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WORKING PAPER

SPECIFICATION OF A CONSUMER DEMAND MODEL
FOR ETHICAL DRUGS IN A REGULATED ENVIRONMENT

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Abstract:

This paper develops a consumer model demand for ethical drugs in a regulated environment in order to explain variations in the cost of medications among populations of patients, diagnosed with the same disease. The main purpose of this paper is to explore whether financial variables influence consumers' decisions and the demand for drugs, in order to relate it to reimbursement policies.

The assumed predictors which may affect consumer's decisions to consume pharmaceuticals are conditions of illnesses, socio-demographic characteristics, financial characteristics and access to information. This model combines a disease approach, in order to identify casemix of patients with similar conditions of diseases and economic variables. In the context of escalation of costs in many health care systems, such a disease approach can provide necessary information on how the costs of pharmacotherapies vary within a population having a similar disease.

INTRODUCTION:

Due to cost containment pressures, many governments and health care providers have to revise the financing of care. This raises of course major issues of access to care and equity. Many systems have been run for more than forty years, without major assessment of how the budgets are spent and potential discrepancies among the population. Therefore, this paper by formulating a consumer demand model for ethical products aims to address a number of issues relevant to policy makers to redesign their cost containment strategies for their drug budgets.

I. THE DEMAND FOR PHARMACEUTICALS AS A DERIVED DEMAND OF HEALTH INPUT:

Most theoretical economic models aiming to represent pharmaceutical consumption use the framework of a production function linking inputs and outputs (M.Grossman,1972; C. Phelps, 1974). In such a case, the output is health and inputs are various health care services.

The demand for pharmaceuticals however can either be :

- a demand of medications as a provision of secondary care in hospitals,
- a demand of medications linked to the prescribing behavior of a physician D (presc),
- a demand for self care medications D(OTC).

The organization of care is a major determinant of interactions between these three components of the demand for pharmaceuticals. At this stage, however we will mainly focus on the modelling of the outpatient prescription drug demand which often represents more than 70 % to 80 % of the market.

The demand for pharmaceuticals or the consumption for drugs is therefore considered as a derived demand (or indirect demand) of a good/or service which aims to provide a better

health status and to satisfy consumer's demand for health. Pharmaceuticals are therefore bought not for themselves, but because they aim to provide an improvement in health and in the satisfaction of the well-being of patients. Their demand is dependent on the demand for complementary inputs and in particular of physicians' visits, and components of the treatments provided by physicians. Contrary however to most works performed on the estimation of factor derived demands of other goods, price or value of health is unobservable (1). Therefore, it is not possible to relate price elasticities of various types of health services with an output price (which would be Health in that case). However health services aim to contribute to an extension of life duration or to improve quality of life and various ways to measure these contributions are now used. Cost-effectiveness studies, for instance, are more and more used to evaluate prescription drugs, or to include them in national reimbursement lists and formularies, or to design options for drug coverage policies. If such studies can be very useful from a company's marketing strategy perspective and can be performed by the company, it is less obvious to use them in the estimation of an aggregate consumption demand function since a large share of the market is covered by products which have not yet been assessed for their contribution to duration of life or quality of life or criteria of cost effectiveness. Their introduction on the market may often be the results of other types of factors (such as the results of bargaining powers between regulators and companies). Moreover, the assessment of costs and effectiveness remains very controversial outside the scope of clinical trials (e.g. R.L. Bohn and J Avorn, 1993).

The objective of this paper is to estimate a relation between consumer demand and some factors related to consumers, so we will not model the contribution of pharmaceutical to health in general, which would require a specification on the pharmaceutical supply and the conditions of access to market.

II FACTORS THAT AFFECT THE DEMAND FOR PHARMACEUTICALS :

This paper examines some factors that affect the demand for outpatient pharmaceutical drugs, both prescription and OTC medications, adopting a consumer perspective. The case of inpatient pharmaceuticals, related to hospital care demand would require a specification for other health services and is not addressed. The main purpose of this paper is to explore whether financial variables influence consumers' decisions and the demand for drugs, in order to relate it to reimbursement policies.

(1) This value of health partially drives the technological needs to find treatments (theory of "needs driven" technological changes versus "opportunity driven" technological changes).

The assumed predictors or factors which may affect consumer's decisions to consume pharmaceuticals are conditions of illnesses and socio-demographic characteristics, financial characteristics and access to information:

1. The conditions of health/illnesses diagnosed by a physician or perceived by the consumer which require some treatments such as pharmaceutical consumption.

The probability of prevalence of illnesses vary a lot among a population according to variables such as age, sex or other criteria such as different health status (e.g. measured by functional status). Therefore, conditions of illnesses will need to be adjusted by such factors.

2. Financial variables:

As any purchase of goods, the purchase of pharmaceuticals lead to costs for the consumer, even in insured markets. Three factors will directly influence the costs to the consumer:

- 2.1. the payment of an insurance premium or social tax to cover the risks of illnesses.
- 2.2. the net price of drugs
- 2.3. the disposable income
- 2.4. the liquidity payment required, if there is a cash payment before the reimbursement by the consumer.

3. Information / education available to the consumer.

(both on illnesses and drug information). Consumers receive information on health products usually through their physician, their pharmacists or through direct advertising or educational campaigns. Education influence individual behaviors towards health and consumption of health services (e.g. A.Leibowitz, 1989).

II.1 . Conditions of illnesses and consumer ' perceptions:

II.1.1. Conditions of illnesses/health status:

Health conditions or conditions of illnesses are a priori the major determinants of demand for health services. However, consumers alone often do not perceive their illness or health status. The morbidity usually declared by the patient can substantially differ from the morbidity observed by professionals such as physicians. For prescription drugs, drugs purchase will therefore be largely determined by prescribing patterns of a physician and his judgment of the conditions of illnesses of the consumer/patient. The pattern of the drug demand (structure of different products purchased is therefore linked to the diagnostic of a physician in relation with one or multiple illnesses). However, if the direct choice of prescribed drugs is not a patient's decision, but a physician's decision, still, the conditions of the patient himself drive the prescribing demand of the physician and therefore will influence drugs'demand.

The specification of the demand for drugs would require a specification of physician's prescribing behaviors since conditions of illnesses are not the only factor which play a role in the decision making process of a doctor. Concerning pharmaceuticals, other factors such as the information/promotional efforts of companies, personal characteristics of physicians, reimbursement and payment methods for physicians, training of physicians can play a role (e.g. P.Denig for a review of drug choices models in medical practices, 1994; M.C. Weinstein, 1983). There is a large controversy about the interactions between physicians and consumer decisions. In particular, previous works have discussed the demand inducement problem by the physician, namely that a physician would prescribe and recommend pharmaceutical services that differ from what the patient would choose if he or she had available the same knowledge as the physician (cf. B.Evans, 1974, T.Rice, 1983). A main argument to support the existence of induced demand is to say that doctors can shift the demand and therefore that the prescription drug demand will be influenced by the prescription drug supply.

A traditional demand equation taking into account the perspective of the sales of the pharmaceutical industry usually includes variables such as prices, but also "effective industry marketing", product quality, order of entry in the market (see, for instance, E.Berndt and others,1994; C.Le Penn,1986). Most corporate marketing policies are usually directed towards physicians through medical journal advertising or direct detailing to the physicians. Therefore pricing and characteristics of drug supply will induce some physicians'

patterns of prescribing and the final consumer demand for drugs.

In a specification of a drug demand model, it would mean that
 $Y_d(\text{Presc}) = F (P, Y_s(\text{presc}), \text{others variables})$.
 where Y_d is the consumer prescription drug demand
 Y_s is the prescription drug supply.

Therefore, if the induced demand theory applies to pharmaceutical demand, that may imply, for instance, that a lower rate of coverage for drugs, may induce doctors to take into account factors like drug' manufacturers' reactions to types of payments (e.g. new drugs on the market, new promotions of different types of treatments...). Given some potential important induced behaviors and interactions between drug supply and drug demand, it is important to control such effects in order to isolate impacts of consumers' characteristics on drug demand. We will control the impact of physicians' prescribing by grouping similar groups of patient profiles, receiving similar types of prescribing treatments for a similar disease. This disease approach does not control for the effect of over or under prescribing of some physicians versus others, but allows to analyze a sample of patients diagnosed with a similar disease and identified with a treatment for the disease.

This consumer demand model can be tested on a selection of different casemix of populations of patients diagnosed with similar diseases, for whom a prospective assessment of an accurate drug therapy by physicians is performed. Within such a casemix of patients, there is still a large scope for different consumers' behaviors towards conditions of illnesses and purchasing behaviors for medications. Therefore, such a model allows to analyze different consumption patterns for pharmaceuticals, linked to different consumers' characteristics and perceptions (appendix 1 provides a summary of the case of hypertensive care, chosen to test the model empirically in a cross section randomized study of 939 French patients diagnosed with hypertension (C.Huttin and J.Avon,1995).

In order to be used by policy makers or third party agencies for reimbursement principles, such analysis would need to be performed for several diseases (for instance with the highest prevalence rate within a nation). In comparison with cost effectiveness studies, such a model underlines the financial conditions of patients to pay for medications and would therefore bring some empirical contributions on the

reality of equity and universality principles in the access to care.

II.1.2. Information and perception of the patient about the illness:

In such a model of consumer demand for pharmaceuticals, the degree of knowledge/information of the consumer is crucial in order to assess its rational behavior both for drug use and judgment about his own health status. Most microeconomic models assume a maximization behavior of the consumer and the fact that he intends to satisfy an expected utility function, trading off health with other goods. As the skills to identify types of illnesses are usually in the hands of the medical profession. Consumers have limited access to knowledge about their needs and according to their level of education or family and environmental conditions, their perception on their health status and their needs to consume health services vary. However, for some types of illnesses, patients are aware of state of illnesses not reported to the medical profession since they often self medicate in such cases (e.g. digestive disorders). Asymmetries of information therefore exist, not only between physicians and consumers (1), but also among groups of consumers. Such asymmetries create a very heterogeneous understanding among consumers about:

1. The perception he can have on his illness
2. The information about the products.
(advertising/information through the physician or drug leaflets).

Health education for instance can considerably change the perceptions of a consumer on his needs for improving his health status (An. Mizrahi and Ar. Mizrahi, 1992). Longitudinal studies of morbidity clearly show how different generations of patients, more educated on health and health services have been treated differently for the disease. An example can be provided by the French consumption of cardiovascular drugs in 1960 and 1980: there was a significant share of patients declaring illnesses, without taking medications in 1960, while in 1980, the proportion of cardiovascular diseases declared and not treated had considerably decreased (INSEE, " Enquetes decennales , 1960 - 1980).

(1) Agency theory has been used to model consumer decision taking into account asymmetry of information between patients and physicians. In this model, we assume given this asymmetry of information, but aim to analyze variations among consumer choices.

There is still a scope for a large variation among consumers in terms of judgments of their needs, their illnesses, their perception of the physicians' effort to cure them, and the need to purchase drugs and comply to this treatment (partly due to the fact that they have different access to information or knowledge about their illnesses and the treatments they can receive).

There is very little knowledge of various degrees of rationality of consumers (E. Engel, 1995). Most cost-benefit or cost effectiveness analysis to evaluate medications usually assume that consumers and physicians can make clear choice between various risk probabilities. However, with respect to consumers, the scope for irrational choice is particularly very high and would require a better understanding of misperceptions or misjudgments (for instance, a patient's misjudgments of the low probability of risks of his illness for his life). There is in this field a large scope for research to explore attitudes towards illnesses and how they influence the consumer decision making process. This would be particularly important for the analysis of consumer demand for health services, when a consumer becomes disable or loses some capacities due to one or multiple illnesses. Conditions of illnesses may largely affect the ability of a patient to judge the type of treatment (see, for instance, critics of the rational choice theories (A. Tversky and D. Kahneman, 1988)).

We assume that the propensity to consume health products for a patient depends on his perception of a physician's judgement about his illness and his own perception of his health status. To take into account the perception of a consumer is especially relevant for pharmaceutical services , since a large share of patients often do not comply to physicians' prescribing patterns (the lack of compliance can reach 25 to 30 % according to types of medications), and if pharmaceuticals are self medicated, there is no physician's judgement. An accurate measurement of patient's perception would however require repeated measures of consumption habits, in relation to his own judgment of his health.

Even if the consumer is not so informed about his disease, there are good reasons to include his own perception of his health status in a consumer demand model, especially in large public insured markets. First, the consumer's judgement about diseases can also meet the economic interest of physicians to provide repeated visits and repeated prescribing, and both are largely refunded by the social security systems. The judgment by a consumer therefore also concerns the physician who prescribed the medication. Second, consumer's perception will be important to define his willingness to go to a pharmacist to purchase the prescribed medications and his degree of compliance with a treatment. Such knowledge about the patient is however very limited and we will limit the scope for variations in consumers' judgements essentially to judgements on state of illness.

II.2 Financial variables:

A second series of factors which affect consumers' choices is his ability and willingness to pay for drugs. As a consumer does not know when and if he will get a disease, therefore he usually chooses some types of health coverage or will have access to it through an employer or a public insurance scheme. Therefore, most consumers pay premiums or social taxes and get partial coverage. Pharmaceuticals are however specific in such health insured markets since they are often not covered (e.g. case of OTC medications) or only partially covered by insurance. Large discrepancies therefore exist among consumers in the total costs for medications. Patients have to pay according to the cost of the medications they have been prescribed, and how much they are refunded by public or private insurance agencies.

Most models on consumer's expected utility, relate a premium level to a level of coverage. It is not obvious however, that for pharmaceutical services, the premium decision plays a direct role, since for different types of consumers the medication bill for instance does not justify a coverage for drugs (which would exceed their potential realistic drug expenses).

Therefore, we will discuss at this stage, a concept of net price, which is related to direct forms of payment, while an exact concept would need to take into account also the indirect payment due to a previous premium or a social tax aiming to fund the health insurance. This indirect payment aims to cover the risk of diseases and the payments of needed treatments in such cases. However, it probably also raises the

propensity to consume since the heavier the premium or the social tax, the more a consumer will expect to have rights to free access to a larger share of the provisions of services.

The contribution of an insurance premium to the net price paid by a consumer for potential health expenditures is barely quantifiable, since usually an insurance premium is global, the payment decision is not related to payment of specific expenditures and often is even not made by the consumer himself (e.g. cases for wives, other dependents, or any person in compulsory public insurance schemes). Therefore, we will consider the financial cost of a premium or a social tax as an exogenous element at this stage.

II.2.1. The net direct price for drugs:

In a consumer survey, the full price of drugs is not very relevant as a variable to explain a consumer decision on drugs, especially in countries where a large share is covered by public and private health insurance and the consumer does not pay the full price of products. An insurance coverage has the same effect as a subsidy in the sense that it lowers the per unit price of care for a consumer. So, a direct payment by the patient can be deducted, it is called the net price to the consumer: $P(1-k)$. P is the retail price for a prescription or a non-prescription drug and k is a parameter that specifies the extent of the coverage from an health insurance plan. We are therefore interested in the relation between the net price $(1-k)P$ paid by the consumer and the consumer demand for drugs. Any policy from a policy maker or a private insurer to modify k , aims to vary the net price paid by the consumer, aiming to modify his demand for drugs : $Y(d) = F[(1-k)P, \text{ other variables}]$

Value of $(1-k)$:

Two opposite effects are due to insurance coverage: one effect is on price and is discussed below, the second effect is on wealth and is discussed in the next section on the role of income. Given a retail price, if the net price paid by a consumer due to health insurance is lower, then, a consumer may consume more drugs. " The lowering of the marginal cost of care due to insurance which increases usage of care, is usually called moral hazard problem (M. Pauly,1968)". Higher drug coverage provides larger access to care and may induce higher level of consumption.

k results from various drug coverage policy choices of public or private insurers as well as the selection of coverage options made by a consumer, his employer or a household's member. k may also be the result of conflictual policies between a public insurer and the additional coverage proposed by an additional insurer. A detailed review of the forms of cost sharing for medications may reveal in fact a large diversity of net prices finally paid by consumers for similar treatments, even in largely regulated markets covered by dominant public insurance schemes. Various types of payments for medicines exist and represent a major source of discrepancies among consumers, especially in cross country comparisons (*)

1. The consumer pays the total price and is not refunded. It concerns prescribed and non prescribed medications. (k=0).

Very often the switch from prescribed medications to over the counter medications (OTC) means that the patient will lose the access to insurance coverage for such medications. The change in drug classifications from one category to another one leads therefore to a change of reimbursement policy. However, especially in countries where universal coverage does not exist, k=0 is also very spread for prescribed medications. In that case the consumer has to pay the full price and consumer demand may switch for categories of medications which are still covered by insurance. The impact on drug use will therefore depend on the degree of substitution between alternative therapies which are still refunded by insurance plans, when the physician is aware of cost differences of different types of medications and the impact of cost differences on patient's compliance.

2. The consumer pays the total price and is partially refunded (if there is no third party payer system but cash payment refundable by the social security).

In that case, $k > 0$. However, there is a liquidity issue since the consumer needs to pay first and may be refunded with a significative time-lag. The net price may underestimate the effects on consumers who may be more aware of the liquidity effect of the payment than the real effect. This liquidity effect may depend a lot from the disposable income and the level of the drug bill to pay cash by the consumer. A liquidity problem mainly arises for patients who are not covered by third party mechanisms and when the coverage rate for the cost of drugs is very low, in comparison with the level of expenditures. We will consider therefore different groups of

patients facing a different burden of cash payment, in relation with their income (adjusted with the number of dependents living in a household).

(*) OECD and United Nations have discussed in their international comparisons studies, the various measures used by governments in their national accounts for prices of health services to the consumers.

If we call L : liquidity effect

CASH : the level of cash payment.

$Y(d) = F [(1-k) P, L, \text{other variables}]$

$L = F [DI (\text{household characteristics}), \text{CASH}]$

3. The consumer pays a reduced price and the social security system pays directly the rest to the pharmacist (third party form of payment). In that case , the consumer pays $(1-k) P$. If a patient gets several medications records, he may pay a full price for some records and a reduced price for other records. Therefore, $(1-k)P$ in that case would represent the total net cost after taking into account the different coverage rates according to the types of medications.

4. The consumer pays a reduced price and the social security system subsidizes the manufacturer. In that case, the consumer pays $(1-k) P$.

5. The consumer has the drug freely ($k=1$), usually when he can benefit of conditions of exemption.

k can be considered as an endogenous variable, since it depends on the characteristics of the reimbursement health plan , affordable to consumers and the selection of a plan may be done by a consumer. This leads to problems of adverse selection and therefore needs to be controlled in a consumer demand model. Coverage levels can be estimated through instrumental variables. In employer based insurance systems for instance, the employee history may explain variations in health insurance coverage. However, when an insurance system is mainly a public insurance scheme, it is compulsory: adverse selection problems are less present. We could assume in such a case, that for consumers benefiting of access to the general regimes of insurance schemes, then the coverage rate remains independent in the demand model. However, even in such systems, when a consumer work status is modified because of unemployment, temporary or part time employment, usual conditions of access to health coverage are more limited. In such cases, some

provisions of free services may exist through specific health schemes, for very low income groups, but "between jobs" or part time workers may face a threshold in getting access to normal insurance coverage and therefore drug benefits.

One objective of public insurance schemes (or equivalent non-profit organizations in competitive health markets) is to avoid potential biases from the unbalance of powers between manufacturers, providers of services and insurers in term of information on conditions of illnesses and appropriate provisions of health services (R. Frank and D. Salkever, 1994). Profit maximizers suppliers / providers or insurers either may induce certain types of demand for inputs / underprovide quality of care or ration certain access to provisions of services. This key argument of these sources of asymmetry of information to justify the role of governments, or substituting mechanisms, may however be reduced through better education/or alternative forms of information provided to patients and the growing role of information processing companies in the field. The control of such information systems however will remain an issue.

Conditions of reimbursement designed by an insurer or a public agency may take into account types of illnesses, types of products or other conditions of exemptions. So, types of payments, and the net price paid by the consumer will depend on insurers' choices. For instance, minor illnesses are usually not covered and therefore drugs are paid out of pockets, because this type of illnesses and the types of treatment is considered as not essential and less expensive by a government or insurers. The choice of a consumer still intervenes for a complementary coverage. For this component therefore, there is a risk of adverse selection effect relating drug coverage level and drug expenditures. This component called, k' , can largely affect the effect of k on the net price paid by the consumer.

The value of Retailer price:

In the calculation of the net price to the consumer, the second component is P , the retailer price. This level of price can be regulated or is dependent on competitive market forces. In a regulated environment, a government agency may fix the level of prices as well as the level of drug coverage. In such a case, it clearly determines one key component of the level of expenditures as well as the net price paid by the consumer. The level of prices may differ for the same product, whether it is a branded or generic and in such a case that will influence the

net price paid by the consumer. Generic entry on pharmaceutical markets usually face high segmentation of demand (cf. H. Grabowski, 1992 ; Z.Li and W. Comanor, 1994). Namely, consumer groups react very differently to generic prices: for instance a patient which suffers from a chronic illness, may be more sensitive to prices, because of regular refills of drugs than a consumer purchasing a drug for a limited treatment. A survey performed for instance on elderlies in the USA (cf. AARP survey) tended to show that despite the fact that most of the sampled population is aware of what a generic is, 50 % at least did not purchase less expensive drugs. However, in regulated markets, generic substitution is limited, generic prices are controlled and rights of substitutions to pharmacists do not always exist. So, a model of consumer demand in a price regulated market will focus at this stage on a partial model where the retailing price is considered as independent, but the net price paid by the consumer, taking into account the effect of various drug coverage is partially endogenous (1).

II.2.2. Drug price information and price perception by the consumer:

Consumer 's information about prescribed ethical products is very limited. In many countries, governments restrict information on prescribed pharmaceuticals to health professions and the patient gets the information once he has bought the product, usually on the leaflet provided with the product (most efficacy, safety conditions of the products, some side-effects or interactions with other medications are not provided to the consumer). As information to patient is a very broad issue, we will focus in this paper on price information and the cost of treatment, since we discuss the relation between consumer demand and the various conditions which influence the patient's ability to pay.

In most competitive environments, price lists can be provided to consumers. On the contrary, in regulated systems, price information is barely known by a consumer. However through repeated treatments (e.g. case of chronic illnesses), a patient may become more informed about the cost of a treatment. Consumers can be informed on drug prices by physicians, pharmacists or different corporate marketing efforts. Such information access to consumers means that price is endogenous : manufacturers modify prices according to demand characteristics. Consumers can be sensitive to drug prices in relation to different brands, branded generics or generics sold on the same market but with different corporate marketing efforts especially if the consumer has to pay out of pocket a

large share of the drug expenditures.

(1) The net price for drugs in a regulated market is dependent on a compulsory insurance plan, additional funds are often provided through companies (which can negotiate better rates for an employee with or without families). Prices are fixed and leave little scope for consumer choice among medications for a same chemical entity.

As more categories of medications are now switched to OTC medications, it is very relevant for consumers, especially when they have to pay a large share out of pocket for medications, to be aware of drug prices, and the availability of best type

of therapies. In a market where drug prices are fixed, the consumer has no incentive to shop around and to find the best price for drugs among various pharmacies, once the drug is prescribed by the physician. However, in more competitive market with free pricing such as in the USA, price information to the consumer is particularly accurate and may introduce substantial differences between purchasing practices of similar groups of patients (with the same type of disease). For instance, Leffler (1981) advocated that heterogeneous consumers have different perceptions of the information available on drugs, especially through advertising and this partially explains the existence of a segmented consumer demand for pharmaceuticals.

An effective search for information from the consumer on drug information ?

The nature of a disease, and therefore the level of drug expenditures required for the treatment of the disease probably introduces a threshold in the incentive for an information search from the consumer. If the disease is limited in time and the person is in rather good health, especially with standard or high level of income, there is limited scope for information search and interest in saving money when purchasing the drugs. On the contrary, when the patient is sicker and requires longer treatment, especially through repeated prescribing from a physician, he will become more informed about the cost of the treatment. His disposable income may interact at this stage and increase his incentive for a search of information on drug prices and ways to limit his spending, if the financial burden becomes too high.

A better consumer information may change the patient-physician relation, and in particular, induce the physician to take more into account the affordability of the treatment for the patient. An effective copayment policy towards consumers for drug consumption may therefore requires a substantial improvement of ways to inform the patients about the products and a better understanding on the price-disposable income-copayment relations.

There is however very limited empirical works in regulated market about variations in price information among consumers for pharmaceuticals and the empirical part of this paper cannot really estimate such potential informational effects on consumer purchasing policy.

II.2.3. consumer demand and disposable income:

Most models relate income and variations of medicine use.

At an aggregate level, for macro comparisons among countries, it is usually very relevant to take into account an average income per capita and there is a correlation between the level of average income and the average demand of health care (Newhouse and Phelps, 1974; Milne and Molana, 1991).

The relation between the demand for pharmaceutical care and income is more ambiguous. A positive relation between income and level of use is not always confirmed in the reality. Some researchers assume that family income has a positive effect on the likelihood of use and an overall negative effect on volume of use (Howard, Lairson and Lee, 1985). The influence of income may also have to be analyzed by taking into account the role of insurance on the remaining disposable of an unhealthy patient or on his wealth level. Health insurance (M. Pauly, 1988) also changes the expectations of the consumer. Insurance coverage may cause positive wealth effects on use, because it increases wealth, especially for unhealthy people. According to M. Pauly (1988), this may however appear, only if higher levels of wealth stimulate spending, and if this wealth effect in the high expenditure situation offset the depressing effects of lower disposable wealth in the low expenditure state.

Previous estimation of income elasticity, at an aggregated level, are greater than one; which confirms the role of income on expenditures. However, there are major differences

among countries. The empirical work by D. Alexander, J. Flynn and L. Linking for instance clearly (1994) shows an elasticity of 1.03 in the UK versus 1.79 for the United States and Japan. One of the explanation would be that changes of income are likely to have a much greater impact on consumption when there is greater access to the health care system. The income elasticity for France is estimated at 1.31 in this study which tends to show, despite a substantial insurance coverage and low prices, quite significative variations of the demand according to levels of incomes. In a research dealing with more desegregated data, the income variable and its relation to consumption of medicines becomes more ambiguous. It is a parameter more dependent on the household level of analysis versus the patient level of analysis. Different characteristics of households may influence the relation between the level of disposable income and the consumer demand. First, income will be affected differently according to who is ill in the household. If the income is normally raised by the ill person, then despite the insurance coverage, an illness status would probably lead to a sharp drop of the disposable income of the household (loss of job, part-time work, invalidity pension depending on the severity of the illness). A proxy to estimate this phenomenon would be to consider whether the person has to change his way of life (in term of work, housing work...). Secondly, the composition of an household (size, number of dependents, number of salaries...) may largely affect the disposable income/per patient.

$$Y(d) = F (DI, \text{other variables})$$

$$\text{Disposable income} = F(\text{size of the household, } D1, \text{ severity of the illness})$$

$D1$: dummy (1,0) if the ill person is the main income raiser or not in the household.
severity of illness/es.

II.3 Formal care versus self medication:

Among major consumer decisions concerning drug consumption, the choice between formal care and self medication may considerably influence the specification of prescription drug demand. Therefore, in modelling a consumer demand for drugs, an important step is to understand the mix between self medication and formal medical care. Relative prices for self medication versus prescribed medication and cost of physician services for instance may lead to switch for self medication when affordability is a problem (A. Leibowitz, 1989). The consumption for OTC medications will depend on the consumption of prescribed medicines. According to previous works

(A. Leibowitz, 1989; M.B. Hedvall, 1992), the main factors affecting OTC medications used by the consumer are insurance plan (which affect the probability to use OTC medications), health status (people in worse health and people with more worries about their health spend more on non essential drugs than healthier people). Access to OTC medications, through self care, eliminates time and cost for formal medical care and may be more accessible for more educated people, and high wage people (A.Leibowitz, 1972), age and sex also tend to play a role in previous studies: usually self care concerns minor illnesses and treats illnesses more frequent in children groups (e.g. for cough and cold, see Knapp 1972, Johnson 1983). Such factors, if they play a different role in the demand for OTC are not therefore so different from factors we have discussed so far. An interesting issue is to understand interactions among two components of the demand for drugs. At a desegregated level, the utility to specify an equation for self-medication is only relevant for certain conditions of illnesses where an alternative choice for a consumer is effective between self medication and formal care (in most OECD countries, it concerns 10% to 25% on average of the pharmaceutical market). When such a choice exists, for a consumer, it is relevant then to introduce in the model, not only a net price related to the product, but also the relative price getting a self medication versus getting a formal care (prescription+physician costs).

III SPECIFICATION OF THE MODEL:

This paper presents a model specification for the level of drug expenditures, Y_d , specified for prescription drugs $Y(\text{presc})$ and OTC drugs $Y(\text{OTC})$. It includes the various factors discussed in the previous sections and the structural equations, to relate $Y(d)$, $Y(\text{OTC})$ and endogenous variables such as the net price paid by the consumer.

- (1) $Y(\text{presc}) = F [S(\text{niPi}), D(\text{ac}), L, \text{GHI}, \text{age}, \text{sex}, \text{PERC}, \text{DI}, \text{Size}]$
- (2) $Y(\text{OTC}) = F [k(Y(\text{presc})), P, L, \text{DI}, \text{GHI}, \text{age}, \text{sex}, \text{PERC}, \text{EDU}]$
- (3) $S(\text{niPi}) = F [\text{instruments}]$

Variables:

$Y(\text{presc})$: Demand for prescribed medications

$Y(\text{OTC})$: Demand for OTC medications (self care)

P_i : retail price of a medication record for the treatment of the disease under study.

niPi : net price paid by a consumer, taking into account the

rate of coverage for a medication i .
 $S(n_i P_i)$: Total of all medication records which are purchased and paid by a consumer.
 $D(ac)$: represents a variable for access to additional coverage (either through complementary coverage or conditions for exemptions of medication costs).
 L : liquidity of a patient (in this paper, it is approximated by the cash payment for the medications relevant for the treatment of the disease).
 $PERC$: index to measure the perception of illness by a consumer
 GHI : General Health Index
 DI : Disposable Income for a patient, belonging to an household
 $Size$: size of the household.

A more generalized formulation of the global net price paid by the consumer can combine the coverage rate for medications $k(d)$ and the other conditions of the health plan in a global net price measure: $(1-k(d))P = nP_i * D_j$.

In this specification, the household income is not endogenous, but we control the size of a household as a factor explaining differences in a disposable income of a patient. Alternative formulations could reconsider the causality between expenditures and income, since an ill person's income is largely dependent on his health status and the treatment of his disease(s).

IV MEASUREMENT OF VARIABLES:

IV.1. Conditions of illnesses / clinical profile of the patient

The clinical profile of a population is a key element for modeling pharmaceuticals consumer demand. In order to control for diversity of conditions of illnesses among patients, the objective is to adopt a disease approach in order to test the influence of such factors. The clinical analysis is used for the classification of the population surveyed into homogenous groups of patients for a specific disease (an example of the constitution of such a casemix of patients is given in appendix 1 for the case of Hypertension). This clinical analysis is also used to control other conditions of illnesses and various physical, functional characteristics of patients which need to

be controlled in order to explain variations of drug expenditures among patients, due to demographic or epidemiological data.

As patient's perception about his health status may also affect his drug consumption according to the previous discussion for the specification of the model, we include a measure about a patient's perception of the answer of the physician concerning the diagnosis of his disease (it is a measure on the consumer's risk assessment about his disease and the potential risk for his quality/duration of life). This perception measure is a categorical measure on a five item scale (used as a proxy for an ordinal scale: it ranks the consumer's perception of a physician's response: it takes the value "5", if it is very bad, with high risk for life, and a value "0" if there is no risk at all). Such a scale may in fact measure not only the vital risk for the patient (from the point of view of a professional) but also a patient's own perception about the accuracy of the judgment made by the physician about his health (since the information is collected through a consumer survey).

IV.2. The net price to the consumer:

An appropriate price measurement should reflect more the net out of pocket cost to the consumer than the retail price, as discussed previously. An attempt to consider the net price paid by the consumer instead of the real price of drugs has been already used by D. Alexander, J. Flynn and L. Linkins (1994). This net price measure is based on an average retail price. For European countries, it is multiplied by one minus the average reimbursement rate for the pharmaceutical bill covered by public insurance. For the purpose of a desegregated demand function, as proposed in this model, a global coverage rate must take into account the specificity of an insurance plan per category of medications, per illness(es), how various conditions of exemptions can influence different types of drug demands.

The net price for the consumer will take into account the price minus the rate of drug coverage (determined by the insurance fund). However other conditions of access to coverage may influence the price paid by the consumer. In particular, his access to additional coverage and if he can benefit of conditions of exemptions for the treatment of other illnesses.

A global net price N_{Pi} per patient should therefore combine the

different components of the drug coverage. In the specification of the model, we have opted for representing two different variables, to control for the effects of the insurance schemes:

- $S(n|P1)$: (retail price - rate of drug coverage by public insurance) where $P1$ is the retail price for all medications concerning the treatment of the specific disease (e.g. hypertensive care). In a regulated market the price is fixed by the government and margins are also fixed. Therefore the retail price is given and considered as an independent variable at this stage of the model.
- $D(ac)$: access to additional insurance schemes or specific conditions of exemptions.
 1. Access to additional insurance schemes measured with dummy variables:

For example in the case of the French system: there are three types of complementary insurance: "mutuelles", "caisses de prevoyance" and private insurances. A specification with dummy variables lead to exclude one out of three (e.g. the caisses de prevoyance). In this example, the two dummy variables are: Dummy variable D_i (1,0) : "mutuelles" coverage
 Dummy variable D_j (1,0) : "private insurance" coverage.

2. Access to condition of exemptions measured with one dummy variable D_{ex} (1,0). A patient may have a right to full exemption, for specific reasons linked to his age, income status or severity of illness.

Such a model specification combines different reimbursement schemes which influence the net price paid by the consumer for the treatment of the disease under study. The measures included in the model would control for different access to different health insurance drug benefits: $NP_i = f(NP1, D_i, D_j, D_{ex})$ for a patient i . As it has been discussed previously, NP_i is partly endogenous, in particular since a consumer can opt for purchasing or not medications, he will either pay full cost or partial cost for one or various medication records, and he may opt for complementary coverage. In order to control for adverse selection problem (linked to additional insurance) and partial endogeneity of the net price variable in the model, we estimate the net price first through instrumental variables and then use such an estimator in the consumer demand equation.

As the model is specified for a regulated environment

where a public insurance coverage is mandatory and has politically driven complementary schemes, we have opted to consider as an endogenous variable at this stage only the net price paid by a consumer linked to the variations of the different medications records (NP1 in the model). The choice of instruments is therefore relevant to NP1 only. Two major instruments have been selected: the number of records for the treatment of the specific disease and an indicator of the patient 's functional status. The number of records for the specific disease is not automatically correlated to the full price since medication records have different prices; on the contrary, it should lead to a larger financial contribution from a patient who pays a fixed/percentage amount per medication record. It does not lead especially to larger drug expenditures for the treatment of the disease since a patient with more records is also more susceptible to benefit of additional coverage or exemption. The second instrument chosen is an indicator of health status and the measurement provides a scaling of the functional status of the person . This provides a global indicator of the patient's health status not directly related to the specific disease under study.

The model specifies the other components of the health insurance coverage through a group of dummy variable $D(ac)$. The use of such dummy variables for representing different access to coinsurance can create inconsistency problems (see J. Newhouse, C.E. Phelps and M.S. Marquis, 1980). The main reason is that such formulations through dummy variables (values 1 and 0) suppose that all patients with a complementary scheme have a similar coverage rate for drug medications. As the access to information on additional drug benefit from various additional schemes is limited, it explains the use of dummies. The interpretation of coefficients associated with such dummies however need to take into account such issues. For instance, it is not a problem if specific conditions of exemptions (Dex) lead to full coverage for all patients. With dummies such as D_i and D_j , we can still test whether there are differences of expenditures according to the type of additional insurance(1).

Such econometric problem need to be discussed in an empirical stage. However, this problem explains that we have restricted the role of dummy variables in the model to the part of the insurance schemes where we do not know the exact coverage for medications. For instance, in the French case, dummies D_i and D_j aim to measure if there are different responses due to the subscription to a "mutuelle" versus a private fund , since both supplemental insurances have normally different financing principles (profit raising versus solidarity principles).

(1) In order to compare insurance/expenditures relations on populations with complementary coverage and without complementary coverage, who may also be very different in term of income groups and facility of access to care, it would be probably more appropriate to use clustering methods to identify various patient profiles with various level of coverage as well as other socio-demographics characteristics of the patients.

IV.3. Other financial variables:

Other financial variables than the net price for medications are considered in the model: disposable income per patient and liquidity variable.

IV.3.1. Disposable Income for a patient:

The level of income is a categorical variable measured at the level of the household. Therefore, we control for the size of the household in order to control for an average level of income disposable per patient. The disposable income is expressed in different forms, in order to test the impact of different incomes for different population groups:

- First, we assume that if income is an important issue for pharmaceutical expenditures it is relevant to consider the people below an average national income .
- Second, we are interested to test the influence of low income group and a need for a specific policy according to low income groups. In such a case, we take into account only the income group of the first income level (representing less that the quartile 10 %).
- Third, as aging of population becomes a major issue for health care expenditures, we consider the income of the over 65 age grouped and below the average income level.

IV.3.2. Liquidity variable:

In the specification of this model , liquidity is limited

to the concept of cash payment for the cost of medications. As we have discussed, insurance benefits may lead to various types of payments and such alternatives introduce different levels of cash payments for each patient. One of the major alternative is if the patient pays cash and then is refunded, versus a third party system, where he does not have to pay (e.g. in this model, we measure liquidity as a dummy variable taking a value 1 when the patient needs to pay cash (totally or partially) for at least one medication record of the treatment of the disease (e.g. hypertension).

V Conclusions:

This specification of a partial consumer demand model for pharmaceuticals can be applied on sampled populations of patients diagnosed with similar diseases. It aims to combine a disease approach and a test of a model taking into account predictors mainly dependent of consumers' decisions. The major objective is to analyze on a population of patients for whom clinical profiles are controlled, three major economic effects on the level of expenditures: the effect of the global net price paid by the consumer, an income effect, taking into account different characteristics of households and liquidity effects.

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APPENDIX 1

Example of the use of a clinical
analysis for a group of patients

the case of HYPERTENSIVE CARE
(Huttin C., Avorn J.)

A clinical analysis of the population treated for hypertensive care has been examined, in collaboration with the Department of Clinical Strategies (Harvard Medical School). For each patient, a number of inclusion criteria has been selected in order to determine the population of patients with similar conditions of illnesses. The list of diagnosis for hypertension has been established with the WHO 9th version, classification of illnesses (similar to IDC9 classification in the USA). The diagnostic codes which identify for hypertension are:

- Malignant hypertension
- Intermittent high blood pressure
- Hypertension
- Hypertensive cardiomyopathy
- Secondary malignant hypertension
- Secondary hypertension

In addition at least one of the following groups of medications used for hypertension therapy has been included:

- anti-hypertensive agents
- Beta-blockers, single associated
- Calcium Channel blocker
- ACE inhibitors
- Diuretics
- Sulfamides, singles
- Sulfamides, combined
- Xanthiques
- Others
- unknown diuretics.

Such inclusion criteria determine the size of the sample and the consumer population under study for the purpose of testing the specification of the consumer model developed in this paper on a French population of patients, randomly selected.

The GHI predictor specified in the expenditure model aims to represent risk factors and confounders such as age and sex. For patients with hypertension in particular, the following diagnosis have been identified, as major conditions which could lead to variations of drug use among patients:

- Diabetes (DIAB)
- Ischemic heart diseases (IHD)
- Heart failures (CHF)
- Cholesterol (CHOL)

Therefore, these four risk factors are included in the model. For identifying the patients with a risk factor, we have identified the same inclusion criteria as the one used for selecting the population with hypertension: namely the list of illness codes for diabetes, ischemic heart disease, heart failure and cholesterol and the list of medications for such illnesses. The descriptive statistics provide a large number of patients which consume medications without declaring the illness or who declare the disease and do not consume medications. Patients which include one at least of the two inclusive criteria are identified with one of the four risk factors.

Other demographic, functional variables and conditions favorable for an illness have been taken into account to control for variations among cases of patients:

- age

- sex
- smoking habit
- alcohol consumption
- hospitalization (if the patient has been hospitalized).
- index of functional disability

APPENDIX 2

Alternative model specifications

Income and health expenditures

The relation between health expenditures and income is very complex (see discussion in the paper). This model aims to emphasize the consumer's decisions, allocation of his budget to health expenditures could therefore be considered as an endogenous variable. Another reason is that raising income depends on health status: illness may affect work ability and therefore ability to raise income. In a variant of the model taking into account income as an endogenous variable, we could select instruments related to work, as well as level of education as proxy to explain the level of income. Other characteristics of a family structure may however be important to consider such as the number of workers within a family or the demographic structure within a family .

