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HEALTH CARE: INTERACTION BETWEEN PUBLIC SYSTEM AND PRIVATE SECTOR

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Health Care:
Interaction between Public System and Private Sector

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A *mu* mare, Antònia,
i mon pare, Pere.

Agraïments.

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Abstract

The second chapter studies the interaction of private and public health care providers. We assume consumers differ in their income levels and allocate a fixed percentage of their wealth to health care. Health care is provided by a public firm maximizing social welfare, and/or private providers maximizing profits. The decision process of firms consists of three stages: entry, quality of health care and quantity produced. The private provider serves the high quality demand and the public supplier serves the lowest. Mixed provision results in a welfare improvement compared to the strictly private regime and is less costly than a purely public regime.

The third chapter assesses whether increases in public health expenditures make total health expenditures grow. We use a moral hazard model of private health care expenditures that relates individual health care purchasing behavior to public health spending. The data considered are from the Family Budget Survey of Spain from 1990-91. We find that public health expenditures reduce private health spending. Although this crowding-out effect is significant each extra monetary unit spent publicly makes private health expenditure decline by less than one. Therefore, total public health care expenditures increase with public health system expansions.

The fourth chapter analyzes the effect that several quality dimensions of the public health system in Spain have on the demand of private health insurance. If sick, consumers can choose either a public treatment provider with a fixed quality, or a private provider with a whole range of different qualities. Expected utility maximization leads individuals to buy a private health insurance plan or not. The decision depends not only on consumer's covariates such as income, socio-demographic characteristics and health status, but also on the public provide-r's treatment quality. The empirical analysis uses the Spanish Health Survey of 1993. We cope with the absence of income data by using the Spanish Family Budget Survey of 1990-91 as a complementary data set, following the Arellano-Meghir method (1992). Results indicate that the higher public quality the lower the probability of buying a private health insurance plan is. This suggest the existence of a crowd-out in the health care provision market.

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Chapter 1

Introduction

The last four decades, health care has received increasing attention from economists. There are at least three reasons explaining such interest: First, the size of the health care sector and its contribution to the overall economy which is measured by its share of the gross national product, and by other macroeconomic measures such as the number of jobs in health care professions and the amount of capital that it is invested in it[1]. Second, health care is an attractive area for economists because of the enormous importance that persons attach to their health, both as consumption good in itself and as a necessary condition to attain other commodities. Allocating resources to pursuing and maintaining health implies facing and choosing from different alternatives that can be evaluated and compared on economic grounds. As it is well known, any decision that involves optimal allocation of scarce resources is a raison d'être of economics. Third, as a consequence of the importance individuals give to health issues and the increasing amount of wealth that societies assign to it, health care is a growing concern for governments.

[1] In 1995, health share of the GNP ranged from 14.2% in the USA to 7.6% in Spain. The percentage of total employment occupied in health care in 1990 was 6.2% in the former and 3.2% in the latter.

Health care expenditure have been growing steadily in all OECD countries in the last thirty years, not only in absolute terms but also per capita. Besides the growth of spending and the growing share of public health expenditure, giving access and the health quality at which it is provided worries also policy designers', and therefore, economists involved in public policy and regulation.

Health economics received a great impulse with Arrow's seminal contribution[2] in 1963 defining the market imperfections that characterize the health care sector. Arrow remarked the "unique nature of the health care setting, and hence, on the importance of the institutions that arise in health care markets, including government, and not-for-profit provision of care, health insurance (commonly compulsory in developed countries but not in the United States), licensure, unique professional status of physicians and other providers and perhaps most importantly, the overriding importance of uncertainty as a dominant factor in the decisions, market structure and institutions surrounding the provision of health care" [3]. After this conceptual breakthrough, health economics evolved borrowing analytic economic tools from other areas with irregular success during the 60's [4]. 1972 brought a decisive change in how economists faced health and medical health demand. That year, Grossman presented his work building up a formal model of demand for health and demand for medical care. Grossman extended and

[2]Arrow K. (1963).

[3]Phelps, C. (1995).

[4]See a Culyer and Wright (1978), Fuchs (1996), Phelps (1995) and Williams (1996) for a detailed discussion of the health economics literature produced since the 60's. Although it is usually accepted that this first period was not too remarkable, it is also recognized that M. Feldstein's contributions (applying quantitative methods and linear programming to the estimation of production functions and other aspects of medical care) constitute quite an exception.

developed G. Becker's concepts of human capital and household production in a health context.

Basically, health economics is an applied field that evolves consistently as other disciplines in Economics advance and provide more analytic tools that can be used to understand the health care sector structure and functioning. As recently as 1990, Feldman and Morrisey[5] thought that health economics was still a new field that had developed from different areas of economics. Victor Fuchs has summarized those disciplines as basically four: 1) Finance and Insurance (incorporating the notions of risk aversion and moral hazard); 2) Industrial Organization (with the ideas of productivity, product differentiation, technological change, monopoly and competitivity); 3) Labor economics (besides a commodity, health is an input for producing labor); and, 4) Public finance (with the concepts of equity of access and public provision of private goods). One particular area that has recently contributed considerably to our knowledge of the health care sector is the Economics of Information. The application of incentive's models to health issues have helped a great deal to analyze how patients, doctors, hospitals and health insurers interact.

On the other hand, also the improvements in Econometrics quantitative methods in general have allowed to test theoretical hypothesis about how health care markets work [6] and to use frontier cost estimation techniques to approach health care production functions. In particular, as C. Phelps remarks, the advances in econometric analysis have opened the possibility

[5]Feldman R. and Morrisey M.A., (1990).

[6]The existence of demand inducement is an example of a subject that has generated a high number of empirical papers. This concept was introduced by Pauly in 1968.

of incorporating "more and more micro data to study (health care) issues", forcing health economics' attention to smaller and smaller choice sets and units of decision. Treating adequately microeconomic data has carried the use of increasingly sophisticated econometric techniques. Many relevant decisions are binary, so techniques to measure demand for such services (insurance, treatment, for instance) require discrete choice modeling capability. Also, hazard models and Markov models of state-transition have provided tools for analyzing outcomes such as 'time spent' in some determined state. In addition, semi-parametric and non-parametric tools (e.g., boot-strapping) have made possible to relax the usual assumptions of normally distributed errors that constrain so often the possibilities of the traditional estimation procedures [7].

The unifying topic of this dissertation is health care. The dissertation consists of three essays that study the effects of the interaction of the private health sector and the public health system under different perspectives. The focus is how the existence of a universally accessible public network influences the health care provision market, private and total health care expenditure and, individual health insurance choices. Finding answers to these questions is specially relevant in an environment as the European one where more than three fourths of health care expenditure are paid by the public sector [8] and private health care firms and insurance companies have been called to play a decisive role in health care reforms.

The coexistence of public and private health care providers determines at

[7] Phelps, C. (1995).

[8] The OECD Europe average (excluding Portugal, Luxembourg and Turkey) was 74.4% in 1992.

which quality and prices health care is supplied. The result of the interaction influences individuals' choices but, at the same time, is influenced by that outcome. We can expect that the existence of a national public health system providing health care at a certain level of quality has different and, maybe even contradictory, effects on the private sector. On the one hand, the existence of a public sector guaranteeing coverage of health care might crowd out the private sector and alter the health products being privately offered. On the other hand, the share of the public budget allocated to health care might make individuals feel somehow 'richer' since more resources are assigned to cover their basic health needs. This sort of income effect might trigger higher private expenditure and these include private health goods and services. The final effect of the public health system is not obvious. It depends on which of those two opposite forces outweighs the other and on the final qualities, type of products and prices that result from the interaction of private and public providers.

This dissertation analyzes the effects of the coexistence of the public and the private health sectors adopting three different points of view. Since I concentrate on the study of different aspects and consequences of the competition between public and private providers, I stay away from informational issues that, in this setting, are considered of secondary order.

The second chapter studies the interaction of private and public health care providers in a theoretical setting. I assume consumers differ in their income levels and allocate a fixed percentage of their wealth to health care. Health care is characterized by two dimensions: units or frequency of purchase and other qualitative attributes (not only technological but also con-

cerning the type of associated 'hotel' accommodation, for instance). In the model, health care is supplied by a public provider, which maximizes social welfare, and/or private providers which maximize profits. The decision process of firms consists of three stages: entry, quality of health care and quantity produced. The simultaneous solution of the mixed oligopoly model where the public provider has a first mover advantage results in that the private provider serves the high quality demand and the public supplier serves the low quality one. Mixed provision carries a welfare improvement compared to the strictly private regime and is less costly than a purely public regime. Supply by a mixture of public and private firms overcomes the market failure that results from limited coverage by private providers. Moreover, the intervention of the public provider imposes a lower bound on the minimum quality offered in the market, which forces the private counterpart to raise its own quality and lower its price.

The second chapter contributes to the previous existing literature in the sense that is treats health care as a good that is characterized by more than one dimension. Often health care goods and services (ranging from insurance plans to treatments) are offered by different types of suppliers. Consumers' choice takes into account more than one feature of the health commodity. Agents care not only about the number units (or frequency of type of treatments included in a plan) consumed or contracted, but also at which quality those are supplied (e.g., technical innovation they guarantee, type of accommodation hospitals offer). Individual evaluation and satisfaction extracted from consumption depends on his/her idyosincratic tastes and preferences over those different attributes. The use of a vertical differentiated

good model allows to capture this fact. The incorporation of a public health provider that is concerned about access and quality but that also pursues the "cheapest" feasible provision (by promoting the existence of a private sector), fits in an stylized description of most OECD public health policies.

The second chapter has some added value with respect to the previous mixed oligopoly literature in the sense that it considers a situation where the competitive solution fails to cover the whole population [9] and where the public provider uses an innovative instrument such as a price low enough to cope with this problem. With respect to the health economics literature, this chapter shows the welfare improvements derived from insuring universal access to health care services through a mixed oligopoly. It also captures the fact that the welfare increases not only by providing all the population with a minimum basic package of health care, but also, by setting a lower bound of the quality at which it is supplied. Moreover, it illustrates the feasibility of using a policy instrument often called to substitute for the actual free-at-source public health care: the use of a price low enough to be affordable for all individuals. The extension of this idea would be the tiquet moderateur or co-payment, i.e. paying for at least part of the marginal cost reduces the welfare loss of full insurance.

Although the second chapter does not provide directly testable predictions, the next two chapters are empirical and related to the theoretical issues which are examined in the second chapter. The empirical chapters analyze different aspects of the effects on qualities, expenditure and health

[9] Like Delbono, Denicoò and Scarpa (1996) but unlike Cremer, Marchand and Thisse (1991) or Grilo (1992), see references in second chapter.

coverage options in a mixed health provision system such as the Spanish one.

The first empirical chapter examine the effect of public health expenditure using an Spanish data set. The chapter assesses whether increases in public health expenditure makes total health expenditure grow. Increasing public expenditure may reduce private health care spending. If the absolute value of this substitution effect is less than one, then total spending in health care raises. I use a moral hazard model of private health care expenditure that relates the substitution effect to the direct income effect. The model generates testable predictions on the two effects. The data considered are the Family Budget Survey of Spain from 1990-91. I find that public health expenditure reduce private health spending but, at the same time, total health expenditure increase with expansions of the public health system. The effects are significant and indicate that public health expenditure crowd out private spending.

The contribution of this third chapter is the incorporation of microeconomic data to the empirical analysis of an issue that has been mainly examined at an aggregate level. The study of income, public health and total health expenditure interdependencies using macroeconomic data provides some important and undeniable information but is also questioned by several authors. C. Phelps, for instance, thinks that, even though the recently-produced OECD international and health outcomes [10] will assist in an improved understanding of many phenomena, only more refined micro data within and across national boundaries will provide a best picture of 'what happens' for most of these issues.

[10]These OECD data sets focus on countries' annual behavior as a unit of observation .

The third chapter adds value to previous literature in the following ways: it uses micro data to test the theoretical predictions of Risa's (1989) moral hazard model of individual private health expenditure and it modifies some of the models original assumptions in order to obtain some less restrictive testable theoretical predictions to answer the issue on how public health expenditure affect individual private health spending. The use of a theoretical model of consumer's behavior giving support to the empirical relationship is also a distinctive feature of this chapter with respect to a large number of works in health economics.

The results of the third chapter illustrate that there is a substitution effect between private and public health care but that this substitution effect is not strong enough to outweighs the positive income effect (net of taxes) that the existence of a public health care network has on private health care expenditure. In other words, each extra monetary unit spent in health care by the public sector makes private health expenditure decrease, but less than proportionally. Therefore, the net result on total health care expenditure is expansive. This result is related to the findings of the second chapter. One of the consequences of the existence of a public health provider in the theoretical chapter is the increase of total health expenditure. The reason is that, due to the existence of a public provider, the part of the population unable to afford health goods and services in the private duopoly spends a positive amount in health goods when they are served by a mixed oligopoly. Although these incumbent consumers do not pay for the full marginal cost of what they consume, they pay for part of it. Therefore, total health expenditure in mixed oligopoly increases due to the existence of a public provider that pays

for part of the health provision cost. As I pointed out, this result goes in the same direction of the findings of the first empirical chapter: the expansions of the public health network expands total health expenditures.

On the other hand, this result fits also with the recent evidence in the OECD countries at an aggregate level: public health share increased in most countries and, at the same time, total health care expenditure grew. Therefore, the substitution effect between public and private is not negative enough to curb total spending in health care.

The fourth chapter is also empirical and analyzes the effect of the public health system quality in Spain on the demand of private health insurance. I assume that consumers may choose either a public treatment provider with a fixed quality, or a private provider with a whole range of different qualities. The decision to buy private insurance depends on the quality of the public provider treatment and on consumer's characteristics such as income, social and demographic variables and health status. The decision rule is estimated using the Spanish Health Survey of 1993. To cope with the absence of income variables in the data, the Arellano-Meghir (1992) approach which enables the combination of two data sets: The Spanish Health Survey of 1993 and the Spanish Family Budget Survey of 1990-91. The empirical analysis suggests that an increase in public health care quality lowers the probability of buying a private health insurance plan and that, therefore, public health care quality crowds out private health care provision. In the same sense that in the theoretical chapter (second) the presence of a public provider imposes a lower bound on qualities that makes the private provider react strategically, in this empirical chapter the public health quality imposes also a constraint for

private providers. This applied work does not show directly that private suppliers increase quality as a reaction to public health provision quality standards, but, it does show that those public standards exert pressure on private providers to revise quality.

This last chapter contributes to the previous literature by using a Spanish data to test how public health care quality influences private health insurance choice. As in the third chapter, the empirical work tests the implications of a theoretical model trying to explain health insurance demand in the presence of a public health care network free-at-source. With respect to the estimation procedure used, this chapter copes with the absence of income information in the main data set (National Health Survey) complementing it with the National Budget Survey. This constitutes an innovation in the health economics literature. Further, it indicates that there exist many techniques susceptible to be applied to health economics which have to be yet explored and incorporated. With respect to the results, I find that, as expected, public health quality does play a role in individual health insurance choices. The implication is that, to avoid the failure in attaining their final objective, indirect effects of improving public health quality have to be taken into account when designing public strategies.

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Chapter 2

Health Care: Private and/or Public Provision

2.1 Introduction

The health care (HC) sector is an important component of total production in the OECD countries. In 1995, the expenditure in HC goods and services as a percentage of GNP in these countries ranged from more than 14% in the USA to about 5% in Turkey. In Spain this percentage was 7.6%. Moreover, these percentages have been increasing rapidly over the last decades. From 1960 to 1990, HC expenditures as a percentage of GNP increased by 5.1 in Spain, 2.7 points in the United Kingdom, 3.5 in Germany and more than 4 points in France, Holland and Italy [1].

The magnitude of HC goods expenditure by itself but also its recent evolution - due to revolutionary but expensive technological changes and the extension of coverage has attracted attention to a sector economic theory traditionally did not focus on.

[1] Informe SESPAS 1993.

A closer look at HC expenditures reveals that the fraction paid privately varies from country to country depending on historic, social and economic factors. In Spain, the public sector accounted for 82.2% of the total HC expenditure in 1991. Similarly, the United Kingdom and Italy's public share was above the 80%, whereas in Germany, France and Holland it was around the 70%[2].

Moreover, families allocate quite different percentages of their budgets to HC goods and services across countries. At the beginning of this decade, this percentage ranged from 15.02% in Germany to 1.29% in the United Kingdom.

These countries have public networks with very different sizes, financing systems and population coverage that complement or substitute private purchase of HC goods. Typically, the public sector co-exists with a private counterpart with a very different objective function underlying its decisions.

Designing a HC delivery system so that *efficiency, cost control and equitable access* are guaranteed has become one of the most dynamic areas of health economics. Different combinations of a public system and profit maximizing private firms have been proposed as solutions to the overly expensive public HC sector. Goldman(1996), Enthoven (1978,1989), Halonen and Propper (1996), McGuire and Riordan (1995), Starr (1993) and van de Ven (1994 and 1995) are only some examples of this already extensive literature.

Theoretical papers addressing the introduction of HC goods and services provision by the private sector have involved models of effort extraction and a

[2]In the USA this percentage was 44.32% in 1994.

how change of property rights could make the production of such commodities more or less efficient [3]. We approach this issue using a model of vertical differentiation with constant marginal costs of production, increasing costs of quality and a Cobb-Douglas characterized demand.

In this chapter, we study different combinations of public and private HC providers. We examine their effect on quality levels offered and the resulting consumer satisfaction. In particular, we consider preventive HC services such as dentist and gynecological exams: services for which consumers decide periodically how much they spend. Purchasers allocate a fixed proportion of their income to buy preventive HC services[4]. Consumers have either a high or a low level of income, and this feature determines how much they are willing to pay for HC goods and services[5].

In our model, suppliers have a constant marginal cost per unit produced and an increasing marginal cost of quality. Firms decide whether to enter, the quality of the good and finally, play a Cournot game to decide the level of output.

We consider three scenarios: in the first, the market is served by a strictly private oligopoly where all firms maximize profits. In the second, a public firm with a first mover advantage shares the market with private providers.

[3]See Maija Halonen and Carol Propper (1996) and Thomas G. McGuire and Michael H. Riordan (1995), for instance.

[4]We use the Cobb-Douglas function proposed by Motta (1992, 1994) based on Sutton's (1991).

[5]It seems plausible to us that citizens decide to allocate a fixed percentage of their income to this sort of HC services and only make a positive expenditure on it if this reservation price exceeds what they have to pay for the commodity. Their willingness to spend may be interpreted as their health-prevision's reservation value, and thus, implicitly, as a measure of their risk aversion to future maladies.

The public firm maximizes consumer surplus subject to universal coverage. Universal coverage of preventive HC goods is introduced as a governmental cost-containment policy: Since early detection of a high number of diseases provides higher chances of overcoming the illnesses and less costly treatments, investment in health prevention is understood as an instrument to save future HC expenditure. In the third scenario, for comparison purposes, we also present the solution of a strictly public scheme.

Mixed Oligopoly is welfare improving with respect to the strictly private regime, and less costly for at least the same level of consumer surplus than the strictly public one. In a Mixed Oligopoly two different quality levels arise: the public provider serves the lower level and the private sector the higher one.

Our paper is related to several previous papers dealing with product differentiation and mixed provision regimes. Moorthy (1988) shows that the market outcome does not always achieve the socially optimal solution in oligopoly markets with quality choice. Since then, a whole line of literature trying to define the specific situations where public intervention could achieve or approach first best outcomes has arisen.

Cremer, Marchand and Thisse (1991) were among the first to deal with mixed oligopolies. In their horizontal differentiated product model, firms choose location and price with quadratic transport costs. Only if the number of competing firms is either two or more than six, a Mixed Oligopoly with one public and n-1 private firms is socially preferable to the private duopoly. Grilo (1992) analyzed the same question in a vertically differentiated duopoly

market with a profit maximizing firm and a total surplus maximizing firm engaged in price competition. She proves that the socially optimal solution can be sustained as a market outcome by using a public firm as a market agent. Both Cremer, Marchand and Thisse (1991) and Grilo (1992) assumed that markets were fully covered.

Later work in the area of private and/or mixed differentiated oligopolies include Cremer and Thisse (1991, 1994), and Delbono, Denicolò and Scarpa (1996). Delbono, Denicolò and Scarpa (1996) assume a vertically differentiated duopoly with a private and a public firm, but they do not analyze the entry stage of the game. Full market coverage is not required in order to address ' it the most important distortion associated with monopolistic and oligopolistic settings, namely that consumption falls below the socially optimal level because prices are greater than marginal costs'. They obtain two subgame perfect equilibria with opposite rankings between public and private quality levels. If the state-owned firm has a first mover advantage, it serves the upper segment of the market.

Our paper captures some aspects of the above work but differs in others. As we stated earlier, we use a vertically differentiated oligopoly and also allow for different structures of provision. As in all the papers mentioned, our model presents a private sector maximizing profits and a public firm maximizing welfare. In contrast to previous work, the health services sector motivates our analysis and justifies some of our assumptions. For instance, in our model the public firm maximizes net consumer surplus and sells at a price unilaterally set low enough, so equity of access is guaranteed.

Unlike Cremer, Marchand and Thisse (1991) and Grilo (1992) but similar

to Delbono, Denicolò and Scarpa (1996), we do not assume full market coverage. We analyze a situation where low income consumers cannot afford the price set in a strictly private scheme of provision. Instead of the Mussa and Rosen (1978) demand model used by Delbono, Denicolò and Scarpa (1996), we use Motta's (1994) variation of Sutton's (1991, ch.3) Cobb-Douglas model.

Although the assumptions of our model are specific to a market where universal access is a concern and consumers allocate ex-ante a fixed percentage of their wealth, the results might be interesting in a more general setting. The findings reinforce our belief that mixed provision of socially desirable goods such as health or education can improve consumers' levels of satisfaction while lessening the burden on the public budget .

This chapter is organized as follows: Section 2 describes demand and supply functions in a generic setting and obtains the strictly private outcome. Section 3 examines and compares the outcomes of the private regime of provision, the mixed scheme solution and finally, the one of a strictly public regime seeking to achieve at least the same level of consumer surplus as the Mixed Oligopoly. Section 4 gives conclusions and points to possible lines for further research.

2.2 The Model

We first characterize demand and then state assumptions about supply.

2.2.1 Demand

Consumer i allocates income m_i among a composite good z_i and preventive health services x_{ik} of qualities u_k, where $k = 1, ...K$. The preferences of this consumer are given by the Cobb-Douglas utility function:

$$U(x_{ik}, z_i) = (u_k x_{ik})^{\beta_i} z_i^{1-\beta_i}.$$

The budget constraint is:

$$\Sigma_{k=1}^{K} p_k x_{ik} + p_z z_i \leq m_i.$$

Consumers differ both in the importance β_i they give to the quality good and in wealth m_i. A well-known result of this Cobb-Douglas model is that each individual allocates $\beta_i\%$ of her total expenditure to preventive health services and the remaining $(1-\beta_i)\%$ to the rest of goods z_i[6].

[6]Although the assumption of allocating a fixed percentage of wealth to preventive HC goods is admittedly special, we think assuming people decide ex-ante how much they allocate every year to these services is reasonable. A very different issue would be how much consumers are willing to spend on curative health care goods (hospital stays, for example) once they know they need them.

On the other hand, we could as well interpret the health good as a health insurance plan if number of units are frequency at which services can be used and quality, the quality at which those services are provided. In this case, we would not be analyzing the decision of buying or not health insurance (we are not considering expected utility maximization given the consumer's illness' risk) but we would be assuming that all consumers do have to allocate a fixed amount of their incomes to assure themselves some type of health coverage (compulsory insurance), and that they decide which one depending on their willingness to pay for it, the frequency/rate at each they can use the services contracted and the quality at which those services are provided

Moreover, the solution is characterized by the feature that, from all the available options, the variety h chosen by the individual is the one that maximizes the quality-price ratio $\frac{u_h}{p_h}$. Thus, in equilibrium, for any two varieties bought, the quality-price ratio will have to be identical[7,8]:

$$\frac{u_j}{p_j} = \frac{u_h}{p_h}, \quad j \neq h, \quad j,h = 1,...,K. \tag{2.1}$$

For each individual, total expenditure on the quality good will total:

$$\Sigma_{k=1}^{K} p_k x_{ik} = \beta_i m_i \quad i = 1,...,N. \tag{2.2}$$

Consumers' total expenditures on this type of health services equal the sum over all N individuals:

$$S = \Sigma_{i=1}^{N} (\Sigma_h p_h x_{ih}) = \Sigma_{i=1}^{N} \beta_i m_i. \tag{2.3}$$

We assume that consumers differ in their income level, but not in the importance they assign to the quality good, i.e., $\beta_i = \beta$ for all $i = 1,...N$. We also assume that there are only two types of consumers: high income consumers m_H and low income consumers m_L, with $m_H > m_L$.

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[7]In this case, the consumer's maximization problem can be seen as a two stage decision choice. In the first one, the consumer decides to split his/her income according to the percentages described. In the second step, he/she has to maximize the satisfaction he/she obtains from the quality good subject to the first decision. More formally, the second step entails choosing the variety k such that: $u_k \epsilon argmax\ of\ \{u_k x_{ik}\ s.t.\ p_k x_{ik} \leq \beta_i m_i\}$ Since $x_{ik} = \frac{\beta_i m_i}{p_k}$, the variety selected will be the one that maximizes $\frac{u_k}{p_k}$.

[8]This condition implies that there are no quality observation problems and the consumer is indifferent between having a higher quality more exhaustive health check-up less often and having a lower quality less exhaustive one more frequently.

2.2.2 Supply

Health services x_{ih} of quality u_h, are provided with a technology with constant marginal cost c and a fixed cost for the quality attained equal to the square of the quality produced (i.e.,u_h^2)[9]. Thus, the total cost of producing x units of quality h is:

$$C(x_h, u_h) = u_h^2 + cx_h.$$

The cost function assumptions seem to match real world technologies used in preventive HC services. Fixed costs cover the instruments used in health preventive check-ups such as screening devices, laboratory components for diagnosis and detection, etc. These fixed costs are incurred once and last for an extended period. Usually, the price of these devices is increasing with the level of sophistication. Constant marginal costs correspond to costs of operating these machines, i.e., materials and non-reusable elements used in the diagnostic tests, energy, personnel, and so on.

Firms play the following three stage game: First, they decide if they enter the market or not. Second, if they enter, they choose the quality level u_h. Third, they decide how many units x_h to produce at the quality decided in the previous stage.

2.2.3 Private Providers

The private outcome of this game can be found using backwards induction [10].

[9] We follow Sutton (1991) and Motta (1994).

[10] The derivation of the equilibrium relations follows Sutton (1991) and Motta (1992).

At the third and last stage of the game, firms simultaneously choose the quantities x_h they produce in order to maximize the variable profits:

$$\Pi_h = (p_h - c)x_h, \quad h = 1, 2, ...K.$$

At this point, they incorporate their knowledge of the condition that the quality-price ratio has to be equal for all the varieties sold in equilibrium as stated in equation (1).

Assume that all firms except for one choose the same level of quality u^*, u being the deviator's chosen quality. Equation (1) gives the condition on prices and qualities for all firms to sell positive quantities in the market, i.e.:

$$\frac{u^*}{p^*} = \frac{u}{p}. \tag{2.4}$$

In order to obtain the demand functions of the n-1 firms and the deviator, condition 4 is incorporated in the total level of expenditure:

$$S = px + (n-1)p^*x^* = \frac{p^*}{u^*}ux + (n-1)p^*x^* = px + (n-1)\frac{p}{u}u^*x^*. \tag{2.5}$$

Rearranging, inverse demand functions for all firms are obtained; the deviant's one is:

$$p = \frac{Su}{ux + (n-1)u^*x^*}. \tag{2.6}$$

And, for the n-1 remaining firms:

$$p^* = \frac{Su^*}{ux + (n-1)u^*x^*}. \tag{2.7}$$

Given the qualities and the number of firms, expressions (6) and (7) are incorporated in the variable profit function of the deviant. The solution of the output subgame is then obtained maximizing the corresponding profit function with respect to output. Simplifying, the quantities produced by the deviant and the n-1 remaining firms are:

$$x\left(u,u^{*},n\right)=\frac{\frac{S}{c}[(n-1)^{2}uu^{*}-(n-1)(n-2)u^{*2}]}{[(n-1)u+u^{*}]^{2}}, \tag{2.8}$$

$$x^{*}\left(u,u^{*},n\right)=\frac{\frac{S}{c}(n-1)uu^{*}}{[(n-1)u+u^{*}]^{2}}. \tag{2.9}$$

Introducing output solutions (8) and (9) into the price equations (6) and (7), prices ($p(u,u^{*},n)$, $p^{*}(u,u^{*},n)$) and profits ($\Pi(u,u^{*},n),\Pi(u,u^{*},n)$) are found.

In the quality subgame played in the second stage, the deviant incorporates the expression of $\Pi^{*}(u,u^{*},n)$ into its total profits:

$$\Pi\left(u,u^{*},n\right)=S\frac{(n-1)u-(n-2)u^{*}}{[u^{*}+(n-1)u]^{2}}-u^{2}. \tag{2.10}$$

Taking the derivative of equation (10) with respect to its own quality u and making it equal to 0, one obtains that only one quality is produced in equilibrium, i.e.[11]:

$$u(S,n)=u^{*}(S,n)=\sqrt{\frac{S(n-1)^{2}}{n^{3}}}. \tag{2.11}$$

By substitution, output, prices and net profit of this symmetric equilibrium are:

[11]The uniqueness of this outcome is proved by Sutton (1991)

$$p(S,n) = c\frac{n}{n-1}; \quad x(S,n) = \frac{S(n-1)}{cn^2}; \quad \Pi(S,n) = \frac{S}{n^2} - u^2. \tag{2.12}$$

At the first stage of the game, firms decide on entry. In this setting, the number of firms operating in the market will be given by the natural number n such that profits satisfy the following system:

$$\begin{aligned} \Pi(n) &= \frac{S}{n^2} - \frac{S(n-1)^2}{n^3} \geq 0 \\ \Pi(n+1) &= \frac{S}{(n+1)^2} - \frac{Sn^2}{(n+1)^3} < 0 \end{aligned}$$

The system is satisfied by n=2. Hence, given a market of size S the private equilibrium outcome will be characterized by the existence of two symmetric firms producing the following quality and quantity:

$$u_j^p(S) = (\frac{S}{8})^{1/2} \quad j = 1,2; \tag{2.13}$$

$$x_j^p(S) = \frac{S}{4c} \quad j = 1,2. \tag{2.14}$$

at the price:

$$p_j^p = 2c \quad j = 1,2. \tag{2.15}$$

With equilibrium profits of[12]:

$$\Pi_j^p(S) = \frac{S}{8} \quad j = 1,2. \tag{2.16}$$

[12]Superscript p is used to identify this outcome as the one from the fully private regime.

2.3 Private and/or Public Provision

We are interested in analyzing and comparing the outcomes of different provision schemes of the quality good when there are two levels of income m_L and m_H, with $m_L < m_H$ and the lower income consumer's willingness to pay for the quality good which strictly less than the marginal cost of providing a single unit:

$$\beta m_L < c. \tag{2.17}$$

We assume that there are N_H and N_L consumers with high and low income, respectively.

2.3.1 Private duopoly with unequal incomes

With strictly private coverage of the market described above, by (15), firms charge twice the marginal cost per unit sold. Thus, the quality good is only affordable to the higher income population, whereas the lower income population remains uncovered.

The outcome of the strictly private duopoly (pd) yields quality of $u_j^{pd}(S_H)$, quantity $x_j^{pd}(S_H)$, price $p_j^{pd}(S_H)$ and profits $\Pi_j^{pd}(S_H)$ given by equations (13), (14), (15) and (16) by substituting the size of the market S in those equations by S_H[13]. S_H is the total expenditure of the N_H higher income consumers:

$$S_H = N_H \beta m_H. \tag{2.18}$$

[13]The superscript p changes to pd for private duopoly

2.3.2 Mixed Oligopoly with unequal incomes

In this section, we are interested in finding the solution when there are two types of providers: one private and one public. The private provider maximizes its profits whereas the public provider maximizes a social welfare function.

Public Provider's Objective Function

We assume that the public decision maker maximizes the population's net consumer surplus (CS) subject to the following two constraints: First, *universal coverage* guarantees the entire access to at least one basic package of the quality good provided. Second, the *satisfaction of the public budget constraint* for a given transfer (F) from the general public budget[14]. Finally, *survival of the private provider* is introduced as an additional condition on the public firm's objective function. This conjecture is made in order to find the 'cheapest solution' to the *consumer welfare maximization goal subject to universal coverage.*

The outcome validates the conjecture made and shows that it was necessary to characterize the lower cost method of maximizing consumer satisfaction subject to equity of access. If the private provider does not exist, the public firm cannot match the welfare level of the mixed structure unless

[14]We overlook questions of general equilibrium and assume that income m_i is net of general taxes. On the other hand, this perception of a publicly funded HC system is not far from real world examples. In Spain, the Instituto Nacional de Salud (INS) basically receives an annual transfer from the General Budget.

it receives a higher transfer from the public general budget. Hence, disappearance of the private provider would mean either a lower level of consumer surplus or more public expenditure, therefore, survival of the private firm turns out to be an instrument to minimize costs for any given level of consumers' welfare[15].

- **Consumer Surplus**

Consumer Surplus is obtained by aggregating the Indirect Utility Functions of the three types of consumers[16]:

1) the high-income buyers that acquire the quality good from the private firm W_H^p,

2) the high-income consumers that buy from the public firm W_H^g, and

3) the low-income consumers that can only buy from the public firm W_L^g.

In equilibrium the quality-price ratio of providers has to be the same if both providers sell positive quantities; see equation (1). We assume that high income consumers choose either provider with equal probability (q_j, for $j = p, g$). One half buys from the private firm and the other half from the public:

$$q_p = q_g = \frac{1}{2}. \tag{2.19}$$

Therefore, after some simplifications, consumer's indirect utility function -net of what is expended on the quality good- is:

[15]Furthermore, from the efficiency point of view, the existence of the private provider is generally considered to enhance technological competition and thus, efficiency.

[16]Public and private firms are indexed by g and p, respectively.

$$NV(p_p, m_i) = U(u_p x_{pi}, z_i) - \beta m_i = m_i \left[(\frac{u_p \beta}{p_p})^{\beta} (1-\beta)^{(1-\beta)} \right] - \beta m_i. \quad (2.20)$$

The net consumer surplus measure involving the three consumer types is:

$$NCS = \lambda_{pH} W_H^p + \lambda_{gH} W_H^g + \lambda_{gL} W_L^g =$$

$$= \lambda_{pH} NV(p_p, m_H) + \lambda_{gH} NV(p_g, m_H) + \lambda_{gL} NV(p_g, m_L) =$$

$$= \lambda_{pH} \frac{N_H}{2} \{ m_H ((\frac{u_p \beta}{p_p})^{\beta} (1-\beta)^{(1-\beta)} - \beta m_H \} +$$

$$+ \lambda_{gH} \frac{N_H}{2} \{ m_H ((\frac{u_g \beta}{p_g})^{\beta} (1-\beta)^{(1-\beta)} - \beta m_H \} +$$

$$+ \lambda_{gL} N_L \{ m_L ((\frac{u_p \beta}{p_p})^{\beta} (1-\beta)^{(1-\beta)} - \beta m_L \}. \quad (2.21)$$

- **Universal Coverage Constraint**

In order to achieve equity of access, the public decision-maker sets a price low enough so that low-income level individuals can buy one unit of the quality good[17]. For this purpose, the public provider price will be set at

[17]This assumption would be intuitively justified if a unit of the quality good is a "basic-minimum package" of the good provided. The public decision maker is interested in guaranteeing the universal affordability of at least one unit of basic services while the more income the consumer has, the more often he/she can get them. A practical example could be periodical teeth cleaning, or health check-ups. Poorer citizens would have one basic annual or bi-annual service publicly provided at the low payable price, whereas wealthier population would be willing and able to either pay the same price as the poorer but get partial check-outs more often, or to get higher quality and more expensive revisions, more seldomly.

βm_L[18]:

$$p_g^{MO} = \beta m_L. \tag{2.22}$$

The implications of (22) on private providers are very strong. The unilateral announcement by the public firm of its price determines the private competitor's price, resulting in[19,20]:

$$p_p^{MO} = \frac{\beta m_L}{u_g^{MO}} u_p^{MO}. \tag{2.23}$$

Equations (22) and (23), along with the assumption of equal probability of the public and private firms selling to the high income level consumers (equation (19)), supplies us with the private x_p^{MO} and public x_{gH}^{MO} quantities sold in the high income market by the two firms:

$$x_p^{MO} = \frac{u_g^{MO}}{u_p^{MO}} \frac{S_H}{2\beta m_L}. \tag{2.24}$$

$$x_{gH}^{MO} = \frac{S_H}{2\beta m_L}. \tag{2.25}$$

[18]In the Spanish case, some public health goods and services are provided for free. Hence, we find the situation described interesting if thought of as a variation of the real world model in which a minimum price or a "moderator-ticket" is introduced. Such a variation has been recently proposed for publicly subsidized drugs and medicines. In another type of situation, low public prices act as orientative prices for competitors. Such use is sometimes applied to homogeneous goods sold in cooperatives. Nevertheless, in our vertically differentiated case, the implications on the competitors of such policy are weakened by the existence of observable different qualities.

[19]Superscript MO stands for Mixed Oligopoly regime of provision.

[20]The simultaneous game in our unequal-income levels setting leads to a, so far, unsolvable problem. Plus, its solution would not necessarily achieve universal coverage of the population, an objective of our public provider.

Besides these quantities sold in the high-income market, the public provider sells N_L units to the low income consumers[21]:

$$x_{gL}^{MO} = N_L \tag{2.26}$$

- **Balanced Budget Constraint**

Given a transfer F^{MO} from the general public budget, the balanced budget constraint yields the following inequality:

$$BB = F^{MO} + (p_g - c)(x_{gH}^{MO} + N_L) - (u_g^{MO})^2 \geq 0. \tag{2.27}$$

- **Private Provider's Survival Conjecture**

The justification of this condition on the public firm's objective function is the requirement for *cost containment.* The existence of a private provider, as said previously, ensures the same level of welfare for less money than if it didn't exist. Accordingly, we include a non-negativity restriction on the private provider's total profits:

$$\Pi_p^{MO} = (p_p - c)x_p - u_p^2 \geq 0. \tag{2.28}$$

Introducing equations (22) to (26) into (21), (27) and (28) and setting the weights assigned to each type of consumers equal to one, we get the final expression of the public decision maker's objective function[22].

[21] Units sold in the low income market will be: $x_{gL}^{MO} = \frac{S_L}{\beta m_L} = \frac{N_L \beta m_L}{\beta m_L} = N_L$.

[22] See Appendix-I for Consumer's Surplus expression

$$Max_{u_g} NCS^{MO} = Max_{u_g}[(S_H + S_L)\left[\frac{1}{\beta}(\frac{u_g^{MO}}{m_L})^{\beta}(1-\beta)^{(1-\beta)} - 1\right]] \quad (2.29)$$

subject to[23]:

$$\Pi_p^{MO} = \frac{S_H}{2}\left[1 - \frac{c}{\beta m_L}\frac{u_p^{MO}}{u_g^{MO}}\right] - (u_p^{MO})^2 \geq 0. \quad (2.30)$$

And[24],

$$BB^{MO} = F^{MO} + \frac{\beta m_L - c}{\beta m_L}(\frac{S_H}{2} + S_L) - \left(u_g^{MO}\right)^2 \geq 0. \quad (2.31)$$

Note that:

(a) Since $(\beta m_L - c) < 0$, F^{MO} has to exceed $\frac{\beta m_L - c}{\beta m_L}(\frac{S_H}{2} + S_L)$ for a quality greater than 0 to be provided.

(b) the maximum public quality attainable u_g will be an increasing and concave function of F^{MO} the transfer from the public general budget: $u_g = [F^{MO} - \frac{\beta m_L - c}{\beta m_L}(\frac{S_H}{2} + S_L)]^{1/2}$

Private Provider's Objective Function

Since its price is determined, equation (23), the function to be maximized by the private provider with respect to its own quality u_p is total profits:

$$\Pi_p^{MO} = \frac{S_H}{2}\left[1 - \frac{c}{\beta m_L}\frac{u_p^{MO}}{u_g^{MO}}\right] - (u_p^{MO})^2. \quad (2.32)$$

[23]Since $x_p^{MO} = \frac{S_H}{2}\frac{1}{p_p^{MO}}$ and p_p^{MO} is given by equation (30).

[24]S_L and S_H are the total amount spent in the low and high income markets respectively. Thus, $S_L = N_L \beta m_L$ and $S_H = N_H \beta m_H$.

Final Outcome

If there is no restriction on the amount of public transfer F^{MO} that can be allocated to preventive HC, the simultaneous solution of (32) and (29) subject to (30) and (31) yields the following result[25]:

$$u_g^{MO} = \frac{\beta m_L}{c}(\frac{2}{27}S_H)^{1/2}; \tag{2.33}$$

$$u_p^{MO} = (\frac{S_H}{6})^{1/2}; \tag{2.34}$$

$$\Pi_p^{MO} = 0; \tag{2.35}$$

$$NCS^{MO} = (S_H + S_L)\left[\frac{(1-\beta)^{(1-\beta)}}{\beta}[\frac{2}{27}S_H]^{\frac{\beta}{2}}(\frac{\beta}{c})^{\beta} - 1\right]. \tag{2.36}$$

The level of the public transfer required is:

$$F^* = \frac{2}{27}S_H(\frac{\beta m_L}{c})^2 + \frac{c-\beta m_L}{\beta m_L}(\frac{S_H}{2} + S_L). \tag{2.37}$$

Therefore, F^* is the maximum public transfer such that the private provider is not driven out of the market.

[25] First, the interior solution of the public decision maker program does not exist since NCS is infinitively increasing with u_g. Second, we assume that the government is decided to spend whatever is needed in Preventive Health today to save future HC expenditures. Thus, the suboptimal case where there are restrictions on the public transfer F^{MO}, is presented in Appendix-II. Third, without loss of generality, we assume that the case where both constraints bind at once is irrelevant, i.e. this particular case has a very small probability of occurring.

2.3.3 Strictly public provision with unequal incomes

For comparison purposes, we analyze the implications the preventive HC good's provision by a public monopolist. We focus on the case where the public authority is interested in guaranteeing universal coverage and achieving at least the same level of consumer surplus as the Mixed Oligopoly[26].

The Objective function of the Public Monopolist

When concerned about consumer welfare, the monopolist's objective function with a fixed transfer F^M from the public budget is again equation (29)[27], subject to a modified public balanced budget constraint. In this case, the public provider has to satisfy the additional demand of the high income population, $\frac{N_H}{2}$, that would have chosen the private provider if it existed.

$$Max_{u_g} NCS^M = Max_{u_g}[(S_H + S_L) \times \left[(\frac{1}{\beta})\left(\frac{u_g^M}{m_L}\right)^{\beta}(1-\beta)^{(1-\beta)} - 1\right]] \tag{2.38}$$

subject to:

$$BB^M = F^M + (\frac{\beta m_L - c}{\beta m_L})(S_H + S_L) - (u_g^M)^2 \geq 0 \tag{2.39}$$

[26]Superscript M refers to Monopoly.

[27]The invariability of the consumer surplus is shown in the Appendix I.

Final Outcome

We are interested in comparing the public monopoly outcome to the Mixed Olipogopoly result. In particular, we analyze the change in public transfer required for the public monopoly to yield the same consumer surplus the Mixed Oligopoly achieves. Thus, we set the consumer surplus to the Mixed Oligopoly level given in equation (37), and study the monopolist's necessary transfer.

Given that the expression for the net consumer surplus in both cases depends on the public quality offered, the public monopolist has to match the public quality supplied by the Mixed Oligopoly public firm in equation (33). Hence, the quality provided by the public monopolist is:

$$u_g^M = \frac{\beta m_L}{c}[\frac{2}{27}S_H]^{1/2}. \tag{2.40}$$

The required transfer to attain this quality is:

$$F^M = \frac{2}{27}S_H(\frac{\beta m_L}{c})^2 + (\frac{c-\beta m_L}{\beta m_L})(S_H + S_L) \tag{2.41}$$

2.3.4 Comparison of the Three Outcomes

We compare the levels of quality, the quantities served, the profits, the consumer surplus achieved and the government's transfer to provide the health preventive good in each of the provision schemes. The results are displayed in Tables I, II and III:

Mixed Oligopoly vs. Private Duopoly with no restrictions on the public transfer

Lemma 1: Provision by a Mixed Oligopoly[28] instead of a Private Duopoly, results in:

- an *improvement* of the quality of the good privately provided,
- a *decrease* in the private price, quantity and profits,
- a public quality which is *inferior* to the private quality, with a price set unilaterally at everybody's affordable level (βm_L), a *positive* transfer from the government equal to F^*
- an *increase* of the consumer surplus,
- an *increase* of the expenditure in health care, due to the fact in the Mixed Oligopoly not only high income consumers spend, but also the low income ones do

Proof Lemma 1: The proof follows from the comparison of: a) the result of solving simultaneously the First Order Conditions of (29) subject to (30) and (31) and the First Order Conditions of (32); with: b) the Private Duopoly outcome in (13), (14), (15) and (16)[29]. Results are displayed in Table I.

Mixed Oligopoly vs. Public Monopoly

When comparing the Mixed Oligopoly outcome with the strictly Public Monopoly, we are interested in answering the following question: How much less/more public money has to be allocated to Preventive HC goods and services if they are supplied by a Mixed Oligopoly instead of a unique public provider?

[28] as described in Section 3.2.

[29] Proof available upon request.

As stated in section 3.3, this question is answered comparing the outcome of a Public Monopoly achieving at least the same level of consumer surplus that the Mixed Oligopoly offers. Table II shows that there are no differences in the quality supplied publicly, its price and level of consumer surplus, but the transfer in the monopoly case is higher[30].

Lemma 2: Switching from a Public Monopoly to a Mixed Oligopoly has the following effects:

- quality and price of the good publicly provided do *not change*,
- public quantity *decreases* in $\frac{N_H}{2}$,
- overall coverage *remains the same*, although total units served are less,
- the public transfer needed in the Mixed Oligopoly is *lower* than in Monopoly regime,
- non-negative private quantity and profits are observed.
- consumer surplus and health expenditure *does not change*

Proof Lemma 2: The proof follows from the comparison of: a) the result of solving simultaneously the First Order Conditions of (29) subject to (30) and (31), and the First Order Conditions of (32); with: b) the outcome of the First Order Conditions of (38) subject to (39)[31]. Results are displayed in Table II.

Remark on Lemma 2: Setting a Mixed Oligopoly for providing preventive health care goods results in greater cost-containment than a public

[30]The fact that universal coverage requires under marginal cost pricing, serving $\frac{N_H}{2}$ more consumers does not imply an increase in the public authority revenues but its undertaking a higher budget deficit.

[31]Proof available upon request

monopoly[32].

Private Duopoly vs. Public Monopoly

We compare the private duopoly outcome with th public monopoly. The results are shown in Table III and are also straightforward:

Lemma 3: Provision by a Private Duopoly instead of a Public Monopoly implies:

- the quality served *increases* with the only-private scheme, but so does the price,
- the quantity *falls* and profits become *positive*,
- the public transfer *disappears*,
- the overall effect on coverage, consumer surplus and health expenditure is *negative.*

Proof of Lemma 3: The proof follows from the comparison of: a) the outcome solving simultaneously the First Order Conditions of (38) subject to (39); with: b) the Private Duopoly outcome in (13), (14), (15) and (16)[33].

[32]The reverse side of the same question is: How much better off are consumers of the quality good with a strictly public provider instead of a Mixed Oligopoly for the same level of public expenditure? This approach requires comparing the change in the consumer surplus of both regimes for the same level of public transfer F^*. Consumers end up worse off under the public monopoly. Consumer surplus is an increasing and concave function of the public quality and the latter is lower in the same monopoly case than in the Mixed Oligopoly. In the public monopoly case, the transfer has the extra deficit generated by the coverage by the additional $\frac{N_H}{2}$ persons covered. This means less money is available to invest in providing quality.

[33]Proof available upon request

2.4 Conclusions and Discussion

For a quality good, the Mixed Oligopoly regime is the least expensive and the most satisfactory for the consumers. The preventive HC services considered as the quality good are those people allocate a fixed percentage of their income to. In addition, universal coverage is considered socially desirable and due to large marginal costs, private firms would not provide full market coverage.

The intuition of why mixed provision of HC preventive services results in a welfare improvement seems directly related to the fact that supply by a combination of public and private firms overcomes the market failure to cover a part of the population. Moreover, the intervention of the public provider imposes a lower bound on the minimum quality offered in the market, and this forces the private counterpart to respond in two ways that benefit consumers. First, the private provider raises its own quality; second, it also has to lower its price. Dominance of the strictly public regime of provision is solely explained by the fact that, for any given public quality, universal coverage is achieved at a socially lower cost with a mixed regime than with a public monopoly.

Further research in at least two directions is suggested: extending Mixed Oligopoly domination to a more general concept of HC goods and services; and better modeling preventive HC itself. Encompassing more health goods and services implies using of a demand function that does not limit expenditures amount on HC to a fixed percentage of income[34].

[34]Our model can fit the expenditures consumers make ex-ante avoiding the eruption of

One of the most obvious limitations of the model is that it does not incorporate questions of asymmetric information. Individuals aware of their higher likelihood of having some type of disease could tend to choose the more frequent and cheaper preventive service[35]. Thus, their choice would be determined by a more complex rule than the asymmetry-free one we use. Therefore, our analysis could be improved trying to capture and formalize such unobservable motivations of preventive HC consumers. Second, in this chapter we assumed no uncertainty about the future health when deciding how much to spend on preventive HC today. This was discarded for simplicity, but it constitutes a limitation worth trying to overcome in the future.

Any extension in the model of preventive HC expenditures [36] should relate that choice to: a) idyosincratic characteristics of the individual, besides wealth, which can influence the decision of opting out of the public regime; and b) the way health "prevision" is perceived to affect future well-being and how this relationship determines investment in preventive HC.

Finally, a further improvement would allow for a technology where the marginal cost of each unit increases with quality. Variable costs of some health check-up procedures increase with the level of sophistication they incorporate. Increasing quality, or level of complexity involved, implies, for instance, greater specialization of the personnel running the devices, which translates into higher wages and so on.

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possible illnesses, but not the ones on which one would be willing to spend 'any amount' once it is known they are needed, such as hospital stays and surgery.

[35]They could prefer to get the most thorough private check-ups less frequently.

[36]or the 'minimum acceptable level' of preventive HC contracted through a private insurer

To conclude, although shortcomings and specificities exist, our work sheds some light on the issue of mixed oligopolistic provision of a 'quality good' that is socially desirable but which market does not fully cover. Moreover, the results obtained reinforce the conclusions of previous related work regarding the social benefits of mixed provision formulae in some specific contexts.

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2.5 Appendices

Table I: No restrictions on F' for $0 \leq F' \leq F^*.(*)$

-	Private Duopoly	Mixed Oligopoly
Private Quality: u_p	$\left(\frac{S_H}{8}\right)^{\frac{1}{2}}$	$\left(\frac{S_H}{6}\right)^{\frac{1}{2}}$
Public Quality: u_g	-	$\left(\frac{2}{27}S_H\right)^{\frac{1}{2}} \frac{\beta * m_L}{c}$
Private Price: p_p	$2c$	$\frac{3}{2}c$
Public Price: p_g	-	$\beta * m_L$
Private Quantity: x_p	$\left(\frac{S_H}{2c}\right)$	$\left(\frac{S_H}{3c}\right)$
Public Quantity: x_g	-	$\frac{m_H}{m_L}\frac{N_L}{2} + N_L$
Private Profits:	$2 * \left(\frac{S_H}{8}\right)$	0
Consumer Surplus:	$S_H \left[\left(\frac{\beta}{2c}\right)^{\beta} * \left(\frac{S_H}{8}\right)^{\frac{\beta}{2}} \frac{(1-\beta)^{(1-\beta)}}{\beta} - 1\right]$	$(S_H + S_L) * \left[\frac{(1-\beta)^{(1-\beta)}}{\beta}\left(\left(\frac{2}{27}S_H\right)^{\frac{\beta}{2}} * \left(\frac{\beta}{c}\right)^{\beta}\right) - 1\right]$
Public Transfer	-	$\left(\left(\frac{\beta * m_L}{c}\right)^2 \frac{2}{27}S_H\right) + \left(\frac{S_H}{2} + S_L\right) * \left(\frac{c - \beta * m_L}{\beta * m_L}\right)$

-	MO - DP	Sign
ΔPrivate Quality: u_p	$5.4 \times 10^{-2} * \sqrt{S_H}$	+
ΔPublic Quality: u_g	$\left(\frac{2}{27}S_H\right)^{\frac{1}{2}} * \left(\frac{\beta * m_L}{c}\right)$	+
ΔPrivate Price: p_p	$-0.5 * c$	(−)
ΔPublic Price: p_g	$\beta * m_L$	+
ΔPrivate Quantity: x_p	$-\left(\frac{S_H}{6c}\right)$	(−)
ΔPublic Quantity: x_g	$\left(\frac{m_H}{m_L}\right) N_H + N_L$	+
ΔPrivate Profits:	$-\left(\frac{S_H}{4}\right)$	(−)
ΔConsumer Surplus:	$S_H^{\frac{2+\beta}{2}} \left(\frac{(1-\beta)^{(1-\beta)}}{\beta} \left(\frac{\beta}{c}\right)^{\beta} \left(\left(\frac{2}{27}\right)^{\frac{\beta}{2}} - \left(\frac{2}{64}\right)^{\frac{\beta}{2}}\right)\right) + S_L \left(\frac{(1-\beta)^{(1-\beta)}}{\beta} \left(\frac{\beta}{c}\right)^{\beta} \left(\frac{2}{27}S_H\right)^{\frac{\beta}{2}} - 1\right)$	+
ΔPublic Transfer	$\left(\left(\frac{\beta * m_L}{c}\right)^2 \frac{2}{27}S_H\right) + \left(\frac{S_H}{2} + S_L\right) * \left(\frac{c - \beta * m_L}{\beta * m_L}\right)$	+

(*)where F' is the transfer received by the public provider. F* is the maximum level of F' compatible with non-negative private provider profits.

Table II: Mixed Oligopoly (MO) vs. Public Monopoly (M).

(No restrictions on F^{MO} for $0 \leq F^{MO} \leq F^{*}$)*

-	Public Monopoly (M)	Δ	MO-M	Sign
Quality u_g^M	$\left[\left(\frac{2}{27}S_H\right)^{\frac{1}{2}} \frac{\beta * m_L}{c}\right]$	$\Delta\, u^{MO} - u_g^M$	$u_g^{MO} - u_g^M$: 0 $u_p^{MO} - u_g^M$: $\frac{\sqrt{S_H \sqrt{6}}}{18} \frac{3c - 2\beta m_L}{c}$	0 +
Price p_g^M	$\beta * m_L$	$\Delta\, p^{MO} - p_g^M$	$p_g^{MO} - p_g^M$: 0 $p_p^{MO} - p_g^M$: $\frac{3c}{2} - \beta m_L$	0 +
Quantity x_g^M	$\left(\frac{m_H}{m_L}\right) N_H + N_L$	$\Delta\, (x_g^{MO} + x_p^{MO}) - x_g^M$	$\frac{N_H m_H}{2}\left(\frac{\beta}{3c} - \frac{1}{2m_L}\right)$	-
Cons Surp	$(S_H + S_L)\left(\frac{2}{27}S_H\right)^{\frac{\beta}{2}} \left(\left(\frac{\beta m_L}{c}\right)^{\beta} \frac{(1-\beta)^{1-\beta}}{\beta m_L^{\beta}} - 1\right)$	ΔCSURP	$(S_H + S_L) \frac{(1-\beta)^{1-\beta}}{\beta m_L^{\beta}} \left(u_g^{MO\frac{\beta}{2}} - u_g^{M\frac{\beta}{2}}\right)$	0
Pub Transfer	$\frac{2}{27} S_H \left(\frac{\beta m_L}{c}\right)^2 + (S_H + S_L)\left(\frac{c - \beta m_L}{c}\right)$	ΔPT	$-\frac{c - \beta m_L}{\beta m_L} \frac{S_H}{2}$	-

* where F^{MO} and F^{M} are the transfers received by the public provider. F* is the maximum level of F^{MO} compatible withnon-negative private provider profits in the mixed oligopoly case.

Table III: Private Duopoly (PD) vs. Public Monopoly (M):

-	Public Monopoly	Δ	PD-M	+/-
Quality: u_g^M	$\left[\left(\frac{2}{27}S_H\right)^{\frac{1}{2}}\frac{\beta m_L}{c}\right]$	Δ:$u^{PD}-u_g^M$	$\left(\frac{S_H}{8}\right)^{\frac{1}{2}}-\left(\frac{2}{27}S_H\right)^{\frac{1}{2}}\frac{\beta * L}{c}$	+
Price: p_g^M	βm_L	Δ:$p^{PD}-p_g^M$	$2c-\beta m_L$	+
Quant.: x_g^M	$\frac{m_H}{m_L}N_H+N_L$	Δ:$x_p^{PD}-x_g^M$	$\frac{S_H}{2c}-\frac{m_H}{m_L}N_H-N_L$	-
-	-	$\Delta\Pi_p^{PD}$	$2\frac{S_H}{8}$	+
NCSURP:	$(S_H+S_L)\left[\left(\frac{2}{27}S_H\right)^{\frac{\beta}{2}}\left(\frac{\beta m_L}{c}\right)^{\beta}\frac{(1-\beta)^{(1-\beta)}}{\beta m_L^{\beta}}-1\right]$	ΔNCS:	$\left[\begin{array}{c} S_H\frac{(1-\beta)^{(1-\beta)}}{\beta}\times \\ \left(\left(\frac{\beta}{2c}\right)^{\beta}\left(\frac{S_H}{8}\right)^{\frac{\beta}{2}}-\frac{1}{m_L^{\beta}}\left(\frac{2}{27}S_H\right)^{\frac{\beta}{2}}\left(\frac{\beta m_L}{c}\right)^{\beta}\right)- \\ -S_L\left[\left(\frac{2}{27}S_H\right)^{\frac{\beta}{2}}\left(\frac{\beta m_L}{c}\right)^{\beta}\frac{(1-\beta)^{1-\beta}}{\beta m_L^{\beta}}-1\right] \end{array}\right]$	-
Pub. Trans.	$\left(\frac{2}{27}S_H\right)\left(\frac{\beta m_L}{c}\right)^2+(S_H+S_L)\frac{c-\beta m_L}{c}$	ΔPT:	$-\left[\left(\frac{2}{27}S_H\right)\left(\frac{\beta m_L}{c}\right)^2+\left(\frac{c-\beta m_L}{\beta m_L}\right)(S_H+S_L)\right]$	-

We assume the public transfers are not constrained, i.e. F^M=F.

Appendix I: Consumer Surplus Computation

The maximization problem of consumer i, with income m_i, is the following:

$$Max_{\{u_h, x_{ih}, z_i\}} U(u_h, x_{ih}, z_i) \equiv Max_{\{u_h, x_{ih}, z_i\}} (u_h * x_{ih})^{\beta} (z_i)^{1-\beta}$$

subject to:

$$\Sigma_{k=1}^{K} p_k x_{ik} + p_z z_i \leq m_i$$

p_k is the price of the good of quality k (x_{ik}). The price of the composite good z will be normalized to one.

As stated in the main text, this maximization problem can be divided in a two staged program where the consumer first decides the income percentages to spend on each good, and then quality and quantity of the differentiated good consumed. We recall that he/she ends up choosing the variety of good x that maximizes the quality-price ratio.

The corresponding marshallian demands are given by the expressions:

$$x_{ih}(p_h, 1, m_i) = \left(\frac{\beta m_i}{p_h}\right) \tag{2.42}$$

$$z_i(p_h, 1, m_i) = (1-\beta) m_i \tag{2.43}$$

And, the Indirect Utility Function results in:

$$V(p_h, 1, m_i) = \left(\frac{\beta m_i u_h}{p_h}\right)^{\beta} ((1-\beta) m_i)^{1-\beta} =$$

$$= m_i \left(\frac{\beta u_h}{p_h}\right)^{\beta} (1-\beta)^{1-\beta} \tag{2.44}$$

Since the object of our interest is the surplus that the agent gets from the consumption of the qualtity good x, we calculate the Net Indirect Utility Function ($NV(p_h, 1, m_i)$) subtracting the expenditure he/she does on this particular good -using expression (1):

$$NV(p_h, 1, m_i) = m_i \left(\frac{\beta u_h}{p_h}\right)^{\beta} (1-\beta)^{1-\beta} - \beta m_i \tag{2.45}$$

In order to obtain the Total Net Consumer Surplus Function (NCS), we compute the Net Indirect Utility Function of all the different types of consumers that arise in each of the regimes of provision considered:

(a) Private Duopoly (PD): there are only two sorts of consumers, the N_H with high income level, and the N_L with low income. The former buy from the private providers (at price $p^{pd} = 2c$) and the later don't buy any unit since what they are willing to pay is less than the price of one single unit of the good ($\beta m_L < 2c$). By (4), the total NCS is:

$$NCS^{PD} = N_H \left(m_H \left(\frac{\beta u^{pd}}{p^{pd}}\right)^{\beta} (1-\beta)^{1-\beta} - \beta m_H\right) =$$

$$= S_H \left(\frac{(1-\beta)^{1-\beta}}{\beta} \left(\frac{\beta}{2c}\right)^{\beta} \left(\frac{S_H}{8}\right)^{\frac{\beta}{2}} - 1\right) \tag{2.46}$$

(b) Mixed Oligopoly (MO): There are three types of consumers, the $\frac{N_H}{2}$ with high income level that choose the private provider of the quality good, and the $\frac{N_H}{2}$ with high income and the $N_L$with low income level that buy from the public supplier. By (4), the NCS is:

$$NCS^{MO} = \frac{N_H}{2}\left(m_H\left(\frac{\beta u_p^{MO}}{p_p^{MO}}\right)^{\beta}(1-\beta)^{1-\beta} - \beta m_H\right) +$$

$$+\frac{N_H}{2}\left(m_H\left(\frac{\beta u_g^{MO}}{p_g^{MO}}\right)^{\beta}(1-\beta)^{1-\beta} - \beta m_H\right)$$

$$+N_L\left(m_L\left(\frac{\beta u_g^{MO}}{p_g^{MO}}\right)^{\beta}(1-\beta)^{1-\beta} - \beta m_L\right) \qquad (2.47)$$

Introducing the fact that the public provider's price (p_g^{MO}) is unilaterally set at βm_L by the public decision maker, and that the 'price-quality' ratio has to be equal for both types of providers, the NCS function results in:

$$NCS^{MO} = (S_H + S_L)\left(\frac{(1-\beta)^{1-\beta}}{\beta}\left(\frac{u_g^{MO}}{m_l}\right)^{\beta} - 1\right) \qquad (2.48)$$

(c) Public Monopoly (M): In this case, there is only a unique quality and a unique price available, thus the NCS is simply:

$$NCS^{M} = N_H\left(m_H\left(\frac{\beta u_g^{M}}{p_g^{M}}\right)^{\beta}(1-\beta)^{1-\beta} - \beta m_H\right) +$$

$$+N_L\left(m_L\left(\frac{\beta u_g^{M}}{p_g^{M}}\right)^{\beta}(1-\beta)^{1-\beta} - \beta m_L\right) =$$

$$= (S_H + S_L)\left(\frac{(1-\beta)^{1-\beta}}{\beta}\left(\frac{u_g^{M}}{m_l}\right)^{\beta} - 1\right) \qquad (2.49)$$

Appendix II:

Case with a maximum public transfer F^{MO} lower than F^*

We present the case, where the public transfer achievable by the public provider is lower than the one that makes the non-negative private profits restriction bind. With this restriction the publicly supplied quality u_g^{MO} is the one that makes the public budget equation equal 0 [37]. Private and public quality, quantity and prices, as well as private profits and level of consumer surplus follow [38]:

$$u_g^{MO} = K^{\frac{1}{2}}$$

$$u_p^{MO} = [(\frac{S_H}{4})(\frac{c}{\beta m_L})]^{\frac{1}{3}} K^{\frac{1}{6}}$$

$$x_g^{MO} = \frac{m_H}{m_L}\frac{N_H}{2} + N_L$$

$$x_p^{MO} = [\left(\frac{S_H}{\beta m_L}\right)^{\frac{2}{3}} \left(\frac{K}{2c}\right)^{\frac{1}{3}}]$$

$$p_g^{MO} = \beta m_L$$

$$p_p^{MO} = [\left(\frac{S_H}{4}\right)^{\frac{1}{3}} \left(\frac{c}{K}\right)^{\frac{1}{3}}] (\beta m_L)^{\frac{2}{3}}]$$

[37] Note that if F is higher than in section 2.3.2, private provider leaves the market. The only feasible alternative that would keep the private provider active, is the one shown here. With this lower F, the balanced public budget constraint binds before the private profits non-negativity constraint does.

[38] where $K = [F - \left(\frac{c-\beta m_L}{\beta m_L}\right)(\frac{S_H}{2} + S_L)]^{\frac{1}{2}}$.

$$\Pi_p^{MO} = (\frac{S_H}{2}) - (\frac{3}{2^{\frac{2}{3}}}) \times (\frac{S_H}{2}\frac{c}{\beta m_L})^{\frac{2}{3}} \times K^{\frac{1}{3}}$$

$$NCS^{MO} = (S_H + S_L) \times [K^{\frac{\beta}{2}} \frac{(1-\beta)^{(1-\beta)}}{\beta m_L^{\beta}} - 1]$$

In this case, F^{MO} is lower than in section 3.2. and since consumer surplus is increasing in F, the level of surplus attained in this public transfer restricted case is lower than the presented there.

Mixed Oligopoly vs. Private Duopoly with restricted F

We present the comparison of the transfer restricted Mixed Oligopoly with the Private Duopoly.

Looking at the Table a of Appendix-II, we see that results are less definitive and they basically depend on the relationship between the amount of the transfer F^{MO} and the size of the high and low income markets S_H, S_L. These conditions are made explicit on the Annex to that table.

Mixed Oligopoly vs. Public Monopoly with restricted F

Table b of Appendix-II shows that switching from a Public Monopoly provision regime to a Mixed Oligopoly one, when F is restricted, implies:

- no change in the quality and price of the services provided publicly,
- a private quality that is higher than the public, and so is its price,
- a decrease in the number of units served,

- a decrease in the public transfer,
- no change in the Consumer Surplus level.

Table-a Appendix-II: Case F$\prec F^*$

-	Private Duopoly	Mixed Oligopoly
Private Quality: u_p	$\left(\frac{S_H}{8}\right)^{\frac{1}{2}}$	$\left(\frac{S_H}{4}\right)^{\frac{1}{3}} * \left(\frac{c}{\beta * m_L}\right)^{\frac{1}{3}} * [K]^{\frac{1}{6}}$
Public Quality: u_g	-	$K^{\frac{1}{2}}$
Private Price: p_p	$2c$	$\left(\frac{S_H}{4}\right)^{\frac{1}{3}} * \left[\frac{c}{K}\right]^{\frac{1}{3}} * (\beta * m_L)^{\frac{2}{3}}$
Public Price: p_g	-	$\beta * m_L$
Private Quantity: x_p	$\left(\frac{S_H}{2c}\right)$	$\left(\frac{S_H}{\beta * m_L}\right)^{\frac{2}{3}} \left[\frac{K}{2c}\right]^{\frac{1}{3}}$
Public Quantity: x_g	-	$\frac{m_H}{m_L}\frac{N_H}{2} + N_L$
Private Profits:	$2 * \left(\frac{S_H}{8}\right)$	$\frac{S_H}{2} - \frac{3}{2^{\frac{2}{3}}}\left(\frac{S_H}{2}\frac{c}{\beta * m_L}\right)^{\frac{2}{3}} K^{\frac{1}{3}}$
Consumer Surplus:	$S_H\left[\left(\frac{\beta}{2c}\right)^{\beta} * \left(\frac{S_H}{8}\right)^{\frac{\beta}{2}} \frac{(1-\beta)^{(1-\beta)}}{\beta} - 1\right]$	$(S_L + S_H)\left[\frac{(1-\beta)^{(1-\beta)}}{\beta m_L^{\beta}} K^{\frac{\beta}{2}} - 1\right]$
Public Transfer	0	$K + + (S_L + S_H)\frac{c - \beta * m_L}{\beta * m_L}$

-	MO - DP	Sign*
ΔPrivate Quality: u_p	$\left(\frac{S_H}{4}\right)^{\frac{1}{3}} * \left(\frac{c}{\beta * m_L}\right)^{\frac{1}{3}} * K^{\frac{1}{6}} - \left(\frac{S_H}{8}\right)^{\frac{1}{2}}$	$f(F, S_H)$
ΔPublic Quality: u_g	$[K]^{\frac{1}{2}}$	+
ΔPrivate Price: p_p	$\left(\frac{S_H}{4}\frac{c}{K}\right)^{\frac{1}{3}} * (\beta * m_L)^{\frac{2}{3}} - 2c$	$f(F, S_H)$
ΔPublic Price: p_g	$\beta * m_L$	+
ΔPrivate Quantity: x_p	$\left(\left(\frac{S_H}{\beta * m_L}\right)^{\frac{2}{3}}\left[\frac{K}{2c}\right]^{\frac{1}{3}}\right) - \left(\frac{S_H}{2c}\right)$	$f(F, S_H)$
ΔPublic Quantity: x_g	$-\frac{m_H}{m_L}\frac{N_H}{2} - N_L$	+
ΔPrivate Profits:	$\frac{S_H}{4} - \frac{3}{2^{\frac{2}{3}}}\left(\frac{S_H}{2}\frac{c}{\beta * m_L}\right)^{\frac{2}{3}} K^{\frac{1}{3}}$	−
ΔConsumer Surplus:	$S_L\left[\frac{(1-\beta)^{(1-\beta)}}{\beta m_L^{\beta}} K^{\frac{\beta}{2}} - 1\right] + S_H \frac{(1-\beta)^{(1-\beta)}}{\beta}\left(\left(\frac{K}{m_L^2}\right)^{\frac{\beta}{2}} - \left(\frac{\beta}{2c}\right)^{\beta} * \left(\frac{S_H}{8}\right)^{\frac{\beta}{2}}\right)$	$f(F, S_H)$
ΔPublic Transfer	$K + + (S_L + S_H)\frac{c - \beta * m_L}{\beta * m_L}$	+

*see next page for discussion on f(.,.)

Annex to Table (a) Appendix-II:

About the signs of f(.,.), we can state that:

1. the condition on the public transfer F for having an *increase* in private quality and a *decrease* in private price is given by $F \leq \frac{1}{32}\frac{\beta^2 m^2}{c^2} S_H + \frac{c-\beta m_L}{\beta m_L}\left(S_L + \frac{S_H}{2}\right)$;

2. that the condition on F for having a *decrease* in private quantity is:

   $F \leq \frac{1}{4}\frac{\beta^2 m^2}{c^2} S_H + \frac{c-\beta m_L}{\beta m_L}\left(S_L + \frac{S_H}{2}\right)$;

3. that the one for *not having* a *decrease* in overall private profits is:

   $F \leq \frac{1}{108}\frac{\beta^2 m_L^2}{c^2} S_H + \frac{c-\beta m_L}{\beta m_L}\left(S_L + \frac{S_H}{2}\right)$;

   Thus, for the private quality to *increase* and the private price and quantity to decrease, all at once, F should satisfy condition given in (1) -so (2) would be met too. For the private profits to *increase*, F should be even less than that, since requirement specified in c) should me met.

   Finally, we get a less intuitive measure for signing the change in the net consumer surplus. This is so because, the N_L consumers that get service under Mixed Oligopoly will be better off than they were under Private Duopoly where they wouldn't be served. But, for the N_H consumers with high income there are two possibilities:

   (a) If the ratio of private quality over price *decreases* (and hence the public does too, all these N_H end up with a lower price-quality ratio than in the Private Duopoly. This *decrease* in welfare of the

N_H consumers, could offset or not the *gain in welfare* experienced by the lower incomes.

(b) If that ratio does not *decrease*, then, it is clear that the consumer surplus variation due to the change in regime is positive since all the N_L and the N_H gain with the change.

In the particular case where F is set at the maximum level given by condition (3), the ratio goes down and actually so does the Consumer Surplus.

The reader will find bellow the general condition on F for the consumer surplus index to be greater in the MO wrt to the PD:

4. there will be an increase in net consumer surplus if:

$$F \geq S_H^{-\frac{\beta}{2}} \left[\left(\frac{\beta}{2c}\right)^{\beta} \left(\frac{S_H}{8}\right)^{\frac{\beta}{2}} \frac{(1-\beta)^{(1-\beta)}}{\beta} - 1 \right]^{-\frac{\beta}{2}} \left[\frac{\beta m_L^{\beta}}{(s_H+s_L)+(1-\beta)^{(1-\beta)}} \right]^{-\frac{\beta}{2}} + \left(\frac{c-\beta*m_L}{\beta*m_L}\right) \left(S_L + \frac{S_H}{2}\right)$$

Table-b Appendix-II: Mixed Oligopoly (MO) vs. Public Monopoly (M)*. $F^{MO} \prec F^*$

-	Public Monopoly	-	MO-M	Sign
Quality u_g^M	$K^{\frac{1}{2}}$	$\Delta\, u^{MO} - u_g^M$	$u_g^{MO} - u_g^M$: 0 $u_p^{MO} - u_g^M$: $\sqrt[3]{\frac{S_H\, c}{4\beta m_L}}\sqrt[6]{K} - \sqrt{K}$	0 +
Price p_g^M	$\beta * m_L$	$\Delta\, p^{MO} - p_g^M$	$p_g^{MO} - p_g^M$: 0 $p_p^{MO} - p_g^M$: $\left(\frac{S_H}{4}\right)^{\frac{1}{3}}\left[\frac{c}{K}\right]^{\frac{1}{3}}(\beta m_L)^{\frac{2}{3}} - \beta m_L$	0 +
Quantity x_g^M	$\frac{m_H}{m_L}N_H + N_L$	$\Delta\,(x_g^{MO} + x_p^{MO}) - x_g^M$	$\left(\frac{S_H}{2\beta * m_L}\right)^{\frac{2}{3}}\left(\frac{4K}{c}\right)^{\frac{1}{3}} - \frac{m_H}{m_L}N_H$	-
Consumer Surplus	$(S_H + S_L)\left[K^{\frac{\beta}{2}}\frac{(1-\beta)^{(1-\beta)}}{\beta m_L^{\beta}} - 1\right]$	ΔCSURP	$(S_H + S_L)\left[\frac{(1-\beta)^{(1-\beta)}}{\beta m_L^{\beta}}\left(K^{\frac{\beta}{2}} - K^{\frac{\beta}{2}}\right)\right]$	0
Public Transfer	$F^M = K + (S_H + S_L)\frac{c-\beta m_L}{c}$	ΔPT	$\left[-\frac{c-\beta m_L}{\beta m_L}\frac{S_H}{2}\right]$	-

where F^{MO} and F^M are the transfers received by the public provider. F is the maximum level of F^{MO} compatible with non-negative private provider profits in the mixed oligopoly case.

Chapter 3

Private Health Expenditure and Public Coverage

3.1 Introduction

In most western countries, total health expenditures steady increase is a growing concern. In many of them national health care system reforms have been attempted in order to curb the raising trend of total health care spending. As it is well known, health care expenditures are equal to the sum of public and private spending on health care related goods and services. The objective of this chapter is to analyze if public health expenditures influence significantly private health care goods' consumption using a microeconomic approach. Public health expenditures may reduce private health consumption which is the substitution effect. We are interested in testing if increasing public health expenditures has an expansive effect on total health care expenditures. The latter does not occur if the substitution effect is negative enough to make the level of spending remain unchanged or even decrease.

We use a standard moral hazard model that relates the individual deci-

sion of how much to spend privately on health care goods and services to the level of public health expenditures assigned to households. As a result, private health care expenditures depend not only on the family's demographic, social and economic characteristics but, also, on how much public health care spending is allocated to the household. We test the theoretical predictions of such model. Our main data set is the Family Budget Survey of 1990-91 (EPF-90/91) that contains information of annual consumption of 21,150 Spanish families. We combine the EPF-90/91 survey with an assignment of public expenditures to households according to their relative position in the national distribution of income.

The empirical literature involving private health expenditures has typically focused on health demand estimation. Given the restrictions of the data available and the specific problems that this type of consumption imposes on the econometrician[1], these papers relate as many idiosyncratic characteristics as possible with consumption behavior. Special attention has been devoted to health insurance demand estimation. Some examples of the European literature on this issue are Murillo, Calonge and González (1996) and Szabó (1997) for Spain and Wagstaff (1986), Propper (1990) for Great Britain.

On the other hand, there is another approach that focuses on the effect that private health insurance have on individual decisions. Specifically, this approach studies how different types of insurance plans determine out-of-pocket health care consumption. One of the pioneering contributions in this

[1]Basically sample selection, i.e., we only observe a positive expenditure in health care goods and services for those households that overcome the threshold determined by a latent variable.

area is the study conducted by Newhouse et ali. for the Rand Corporation[2]. It analyzes health care demand under several health insurance plan options (i.e., deductibles, different level of co-payments and other incentive schemes). There is a whole line of related literature, including Cutler and Reber (1996), Buchmueller and Feldstein (1996) among the most recent. In countries like the US, private health insurance is the main source of health care financing. Thus, studies relating consumer behavior and type of insurance plans have a big relevance in understanding health expenditure evolution and, therefore, they are important for policy design.

Contrary to the US, in Europe health care is mostly financed by public authorities. In Spain, only 7% of the population is covered by a private insurance and up to 85% of health care expenditure is publicly financed. Therefore, more work on the effect that public health coverage has on individual private health expenditures is needed. Several studies use macroeconomic data on GNP, private health expenditure, public health spending and other aggregated measures, (e.g., Parkin and McGuire (1987); Gerdtham, Sogaard, Anderson and Jousson (1992); O'Connell (1996)). The use of aggregated data in order to infer individual behaviour, though, has been criticized by authors such as C. Phelps (1995) (see also González and Murillo (1993)). Generally, cross-section models using country macroeconomic indicators omit factors that might affect the dynamics of health expenditures such as specific national price, technology and public policy trends.

The absence of a microeconomic literature relating public and private

[2]Newhouse, Manning, Orr et alia (1977). For and updated reference, see Newhouse (1993).

health expenditures is probably due to the difficulty in obtaining a variable that reflects the available public health care network and in introducing such measure in the microeconomic decision process of the agent. Risa (1989) proposes a theoretical moral hazard model of private health demand but he does not test its predictions using microeconomic data. Instead, Risa uses macroeconomic data of the OECD countries on public and private health expenditures, gross national product, percentage of population over 65 years and several other variables that are thought to determine health care expenditures. Risa's results are not conclusive although he finds out that public health care expenditures do not seem to have an expansive effect on total health care expenditures. The validity of Risa's test is questionable due to the fact that, as we mentioned before, aggregation of microeconomic decisions does not necessarily respect individual rationale. Although macro data results from aggregating the outcomes of individual decision processes, the sum of those outcomes may not reflect the individually behavior. Aggregation can magnify measurement errors and not well behaved utility functions may make inference not viable.

Starting out with Risa's (1989) formulation, our paper constructs a simplified ad hoc model of private health expenditures which is easily testable with microeconomic data. Relaxing Risa's implications, our model establishes a relationship between the existence of a public health care network and the private health care demand of the consumers. Public and private health care investments determine the technological quality of health care treatments available. Technological quality is a decisive factor in the probability of recovery of sick agents. Consumers choose their private levels of

private health care maximizing expected utility, given the probability of being cured. Therefore, public health care investments intervene in the private consumption decision in a context of risk.

On one hand, we test empirically the theoretical predictions of Risa's (1989) private health demand model. The result of this validation is ambiguous. The sign of the health status, public health expenditures and income per capita are the expected ones. However, the relationship between direct income effect and public health expenditures substitution effect derived from Risa's model is not satisfied by our data. Given that Risa's model is not completely validated by our data, we supply an alternative test (or not based in his theoretical predictions) on how individual private health expenditure reacts to public health care and how total health care expenditures is affected by the relationship between its two components. We approach these issues using a more simplified and less restrictive framework. We find that expansions of the health care system have a negative substitution effect on private health demand. This negative effect does not offset every extra monetary unit spent in health care by the public authorities. Therefore, we conclude that public health care expenditure does seem to have an expansive effect on overall health care expenditures.

The chapter is organized as follows. Section 2 considers a theoretical model of private health care consumption and gives testable predictions. Section 3 describes the data set used; gives descriptive statistics of the sample; and, explains the assignment of public health care to the households. Section 4 describes the econometric methodology applied to obtain the coefficients and, tests the empirical predictions of the theoretical model. Section

5 concludes this chapter.

3.2 Theoretical framework

The theoretical framework we use for testing how public health expenditures affect private disbursements in health care is based on the standard moral hazard model proposed by Risa (1989). In this section, we first of all introduce Risa's basic model and, secondly, we construct a less restrictive model of private health care demand.

Basic Model

The model analyzes the private health care demand of individuals who maximize their expected utility given a certain level of free-at-source public health care. Consumers are considered to be risk avers in their health-adjusted income. For simplicity reasons, this formulation disregards informational problems between doctors and patients or doctors and health insurers. It assumes that there is technological substitubility between private and public medicine. The focus of the empirical test is to see how out-of-pocket payments for private health care react to public health care expenditure. Since we want to analyze how free-at-source public health care goods and services affect consumer's private health care goods and services purchases, we examine the behavior of agents that are not covered by any other type of comprehensive health coverage other than the public[3].

[3]If private health insurance coverages are allowed in this context, consumers could consume health care goods and services that would be paid by the private insurer.

Individual Preferences and health

The model assumes that a typical agent has preferences (V) defined over his/her health (h) and a composite good (k). The composite good accounts for all other commodities he/she can purchase given his/her income (Y). Considering all income is fully consumed, there exists a *monetary equivalent of ill health* (m) that reflects how much income the individual is willing to give up for recovering full health ($h = 1$):

$$V(Y, h) = V(Y - m, 1), \quad \text{where } h \in [0, 1] \tag{3.1}$$

Assuming that V is increasing and concave in both arguments[4], and invertible, it is possible to obtain a function m that expresses how the monetary equivalent of ill-health depends on income and health:

$$m = m(Y, h) \tag{3.2}$$

Totally differentiation of (2) provides with the partial derivatives of the monetary equivalent of ill-health with respect to income and health[5] :

$$m_y = \frac{dm}{dY} = \frac{V_k(Y - m, 1) - V_k(Y, h)}{V_k(Y - m, 1)} \tag{3.3}$$

$$m_h = \frac{dm}{dh} = \frac{-V_h(Y, h)}{V_k(Y - m, 1)} \tag{3.4}$$

Given the assumptions on V, (4) is clearly negative. The monetary equivalent is assumed to be increasing in income ($m_Y > 0$), therefore, the wealth-

[4] $V_Y \geq 0$, $V_h geq 0$, $V_{YY} \leq 0$, $V_{hh} \leq 0$ and $V_{yh} \leq 0$.

[5] Using a standard terminology, a subscript j affecting a function $g()$, indicates the derivative of the function $g()$ with respect to j.

ier, the more the consumer is willing to pay for full recovery[6]. Since the monetary equivalent of ill health implicitly incorporates the health status of the consumer, equation (1) can be simplified. The consumer's utility if sick can be viewed as:

$$V(Y - m, 1) = U(Y - m(Y, h)) \tag{3.5}$$

Using (5), we can talk of the individual being risk avers with respect to his/her health-adjusted income $(Y - m)$.

Medical Technology

The medical technology available determines the probability that a treatment fails in restoring consumer's health. It is assumed that the probability of not being cured (p), depends on how much public authorities spend in health care (x) and how much individuals allocate privately to health care goods and services c. In other words, the efficiency of medical treatments is a result of the total amount invested in health care, i.e., either public or private. Therefore, the probability of a medical treatment failure and the can be written as:

$$p = p(c, x) \tag{3.6}$$

The assumptions on $p(c, x)$ are that it is decreasing and convex on both arguments:

[6] As Risa discusses, this assumes that $V_k(Y-m, 1) > V_k(Y, h)$. Given that the derivative of utility with respect to consumption when healthy is positive $(V_k(Y, 1) > 0)$, the above inequality implies that $V_k(Y - m, 1) - V_k(Y, 1) > V_k(Y, h) - V_k(Y, 1)$.

$$p_c, p_x < 0 \tag{3.7}$$

$$p_{cc}, p_{xx} > 0 \tag{3.8}$$

The fact that the probability of being cured ($w(c,x) = 1-p(c,x)$) depends on how many resources are allocated totally to health care, has the implicit assumption that there are no informational problems. Patients receive the best treatment available with the objective to regain their health status again. Doctors give advice to sick consumers with the only purpose of curing them, perverse incentives on doctors' side (that may result in health care demand induction) are not contemplated[7].

Private health care demand

Consumers decide how much to spend in private health care (c) maximizing their expected utility given the risk of not recovering if ill ($p(c,x)$). Public health expenditure (or coverage) (x) are free at source and financed through taxes. Since the theoretical implications on the coefficients we want to test are the same taking into account taxes or not, we use the more simplified version of Risa's model[8].

Thus, the optimal level of private health expenditures (c) is the solution of the following problem:

[7]Although the assumption of non existence of informational problems imposes limitations on the scope of issues this model can address, it possibilitates finding a solution to the particular question of how public health care expenditures affect private health demand.

[8]One simple justification of this assumption is to consider that increases in public health expenditure is due to program funding reallocation (from defence programs to health care for instance).

$$\max_c U^* = (1 - p(c,x))U(Y - c) + p(c,x)U(Y - c - m(Y,h)) \qquad (3.9)$$

Consequently, the first order and second order conditions to be satisfied by c^*x for being optimal and unique are:

$$U_c^* = -p_c(U^1 - U^0) - (1-p)U_y^1 - pU_y^0 = 0 \qquad (3.10)$$

$$U_{cc}^* = -p_{cc}(U^1 - U^0) + 2p_c(U_y^1 - pU_y^0) + (1-p)U_{yy}^1 + pU_{yy}^0 < 0 \qquad (3.11)$$

where $U^1 = U(Y - c)$ and, $U^0 = U(Y - c - m(Y,h))$ indicate the utility of the individual if fully recovered and if sick, respectively.

Whenever (11) is satisfied[9], the chosen private health care expenditure can be expressed as a function of public health expenditure, income and health:

$$c^* = c(x, Y, h) \qquad (3.12)$$

Comparative statics of private health care expenditures with respect to health, income and public health system

Total differentiation of (12), supplies with information about how individual private health expenditure c^* changes when health (h), income (y)

[9]Risa(1989a) shows that if health is a normal good, then $-p_{cc}\frac{c}{p_{cc}} \geq -p_c\frac{c}{p}$ is a sufficient condition for (11) to hold.

and public health care spending (x) change. After some simplifications, the partial derivatives of c^* with repect to h, y and x are:

$$c_h^* = \frac{1}{U_{cc}}\left[pU_y^0 m_h\left(\frac{p_c}{p} + R^0\right)\right] \tag{3.13}$$

$$c_y^* = \frac{1}{U_{cc}}\left[p_c(U_y^1 - U_y^0) + (1-p)U_{yy}^1 + pU_{yy}^0 + pU_y^0 m_y\left(\frac{p_c}{p} + R^0\right)\right] \tag{3.14}$$

$$c_x^* = \frac{1}{U_{cc}}\left[p_{cx}(U^1 - U^0) - p_x(U_y^1 - U_y^0)\right] \tag{3.15}$$

where $R^0 = -\frac{U_{yy}^0}{U_y^0}$ is the measure of the absolute risk aversion if sick.

The amount spent in private health care is decreasing in health ($c_h^0 < 0$), except when R^0 is negative (i.e., when the utility function presents Decreasing Absolute Risk Aversion Utility). How c^* reacts to a change in income (14) can be simplified using (3) and (4):

$$c_y^* = \frac{1}{U_{yy}}\left[p_c(U_y^1 - U_y^0) + (1-p)U_{yy}^1 + pU_{yy}^0\right] + \frac{m_y}{m_h}c_x^* \tag{3.16}$$

Note that (16) has two terms, the first one (in brackets), corresponds to the direct effect that an increase of income has on the private health expenditures (c^*). The second, reflects the indirect effect that changes in income have on the monetary equivalent $m(Y,h)$ and, therefore, how much the consumer is willing to pay for restoring his/her health.

Finally, the sign of c_x^* is negative whenever the elasticity of p_x with respect to private health expenditures is strictly greater than the elasticity of the probability p itself[10]:

[10]See Risa (1989) for further details.

$$El_c p_x > El_c p \tag{3.17}$$

Therefore, if the crossed effects of private and public health expenditures p_{xc} on the probability of being cured $(1 - p(c, x))$ are sufficiently strong, private health expenditures decrease when public health care spending increases.

Additive Medical Technology

At this point, a further assumption is made, i.e., medical technology depends equally on the amount invested publicly and privately. The bottom line of this simplification is that what determines the probability of a treatment being succesful is not what is spent privately or publicly but the total expenditure effort in health care:

$$p(c, x) = p(c + x) \tag{3.18}$$

(18) implies that the partial derivatives of the probability of failure with respect to private and public health care expenditures are identical:

$$p_c = p_x \tag{3.19}$$

In the Spanish case, this simplification is not far from reflecting what consumers believe about private and public health care technology. There are several surveys (i.e., Roigé (1993)), showing that Spanish health care users are convinced that private and public health care technologies are equally efficient. The difference between the two types of providers is thought to be

only the hotel accomodation and associated ammenities (private hospitals offer single room with an extra bed for the companion, for instance).

Private health care expenditures and public health care system

Given (18) and (19), the first term of (16) (direct effect of income on private health expenditures) can be simplified and expressed in terms of (15):

$$(c_y^*)_{dir} = 1 + c_x^* \tag{3.20}$$

Equation (20) establishes a empirically useful relationship between the private health care expenditures' sensibility to changes in income and increases of the public health care system. This expression relating both effects is later used for testing if public health expenditures have an expansive effect on the total resources spent in health care using empirical data.

The model assumes the direct effect of income on private health expenditures to be less than the unit $(c_y^*)_d ir < 1$, i.e., for each additional unit of income, the consumer spends less than one extra unit in private health care. Therefore, given (20), private health expenditures have to decrease when public health care expenditures grow ($c_x^* < 0$).

Total health care expenditures and public health care system

There is a further question we are interested in: if an increase in public health care spending has a negative effect on private health care expenditures, what happens with the total amount of resources allocated to health care? The answer requires determining if an extra monetary unit spent by the

public health authorities provokes a fall in private health care expenditures that is less than proportional ($|c_x^*| \leq 1$), i.e., the public authority increases its budget by one and private expenditures fall, but by less than one.

Assuming that equality (20) is true and assuming that $c_y^* < 1$, (i.e. each extra unit of income does not mean more than an extra unit of private health care purchases), the expansive effect of public health spending depends on the sign of the direct effect of income on private health expenditures. Moreover, a direct income effect on the private demand for health greater than zero, implies increased total spending as a consequence of an expanding public system. This is so since a positive income effect becomes a sufficient condition for $c_x^* > -1$.

$$|c_x^*| < 1 \Rightarrow c_x^* > -1 \Rightarrow (c_y^*)_{dir} > 0 \tag{3.21}$$

Risa's model empirical test of public health expenditures being expansive is, therefore, based on testing that the direct income effect is positive, since, under his modelization, is equivalent to testing that $c_x^* > -1$. In the empirical section, we contrast Risa's theoretical hyothesis using a Spanish data set. In order to perform a validation of the above model we test empirically the following questions:

1. First, is the effect of the direct income effect positive (c_y^*) and less than the unit?

2. Second, is the effect of public health care on private expenditure (c_x^*) negative?

3. Third, does the relationship between the income and the public health system effects on private health care satisfy equation (20)? If this is so, then a positive direct income effect (c_y^*) above secures that expansions in public health care spending have a multiplicative effect on total health care expenditures.

Simplified model of private health expenditures

We simplify Risa's basic model relaxing some of the assumptions his model makes[11]. For our purposes, we only need that the agent's utility function behaves well with respect to its two arguments[12] (composite consumption good and health). As before, we use the illness-monetary-equivalent defined by equation (1) but, instead of the approach described above, we look at the maximization problem of the consumer in terms of the probability of being cured (w) that depends on both public (x) and private health expenditures c increasingly and concave. Therefore, how much to spend on private health expenditures is now the solution to maximizing the following expected utility function:

$$\max_{c} U^* = w(c,x)U(Y-c) + (1-w(c,x)U(Y-c-m(Y,h)) \qquad (3.22)$$

In consequence, the first and second order conditions for the level of private health expenditures c^* to be optimal are:

[11]The following model is basically the same as the presented above. In this version, we use the probability of being cured instead of not recovering and we disregard the issue of the relationship between consumer's risk attitude and private health care behavior. We think that this simplified version is somehow clearer as a support for the empirical test

[12]$U = U(k,h)$, $U_k \geq 0$, $U_h \leq 0$, $U_{kk} \leq 0$, $U_{hh} \leq 0$, $U_{kh} \geq 0$. I.e., consumption and health are normal goods, consumer's satisfaction increases with both arguments at a drecreasing rate and, the healthier the more satisfaction the agent gets from being healthy.

$$U_c^* = w_c(U^1 - U^0) - w(c,x)U_y^1 - (1 - w(c,x))U_y^0 = 0 \tag{3.23}$$

$$U_{cc}^* = w_{cc}(U^1 - U^0) + 2w_c(c,x)(U_y^0 - U_y^1) + w(c,x)(U_{yy}^1 - U_{yy}^0) + U_{yy}^0 < 0 \tag{3.24}$$

where $U^1 = U(Y - c)$ and, $U^0 = U(Y - c - m(Y,h))$ as previously.

As in Risa's model, assuming that (23) is satisfied, (24) implicitly defines the optimal private health expenditures as a function of income, public health expenditures and health status:

$$c^* = c(x, Y, h) \tag{3.25}$$

Equation (25) gives theoretical support to the test on the coefficients of a simple structural model where private health expenditures depend on income, public health expenditures and health status of the agent. Our interest is to sign the coefficients of this model, and, also, to assess if for each extra unit spent by public health authorities in health, private health expenditures decrease more or less than proportionally. In other words we test if the effect of public health expenditure is expansive, i.e., can we say that $c_x^* > -1$?

Next section contains the description of the data set, the econometric procedure used and the results of the tests on the coefficients obtained.

3.3 The Data

As described above, our objective is to test if the theoretical predictions on individual's private health care spending behavior are satisfied. In this

section, first, we describe the micro data set we use and, second, we explain the procedure followed to assign a level of public health expenditure to each family of the sample.

3.3.1 The Family Budget Survey

Our main data source is the Family Budget Survey of Spain for 1990-91 (EPF-90/91), collected by the Instituto Nacional de Estadística. The EPF-90/91 contains information about the annual expenses and social, demographic and economic characteristics of 21,155 Spanish households.

Although the EPF-90/91-survey is a very informative statistical data set for empirical health economics studies in Spain, it does not provide information about the health status of individuals. As Murillo and González (1992) points out, family budget surveys report only effective payments but not real use of health services. Therefore, services paid by the public system or by health insurance companies are not accounted for. Last, but not least, since it aggregates the expenditures of all members in a household, strictly individual spending behavior is lost.

More specifically, the EPF-90/91 survey provides family expenditures classified in nine groups: I-Food, Drink and Tobacco; II-Clothing; III-Housing, Heating and Electricity; IV-Furniture; V-Medical and Health Care Expenses; VI-Transports and Communications; VII-Leisure, Education and Cultural Activities; VIII-Other Goods and Services; and, IX-Other Expenditures. For the purpose of our paper, we select group V: Medical and Health Care Services. Group V details the expenses incurred in different categories:

1. Medication and other pharmaceutical products

2. Therapeutic instruments and other

3. Non hospital services, including doctors, nurses and other health providers

4. Payments for private health insurance coverage

5. Other expenditures in doctors and health care not mentioned previously

Since the objective of our study is to analyze the health care expenditure behavior of families that are either covered by the public system or have to pay their health expenditures out-of-pocket, we select a group of households that do not buy private health insurance. We do not want to include agents that can make use of health care services for which they do not pay directly or which are not provided by the public network. We obtain their private health expenditures aggregating categories 1,2,3, and 5 from above.

Sample

First of all, we take "the family unit or the household" as the decision unit. We understand family unit as a person or group of persons that live in the same household and consume food and other goods and services from a common budget. This is a standard and well documented assumption in this field[13]. Most budget surveys in all western countries, report expenditures at the household level, making individual consumption not recoverable. Taking households as the decision unit, is one of the only solutions to this problem.

Second, we select households from Catalunya, one of the 18 regions of Spain. Third, we analyze the behavior of families that are covered by the

[13]See, for instance, Van de ven and Van Praag (1981).

public health system only[14]. According to the theoretical model we described in section 2, these households can only complement the free-at-source public health care by paying out of their pockets any extra health-related goods they acquire.

Private health care expenditures, income and health status

We consider private health care c as any payment that the family makes for a health care related good or service. This is the result of aggregating categories 1,2,3 and 5 of the group V of the expenditures reported by the EPF-90/91[15].

We take the annual expenditure of the household as a proxy of its disposable income (y). The annual budget is generally accepted as better indicator of the permanent income of the family than the declared income. For different types of reasons, interviewees tend to understate their real income and therefore, annual expenditure is usually taken instead. To have a more accurate measure of the payment capacity of the family, we use the income per capita, i.e. total expenditures divided by the number of members in the household.

With respect to health status, the EPF-90/91 provides with two pieces

[14]Health care provided by the Seguridad Social in Spain. The percentage of population not covered by a private health insurance in Spain is slightly more than 93%. Therefore, not correcting by this initial selection of 3% households could in fact be having a small effect on the bias we can incur in when estimating the coefficients of interest. Maddala (1994), Section 9.6: "Multiple Criteria for Selectivity", on pages 278-283, discusses a possible solution to multiple selection criteria for limited dependent variables.

[15]We do not consider those households which main income earner is covered by a private health insurance. We also disregard the cases where the spouse or the parents of the head of the family have private insurance, due to the fact that then, the coverage is extended to the rest of the members.

of information: the age of the members and the type of household[16]. We approximate the health status of the family using both the percentage of members over 65 years it has and the type of family unit the interviewee is.

Professional category and education level of the head of the family

In order to estimate our equation of interest, we also include other household-characterizing variables such as: the professional category and the level of education of the head of the family and the size of the town where the household lives.

The EPF-90/91 classifies the professional category of the head of the household according the most recent occupation he/she has had. The classification is the following:

1. Manual workers of the industry and services
2. Non manual workers of the industry and services
3. Independent workers of the industry and services
4. Workers in Agriculture
5. Retired workers
6. Other (includes unemployed and other inactive)

[16] Families are categorized in seven types depending on their composition: 1) person or couple of persons over 65 years old with no children; 2) one person under 65 years old; 3) person or couple of persons under 65 years old, without children; 4) couple of adults with children; 5) one person with children; 6) other type of households without children; and, 7) other type of households with children.

The level of education of the head of the family is given by the number of years spent in the education system:

1. 0 years: Illiterate
2. Up to 14-16 years old: primary studies (i.e., EGB or FP1 in the Spanish terminology)
3. Up to 18 years old: High School degree (i.e., BUP, COU or FP2)
4. 3 years of University or equivalent (University Diploma)
5. More than 3 years in the University: Superior Degree or equivalent

Table 2 contains the average of the continuous variables (income per capita, private health expenditure and percentage of members over sitxy five years old in the family) tabulated according to the values of the categorical variables (province, level of studies, professional category, sex, size of the town and type of household).

3.3.2 Public Health Expenditures

We impute public health expenditures to each family in our sample by constructing an ad-hoc variable that is based on the work of Molina Morales and Jaén García (1994).

Molina Morales and Jaén García (1994) classify Spanish households according to their relative position in the national average income distribution[17]. The public health system is defined as the sum all health coverages

[17]Using total average expenditures as a proxy of permanent income.

that are financed with public resources, i.e.: Social Security, government mutualities and charity. Using the national health survey of Spain of 1987, they obtain the public health system coverage for each of those groups. The average public coverage is 97.07% of the population, reaching 93.8% of high income groups and 98% of the 8% medium-low class. They first distribute the total amount spent by the public health system to the deciles of income depending on the number of public health system consumers in each income group. In this first stage, they do not include subsidies to prescription drugs. The expenditures in subsizing medication is imputed using estimates of the subsidized-prescriptions consumption for each group of income. The public health expenditure by household varies but its incidence is decreasing. It varies from 20,83% in the first group to 4,7% in the highest income level.

We assume that public health authorities behaved the same in 1990/91 than in 1987. Thus, we project to 1990/91 the Molina-Morales and Jaén-García's distribution of public health care among expenditure deciles. Given this assumption, we multiply each household's 1990/91 average total expenditure by the percentage of the attributable public health care to that family, and we obtain the household's imputable public health care disbursement.

Table 1 shows which is the average total expenditures per household in each of the deciles of income and which is the percentage that the imputed public health expenditures represent:

Table 1: Public health care expenditures imputation

Decile in the total average expenditure distribution	Average total expenditure per decile	Weight of public health expenses on household budget by decile of income
1	898,509	20.83%
2	1,350,564	14.66%
3	1,636,556	12.30%
4	2,009,142	10.42%
5	2,223,509	9.70%
6	2,498,625	8.60%
7	2,804,986	8.60%
8	3,090,156	7.60%
9	3,619,931	6.40%
10	5,139,076	4.70%

Table 2: Descriptive Statistics of income per capita, private health expenditures, public health system assignment and percentage of over 65 years old household members

		income per capita	priv health expenditure	% over 65	pub health expenditure
Province	Barcelona	892618.85	36226.18	.21	220435.28
	Girona	899486.04	32377.32	.26	219290.72
	Lleida	900521.52	31480.82	.25	218531.27
	Tarragona	824420.58	22904.64	.23	217608.87
Education	Illiterate	689703.97	19706.98	.43	208127.44
	Primary	840326.89	30104.81	.22	219277.22
	Secondary	1012543.5	31472.20	.06	227319.84
	Diplomature	1336378.20	65867.80	.20	229998.50
	University	1515771.00	54111.01	.05	233707.87
Prof. Cat.	Manual Ind&S	829439.76	24158.87	.03	226333.76
	Non Manual	1094192.40	34010.10	.03	228434.44
	Independent	937945.62	26202.82	.06	227634.40
	Agriculture	838586.26	24271.89	.08	222737.77
	Retired	802682.07	36317.18	.62	207624.97
	Other inactives	793430.71	43143.46	.28	206863.34
Size town	[0:10000]	789501.66	24658.64	.29	215516.05
	[10,001 : 50,000]	866450.43	25332.77	.19	220034.33
	[50,001 : 100,000]	845883.62	39819.96	.18	219249.60
	[100,001: 500,000]	901261.05	32053.28	.24	221275.94
	more than 500,001	1127250.20	48997.96	.20	222546.54
Sex Head Household	male	859544.45	28632.33	.19	221628.36
	female	977554.95	49015.36	.45	205661.74
Household type	couple +65, no chil.	824937.39	39237.74	.90	199725.12
	one adult, no chil.	1445738.50	52851.85	0	202388.24
	couple -65, no chil.	1237141.6	33518.83	.03	218210.62
	couple -65 with ch.	789189.78	26371.02	0	224384.39
	adult with children	479755.57	25401.58	0	199478.51
	other hh, no child.	924001.09	37658.29	.20	224378.35
	other hh with child.	702024.84	19187.09	.05	228823.30
General:		878099.01	31334.47	.23	219117.96

3.4 Empirical test: the effect of public health care spending on the private health expenditure decision

In this section we first discuss the econometric procedure we follow to estimate our equation of interest and then, we present the results of our empirical test on the coefficients.

3.4.1 Estimation of the private health expenditure

Estimating the coefficients of the private health-care-related goods and services demand equation using micro data presents the problem that the endogenous variable c is censored. Only households that make a positive expenditure report how much they spent. The rest of families declare a null expenditure.

Let c_i be the private health care expenditures of household i; y_i its corresponding income per capita; x_i the assigned public health care expense to the family; Q_i a proxy of the health status of its members and, m_i some other characteristics household. Since c_i is different than zero only if household i decided to spend in a previous stage, applying Ordinary Least Squares on the following equation:

$$c_i = \beta_1 + \beta_2 y_i + \beta_3 x_i + \beta_4 Q_i + \beta_5 m_i + \nu_i \tag{3.26}$$

produces inconsistent[18] estimates of β_1, β_2, β_3, β_4 β_5.

[18]See for instance, Schneider H. (1986).

The question of which is the adequate econometric procedure for obtaining consistent coefficients of equations such as (26) has generated a lot of literature in the field, and even some controversies[19]. The pioneer method in coping with the null observations' problem is Tobin's (1958) . Tobin's model[20] assumes that the demand of a commodity is the result of two decisions: participating in the market (dichotomic variable) and, how much to spend (continuous variable). The basic presumption of this approach is that there is a common stochastic process that determining both decisions[21].

Posterior generalizations[22] of Tobin's model allow for the dissociation of the process that determines the censoring rule from the process that generates the continuous observations. The most commonly used (and the one we adopt) is the Heckman model[23]. This model proposes the estimation of demand equations following a two step procedure. First, the censoring rule equation is estimated. Second, the coefficients obtained in step one are used to compute the coefficients in the demand equation of interest using Ordinary Least Squares.

In this paper, we follow Heckman's model. In the first step, we estimate the decision of entering the market first (i.e., making a positive expenditure

[19]Pellissé (1994) describes the maybe most famous argument about estimation procedures of censored dependent variable equations. The controversy arose when Maddala criticized the use of successive decision step methods in estimating medical health services demand in the study of Newhouse, Manning, Morris, Orr, Duan, Keeler, Liebowitz, Marquis, Marquis and Phelps for the RAND Corporation (1987).

[20]Known as Tobit.

[21]Blundell and Meghir (1987).

[22]These are the so-called bivariate extensions of the Tobit model.

[23]Other extensions include Blundell and Meghir's (1987) method that proposes to distinguish between the null observations due to purchase infrequency from the corner solutions or even from the errors in answering successive surveys.

in health care goods). In the second, how much to spend on this type of goods and services correcting by the selection bias. In our case, the dissociation between both decisions can be interpreted as the result of the existence of some initial search fix costs that the consumer has to incur in prior to make a positive expenditure in health. Only families for which the marginal benefit of entering the market is greater than the cost of doing so, decide in a posterior stage the quantity they want to purchase. The factors that intervene in one and the other decision do not have to be the same necessarily[24].

The structural form we use is defined by two equations: The first corresponds to the decision rule (D_i) of participating in the market. The second determines the expenditure in private health care goods and services (c_i).

Decision Rule Equation

Let's Z_i be the characteristics of household i, and, U_{i1} and U_{i0} the utility levels of household i when it enters the market of private health care goods and services ($D_i = 1$) and when it does not ($D_i = 0$), respectively. The choice depends on which option reports a greater benefit or satisfaction level:

$$D_i = \begin{cases} 1 & \text{if } U_{i1} > U_{i0} \\ 0 & \text{if } U_{i1} \leq U_{i0} \end{cases} \tag{3.27}$$

where:

[24]See Murillo, Calonge and González (1996) for testing if purchase and expenditure level decisions are taken separately in the case of Spanish private health expenditures. The test relies in the comparison of the results of a probit model on the purchase decision with a tobit model for the expenditures and on the normality test of the latter's residuals. Following their result, we assume that estimating two different equations is the right specification.

$$U_{i1} - U_{i0} = (Z_i'\alpha_1 + e_{i1}) - (Z_i'\alpha_0 + e_{i0}) = (\alpha_1 - \alpha_0)Z_i' + (e_{i1} - e_{i0}) = \Gamma Z_i' + \varepsilon_i \tag{3.28}$$

Therefore, the probability that the consumer participates in the market ($D_i = 1$) is a function of its characteristics Z_i:

$$P(D_i = 1) = P(U_{i1} - U_{i0} > 0) = P(\Gamma Z_i' + \varepsilon_i > 0) = F(-\Gamma Z_i') \tag{3.29}$$

Distributional assumptions on F make it possible to obtain estimates of Γ. When e_i is presumed to be normally distributed, the above probabilistic model is known as Probit model. If the logistic distribution is used instead, its name is Logistic Model. In this paper, we use the latter, and, therefore, equation (29) has the following expression:

$$P(D_i = 1) = \frac{\exp\left(\frac{-\Gamma Z_i'}{2}\right)}{\sqrt{2\Pi}} \tag{3.30}$$

Private health care demand

The second equation to be estimated is private health goods and services demand, i.e., how much the consumer is willling to spend once he/she decides to participate in the market.

$$c_i = \beta_1 + \beta_2 y_i + \beta_3 x_i + \beta_4 Q_i + \beta_5 m_i + \nu_i \tag{3.31}$$

As before, y_i, x_i, Q_i, and m_i indicate: income, assigned public health expenditures, health status and other characteristics of household i respectively and, ε_i is a normally distributed error. Since we only observe a positive

expense in private health care goods ($c_i > 0$) when the family decided to enter the market ($D_i = 1$), we correct for the bias introduced by the sample selection following Heckman (1976).

Heckman's procedure assumes that the error terms in the decision rule and the private health demand have a Bivariate Normal distribution, with zero mean, unit variance and ρ correlation:

$$(\varepsilon_i, \nu_i) \rightarrow \text{Bivariate Normal } (0, 0, 1, 1, \rho) \tag{3.32}$$

Therefore,

$$\begin{aligned} E(c_i|D_i = 1) &= \beta_1 + \beta_2 y_i + \beta_3 x_i + \beta_4 Q_i + \beta_5 m_i + E(\nu_i|\varepsilon_i > 0) = \\ &= \beta_1 + \beta_2 y_i + \beta_3 x_i + \beta_4 Q_i + \beta_5 m_i + \rho\sigma_\varepsilon \lambda(\Gamma Z_i') \end{aligned} \tag{3.33}$$

Where ρ is the correlation between ν_i and ε_i, σ_ε the standard deviation of ε and, λ:

$$\lambda(\Gamma Z_i') = \frac{\varphi(\Gamma Z_i')}{\phi(\Gamma Z_i')} \tag{3.34}$$

where φ and ϕ are the density and the accumulated probability functions of normal distribution.

The estimation procedure consists in two stages:

1. Estimate the Probit Model (30) by Maximum Likelihood and obtain $\hat{\Gamma}$.

   In addition, for all observations in the sample of positive expenditures households, compute:

$$\hat{\lambda} = \frac{\varphi(\Gamma Z_i')}{\phi(\Gamma Z_i')} \tag{3.35}$$

and

$$\delta_i = \hat{\lambda}_i(\hat{\lambda}_i + \Gamma Z_i')Z_i') \tag{3.36}$$

2. Estimate β_1, β_2, β_3, β_4, and β_5 by using Ordinary Least Squares to the equation:

$$c_i = \beta_1 + \beta_2 y_i + \beta_3 x_i + \beta_4 Q_i + \beta_5 m_i + \beta_6 \hat{\lambda}(\Gamma Z_i') \tag{3.37}$$

3.4.2 Results of the estimation

We describe first, the results of the first step of Heckman's model estimation procedure. Second, we report the outcome of the private health care expenditure equation estimation, correcting the selection bias. Finally, we show the result of the tests on the coefficients suggested by the theoretical model.

Probit Model

We estimate the purchase decision equation (equation 30 above) using a probit model with the following explanatory variables:

1. income per capita in the household and income per capita squared[25]

2. percentage of members over sixty five years and its squared value[26]

[25]This allows for a quadratic dependence of the latent decision variable of positive purchase with respect to income.

[26]Also, quadratic dependence of the purchase decision on health is permitted.

3. type of household

4. assigned public health expenditures

Table 3 contains the coefficients of the final round of the estimation, the variables that do not appear have been dropped in previous stages due to their non significativity[27]. The second column presents the coefficients and the last column, the Odd-Ratio. The Odd-Ratio reports the increase in the probability of purchasing that the average household experiments due to: a) one extra unit of the independent variable if continuous; and, b) the fact that a dummy takes value one instead of null if the variable of interest is dichotomic.

[27]This is the case of income per capita that plays an important role in the level of expenditure but not in the decision of entering the market. The reason is, as pointed out in Folland, Goodman, Stano (1993) that thresholds for deciding to participate in the market can be related to many other factors different than the wealth of the family. Consumers with the same income can have very different decisions with respect to visiting a doctor for treating a flu, thus variations of their income would not explain variations in the outcome of this decision. On the other hand, higher income is correlated with higher information and knowledge in many occasions. This could make wealthier agents to be more aware of the existence of free-of-charge public alternatives. Murillo, Calonge and González obtain a similar result when analyzing private health expenditure in Spain.

Table 3: Probit Model

Probit Estimates					**Number of observations**		= 1342
					χ^2_{14}		=157.06
					Prob > χ^2		=0.0000
Log Lokelihood = -724.86859					Pseudo R^2		=0.0977
positive	**coeff**	**Std. Er**	z	$P > \|z\|$	**[95% Conf**	**Interval]**	dF/dX†
Girona†	-.1718781	.1027796	-1.672	0.094	-.3733224	.0295662	-.0582177
Lleida†	.1686724	.1141672	1.477	0.140	-.0550912	.392436	.0536001
Tarragona†	-.2091691	.0989859	-2.113	0.035	-.4031778	-.0151603	-.0708625
diploma†	.1919716	.206366	0.930	0.352	-.2124983	.5964414	.0595435
univ†	.0918415	.2196769	0.418	0.676	-.3387172	.5224002	.0293984
Itipha_4†	.4993813	.1281111	3.898	0.000	.2482882	.7504745	.1493037
Itipha_6†	.2513099	.118659	2.118	0.034	.0187425	.4838773	.079686
Itipha_7†	.3817864	.1376992	2.773	0.006	.1119009	.6516719	.1151557
health	.742318	.5059147	1.467	0.142	-.2492567	1.733893	.2442469
sqhealth	-.860597	.4950701	-1.738	0.082	-1.830917	.1097225	-.2831646
pubexpend	.0000175	2.51e-06	6.994	0.000	.0000126	.0000225	5.77e-06
Icatpr_4†	.3393942	.1811468	1.874	0.061	-.0156471	.6944354	.1004693
Icatpr_5†	.2688179	.1287492	2.088	0.037	.0164741	.5211616	.0851042
Icatpr_6†	.2205567	.1361955	1.619	0.105	-.0463815	.4874949	.0684608
constant	-3.565.795	.5548761	-6.426	0.000	-4.653332	-2.478258	

Observed Probability: .7138599

Predicted Probability: .7326148 (evaluated at means of independent vars)

†"dF/dX" is for discrete change of dummy variable from 0 to 1

The variables that make the probability of entering the market of private health care goods and services significantly increase are:

1. Percentage of members over sixty five years old in the household. Note that both the linear and the quadratic expressions of this health measure are significant (at 85% and 92% level of significativity, respectively). In order to calculate the effect of this variable we have to incorporate the effect of both linear and quadratic terms evaluated at the average health status of the population. Thus, in this case the effect is: $\beta_{h1} + 2\beta_{h2}(Q_{av}) = 0.742318 + 2(-0.860597)(0.2307528) = 0.345148$. The linear term has a positive influence on the probability whilst the quadratic term's effect is negative, thus, the probability of purchasing depends positively on health but at a decreasing rate.

2. Being the household a couple with children or any other type of household (with or without children) other than being a couple of sixty five without children or a couple without children or living alone.

3. Public health care expenditure assigned to the household. Although significant, this coefficient is very close to 0. The fact that it makes the probability of participating in the private health care market go slightly up is somehow counter intuitive. The explanation of this result maybe lies in the fact that households with higher public health expenditure assigned are families with also higher tendency to use the health care system, since this is one of the criteria used in the public health expenditures to households in the sample. Therefore, it is logical to expect this correlation is picked up by the assigned public health expenditure variable.

4. Working either in the agricultural sector, or being retired, or being some other kind of inactive (which include rentists, unemployed and housekeepers, for instance) instead of being either a worker of the industrial or services sectors, or an independent worker (or self-employed).

The only two variables (besides the squared health status measure) that make the probability of making a positive expenditure in private health care goods and services decrease are living in Girona (at 90%) or Tarragona (95%) instead of Barcelona.

Expenditure Equation

Following Heckman's procedure, we use the coefficients obtained in the previous estimation step to correct for the sample selection. The robust coefficients of the private health expenditure demand are displayed in Table 4 and discussed below.

Table 4: Private Health Care Expenditure Equation

Probit Estimates					**Number of obs**	= 1342
					$\chi^2_1 4$	= 154.50
Log Likelihood = -12969.4852675					Prob > χ^2	= 0.0000
expendit	**coeff**	**Std Er**	z	$P > \|z\|$	**[95% Conf**	**Interval**
Tarragona	-6040.71	6551.644	-0.922	0.357	-18881.7	6800.276
Itmmun_3	13726.48	8329.428	1.648	0.099	-2598.9	30051.86
Secondary Ed	4824.193	5984.299	0.806	0.420	-6904.818	16553.2
Diploma Ed	18454.4	13621.03	1.355	0.175	-8242.332	45151.14
male	2329.073	9331.026	0.250	0.803	-15959.4	20617.55
Itipha_4	23257.49	11128.8	2.090	0.037	1445.444	45069.53
Itipha_5	39532.04	43065.45	0.918	0.359	-44874.69	123938.8
Itipha_6	22340.84	9773.813	2.286	0.022	3184.518	41497.16
Itipha_7	24917.4	12445.97	2.002	0.045	523.375	49311.06
health	26589.44	10852.37	2.450	0.014	5319.19	47859.68
incap	.08976	.0187477	4.788	0.000	.0530152	.1265049
sqincap	-1.10e-08	4.60e-09	-2.403	0.016	-2.01e-08	-2.04e-09
Icatpr_3	-7840.328	9682.029	-0.810	0.418	-26816.76	11136.1
Icatpr_6	11801.37	10002.01	1.180	0.238	-7802.208	31404.96
pubexpend	-.6297141	.2760943	-2.281	0.023	-1.170849	-.0885792
constant	85798.08	51709.37	1.659	0.097	-15550.43	187146.6
$\tan(\rho\Pi/2)$	-.5414547	.1008955	-5.366	0.000	-.7392064	-.3437031
$\ln(\sigma)$	11.3619	.0256676	442.656	0.000	1.131.159	1.141.221
ρ	-0.316		-5.366			
σ	85982.495		442.656			
λ	-27164.297	4661.417				

Note: The procedure used estimates tangent of $(\rho\Pi/2)$ and logarithm of (σ). The reason is that this approach extends the range of these parameters to infinity in both directions, thus avoiding boundary problems. Test of ρ is made in transformed units. However, $\tan(0) = 0$, so the reported test for $\tan(\rho\Pi/2) = 0$ is equivalent to the test of $\rho = 0$. The fact that $z = (-5.366)$, significantly different from zero result justifies the Heckman selection equation with this data.

The variables that influence positively the level of private health expenditures are:

1. Having three years of superior education (diploma) or equivalent instead of any other level of education, although is significative only at the 70

2. Health status: In this case, the effect is only linear. Having a higher percentage of members older than 65 years makes the amount privately spent in health care go up by 26,589 monetary units per year.

3. Income per capita: Since both quadratic and linear coefficients are significant,the overall effect of income per capita on private health expenditures is: $\beta_{y1} + 2\beta_{y2}(y_{av}) = 0.08976 + 2 \times (-0.0000000110) \times (939,538.8) = 0.06909316$. Therefore, for every one hundred extra monetary units of income per capita in a household, six of them are spent in private health care goods and services.

4. Being a couple with children or any other type of household (with or without children) instead of being either a couple over sixty five years without children or a couple without children or living alone (note that being one adult with children is finally not significant). The increase of having children with repect to not having any is quite striking: couples with children invest (in average) 23,257 monetary units in private health expenditures more than a retired couple, a couple or an adult with no children.

5. Living in a size of town that has between 50,000 and 101,000 inhabitants instead of any other type. The explanation of this increment of the

amount spent if the consumers live in a medium sized town instead of any other dimension, could lie on the fact that medium sized town seem to have a less articulated public health system than the larger or even smaller towns (in terms of fewer primary care centers and/or fewer hospital beds per inhabitant), forcing their residents to make a more intense use of private health care commodities and facilities.

The only significant variable that has a negative effect on the level of private health expenditures is the public health expenditures assigned to the household. Every extra one hundred monetary units that the public system assigns to the household implies a reduction of six monetary units spent in private health care. The effect is not too big, but significantly negative.

Test of the theoretical model predictions

Finally, we test the predictions on the coefficients that the theoretical model suggested. It should be noted that, first, the effect of the direct income on the private health care expenditure is positive but less than the unit as the model assumed[28]. Second, that the effect of the household's assigned-public-health-expenditures is negative (both extrems of the 95% interval of the *pubexpend* coefficient are negative).

The theoretical model used predicts that public health expenditures have an expansive effect on total health expenses if equation (20) is satisfied and it is true that the direct income effect is positive[29].

[28]Testing if $\beta_{y1} + 2\beta_{y2}(y_{av}) \geq 1$ has an associated chi-squared statistic of $\chi^2_1 = 6916.86$, therefore $Prob > \chi^2 = 0.0000$, and the null hypothesis is rejected.

[29]We remind the reader that satisfaction of equation (20) ($c^*_y = c^*_x + 1$) meant that a sufficient condition for the expansive effect to be true is that the direct income effect is positive ($c^*_x > -1 \Rightarrow c^*_y - 1 > -1 \Rightarrow c^*_y > 0$).

As we developed in section 2, we test the expansive effect of public health expenditures on total health expenditures using two approaches. First, we test if the relationship between income effect and public health expenditures effect on private health spending is satisfied (equation (20)). If it is, we could draw conclusions based on the sufficient condition (21), i.e. a positive income effect means an expansive effect of public system. Second, we perform a less constructed test based on the less restrictive model: we check if the public health expenditures coefficient is less than one, in absolute value. The results are as follow:

The test of equation (20) produces a chi-squared statistic of 0.94. since this statistic is distributed as a chi-squared with one degree of freedom, we reject the null hypothesis that equality (20) holds (the associated p-value is 0.3314). The conclusion is that the theoretical prediction seems not to be satisfied by the behavior of the consumers in our sample. Therefore, the sufficient condition in (21) can not be used to infer the expansive effect of public health care expenditures on total health expenditures. I.e., the fact that the direct income effect is positive, does not have to mean necessarily that increasing the public health system makes the overall health expenditures grow.

We also test if the absolute value of the coefficient of public health expenditures is greater or equal than one. The result is that we do reject the null hypothesis with a 95% of confidence. Therefore, thus, we can not discard that increasing public health expenditures by a unit has an effect on private health spending less than proportional. Thus, our test indicates that the overall effect of increasing the public health system on total health expen-

ditures could have an expanding effect on the overall resources allocated to health care.

3.5 Conclusions

The main results of this chapter are as follows:

First, with respect to testing the predictions of the theoretical model of private health expenditure, the main conclusion is that health status, public health expenditures and income effect satisfy the expected signs. In other words, the less healthy a household, the more it spends in private health; the bigger the public health system available to the family, the less percentage of the budget goes to private health care goods and services; and, the higher the income per capita, the bigger proportion of the budget that the family assigns to private health care. In this sense, the model is validated. But, the model does not seem to fit well the relationship between income and public health system. The hypothesis that the former is equal to the latter plus the unit is rejected. Therefore, this particular prediction cannot be used to infer the effect of expanding public health expenditure on total health care expenditures.

Second, the test on the coefficients indicates that increases in public health expenditures could result in a net increase in total health care expenditures since, for every extra monetary unit invested by the public authorities in health, private health expenditures decrease by less than one.

Third, there are some policy implications of our study. The GNP percentage of resources allocated to health care seems to increase with a growing

national health systems. Consequently, if the increasing trend of public and total health expenditures is a concern, designing health care network expansions based in alternative resources other than public funds should be considered. Managed care is often pointed as one of these alternative less public-based health care systems. In this latter scheme of health care provision, public authorities become some sort of financial mediators between consumers and providers, lessening the burden of the public health care budget.

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Chapter 4

Public Health Care And Private Insurance: The Quality of Provision as a Link

4.1 Introduction

The objective of our study is to quantify to what extent the quality of provision of public health care influences decisions about whether to buy private insurance.

In Spain, the majority of the population has access to public health care. In addition, Spaniards have the possibility of choosing any of the privately provided health care services that can be contracted as a complement to or as a substitute for public health care free-at-source. In fact, 98% of the population is covered by a national health care system basically financed through taxes[1]. A centralized organism takes care of 42% of the citizens while the rest (58%) are attended by the regional administrations that have the health care competence transferred to them by the central government.

[1]Taxes cover approximately 80% of the public health care expenditure.

These regions are Andalucía, Canarias, Catalunya, País Valencià, Navarra and Galicia. The private health care sector configuration has been deeply influenced by the growth of the National Health System (NHS). The NHS recently expanded, developing its own patient care network instead of reaching deals with the pre-existing private providers[2]. In 1995, for instance, 7.6% of the Spanish GNP was spent on health care from which more than three fourths was paid publicly.

Around 7% of the Spanish population is privately insured[3], buying their insurance plans either individually, through their employer or through any of the state owned Mutualities[4].

Nowadays, the most important problems of the Spanish health system are: the continuous budget deficits, and the existence of long waiting lists in both diagnosis and treatment services[5].

As refer to the first problem, deficits have been caused by the steady growth of health care expenditure (see Graphic 1 in Appendix I). Contributing factors to this evolution are not only the extension of the Social Security coverage to additional population, but also the inclusion of new therapeutic

[2]The 1993 Insurance Association Summary (Informe SESPAS, 1993) reports that between the seventies and 1983 the expansion of the National Health System resulted in a progressive loss of protagonism of health insurance companies, private health providers, private charity and other non-profit organizations.

[3]7.4% is the 1993 percentage in the Annual Report of the Health and Consumption Department of Spain ("Memoria 1995", Ministerio Sanidad y Consumo).

[4]These mutualities (MUFACE, MUNPAL, ISAFAS and MUGEJU) cover civil servants. These type of workers have the option to choose, at no extra cost, a private insurance instead of keeping the public health care carrier (Social Security). See Appendix I for some more details about the percentage of enrolled and some more statistics referring the private health insurance market structure in Spain.

[5]NERA Report 1996.

and preventive technologies in the basic public package.

The trend of increasing public health care expenses motivates recent government attempts to control expenditure by developing new schemes of financing and providing health care. Curbing the growth of expenditure is the driving force behind the several trials of reforming the public health system since the 1980s.

With respect to the waiting lists and improving the care quality, several plans of queue reduction for some specialties and assistance quality improvement have been planned and actually implemented[6]. Precisely, this chapter focuses on the analysis of the waiting lists problem.

In this work, we want to approximate the effect of the effort to improve two dimensions of the public health care quality. The quality dimensions we consider are the waiting times in doctors' offices and the length of waiting lists for surgical procedures. Since it is generally accepted that waiting for receiving a health treatment has a cost in terms of health[7], we understand that velocity of delivery can be viewed as a qualitative attribute of a health care system. Moreover, our presumption is that it plays an important role in the consumer's decision of opting out or not the public network and purchasing a private health insurance plan. Therefore, we disregard the possibility that waiting times are an indicator of higher demand due to higher quality[8].

[6]The cost of the most recent plan in reducing the waiting list length was 3,500 million pesetas. 16% of the investment was used to pay doctors in afternoon exceptional shifts (they called this system "peonadas"), 17% went to reimburse private engaged hospitals and, 7% to pay supporting public centers.

[7]The longer the wait, the higher the possibility of damage to health is and the lower the probability of full recovery after the treatment.

[8]If waiting for a health treatment in the public network was an indicator of the public

Our interest is motivated by the belief that it is necessary to have empirical measures of the impact of specific health care policies on both the private and the public sectors. Knowing the extent of such effects is essential to define which public-private collaboration model is adequate.

The results we obtain show that there exists a positive relationship between a lower quality of public health care (waiting times) and a higher probability of buying private insurance.

Our study is related to empirical literature focused in the general question of the substitution between public health provision and private insurance. Cutler and Gruber (1995) prove that the Medicaid shifts private insurance demand in the USA, and Besley, Hall and Preston (1996) conclude that waiting lists play a role in the health insurance decision.

On the other hand, our analysis has connections to the existing literature studying private health insurance purchase decision in Spain, mainly Calonge, González and Murillo (1996), González (1995) and Szabó (1997). In comparison to the first two studies, we use a different source of information (the Survey of National Health instead of the Family Budget Survey)

provision having a better quality, it would be true that the benefits of waiting in queue for being treated in a public institution minus the cost (in terms of health) incurred by the consumer due to the wait, outweighed the benefits of purchasing the treatment from a private provider and receiving it immediately. Note that this would hold even for consumers with no income restrictions. Such big difference between public and private health care technological quality (in favor of the public one) would clearly contradict the evidence on Spaniards believing that strictly technological attributes are similar between private and public systems. Differences in quality between the two providers are perceived to lie in the associated facilities, comfort of accommodation, and other dimensions of the health care provision. Our hypothesis is that waiting times is one of those distinguishing qualitative factors between public and private provision and can not be understood as a sign of people willing to wait.

and this allows us to control by the "health status". On the other hand, the incorporation of subjective health, limitation of daily life, doctor or health center visits and report of accidents, permits the analysis of questions that Szabó (1997) laterally points out: Is there any trace of Adverse Selection or Moral Hazard in the Spanish health insurance market? Since our main interest is studying which is the effect of a public health care provision quality proxy on the health insurance purchase decision, not only do we use a different database than did González, Calonge and Murillo (1996) and González (1995), but we also try to answer a different set of questions. One of the differences between our work and Szabó's (1997) is that we attempt to overcome a serious problem of the National Health Survey: the absence of income information. We propose a method of correcting the lack of income information of the National Health Survey by using the Family Budget Survey.

Our results point out that some of the recent policies designed to reduce waiting lists may not be as effective as was hoped. The reason is that, without supplementary measures, their indirect effects could have canceled the main objective of reducing queues. Reading our finding inversely, they suggest that shortening the public hospitals' waiting lists without giving incentives to the private health care expenditure can paradoxically end up provoking renewed congestion of the system. Not only can new congestion result, but also the private insurance sector risks significant losses.

The chapter is organized as follows: Section 2 consists of a descriptive analysis of the data set used, a characterization of the privately insured, and a description of the proxy of public health care quality used. Section 3 describes the theoretical model relating private health insurance purchase

and public health care quality, the econometric model used, and the results of the estimation. Finally, Section 4 contains the main conclusions and some remarks.

4.2 The Data and some descriptive analysis

In this section, first, we present a description of the database used. Secondly, we characterize the typical health insurance beneficiary and we report some univariate analysis. We look for any trace of Adverse Selection, Moral Hazard or Differentiated Use of the Medical Services. Finally, in the last subsection, we describe the public health quality measure we construct in order to achieve our research objective.

4.2.1 Database: The National Health Survey

Our main database is the 1993 National Health Survey of Spain (ENS-93) gathered by the Ministerio de Sanidad y Consumo. It was conducted between February and March of 1993, and we use the answers of 21,120 adults.

The ENS-93 contains information about:

- *Subjective health evaluation:* chronic illnesses, daily activity limitation due to an acute or chronic disease episode in the last two weeks, occurrence of accidents in the last year (and care required)
- *Health services use:* visits to the doctor (specialty, doctor's affiliation, time required to get to the office, minutes spent in the waiting room); hospitalizations in the last year (reason, days on the waiting list, type

of entrance, payer); emergency room use (reason and affiliation) and use of medication

- *Health coverage:* interviewee's health insurance by entitlement or by being a beneficiary. The options are: Social Security Social (SS); SS chosen through the state-owned mutualities; public Health Plan (PHI); PHI chosen through the state mutualities; no health coverage; out-of-pocket payments; charity and others (Summary in Table 2 of Appendix I). The survey also provides the age and the coverage of other members of the family

- *Life style:* tobacco consumption, drinking habits, exercise and average number of hours of sleep

- *Social and demographic characteristics:* Age, sex, education level, employment situation, most recent occupation, number of members of the family, region[9], province and size of the town of the interviewee

- *Head of the household:* in the cases where the interviewee is not the main income earner, we are told the education level, the employment situation and the most recent occupation of the person that makes the most money in the household

Even though this information is valuable, it is not as complete as we had wished: its deficiency is that it does not explicitly give any income variable. In general, the education level, the employment situation and the most recent occupation of the head of the family have been treated as the variables that

[9]Autonomous Community.

pick up the effect of the economic situation of the household. But, we think that this approach is only a partial remedy that could bias on the results. Moreover, in the case of health insurance purchase, the National Health Survey (ENS-93) does not give any information about either how much the buyer paid for it or which services such plan covers.

4.2.2 Supplementary Data Base

In order to overcome the ENS-93 deficiency, we use the Family Budget Survey (EPF-90/91), conducted by the Instituto Nacional de Estadística. The EPF contains, among much more data, the social and demographic characteristics and yearly consumption expenditure of 21,155 Spanish families.

For this study, the crossing of the two surveys is conducted at two levels:

1. The first is restricted to the use of different moments of the provincial and regional income distribution provided by the EPF-90/91. We assign to each individual in the ENS-93 the following extra variables: the average income of the two lowest and the highest percentiles of the province where he or she lives. These distribution moments are included in order to, roughly capture the dispersion degree of the income in the area of residence.

2. The second use of the EPF-90/91 is to obtain a prediction of the income of each household interviewed in the ENS-93, following the approach of Arellano and Meghir (1992). As we explain in Apendix E with

more detail, we first test the compatibility of the surveys [10] and select some variables common to both data sets, i.e., region, number of adults in the household, professional category of the head of the family (see Appendix A for a more detailed information). Then, we regress the household income per capita on the selected variables using the EPF-90/91. Finally, we apply these estimates to the values that these same variables take for each household in the ENS-93, and we obtain the correspondent predicted income per capita. We should remark: First, that, to avoid regressors-error term's correlation problems, the variables used to predict income cannot be used in the equation of interest, i.e., the health insurance purchase decision. Second, that using Arellano and Meghir (1992) procedure provides with consistent estimates of the coefficients in the health insurance purchase decision equation, although there is a cost in terms of efficiency[11].

4.2.3 Profile of the insured: Adverse selection and moral hazard

In this section, we will report the results of the ENS-93 exploratory analysis. We would like to characterize the individual who purchases private health

[10] As in Arellano and Meghir (1992) and Segura-Bonet (1996), this test consists in not rejecting the null hypothesis of the equality of coefficients of both surveys

[11] The standard errors of the estimated parameters should be adjusted because they have been conditioned on previously estimated parameters. The process for obtaining such corrected standard errors is throughly detailed in Arellano and Meghir (1992), pages 557-558. We do not perform this type of adjustment due to the fact that our equation of interest has a dichotomic endogeneous variable and that there are reasons to believe that both surveys used are affected by heteroskedasticity problems. Both fact imply curbsome computations that we leave, in any case, for further research. We do correct for the heteroskedasticity using robust confidence standard errors based on Huber's (1967) method (which is equivalent to White's (1980)).

care and to differentiate his behavior with respect to the non-purchaser[12]. This information is not only illustrative by itself, but also it helps us to know which variables are candidates to explain the insurance purchase decision.

On the other hand, we are also interested in examining if there are any traces of Adverse Selection (Are the insured less healthy? Do they have a higher accident rate?) or Moral Hazard (Are the insured less careful with their health? Do they take fewer preventive measures?).

We consider "privately health insured" any individual who is either the primary titular or simply the beneficiary of a private health insurance plan.

The main conclusions are the following[13]:

Insured average profile:

- The average insured is a man almost 45 years old (more two years older than the uninsured)
- He is married and lives in a household with his wife (with or without children)
- The number of members of the family is typically around 3, below the number of the uninsured
- The insured has a higher education level than the uninsured (22.3% have a university degree)

[12]For this analysis, we conduct an Equality of Means T-Student test, assuming variances are unequal.

[13]See Tables in Appendix D

- The insured works with a higher probability than the uninsured
- The insured's most recent occupation was as an entrepreneur (or running a business), a professional, a white-collar employee or a skilled manual worker

In addition, our findings with respect to the Adverse Selection, Moral Hazard or Differentiated Use hypothesis are:

Adverse Selection Issues:

- On average, the insured have more accidents and more serious ones than the uninsured: These accidents happen more often in the workplace and they are treated in health care centers and nurseries. The question that this raises is "Do people more likely to have accidents insure themselves more often?."
- Given some positive use of medication, the insured take more often drugs for chronic illnesses such as rheumatism, high blood pressure and diabetes. This could indicate that there are more chronic patients among the insured than there are among the uninsured. We also find more smokers.
- Objections to the Adverse Selection hypothesis: The insured feel that they have good health with higher frequency than do the uninsured. They also tend to have better teeth and exercise more regularly.

Moral Hazard Evidence:

- The analysis we perform is not conclusive. We cannot state that the insured tend to have a less "illness-preventive" attitude. They go the same number of times to the dentist as the uninsured although, given that they go, they tend to consume more teeth cleaning treatments[14].

Health Services Use:

- The insured do not go to the doctor more often than the uninsured, but, looking only at the group that visit to the doctor, then the insured visit more frequently see the specialist than the uninsured.
- They enter the hospital through the emergency room less often than the uninsured. Surgery is the most common reason for entrance and their hospital stays are paid most of the times by the private insurer or by the patient out-of-pocket.
- The insured buy dental insurance more frequently than the uninsured.

The conclusion is there are some signs of a relative Adverse Selection among private health insurance enrollees. But, since we do not have information about the price paid by the insured, we cannot determine is if this selection is already taken into account and internalized by the insurance companies when setting the premia. Even though the law prohibits it, insurers

[14]We included the "Higher Incidence of Accidents" result under the Adverse Selection discussion. The reason of not classifying it under the Moral Hazard section is that we consider that more accidents in the workplace are, in any case, a sign of the fact that people with higher accident propensity buy more frequently health insurance than the rest. It is not very sensible to think that insured people have more accidents because being insured induce them to lower their preventive behavior.

have means (age, sex, employment situation and occupation) for filtering the physical conditions and the risk propensities of the clients, and the companies can very well discriminate with the prices they charge.

With respect to the existence of Moral Hazard, we do not have enough evidence to draw any conclusions. Referring to the use of the health services, we do observe some evidence of different behavior between insured and uninsured that corroborates results obtained by other authors (Szabó (1997)).

4.2.4 Health care provision quality: Relevance and proxy variables

The issue of how the public health care provision improvement affects the private health insurance sector has been infrequently treated by health Economics. The first problem encountered is the construction of a measure of the "quality" of the public health care provision. Ideally an evaluation would be based on treatment success rates such as morbidity and mortality ratios, percentages of full recoveries, and iatrogenic infections. Unfortunately, the data available do not provide such information (including the National Health Survey). Therefore, we have to opt for alternative measures. We choose a partial dimension of the public health care quality: the surgical procedures' speed of delivery (public hospitals surgery waiting lists); and, the doctors' office waiting time.

Before describing the variables we construct to measure the public health system waiting times, we would like to remark that the waiting time has been

often used as the "non monetary cost" of the public health system. Another approach treats it as the result of a non-cooperative resource allocation that results in efficiency and welfare losses[15]. On the other hand, waiting lists have been also viewed as a proxy to the "health discount factor", or what a consumer is willing to pay in terms of health for not being treated immediately[16]. The longer the wait, the higher the possibility of damage to health is and the lower the probability of full recovery after surgery is. Based on the cost of waiting, part of the literature understands the waiting lists as an access-rationing device of the public authority[17].

As we mentioned above, we think that the velocity of delivery is a qualitative attribute of the public health care system. Often, the promptness in undertaking a surgical procedure plays an important role in the patient's ultimate recovery. In this sense, we understand that waiting time is a definitively important dimension of the public health care quality, one considered by the consumer when he or she decides whether to buy private health insurance. Like Besley, Hall and Preston (1996) when they evaluate the waiting lists in the British national health system, we understand the private provision in the market context, and we conceive it as an 'alternative" to the public sector[18].

Our final choice for measuring "how much slower" consumers access med-

[15]Iversen (1993).

[16]Cullis and Jones (1986) and Feldman (1994).

[17]As Nichols, Smolenslky and Tideman (1971); Barzel (1974); Lindsay and Feigebaum (1984); Deacon and Sonstelie (1985) and Deacon and Sonstelie (1989).

[18]Aligned with Stiglitz (1974), Sonstelie (1982) and Ireland (1990). A related, but slightly different, approach understands the private sector as a "supplement": Individuals supplement the public provision instead of opting out of it and buying a private alternative to the public system (Epple and Romano (1996) and Gouveia (1993)).

ical services depending on their type of insurance coverage is to use:

- The provincial average days on the waiting list for surgical procedures financed by the Social Security. In this case, we could not obtain the public-private differential because the average number of days in the surgery waiting list paid by private carriers was not significantly different from 0[19].

- The difference between the provincial average of minutes spent in Social Security doctors' offices and the provincial average of minutes spent in private doctors' office. For this waiting time measure we had to take into account that the type of specialist visited by the respondent depends very acutely on the interviewee being insured or not. Moreover, in some provinces, some specialties are only visited by insured people and the other way around. Therefore, it is difficult to obtain a provincial "public-private-differential of the doctor's office waiting time". In order to eliminate the systematic effect of the specialties on the doctors' visiting patterns of insured and uninsured consumers, we regress the logarithms of the office waiting time on the (dummied) specialties. From this regression, we obtain residuals that are waiting times "net" of the systematic effect of specialties (NWT). Then, we are able to calculate two provincial averages without facing missing-values problems:

[19]The fact that the privately insured waiting list for surgical procedures is almost null made us be think that, maybe, private insurers discriminate against consumers more likely to undertake surgery proceudres. Another possibility is that insurers make access to surgery procedures difficult. The examination the plans and conditions of the main health insurance companies does not confirm the latter. With respect to the filtering of patients, it could very well be at work. For instance, women are required to be enrolled for longer time than average before pregnancies and birth-giving is covered by the private insurer. And, in general, worse risks (e.g., elderly and chronicly ill) are charged higher premia.

First, we compute the average office net-waiting-time (NWT) of visits made to doctors that were paid by the public health system. Second, we do the same for visits paid by a private insurance. Finally, we obtain the difference between the public and private net-waiting-times for each of the 52 provinces. We then test that the provincial variation is significant, i.e. we reject the null hypothesis that these 52 public-private waiting time measures are equal.

Table 4.1: **Regional percentages of privately insured and value of the public provision quality proxies**

	Privately Insured[1]	Surgery wait list[2]	Office wait[3]
Andalucía	7.11%	4.34	0.87
Aragón	10.64 %	4.20	0.85
Asturias	5.07%	3.50	-0.62
Baleares	23.15%	4.48	-0.26
Canarias	3.76%	4.58	0.37
Cantabria	4.04%	3.93	0.86
Castilla La Mancha	5.43%	4.34	0.54
Castilla León	6.18%	3.69	0.13
Catalunya	19.29%	3.63	0.79
C. Valenciana	7.05%	4.54	0.13
Extremadura	4.78%	3.96	0.83
Galicia	5.82%	4.30	0.72
Madrid	18.26%	4.42	0.13
Murcia	6.88%	4.04	0.26
Navarra	6.57%	4.71	-0.04
País Vasco	5.71%	2.62	0.43
Rioja	8.44%	3.10	0.36
Ceuta y Melilla	14.81%	2.12	0.58

Notes:

1 Percentage of respondents that are titular or beneficiaries of a private health insurance plan subscribed individually or through the employer.

2 Logarithm of the waiting list length for surgical procedures financed by the Social Security. First, we calculate the provincial values. Secondly, we obtain the regional results by weight-averaging the provincial measures. The correcting weights are the ones provided by the Ministerio de Sanidad y Consumo.

3 Difference between the logarithms of the average waiting time in the Social Security doctors' offices and the average waiting time in the private insurance doctors' offices. Again, we first calculate the provincial values and then, we obtain the regional ones applying the corresponding correcting weights.

2 and 3: We would like to point out that taking logarithms of the waiting times and constructing regional averages decreases the magnitude of the regional differences, in absolute terms. Taking logarithms of non-normally distributed variables is a standard procedure when performing econometric estimations, but it does not imply any loss of information about the relative differences. In any case, before running the regressions, we test that the provincial differences are statistically significant (we reject the hypothesis of all of them being equal). Thus, we make sure that they are a valid source of variation for explaining the different levels of insurance.

4.3 Purchase of private health insurance and public health care quality

In this section, we first present the theoretical model that supports the econometric regressions relating private health insurance and public health care quality. Secondly, we describe the results of our estimations.

4.3.1 Theoretical model

We understand that the private health insurance purchase decision is the result of an Expected Utility Maximization process.

Formally, we consider that a typical consumer can be ill with an individual probability θ. In order to recover to a healthy state, he or she has to consume a unit of treatment q. The treatment received has to be higher than a minimum quality required for achieving recovery (q_B) but lower than the maximum (q_A) of all the possible treatments, i.e., $q \in [q_B, q_A]$.

The treatment options available are:

- From medical health insurance at a quality q of cost p for the provider.
- From Social Security (public provider free-at-source) at quality Q.

We characterize the typical consumer as follows:

- $U(y)$ is the consumer's utility function when he is healthy. $U()$ depends positively on his/her income at a decreasing marginal rate, i.e., $U'(y) \geq 0$ and $U''(y) \leq 0$.

- $u(q, y)$ is the utility achieved when the individual is ill and receives a treatment q. $u()$ is an increasing and concave function of the income. In addition, for a given level of wealth y, the utility is increasing with the quality of the treatment. Formally: $u_y(q, y) \geq 0$, $u_{yy}(q, y) \leq 0$ and $u_{qy}(q, y) \leq 0$

With respect to the health insurance market, arbitrage makes the highest quality q^A to be the one provided. Otherwise, there would be always a firm providing more quality for the same price in order to capture consumers.

We simplify the model by assuming that consumers are reimbursed for every monetary unit spent in health care.

Let π be the price of the premium paid by the consumers. Again, by the effects of arbitrage, we know that the average premium has to be equal to the expected cost of a consumer. This is: $\pi = \theta p^A q^A$.

Therefore, the possible satisfaction levels of the consumer are:

- $U(y-(p^A q^A)$, if healthy but having subscribed a health insurance plan and paid a premium: $\pi = \theta p^A q^A$.
- $u(q^A, y - \theta p^A q^A)$, if ill and insured, receiving a treatment of quality q^A
- $U(y)$, if healthy and does not buy private health insurance
- $u(Q, y)$, if ill and receives a treatment of quality Q through the tax-financed Social Security

Since the individual's probability of being ill is θ the Expected Utility if he/she buys private health insurance is:

$$V^A(\theta, p^A, q^A, y) = \theta u(q^A, y - (p^A q^A) + (1 - \theta)U(y - \theta p^A q^A) \tag{4.1}$$

Similarly, if he does not get private health insurance the expected utility is:

$$V^P(\theta, Q, y) = \theta u(Q, y) + (1 - \theta)U(y) \tag{4.2}$$

Therefore, the typical consumer will only subscribe to a private health insurance plan whenever (4.1) is higher than (4.2). This is:

$$V^A(\theta, p^A, q^A, y) \geq (V^P(\theta, Q, y)$$

The conclusion is that buying health insurance among other factors depends on:

- The public health care quality Q compared to the health insurance's one q^A
- The individual (or household) characteristics such as the income level y and the health status or risk of illness θ

Even though this result is a simplification, it confirms a logical intuition about what determines the health insurance purchase: the household and personal characteristics of the potential customer and the quality of the free-at-source public alternative.

4.3.2 Health insurance decision and the effects of the public health care quality

For analyzing the effect that public health care quality has on the health insurance purchase decision, we estimate a bivariate qualitative dependent variable model. In particular, being d_{ij} the dependent variable, d_{ij} is 1 if the household[20] i of province j purchases health insurance, and d_{ij} is 0 if it does not. Following the previous section's reasoning:

$$\begin{aligned} d_{ij} &= 1 \quad if V_{ij}^A(\theta, p^A, q^A, y) - V_{ij}^P(\theta, Q, y) > 0 \\ d_{ij} &= 0 \quad if V_{ij}^A(\theta, p^A, q^A, y) - V_{ij}^P(\theta, Q, y) \leq 0 \end{aligned}$$

for the individuals $i = 1, 2, \ldots N_j$ from provinces $j = 1, 2, \ldots 52$.

As usual, we assume that V_{ij}^A and V_{ij}^P depend linearly on the exogenous variables and that they are distributed normally with 0 mean and σ^A and σ^P variances, respectively. Formally:

$$\begin{aligned} V_{ij}^A(\theta, p^A, q^A, y) &= f_{ij}(\theta, p^A, q^A, y) + \varepsilon_{ij}^A \sim N(0, \sigma^A) \\ V_{ij}^P(\theta, Q, y) &= g_{ij}(\theta, Q, y) + \varepsilon_{ij}^P \sim N(0, \sigma^P) \end{aligned}$$

Normalizing the variances to 1 ($\sigma^A = \sigma^P = 1$), the probability of buying private health insurance can be expressed as:

$$P(d_{ij} = 1) = P(V_{ij}^A - V_{ij}^P > 0) = P(\varepsilon_{ij}^A - (P_{ij} < f_{ij}(\theta, p^A, q^A, y) - g_{ij}(\theta, Q, y)) =$$

$$P(\xi_{ij} < h_{ij}(z_{ij})) = F(h_{ij}(z_{ij}))$$

with $\xi_{ij} \sim N(0, \sigma)$ and for some linear function h of z_{ij}.

[20] As in many other health Economics studies, we consider the household to be the basic unit of decision

In particular, z_{ij} is the reduced expression of the difference of the variables that intervene in V_{ij}^A and V_{ij}^P) and that we can express as:

- The household i characteristics living in province j: x_{ij}
- Provincial public health care quality: Q_j
- Variables that capture the fixed effects of the region K: c_K

Therefore, we assume that function h depends on x_{ij}, Q_j, c_K in the following linear form:

$$h_{ij}(z_{ij}) = (\beta x_{ij} + \gamma Q_j + \eta c_K)$$

Consequently, the probability of buying health insurance is:

$$P(d_{ij} = 1) = P(\xi_{ij} < (\beta x_{ij} + \gamma Q_j + \eta c_K) = F(\beta x_{ij} + \gamma Q_j + \eta c_K)$$

Presuming that we know ξ_{ij}'s probability distribution function F, we can estimate the parameters of interest: β, γ and η. Actually, the literature treats almost indistinctly the case where the probability function F is assumed to be Normal[21]. and the case where it is assumed to be Logistic[22] The first type of model is called "Probit" and the second "Logit." For practical reasons, but without loss of generality, we will estimate β, γ and η using the Logit model.

Other hypothesis to be noted are:

[21] $\xi_{ij} \sim N(0, \sigma)$

[22] $\xi_{ij} \sim \frac{\exp(\beta x_{ij} + \gamma Q_j + \nu C_k)}{1 + \exp(\beta x_{ij} + \gamma Q_j + \nu C_k)}$.

- We consider that buying health insurance is a household decision; correspondingly, d_{ij} takes value 1 if either the respondent is the person who contracts the insurance plan or he/she is just a beneficiary.

- Buying health insurance through the employer or individually are equivalent. We know that there are some price advantages in the latter case but, since we cannot control for prices, we have to treat both situations equally.

- Our provincial measures of the public/private waiting time differentials in the office and for surgical treatments are good proxies for the same variables in the precedent period, when the decision was made to buy or not to buy.

- The variables that capture the regional effects pick up, among other unobservable factors, the regional level of premia and the infrastructure.

Estimation of the Health Insurance Purchase Decision:

Sample:

We divide the sample into two sets:

1. The set of households for which the respondent is the head of the family (HH sample)

2. The set of households for which the interviewee is not the main income earner (NHH sample)

The reason for separating these two groups is that the information that we have for them is not homogeneous. For the HH-sample we have all the information referring to the head of the household (such as health status, medical services use, age, height, accidents, education level, employment situation, most recent occupation and other). We are not given any data about the rest of the family members except for how many there are, their age and their health coverage. For the NHH-sample, on the other hand, we have all the information referring to the respondent him/herself. About the main income earner (head of the household) we only know his/her education level and his/her most recent occupation. We do not have the age of the head of the family or any details about his/her health status[23]. Therefore, since the head of the family characteristics available for one or the other sample are very different, estimating the parameters of interest using both samples jointly would be statistically incorrect[24].

We present our results in four tables that are at the end of the chapter. Tables R11 and R12 refer to the households where the respondent is not the head of the family. Tables R21 and R22 correspond to the households where he/she is. Tables R11 and R21 report the coefficients of the variables that explain the probability of buying insurance (β, ξ and η in our simplified model). Tables R12 and R22 describe how "a change" of any of these variables influences the probability of buying or not insurance. For the continuous variables, these coefficients are the marginal probability caused by infinitesimally increasing the regressor. For the dichotomic variables, this

[23]35 It is not possible to infer the head of the household age from the age-coverage list of the family members.

[24]Following the advice of the Universitat Pompeu Fabra Statistics Professor Michael Greenacre.

"marginal probability"[25] indicates how the probability of purchase increases with the individual exhibiting the condition or characteristic involved (e.g., being overweight, being a male, living alone and in region A) instead of not (e.g., being thin, being a female, living with more persons and not in region A)[26].

The base or reference case is a respondent who has the average values for the continuous variables and who satisfies the omitted dichotomic variables. Restricting ourselves to the dichotomic ones, the base case of the NHH-sample is: an illiterate woman, working on a farm, that does not exercise regularly, who did not suffer any accident in the previous year. She is not overweight, she does not smoke, she does not drink too much, and she lives alone in a small town (fewer than 2,000 inhabitants). The base case of the HH-sample is: a woman who works, who does not exercise regularly, that did not suffer any accidents in the last year, who is not overweight, does not smoke, does not drink heavily and lives alone in a small town (fewer than 2,000 inhabitants).

Results:

These results show what we intuitively thought:

1. Public health care quality affects the decision about buying or not buying private insurance although only the length of the surgical waiting

[25]Somehow abusing of the exact meaning of this term.

[26]See Greene (1993) for a formalized description of the marginal effects of the continuous and discrete variables.

list seems to matter (not the time in the doctor's office)[27]. The higher public the quality (shorter waiting lists), the less probable it is that an alternative private health insurance is bought.

2. The income and the education level have a positive effect on the probability of buying private health insurance[28] [29].

We would like to stress that the most interesting results are those concerning the HH-sample group, i.e., households for which the respondent is the head of the family. The reason is that for those cases we have the health status, the life style, etc. of the person of the highest economic weight in the family. On the contrary, for the NHH-sample (no heads of families), the person who answers is not the main earner and we find a dissociation between the health status information and the willingness to pay for insurance. Moreover, there are reasons to believe that, often, if the interviewee is not the head of the family, he/she does not know exactly his/her health insurance coverage.

First, we describe the results for the non-heads of family sample and secondly, for the main income earners group.

[27]This two variables correspond to the abbreviations: WAIT LIST and T OFFICE in Tables R11 and R21 at the end of the chapter. Their significance is given by the third column (z).

[28]As previous works using the EPF-90/91 had found before (Murillo, Calonge and González (1996) and González (1995)).

[29]In Appendix B, we do the exercise of running a regression where we do not include the predicted income but some moments of the income distribution in the province of residence instead. This allows us to include the level of studies and last occupation of the head of the family. The result is that the public hospital surgical procedure waiting list is still a significant variable. It has a positive sign for both the group of households where the interviewee is not the head of the family and the group of households where he/she is not (at the 90% of significance).

Non head of household group[30]:

- The variables that have a significant positive effect on the probability of buying insurance are:
  - The age of the interviewee
  - Having some education level. The probability increases with years of education
  - Working or having worked as a self employed worker, running or having ran in business with 5 employees or more
  - The income level of the family
  - Being overweight, indicating a possible Adverse Selection
  - The length of waiting list for surgical procedures in public hospitals in the province of residence
  - Living in Baleares (or Ceuta and Melilla[31]) rather than in Andalucía
  - Average income of the provincial highest percentile, i.e., the richer the wealthiest fraction of the population in the respondant's province, the higher is the probability that a household buys health insurance.
- The variables that have a significant negative effect on the decision are:

[30]Tables R11 and R12 at the end of the chapter. Significant variables are typed in bold font to simplify the analysis. Coefficients are listed in first column of Table R11 and their marginal effects in table R12 (R12 maybe is more easily interpreted by the reader)

[31]There are reasons to believe that this region suffers some type of insured over-representation, and, actually, it is excluded from the ENS-93 Main Results Summary.

- Living alone[32]
- Living in: Canarias, Cantabria, Galicia, Madrid or Navarra instead of Andalucía.

Head of household group[33]:

- The variables that have a significant positive effect on the probability of buying private health insurance are:
  - The age of the respondent (significance 85%)
  - Healthy life style such as exercising regularly (correlated with education[34])
  - Being overweight (worse health condition?)
  - Per capita income of the household
  - Length of one's province of residence waiting list for surgical procedures in public hospitals (at the 90% level of significance)
  - Living in Baleares or Catalunya (again Ceuta and Melilla) instead of Andalucía
  - Living in cities with more than 100,000 inhabitants.

[32]Since we are describing non-heads of family, lonely respondents have a lower probability of being covered by the spouses' or parents' coverage than those that live with company.

[33]Tables R21 and R22 at the end of the chapter

[34]The inclusion of the income prediction as a regressor does not allow us to use the instruments used in that prediction (number of adults, province, head of the household's education and professional category) as exogenous variables in the health insurance purchase decision equation.

- The variables that have a

  significant negative effect on the probability of buying health insurance are:

  - That the respondent who is the head of the family is retired or unemployed
  - That the respondent tends to drink heavily
  - That the respondent lives alone
  - That the respondent lives in Cantabria, Canarias, Extremadura, Galicia or Navarra instead of Andalucía.

4.4 Conclusions and remarks

The two main conclusions of our study are: First, public provision and public health insurance are interrelated and quality is one of the links connecting them. In particular, our results indicate that the worsening of the quality of public health care has the effect of shifting consumers towards the private sector. Reading this inversely the outcome is that an improvement in the public health system results in a negative shift of agents who abandon private health insurance. This is what in other areas of economics is called "crowd-out" effect. Second, our results show that health insurance demand is subject to a very high income effect: The higher the per capita income, the higher is the probability of opting out of buying private health insurance. This confirms what Murillo, Calonge and González (1996) and González (1995) found using a different data source.

According to our findings, only improvements in the public health care

system that take into account both effects can succeed. Unilateral efforts in reducing congestion in the public health system can be counter-productive: as we have seen, the improvement of public services triggers the substitution of public health insurance for private health insurance, clogging the public system again. The way out of this apparently unsolvable problem could lie in complementing quality improvement with incentives to private health expenditure such as fiscal measures. The recipe seems to be trying to cancel the public-quality-improvement Substitution Effect with fiscal incentives that we find out have a strong positive income effect.

Since congestion and deficit are the two most acute problems of the public health system, and its solution is to avoid exerting isolated efforts (such as reducing waiting lists), it is reasonable to look for other options that give a bigger role to the private health insurance sector. Possible alternatives to the present system are: Generalizing the substitutive insurance Providing incentives to the public health expenditure[35].

The first option consists in the government guaranteeing access to health care but not necessarily providing it. The public institution signs treaties with the private sector and the latter supplies health services to the consumer. In this scheme, the public entity becomes a financial mediator. It obtains revenues from the government and from consumers and transfers payments to public or private companies, and these organizations are responsible for providing pre-established health services[36].

[35]By subsidizing health insurance purchase, for instance.

[36]In fact, this is the Spanish system for health coverage of civil servants. In state owned mutualities such as MUFACE, ISFAS, etc. The public institution is INSALUD (Instituto Nacional de Salud). INSALUD receives transfers from the government and from the

The second alternative is subsidizing private health expenditure. In this case, the public authority would allow the collaboration of private insurers in partial complementary health care packets. This option would not imply, as does the previous one, risk transfers from the public authority to the private insurer, but contingent contracts. The consumer incentives to subscribe to such complementary plans could derive from direct or indirect subventions.

Finally, we would like to stress that there is further research to be done on this subject. Nevertheless, we believe that our conclusions about the crucial impact of the quality of the public health system seem robust and worth considering when attempting to improve the health care system.

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contributors, and it transfers the payments to either the Social Security or those private providers guaranteeing at least the same technical quality the public system The MUFACE 1995 Annual Memory reports that more than 85% of the civil servants choose private providers instead of staying in the Public Health System. The providing companies receive a payment in proportion to the number of entitled and benefited they have. This type of payment is called "capitative" and is annual and prospective. The health services provider obtains this transfer "ex-ante," independently of the final cost to cover each consumer. Therefore, this type of payment does not adjust to the different risks. See López(1996) and Pellissé (1996) for a discussion about how this annual prospective capitative payment can imply contradictory effects: On one side, it gives incentives for the firms to be more efficient and minimize provision costs. On the other hand, it pushes them towards "Cream-skimming", or, in other words, to be willing to attract only the less costly consumers (or better risks). If this system is generalized as an alternative to the present health care system configuration, there are two requirements that should be seriously addressed:

- That the chosen financing system induces the optimal effort from the providers and financial intermediaries
- That the payment to the health services suppliers is actuarially fair. If the average cost of reference for the public authority was an adversely selected portfolio of consumers, there would be a distortion in the payment system that would endanger the equity of access to health care principle

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Table R11

Logit model coefficients for non heads of family

Logit Estimates — **Number of obs = 8763**; **chi2(51) = 746.38**; **Prob > chi2 = 0.0000**; **Log Likelihood = -1638.2761**; **Pseudo R2 = 0.1855**

INSURED	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
AGE	**.0117099**	**.0038886**	**3.011**	**0.003**	**.0040883**	**.0193315**
Inestr_2	**.4658635**	**.2169036**	**2.148**	**0.032**	**.0407401**	**.8909868**
Inestr_3	**.9555393**	**.2480405**	**3.852**	**0.000**	**.4693889**	**1.44169**
Inestr_4	**1.019246**	**.271903**	**3.749**	**0.000**	**.4863257**	**1.552166**
Inestr_5	**1.267325**	**.2729994**	**4.642**	**0.000**	**.7322561**	**1.802394**
Ioccr_3	**.6299649**	**.2275389**	**2.769**	**0.006**	**.1839968**	**1.075933**
Ioccr_5	.0415049	.2182767	0.190	0.849	-.3863095	.4693193
Ioccr_6	.7292341	.6273498	1.162	0.245	-.5003488	1.958817
Ioccr_7	.0237942	.7312775	0.033	0.974	-1.409483	1.457072
Ioccr_8	.3650627	.3381608	1.080	0.280	-.2977203	1.027846
Ioccr_9	.1037296	.1907975	0.544	0.587	-.2702267	.4776858
Ioccr_10	.0050032	.1782305	0.028	0.978	-.3443221	.3543285
Ioccr_11	-.1653021	.1901888	-0.869	0.385	-.5380653	.2074612
Iemplh_2	.1377716	.1422499	0.969	0.333	-.1410331	.4165763
Iemplh_4	-.4880473	.326662	-1.494	0.135	-1.128293	.1521985
INCOMECAP	**2.277807**	**.2108301**	**10.804**	**0.000**	**1.864587**	**2.691026**
numfam	.019003	.0365736	0.520	0.603	-.0526799	.090686
SPORTS	.0935374	.1293467	0.723	0.470	-.1599775	.3470523
acc	.182236	.193986	0.939	0.348	-.1979695	.5624415
OVERWEIGH	**.4898173**	**.1616874**	**3.029**	**0.002**	**.1729159**	**.8067187**
SMOKER	.1121516	.1121941	1.000	0.317	-.1077448	.332048
MALE	-.182877	.1312352	-1.394	0.163	-.4400932	.0743392
alc	.0443755	.1436081	0.309	0.757	-.2370912	.3258422
alone	**-1.462863**	**.7475421**	**-1.957**	**0.050**	**-2.928019**	**.0022924**
T OFFICE	.0746526	.2313856	0.323	0.747	-.3788549	.5281601
WAIT LIST	**.41154**	**.1863646**	**2.208**	**0.027**	**.0462721**	**.7768079**
Iccaa_2	.2903208	.3399688	0.854	0.393	-.3760059	.9566475
Iccaa_3	-.5440153	.5684328	-0.957	0.339	-1.658123	.5700926
Iccaa_4	**.9663666**	**.3482257**	**2.775**	**0.006**	**.2838569**	**1.648876**
Iccaa_5	**-2.062687**	**.6260761**	**-3.295**	**0.001**	**-3.289773**	**-.8356**
Iccaa_6	**-1.585152**	**.6082647**	**-2.606**	**0.009**	**-2.777329**	**-.3929747**
Iccaa_7	-.6490796	.3851033	-1.685	0.092	-1.403868	.1057089
Iccaa_8	.1677683	.5033843	0.333	0.739	-.8188468	1.154383
Iccaa_9	.124158	.3169768	0.392	0.695	-.4971051	.745421
Iccaa_10	-.3557228	.3570372	-0.996	0.319	-1.055503	.3440572
Iccaa_11	-.2682033	.4214324	-0.636	0.525	-1.094196	.5577891
Iccaa_12	**-.7643809**	**.3574897**	**-2.138**	**0.033**	**-1.465048**	**-.0637141**
Iccaa_13	**-.6599821**	**.320285**	**-2.061**	**0.039**	**-1.287729**	**-.0322351**
Iccaa_14	-.2413516	.3796498	-0.636	0.525	-.9854515	.5027482
Iccaa_15	**-1.412952**	**.4814905**	**-2.935**	**0.003**	**-2.356656**	**-.469248**
Iccaa_16	-.5611662	.5337388	-1.051	0.293	-1.607275	.4849426
Iccaa_17	.5194748	.4552951	1.141	0.254	-.3728872	1.411837
Iccaa_18	**3.124702**	**.6760559**	**4.622**	**0.000**	**1.799656**	**4.449747**
last perc	-.6274967	.6909667	-0.908	0.364	-1.981767	.7267732
high perc	**2.843637**	**1.092811**	**2.602**	**0.009**	**.7017666**	**4.985506**
ITAMAN_2	-.0863338	.2509917	-0.344	0.731	-.5782685	.405601
ITAMAN_3	-.08678	.2441285	-0.355	0.722	-.5652632	.3917031
ITAMAN_4	.1113956	.2879408	0.387	0.699	-.4529581	.6757493
ITAMAN_5	.107725	.2350009	0.458	0.647	-.3528682	.5683182
ITAMAN_6	-.3029951	.354944	-0.854	0.393	-.9986726	.3926824
ITAMAN_7	.4300253	.2743632	1.567	0.117	-.1077166	.9677673
_cons	-68.1995	17.98371	-3.792	0.000	-103.4469	-32.95207

Table R12

"Marginal" probability of logit model for non heads of family

Logit Estimates — **Number of obs = 8763**; **chi2(51) = 746.38**; **Prob > chi2 = 0.0000**; **Log Likelihood = -1638.2761**; **Pseudo R2 = 0.1855**

INSURED	Incr. Prob*	Std. Err.	z	P>|z|	[95% Conf.	Interval]
AGE	**1.011779**	**.0039344**	**3.011**	**0.003**	**1.004097**	**1.01952**
Inestr_2	**1.593389**	**.345612**	**2.148**	**0.032**	**1.041581**	**2.437534**
Inestr_3	**2.600072**	**.6449233**	**3.852**	**0.000**	**1.599017**	**4.227834**
Inestr_4	**2.771104**	**.7534713**	**3.749**	**0.000**	**1.62633**	**4.721685**
Inestr_5	**3.55134**	**.9695135**	**4.642**	**0.000**	**2.079767**	**6.064147**
Ioccr_3	**1.877545**	**.4272145**	**2.769**	**0.006**	**1.202012**	**2.932728**
Ioccr_5	1.042378	.2275268	0.190	0.849	.6795602	1.598905
Ioccr_6	2.073492	1.300805	1.162	0.245	.6063191	7.090934
Ioccr_7	1.02408	.7488863	0.033	0.974	.2442695	4.293369
Ioccr_8	1.440604	.4871559	1.080	0.280	.742509	2.795038
Ioccr_9	1.1093	.2116518	0.544	0.587	.7632065	1.612339
Ioccr_10	1.005016	.1791244	0.028	0.978	.7087006	1.425223
Ioccr_11	.8476376	.1612112	-0.869	0.385	.5838768	1.23055
Iemplh_2	1.147713	.1632621	0.969	0.333	.8684606	1.51676
Iemplh_4	.6138238	.2005129	-1.494	0.135	.3235851	1.164391
INCOMECAP	**9.755262**	**2.056703**	**10.804**	**0.000**	**6.453273**	**14.7468**
numfam	1.019185	.0372752	0.520	0.603	.9486836	1.094925
SPORTS	1.098052	.1420294	0.723	0.470	.852163	1.414891
acc	1.199897	.2327632	0.939	0.348	.8203949	1.754952
SOBREPES	**1.632018**	**.2638767**	**3.029**	**0.002**	**1.188766**	**2.240544**
SMOKER	1.118682	.1255096	1.000	0.317	.8978567	1.39382
MALE	.8328706	.1093019	-1.394	0.163	.6439764	1.077172
alc	1.045375	.1501243	0.309	0.757	.7889193	1.385197
alone	**.2315723**	**.17311**	**-1.957**	**0.050**	**.0535029**	**1.002295**
T OFFICE	1.07751	.2493203	0.323	0.747	.684645	1.695809
WAIT LIST	**1.50914**	**.2812503**	**2.208**	**0.027**	**1.047359**	**2.17452**
Iccaa_2	1.336856	.4544895	0.854	0.393	.6865983	2.602955
Iccaa_3	.580413	.3299258	-0.957	0.339	.1904962	1.768431
Iccaa_4	2.628377	.9152684	2.775	0.006	1.328243	5.201132
Iccaa_5	**.127112**	**.0795818**	**-3.295**	**0.001**	**.0372623**	**.4336142**
Iccaa_6	**.2049167**	**.1246436**	**-2.606**	**0.009**	**.0622045**	**.6750458**
Iccaa_7	.5225265	.2012266	-1.685	0.092	.2456449	1.111498
Iccaa_8	1.182663	.5953338	0.333	0.739	.4409399	3.172067
Iccaa_9	1.132195	.3588794	0.392	0.695	.6082891	2.107328
Iccaa_10	.7006668	.2501641	-0.996	0.319	.3480174	1.410659
Iccaa_11	.7647523	.3222914	-0.636	0.525	.3348088	1.746806
Iccaa_12	**.4656221**	**.1664551**	**-2.138**	**0.033**	**.231067**	**.9382732**
Iccaa_13	**.5168606**	**.1655427**	**-2.061**	**0.039**	**.2758966**	**.9682789**
Iccaa_14	.7855654	.2982397	-0.636	0.525	.3732707	1.653259
Iccaa_15	**.2434236**	**.1172062**	**-2.935**	**0.003**	**.0947365**	**.6254725**
Iccaa_16	.5705433	.3045211	-1.051	0.293	.200433	1.624082
Iccaa_17	1.681144	.7654168	1.141	0.254	.6887429	4.103485
Iccaa_18	**22.7531**	**15.38237**	**4.622**	**0.000**	**6.047568**	**85.60526**
last perc	.5339267	.3689256	-0.908	0.364	.1378255	2.068396
high perc	**17.17812**	**18.77244**	**2.602**	**0.009**	**2.017313**	**146.2776**
ITAMAN_2	.917288	.2302317	-0.344	0.731	.5608687	1.500204
ITAMAN_3	.9168788	.2238363	-0.355	0.722	.5682106	1.479498
ITAMAN_4	1.117837	.3218709	0.387	0.699	.6357448	1.965505
ITAMAN_5	1.113741	.2617302	0.458	0.647	.7026698	1.765296
ITAMAN_6	.7386027	.2621626	-0.854	0.393	.3683681	1.480948
ITAMAN_7	**1.537296**	**.4217776**	**1.567**	**0.117**	**.897882**	**2.632061**

*Odds Ratio

Table R21

Logit model coefficients for heads of family

Logit Estimates — **Number of obs = 7375**; **chi2(39) = 722.80**; **Prob > chi2 = 0.0000**; **Log Likelihood = -1804.9686**; **Pseudo R2 = 0.1668**

INSURED	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
AGE	.0059732	.0042083	1.419	0.156	-.0022749	.0142213
Iemplh_2	-.5644827	.1658481	-3.404	0.001	-.889539	-.2394263
Iemplh_4	-1.135476	.2618249	-4.337	0.000	-1.648643	-.6223083
INCOMECAP	2.249996	.176642	12.738	0.000	1.903784	2.596208
numfam	.0123375	.0400943	0.308	0.758	-.066246	.0909209
SPORTS	.412455	.1241491	3.322	0.001	.1691273	.6557827
acc	.1576411	.1769721	0.891	0.373	-.1892177	.5045
OVERWEIG	.2762741	.1657828	1.666	0.096	-.0486541	.6012023
SMOKER	.0311832	.0940994	0.331	0.740	-.1532482	.2156145
male	.1978498	.1237855	1.598	0.110	-.0447652	.4404649
alc	-.3383181	.1107456	-3.055	0.002	-.5553756	-.1212607
alone	-.4554215	.1682759	-2.706	0.007	-.7852361	-.1256068
T OFFICE	.0387063	.2023181	0.191	0.848	-.3578298	.4352425
WAIT LIST	.2697819	.1552126	1.738	0.082	-.0344293	.5739931
Iccaa_2	.0680191	.302192	0.225	0.822	-.5242663	.6603046
Iccaa_3	-.2998935	.4649817	-0.645	0.519	-1.211241	.6114538
Iccaa_4	.7706645	.3277771	2.351	0.019	.1282332	1.413096
Iccaa_5	-1.086216	.4427343	-2.453	0.014	-1.95396	-.2184733
Iccaa_6	-1.412677	.5040096	-2.803	0.005	-2.400517	-.4248358
Iccaa_7	.2459486	.3121716	0.788	0.431	-.3658965	.8577937
Iccaa_8	-.2796814	.4870478	-0.574	0.566	-1.234278	.6749147
Iccaa_9	.9158649	.2979103	3.074	0.002	.3319714	1.499758
Iccaa_10	-.1622337	.2964757	-0.547	0.584	-.7433155	.4188481
Iccaa_11	-.9987507	.4984892	-2.004	0.045	-1.975771	-.0217299
Iccaa_12	-.5100623	.2941365	-1.734	0.083	-1.086559	.0664346
Iccaa_13	.314279	.3306948	0.950	0.342	-.333871	.9624289
Iccaa_14	.0652906	.3291121	0.198	0.843	-.5797573	.7103385
Iccaa_15	-.8280112	.4134526	-2.003	0.045	-1.638363	-.0176591
Iccaa_16	-.2028979	.4448478	-0.456	0.648	-1.074784	.6689878
Iccaa_17	.058935	.4027532	0.146	0.884	-.7304467	.8483168
Iccaa_18	2.009198	.6723478	2.988	0.003	.6914208	3.326976
last perc	.2674497	.5216726	0.513	0.608	-.7550099	1.289909
high perc	-.5515231	1.023705	-0.539	0.590	-2.557948	1.454901
ITAMAN_2	.2053737	.2316781	0.886	0.375	-.248707	.6594544
ITAMAN_3	.0857646	.2265577	0.379	0.705	-.3582803	.5298096
ITAMAN_4	.3219548	.2702055	1.192	0.233	-.2076383	.8515479
ITAMAN_5	.5392609	.21689	2.486	0.013	.1141644	.9643575
ITAMAN_6	.753775	.2945633	2.559	0.010	.1764415	1.331108
ITAMAN_7	.6908926	.2509745	2.753	0.006	.1989917	1.182794
_cons	-30.57329	16.62405	-1.839	0.066	-63.15583	2.009251

Table R22

"Marginal" probability of logit model for heads of family

Logit Estimates — **Number of obs = 7375**
chi2(39) = 722.80
Prob > chi2 = 0.0000
Log Likelihood = -1804.9686 — **Pseudo R2 = 0.1668**

INSURED	Incr. Prob*	Std. Err.	z	P>|z|	[95% Conf.	Interval]
AGE	1.005991	.0042335	1.419	0.156	.9977277	1.014323
Iemplh_2	**.5686543**	**.0943102**	**-3.404**	**0.001**	**.4108451**	**.7870793**
Iemplh_4	**.3212692**	**.0841163**	**-4.337**	**0.000**	**.1923107**	**.5367041**
INCOMECAP	**9.487696**	**1.675926**	**12.738**	**0.000**	**6.711241**	**13.41278**
numfam	1.012414	.0405921	0.308	0.758	.9359006	1.095182
SPORTS	**1.510522**	**.1875299**	**3.322**	**0.001**	**1.184271**	**1.92665**
acc	1.170746	.2071893	0.891	0.373	.8276063	1.656157
OVERWEIGH	**1.318209**	**.2185363**	**1.666**	**0.096**	**.9525105**	**1.824311**
SMOKER	1.031674	.0970799	0.331	0.740	.8579168	1.240624
MALE	1.218779	.1508672	1.598	0.110	.9562219	1.553429
alc	**.7129684**	**.0789581**	**-3.055**	**0.002**	**.5738567**	**.885803**
alone	**.6341806**	**.1067173**	**-2.706**	**0.007**	**.456012**	**.8819616**
T OFFICE	1.039465	.2103026	0.191	0.848	.6991921	1.545338
WAIT LIST	**1.309679**	**.2032787**	**1.738**	**0.082**	**.9661567**	**1.775342**
Iccaa_2	1.070386	.3234621	0.225	0.822	.5919895	1.935382
Iccaa_3	.7408971	.3445036	-0.645	0.519	.2978275	1.843109
Iccaa_4	**2.161202**	**.7083925**	**2.351**	**0.019**	**1.136818**	**4.108655**
Iccaa_5	**.337491**	**.1494188**	**-2.453**	**0.014**	**.1417118**	**.803745**
Iccaa_6	**.2434907**	**.1227217**	**-2.803**	**0.005**	**.090671**	**.6538771**
Iccaa_7	1.278834	.3992156	0.788	0.431	.6935746	2.357953
Iccaa_8	.7560246	.3682201	-0.574	0.566	.291045	1.963865
Iccaa_9	**2.498936**	**.7444587**	**3.074**	**0.002**	**1.393713**	**4.480606**
Iccaa_10	.8502425	.2520763	-0.547	0.584	.4755347	1.520209
Iccaa_11	**.3683393**	**.1836132**	**-2.004**	**0.045**	**.1386543**	**.9785045**
Iccaa_12	**.6004581**	**.1766167**	**-1.734**	**0.083**	**.3373753**	**1.068691**
Iccaa_13	1.369272	.452811	0.950	0.342	.7161462	2.618048
Iccaa_14	1.067469	.3513171	0.198	0.843	.5600343	2.03468
Iccaa_15	**.4369174**	**.1806446**	**-2.003**	**0.045**	**.1942978**	**.982496**
Iccaa_16	.8163616	.3631567	-0.456	0.648	.3413716	1.95226
Iccaa_17	1.060706	.4272029	0.146	0.884	.4816938	2.335712
Iccaa_18	**7.457336**	**5.013923**	**2.988**	**0.003**	**1.99655**	**27.85398**
last perc	1.306628	.681632	0.513	0.608	.470006	3.632457
high perc	.5760717	.5897274	-0.539	0.590	.0774636	4.284061
ITAMAN_2	1.227984	.284497	0.886	0.375	.7798084	1.933737
ITAMAN_3	1.08955	.2468459	0.379	0.705	.6988771	1.698609
ITAMAN_4	1.379822	.3728357	1.192	0.233	.8125008	2.343271
ITAMAN_5	**1.714739**	**.3719097**	**2.486**	**0.013**	**1.120936**	**2.623102**
ITAMAN_6	**2.125007**	**.625949**	**2.559**	**0.010**	**1.192965**	**3.785237**
ITAMAN_7	**1.995496**	**.5008186**	**2.753**	**0.006**	**1.220172**	**3.263478**

*Odds Ratio

Summary of Variables Definitions

Age	= Respondent's Age
Iemplh_2	= The Head of the Household (HH) is retired, having worked before (*See next page's Note1 footnote)
Iemplh_4	= The HH is unemployed, having worked before
income cap	= Per capita income of the household
numfam	= Number of members of the household
sports	= The interviewee practices exercise regularly
acc	= The interviewee had at least one accident in the previous year
overweight	= The interviewee has some overweight problem
smoker	= The interviewee smokes regularly
alc	= The interviewee drinks alcohol regularly
alone	= The interviewee lives alone
male	= The interviewee is a male
T.CONSULT	= Differential between the public and private waiting time in the doctor's office
WAIT LIST	= Waiting list length for surgery procedures in public hospitals
last perc	= Average Income of the lowest percentile of the province
high perc	= Average Income of the highest percentile of the province
ITAMAN_2	= The interviewee lives in a town of 2001 to 10,000 inhabitants
ITAMAN_3	= The interviewee lives in a town of 10,001 to 50,000 inhabitants
ITAMAN_4	= The interviewee lives in a town of 50,001 to 100,000 inhabitants
ITAMAN_5	= The interviewee lives in a town of 100,001 to 400,000 inhabitants
ITAMAN_6	= The interviewee lives in a town of 400,001-1,000,000 inhabitants
ITAMAN_7	= The interviewee lives in a town of more than 1,000,000 inhabitants (The omitted size is less than 2,000 inhabitants)
Inestr_2	= The interviewee (not HH) has primary studies (**See Note2, footnote of next page)
Inestr_3	= The interviewee (not HH) studied up to the age of 19
Inestr_4	= The interviewee (not HH) has a non-University Superior Degree
Inestr_5	= The interviewee (not HH) has a University Degree (The omitted level if illiterate)
Ioccr_3	= The interviewee (not HH) works as an Independent worker or entrepreneurs with 5 or fewer employees
Ioccr_5	= The interviewee (not HH) works as an Independent Professional

Ioccr_6 = The interviewee (not HH) is an Executive Manager and has up to 5 subordinated employees
Ioccr_7 = The interviewee (not HH) is an Executive Manager and has 6 or more subordinated employees
Ioccr_8 = The interviewee (not HH) works as an intermediate worker
Ioccr_9 = The interviewee (not HH) has any other type of office job
Ioccr_10 = The interviewee (not HH) works outside the office or as a qualified worker
Ioccr_11 = The interviewee (not HH) is a manual or non-qualified worker

Iccaa_2 = The interviewee lives in Aragón
Iccaa_3 = The interviewee lives in Asturias
Iccaa_4 = The interviewee lives in Baleares
Iccaa_5 = The interviewee lives in Canaries
Iccaa_6 = The interviewee lives in Cantabria
Iccaa_7 = The interviewee lives in Castilla León
Iccaa_8 = The interviewee lives in Castilla La Mancha
Iccaa_9 = The interviewee lives in Catalunya
Iccaa_10 = The interviewee lives in Valencia
Iccaa_11 = The interviewee lives in Extremadura
Iccaa_12 = The interviewee lives in Galicia
Iccaa_13 = The interviewee lives in Madrid
Iccaa_14 = The interviewee lives in Murcia
Iccaa_15 = The interviewee lives in Navarra
Iccaa_16 = The interviewee lives in Pais Vasco
Iccaa_17 = The interviewee lives in La Rioja
Iccaa_18 = The interviewee lives in Ceuta and Melilla

(Andalucía is the omitted region)

**NOTE1: The head-of-the family labor situation could be included in the regressions because it was not used in the income prediction based on the EPF-90/91. We only included his/her last occupation but not his/her labor situation.*

***NOTE2: The variables Iocc and Inest ending in r_ refer to the occupation and level of studies of the interviewee if he is not head of the household. When these variables are ended in h_, they refer to the Head of the Household.*

4.5 Appendices

Appendix I

Market shares of the principal health insurance in Spain

Health Insurance (FIE)

Companies:	1993	1992
Asisa	24.42 (1)	23.4 (1)
Sanitas	15.37 (2)	16.6 (2)
Cia Adeslas	13.89 (3)	
Asist. Sanitaria Colegial Seg.	6.39(4)	6.5 (4)
Igualatorio Médico Quirúr.	5.15 (5)	5.3 (5)
Previasa	4.86 (6)	12.3 (3)

Illness' Insurance (II)

Companies:	1993	1992
Mapfre Vida S.A.	15.90 (1)	16.0 (1)
La Estrella	14.24 (2)	15.7 (2)
Previasa	10.20 (3)	11.5 (4)
Previsión Mallorquina	10.03 (4)	12.2 (3)
Centro Asegurador	9.42 (5)	10.4 (5)

Source: UNESPA, Estadística Año 1993 y 1994

Health insurance coverage by region in Spain

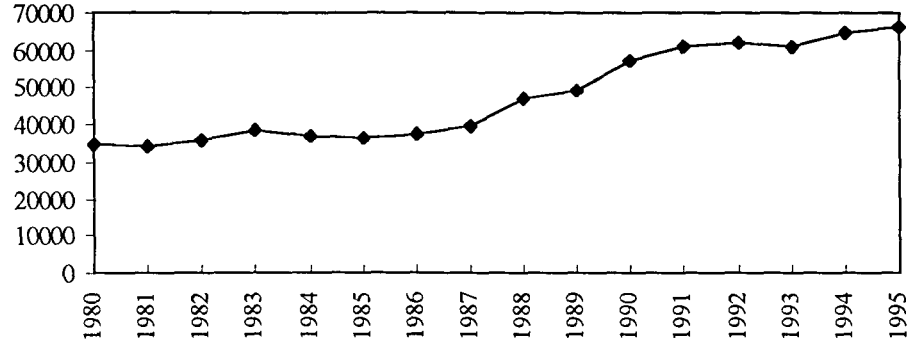
	Social Sec. excluss	Gov. Mutua. SS	Gov. Mutua. Private Ins.	Private Ins. Indiv.	Private Ins. Empl.	Private Ins. Total	Chari.	Priv. Doc.	Igualas
Total	86.6	2.5	2.0	6.4	1.5	7.9	0.2	0.5	0.1
Andalucía	90.3	2.4	1.7	3.5	1.1	4.6	0.2	0.5	0.0
Aragón	86.0	2.9	3.7	5.1	1.2	6.3	4.0	0.8	0.0
Asturias	90.0	1.5	1.5	2.4	1.5	3.9	0.0	0.5	0.0
Baleares	75.2	0.9	4.4	18.3	0.5	18.8	0.6	0.1	0.3
Canarias	93.0	1.9	1.8	1.2	0.2	1.4	0.5	0.6	0.1
Cantabria	91.6	2.7	1.6	1.5	0.5	2	0.0	0.5	0.1
Castilla-LM	91.4	2.5	0.7	3.3	1.3	4.6	0.1	0.2	0.1
Castilla-Len	90.6	2.9	1.8	2.6	1.1	3.7	0.5	0.9	0.3
Catalunya	79.1	1.5	2.2	14.7	2.1	16.8	0.1	0.2	0.2
C. Valenciana	91.0	1.4	1.9	3.7	1.3	5	0.0	0.3	0.0
Extremadura	91.4	3.3	3.1	1.2	0.2	1.4	0.1	0.4	0.0
Galicia	90.5	2.9	1.5	2.7	0.8	3.5	0.8	1.5	0.0
Madrid	76.6	4.1	2.2	12.3	3.6	13.9	0.1	0.5	0.2
Murcia	87.0	4.0	2.3	3.9	0.4	4.3	0.0	0.3	0.1
Navarra	90.1	2.4	1.0	2.6	2.0	4.6	0.3	0.5	0.8
Pais Vasco	90.1	2.0	1.3	3.2	1.0	4.2	0.1	0.4	0.1
La Rioja	91.2	2.3	1.0	3.5	1.1	4.6	0.0	0.3	3.0

Source: Encuesta Nacional de Salud, 1993. Principales Resultados.

Graphic 1:

Public Health Care Expenditure

(Thousands of constant pesetas per covered person)



Source: Ministerio de Sanidad y Consumo (1996)

Appendix A1:

Per capita income estimation using the family budget survey (EPF-90/91)

DEPENDENT VARIABLE: PER CAPITA FAMILY INCOME LOGARITHM

Source	SS	df	MS	Number of obs =	21155
Model	1603.65542	60	26.7275903	F(60, 21094) =	96.45
Residual	5845.66296	21094	.277124441	Prob > F =	0.0000
				R-squared =	0.2153
Total	7449.31838	21154	.352147035	Adj R-squared =	0.2130
				Root MSE =	.52643

lnincap	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
albacete	-.1254101	.0398596	-3.146	0.002	-.2035379	-.0472822
alicante	-.1053907	.0361025	-2.919	0.004	-.1761543	-.0346271
almería	-.0691958	.0406496	-1.702	0.089	-.1488722	.0104805
ávila	-.151773	.0409321	-3.708	0.000	-.232003	-.071543
badajoz	-.436448	.0379751	-11.493	0.000	-.5108821	-.3620139
baleares	.0431942	.0385152	1.121	0.262	-.0322986	.118687
barcelona	.0625349	.0360936	1.733	0.083	-.0082113	.133281
burgos	-.0304264	.0407244	-0.747	0.455	-.1102494	.0493966
cáceres	-.1567179	.0399728	-3.921	0.000	-.2350677	-.0783681
cádiz	-.2631847	.0364162	-7.227	0.000	-.3345633	-.1918061
castelló	-.2299219	.0402446	-5.713	0.000	-.3088044	-.1510393
ciudad r.	-.2045417	.0402851	-5.077	0.000	-.2835035	-.1255798
córdoba	-.2245148	.0386994	-5.802	0.000	-.3003686	-.148661
coruña	-.1480612	.0362161	-4.088	0.000	-.2190475	-.0770748
cuenca	-.1984078	.0413529	-4.798	0.000	-.2794627	-.117353
girona	.0537468	.0403672	1.331	0.183	-.025376	.1328697
granada	-.2441889	.0386425	-6.319	0.000	-.3199311	-.1684467
guadalaj	-.1911057	.0407712	-4.687	0.000	-.2710203	-.111191
guipúzcoa	-.0104172	.0381113	-0.273	0.785	-.0851183	.0642838
huelva	-.1167651	.0433004	-2.697	0.007	-.2016371	-.0318931
huesca	-.1881686	.0403025	-4.669	0.000	-.2671645	-.1091726
jaén	-.3875621	.0384018	-10.092	0.000	-.4628327	-.3122916
león	-.0954626	.0377636	-2.528	0.011	-.1694821	-.0214432
lérida	.0161594	.0417295	0.387	0.699	-.0656337	.0979524
logroño	-.1170447	.0401505	-2.915	0.004	-.1957427	-.0383467
lugo	-.0138351	.0402501	-0.344	0.731	-.0927285	.0650582
madrid	.1187082	.0346243	3.428	0.001	.050842	.1865745
málaga	-.1435155	.0368868	-3.891	0.000	-.2158165	-.0712145
murcia	-.1661102	.0370065	-4.489	0.000	-.2386458	-.0935746
navarra	.1169299	.0398798	2.932	0.003	.0387624	.1950974
orense	-.2867591	.0410617	-6.984	0.000	-.3672432	-.206275
oviedo	-.0312387	.038236	-0.817	0.414	-.1061841	.0437067
palencia	-.2154099	.0404557	-5.325	0.000	-.2947062	-.1361136
palmas	-.2335425	.0404743	-5.770	0.000	-.3128752	-.1542098
ponteved	-.1506871	.0378097	-3.985	0.000	-.224797	-.0765773
salamanca	-.3886441	.0413419	-9.401	0.000	-.4696773	-.3076109
sta. cruz	-.2987664	.0385768	-7.745	0.000	-.3743799	-.2231528
santander	-.0751957	.0400257	-1.879	0.060	-.1536491	.0032577
segovia	-.2131228	.0405387	-5.257	0.000	-.2925818	-.1336638
sevilla	-.1991448	.0354633	-5.616	0.000	-.2686556	-.129634
soria	.0034518	.0417493	0.083	0.934	-.07838	.0852836
tarragona	-.0264539	.0392449	-0.674	0.500	-.1033769	.0504691
teruel	-.1595395	.0420074	-3.798	0.000	-.2418772	-.0772017
toledo	-.1197429	.041696	-2.872	0.004	-.2014703	-.0380155
valencia	-.1606491	.034726	-4.626	0.000	-.2287146	-.0925835
valladol.	-.1459951	.0396826	-3.679	0.000	-.223776	-.0682142
vizcaya	-.0028618	.0362465	-0.079	0.937	-.0739077	.0681841
zamora	-.1835418	.040853	-4.493	0.000	-.2636168	-.1034669
zaragoza	-.1248165	.0380472	-3.281	0.001	-.199392	-.0502411
ceuta	-.3753899	.0546304	-6.871	0.000	-.4824696	-.2683101
melilla	-.5730534	.0620656	-9.233	0.000	-.6947066	-.4514001

Inest1_2	**.2091594**	**.0095617**	**21.875**	**0.000**	**.1904178**	**.2279011**
Inest1_3	**.4586256**	**.0148441**	**30.896**	**0.000**	**.42953**	**.4877211**
Inest1_4	**.6522619**	**.0173124**	**37.676**	**0.000**	**.6183283**	**.6861954**
Ipercp_2	**-.3228432**	**.0120179**	**-26.864**	**0.000**	**-.3463991**	**-.2992873**
Icateg_1	**-.088362**	**.0200585**	**-4.405**	**0.000**	**-.1276783**	**-.0490458**
Icateg_2	**.0800516**	**.013425**	**5.963**	**0.000**	**.0537376**	**.1063656**
Icateg_3	**.11414**	**.0181068**	**6.304**	**0.000**	**.0786493**	**.1496306**
Icateg_4	.0006302	.0092833	0.068	0.946	-.0175658	.0188262
Icateg_5	**-.1376919**	**.0170018**	**-8.099**	**0.000**	**-.1710167**	**-.1043671**
_cons	**13.57212**	**.0313655**	**432.708**	**0.000**	**13.51064**	**13.6336**

*Bold rows indicate that the variable is significant (at 95%)

Variable signification

Inest1_2= The head of the household (HH) has primary studies

Inest1_3= The HH has intermediate studies

Inest1_4= The HH has a superior degree
(The omitted level is being illiterate)

Ipercp_2= The household has, at least, two adults
(the omitted variable is one or less)

Icateg_0= The HH either never worked or is a rentist (this captures the answers 3,5,6,7 or 8 P41 to the l'ENS-93
(This is the omitted variable).

Icateg_1= The HH, working at present or having worked before, belongs to the 1st category (See Appendix A23)

Icateg_2= The HH, working at present or having worked before, belongs to the 2nd category

Icateg_3= The HH, working at present or having worked before, belongs to the 3rd category

Icateg_4= The HH, working at present or having worked before, belongs to the 4th category

Icateg_5= The HH, working at present or having worked before, belongs to the 5th category

Note: We use the province of residence, the number of adults, the level of studies and the last occupation of the Head of the Household as instruments for predicting the per capita income. This fact will void them as regressors for the private health insurance purchase estimation. The reason is that if we assume that those instruments predict the income of the family, including them and the prediction would violate the assumption that the error term of the insurance purchase decision equation is distributed as a simple logistic variable. Note that prediction together with predictors would make regressors and perturbation be correlated.

Appendix A2

Variables involved in the ENS-93/EPF-90/91-complementing

A.2.1. Head-of-the-family level of studies

EPF 90/91	LEV ST	ENS93
Illiterate or without studies	1	Without studies
Completed Primary School or studied until age f 14-15 (EGB or FP-I)	2	Studied until age 14-15
Junior High, High School or Completed Professional Formation (BUP, COU or FPII) up to 16-19 y	3	Studied until age of 16-19
Three year University Degree or University/Superior Degree or equiv.	4	Non University Superior Degree or University Degree

Source: Our own, using EPF-90/91 and ENS93 Questionnaires

A.2.2 Number of adults

Even though the EPF-90/91 gives us information about the number of income earners, the ENS-93 does not. Therefore, we choose a proxy variable that we name "number of adults in the household".

For the ENS-93, the number of adults is calculated using question number 19 of the survey. This question provides us with a list of the members of the household and their ages.

For the EPF-90/91, we use question "type of the household" where the respondent is asked about the composition of the family.

A.2.3 Social professional category

For the social professional category of the head of the household, we construct different social professional groups, according to the social, economic and labor activity given in both surveys.

Classification based on the Professional Category

EPF 90/91	CATE	ENS93
Entrepreneurs and management in Agricultural Business	1	Small land farmers (working for their own) + Large land farmers (working for their own)
Entrepreneurs, professionals and non-agricultural independent workers	2	Independent workers or entrepreneurs with 5 or fewer employees + Independent workers or entrepreneurs with 6 or more employees + Independent Professionals
Employed Professional Directors and Administrative Personnel	3	Direction Members + Intermediate Workers (privately employed or civil servants)
Rest of Services Workers and Military Professionals + Qualified workers and members or non-agricultural cooperatives	4	Other office employees + other employees with out-of-the-office activities and Qualified workers
Non qualified non-agricultural workers + Rest of workers and members of agricultural cooperatives	5	Manual non qualified workers
Unemployed + Retired + Other Labor Inactive	0	Unemployed + Retired + Other Labor Inactive

Source: Our own, using EPF-90/91 and ENS93 Questionnaires

Appendix B

Table B1: Logit model coefficient for non heads of family

Logit Estimates — Number of obs*= 9039; chi2(62) = 823.57; Prob > chi2 = 0.0000; Log Likelihood = -1663.529; Pseudo R2 = 0.1984

asseg	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	**.0120007**	**.0036817**	**3.260**	**0.001**	**.0047848**	**.0192166**
Inestr_2	.3210584	.2270523	1.414	0.157	-.1239561	.7660728
Inestr_3	**.7638027**	**.2571119**	**2.971**	**0.003**	**.2598727**	**1.267733**
Inestr_4	**.907611**	**.2784487**	**3.260**	**0.001**	**.3618615**	**1.45336**
Inestr_5	**1.100919**	**.2791725**	**3.944**	**0.000**	**.553751**	**1.648087**
Ioccr_3	**.6289424**	**.2291853**	**2.744**	**0.006**	**.1797475**	**1.078137**
Ioccr_5	-.0827673	.2176609	-0.380	0.704	-.5093748	.3438401
Ioccr_6	.8188402	.6173849	1.326	0.185	-.391212	2.028892
Ioccr_7	.2584458	.6912427	0.374	0.708	-1.096365	1.613257
Ioccr_8	.3105671	.3388633	0.916	0.359	-.3535927	.9747269
Ioccr_9	.0419071	.1922217	0.218	0.827	-.3348406	.4186547
Ioccr_10	.0458277	.178581	0.257	0.797	-.3041846	.3958399
Ioccr_11	-.0532506	.18764	-0.284	0.777	-.4210183	.3145171
Inesth_2	**.5761341**	**.2252762**	**2.557**	**0.011**	**.1346009**	**1.017667**
Inesth_3	**1.004138**	**.2465151**	**4.073**	**0.000**	**.5209775**	**1.487299**
Inesth_4	**1.061606**	**.2699592**	**3.932**	**0.000**	**.532496**	**1.590717**
Inesth_5	**1.15433**	**.2646229**	**4.362**	**0.000**	**.635679**	**1.672982**
Iocch_1	-.5392935	.3773605	-1.429	0.153	-1.278906	.2003194
Iocch_3	-.1347658	.2951201	-0.457	0.648	-.7131906	.443659
Iocch_4	**1.109916**	**.3751527**	**2.959**	**0.003**	**.3746301**	**1.845202**
Iocch_5	**.6087975**	**.2914769**	**2.089**	**0.037**	**.0375132**	**1.180082**
Iocch_6	.1329395	.3965612	0.335	0.737	-.6443063	.9101852
Iocch_7	**.8020964**	**.3326144**	**2.411**	**0.016**	**.1501842**	**1.454009**
Iocch_8	.4529882	.3106548	1.458	0.145	-.1558841	1.06186
Iocch_9	.0884116	.2987507	0.296	0.767	-.497129	.6739523
Iocch_10	-.4707747	.281419	-1.673	0.094	-1.022346	.0807964
Iocch_11	**-.729567**	**.3208465**	**-2.274**	**0.023**	**-1.358414**	**-.1007195**
numfam	-.043469	.0368863	-1.178	0.239	-.1157648	.0288268
sports	.0862499	.1279985	0.674	0.500	-.1646225	.3371222
acc	.2489641	.1893606	1.315	0.189	-.1221758	.620104
overweigh	**.4724119**	**.1603249**	**2.947**	**0.003**	**.1581809**	**.7866429**
smoker	.0945732	.1121113	0.844	0.399	-.1251609	.3143073
male	-.1228157	.12888	-0.953	0.341	-.3754158	.1297845
alc	.0310967	.1429004	0.218	0.828	-.248983	.3111763
alone	-1.111468	.7438645	-1.494	0.135	-2.569415	.3464799
T OFFICE	.1352028	.2327692	0.581	0.561	-.3210164	.5914221
WAIT LIST	**.4673547**	**.1714002**	**2.727**	**0.006**	**-.1314165**	**.803929**
Iccaa_2	.6195349	.3341263	1.854	0.064	-.0353406	1.27441
Iccaa_3	-.2625392	.5664652	-0.463	0.643	-1.372791	.8477122
Iccaa_4	**1.591353**	**.3402989**	**4.676**	**0.000**	**.9243797**	**2.258327**
Iccaa_5	**-1.753784**	**.5548604**	**-3.161**	**0.002**	**-2.84129**	**-.6662771**
Iccaa_6	**-1.570444**	**.6060529**	**-2.591**	**0.010**	**-2.758286**	**-.3826023**
Iccaa_7	-.5899395	.3849412	-1.533	0.125	-1.34441	.1645314
Iccaa_8	.2435227	.4898094	0.497	0.619	-.7164861	1.203532
Iccaa_9	.5336496	.3113421	1.714	0.087	-.0765696	1.143869
Iccaa_10	-.167913	.3504636	-0.479	0.632	-.854809	.518983
Iccaa_11	-.5831309	.4193418	-1.391	0.164	-1.405026	.2387639
Iccaa_12	-.6704379	.3571555	-1.877	0.060	-1.37045	.029574
Iccaa_13	-.0315481	.3111155	-0.101	0.919	-.6413234	.5782271
Iccaa_14	-.2001785	.3785693	-0.529	0.597	-.9421608	.5418037
Iccaa_15	-.9135806	.4736247	-1.929	0.054	-1.841868	.0147068
Iccaa_16	-.424089	.526751	-0.805	0.421	-1.456502	.608324
Iccaa_17	.644537	.4492562	1.435	0.151	-.235989	1.525063
Iccaa_18	**2.013091**	**.6580278**	**3.059**	**0.002**	**.7233802**	**3.302802**
last perc	-.0675377	.6657524	-0.101	0.919	-1.372389	1.237313
high perc	**3.307445**	**1.030702**	**3.209**	**0.001**	**1.287306**	**5.327585**
ITAMAN_2	-.0546416	.2503184	-0.218	0.827	-.5452566	.4359735
ITAMAN_3	-.1128352	.2449739	-0.461	0.645	-.5929751	.3673048
ITAMAN_4	.1148115	.2890034	0.397	0.691	-.4516247	.6812477
ITAMAN_5	.048963	.2386957	0.205	0.837	-.418872	.516798
ITAMAN_6	-.4671017	.3606037	-1.295	0.195	-1.173872	.2396685
ITAMAN_7	.3666462	.2741328	1.337	0.181	-.1706442	.9039366
_cons	**-51.0335**	**17.00197**	**-3.002**	**0.003**	**-84.35675**	**-17.71025**

*Note that there are more observations than in the R11-R12 tables. The regressions using the income prediction involved more variables and this implies a higher incidence of missing values.

Table B2: "Marginal" probability logit model for non heads of family

Logit Estimates — Number of obs = 9039; chi2(62) = 823.57; Prob > chi2 = 0.0000; Log Likelihood = -1663.529; Pseudo R2 = 0.1984

asseg	canvi prob	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	**1.012073**	**.0037261**	**3.260**	**0.001**	**1.004796**	**1.019402**
Inestr_2	1.378586	.3130112	1.414	0.157	.8834187	2.151301
Inestr_3	**2.146423**	**.5518708**	**2.971**	**0.003**	**1.296765**	**3.552788**
Inestr_4	**2.478395**	**.6901057**	**3.260**	**0.001**	**1.436**	**4.277464**
Inestr_5	**3.006928**	**.8394516**	**3.944**	**0.000**	**1.739767**	**5.197029**
Iocer_3	**1.875626**	**.4298658**	**2.744**	**0.006**	**1.196915**	**2.9392**
Iocer_5	.9205653	.200371	-0.380	0.704	.6008711	1.410353
Iocer_6	2.267868	1.400148	1.326	0.185	.6762368	7.605658
Iocer_7	1.294916	.8951012	0.374	0.708	.3340832	5.01913
Iocer_8	1.364199	.4622768	0.916	0.359	.7021609	2.650443
Iocer_9	1.042798	.2004484	0.218	0.827	.7154521	1.519915
Iocer_10	1.046894	.1869553	0.257	0.797	.7377247	1.485631
Iocer_11	.9481424	.1779094	-0.284	0.777	.6563781	1.369598
Inesth_2	**1.779147**	**.4007994**	**2.557**	**0.011**	**1.14408**	**2.766733**
Inesth_3	**2.729554**	**.6728762**	**4.073**	**0.000**	**1.683673**	**4.425127**
Inesth_4	**2.891011**	**.7804552**	**3.932**	**0.000**	**1.703178**	**4.907265**
Inesth_5	**3.171899**	**.8393571**	**4.362**	**0.000**	**1.888304**	**5.328031**
Iocch_1	.5831601	.2200616	-1.429	0.153	.2783415	1.221793
Iocch_3	.8739206	.2579115	-0.457	0.648	.4900781	1.558399
Iocch_4	**3.034104**	**1.138252**	**2.959**	**0.003**	**1.454453**	**6.329377**
Iocch_5	**1.83822**	**.5357986**	**2.089**	**0.037**	**1.038226**	**3.25464**
Iocch_6	1.142181	.4529447	0.335	0.737	.5250266	2.484783
Iocch_7	**2.230212**	**.7418004**	**2.411**	**0.016**	**1.162048**	**4.280238**
Iocch_8	1.573006	.4886618	1.458	0.145	.8556584	2.891746
Iocch_9	1.092438	.3263666	0.296	0.767	.6082745	1.961976
Iocch_10	.6245183	.1757513	-1.673	0.094	.35975	1.08415
Iocch_11	**.4821177**	**.1546858**	**-2.274**	**0.023**	**.257068**	**.9041867**
numfam	.9574623	.0353172	-1.178	0.239	.8906847	1.029246
sports	1.090079	.1395284	0.674	0.500	.8482138	1.40091
acc	1.282696	.2428921	1.315	0.189	.8849927	1.859121
overweig	**1.603858**	**.2571383**	**2.947**	**0.003**	**1.171378**	**2.196012**
smoker	1.09919	.1232316	0.844	0.399	.8823549	1.36931
male	.8844267	.1139849	-0.953	0.341	.6870036	1.138583
alc	1.031585	.147414	0.218	0.828	.7795932	1.36503
alone	.3290756	.2447877	-1.494	0.135	.0765803	1.414081
T OFFICE	1.144769	.2664669	0.581	0.561	.7254114	1.806556
WAIT LIST	**1.595767**	**.2735148**	**2.727**	**0.006**	**1.140443**	**2.232881**
Iccaa_2	1.858064	.620828	1.854	0.064	.9652766	3.576592
Iccaa_3	.7690962	.4356663	-0.463	0.643	.2533988	2.3343
Iccaa_4	**4.91039**	**1.671**	**4.676**	**0.000**	**2.520305**	**9.567069**
Iccaa_5	**.1731177**	**.0960562**	**-3.161**	**0.002**	**.0583504**	**.5136171**
Iccaa_6	**.2079528**	**.1260304**	**-2.591**	**0.010**	**.0634004**	**.6820841**
Iccaa_7	.5543608	.2133963	-1.533	0.125	.2606934	1.178841
Iccaa_8	1.275735	.6248672	0.497	0.619	.4884656	3.331863
Iccaa_9	1.705144	.5308831	1.714	0.087	.9262884	3.138889
Iccaa_10	.8454274	.2962915	-0.479	0.632	.4253644	1.680318
Iccaa_11	.5581481	.2340548	-1.391	0.164	.2453608	1.269679
Iccaa_12	.5114845	.1826795	-1.877	0.060	.2539927	1.030016
Iccaa_13	.9689443	.3014536	-0.101	0.919	.5265951	1.782875
Iccaa_14	.8185846	.309891	-0.529	0.597	.3897847	1.719105
Iccaa_15	.4010855	.189964	-1.929	0.054	.158521	1.014815
Iccaa_16	.6543656	.3446878	-0.805	0.421	.23305	1.837349
Iccaa_17	1.905105	.8558801	1.435	0.151	.7897894	4.595433
Iccaa_18	**7.486422**	**4.926274**	**3.059**	**0.002**	**2.061389**	**27.18871**
last perc	.9346924	.6222738	-0.101	0.919	.2535007	3.446341
high perc	**27.31525**	**28.15389**	**3.209**	**0.001**	**3.623012**	**205.9399**
ITAMAN_2	.9468245	.2370076	-0.218	0.827	.579693	1.546468
ITAMAN_3	.8932979	.2188346	-0.461	0.645	.5526805	1.443838
ITAMAN_4	1.121662	.3241641	0.397	0.691	.6365931	1.976342
ITAMAN_5	1.050181	.2506738	0.205	0.837	.6577884	1.67665
ITAMAN_6	.6268163	.2260323	-1.295	0.195	.3091675	1.270828
ITAMAN_7	1.442887	.3955427	1.337	0.181	.8431215	2.469305

** The signification of the variables is the same that in the R11-R12 tables. The exception is that now we include the level of studies of the head of the household (Inesth_) and his/her last occupation (Iocch_) since there are not error correlation problems.

Appendix C

Table C1: Logit model coefficient for heads of family

(MODEL WITHOUT INCLUDING THE EPF-90/91 INCOME PREDICTION**)

Logit Estimates — Number of obs*= 8014; chi2(50) = 785.79; Prob > chi2 = 0.0000; Log Likelihood = -1906.206; Pseudo R2 = 0.1709

asseg	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0026319	.0033129	-0.794	0.427	-.009125	.0038612
Inesth_2	**.5836722**	**.1909632**	**3.056**	**0.002**	**.2093913**	**.9579531**
Inesth_3	**1.151225**	**.2143124**	**5.372**	**0.000**	**.7311805**	**1.57127**
Inesth_4	**1.267578**	**.2332029**	**5.436**	**0.000**	**.8105083**	**1.724647**
Inesth_5	**1.642355**	**.2298559**	**7.145**	**0.000**	**1.191846**	**2.092865**
Iocch_1	-.4380388	.3928937	-1.115	0.265	-1.208096	.3320186
Iocch_3	**.616451**	**.2385565**	**2.584**	**0.010**	**.1488889**	**1.084013**
Iocch_4	**1.228609**	**.3790647**	**3.241**	**0.001**	**.4856562**	**1.971562**
Iocch_5	**.574495**	**.2484684**	**2.312**	**0.021**	**.0875059**	**1.061484**
Iocch_6	**.7350677**	**.3534191**	**2.080**	**0.038**	**.042379**	**1.427756**
Iocch_7	.2751627	.3395646	0.810	0.418	-.3903717	.9406971
Iocch_8	.4855046	.2734857	1.775	0.076	-.0505174	1.021527
Iocch_9	.165826	.2500437	0.663	0.507	-.3242506	.6559027
Iocch_10	-.1392552	.2330557	-0.598	0.550	-.5960361	.3175257
Iocch_11	-.3345162	.251392	-1.331	0.183	-.8272354	.158203
numfam	-.026719	.0390629	-0.684	0.494	-.1032809	.0498429
sports	**.3526124**	**.1232979**	**2.860**	**0.004**	**.110953**	**.5942718**
acc	.2250413	.1719139	1.309	0.191	-.1119037	.5619864
overweig	.2047864	.1612468	1.270	0.204	-.1112515	.5208244
smoker	.0295316	.093424	0.316	0.752	-.153576	.2126393
male	.1528764	.1224108	1.249	0.212	-.0870443	.3927971
alc	**-.2867596**	**.109612**	**-2.616**	**0.009**	**-.5015952**	**-.071924**
alone	.0295125	.1575015	0.187	0.851	-.2791847	.3382098
T OFFICE	-.021987	.1968134	-0.112	0.911	-.4077341	.3637602
WAIT LIST	**.02545301**	**.154678**	**1.646**	**0.100**	**-.0486341**	**.5576942**
Iccaa_2	.2618668	.2942204	0.890	0.373	-.3147945	.8385282
Iccaa_3	-.0932363	.4399747	-0.212	0.832	-.9555709	.7690982
Iccaa_4	**1.25174**	**.3098861**	**4.039**	**0.000**	**.644374**	**1.859105**
Iccaa_5	**-1.149574**	**.4375302**	**-2.627**	**0.009**	**-2.007118**	**-.2920307**
Iccaa_6	**-1.406311**	**.4988261**	**-2.819**	**0.005**	**-2.383992**	**-.4286296**
Iccaa_7	.1684318	.3068017	0.549	0.583	-.4328884	.769752
Iccaa_8	-.1608031	.4739642	-0.339	0.734	-1.089756	.7681496
Iccaa_9	**1.199472**	**.2855813**	**4.200**	**0.000**	**.6397433**	**1.759201**
Iccaa_10	-.044749	.2849827	-0.157	0.875	-.6033049	.5138069
Iccaa_11	**-1.396536**	**.4958064**	**-2.817**	**0.005**	**-2.368298**	**-.4247731**
Iccaa_12	-.3627633	.2821878	-1.286	0.199	-.9158412	.1903146
Iccaa_13	**.7686689**	**.3146996**	**2.443**	**0.015**	**.151869**	**1.385469**
Iccaa_14	-.0023091	.3214303	-0.007	0.994	-.6323008	.6276827
Iccaa_15	-.3279366	.3968244	-0.826	0.409	-1.105698	.449825
Iccaa_16	-.3015954	.4366826	-0.691	0.490	-1.157478	.5542868
Iccaa_17	.0046886	.3933984	0.012	0.990	-.7663581	.7757353
Iccaa_18	.8625288	.6486051	1.330	0.184	-.4087138	2.133771
last perc	.7215825	.5070566	1.423	0.155	-.2722301	1.715395
high perc	.2263481	.9726591	0.233	0.816	-1.680029	2.132725
ITAMAN_2	.1934	.2326348	0.831	0.406	-.2625558	.6493557
ITAMAN_3	.0843958	.228746	0.369	0.712	-.3639381	.5327296
ITAMAN_4	.3282852	.2690408	1.220	0.222	-.199025	.8555955
ITAMAN_5	**.5317418**	**.220705**	**2.409**	**0.016**	**.099168**	**.9643156**
ITAMAN_6	**.7475191**	**.2945974**	**2.537**	**0.011**	**.1701188**	**1.324919**
ITAMAN_7	**.6857009**	**.2536872**	**2.703**	**0.007**	**.1884831**	**1.182919**
_cons	-16.75396	15.82398	-1.059	0.290	-47.76838	14.26046

*Note that there are more observations than the R21-R22 tables. The regressions using the income prediction involve more variables, this implies a higher incidence of missing values.

Table C2: "Marginal" probability logit model for heads of family

Logit Estimates — Number of obs = 8014; chi2(50) = 785.79; Prob > chi2 = 0.0000; Log Likelihood = -1906.206; Pseudo R2 = 0.1709

asseg	Canvi Prob	Std. Err.	z	P>|z|	[95% Conf.	Interval]
EDAT	.9973716	.0033042	-0.794	0.427	.9909165	1.003869
Inesth_2	**1.792609**	**.3423223**	**3.056**	**0.002**	**1.232927**	**2.606356**
Inesth_3	**3.162064**	**.6776696**	**5.372**	**0.000**	**2.077532**	**4.812755**
Inesth_4	**3.552237**	**.8283918**	**5.436**	**0.000**	**2.249051**	**5.610539**
Inesth_5	**5.167326**	**1.18774**	**7.145**	**0.000**	**3.293155**	**8.108108**
Iocch_1	.6453008	.2535346	-1.115	0.265	.2987655	1.393779
Iocch_3	**1.852342**	**.4418883**	**2.584**	**0.010**	**1.160544**	**2.956521**
Iocch_4	**3.416475**	**1.295065**	**3.241**	**0.001**	**1.625241**	**7.181889**
Iocch_5	**1.776233**	**.4413379**	**2.312**	**0.021**	**1.091449**	**2.890658**
Iocch_6	**2.085623**	**.7370991**	**2.080**	**0.038**	**1.04329**	**4.169335**
Iocch_7	1.316745	.4471199	0.810	0.418	.6768053	2.561767
Iocch_8	1.624995	.4444128	1.775	0.076	.9507374	2.777432
Iocch_9	1.180368	.2951435	0.663	0.507	.723069	1.926881
Iocch_10	.870006	.2027599	-0.598	0.550	.5509914	1.373725
Iocch_11	.7156842	.1799173	-1.331	0.183	.4372564	1.171404
numfam	.9736348	.038033	-0.684	0.494	.9018736	1.051106
esports	**1.42278**	**.1754257**	**2.860**	**0.004**	**1.117342**	**1.811711**
acc	1.252374	.2153006	1.309	0.191	.8941304	1.754153
sobrepes	1.227263	.1978923	1.270	0.204	.8947137	1.683415
fumador	1.029972	.0962241	0.316	0.752	.8576356	1.236938
home	1.165181	.1426307	1.249	0.212	.9166365	1.481118
alc	**.7506922**	**.0822849**	**-2.616**	**0.009**	**.6055639**	**.9306016**
sol	1.029952	.162219	0.187	0.851	.7564002	1.402435
T. CONSUL	.978253	.1925333	-0.112	0.911	.6651557	1.438729
LLISTA E	1.289855	.1995127	1.646	0.100	.9525297	1.74664
Iccaa_2	1.299354	.3822963	0.890	0.373	.7299389	2.31296
Iccaa_3	.9109782	.4008073	-0.212	0.832	.3845925	2.157819
Iccaa_4	**3.49642**	**1.083492**	**4.039**	**0.000**	**1.904794**	**6.417991**
Iccaa_5	**.3167716**	**.1385972**	**-2.627**	**0.009**	**.1343754**	**.7467456**
Iccaa_6	**.2450457**	**.1222352**	**-2.819**	**0.005**	**.0921819**	**.6514012**
Iccaa_7	1.183448	.3630837	0.549	0.583	.6486329	2.159231
Iccaa_8	.8514597	.4035614	-0.339	0.734	.3362986	2.155774
Iccaa_9	**3.318365**	**.947663**	**4.200**	**0.000**	**1.895994**	**5.807797**
Iccaa_10	.9562375	.2725112	-0.157	0.875	.5470009	1.671643
Iccaa_11	**.2474527**	**.1226886**	**-2.817**	**0.005**	**.0936399**	**.6539181**
Iccaa_12	.6957511	.1963325	-1.286	0.199	.4001798	1.20963
Iccaa_13	**2.156893**	**.6787733**	**2.443**	**0.015**	**1.164008**	**3.996699**
Iccaa_14	.9976936	.3206889	-0.007	0.994	.5313678	1.873265
Iccaa_15	.7204087	.2858758	-0.826	0.409	.3309797	1.568038
Iccaa_16	.7396373	.3229867	-0.691	0.490	.3142779	1.740699
Iccaa_17	1.0047	.3952472	0.012	0.990	.4647024	2.172189
Iccaa_18	2.369144	1.536639	1.330	0.184	.6645044	8.446662
últ perc	2.057687	1.043364	1.423	0.155	.761679	5.558871
alt perc	1.254012	1.219726	0.233	0.816	.1863686	8.437827
ITAMAN_2	1.213368	.2822716	0.831	0.406	.7690835	1.914307
ITAMAN_3	1.088059	.2488892	0.369	0.712	.6949342	1.703576
ITAMAN_4	1.388585	.373586	1.220	0.222	.8195294	2.352775
ITAMAN_5	**1.701894**	**.3756165**	**2.409**	**0.016**	**1.104252**	**2.622992**
ITAMAN_6	**2.111754**	**.6221173**	**2.537**	**0.011**	**1.185446**	**3.761882**
ITAMAN_7	**1.985163**	**.5036104**	**2.703**	**0.007**	**1.207417**	**3.263886**

** The signification of the variables is the same that in the R21-R22 tables. The exception is that now we include the level of studies of the head of the household (Inesth_) and his/her last occupation (Iocch_) since there are not regressors/errors correlation problems.

Appendix D1

T-test of equality of means

Insured>Uninsured	**Insured = Uninsured**	**Insured<Uninsured**
Subjective good health	Restricted activity (due to bad health)	
Accidents: number importance at work		
Prescription Drugs: (given purchase) Diabetes Blood Pressure Rheumatism		Purchase of prescription drugs (last two weeks) Purchase of vitamins
Visits to Specialists Time waiting in office		Visits to GP's Public Doctors
Dentists: Tooth extraction Dental Insurance Private dentists	# times dentist Money spent in dentristy good teeth	Cavity filling Public dentists
Surgery procedures	# times in hospital (last year) # days hospital stay	Been in Waiting Lists Hospital entrance through emergency room # days in waiting list
	Visit Emergency Room	
Smokers Male Married Sports	Alcohol problems Overweight	Sleeping Hours Students

Appendix D2

Insurance and some descriptive statistics

Reason of Hospitalization and Insurance Coverage (%)

	Birth	Surgery	Diagnosis	Treatment	Other
Uninsured	14.67	44.43	10.51	23.55	6.84
Insured	15.25	47.46	11.02	22.03	4.24
Total	14.71	44.66	10.55	23.44	6.64

Who paid the hospital expenses (%)

	Public	Mutuality	Charity	Private Insurer	Out-of-pocket	Other
Uninsured	90.11	3.66	0.51	1.98	3.08	0.66
Insured	18.42	5.26	0.00	59.65	10.53	6.14
Total	84.58	3.79	0.47	6.42	3.65	1.08

Respondent and household characteristics and insurance

Insurance, gender and average (%)

	Female	Male	Total
Uninsured	44.70 yr. 51.92%	42.58 yr. 48.08%	43.68 yr.
Insured	43.14 yr. 46.34%	41.81 yr. 53.66%	42.42 yr.
Total	44.61 yr. 51.54%	45.52 yr. 48.46%	43.60 yr.

Insurance, civil status and number of family members

	Single	Married	Separated	Divorced	Widow
Uninsured	3.79 29.73%	3.46 61.04%	2.76 1.24%	2.60 0.49%	2.16 7.50%
Insured	3.43 29.94%	3.44 62.92%	2.41 1.69%	2.12 0.56%	2.31 4.87%
Total	3.76 29.75%	3.46 61.17%	2.73 1.27%	2.56 0.49%	2.17 7.32%

Insurance and type of household (%)

	Alone	Spouse with wo. children	Partner with or wo. children	With children & no partner
Uninsured	7.04	62.02	1.41	29.53
Insured	6.65	64.19	1.13	28.03
Total	7.01	62.17	1.39	29.34

Insurance and number of members in the household

	Total	less 18 yr.	more 65 yr.
Uninsured	3.45	0.63	0.42
Insured	3.36	0.60	0.36
Total	3.44	0.63	0.42

Is the respondent the highest income in the household (%)

	Yes	No
Uninsured	44.69	55.31
Insured	52.01	47.99
Total	45.19	54.81

Insurance and level of education (years in school) (%)

	0 years	until 14/15 yr.	until 16/19 yr.	Superior	University
Uninsured	16.18	51.54	17.92	7.14	7.22
Insured	6.09	35.27	23.37	12.96	22.31
Total	15.49	50.43	18.30	7.54	8.25

Insurance and employement situation (%)

	Works	Retired & worked	Retired & did not wk	Unem & worked	Unem & did not wk	Stud	House keeper	Other
Uninsured	38.82	13.74	4.20	7.73	1.58	10.51	23.01	0.41
Insured	54.81	10.04	1.77	5.23	0.71	9.41	17.47	0.57
Total	39.91	13.49	4.03	7.56	1.52	10.43	22.63	0.42

Insurance and last occupation, if currently working or worked before (%)

		Uninsured	Insured
Independent worker	**Small farmer**	7.27	1.97
	Farmer	0.11	0.00
	Employer $\leq$ 5 employees	13.36	16.39
	Employer $\geq$ 6 employees	0.61	1.66
Professionals	**Professionals**	8.09	20.23
Employees	**Management $\leq$ 5 employees**	0.90	2.49
	Management $\geq$ 6 employee	1.17	3.01
	Intermediate	2.95	7.78
	White collars	9.82	14.73
	Blue collars, skilled	29.35	21.27
	Blue collars, unskilled	26.36	10.48

Appendix E:

Compatibility test of Surveys based on Arellano-Meghir (1992)

For testing the compatibility of the Health Survey of Spain (ENS-93) and the Spanish Family Budget (EPF-90/91) we follow the procedure suggested by Arellano-Meghir (1992). We describe above the application of the method in our case.

1. We choose a set of variables that exist in both surveys:
   (a) Region of residence
   (b) Level of education
   (c) Professional category
   (d) Size of the city
   (e) Number of members of the household
2. We run a regression where the continuous variable common in both surveys is the dependent variable and the rest are the regressors. Unfortunately, the only common continuous variable available is the number of members of the household, which is censored from the right (it only takes values from 1 to 9). We run a regression of number of members of the family on region, education, professional category and size of the city using:
   (a) only the ENS-93 data set,
   (b) only the EPF-90/91 data set,
   (c) using both data sets, appended.

3. We perform a F test to examine that the slopes of both surveys are similar (for more details, see Greene (1993), page 212). Let's $e_1'e_1$ be the sum squared of residuals of regression described in 2a, $e_2'e_2$ the sum squared of the residuals described in 2b, and $e'e$ the sum of residuals described in 2c (both surveys at once). Let's n_1 and n_2 the number of observations in the ENS-93 and EPF-90/91 respectively and k the number of regressors involved in 2a, 2b and 2c. Then, the statistic described below has an F distribution with $(k, n_1 + n_2 - 2k)$ degrees of freedom:

$$F_{(k,n_1+n_2-2k)} \sim \frac{\frac{(e'e-e_1'e_1-e_2'e_2)}{k}}{\frac{e_1'e_1+e_2'e_2}{n_1+n_2-2k}}$$

The numbers of observations, regressors and the sum of squared residuals associated to 2a, 2b and 2c regressions are:

		observations n	regressors k	Sum Squared Residuals $(e'e)$
2a	ENS-93	19,971	29	39,975.5388
2b	EPF-90/91	21,155	29	42,810.4806
2c	Both jointly	41,126	29	83,204.4186

Therefore, the statistic F has a value of 1.45259. Since an F with (29, 41,068) degrees of freedom at the 95% confidence takes the value 1.46, we do not reject the null hypothesis of equality of the coefficients across both surveys.