Nº 195
Agosto 2001

Documento de Trabajo
ISSN (edición impresa) **0716-7334**
ISSN (edición electrónica) **0717-7593**

Self Selection and Moral Hazard in Chilean Health Insurance.

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In Chile, dependant workers are mandated to purchase health insurance and they can chose between one public provider and several private providers. Here, we analyze the relation between utilization and the choice of either private or public insurance. Independent workers, however, are not mandated. In this case, we analyze the relationship between utilization and the decision to purchase insurance.

The results show adverse selection against insurance companies for independent workers and against FONASA for dependant workers. Moral hazard is negligible in the case of hospitalization. Regarding medical visits, over consumption is quantitatively important and statistically significant in all cases (against insurance for independents; against public and private insurance in the case of dependant workers).

JEL classification: I11, C35, G22.

Keywords: Health insurance; moral hazard; adverse selection; self selection; count data models.

I. INTRODUCTION

The relationship between health insurance plans and health care services utilization is well known, and arises from the interaction of moral hazard and consumer self-selection, with the design of insurance policies.

The presence of moral hazard in the health insurance market has been widely studied. Moral hazard refers to the over-consumption of health care services that arises because insured individuals face a lower price than the market price[1]. Newhouse (1993) presents the results of a controlled experiment in the United States, in which significant service over-consumption (moral hazard) is found among plans with greater coverage. Cameron, Trivedi, Milne and Piggot (1988) analyze the relationship between the purchase of health insurance and the demand for health care services in Australia, finding that moral hazard significantly affects demand for the various health care services analyzed. Bertranou (1998) undertakes a similar study in Argentina, also finding that moral hazard is an important determinant of the demand for health care services.

Adverse selection in the health care market has been analyzed in numerous studies. Cutler and Zeckhauser (1997) say that when high-risk individuals choose different plans than low-risks individuals, there is differential selection. The authors define adverse selection as the differential selection that arises because individuals are not charged marginal costs when switching among plans[2]. We use this definition of adverse selection in the paper[3]. Cutler and Zeckhauser (1997) and Cutler and Reber

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[1] In the paper we use the concepts of overconsumption and moral hazard. Over consumption refers to more consumption by a group in a certain situation (or health plan) in comparison with what that same group would consume in an alternative situation. Moral hazard goes further than this, and implies that this overconsumption leads to deadweitht loss due to the difference between marginal benefits and marginal cost (market price). The relationship between these two concepts is further discussed below.

[2] The concept of adverse selection generally is defined as a problem of information. In the definition of Cutler and Zeckhauser (1997), adverse selection arises when individuals are not charged marginal costs when switching between plans, and this may be due to asymmetry of information, or because the insurer cannot charge different premiums by law, or employers adopt this policy to help spread risks.

[3] In the paper we use the concepts of self selection and adverse selection. Self selection is a broader concept than adverse selection. The relationship is discussed in section V.3.

(1998) identify three sources of deadweight loss associated with adverse selection, which can be minimized by permitting insurance providers to adjust their premiums based on risk and to utilize reinsurance. The authors analyze two cases in the United States,[4] and find significant adverse selection. In addition, Cameron, Trivedi, Milne and Piggot (1988), and Bertranou (1998), find significant adverse selection among consumers of the various health insurance plans analyzed.

Many comparisons of the public and private insurance systems in Chile use health care utilization data, without taking into account self selection, leading to an erronoeous interpretation of the data. Self-selection among consumers refers to the fact that the population affiliated with a particular health insurance plan –public or private– is not a random sample of the total population, but rather a sample of individuals (or families) with particular characteristics which have led them to self-select as members of this group. Thus, even if we control for observable characteristics affecting the demand for health care (age, sex, etc.), the quantity of services consumed by those who currently subscribe to insurance plan A cannot be used to estimate the quantity that would be consumed by those who currently subscribe to other health insurance plans or no plan at all, *if they switched to insurance plan A*. Similarly, it cannot be used to estimate the quantity which would be consumed by the current subscribers to plan A if they switched to another insurance plan.

II. DESCRIPTION OF THE CHILEAN HEALTH CARE SYSTEM

In the Chilean health care system, *independent* workers may purchase the health insurance plan of their choice, or they may elect not to purchase insurance. *Dependant* workers must spend 7% of their taxable income on health insurance. They can choose whether to allocate their contribution to the public insurance (National Health Fund, FONASA) or to a private health insurance institution (ISAPRE).[5] Analysis of the

[4] They analyze health insurance plans offered to workers by Harvard University and the Massachusetts Group Insurance Commission.

[5] The population classified as "indigent" is, by definition, covered by public health insurance, although with more restrictions on provider selection than are faced by paying members of the system.

behavior of *independent* workers, with and without insurance, may detect the presence of adverse selection and moral hazard associated with the purchase of health insurance, whether public or private. This exercise permits the confirmation of a result frequently encountered in the literature: those who purchase health insurance have higher health risk, on average, than an average individual in the population, and consume a higher quantity or quality of health care services.

The question of greatest interest in this study, however, relates to the behavior of *dependant* workers, since they are only permitted to choose between public or private insurance, and not to forgo health insurance entirely. Among this group of workers, we compare beneficiaries of ISAPRE and FONASA, in order to detect self-selection and over-consumption associated with the purchase of one kind of insurance (as opposed to the other). To detect self-selection, we analyze the relation between the probability of affiliation to one kind of insurance, and the *observable* and *non-observable* characteristics of the beneficiaries. To estimate over-consumption, we compare the consumption of health care services with ISAPRE and FONASA. In the case of dependant workers, we do not estimate the expected value of moral hazard, since we can't compare consumption between insured individuals and individuals who face the market price of services (non insured individuals).

Two characteristics of the Chilean health insurance system allow us to presume the existence of adverse selection. In both cases, this adverse selection is expected to operate against FONASA. The first involves the rules for premium-setting applied to public and private insurance (see Aedo and Sapelli, 1999). Within FONASA, the premium is determined by income alone, while in the ISAPRE sector, it is a function of income as well as some determinants of the risk of the insured and his or her dependants. ISAPREs may adjust premiums according to age, sex and number of dependants. We will call these risk factors "adjustable risk factors". Thus, membership in FONASA is relatively more attractive for those with greater adjustable risk factors, since the effective price of public insurance decreases as the expected expenditure rises. Individuals will self-select, choosing the insurance plan which offers them the lowest effective price. In other words, the FONASA beneficiaries, on average, are expected to exhibit higher adjustable risk factors, or *observable* risk, than the ISAPRE beneficiaries.

The second characteristic of the Chilean system leading to an expectation of adverse selection against FONASA is the free implicit catastrophic insurance offered by

FONASA. First, until just a few months ago, FONASA was not able to determine whether or not a patient was affiliated to an ISAPRE. This provided an incentive for ISAPRE beneficiaries to make sequential use of both types of insurance, according to their relative price and quality, taking advantage, for example, of the low cost of hospitalization in the FONASA system. Second, ISAPRE beneficiaries are always permitted to switch to FONASA; thus, FONASA operates explicitly as a last-resort insurer. This suggests that individuals who are stricken with chronic illnesses, or those who experience an acute decline in health, have an incentive to switch to FONASA, in order to obtain greater coverage for the required services.[6] If this is true, it implies that FONASA beneficiaries, on average, should also exhibit greater *non-observable* risk than ISAPRE beneficiaries.

III. THE DATA

For the empirical part of the study, we utilize the information provided by the 1996 CASEN Survey[7]. According to this report, 60% of the total population are FONASA beneficiaries, 25% are ISAPRE beneficiaries, and 11% have no insurance. The remaining individuals are distributed among the Armed Forces and law enforcement (3%), and other groups that have special coverage schemes. Among workers with income, 68% are dependant (excluding the 6% who are domestic workers and the 3% affiliated with the Armed Forces and law enforcement), and 24% are independent.

When we consider FONASA beneficiaries, ISAPRE beneficiaries, and people without insurance, we observe that the percentage of non-insured and ISAPRE beneficiaries increases systematically with income. Regarding age, within all income

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[6] Although this has to be adjusted for variations in quality.

[7] The National Socioeconomic Survey [*Encuesta de Caracterización Socioeconómica Nacional*, CASEN] has been carried out every two years since 1985 (with the exception of the 1989 survey, which took place in 1990). It consists of a series of questions to determine the socio-demographic characteristics of the household and its inhabitants: housing and living conditions, education, health, employment, other income, and related matters. A total of 35,730 households and 134,262 individuals were covered by the survey in 1996, and the report's validity has been affirmed on numerous occasions.

quintiles the percentage of ISAPRE beneficiaries is significantly lower among people over 65 than among other age groups (the inverse occurs among FONASA beneficiaries). The effect of age on the choice of ISAPRE or FONASA seems to be stronger among lower-income groups. At the same time, age is negatively related to the decision not to purchase insurance. With respect to gender, the percentage of ISAPRE beneficiaries is slightly lower among women than men, and the same is observed for non-insured persons, across all income groups. Finally, the size of the city of residence appears to be directly related to the probability of ISAPRE affiliation, with a more pronounced impact in lower-income groups.

The number of services consumed by the non-insured is lower than in FONASA and the ISAPREs (except in the case of emergency care and dental services). This may be due to the effect of moral hazard, or self selection. The latter possibility is suggested by the fact that young people and men exhibit a lower probability of purchasing insurance.

In comparing per-capita service consumption among non-indigent FONASA and ISAPRE beneficiaries, within each income quintile the number of medical visits, emergency visits, preventive care visits and hospitalization days are higher for FONASA than for ISAPRE beneficiaries, while the inverse occurs with dental care and surgery[8]. This may be due to the lower (higher) cost[9] faced by FONASA, -as opposed to ISAPRE- beneficiaries for the first (second) group of services, suggesting moral hazard. Higher or lower levels of service consumption by FONASA as compared to ISAPRE beneficiaries may also be explained by adverse selection.

[8] Sapelli and Vial (1998) find no significant relationship between income group and service utilization. A quantum index is used to compare service utilization levels in this study (using the services included in the CASEN Survey and controlling for demographic characteristics).

[9] Costs include the cost of time.

IV. THE MODEL

Cameron and Trivedi (1991) and Cameron, Trivedi, Milne and Piggott (1988). model the individual demand for health insurance and health care services, taking the interdependence between these decisions into account, within a framework of intertemporal (two period) utility maximization under uncertainty. In the initial period, individuals (or family groups) choose the health insurance plan, without knowledge of the health status which will determine their demand for services during the period to follow. Individuals choose a health insurance plan and make consumption decisions so as to maximize expected utility.

Following this model, we will consider the case of an individual who must purchase a health insurance plan at moment 0 (when his or her health is unknown), and who consumes health care services and other goods at moment 1, once his or her health status is revealed. The individual's utility (U) is a function of his or her consumption of various health care goods (C), and his or her level of health (H): $U=U[C_1, H]$. Health care services are considered as an input for the production of health, so that health depends on the quantity of services (e) in state *s* (the presence or absence of illness), given the characteristics of the individual (A), and of the health insurance plan (B): $H=H(e;s/A,B)$. The subjective probability distribution of s (uncertain health status) depends on the individual's characteristics: (s/A). The individual maximizes expected utility in order to reach the optimal consumption of services and other goods (e*,C*), as well as the optimal choice of health insurance subject to two restrictions: that income at the initial moment (Y_0) is divided into the payment of the premium (P_j), for the insurance plan chosen (j), and disposable income at moment 1 (Y_1). The second restriction indicates that disposable income after payment of the premium can be used for the consumption of goods (C) or for the consumption of health care services (e_k), whose price, p_{jk} , depends on the health insurance plan chosen.

The demand for health care services is derived from the maximization of individual utility once insurance plan *j* has been chosen and the individual's health status (s) has been revealed. The individual chooses health insurance plan j to be purchased in moment 0, so as to reach the maximum level of expected utility, given his or her restrictions.

On the basis of this theoretical model, we can evaluate the empirical data in the Chilean case. Given the relationship between the individual's health insurance decisions and the consumption of health care, the presence of self-selection bias must also be detected as the empirical analysis is carried out.

The empirical model which explains the quantity of health care services consumed, is a reduced form equation of the model discussed above. The value of p_j is non-observable, but a dummy variable is substituted which indicates the selected health insurance plan j.

For the expected indirect utility function, the empirical study utilizes a linearized version of $E[V_j]$, corresponding to the expected indirect utility function associated with the purchase of private insurance (ISAPRE), public insurance (FONASA), or the failure to purchase health insurance (non-insured).

V. EMPIRICAL METHODOLOGY

The theoretical model allows the evaluation of the quantity of services consumed by Chilean households that hold public or private insurance, to detect over-consumption associated with the purchase of one kind of insurance[10]. In addition, it permits to estimate the probability of affiliation to each type of insurance, and to correct for possible self-selection bias. When evaluating the number of health care services consumed, the number of services consumed by the household head in the three months prior to the survey is used as a dependant variable.

The choice of health insurance is analyzed as a choice of the household head, based on the characteristics of household members. In classifying individuals according to the choice of public, private or no health insurance, it is assumed that this choice was made prior to the three-month period in question.

[10] Over-consumption can only be measured in terms of an increase in physician visits or hospital days; it is not possible to control for quality based on the information used. Thus, a higher expected number of physician visits among FONASA beneficiaries than among ISAPRE beneficiaries reflects the existence of over-consumption in FONASA, under the assumption that the quality of physician visits is similar in both subsystems.

In the empirical work we separate dependant and independent workers. For this separation to be possible without introducing biases, the non-observable variables determining the choice to join the dependant or independent workforce and those determining the choice between ISAPRE and FONASA, as well as those determining the decision to consume health care services, must be independent of each other. This assumption is supported by the results of Sapelli and Torche (1999).

To estimate the quantity of health care services consumed by households, count data models must be used, since the dependant variables (number of physician visits and days of hospitalization) are discrete. In adition, the presence of selection based on non-observable variables requires the utilization of a model which considers self-selection.

1.- Count data model without correcting for self-selection

Designating the number of services provided to the household i as y_i, the Poisson model supposes that the variable y_i has a Poisson distribution with parameter λ_i:

$$(1) \qquad Prob(Y_i = y_i) = \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!}$$

The parameter λ is related to the regressors x_i such that $\lambda_i = \exp(\beta' x_i)$. The expected number of events, or conditional mean is: $E[y_i / x_i] = \lambda_i = \exp(\beta' x_i)$. A characteristic of this model is that the conditional variance is equal to the conditional mean; that is to say, $Var[y_i/x_i] = \lambda_i = \exp(\beta' x_i)$

The Poisson model has been extended to incorporate the unobserved heterogeneity of the data, through the re-specification of the distribution as a conditional Poisson, with $\lambda_i = \exp(\beta' x_i + \varepsilon_i)$. From this re-specification, the negative binomial model (Negbin) arises, when we assume that ε_i is the logarithm of u_i, a gamma variate with mean 1 and variance α. In the Negbin model, the conditional mean function is: $E[y_i/x_i] = \exp(\beta' x_i)$, and the conditional variance corresponds to: $Var[y_i/x_i] = E[y_i/x_i] \cdot \{1 + \alpha E[y_i / x_i]\}$. Greene (1997) derives another model of heterogeneity, the log normal model, which is utilized later in the development of the selection model. For this it is assumed that the distribution of ε_i is normal, with mean 0 and variance σ^2. The conditional mean function in this model is: $E[y_i / x_i] = \exp(\beta' x_i + \sigma^2/2)$, and the conditional variance corresponds to: $Var[y_i/x_i] = E[y_i / x_i] \cdot \{1 + [\exp(\sigma^2) - 1] \cdot E[y_i / x_i]\}$.

Utilizing these count data models, it is possible to estimate the number of services consumed, assuming that the dichotomous variable indicating the health insurance plan chosen is exogenous, and thus to estimate the moral hazard associated with the purchase of an insurance plan. First, the number of health care services consumed within a sample of independent workers could be estimated, incorporating a dummy variable with value one if the individual belongs to ISAPRE or FONASA, and zero if he or she has no health insurance. Second, the number of health care services consumed within the sample of dependant workers could be estimated, incorporating a dummy variable with value one if the individual chooses ISAPRE, and zero if FONASA is chosen.

2.- Count data model considering self-selection in health insurance

To correctly evaluate the relationship between the purchase of health insurance and the demand for health care services, it is necessary to solve two problems present in the estimations described above: (i) the effect of the observable variables considered in the estimation of the number of services may be different for ISAPRE and FONASA beneficiaries, or for the non-insured people, and the sign and magnitude of over-consumption may differ for different segments of the population[11]; and (ii) people do not purchase a particular health insurance plan randomly. The choice of insurance involves a self-selection process, so that the dummy variable used cannot be treated as an exogenous variable.

The first problem is solved through a more general model, which allows for different marginal effects in different population segments. When estimating the number of health services consumed, the independent workers who purchase insurance and those who do not are separated into subsamples. In addition, the dependant workers who are FONASA beneficiaries are separated from ISAPRE beneficiaries.

The second problem is solved by correcting for self-selection of individuals in health insurance decisions. The choice of a health insurance plan depends on the observable characteristics of the person (or family unit), as well as upon non-observable

[11] Thus, for example, the effect of moral hazard may work in opposite directions for lower- and higher-income individuals: it is possible that low-income individuals face lower costs for physician visits in FONASA than in an ISAPRE, while the opposite may be true for higher-income individuals.

characteristics, which may be correlated with the quantity of services actually consumed in the following period. To correct the possible self-selection bias, the count data models are modified, using the model of Full Information Maximum Likelihood (FIML) developed by Greene (1997).

The model to explain the quantity of services consumed in the insurance plan i takes the form:

$E[y_i/ d_i,\varepsilon_i] = \exp(\beta' x_i + \varepsilon_i)$

With y_i= the number of services consumed by the family unit i

d_i= dummy variable with a value of one if insurance plan i is purchased

x_i= vector of characteristics of family unit i

ε_i = heterogeneity component in the count equation

The choice of insurance plan involves a self-selection process, such that d_i=1 if the person chooses insurance plan i, or zero if not:

$$(3) \qquad d_i = \begin{cases} 1 & \text{if } \alpha' w_i + \mu_i > 0 \\ 0 & \text{if not} \end{cases}$$

With

w_i = vector of the characteristics of family unit i which affect their choice of insurance plan.

μ_i = random term.

joint distribution of ε_i and μ_i: $[\varepsilon_i,\mu_i] \sim N_2 [(0,0);(\sigma^2,\rho\sigma,1)]$

In estimating the number of services for each type of insurance separately, if μ_i and ε_i are correlated with each other, the expectation of y_i for the group of persons in insurance plan i corresponds to:

$$(4) \qquad E[y_i/ d_i=1] = \exp(\beta' x_i + \sigma^2/2)\{\Phi(\alpha' w_i + \theta)/\Phi(\alpha' w_i)\}$$
$$= \exp(\beta^{*\prime} x_i)\{\Phi(\alpha' w_i + \theta)/\Phi(\alpha' w_i)\}$$

With $\theta = \rho\sigma$

Φ = cumulative distribution function from a normal standard

3.- *Measurement of Adverse Selection and Moral Hazard.*

Adverse Selection

Self selection against an insurance plan is present if the estimated value of $\theta = \rho\sigma$ is positive, since a positive sign of ρ indicates that the non-observable variables determining the choice of that insurance plan are positively correlated with the non-observable variables determining the quantity of health care services consumed by the workers affiliated with that insurance plan. In turn, a negative value of ρ indicates favorable selection for a particular health insurance plan.

There are two kinds of adverse selection: adverse selection related to observable and non-observable risk variables[12]. The existence of self selection against an insurance policy reveals a positive relation between non-observable risk variables and the probability of purchasing that policy. If we find that risk variables (observable or non-observable) are positively associated with the probability of purchasing an insurance policy, and individuals are not charged marginal cost when purchasing the insurance (or switching between FONASA and ISAPRE), there is adverse selection[13].

As was noted above, public insurance does not adjust insurance premiums by risk factors, but private insurance does. Consequently, when we consider independent workers, a positive relation between risk variables and the probability of purchasing insurance (public or private) is consistent with the existence of adverse selection. It is adverse selection based on adjustable risk factors against FONASA and based on non-observable risk factors against ISAPREs.

When we consider dependant workers, a positive relation between the risk variables and the probability of purchasing public insurance reveals the existence of adverse selection (against FONASA).

Moral Hazard

In the sample of *independent workers*, the expected value of moral hazard associated with the purchase of health insurance is obtained from the difference

[12] Observable and non-observable to the reasearcher.

[13] Using Cutler and Zeckhauser's (1997) definition of adverse selection.

between: i) the expected value of the number of services consumed by individual *i* after purchasing the insurance, and ii) the expected value of the number of services which this individual would consume if he or she had not purchased health insurance (S= with insurance, P= non-insured):

(5) Moral Hazard (S)= MH(S)= $E(y_{Si}/S=1) - E(y_{Pi}/S=1)$

To estimate this difference, we use the estimated coefficients of α and β (*a* and *b*) for the subsamples of the sector with insurance (a_S and b_S) and without insurance (a_P and b_P):

(5') $MH(S)= \exp(b_S*'x_i)\{\Phi(a_S'w_i+t_S)/\Phi(a_S'w_i)\}-\exp(b_P*'x_i)\{(1-\Phi(a_P'w_i+t_P))/(1-\Phi(a_P'w_i))\}$

For *dependant workers*, the expected value of over-consumption associated with the purchase of private insurance (versus public insurance) is obtained as the difference between: i) the expected number of services consumed by the individual *i* within ISAPRE sector, and ii) the expected number of services which the individual would consume if he or she were affiliated with FONASA (I= ISAPRE, F=FONASA):

(6) Over-consumption (ISAPRE)= OC(I)= $E(y_{Ii}/I=1) - E(y_{Fi}/I=1)$

This difference is estimated using the estimated coefficients of α and β (*a* and *b*) for the subsamples of persons affiliated with an ISAPRE (a_I and b_I) and with FONASA (a_F and b_F):

(6') $OC(I)= \exp(b_I*'x_i)\{\Phi(a_I'w_i+t_I)/\Phi(a_I'w_i)\}- \exp(b_F*'x_i)\{(1-\Phi(a_F'w_i+t_F))/(1-\Phi(a_F'w_i))\}$

Equally, the expected value of over-consumption associated with the purchase of public insurance is calculated as the difference between: i) the expected value of the number of services consumed by an individual *i* (affiliated with FONASA) within FONASA sector, and ii) the expected value of the number of services he or she would consume within the ISAPRE sector:

(7) Over-consumption (FONASA)= OC(F)= $E(y_{Fi}/I=0) - E(y_{Ii}/I=0)$

This difference is estimated as:

(7') $OC(F)=\exp(b_F^{*\prime}x_i)\{\Phi(a_F'w_i+t_F)/\Phi(a_F'w_i)\}- \exp(b_I^{*\prime}x_i)\{(1-\Phi(a_I'w_i+t_I))/(1-\Phi(a_I'w_i))\}$

A positive value of OC(j) indicates that consumers of insurance plan j consume a greater quantity of services than they would consume if they purchased *the other type of insurance*, and vice versa. But moral hazard refers to the difference between the consumption with and *without* insurance. Therefore, when we consider dependant workers, the expected value of the over-consumption associated with the purchase of one type of insurance (versus the other) does not necessarily correspond to the concept of moral hazard.

A positive value of OC(F) reveals that FONASA beneficiaries pay a lower price of health care services in FONASA than in ISAPRE ($(p_F/F)<(p_I/F)$). But p_I is lower than the non-insurance price of health care services (marginal cost, MC), so OC(F) corresponds to an underestimation of the expected value of moral hazard in FONASA[14].

A positive value of OC(I) for ISAPRE beneficiaries, indicates the price of health care services in ISAPRE is lower than the price in FONASA ($(p_I/I)<(p_F/I)$). However, we don't know the relation between (p_F/I) and the market price of health care services (that we assume equal to marginal cost, MC). It could be above marginal cost, since (p_F/I) includes the cost of time associated to rationing by queues. If $(p_F/I)<MC$, a positive value of OC(I) reveals that $(p_I/I)<(p_F/I)<MC$, so OC(I) corresponds to an underestimation of the expected value of moral hazard in ISAPRE. But if $(p_F/I)>MC$,

[14] It should be noted too that moral hazard refers to consumption over the level of consumption at marginal cost given by the private demand curve for health care services. Since FONASA includes all the poor, the private demand curve may not be considered relevant. May be one should consider the social demand curve as a more adequate measure against which to determine possible over consumption. If this notion were accepted, then moral hazard would be consumption of health services whose *social* marginal benefit –as opposed to private- is below marginal cost. However, the paper utilizes the traditional definition of moral hazard.

OC(I) corresponds to an overestimation of the expected value of moral hazard in ISAPRE[15].

4.- Description of the Variables

According to the theoretical model, the demand for health care services depends on income, characteristics of the individual, his or her health status, and the price of services associated with the insurance plan chosen in the previous period. The independent variables used in the count equations include income, some demographic characteristics of the individual, and a dummy indicating whether the individual reports having suffered an illness or accident during the previous three months. Affiliation to a health insurance plan is utilized as a proxy for the fees charged for services.

The choice of health insurance plan, in turn, is a function of the individual's income, the premium charged for each insurance plan, and the demographic characteristics of the individual and his or her dependants. In accordance with the theoretical framework, information about the health status is assumed to be unknown at the moment when the decision to purchase the insurance plan is made.[16] Thus, the dichotomous variable indicating illness is used as the revelation of the individual's health status at moment 1, when the demand for health care services arises, and not as a proxy for the previous health status, as it has been utilized in other studies.[17] Table 1 presents the expected signs of the variables utilized in the count and selection equations (these are explained in Appendix 1).

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[15] The analysis assumes that the cost of time associated with the purchase of health care services in the ISAPRE sector is negligible in relative terms.

[16] In other studies utilizing the proposed theoretical framework (see, for example, Bertranou (1998)), variables indicating the presence of chronic illness in the family unit are used; however, this is not possible in the Chilean case, since the CASEN survey does not provide this information.

[17] In the Probit model, which explains the selection of health insurance, Sapelli and Torche (1998) incorporate the dummy variable of illness as a proxy for the health status at the time when the insurance is purchased. This is justified by the high correlation, over short periods of time, between states of health at one moment and another. However, this approximation is not useful in this study, where it is necessary to differentiate the variables known before and after the purchase of insurance, for the joint estimation of the selection and count data models.

VI. RESULTS

We analyze self selection and over-utilization in six instances: the utilization of physician visits and hospital days within three population groups: holders of a private insurance policy and of public insurance in the case of dependent workers, and members of a health insurance plan (be it private insurance or public insurance) in the case of independent workers. The signs of the estimated coefficients are consistent with those predicted, except for the fact that some variables are not significant (see regression results in tables 2 to 5).

Table 2 shows the regression results for physician visits consumed by independent workers with and without insurance. The hypothesis of self selection on unobservables is rejected, hence we present the results for a Negative Binomial model (a model without selection). All the estimated coefficients have the predicted sign when they are significantly different from zero. However, utilization does not appear to be affected by income or residential area for those that are insured.

When we estimate the count data selection model for hospital days for independent workers, we can not reject the hypothesis of self selection against the insurance based on unobservables. Table 3 shows the regression results for independent workers, with and without insurance. All the estimated coefficients show the predicted sign when they are significantly different from zero. However, income, on-the-job or traffic injury and being male are not significantly different from zero in the non-insured sector. Even in the insured sector, household income has a small effect over hospital stays (the estimated marginal effect is 0.008).

The selection equation explains the determinants of the decision to purchase health insurance (public and private). The probability of purchasing health insurance is greater for families with higher income, young children, larger household size, and more education; and when the household head is older, female, and contributes to a Pension Saving Account. These results are consistent with the prediction of adverse selection against public insurance in terms of observable risk variables. Finally, a significant correlation is found between the errors of the selection and count equations (r significantly different from zero), proving that there is self selection.

For physician visits consumed by dependent workers, no significant correlation is found between the errors of the selection and count equations, so we reject the

hypothesis of self selection on unobservables. Table 4 shows the results of the Negative Binomial model, which explains the number of physician visits consumed by the household head. For both public and private insurance, utilization of physician visits increases with worse health status and older age, as predicted. Income is significant only for private insurance beneficiaries (with a positive sign), but not for public insurance. Living in a rural area is not significant in both cases. The gender variable is not significant in the private sector, but is significant in the public sector. This is possibly a consequence of the design and pricing of private insurance. Older age, on the other hand, appears to significantly affect utilization in private insurance (increasing it) but does not affect utilization in public insurance.

Table 5 presents the results of the count selection model for hospital stays for dependent workers. The utilization equation's results are somewhat different to those for physician visits. All variables are significant and with the predicted signs, except for income for private insurance and old age for public insurance. Income has a negative effect on hospital stays for the public insurance beneficiaries, which can be explained by the medical practice of keeping lower-income patients in the hospital longer than higher-income patients. For age, the results observed are U shaped: days of hospitalization are greater for the young and for the old, and are lower at intermediate ages.

The selection equation explains the determinants of the decision to chose public or private insurance. The results are consistent with the predictions, and most are statistically significant. A higher income, younger age, smaller number of dependents, residence in an urban area, higher educational level, and employment with a larger company *increase* the probability of choosing private insurance. The finding that older age and more dependents positively affects affiliation to the public insurance indicates the presence of self selection against public insurance based on observable risk variables. All these results agree with previous work in the area (see Sapelli and Torche (1998)). A significant correlation is found between the errors of the selection and count equation (r significantly different from zero).

Results regarding the presence of self selection and moral hazard

Self selection in the insurance/no insurance choice (independent workers)

For independent workers, there is no significant correlation between the non-observable variables determining utilization of physician visits and the decision to purchase health insurance. This indicates the absence of self selection on unobservables related to the utilization of physician visits.

A positive and significant correlation between the non-observable variables determining the number of hospital days and the choice to buy insurance is found. This finding reflects the presence of self selection on unobservables against insurance, related to hospital stays. Hence, people with more unobservable health risk adversely select themselves into the insurance sector. As mentioned before, adverse selection against the public insurance in terms of observable risk is also present.

Self selection in the private insurance/public insurance choice (dependent workers)

For dependent workers, in the case of physician visits there is no significant correlation between the non-observable variables determining both decisions. This indicates the absence of self selection for either of the two kinds of insurance based on non-observable variables that affect the utilization of physician visits.

With respect to hospital days, dependent workers with a greater probability of requiring hospitalization tend to choose public insurance, revealing self selection against public insurance. This is consistent with the fact, observed in previous research, that public insurance operates as an implicit catastrophic reinsurer (Díaz, Gazitúa, Torche and Valdés, 1995).

We also find that self selection is present against public insurance based on variables which are observable (by the private insurances and by the researchers), like age and number of dependants. This is due to the different payment structures of the two types of insurance.

Independent workers: Moral hazard

The expected value of moral hazard on physician visits for independent workers who purchase insurance is positive on average (although its magnitude depends on individual characteristics, see table 6). The estimated value indicates that, on average,

insured workers consume more than twice the quantity consumed by non insured workers. When we consider private and public insurance beneficiaries separately, we find that moral hazard is larger in the case of public insurance. This result is consistent with the fact that independent workers who purchase public insurance have access to almost complete coverage in physician visits, but in the private insurance sector copayments are usually different from zero.

For hospital days moral hazard is not significantly different from zero, a result consistent with a much lower price elasticity of demand for hospitalization than for physician visits.

Bertranou (1998) studies the relationship between utilization of outpatient health care services and health insurance in Argentina. His results are of similar size to ours. For working people without mandatory insurance he finds higher utilization among the insured (45% above average utilization using an OLS regression). When he uses two stage least squares to account for the endogeneity of the dummy variable for health insurance, he finds an even higher utilization among the insured.

Dependent workers: Over-utilization in private and public insurance

The expected value of over-utilization of hospitalization days associated with the purchase of private and public insurance is not significantly different from zero. In the case of physician visits, the expected value of over-utilization is positive for both public and private insurance. (See Table 7).

Cameron et al. (1988) examine the relationship between health care utilization and health insurance in Australia. Using a Negative Binomial model, they find that the utilization of physician visits is 21% higher for those with private in surance (the control group has public insurance). When they use instrumental variables to deal with self selection, the effect of insurance on physician visits for the poor turns out to be not significant, but for the rich they find a much larger effect.

The fact that over-utilization is present in both public insurance and private insurance shows an allocation of individuals between both insurance systems that is based on a kind of comparative advantage, in which consumers choose the type of insurance which allows them to consume the most. This allocation is possible because of the different rationing systems in the two types of insurance. In the private sector, services are rationed by price. But in the public sector, services are predominantly

rationed by queues. This structure allows people to self-select in the sector (private or public insurance) where they face a lower cost of services: for private insurance beneficiaries queues are more costly, because they have a higher opportunity cost (they have a higher income, on average); for public beneficiaries, the opposite is true. Therefore, the existence of a mixed system may increase moral hazard in comparison to a system where there is only one type of insurance. This is an issue of design that must be taken into account in a mixed system[18].

VII. CONCLUSION

For independent workers, we find that insurance plans in Chile receive an adverse selection of the population, and their affiliates consume more than they would have if they had not purchased insurance (moral hazard).

When analyzing the choice between public insurance and private insurance for dependent workers, we find that self selection is present against public insurance based on variables which are *observable* (by private insurance and researchers). This is to be expected, given the different pricing structure of each type of insurance: private insurance has risk-adjusted premiums, while public insurance does not. With respect to *non-observable* variables, we find that self selection is only present in hospitalization, and operates against public insurance. This result may be related to public insurance providing free catastrophic insurance.

Private insurance does not face adverse selection, possibly due to the design of insurance plans. However, this design does not prevent over-utilization. To measure over-utilization, we examine whether people consume more after choosing private insurance (or public insurance), than they would have had they preferred the other insurance. The results indicate that, for physician visits, over-utilization is present in both public and private insurance. This result implies that individuals allocate themselves according to where they have an utilization "comparative advantage";

[18] This would be true unless relative prices (including their composition between money and time costs) are determined in such a way as to deliberately sort the well off into private insurance and set the prices for the poor so they consume the optimum amount of medical services (measured on the social demand curve).

individuals choose the type of insurance which allows them to consume the most. This allocation is possible due to the different pricing structures in public and private insurance.

There is no over-utilization in the case of hospitalization, for either public insurance or private insurance. This is to be expected, since the price elasticity of demand for hospitalization is low.

In sum, for independent workers, our findings replicate those usually found in the literature. For dependent workers, we find that the existence of a mixed system may increase moral hazard in comparison to a system where there is only one type of insurance. Since insured persons select the type of insurance which permits them to consume the most (public or private insurance), the design of the system may be increasing the magnitude of the moral hazard problem.

APPENDIX 1

Variables used in the selection and count data models: dependant workers

In considering the count equation explaining physician visits consumed by dependant workers, the expected signs of the coefficients in the FONASA sector differ from those in the ISAPRE sector:

i) Income: In the ISAPRE sector, higher consumption of services is expected as income rises, since the *income effect* is combined with a *substitution effect* in the same direction: the premium paid rises with increasing income, and thus the health plan's coverage improves (so that the consumer faces lower service fees). In the FONASA sector, on the other hand, the expected sign of income is uncertain, since the *income effect* is counteracted by the *substitution effect*, due to the higher co-payments charged to higher-income consumers in the Institutional Option, and to the rising cost of the consumer's time. The logarithm of per-capita household income is incorporated into the count data models.

ii) Publicly-known risk variables: In the ISAPRE sector, publicly-known risk variables present an uncertain sign, since rising household risk increases the demand for services (all else remaining constant), but the price for these services also increases, since the health plans for high-risk households offer lower coverage (for a given premium). In the FONASA sector, however, more consumption of physician visits is expected as risk grows..

iii) Area of residence: As in the case of independent workers, residence in a rural zone may have a negative effect, because of the greater cost of time associated with the consumption of services, and because of the lower availability of service providers.

iv) Illness: As with independent workers, the variables indicating illness among household members have an expected positive sign in both sectors, since neither FONASA nor the ISAPREs differentiate their premiums based on the current health status.

Among dependant workers, the different price structures in the public and private systems determine the expected sign of the variables in the selection equation explaining the decision to purchase public versus private insurance:

i) Income: Within the ISAPRE sector, as income rises, the fees charged also rise, but the health plan also improves with higher premiums (thus higher income leads to a better health plan, all else remaining constant). FONASA, in contrast, charges a premium which depends on the beneficiary's income and offers the same health plan to all non-indigent members in the Free Choice Option, as well as a plan which favors lower-income beneficiaries in the Institutional Option. This indicates that the cost of insurance (load factor [*factor de cargo*]) in FONASA increases with income; that is to say, higher-income beneficiaries implicitly cross-subsidize lower-income ones, which does not occur in the ISAPRE sector.[19] Thus, higher income should positively affect the probability of choosing the ISAPRE sector. This variable is introduced again in relation to age, where it is expected that the variable's sign should be positive in FONASA and negative for ISAPREs. This is because income elasticity should be higher in FONASA, where the price does not vary with income.

ii) Publicly-known risk variables: In the private sector, ISAPREs are permitted to differentiate their premiums based on age, sex and the number of dependants, so that as expected expenses for the household rise (all else remaining constant), the premium for the health care plan also increases. This implies that implicit, *ex ante* cross-subsidies toward higher-risk households do not exist. Within FONASA, as publicly-known household risk increases, the premium paid for the health plan as well as the co-payments charged remain constant, while the expected benefit of this insurance increases; thus, the cost of public insurance decreases as household risk rises (higher-risk households receive implicit cross-subsidies from lower-risk households). That is to say, the variables which increase household risk (higher number of dependants, higher

[19] Strictly speaking, cross-subsidies in favor of lower-income beneficiaries do in fact exist in some ISAPREs for business policy reasons; however, these are assumed to be lower than those in FONASA.

number of women of childbearing age, increased age, etc.) should negatively affect the probability of affiliation with the ISAPRE sector.

iii) Area of residence: A greater probability of affiliation with the ISAPRE sector (all else remaining constant) is expected in larger cities than in smaller towns and rural areas, due to a greater supply of ISAPRE health plans and private service providers.

iv) Average years of education of the household head and spouse: The choice of a health plan in the ISAPRE sector is complex; in FONASA, on the other hand, there is only one plan. With higher levels of education, the cost of obtaining the necessary information to choose an ISAPRE health plan decreases, thus increasing the probability of affiliation with this sector.

v) Company size (employer of the household head): This variable is incorporated to capture the effect of group health plans offered to company employees. As company size rises, the negotiating power for group health plans increases, which should increase the probability of affiliation with an ISAPRE.

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