the trade-off between attributes.

Despite some advantages, SP data are not always considered to be valid for model estimation due to the uncertain reliability of information elicited under hypothetical scenarios. SP data may contain biases and large random errors if the decision making protocol exercised in a hypothetical situation differs from that exercised in a real choice context. Some of the difficulties we may face are the following (Morikawa et al, 2002): (i) the respondent considers only the most important attribute of the alternatives (the prominence hypothesis); (ii) the response is influenced by an inertia of the current actual choice; (iii) the respondent uses the questionnaire as an opinion statement for his or her own benefit; (iv) the respondent does not consider situational constraints and (v) the respondent misinterprets or ignores an attribute if the attribute value lacks reality.

In order to avoid all these problems, it becomes crucial to design the experiment perfectly. This implies correctly identifying the attributes and their corresponding levels, constructing choice sets and alternatives, determining dominance criteria and presenting a realistic scenario.

3.1 Choice Modeling Methodology

Discrete choice models have been extensively used to analyze consumer choice behavior because they enable us to measure the influence of demand attributes. This class of models is based on the random utility theory (RUT) developed by Thurnstone in 1927; however, current theory and methods owe most of their legacy to McFadden who extended Thurstone's original theory for comparisons of pairs of alternatives to multiple comparisons and choices.

RUT leads to families of probabilistic discrete choice models that describe the behavior of individuals in response to changes in choice attributes and/or factors that measure differences in individuals. Families of probabilistic discrete choice models can be derived by specifying a particular probability distribution for ε_{ij}. McFadden postulated that the random components were i.i.d.extreme value type I which leads to the multinomial or conditional logit model.[8]

In this paper, we use a generalization of the well-known conditional logit regression model introduced by McFadden (1973). In economics literature, the generalization was proposed by Beggs et al (1981) and further developed by Hausman and Ruud (1987) under the name of *rank-ordered logit model*. The model was independently formulated by marketing researchers who called it the *exploded logit model* (Chapman and Staelin, 1982). They developed a procedure to enhance the estimation of the parameters of the stochastic utility model by exploiting the additional information contained in the preference rank ordering of choice set alternatives.[9]

In a rank ordered logit model, each of the terms in the product has the form of a conditional logit model. The first step is to choose the most preferred item from among the entire set of J items. McFadden's model for the probability of choosing item j^* from among the entire set is:

$$\frac{\exp(X_{ij^*}\beta)}{\sum_{j=1}^{J}\exp(X_{ij}\beta)} \tag{1}$$

When that choice has been made, the probability that the respondent will

[8] Historically this distribution has been referred to by several names, including, Gumbel, Weibull or double-exponential.

[9] Also called Contingent Ranking.

choose item m from among the remaining items is:

$$\frac{\exp(X_{im}\beta)}{\sum_{j=1} \exp(X_{ik}\beta) - \exp(X_{ij^*}\beta)} \tag{2}$$

i.e. the term associated with j^* is removed from the denominator. This continues so that, at each step, the denominator is calculated by substracting the numerator in the previous step from the denominator in the previous step. If the final choice is between items r and s, the probability of choosing r is:

$$\frac{\exp(X_{ir}\beta)}{\exp(X_{ir}\beta) + \exp(X_{is}\beta)} \tag{3}$$

Taking the product of all these probabilities, we get:

$$Li = \prod_{j=1} \frac{\exp(X_{ij^*}\beta)}{\sum_{k=1}^{J} \delta_{ik} \exp(X_{ik}\beta)} \tag{4}$$

where $\delta_{ik} = 1$ if $Y_{ik} > Y_{ij}$ and 0 otherwise. Let Y_{ij} be the rank given to alternative j by respondent i. If there are J alternatives in each choice set, then Y_{ij} can take integer values from 1 through to J, where 1 is the "best" rank and J is the "worst".

In order to obtain efficient estimators it is indispensable for the survey to be designed in a way that minimizes the variance and co-variance matrix of utility function parameter estimates. This requires the design of an experiment from which attributes and their corresponding levels are identified, factorial design and choice sets are constructed and a questionnaire is written.

4 Experimental Design

Recently there has been an increasing interest in choice modeling experiments applied to health economics for eliciting individuals' preferences for non-existing healthcare programs, relationships between doctor and patient and willingness to pay for different healthcare treatments.

In contrast to revealed preferences, stated preference data are generated by some systematic and planned design processes in which attributes and

levels are pre-defined without measurement error and combined to permit rigorous testing of certain hypotheses of interest. This systematic process is called *factorial design* and consists of the factorial enumeration of all possible combinations of attribute levels, that is, each level of each attribute is combined with every level of all other attributes thereby building different choice alternatives. Afterwards, each individual is presented with a sequence of choice sets and asked to rank their most preferred alternatives. Each choice set contains several alternatives defined by a set of attributes and attribute levels. Individuals' preferences are revealed by their choices (Carlsson et al, 2002).

A natural and important question is how good the priors about the parameters in the utility function are. Some indicative information can be obtained from reviewing literature and consulting experts, but running focus groups and pilot studies is also of vital importance. As a preliminary step, focus groups and pilot studies are used to collect information about suitable attributes and attribute levels to include in the experiment. Furthermore, they are often used to test the questionnaire and to give information about how respondents receive and interpret the information presented. Further sections describe in more detail the development of focus groups and pilot test carried out throughout our experiment.

A description of the development of a choice modeling experiment, which is applicable to all types of stated preference surveys is given by Ryan et al (1997), Hanley et al (2001), Carlsson et al (2002) and all of them identified the following stages: (i) selection of attributes and assignment of corresponding levels, (ii) construction of the choice sets by combining the attribute levels in each of the alternatives, (iii) collection of responses and (iv) econometric analysis of data. The first stage consists of identifying the relevant attributes and their corresponding levels to be valued. This is usually done through literature reviews, focus groups discussions and consulting experts. From conclusions, the dependent variables of the utility function are selected. The second stage, which is usually called statistical design, implies the choice of a full factorial versus a fractional factorial design, the construction of choice sets to be presented to the respondents and the choice of a survey procedure to measure individual preferences (ratings, rankings and choices). The collection of responses implies a fieldwork in which a representative sample of individuals is selected and asked to answer socio-economic questions and ranked the alternatives in each of the choice sets. Finally, once dataset is constructed, maximum likelihood estimation procedure is applied in order to

obtain the results.

The present section analyzes the first three stages of the experimental design and additionally selects the active ingredients to which the choice survey applies. The next section summarizes the results of the estimated models including the effects of each of the choice attributes (main effects) and demand segmentation according to socio-economic and habit purchase characteristics (interactions).

4.1 Selection of Drugs

We developed two parallel experiments -one referring to a common infection and the other to a chronic disease- with the aim of seeing whether the degree of illness awareness could modify consumers' decision between a brand-name and a generic drug. So as to present a realistic scenario to individuals, we identified two active ingredients that should fulfil some basic conditions.

The first active ingredient we looked for had to be used for common infections, such as a throat infection, implying an occasional and non-continuous treatment at individual level but a high level of consumption among the population at large. For the second experiment, we needed a drug for a chronic disease implying a long and repeated treatment throughout the year. The selected chronic disease had to be widely spread among population, though it could not be subject to "price reduction".[10]

For the first experiment, we selected a throat infection and an antibiotic to treat it.[11] The use of an antibiotic could not be repeated and continuous throughout the year and a throat infection is only supposed to be caught occasionally. From the conclusions derived from the focus group discussions and the statistics on consumption of active ingredients, we realized that amoxiciline could be a potential candidate. According to the National Health System (SNS) statistics, although amoxiciline has recently dropped positions in the rankings of the most consumed compounds, it is still one of the most relevant by number of packages, together with paracetamol and acetylsalicylic acid (Table 2.7).[12]

[10] According to Royal Decree 83/1993, patients affected by one of the chronic disease contemplated in the mentioned Royal Decree must just pay a 10% of the total price.

[11] A recent study published at JAMA (2001) found that the great majority of patients that visit the doctor because of a throat infection receives an antibiotic treatment, although this therapy is only appropriate for the 10% of cases *(Correo Farmacéutico, 17/09/2001).*

[12] Spanish Ministry of Health. Statistics available at www.pmfarma.com

Consumption in volume (# packages)	1996		1997		1998		1999		2000	
	Packages	Ranking	Packages	Ranking	Packages	Ranking	Packages	Ranking	Packages	Ranking
Paracetamol	17,106	1	18,067	1	20,170	1	23,960	1	25,349	1
Annual growth rate			*5.6%*		*11.6%*		*18.8%*		*5.8%*	
Amoxiciline	11,434	2	10,722	2	10,320	3	10,433	3	9,187	5
Annual growth rate			*-6.2%*		*-3.7%*		*1.1%*		*-11.9%*	
Acetylsalicylic Acid	7,928	6	8,835	6	9,821	2	10,833	2	11,467	2
Annual growth rate			*11.4%*		*11.2%*		*10.3%*		*5.9%*	

Source: Spanish Ministry of Health. Statistics available at www.pmfarma.com.

Table 2.7. Ranking of Most Consumed Compounds (# packages)

There are several amoxiciline homogeneous groups, each of them differing according to dosage, package and form (i.e. amoxiciline 500 mg 24 capsules, amoxiciline 1 g 12 capsules). In each homogeneous group, there are several brand-name drugs (Clamoxyl, Ardine, Amoxi Gobens, Agerpen, Amoxibacter) and, at least, one generic version identified by the name of the laboratory (Cinfa, Benox, Esteve, Ratiopharm, Mundogen, Geminis, Normon).[13]

For the second experiment, after an in-depth analysis of various chronic diseases (e.g. hypertension, diabetes, psoriasis), we finally selected high blood cholesterol because it is a widely spread cardiovascular risk factor and cholesterol lowering therapies are not subject to "price reduction". In Spain, some chronic therapies are subject to "price reduction", that is, Social Security (third-party) partly finances the cost of treatment and patients only pay a 10% copayment. In these cases, individuals are less sensitive to price.

The prevalence of hypercholesterolemia among the Spanish population is quite high. In the 35 to 64 year old age category, 18% of the population have high blood cholesterol equal or superior to 250 mg/dl and 57.8% have a level equal or superior to 200 mg/dl. Elevated Low Density Lipoprotein (LDL) is a major cause of coronary heart disease (CHD). In Spain, cardiovascular diseases rank as the first cause of death and their demographic, health and social impact is increasing (Plaza Perez et al, 2000). Although high blood cholesterol is considered a severe risk factor, drug therapy is not always recommended. Everyone with elevated LDL cholesterol is treated with therapeutic life-style changes and drug therapy is reserved for those at relatively high risk. Major risk factors are: cigarette smoking, hypertension,

[13]Brand-name drugs have commercial names while generic drugs are labeled with the name of the laboratory.

low levels of High Density Lipoprotein (HDL) cholesterol, family history of premature coronary heart disease and diabetes.[14]

Statins -HMG CoA reductase inhibitors- are first line drugs for the treatment of high blood cholesterol. In cases of moderate-severe hypertriglyceridemia or low HDL-cholesterol, fibrates are preferred.[15] Statins are the most effective and practical class of drugs for reducing LDL cholesterol concentrations. Other agents (bile acid sequestrants, nicotinic acid and some fibrates) can also moderately lower LDL levels. Table 2.8. shows the most consumed statins in the Spanish National Health System. Atorvastatin has recently entered the market and obtained a high degree of penetration.

Consumption in value (thousand €)	**1997**	**1998**	**1999**	**2000**
Simvastatin	65,795	77,826	90,811	102,381
Atorvastatin	2,459	64,733	99,394	121,946
Pravastatin	46,236	49,661	58,928	72,752
Lovastatin	45,547	42,686	n.a.	n.a.

Source: Spanish Ministry of Health. Statistics available at www.pmfarma.com.

Table 2.8. Ranking of Statins Consumption

Both lovastatin and simvastatin are in the reference price system, that is, the patent on the corresponding brand-name drugs has already expired and generic versions are available in the pharmaceutical market. There are several lovastatin and simvastatin homogeneous groups, each of them differing according to dosage, package and form. In each homogeneous group, there are several brand-name drugs (Zocor, Pantok, Nergadan, Mevacor) and, at least, one generic version (Cinfa, Benox, Esteve, Ratiopharm, Mundogen, Geminis, Normon).

[14] Risk assessment for determining the 10-year risk for developing coronary heart disease is carried out using Framingham risk scores. The risk factors included in the Framingham calculation of 10-year risk are: age, total cholesterol, HDL cholesterol, systolic blood pressure, treatment for hypertension and cigarette smoking.

[15] Examples of statins: lovastatin, simvastatin, pravastatin, fluvastatin, atorvastatin, cerivastatin. Examples of fibrates: gemfibrozil, fenofibrate and clofibrate.

4.2 Attributes and Levels

Neoclassical economic theory assumes that individuals choose the product that provides a greater level of satisfaction. The final decision depends fundamentally on the following factors: (i) product characteristics, (ii) product price, (iii) socio-demograhic characteristics of the consumer (i.e. age, gender, education, income) and (iv) use of the product made by the consumer in the past. Choice modeling estimates the importance of these factors in the decision taken by the consumer.

Therefore, the first stage of a choice design consists of identifying the relevant attributes -and their corresponding levels- of the good to be valued. Monetary cost is typically one of the factors to be included because it allows for the estimation of willingness-to-pay (WTP). The rest of attributes and their levels of variation are identified through reviewing the relevant literature, focus groups discussions and consulting experts. The attribute levels should be feasible, realistic and non-linearly spaced, and they should span the range of respondents' preference maps. Kanninen (2002) shows that, in an optimal design, each attribute should only have two levels, even in the case of a multinomial choice experiment and the levels should be set at two extreme points of the distribution of the parameters.

From reviewing the relevant literature, we identified *a priori* a set of factors that may influence the consumers' decision between commercial drugs: supplier inducement and brand loyalty. We also conducted two focus groups discussions aimed at collecting participants' opinions and perceptions about the consumption of drugs and the entry of generic versions into the pharmaceutical market (Appendix A).

We finally identified the following five attributes which are classified in three different clusters: (i) **price elasticity**: the whole price of the drug, that is, the price level is supposed to be the total amount paid by consumers (there is no reimbursement mechanism); (ii) **brand loyalty**: we include "commercial name" -either a brand-name drug (incumbent) or a generic version- and "laboratory reputation", whether a producer is well-known or unknown and (iii) **supplier inducement**: we include "physician's prescription" and "pharmacist's recommendation".

Table 2.9 shows drugs attributes and levels. The process by which each level of each attribute is combined with every level of all other attributes generates the different alternatives to be valued by individuals.

Attibute	Levels for Amoxiciline	Levels for Statins
Commercial name	Clamoxyl (brand-name)	Brand-name
	Ardine (brand-name)	
	Generic	Generic
Laboratory reputation	Known	Known
	Unknown	Unknown
Price	1 €	6 €
	4 €	16 €
	20 €	40 €
Physician prescription	Prescribed	Prescribed
	Not prescribed	Not prescribed
Pharmacist recommendation	Recommended	Recommended
	Not recommended	Not recommended

Table 2.9. Attributes and Levels

In both experiments, we include the same attributes, though the levels may vary according to the specific active ingredient. However, the levels for "Laboratory reputation", "Physician prescription" and "Pharmacist recommendation" are exactly equal for both the amoxiciline and statins experiments. "Laboratory reputation" takes two levels -known and unknown- and detects the reliance of patients on the drug producer. Instead of making a list using real names of laboratories, we classify them according to popularity. Train et al (2000) uses the same concept in an experiment about electricity suppliers.

"Physician prescription" takes two levels, either it is a commercial brand directly prescribed by the physician or it is not. Although we assume that the physician always prescribes the active ingredient -amoxiciline or statins-, in some cases, they prescribe the brand-name drug and in others the generic version (Hellerstein, 1998). "Pharmacist recommendation" also takes two levels, either the commercial brand is recommended by the pharmacist or it is not. The advice of the pharmacist may or may not coincide with the physician's prescription. We introduce the role of the pharmacist because, due to substitution laws, they can actively participate in the prescription and dispensing process.

"Commercial name" and "Price" levels vary according to each active ingredient.

For the amoxiciline experiment, we took the homogeneous group of Amoxiciline 500 mg 24 capsules as the reference, one of the most standard in terms of dosage, package and form. In this case, commercial name can take three

different values, two equivalent specialities (EQ) -Clamoxyl and Ardine- and the corresponding generic version (EFG).[16] Clamoxyl and Ardine are incumbent brand-name drugs in the pharmaceutical market and both well-known by population. "Price" ranges from the extreme values of 1 euro to 20 euros, with the average price of 4 euros being equal to the reference price for Amoxicline 500 mg 24 capsules.[17]

In the case of statins, the benchmark is the homogeneous group of Lovastatin 20 mg 28 capsules. "Commercial name" takes only two values, either a brand-name drug or a generic version. Although lovastatin is the reference active ingredient, we considered an extensive list of brand-name drugs, which included Zocor, Cardyl, Mevacor, Taucor, etc. "Prices" ranges from the extreme values of 6 euros to 40 euros, with the average price of 16 euros being the reference price for Lovastatin 20 mg 28 capsules.

4.3 Statistical Design

Statistical design theory consists of combining the levels of the attributes into a number of alternative scenarios or profiles to be presented to respondents. In the amoxiciline experiment, we have three attributes with two levels of variation and two attributes with three levels of variations which implies a total of 72 ($2^3 * 3^2$) scenarios. For the statins, we have four attributes with two levels of variation and one attribute, price, with three levels which implies a total of 48 ($2^4 * 3$) possible alternatives. Such a complete enumeration of all possible combinations is often called "complete factorial" or "full factorial".

From the point of view of maximizing the amount of information, it would be desirable if all individuals could rank all possible attribute levels combinations according to their preferences, in our case, 72 and 48 combinations respectively. However, this would be too cognitively demanding as well as time consuming, so the complexity of the choice experiment thus needs to be reduced. One way is to let the individuals compare a small number of alternatives in a choice set. *Fractional factorial designs* are able to reduce the number of scenario combinations presented with a concomitant loss of estimating power. The profiles identified by the experimental design are then grouped into choice sets to be presented to respondents (Hanley et al, 2001).

[16] EQ: Especialidad Equivalente. EFG: Especialidad Farmacéutica Genérica.

[17] The reference price for Amoxiciline 500 mg 24 capsules is established by the Spanish Ministry of Health.

The central question is then how to combine the alternatives from the full factorial design into the choice sets (fractional factorial) so that a maximum amount of information is extracted given other constraints such as the number of choice sets in the experiment. In particular, the main objective is to estimate all coefficients with high precision in order to calculate an accurate value for each attribute, that is, to minimize the error around the estimated parameters β:

$$U_{ij} = X_{ij}\beta + \varepsilon_{ij} \tag{5}$$

McFadden (1973) shows that the distribution of $\hat{\beta}$ is asymptotically normal with mean β and covariance matrix:

$$\Omega = \sigma^2 (X'X)^{-1} \tag{6}$$

Thus, the problem of optimal design can be seen as a problem of defining the design matrix X, in such a way that the size of the covariance matrix of the estimator β is minimized. The goodness or efficiency of an experimental design can be quantified. Common measures of design efficiency are based on the information matrix $X'X$. The variance-covariance matrix of the vector of parameter estimates β is proportional to $(X'X)^{-1}$. An efficient design will have a small variance matrix and the eigenvalues of $(X'X)^{-1}$ provide measures of its size. The most prominent efficiency measures are based on the idea of quantifying size by averaging (in some sense) the eigenvalues or variances. Some examples of efficiency measures are A-efficiency, D-efficiency and G-efficiency, however, the most common is D-efficiency because it is less computationally burdensome:[18]

$$D - efficiency = \bar{\bar{\Omega}}^{\frac{1}{k}} \bar{\bar{}}^{-1} \tag{7}$$

where k is the number of parameters to estimate. The aim is to maximize D-efficiency and minimize the error measure inversely related to it (Huber and Zwerina, 1996):

$$D - error = \bar{\bar{\Omega}}^{-1} \bar{\bar{}}^{\frac{1}{k}} \tag{8}$$

Huber and Zwerina (1996) identify four properties that characterize efficient choice designs: (i) level balance, (ii) orthogonality, (iii) minimal overlap and

[18] A-efficiency is a function of the arithmetic mean of the eigenvalues. D-efficiency is a function of the geometric mean of the eigenvalues and G-efficiency is based on the maximum standard error for prediction over the candidate set. All three of these criteria are convex functions of the eigenvalues of $(X'X)^{-1}$ and hence are usually highly correlated.

(iv) utility balance. A design that satisfies these principles has a maximum D-efficiency (and therefore a minimum D-error). Two of these, level balance and orthogonality, also characterize linear designs. The third, minimal overlap, becomes relevant for choice designs, because each attribute level is only meaningful in comparison to others within a choice set. Utility balance requires that the utility of each alternative in a choice set is equal.[19]

Kuhfeld et al (1994) use a computerized search algorithm to minimize D-efficiency in order to construct an efficient, but not necessarily orthogonal linear design. A modified Federov algorithm works in the following way: an initial design is randomly drawn from a full factorial design. From the initial design the algorithm will, through an iterative process, exchange alternatives in the initial design with ones from a list of candidate alternatives until it is not possible to reduce D-error any further. Experts have worked with SAS language in order to obtain, as final output, a design matrix of alternatives determined by the number of choice sets and the number of alternatives in each choice set taking into account orthogonality criteria.[20] It is also common to add a non-purchase alternative (blank card) to the choice set; that is, the option to choose none of the rest of the alternatives ("nothing is important").

Finally, it is important to present attribute levels in a choice set so that none of the attributes become dominant or inferior. Traditional designs, such as orthogonal designs, disregard this aspect and only ensure that we can estimate the effects of the different attributes independently of each other. A D-optimal design explicitly considers the importance of the levels of the attributes and ensures that the alternatives in the choice sets provide more information about the trade-off between the different attributes. However, this requires explicit incorporation of prior information about the respondents' preferences into the design. Thus, a key issue when applying more advanced designs is the need for more prior information. One source of information is the results from previous studies, but primarily the information

[19] Orthogonality is satisfied when the levels of each attribute vary independently of one another. Level balance is satisfied when the levels of each attribute appear with equal frequency. Minimal overlap is satisfied when the alternatives in each choice set have nonoverlapping attribute levels. Utility balance is satisfied when the utilities of alternatives within choice sets are the same (Huber and Zwerina, 1996).

[20] There are two modules in SAS for experimental designs. QC is devoted to experimental designs and module IML of matricial language. There are several macros such as MKTDES and CHOICEFF. The latter is more appropiate for a choice model experiment because it takes into account a multinomial logit model.

is obtained from own focus groups and pilot studies (Carlsson et al, 2002).

4.3.1 Our Experiment

We carried out two different choice designs, one for amoxiciline and the other for statins. Due to the elevated number of combinations, a fractional factorial design seems to be the best solution, thus implying the construction of several choice sets each composed of a limited number of alternatives. As stated before, one of the alternatives in each choice set must be the blank card or the non-purchase option.

We assumed the blank card for the throat infection to be "Home remedies", a natural alternative to treat an infection without taking antibiotics and the blank card for high blood cholesterol to be "Soya lecitine", a natural medicine used to reduce and maintain LDL cholesterol. Taking into account the potential number of respondents, we finally construct 50 choice sets, each composed of 5 alternatives, one of them being the blank card. Besides this, we also carried out two different choice experiments for each active ingredient, with each experiment differing in the utility function form: in the first case, we assumed a linear utility function with logarithmic price and in the second one, a linear utility function with quadratic price. In both scenarios, the design matrix was exactly the same.

Once the design matrix had been obtained, we had to analyze the existence of dominant or inferior alternatives in each choice set. The idea behind this is to eliminate those alternatives in a choice set that are dominant because otherwise there could be a loss of information in the trade-off. In fact, we want utility balance criteria to be satisfied and therefore we need prior information about consumers preferences in the pharmaceuticals market. Below, we present the main assumptions about dominance:

- Those drugs (alternatives) in a choice set that are neither prescribed by the physician nor recommended by pharmacist are considered as "bad" if the rest of the attributes levels (commercial name, laboratory and price) are equal.

- The alternative formed by levels "generic", "unknown laboratory", "maximum price", "non prescribed" and "non recommended" is also a "bad", that is, assuming individual rationality, no respondent would choose it. In this sense it is a dominated alternative, implying that the rest of the alternatives in the same choice set are always superior.

- The attributes combination composed of "brand-name drug" (in the case of amoxiciline, Clamoxyl), "known laboratory", "minimum price", "prescribed" and "recommended" can be considered a "good", that is, it is the best combination and therefore, assuming individual rationality, will always dominate the rest of the alternatives whatever the choice set.

- If some alternatives have the same levels of "commercial name", "laboratory" and "price", then we have to look at the "physician prescription" and "pharmacist recommendation" attributes. Therefore, the order of preferences will be: (1) prescribed and recommended, (2) prescribed and non-recommended, (3) non-prescribed but recommended and (4) non-prescribed and non-recommended. The same applies if the price is low and the drug is highly prescribed and recommended.

The application of these dominance criteria aims to avoid the lexicographic preference orderings where only one attribute matters and individuals do not trade. In the case of a lexicographic ordering of goods and characteristics, an individual is not prepared to trade-off and so goods or characteristics cannot be substituted for one another (non-compensatory decision making). In the case of a lexicographic ordering of a bundle of goods, there are no other bundles to which it is indifferent (Scott, 2002).

Finally, we imposed some additional conditions for the construction of choice sets: (i) at least one drug (alternative) must be a generic version, (ii) at least one drug (alternative) must be prescribed by the physician and (iii) at least one drug (alternative) must be recommended by the pharmacist (Appendix B).

4.4 Collection of Data

The experiment was conducted by the author with the help of students.[21] It was essential to ensure that respondents understood the context, were motivated to cooperate and able to participate in an informed manner. The context had to be as realistic as possible in order to encourage reliable and truthful responses (but not to bias the answers).

[21] We selected students from Pompeu Fabra University in Barcelona and Carlos III University in Madrid.

The interview consisted of two parts: firstly individuals were asked about socio demographic characteristics such as age, gender, educational level, professional status, income and other factors (see questions 1-9) and habits of drug purchase (see questions 10-24 in the amoxiciline questionnaire and questions 10-28 in the cholesterol questionnaire) and afterwards they were asked to rank a set of alternatives according to their preferences for generic or brand-name drugs taking into account different combinations of attributes. They were all close-ended questions with few levels of variation. At the end, respondents were asked about their name and address (Appendix C). This information about respondents will serve as control variables and will also allow for the segmentation of demand according to socio-economic characteristics and drug purchase habits.

In order to rank alternatives, a realistic scenario must be defined. For the amoxiciline experiment, respondents had to imagine a situation in which they have a throat infection and, consequently, go to the primary care doctor. In this case, the physician prescribes an antibiotic - amoxiciline- and afterwards the patient has the option of throwing the prescription away and preparing a natural remedy at home (blank card) or the option of buying a chemical drug (the rest of the alternatives in the choice set).[22] Each alternative in the choice set represents a drug that can be either a generic or a trade-name drug, prescribed or not prescribed, recommended or not recommended, etc. For the statins experiment, respondents had to imagine a situation in which the physician diagnoses high blood cholesterol and consequently prescribes one type of statins. The patient has the option of taking a natural medicine (blank card) or the option of buying one of the chemical drugs represented in the choice set.

In order to carry out both experiments -amoxiciline and statins-, we have to select two different subsamples, one formed by the general population and the other by people with high blood cholesterol. However, both subsamples are asked to rank the alternatives for amoxiciline and statins.The interviews took place in primary healthcare centers, chemist's shops, hospitals or other indoor and outdoor locations mainly in the cities of Madrid and Barcelona (Spain).

[22]Under this scenario, patient noncompliance could appear.

4.4.1 Summary Statistics

The study recruited a total sample of 439 adults from 20 to 65 years old. Of these, 315 belong to general population and 124 have high blood cholesterol; the latter were mainly found in hospitals and primary healthcare centers. According to a review of choice modeling experiments, the ratio between the number of individuals surveyed (439) and the number of attributes estimated (5 plus blank card) moves around the average (Table 2.10).

Title of the paper	Journal	# individuals	# attributes	Estimation method
"Predicting Consumer Preferences for Fresh Salmon: the Influence of Safety Inspection and Production Method Attributes" (Holland and Wessels)	Agricultural and Resource Economics Review (1998)	756 (mail survey)	3 attributes (main effects and interaction effects)	Rank ordered logit
"Measuring willingness-to-pay for risk reduction: an application of conjoint analysis" (Telser and Zweifel)	Health Economics (2002)	500 (face-to-face survey)	4 attributes (main effects)	Random effects probit
"Using conjoint analysis to assess women's preferences for miscarriage management" (Ryan and Hughes)	Health Economics (1997)	196 (mail survey)	5 attributes	Simple probit model
"Choice Modelling Approaches:a superior alternative for environmental valuation?" (Hanley et al)	Journal of Economic Surveys (2001)	267 (mail survey)	8 attributes	Conditional logit model
"An application of a Product Positioning Model to Pharmaceutical Products" (Green and Krieger)	Marketing Science	356 (mail survey)	9 attributes	Conjoint analysis
"Assessing the Potential Demand for Electric Cars" (Beggs et al)	Journal of Econometrics (1981)	200 (survey)	9 attributes	Rank ordered logit
"Conjoint Analysis of Price Premiums for Hotel Amenities" (Goldberg et al)	Journal of Business (1984)	180 (face-to-face interviews)	43 attributes	Conjoint analysis
"Residential Broadbrand Subscription Demand: an Econometric Analysis of Australian Choice Experiment Data" (Madden and Simpson)	Applied Economics (1997)	598 (face-to-face interviews)	13 attributes	Conditional logit model
"Cellular Telephones in the Israeli Market: the Demand, the Choice of Provider and Potential Revenues" (Tishler et al)	Applied Economics (2001)	1000 (face-to-face interviews)	16 attributes	Conditional logit model
"Customers' Choice Among Retail Energy Suppliers: the Willingness-to-Pay for Service Attributes" (Train et al)	EPRI document (2000)	1205 (phone-mail-phone format)	40 attributes	Rank ordered logit

Table 2.10. Review of Choice Modelling Experiments

The general population subsample is representative of the Spanish population with respect to gender and age. According to statistics, the Spanish population from 20 to 65 years old is formed by a 50% male and a 50% female component. These percentages with respect to age are: 38% people from 20-34 years old, 26% from 35-44, 22% from 45-54 and 11% from 55-65 years

old.[23] This slightly differs from the structure of our subsample (Table 2.11). We have a higher proportion of women due to the fact that they are usually the one in charge of going to the chemist's shop and buying the drugs.

We do not have much information about details of the prevalence of cholesterol among the Spanish population, however we know that high blood cholesterol affects older and male people more than younger and female ones. This trend is also reflected in our sample.

[23] Source: National Statistics Institute (Instituto Nacional de Estadística, INE), www.ine.es.

Summary Statistics for Explanatory Variables

Variable name	Full sample (n=439)	General population (n=315)	High blood cholesterol population (n=124)
Socio-economic Characteristics			
Sex	439	315	124
Male	41%	37%	52%
Female	59%	63%	48%
Age	436	313	123
20-34	31%	42%	5%
35-44	23%	26%	14%
45-54	27%	21%	40%
55-65	19%	11%	41%
Level of Education	438	315	123
None	3%	1%	6%
Primary	26%	21%	40%
Secondary	22%	20%	27%
University	49%	57%	28%
Professional Status	439	315	124
By his/her own	24%	25%	20%
Employed	48%	50%	40%
Unemployed	8%	8%	6%
Housewife	16%	12%	27%
Others*	5%	4%	6%
Family Head	438	315	123
Yes	45%	43%	50%
No	55%	57%	50%
Children	439	315	124
Yes	62%	55%	80%
No	38%	45%	20%
Household Net Income	407	289	118
< 3000 €/month	79%	76%	86%
> 3000 €/month	21%	24%	14%
Health Care Habits			
Private Insurance	439	315	124
Yes	32%	34%	26%
No	68%	66%	74%
Household Drug Expenditure	435	311	124
< 30 €/month	85%	90%	72%
> 30 €/month	15%	10%	28%
Laboratory Identification	438	315	123
Yes	32%	33%	31%
No	68%	67%	69%
Chemist's Loyalty	437	314	123
Yes	68%	64%	79%
No	32%	36%	21%
Generic Drugs			
Generic Knowledge	439	315	124
Yes	86%	88%	81%
No	14%	12%	19%
Generic Purchase	439	315	124
Yes	46%	46%	44%
No	54%	54%	56%
Region of Residence	438	315	123
Catalonia	84%	87%	76%
Rest of Spain	16%	13%	24%
Interview Location	439	315	121
Primary health care center	14%	12%	21%
Hospital	13%	2%	37%
Chemist's shop	11%	13%	5%
Others**	62%	73%	37%

* Others include students, retired and disabled individuals.

** Others include inward and outward locations, for example, the airport, a gym, a restaurant or bar and a park or the street respectively.

Table 2.11. Summary Statistics

Other relevant socio-economic characteristics of our sample are: 1) 49% of the total sample have university studies, 2) 48% of them are employed, 3) although the data are missing in 7% of cases, nearly 80% of the respondents declared that they earned a net household income inferior to 3.000 euros/month.

Nearly 70% of respondents do not have private insurance and just 15% declared that they spend more than 30 euros per month on drugs and medicines. 32% state that they take into account the name of the laboratory when buying a drug while 68% declare that they always buy drugs in the same chemist's shop. 86% of the respondents state that they are aware of the existence of generic drugs and, from the full sample, only 46% declare that they have once bought a generic drug.

5 Results

As explained before, the attributes that influence the drug purchase decision are: (i) price, (ii) commercial name, (iii) laboratory reputation, (iv) physician prescription and (v) pharmacist recommendation. The price parameter will give an idea about elasticity and will also allow us to calculate willingness to pay (WTP). The attributes "commercial name" and "laboratory reputation" are both associated to **brand loyalty** while "physician prescription" and "pharmacist recommendation" are measures of **supplier inducement**. We also include the blank card or outside option in order to get consistency with economic theory. The general utility function to be estimated has the following form:

$$\begin{gathered} U_{ij} = \alpha_i BRAND_j + \beta_i LAB_j + \gamma_i PRICE_j \\ + \delta_i PHYSICIAN_j + \eta_i PHARMA_j + \theta_i BLANK_j + \varepsilon_{ij} \end{gathered} \tag{9}$$

where:

- BRAND is a dummy variable equal to 1 if the "commercial name" takes the level GENERIC and 0 otherwise.
- LAB is also a dummy variable equal to 1 if the "laboratory reputation" takes the level UNKNOWN and 0 otherwise.
- PRICE is a continuous variable that takes three different values for each experiment.

- PHYSICIAN is a dummy variable equal to 1 if the "physician prescription" takes the level YES and 0 otherwise
- PHARMA is a dummy variable equal to 1 if the "pharmacist recommendation" takes the level YES and 0 otherwise.
- BLANK is a dummy variable equal to 1 if the alternative is the blank card (home remedies or soya lecitine) and 0 if the alternative is a chemical drug.

As shown in Table 2.9, the variable BRAND differs across experiments. In the case of amoxiciline, "commercial name" takes three different levels -Clamoxyl, Ardine and Generic- and therefore it must be decomposed in the utility function as follows:

$$\begin{aligned} U_{ij} = \alpha_i GENERIC_j + \mu_i ARDINE_j + \beta_i LAB_j + \gamma_i PRICE_j \\ + \delta_i PHYSICIAN_j + \eta_i PHARMA_j + \theta_i BLANK_j + \varepsilon_{ij} \end{aligned} \tag{10}$$

where:

- GENERIC is a dummy variable equal to 1 if the "commercial name" takes the level GENERIC and 0 otherwise.
- ARDINE is a dummy variable equal to 1 if the "commercial name" takes the level ARDINE and 0 otherwise.

We drop Clamoxyl because it is the most prevalent level and, therefore, both variables are measured with respect to it.

The estimated coefficients can be interpreted as the marginal utility derived from each attribute. In the case of PRICE, marginal utility can be easily interpreted. For those dummy variables 0-1, marginal utilities are interpreted as the difference in utility from 0 to 1. For example, the LAB coefficient represents the disutility of purchasing a drug produced by an unkown laboratory with respect to a well-known one. Once the parameter estimates have been obtained, a WTP compensating variation welfare measure that conforms to demand theory can be derived for each attribute using the formula below if the utility function is linear:[24]

$$WTP = -\frac{A}{\hat{\gamma}} \tag{11}$$

[24] WTP = Market price + consumer's surplus

where A is equal to any non-price estimated coefficient and γ is the price parameter. .

Socio-economic variables can be included along with choice set attributes, but since they are constant across choice occasions for any given individual (for example, sex and age is the same for each choice they make), they can only be entered as interaction terms. This is the reason why we firstly present the main effects estimated models -both for amoxiciline and statins- and afterwards, we present the *demand clustering exercise*, in which we calculate the main effects model for those segments that have different behavior with respect to drug purchasing. We identify demand clusters according to socio-demographic variables and drug purchase habits.

5.1 "Main Effects" Model

We used the *rank-ordered* or *exploded logit* to estimate utility function. As stated before, the rank-ordered logit is a generalization of McFadden's conditional logit since each of the terms in the probability product has the form of a conditional logit. In our experiment, each respondent had to fully rank a set of five alternatives. First, we asked them to choose the most-preferred one; then, to choose the most preferred card among the rest of alternatives and so on.[25]

We also undertook several likelihood ratio (LR) tests in order to identify the best model specification. We contrasted the unrestricted model with linear and quadratic (logarithm) price with the restricted one with linear price and, according to the results, we can accept the restricted model in all cases ($\chi^2(1) < 3.84$). There is no doubt about the specification of the rest of the attributes.

Table 2.12 displays the results of the "main effects" model for the amoxiciline experiment. All parameters are significantly different from zero. Note also that all of them have the expected signs. In particular, the GENERIC and ARDINE parameters are both negative, which indicates a noteworthy loyalty to Clamoxyl among the population. Remember that Clamoxyl is the incumbent and most popular brand. The LAB parameter is negative, as

[25] We estimate the rank-ordered logit model using the command **elogit** (exploded logit) from STATA.However, we also estimate each of the main effects models using a generalization of the **clogit** (conditional logit) command of STATA. That is, we replicate the results of the elogit with an extensive form of clogit, taking into account four orderings and four different choice sets. **elogit** is an ADO file proposed by Jeroen Weesie.

expected, which implies preference for a well-known laboratory producer instead of an unknown one. The PRICE parameter is very small, this being evidence of low price elasticity. The two parameters associated with supplier inducement exert a strong influence on the drug purchasing process. PHYSICIAN prescription is the most dominant factor in the decision between commercial drugs and PHARMA is also a powerful attribute. This pattern is also reflected in the WTP values; individuals would have to be paid more than 9 euros in order to switch from Clamoxyl to the corresponding generic version and more than 6 euros to switch from Clamoxyl to Ardine. On the other hand, they are prepared to pay more than 24 euros for a favourable physician prescription and more than 7 euros for a favourable pharmacist recommendation.

Variable	Coef.	Std. Error	P>|z|	WTP
GENERIC	-0.37**	0.07	0.00	9.63
ARDINE	-0.25**	0.09	0.01	6.63
LAB	-0.10*	0.06	0.08	2.73
PRICE	-0.04**	0.00	0.00	1.00
PHYSICIAN	0.95**	0.07	0.00	-24.65
PHARMA	0.29**	0.06	0.00	-7.50
BLANK	-1.45**	0.11	0.00	37.67
Number of Observations	6118			
Log likelihood	-1778.11			
Pseudo R2	0.1501			

** significant at 1%

* significant at 10%

Table 2.12. Amoxiciline Main Effects Model (full sample)

Table 2.13 displays the results of the "main effects" model for the statins experiment. In this case, all coefficients are significantly different from zero except for the parameter associated with the commercial name, GENERIC. This is an expected result considering the fact that we use the full sample to estimate the coefficients. The full sample is composed of 70% general population and 30% people with high blood cholesterol. The general population can not recognize any brand-name drug for cholesterol and we also realize that people with high blood cholesterol often forget the commercial name of the capsules they take every day. Therefore, it is not rare to get a nul value for brand loyalty. One point worth mentioning is the fact that the LAB parameter is more statistically significant than in the amoxiciline experiment.

One possible explanation is that when individuals can not recognize the commercial brand they give more importance to the producer. Therefore, there also exists a kind of brand loyalty. As expected, the signs for PHYSICIAN and PHARMA are positive; however if we compare these parameters with the ones obtained in the amoxiciline experiment, we realize that when people are asked about a chronic disease they value physician prescription and pharmacist recommendation even more. In this case, they are willing to pay substantially more for experts advice.

Variable	Coef.	Std. Error	P>|z|	WTP
GENERIC	0.01	0.06	0.84	n.a.
LAB	-0.19*	0.06	0.00	5.97
PRICE	-0.03*	0.00	0.00	1.00
PHYSICIAN	1.35*	0.07	0.00	-43.28
PHARMACIST	0.44*	0.06	0.00	-14.06
BLANK	-1.23*	0.11	0.00	39.46
Number of Observations	6118			
Log Likelihood	-1711.54			
Pseudo R2	0.1819			

* significant at 1%

Table 2.13. Statins Main Effects Model (full sample)

We are now in position to give an idea about the importance of supplier inducement and brand loyalty in the drug purchasing process. We find that both exert a relevant influence, however, when individuals face a chronic disease, the higher the dominance of expert inducement and the lower the influence of brand loyalty. Furthermore, when faced with a chronic disease, individuals become more price inelastic.

5.2 Interaction Models: Demand Segmentation

As stated before, if we want to include socio-economic variables in the estimation model, we have to use *interactions* with choice attributes. Using those interactions, we are able to explore demand segmentation (clustering). In order to identify significant clusters, we proceed as follows: we conduct likelihood ratio tests and we only accept those restricted models in which the interactions of a socio-economic variable with all the choice attributes are accepted. In those cases, we estimate several different models, one for each

demand segment (i.e. if sex is significant, we estimate a model for males and another one for females).

The first interaction we analyze is the characteristic of having or not high blood cholesterol, however we can not find significant evidence that those individuals with a cardiovascular risk factor exhibit drug purchase habits which are different from those of the rest of the population. Afterwards, we check other segmentations using socio-economic characteristics such as sex, age, income, education level and other factors. We can only accept the restricted models for age and education level.

Now, we estimate the main-effects model for each AGE category (20-34 years old, 35-44 years old, 45-54 years old and 55-65 years old):

$$U_{ij} = \alpha_i GENERIC_j * AGE + \mu_i ARDINE_j * AGE + \beta_i LAB_j * AGE + \gamma_i PRICE_j * AGE + \delta_i PHYSICIAN_j * AGE + \eta_i PHARMA_j * AGE + \theta_i BLANK_j * AGE + \varepsilon_{ij} \quad (12)$$

Table 2.14 shows that the old firmly trust incumbent brands and doctor's prescription; on the contrary, those in the youngest age category are easily influenced by pharmacist's recommendation and, despite not being loyal to established brands, they value laboratory reputation. People from 55 to 65 years old are also more price inelastic probably because they value health more than the youngest.

Amoxiciline	**20-34 years old**		**35-44 years old**		**45-54 years old**		**55-65 years old**	
Variable	**Coef.**	**Std.Error**	**Coef.**	**Std.Error**	**Coef.**	**Std.Error**	**Coef.**	**Std.Error**
GENERIC	-0.18	0.13	-0.50***	0.15	-0.37***	0.14	-0.48***	0.16
ARDINE	-0.33**	0.17	-0.36*	0.20	-0.09	0.19	-0.21	0.22
LAB	-0.20*	0.11	-0.03	0.12	-0.01	0.12	-0.19	0.14
PRICE	-0.05***	0.01	-0.04***	0.01	-0.04***	0.01	-0.02***	0.01
PHYSICIAN	0.73***	0.12	0.88***	0.14	1.07***	0.13	1.27***	0.16
PHARMA	0.34***	0.11	0.15	0.13	0.32***	0.12	0.32**	0.14
BLANK	-1.66***	0.20	-1.67***	0.24	-1.11***	0.22	-1.43***	0.26
Number of Observations	1904		1372		1610		1190	
Log Likelihood	-549.39		-399.43		-471.09		-330.96	
Pseudo R2	0.1562		0.1486		0.1443		0.1867	

*** significant at 1%

** significant at 5%

* significant at 10%

Table 2.14. Age Clustering

Table 2.15 shows that the more highly-educated people (secondary and university studies) value Clamoxyl less than those with a lower level of education but that they value laboratory reputation more than those with a lower level of education. Furthermore, highly-educated people value pharmacist's

recommendation more than people with a lower level of education.

$$U_{ij} = \alpha_i GENERIC_j * EDU + \mu_i ARDINE_j * EDU + \beta_i LAB_j * EDU + \gamma_i PRICE_j * EDU + \delta_i PHYSICIAN_j * EDU + \eta_i PHARMA_j * EDU + \theta_i BLANK_j * EDU + \varepsilon_{ij} \quad (13)$$

Amoxiciline	Low-educated		High-educated	
Variable	**Coef.**	**Std. Error**	**Coef.**	**Std. Error**
GENERIC	-0.54***	0.13	-0.29***	0.08
ARDINE	-0.31*	0.18	-0.24**	0.11
LAB	-0.07	0.11	-0.13*	0.07
PRICE	-0.04***	0.01	-0.04***	0.00
PHYSICIAN	0.93***	0.12	0.96***	0.08
PHARMA	0.12	0.12	0.38***	0.07
BLANK	-1.38***	0.21	-1.48***	0.13
Number of Observations	1750		4354	
Log Likelihood	-518.3		-1250.06	
Pseudo R2	0.1339		0.1604	

*** significant at 1%

** significant at 5%

* significant at 10%

Table 2.15. Education Clustering

One of the most significant results is the segmentation between those respondents with high switching costs, that is, those that have never tested a generic drug and those with low switching costs, that is, those that have bought generic versions at least one. We find that those patients exhibiting high switching costs place blind trust in a doctor's opinion and are reluctant to switch to drugs other than the established one. On the contrary, those that have already tested and learnt about generics are more easily influenced by a pharmacist's recommendation and laboratory reputation.

$$U_{ij} = \alpha_i GENERIC_j * GEN + \mu_i ARDINE_j * GEN + \beta_i LAB_j * GEN + \gamma_i PRICE_j * GEN + \delta_i PHYSICIAN_j * GEN + \eta_i PHARMA_j * GEN + \theta_i BLANK_j * GEN + \varepsilon_{ij} \quad (14)$$

Amoxiciline	Have ALREADY Bought Generic Drugs		Have NEVER Bought Generic Drugs	
Variable	**Coef.**	**Std. Error**	**Coef.**	**Std. Error**
GENERIC	-0.02	0.10	-0.72***	0.10
ARDINE	-0.28**	0.13	-0.25*	0.13
LAB	-0.15*	0.09	-0.06	0.08
PRICE	-0.04***	0.01	-0.04***	0.01
PHYSICIAN	0.79***	0.10	1.14***	0.09
PHARMACIST	0.37***	0.09	0.18**	0.08
BLANK	-1.19***	0.16	-1.75***	0.16
Number of Observations	2786		3332	
Log Likelihood	-827.69		-930.27	
Pseudo R2	0.1312		0.1836	

*** significant at 1%

** significant at 5%

* significant at 10%

Table 2.16. Switching Costs

It seems to be a general behavior pattern: those that are loyal to commercial brand usually value physicians prescription the most and those that are not loyal to brand-name drug value laboratory reputation and a pharmacists recommendation. We also examined the correlation between socio-economic variables. Table 2.17 shows that correlation between age and education level is -0.26 and correlation between age and the variable "have bought generics" is -0.01. Under no circumstances, can we conclude that a correlation problem exists among explanatory variables.

Correlations	Age	Education	Generic purchase
Age Rank (from young to old)	1.00		
Education (low-educated=0, high-educated=1)	-0.26	1.00	
Generic purchase (no=0, yes=1)	-0.01	-0.05	1.00

Age	Low-educated	High-educated
20-34 years	13%	87%
35-44 years	30%	70%
45-54 years	32%	68%
55-65 years	49%	51%

Age	ALREADY bought generics	NEVER bought generics
20-34 years	41%	59%
35-44 years	48%	52%
45-54 years	54%	46%
55-65 years	40%	60%

Table 2.17. Correlation Matrix

In this section, we only show the most relevant demand clustering for research purposes; however, the marketing department of pharmaceutical companies should be interested in applying a *K-Means Cluster* analysis. In

this approach, one uses cluster analysis to group subjects according to some measure of distance, relatedness or similarity between vectors of coefficients. Once clusters or segments are identified, one normally tests whether the segments differ significantly on various segmentation measures of interest.

6 Concluding Remarks

Despite the importance of supplier inducement and brand loyalty in the drug purchasing process, little empirical evidence is to be found with regard to the influence of these factors in the process by which patients decide between commercial drugs at the chemist's. Under the new scenario of easier access to information, patients are becoming more demanding and may even go as far as questioning their physicians' prescription. Furthermore, new regulation also encourages patients to adopt an active role in the decision between brand-name and generic drugs. In this sense, healthcare systems are going through a transition from a physician-directed system to a patient-directed one. Therefore, the new pharmaceutical framework makes the analysis of patient preferences interesting, however the empirical literature on pharmaceuticals demand is very limited and has always been focused on the behavior of either physicians or pharmacists. Furthermore, all of them use revealed preference data to estimate the objective utility function

On the contrary, this paper directly focuses on consumers' preferences using stated preference data obtained from a choice survey. For this purpose, we carried out two different choice modeling experiments -one referring to a common infection and the other to a chronic disease- with the aim of seeing whether the degree of illness awareness could modify consumers' decision.

The "main effects" model shows the significant importance of experts' inducement -although physician's prescription is always more reliable than pharmacist's recommendation- and, to what extent, both brand loyalty and laboratory reputation influence the final decision. We also found that, when individuals face a chronic disease, the higher the dominance of the expert inducement and the lower the influence of brand loyalty. Furthermore, when faced with a chronic disease, individuals become more price inelastic.

Using interactions between choice attributes and characteristics of the respondents, I found that age is a relevant variable in the decision between a brand-name and a generic drug at the chemist's. The old firmly trust incumbent brands and doctor's prescription; on the contrary, those in the

youngest category are easily influenced by a pharmacist's recommendation and, despite not being loyal to incumbent brands, they value laboratory reputation. In addition to this, those patients exhibiting high switching costs firmly trust doctor's opinion and are reluctant to switch to drugs other than the incumbent. On the contrary, those that have already tested and learnt about generics are more easily influenced by a pharmacist's recommendation and laboratory reputation.

Another significant implication derived from our results has to do with pharmaceuticals public policy, such as the Generic Paradox. Since generic drugs are generally equivalent and priced lower than their brand-name counterparts, they are expected to entail substantial savings for both National Health Systems and final consumers. However, despite the a priori advantages of generic drugs, their penetration rate does not catch up with the market share of those branded drugs with the same active ingredient. One possible interpretation of this situation is the rise of uncertainty among patients. According to our results, both physicians and pharmacists exert an important influence on patients' decisions, therefore, they become key agents in the learning process by which consumers accept generic versions as a feasible alternative.

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Appendix A. Guideline for a Focus Group on Pharmaceutical Drugs

Focus groups consist of discussion sessions in which about eight people are gathered together in order to argue about a topic of interest. The participants are guided by a team leader or moderator who asks questions and helps the group to be involved in a natural and free conversation among themselves. Therefore, focus groups are aimed at encouraging participants to talk with each other rather than answering questions directly to the moderator.Focus groups usually have a narrow purpose which is to collect the perceptions, feelings and opinions of consumers regarding key attributes of a product or service. The topic of a focus group must be carefully predetermined and based on a previous and in-depth analysis about the situation under scrutiny. Once the purpose statement is clearly defined, the process of writing a script starts which consists of constructing a list of questions that move from general to specific. Taking into account this overview, focus groups must also satisfy the following particular conditions (Krueger, 1994):

- Focus groups are typically composed of six to ten people, small enough for everyone to have an opportunity to share insights but large enough to provide a diversity of perceptions.
- Multiple groups with similar participants are needed in order to detect patterns and trends across groups. Intergroup heterogeneity is required.
- Participants in a same group must be reasonable homogenous and have similar background or experience. Intragroup homogeneity is required.
- Focus groups make use of qualitative data. Results are solicited through open-ended and "think back" questions. It is important to avoid dichotomous questions.in order to force participants to talk to each other.

We conducted two different focus groups, each composed of nine people, in order to collect their opinion and perception about the consumption of drugs and the entrance of generic versions into the pharmaceutical market. Although all participants had similar education background, the first group was composed of older people with children while the second group was composed of younger people with no family responsabilities.

1. Opening question: During this session, we are going to discuss about pharmaceutical drugs. Just to start, I would like to know your opinion

about the consumption of medicines.[The aim of the above question is to determine whether participants in the discussion group are more or less reluctant to consume chemical drug, their disposal to use domestic and natural remedies and the practice of self-prescription, etc.]

2. What type of drugs could I find in your medicine chest at home?; could you let me know the commercial brand name and the laboratory of any of them?

3. Introductory question: How do you assess the entry of generic drugs in the pharmaceutical market? [The aim is to perceive the level of knowledge of generic drugs and their opinion about the penetration in the market.]

4. In your opinion, which are the main differences/similarities between a branded drug and its generic version?

5. Transition question: What is your opinion about the information provided by the Ministry of Health and other sanitary institutions on generics? [The aim is to notice whether final consumers are aware of the public advertising campaigns funded by the goverment.]

6. How do you perceive the information provided by your physician and/or your pharmacist about generics? Remember last time you visited the doctor, what type of medicines did he/she precribe to you? Remember last time you bought a drug in a chemist's; did the pharmacist advice you to buy a cheaper but equivalent medicine?; have you suggested the substitution of the prescribed drug by a cheaper one?

7. Key questions: In your opinion, what factors influence the final purchase decision between a branded and a generic drug with the same chemical compound? [The aim is they mention all likely attributes and factors that determine the demand for a generic drug, among them price, name of the laboratory, format, prescriptor, dispensor, type of illness, etc.]

8. How do you assess the new regulation that allows pharmacists to substitute the drugs prescribed by the physician for cheaper ones?

9. Imagine that you go to the chemist's with your physician's prescription and the pharmacist gives you the chance to substitute the prescribed

drug for a cheaper one; under what conditions are you going to accept the substitution?; what factors would make you refuse the substitution?

10. Ending question: Do you consider we have missed any important issue?

Do not hesitate to contact me if you have additional comments and suggestions. Thanks to all for your collaboration.

Appendix B.Contingent Ranking

This appendix displays an example of a choice set used for the contingent ranking experiment. Remember that each choice set is composed of five cards, each representing a drug alternative, and that card number five is always the blank card or outside option. In the case of amoxiciline, the blank card is "home remedies" (remedios caseros).

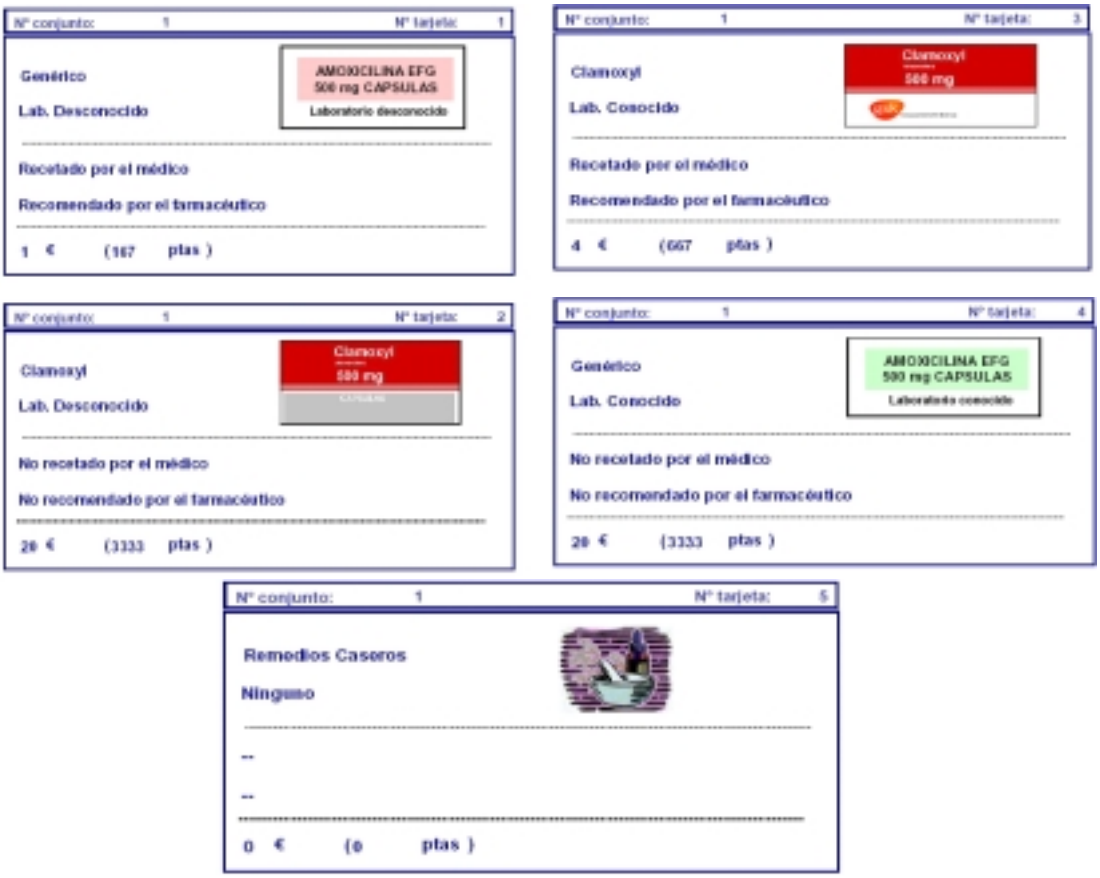

Figure 2.5. An Example of Choice Set

Choice Set Number:

First Choice:

Second Choice:

Third Choice:

Fouth Choice:

Fifth Choice:

Appendix C. Questionnaire

Table 2.18 shows the questions included in our questionnaire.

Question	**Answer Range**
Sex	male, female
Spanish Nationality	yes, no
Age	years
Educational Level	none, primary, secondary, university
Professional Level	by my own, employed
Family Head	yes, no
Home size	number
Children	yes, no
Household Net Income	range
Social Security Member	yes, no
Mutuality Member	yes, no
Private Insurance	yes, no
Household Drug Expenditure	range
Generic Knowledge	yes, no
Generic Purchase	yes, no
Physician Generic Prescription	yes, no
Pharmacist Generic Recommendation	yes, no
Laboratory Identification	yes, no
Chemist's Loyalty	yes, no
Personal Identification	name, region of residence
Interview Location	hospital, primary care center, chemist, others

Table 2.18. Questionnaire