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Abstract
This paper provides evidence on ex-ante moral hazard in Portugal. The issue is addressed in a setting where people buy voluntary private health insurance, on top of existing Government coverage. We identify the main factors that lead people to adopt healthy lifestyles, such as taking up sports and not smoking, which are associated with primary prevention. Moreover, it allows for an inference of the role of risk aversion of individuals in these decisions.

We use a GHK recursive simulator of multivariate probit for insurance demand, smoking and sporting decisions, to provide joint estimates taking into consideration potential endogeneity of these decisions.

Our results indicate that there is some evidence of ex-ante moral hazard with respect to primary prevention behaviors. Differences in risk aversion across individuals do not seem to play a primary role in explaining distinct life styles.

Keywords: ex-ante moral hazard, prevention, lifestyles.

JEL classification: I10, D82, D12.

1 Introduction

The main causes of death in developed countries include heart diseases, lung cancer, cerebrovascular diseases, and diabetes. In Portugal, the main causes of death reported by WHO are the following, in percentage of all death causes: cerebrovascular disease – 21%, ischemic heart disease 12%, lower respiratory infections 6%, diabetes – 4%, trachea, bronchus and lung cancer – 3% and chronic obstructive pulmonary disease – 2%.[1] Most of these diseases can be prevented or the probability of its occurrence minimized , by following a healthy lifestyle. This means, for instance, a life without tobacco and with regular physical activity.

Such prevention is different from the prevention that is undertaken with medical examinations and services. This latter type of prevention is denoted by secondary prevention, while the former is primary prevention (Dave&Kaestner, 2006).[2] Our concern in this paper is with the primary level of prevention, often referred to as self-protection behavior. In particular, we care about smoking and sporting decisions.

These decisions are influenced by several factors. We find that smoking is mostly a choice taken by men, getting older, and that going to the doctor may change that choice. The decision to practice sport is associated with women, with slim people and with family and friends. Moreover, we also find that the preventive decisions may be correlated with the fact that people hold additional health private insurance.

The Portuguese public health system (named SNS) covers the whole population.[3] Moreover, the National Health Service is coupled with additional layers of health insurance coverage (termed "health subsystems"). These are the result of occupation-based health insurance funding schemes, which are mandatory for employees of several large companies and civil servants. Despite this coverage, there is a percentage of the population who chooses to take out supplementary voluntary private health insurance.

One may wonder if people who buy extra private health insurance, care

[1] World health statistics (2006), Dead and Daly estimates by causes – 2002.

[2] These two prevention categories are a simplification (Dave&Kaestner, 2006) of the three categories proposed by Kenkel (2000). The third category may be left out because it concerns to the actions that reduce disability associated with chronic diseases, while the first and second categories are actions that aim at reducing the occurrence of a disease.

[3] Further details on the Portuguese health system can be found in Barros and Simões (2007).

less about primary prevention. This phenomenon is called ex-ante moral hazard. On the other hand, if these people are risk averse, they are more prone to hold private insurance and choose healthy lifestyles simultaneously. The decision to take "preventive" measures to avoid negative health shocks cannot be seen independently of the decision to take insurance.

Usually the literature emphasis the role of ex-post moral hazard, which differs from ex-ante moral hazard. Ex-ante moral hazard happens before the occurrence of illness episodes and the individuals have the possibility to influence the probability of the sickness episode. The ex-post moral hazard comes into play after the loss has happened and individuals increase the use of health care more than they would need (Ehrlich and Becker, 1972). The scarce empirical evidence on ex-ante moral hazard is not conclusive. Some authors find evidence supporting its existence (Dave and Kaestner, 2006), others do not (Courbage and Coulon, 2004).

The aim of this paper is to estimate the effect of holding an additional and voluntary private health insurance on the primary prevention activities, using data from the Portuguese Health Survey. Our data comprises a sample of 33146 adult individuals. About 7,6% of these people bought additional private health insurance, 10% do physical activity and 21% smoke.

Our contribution comes from the possibility of verifying the existence of ex-ante moral hazard, taking into account the endogeneity of buying voluntary health insurance. We capture this endogeneity by using a system of probits estimated by GHK simulator, where decisions to do preventive actions and to buy voluntary private insurance are taken as simultaneous.

It may be argued that the decisions to buy insurance and to do preventive activities are not simultaneous but sequential. On the one hand, it is difficult to identify evidence on any specific sequence because insurance contracts are often annually renewed and, either smoking, or sport habits can exist already or be created meanwhile. On the other hand, when it comes to estimation, Greene (1998) showed that it is basically the same to estimate in a two-step procedure or to estimate the probits simultaneously. For these reasons, we estimate a system simultaneous probits.

The estimated coefficients of the controls characterize the people who undertake primary prevention activities. We use a set of controls that describe the person status on several dimensions: social, economic, health, insurance and residential location. Moreover, by splitting the sample in two sub-samples, for young and old adults, we can differentiate the determinants of smoking and sport decisions in different stages of life. In this way, we are

able to provide some insights for health policy makers.

Finally, residuals correlation across equations provide information to extrapolate about the existence of risk aversion. It may be the case that risk averse people buy health insurance and adopt lifestyles, which would explain the possible inexistence of ex-ante moral hazard. However, our finding suggestion that risk aversion differences motivates different life styles and so it sustain the argument about the possibility of ex-ante moral hazard.

This paper is organized as follows. The next section is on the literature review. In section 3 we describe the theoretical foundations and the econometric modeling. Next, we describe our data and undergo a small descriptive data analysis. Section 6 is devoted to present the variables, the estimated model and the tested hypothesis. The results are reported and discussed on section 7. The conclusion is in the last section. Tables are presented in the appendix.

2 Literature review

The empirical evidence on ex-ante moral hazard (Zweifel and Manning, 2000) is scarce, compared with the work done for the ex-post moral hazard.[4] Moreover, the scarce evidence on the existence of ex-ante moral hazard is performed on the secondary level of prevention, not on the primary level, as we focus here. Existing empirical work does not provide conclusive evidence about the existence of ex-ante moral hazard. The most important natural experiment on insures behavior, the Rand Health Insurance Experiment, didn't confirm the existence of ex-ante moral hazard (Newhouse, 1993).

Kenkel (2000) reports no evidence of moral hazard in the US, in 1990. He estimated a simple logit, in particular, the effect of holding private insurance on the odds of preventive behaviors such as obesity, smoking, drinking, seat belt use and Pap examination. His estimation is mainly an exploratory analysis. He found that holding a health insurance leads to healthier choices by men and women. However, not only is the sample restricted to those people who did not hold public health insurance, but also he did not take into account the individuals heterogeneity. Therefore, his estimations may be biased towards to the inexistence of ex-ante moral hazard.

More recently, Courbage and Coulon (2004) tested weather buying private health insurance changes the prevention activities of British people. These

[4] See Barros *et al.* (2008) and the references therein.

authors estimated four independent and simple probits to explain four different preventive behavior (sporting, smoking, breast screening and cervical smear) using a set of explanatory variables that include age, gender, income, education, subjective well-being and also health insurance coverage. They found no evidence of ex-ante moral hazard since the estimated coefficients for private insurance were favorable to the decision of prevention. However, that result may be biased due to the endogeneity of subjective well-being and of private insurance variable, arising risk aversion.

Finally, Dave and Kaestner (2006) analyzed the effect of health insurance on the health behavior on elderly people users of Medicare in the US. They used two econometric and complementary approaches that require two different sets of data, one longitudinal and the other cross-sectional. The longitudinal data set allows the observation of individuals along some time and compare what happens when people become insured, that is before and after the age of 65. The cross-sectional data allows the comparison of two main groups of people, the uninsured and the insured, aged from 60 to 69 years old. Due to the characteristics of these data sets, the authors are able to separate the effects that health insurance have on people behaviors. They separate the ex-ante moral hazard effect from the physicians' visits effect, when public health insurance is considered. The compulsory public health insurance by the age of 65 has two opposite effects. One effect is the decrease of concern with prevention. The other effect comes from the increased contact with doctors that motivate people for prevention.

The authors found some evidence for ex-ante moral hazard in both approaches. According to their econometric estimate, for instance, a man (woman) insured by Medicare has a 34% (48%) lower probability of doing physical activity and 18,9% (16,9%) lower probability of quitting smoking. Still, the interpretation of their findings has to be assessed carefully. The change in insurance status can be completely anticipated by people and this may have implications for behavior. Preux (2009) addresses the issue on anticipatory behaviour when future health insurance coverage is expected and he found weak evidence of ex-ante moral hazard.

The main difference between Dave and Kaestner study and ours is in the type of the health insurance and the type of data set. They have considered a compulsory public health insurance, while we take a voluntary private health insurance. They used a large data set, both longitudinal and cross-sectional, we have available a one year cross-section dataset.

There are other empirical works that look at the determinants of the

demand for private health insurance, of the decisions to smoke and do exercise (though do not consider the simultaneous nature of such decisions). We next describe the more relevant of these works to our discussion. We identify their control variables and main results, which have also contributed to construct and interpret our own model.

About the determinants of the demand for private health insurance, Propper (1989) estimated a binary logit model, applied to the English and Welsh populations, on the determinants of demand for private insurance. She found that the probability of a person buying private health insurance depends positively on a higher income and on being employed but negatively on the number of children in the family.

Several empirical works about the demand for private health insurance exist. For instance, in Israel (Machnes, 2006), in Ireland (Finn and Harmon, 2006), in Great Britain (Besley *et al.*,1998) and in Australia (Hopkins and Kidd, 1996). They found that income, age, marriage and education are positive determinants while family size is a negative one. Moreover, not only work and health status were found to play a significant role in the demand for insurance, but also the NHS waiting lists.

Recently, the work by Barros and Lourenço (2007), using data from Portugal, has found that the significant factors explaining the decision to buy voluntary private health insurance include income, gender (male), age, marriage, education, living alone and being a student.

However, none of these studies considered the problem of moral hazard or the existence of risk aversion. They all use basically the same set of explanatory variables, which we have also included in our econometric estimate.

Most of the work done on the determinant features of smoking, either on the initiation, or in the cessation takes an inter-temporal or dynamic analysis. With our data set, such approaches are not feasible. The single cross-section available forces us to take a static analysis. Nonetheless, some of previous work on tobacco consumption is closer to our setting and provides guidance on relevant variables to include. The work by Viscusi *et al.* (2000) looks for the static determinants of smoking intensity, using a Spanish phone survey. They estimated a tobit model for the number of cigarettes smoked per day. They found that 25-50 years old adults, males, head of the household and preferring whisky to beer increases the odds of smoking, but being educated and considering the beliefs about the risk involved, reduces the amount of cigarettes smoked. The critical difference to our approach in this paper is that Viscusi et al. (2000) have not considered the possibility that holding a

private insurance could change individual behavior.

The determinants of sporting activity have been estimated by Humphreys and Ruseski (2006) for the US and Farrell and Shields (2002) for England. Both studies use similar explanatory variables, which we have borrowed to build our set of explanatory factors. Farrell and Shields estimated a probit model to explain sport participation and found that doing sport is positively related with the level of education, with income, being male and negatively related to age. Humphreys and Ruseski (2006) developed a two stage estimation procedure, where the first stage is a probit equation that estimates sport participation and the second stage is an OLS to estimate the time spent on sport. Their findings can be summarized as follows. Sports participation is more likely with higher income and education and less likely the older people are, if people are married, if there are children in the family and if people are employed. On the other hand, the time spent doing sport increases with age and employment and decreases with income, education, being married and being female.

Our approach integrates of all these three intertwined decisions - to buy health insurance, to smoke and to do sport - on one single model, allowing for common factors to play a role. In this way, we are able to capture the direct and the implicit relationship between these decisions, that no other work seems to have considered before, as far as we are aware of.

3 Theoretical foundations

We build our analysis on the theoretical foundations laid down in two sources. One source is the work of Ehrlich and Becker (1972) on the demand for self-protection. The other source is the traditional Grossman model (1972), based on the human capital theory, that explains how and why agents invest in health capital.

The Grossman model formalizes the demand for health, based on the idea that health is a personalized capital good that deteriorates with time and which can be built through investment. An individual is both consumer and producer of his health. For this purpose each individual has to decide how to allocate is limited time and income. The payoff of this investment is the healthy time that the individual can use to work and earn money. This model provides a set of exogenous variables that allows us to characterize the people that undertake healthy lifestyles, such as age, income, education and

status.

The Ehrlich and Becker model formalizes the demand for self-protection and explains the existence of ex-ante moral hazard. The model is based on the idea that a self-protection decision requires individual effort and that the probability of becoming sick decreases with such effort. Utility depends positively on the degree of insurance coverage and negatively on the preventive effort. Knowing this, an individual wants to maximize his expected utility to determine the optimal amount of self-protection and of insurance simultaneously.

If we consider that self-protection is captured by two types of behaviors (such as the decisions to sport and to smoke), Then the first-order conditions are a system of three structural equations, one for each lifestyle and one for the insurance coverage decision.

The authors show that it is the effect of a change in the amount of preventive activities on the premium that influences the existence, or not, of ex-ante moral hazard. When people choose the optimal level of these activities and the insurance premium is fair, then there is no scope for ex-ante moral hazard. So the probability of getting sick and the amount of prevention are such that a fair premium is sustained. When people choose less self-protection activities, increasing the probability of getting sick, the premium becomes higher than the fair level, and so ex-ante moral hazard emerges.

Unfortunately, we do not have data on the insurance premiums. We propose to test the existence of ex-ante moral hazard through the way preventive behavior is chosen when people hold private insurance.

It is also known that risk averse people choose to buy private insurance, under “fair" conditions. Thus, it is possible to get some insight on risk aversion by analyzing the relationship between the decision to buy private insurance and the decision to do prevention.

The model by Ehrlich and Becker is set in a context of voluntary decision to buy private insurance, without any previous existing health coverage. In the Portuguese case, the whole population is exogenously covered by a public health system. Applying this model to the Portuguese case, the National Health Service does not generate qualitative differences because the individuals may also decide to buy voluntary private health insurance. The reasons to buy additional health insurance in the presence of a National Health Service are related to the existence of waiting lists (mainly for elective surgery and for visits to specialists) and relatively high co-payments (especially in

pharmaceutical products).[5]

4 Econometric model

We use a multivariate probit which accounts for the three dependent variables simultaneously. The estimation of simple probits would yield inconsistent estimates because it would disregard the endogeneity problem of insurance demand and also the correlation between the errors of the three probits.

The estimated system of probits corresponds to a reduced-form approach to the three first-order conditions mentioned in the previous section. This system of equations enables us to explore the correlations between non-observable variables:

$$\begin{cases} y_1 = \begin{cases} = 1 \; if \; ax_1 + \mu_1 > 0 & \text{(insurance decision)} \\ = 0 \; if \; otherwise \end{cases} \\ y_2 = \begin{cases} = 1 \; if \; b_0 y_1 + bx_2 + \mu_2 > 0 & \text{(smoking decision)} \\ = 0 \; if \; otherwise \end{cases} \\ y_3 = \begin{cases} = 1 \; if \; c_0 y_1 + cx_3 + \mu_3 > 0 & \text{(sport decision)} \\ = 0 \; if \; otherwise \end{cases} \end{cases}$$

where y_2 and y_3 are binomial variables capturing the prevention related behavior such as sport and smoking, respectively; y_1 is a binomial variable indicating if the person has private health insurance; x_1 , x_2 and x_3 are a set of control variables; finally a, b, b_0, c and c_0 are coefficients.

We assume that error terms (μ_1, μ_2, μ_3) follow a multivariate normal distribution with zero mean and Σ matrix of variance-covariance, with a unit diagonal and the off-diagonal elements equal to ρ_{ij}.

The evaluation of the likelihood function of such multivariate probits requires the computation of trivariate normal integrals, which are approximated via the Geweke-Hajivassiliou-Keane (GHK) smooth recursive simulator.[6]

The GHK simulator belongs to the class of sampling simulators where one draws from some distribution other than the considered joint distribution, and then re-weights to obtain an unbiased simulator. In this way, the sampling can reduce the simulation error by oversampling parts of the

[5] See Barros and Simões (2007) for further details.

[6] In a multivariate probit the covariance matrix is difficult to estimate and usually there is no close form solution for the evaluation of the multivariate normal distribution, this is why the estimation is based on a simulation method.

error distribution that are most informative. In the case of a multinomial probit model, the main characteristic of the GHK simulator here employed is that it splits the joint normal probability density function into a series of conveniently simulated conditional probabilities from a truncated normal distribution, where the joint probability can be written as the product of each of the conditional simulated probabilities coming from the truncated normal (Cappellari and Jenkins, 2003).

5 The dataset: exploratory data analysis

5.1 Descriptive analysis

Our data comes from the Portuguese 4^{th} National Health Survey (2005) which is a nationally representative sample. The survey includes a broad set of questions covering several topics from personal identification to sport, food and alcohol habits. Our working sample considers all adults, meaning individuals older than 18 year's old, where 47.5% are males and 52.5% are females.

In Table 1, we present the descriptive statistics about sport, smoke and private health insurance (represented as $PrivIn$) for adults. Our key dependent variables are holding private insurance, do sport and smoke. We see that the percentage of men that smokes (about 32%) is much higher than that of women (about 10%). But when it comes to sport, both men and women are similar and about 10% of them do frequent physical activity.

The proportion of adults buying private insurance is not very large but is already significant, around 7.6%.

Table 1 - Descriptive statistics about sport and smoke

	Men		Women		Men and Women	
	Nr	*%Total*	Nr	*%Total*	Total	%
	15735	*0.475*	17411	*0.525*	**33146**	-
Smoke	5067	*0.322*	1816	*0.104*	6883	*0.208*
Sport	1622	*0.103*	1770	*0.102*	3392	*0.102*
Smoke and sport	515	*0.033*	163	*0.009*	708	*0.021*
Privin	1333	*0.084*	1180	*0.068*	2513	*0.076*

Table 2 presents some cross-statistics between private insurance holding and smoke and sport. We find that 26% of those who buy private insurance are also smokers and about 8% of them do regular exercise. An insignificant number of adults who buy private insurance also smoke and do sport simultaneously (around 1.6%).

Table 2 - Descriptive statistics about private insurance, smoke and sport

	Total	*%*
Privin	*2513*	*0.076*
Privin and smoke	*654*	*0.260*
Privin and sport	*193*	*0.077*
Privin and smoke and sport	*39*	*0.016*

In Table 3, we present the tetrachoric correlation[7] of these variables.

Table 3 – Dependent Variables Tetrachoric Correlations

[7]The tetrachoric correlation is a coefficient computed for two normally distributed binary variables.

	Sport	Smoke	Privin
Sport	1	-	-
Smoke	0.0037 Pearson coef=0.0244 (pr=0.876)	1	-
Privin	-0.1318 Pearson coef=19,2802 (pr=0.000)	0.1251 Pearsonc oef=45,513 (pr=0.000)	1

The correlation coefficients are not very high, indicating a slight association. The sign of the correlation coefficient between sport and private insurance is negative, while between private insurance and smoke is positive. This leads us to suspect of the existence of ex-ante moral hazard. Almost no correlation exists between smoke and sport, indicating that these variables tend to be independent. This feature of the data supports the assumption that the sport decision is not relevant explain the smoking decision and vice-versa.

The Chi-square test allows checking if there is a significant statistical relationship between any two variables. The probabilities between parentheses give the level of significance. The correlation coefficient between smoke and sport is not significant, while the other two are.

5.2 Variables

The dependent variables have the following definitions.

PrivIn – Holding, or not, a voluntary private health insurance on top of SNS or any other healthcare subsystem. This is a dichotomous variable where 1 means having voluntary private health insurance and 0 otherwise.

Sport - Practice sport or physical activity regularly. The definition of this variable is provided by CDC – Center for Disease Control and Prevention, US. Accordingly, the variable takes value 1 if moderated physical activity (moderate physical activity means exercise more than 30 minutes each day, more than 5 days a week) or intense physical activity (intense physical activity means exercise more than 20 minutes each day, more than 3 days a week) is undertaken by the individual, and value 0 if otherwise.

We note that this concept of “sport" is a wide one. It includes many physical activities like walking dogs and gardening. We excluded the observations in which the individual was doing physical activity for more than 5 hours each day. This case is not part of our sample because it is either an observation with large measurement error, or the person is a sport professional, or has a strong manual job.

Smoke - Smoking occasionally or daily – 1 if smoking; 0 if no smoking.

The list of control variables is summarized in the following table.[8]

Table 4 - List of control variables

Variable	***Description***
Variables describing social and economic status	
Male	1 if male; 0 if female.
Age	Number of years old.
Age2	Square of Age.
Schyr	School years: number of completed schoolling years
Loginc	Logarithm of income per capita. This is computed from the average income of the chosen interval of incomes by respondent, divided by the square of the number of individuals in the family in order to take into account economies of scale.
Housize	Number of people in the familiy.
Variables describing a person status	
Single	1 if single; 0 otherwise.
Married	1 if married; 0 otherwise.
Divorced	1 if divorced; 0 otherwise.
Alone	1 if alone; 0 otherwise.
Variables describing a person occupation	
Work	1 if works; 0 otherwise.
Student	1 if studies; 0 otherwise.
Unemploy	1 if unemployed; 0 otherwise.
Retired	1 ir retired; 0 if otherwise.
Variables describing the type of health subsystem	
Publ	1 if public health subsystem user; 0 otherwise.
Priv	1 if private health subsystem user; 0 otherwise.
Variables describing the health status	
Chrndis	1 if individual has at least one chronic disease; 0 if no chronic disease.
BMI	Body Mass Index. This is computed as a ratio between the weigt in kilograms and the height in square meters.
Nrvis	Number of visits to the doctor in the last 3 months.
Variables describing the regions – NUT2 classification	
N	North
C	Centre
L	Lisbon and Tagus Valey
A	Alentejo
S	Algarve
Z	Azores

[8]The chronic diseases considered are the following: diabetes, asthma, high blood pressure, chronic pain, rheumatism, osteoporosis, glaucoma, retina diseases, cancer, kidneys diseases, anxiety, chronic hound, bronchitis, CVA, obesity, depression and heart attack.

The following adjustments on data have been performed.

i) We have taken SNS as the default health system since all population is entitled to use it.

ii) The variable number of visits to the doctor in the last 3 months is clearly endogenous in the private insurance demand probit. So it is not included in the set of controls in this estimate. Nonetheless, this variable is included in the probits for sport and smoking decisions, so that we capture the influence that doctors have on patients. In this way, we attempt to capture the effect found by Dave and Kaestner (2006) that doctors counseling has an impact on the health decisions of patients.

iii) We did not consider the health status measured through self-assessment as a explanatory variable because it raises problems of endogeneity and of measurement errors since it is captured after the decisions to practice sport, to (no)smoke and to use private insurance facilities.

iv) We considered a set of regional variables in the insurance probit, to differentiate the access to health insurance for each individual, in order to identify the system of probits. Since these variables give the location of the respondent residence, we are implicitly capturing the regional differences that exist concerning the availability of insurance offices and agents.[9]

These location variables are excluded from the smoke and sport probit because they don't influence these variables. On the one hand, smoking has cultural and habit components which cannot be differentiated across Portuguese regions since Portugal is a country where the political state coincides with the nation. On the other hand, it is common knowledge that it rains more in the north than in the south, which could influence the decision to practice outdoor sport and the number of gymnasiums. However, looking at other complementary information, no such correlation is found.[10]

In Table 5, we present some correlations of interest.

Table 5 - Most relevant correlations

[9] To prevent perfect colinearity, the dummy of the region Madeira was excluded from the estimations.

[10] According to the Portuguese Gymnasiums and Academias Association (AGAP) more than 50% of the members are located in Lisbon area and around 20% in the North region. Our data shows that the people who practice sport are spread more or less evenly across the country.

	Sport	*Smoke*	*Privin*
Loginc	-0.0103	0.0432	0.2466
Schyr	-0.033	0.0715	0.2427
Married	0.0128	-0.0613	0.0483
Alone	0.0023	-0.0375	0.0628
BMI	-0.0150	-0.0037	-0.0158
Student	-0.054	-0.0024	0.0108
Nrvis	-0.0298	-0.0873	0.0032

There is a correlation worth mentioning. The correlation between income and schooling is equal to 0.453. A positive and high correlation would be expected, as it is stated in the theory of the human capital. However, this correlation is not as high as one would expect. Therefore, these two variables do not create collinearity in the econometric estimation.

We did not consider that sport could be a explanatory variable of smoke and vice versa because after observing the data and considering some anecdotal evidence, we realized that smoking and doing sports are not intertwined decisions. As described above, the number of individuals who smoke and do sport is very small. We assume these variables have their own behavior and determinants for individual agents.

Although smoke and sport are not directly related, there is an implicit relationship captured by the residual correlation of the two probits. Risk aversion inter-relates both decisions taken by one individual. A more risk-averse person may do both more sport and have a smaller probability of smoking. Moreover, other non observable variables may influence those decisions such as advertising and fashion. For this reason, we considered these decisions in a system of probits.

6 Main hypotheses

The main hypotheses to be tested and derived from the theoretical analysis can be stated in the following way.

Hypothesis 1 ***Hypothesis 2*** *There is ex-ante moral hazard. The coefficient* b_0 *and* c_0 *are statistical significant and* b_0 *is positive while* c_0 *is negative.*

In order to identify the existence, or not, of ex-ante moral hazard, the estimated coefficients should be significantly negative and positive, respectively, meaning that an individual with coverage from a private health insurance reduces the probability of adopting preventive healthy behaviors of smoking and doing sport.

Hypothesis 3 *The variable "private insurance coverage" is endogenous in the probits for smoke and sport. The correlation* (μ_1, μ_2) *is negative and the correlation* (μ_1, μ_3) *is positive and both are statistically significant.*

If private health insurance coverage (*PrivIn*) is exogenous in the smoke and sport probits, then it would be enough to estimate simple probits. But if it is endogenous[11], estimation needs to be carried out simultaneously.

It is expected that endogeneity exists due to risk aversion. Risk aversion is not observable and so it is accounted in the error term of each equation. That is, $\mu_1 = \beta_1 v + \varepsilon_1$, $\mu_2 = \beta_2 v + \epsilon_2$ and $\mu_3 = \beta_3 v + \epsilon_3$, where v is the risk aversion attitude variable and ϵ is the remaining error term.[12]

A positive (negative) and significant correlation between the error terms μ_1 and $\mu_3(\mu_2)$ suggests the presence of risk aversion differences across individuals, when no other common non-observable and relevant variable exists between probits.[13]. A null correlation also brings information about hypothesis 1. If there is ex-ante moral hazard, then it cannot be due to risk aversion or other non-observable variable.

Hypothesis 4 *There is an implicit relationship between the sport and the smoke decisions. The correlation* (μ_2, μ_3) *negative and statistically significant.*

It is the existence of non-observable variables, such as risk aversion and fashion, that intertwine the decisions to smoke and do sport. The residuals

[11] Meaning that there is correlation between *PrivIn* and the residuals μ_2 and μ_3 arising from some common variable.

[12] The error term ϵ includes all the other possible non observable variables. For instances, ϵ_1 and ϵ_2 may also include the impact of advertising campaigns aimed at promoting healthy life styles, and ϵ_3 may also include the coverage quality of the public health system.

[13] The negative correlation between μ_2 and μ_3 could also be related to risk aversion. However, there are some common variables in these error terms, such as peer pressure, preferences and habit, that advise caution in the interpretation of this correlation as potential risk aversion.

correlation provides us the means to test the existence of such relationship. We expect to find a negative correlation because risk aversion contributes to do sport against smoke. Other possible influences, such as fashion and advertising campaigns, also seem to pull theses decisions in opposite directions.

Hypothesis 5 *There are regional differences concerning the health insurance offer. The coefficient for the Lisbon region should be the larger.*

The estimated positive sign for these coefficients basically means that there is enough offer to cover the demand for private insurance. However, we expect to find differences in the magnitude of such estimated coefficients. The region of Lisbon and Tagus Valley should present a higher estimated coefficient. This is so because it has a higher population density and higher economic development, and therefore a more intense private insurance offer in the form of offices and agents. Differently it should happen with regions with lower population density and/or with lower economic development. These regions will have a lower estimated positive coefficient.

Hypothesis 6 *The economic, social and health status play a relevant role as determinants in the three decisions considered in the multivariate probit.*

This hypothesis intends to list the variables that allows us to characterize the individuals that buy private insurance, do sport and smoke. We expect to find differences according to gender, age, education, income, occupation, and health status as other empirical work have found. We have also tested 3 different probits. The first probit we excluded the square age, to check the non linear influence of age. In the second estimate, the variable number of visit (nrvis) was excluded because it could be causing estimation bias due to endogeneity. The third probit includes all variables.

7 Main results

Table 6 (in the appendix) presents the results of the multivariate probit for all adults.

From the estimated coefficients, we find some evidence on the existence of ex-ante moral hazard, supporting first hypothesis. The estimated coefficient of private insurance in the sport probit is statistically significant and negative. It shows that holding voluntary private health insurance, decreases the

probability of doing sport. However, looking at the coefficient of *PrivIn* in the probit of smoking decision, we find that it is statistically non significant. The sign is positive, indicating ex-ante moral hazard, when the variable on doctors' visit is excluded. But when this variable is included the sign becomes negative, contradicting the first impression. Therefore, only partial existence of ex-ante moral hazard seems to be present.

On the other hand, it can be argued that smoking is a special behavior and a static analysis based on a single cross-section of data may not be the most appropriate method to understand its determinants. Smoking status can be due addiction, peers influence and time inconsistent preferences.

The main finding is that for Portuguese people, the demand for double (and triple) coverage seems not to reflect a preventive attitude since the preventive actions, such as do sport, are not undertaken in general.

With respect to the second hypothesis, we consider that the variable private insurance is endogenous in the probits of sport and smoking. Surprisingly, the estimated residual correlations between (i) sport probit and private insurance probit residuals ($rho21$ in Table 6) and (ii) smoking probit and private insurance probit residuals ($rho31$ in Table 6) are very small and also they are not statistically significant .

Moreover, the likelihood ratio test indicates that the hypothesis that all correlation coefficients are jointly null cannot be rejected. Thus, we cannot conclude that holding private insurance is an endogenous variable in the sport and smoke probits. The (non observed) risk aversion heterogeneity does not seem to play role determining the preventive decisions. According to this result, the probits could be estimated singularly rather than in a system. We have performed such single estimates and we found no relevant difference to the system estimation.

It is worth remarking that this result, on the second hypothesis, reinforces the result of the first hypothesis. This is because there is no evidence on risk aversion that could lead to the choice of some preventive behavior, or to the purchase of private health insurance. Thus, the effect attributed to ex-ante moral hazard does not seem to arise from risk aversion.

As expected from the third hypothesis, the correlation of sport and smoke probit residuals is negative and statistical significant. This correlation indicates that preventive behavior is influenced by common non-observable variables (such as fashion and advertising campaigns), which are pulling apart the decisions to do sport and to smoke.

The fourth hypothesis concerns access to private health insurance by in-

dividuals. The hypothesis is not rejected by our estimates. Indeed, the existence of enough private insurance offer, guarantees that individuals have access to private insurance no matter the region.

As we hypothesized the main difference is in the dimension of the estimated coefficient of the Lisbon and Tagus Valey region. This region is the most dense populated and the most developed region in the country. It comes as no surprise that its estimated coefficient is the highest. Thus, being in this region, provides wider access to insurance offices and agents.

Finally, concerning the last hypothesis, the most relevant and surprising determinants of holding a private health insurance and taking preventive decisions can me summarized as follows.

On the factors explaining the decision to hold private health insurance, an individual who is male, is married and is not totally healthy is more likely to buy a private health insurance. Also age, number of school years and income are positively associated with buying private health insurance. On the other hand, larger households and being unemployed or retired, reduces the likelihood of buying voluntarily health insurance.

The results obtained here are not much different from those obtained by Barros and Lourenço(2007), who have explored the determinants of private health insurance demand alone.

Moving to the factors explaining the decision to neglect a preventive behavior and choose smoking, gender (male) and older age explain a positive probability of smoking.

The higher the number of visits to a doctor, the lower is likelihood that the individual decide to smoke. This may reflect a positive monitor and educative effect from doctors or it may be the result of a sickness that drives smoking cessation. If the individual is going often to the doctor is because is not totally healthy and smoking may not be helping, so the best decision may be not to smoke.

Finally, on the factors explaining the decision to take a preventive behavior and choose sporting, the results suggest that being a female, or not living alone, and working are positively associated with likelihood of doing sport. These results are in line with common expectations.

Somewhat surprisingly, the number of visits to the doctor is negatively associated with the probability of doing sport. We would expect that the doctors advice would result in more exercise. However, here we may be capturing is the effect that feeling sick is a motive for choosing to seat in the sofa instead of going for a walk. We cannot exclude reverse causation

explanations.

To probe deeper into some of the results, we also estimated the model for 2 sub-samples: the young adults, aged between 18-39 years old, and the old adults, older than 40 years old. The estimations are presented in Table 7 (in the appendix).

Overall the results do not differ much across sub-samples, but some points are worth noting. There are some differences in the magnitude of the coefficients, as one would expect from the two samples. The old adults results do not different greatly in sign and in significance from the all adults estimates. The most relevant difference is that we do not find clear evidence of ex-ante moral hazard in the sport probit. The estimated coefficient is not statistically significant but the sign is negative.

The young adults results present some other worthwhile referring differences. Firstly, age and marriage are not statistically significant coefficients in the private health insurance probit. This is somehow expected for young adults.

Education plays a role in the decision to take prevention actions and not to smoke while the number of visits to the doctor is not statistically significant.

The evidence of ex-ante moral hazard in young adults is stronger than in all adults estimates. For young adults, taking voluntary health insurance is more likely to be uncorrelated to expected care needs. Therefore, it may make easier the presence of ex-ante moral hazard associated with voluntary health insurance status.

8 Conclusion

We addressed the existence of ex-ante moral hazard. Estimates regarding this effect were produced using the 4^{th}National Health Survey on Portugal. We found some evidence that people care less about preventive behaviors when they have additional health insurance. However, this evidence is not totally clear, most likely because smoking has some special feature related to peers effect, addiction and time inconsistent preferences, which cannot be captured in a static model.

There is almost no implicit correlation between healthy life styles (primary prevention decisions) and the decision to hold a private health insurance contract. This implies that risk aversion heterogeneity across individuals is

not playing a relevant role in the decisions regarding smoking and doing sports. Thus, risk aversion is not contributing to the effect of the ex-ante moral hazard.

An indirect relationship was found between the decisions of smoking and of doing sport. A potential explanation is the role played by fashion and advertising campaigns. We do not have data enabling a proper testing of this conjecture. Still, for policy purpose, it is a value added to know that those intangible and difficult to measures influences have effect on people' decisions.

The public and private health subsystems don't contribute for the decision to buy voluntary private health insurance nor do they seem to influence the decision to take preventive action.

Finally, the econometric estimation of the different determinants of self-protection decisions provide the key descriptive factors of people decisions. Knowing who and what makes people decide is valuable to design a policy aimed at motivating people to smoke less and do more sport.

To sum up, the main contribution of this work is the empirical evidence about the existence of ex-ante moral hazard, with primary prevention choices and voluntary private health insurance estimated with model of simultaneous equations (probits).

Nevertheless, our analysis is a static one and based on a single cross-section of data. The richness of the data set allowed for a more complex model than earlier studies, at the cost of the time dimension. A dynamic analysis, using different years of observations and lagged variables may provide more accurate results, in particular, concerning smoking. Another possible extension is to include one more life style in the decision process, food choices, which is also a primary prevention decision with implications for health.

References

Barros, Pedro and Lourenço, Oscar (2007), Seguro privado em Portugal, Working Paper presented in the 10^{th} Portuguese National Conference in Health Economics.

Barros, Pedro and Simoes, Jorge (2007), Portugal Health System Review, Health Systems in Transition, 9(5), Allan, S. and Mossialos, E. (Ed.), European Observatory on Health Systems and Policies.

Barros, Pedro et al. (2008), Moral hazard and the demand for health services: A matching estimator approach, Journal of Health Economics, 27(4), 1006-25.

Besley, Tim et al.(1998), Private and public health insurance in the UK, European Economic Review, 42, 491-7.

Cappellari, L. and Jenkins,Stephen. P. (2003), Multivariate Probit Regression Using Simulated Maximum Likelihood, Stata Journal, StataCorp LP 3(3), 278-294.

Courbage, Christophe and Coulon, Augustin (2004), Prevention and private health insurance in the UK, Geneva papers on risk and insurance, 20(4).

Dave, Dhaval. and Kaestner, Robert (2006), Health insurance and exante moral hazard: evidence from medicare, NBER Working Papers 12764.

Eherlich,Isaac and Becker,Gary (1972), Market insurance, self-insurance and self-protection, Journal of Political Economy, 80(4), 623-648.

Farrell, Lisa and Shields, Michael (2002), Investigating the economic and demographic determinants of sporting participation in England, Journal of Royal Statistical Society 165(2), 335-348.

Finn, Claire and Harmon, Colm (2006), Health insurance and health services utilization in Ireland, Health Economics, 10(2), 135-145.

Greene,William (1998), Gender economics courses in liberal arts colleges: further results, Journal of Economic Education, Fall, 291-300.

Grossman, Michael (1972), On the Concept of Health Capital and the Demand for Health, Journal of Political Economy, 82, 223-255.

Hopkins,Sandra and Kidd, Michael (1996), The determinants of the demand for private health insurance under Medicare, Applied Economics, 28(12), 1623 - 1632.

Humphreys, Brad and Ruseski, Jane (2006), Economic determinants of participation in physical activity and sport, Working Paper Series, WP 06-13, International Association of Sport Economists.

Kenkel, Donald (2000), Prevention. In Culyer, A.J. and J.P. Newhouse (eds.), Handbook of Health Economics, North Holland.

Machnes, Y. (2006), The demand for private health care under national health insurance, the case of the self-employed, The European Journal of Health Economics, 7(4), 265-269.

Newhouse, J. (1993), Free for all? Lessons from the RAND health insurance experiment, A RAND Study, Cambridge and London, Harvard University Press.

Preux, L. B. (2009), Ex Ante Moral Hazard & Anticipatory Behaviour: Some Evidence, Working Paper presented in the 11^{th} National Conference of Health Economics - Portugal.

Propper, Carol (1989), An econometric analysis of the demand for private health insurance in England and Wales, Applied Economics, 21(6), 777-92.

Viscusi, W. Kip et al. (2000), Smoking risks in Spain: Part III – Determinants of smoking behavior, Journal of Risk and Uncertainty, 21(2/3), 213-34.

World Health Organization (2004), The world health report 2004 - changing history, Annex Table 2: Deaths by cause, sex and mortality stratum in WHO regions, estimates for 2002.

Zweifel,Peter and Manning, Willard G. (2000), Moral hazard and consumer incentives in health care. In Culyer, A.J. and J.P. Newhouse (eds.), Handbook of Health Economics, North Holland.

APPENDIX

TABLE 6 – Multivariate probit (all adults)

Number of obs = 27657	Number of obs = 27686	Number of obs = 27657
Wald chi2(64) = 5997,62	Wald chi2(65) = 5862,04	Wald chi2(67) = 5835,16
Prob > chi2 = 0,000	Prob > chi2 = 0,0000	Prob > chi2 = 0,0000
Log plikelihood = -29278,612	Log plikelihood = -29162,321	Log plikelihood = -29145,737

privins	coef	P>|z|	coef	P>|z|	coef	P>|z|
male	0,114	0,000	0,118	0,000	0,120	0,000
age	-0,005	0,000	0,049	0,000	0,049	0,000
age2			-0,001	0,000	-0,001	0,000
schyr	0,066	0,000	0,067	0,000	0,067	0,000
married	0,290	0,000	0,168	0,035	0,166	0,037
single	-0,120	0,167	-0,115	0,188	-0,116	0,184
divorced	0,124	0,203	-0,011	0,907	-0,015	0,879
work	0,103	0,019	0,063	0,150	0,062	0,157
retired	-0,291	0,000	-0,142	0,021	-0,143	0,021
unemploy	-0,243	0,002	-0,283	0,000	-0,283	0,000
student	-0,040	0,574	0,098	0,179	0,094	0,195
loginc	0,452	0,000	0,444	0,000	0,444	0,000
housize	-0,029	0,005	-0,032	0,002	-0,032	0,002
publ	-0,256	0,000	-0,286	0,000	-0,285	0,000
priv	-0,070	0,253	-0,095	0,122	-0,093	0,131
chrndis	0,067	0,013	0,057	0,032	0,058	0,031
BMI	-0,001	0,174	-0,001	0,173	-0,001	0,170
N	0,144	0,002	0,147	0,002	0,146	0,002
C	0,020	0,688	0,025	0,603	0,024	0,624
LVT	0,284	0,000	0,290	0,000	0,288	0,000
A	0,067	0,174	0,068	0,169	0,066	0,183
S	0,112	0,018	0,112	0,019	0,111	0,019
Z	-0,363	0,000	-0,358	0,000	-0,359	0,000
cons	-4,843	0,000	-5,794	0,000	-5,790	0,000

smoke	coef	P>|z|	coef	P>|z|	coef	P>|z|
privins	0,004	0,942	0,004	0,936	-0,011	0,830
male	0,747	0,000	0,759	0,000	0,756	0,000
age	-0,018	0,000	0,034	0,000	0,034	0,000
age2			-0,001	0,000	-0,001	0,000
schyr	0,000	0,914	0,002	0,595	0,002	0,527
married	-0,030	0,612	-0,110	0,072	-0,112	0,067
single	0,024	0,679	0,042	0,474	0,040	0,495
divorced	0,603	0,000	0,491	0,000	0,489	0,000
alone	0,036	0,312	0,008	0,811	0,010	0,773
work	0,176	0,000	0,148	0,000	0,148	0,000
retired	0,004	0,923	0,181	0,000	0,185	0,000
unemploy	0,480	0,000	0,449	0,000	0,449	0,000
student	-0,469	0,000	-0,334	0,000	-0,334	0,000
loginc	0,021	0,173	0,011	0,473	0,013	0,421
housize	0,026	0,000	0,027	0,000	0,026	0,000
publ	0,004	0,873	-0,028	0,289	-0,029	0,285
priv	0,078	0,127	0,048	0,351	0,050	0,326
chrndis	-0,041	0,049	-0,057	0,005	-0,049	0,017
nrvis	-0,012	0,065			-0,011	0,083
_cons	-0,701	0,000	-1,649	0,000	-1,650	0,000

sport	coef	P>|z|	coef	P>|z|	coef	P>|z|
privins	-0,171	0,006	-0,234	0,000	-0,173	0,005
male	-0,044	0,044	-0,038	0,075	-0,043	0,049
age	-0,003	0,006	0,005	0,253	0,004	0,296
age2			0,000	0,056	0,000	0,071
schyr	-0,026	0,000	-0,025	0,000	-0,025	0,000
married	0,175	0,005	0,162	0,010	0,161	0,010
single	0,012	0,839	0,016	0,786	0,015	0,797
divorced	0,145	0,037	0,126	0,074	0,126	0,075
alone	-0,160	0,000	-0,165	0,000	-0,164	0,000
work	0,138	0,000	0,137	0,000	0,133	0,000
retired	-0,108	0,014	-0,091	0,043	-0,088	0,050
unemploy	-0,123	0,036	-0,129	0,027	-0,129	0,027
student	0,039	0,523	0,061	0,327	0,059	0,347
loginc	0,003	0,857	0,006	0,752	0,002	0,930
housize	0,022	0,006	0,023	0,004	0,023	0,005
publ	0,054	0,069	0,045	0,129	0,048	0,105
priv	-0,030	0,634	-0,037	0,554	-0,034	0,584
chrndis	-0,049	0,041	-0,060	0,010	-0,051	0,033
BMI	-0,002	0,002	-0,002	0,002	-0,002	0,002
nrvis	-0,014	0,050			-0,014	0,050
_cons	-0,994	0,000	-1,179	0,000	-1,131	0,000

	coef	P>|z|	coef	P>|z|	coef	P>|z|
rho21	0,011	0,608	0,000	0,994	0,009	0,684
rho31	0,005	0,849	0,036	0,168	0,004	0,879
rho32	-0,025	0,071	-0,023	0,085	-0,025	0,069

Likelihood ratio test of
rho21 = rho31 = rho32 = 0:
chi2(3) = 3,5792
Prob > chi2 = 0,3106

Likelihood ratio test of
rho21 = rho31 = rho32 = 0:
chi2(3) = 4,90436
Prob > chi2 = 0,1789

Likelihood ratio test of
rho21 = rho31 = rho32 = 0:
chi2(3) = 3,51687
Prob > chi2 = 0,3186

TABLE 7 – Multivariate probit (sub-samples by age)

	age +40	**age 18-39**
	Number of obs = 17193	Number of obs = 10464
	Wald chi2(67) = 5854,73	Wald chi2(67) =9323,27
	Prob > chi2 = 0,000	Prob > chi2 = 0,000
	Log plikelihood = -16450,641	Log plikelihood = -12481,246

privins	Coef.	P>z	Coef.	P>z
male	0,158	0,000	0,063	0,100
age	0,047	0,011	-0,024	0,475
age2	-0,001	0,001	0,001	0,321
schyr	0,072	0,000	0,059	0,000
married	0,155	0,056	-0,001	0,999
single	-0,088	0,386	-0,302	0,452
divorced	0,002	0,988	-0,224	0,591
work	0,037	0,488	0,089	0,260
retired	-0,152	0,023	-4,035	0,000
unemploy	-0,432	0,000	-0,145	0,219
student	-4,455	0,000	0,084	0,389
loginc	0,417	0,000	0,489	0,000
housize	-0,017	0,220	-0,059	0,000
publ	-0,249	0,000	-0,384	0,000
priv	-0,109	0,153	-0,064	0,547
chrndis	0,046	0,181	0,081	0,054
BMI	-0,002	0,062	0,000	0,790
N	0,106	0,092	0,185	0,007
C	-0,007	0,914	0,062	0,410
LVT	0,236	0,000	0,347	0,000
A	0,024	0,716	0,117	0,124
S	0,086	0,173	0,131	0,068
M	-0,279	0,000	-0,528	0,000
_cons	-5,571	0,000	-4,657	0,000

smoke	Coef.	P>z	Coef.	P>z
privins	-0,104	0,133	0,030	0,697
male	0,877	0,000	0,639	0,000
age	-0,020	0,069	0,053	0,022
age2	0,000	0,344	-0,001	0,022
schyr	0,027	0,000	-0,037	0,000
married	0,008	0,904	-0,167	0,472
single	0,156	0,025	0,132	0,567
divorced	0,469	0,000	0,553	0,021
alone	-0,208	0,000	0,159	0,001
work	0,156	0,001	0,067	0,179
retired	0,186	0,001	-0,204	0,461
unemploy	0,431	0,000	0,406	0,000
student	-0,509	0,371	-0,246	0,000
loginc	0,010	0,630	0,047	0,052
housize	0,048	0,000	-0,003	0,781
publ	-0,036	0,300	-0,058	0,189
priv	0,073	0,250	-0,050	0,560
chrndis	-0,096	0,000	0,056	0,079
nrvis	-0,023	0,011	0,010	0,286
_cons	-0,371	0,272	-1,673	0,000

sport	Coef.	P>z	Coef.	P>z
privins	-0,032	0,692	-0,296	0,004
male	-0,072	0,013	0,003	0,920
age	0,020	0,097	-0,057	0,042
age2	0,000	0,039	0,001	0,056
schyr	-0,028	0,000	-0,020	0,000
married	0,125	0,091	0,363	0,235
single	-0,054	0,467	0,180	0,557
divorced	0,080	0,323	0,395	0,210
alone	-0,124	0,032	-0,211	0,000
work	0,118	0,005	0,169	0,006
retired	-0,072	0,134	-3,971	0,000
unemploy	0,015	0,840	-0,276	0,004
student	-3,843	0,000	0,013	0,870
loginc	-0,017	0,443	0,005	0,860
housize	0,032	0,006	0,011	0,376
publ	-0,129	0,441	0,032	0,535
priv	-0,219	0,188	-0,104	0,352
chrndis	-0,290	0,118	0,030	0,437
BMI	-0,210	0,243	-0,001	0,068
nrvis	-0,103	0,001	-0,020	0,122
_cons	-0,003	0,006	-0,458	0,391

	Coef.	P>z	Coef.	P>z
rho21	0,027	0,347	0,011	0,738
rho31	0,015	0,665	0,046	0,309
rho32	-0,035	0,061	-0,033	0,114

Likelihood ratio test of
rho21 = rho31 = rho32 = 0:
chi2(3) = 4,77752
Prob > chi2 = 0,1888

Likelihood ratio test of
rho21 = rho31 = rho32 = 0:
chi2(3) = 3,83193
Prob > chi2 = 0,2802