Does health care program participation favor advantageous selection? Some econometric results from insurance company data

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Abstract

In France, since a recent reform, employers have to offer a complementary private health care insurance to workers and insurers have incentives to invest an increasing proportion of insurance premiums in prevention actions. Hence, these contracts are often coupled with a supply of free health prevention program. Since asymmetric information is often advanced as an explanation of the tightness of the Long-term Care (LTC) insurance market, we study these phenomena in the framework of the introduction of these new programs. Starting from the paper of Ehrlich and Becker (1972), we propose a theoretical model to study the equilibrium properties of the trade-off between self-protection and LTC insurance coverage decisions. We show that the presence of prevention program changes the nature of the trade-off between self-protection and insurance coverage decisions: the relation is still undetermined under the general case but becomes substitutable in the specific case of a fair premium. These properties are tested empirically with an original survey data set on policyholders, containing information on behavioral bias and individuals' preferences, as well as additional information unobservable for the insurer. We show that the ex-ante moral hazard effect is, in reality, driven by (non-rational) individuals' preferences when we consider non-rationality assumption. In addition, in line with the properties of the theoretical model in the general case, the prevention program encourages both self-protection effort and LTC insurance purchase: advantageous selection, previously unobservable for the insurer, passes through another channel and is consequently revealed.

JEL codes: C35, D82, D91, I11, J14
Keywords: Self-protection; Long-term care insurance; Asymmetric information; Prevention program

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I. Introduction

The extension of the life expectancy should significantly increase the expenditure of social welfare for the financial risk of long-term care during the next decades. This context limits the possibilities of the public authorities to alleviate the out-of-pocket health care expenditures supported by individuals at risk (De Donder, 2015). The level of this burden, near than 7.2 billion euros in France, represents in 2012, a cost of 396 € per individual and per month (Zerrar, 2016). Furthermore, this amount does not include the indirect costs of the informal aid (family help) to the elderly who suffer from a loss of mobility and autonomy in their daily's activity, nor the social cost due to the spillover effect on the own health of the family's members. Lumby, Browning and Finke (2017) estimate that 70% of Americans over the age of 65 will require some kind of long-term care aid in the next future and that this part of the population is expected to double in 2050. In France, Gallou (2015) evaluates that 41% of French people at the age of 60 will benefit of at least one year of long-term health care service.

In this context, the market of private health insurance is one of the manners for individuals to cover a part of this financial risk. Unfortunately, in 2017, only 7.1 million individuals were holding a private insurance contract for the dependency risk, and about 2.2 million of them owned a specific long-term care insurance contract that is separated from the general private health insurance contract (FFA, 2017, De Donder, 2015).

While the risk and its severity are quantitatively brought up, the main potential barriers in the development of the market of the long-term care insurance (on the supply side as well on the demand side) were clearly identified by the theoretical as the empirical literature. Incomplete information, like moral hazard or adverse selection problems, are generally advanced to explain the perception of too high level of insurance premium for long-term care insurance contract by individuals (De Donder, 2015). Subjective perception of the risk of dependency is sometimes also biased by literacy (Matzek and Stum, 2010). However, in the specific case of dependency risk, the level of insurance benefit in case of disease is fixed *ex-ante* by the insurer, which should reduce the incentives to moral hazard behavior. The potential health loss due to this kind of illness is irrevocable and all the over health consumption good is paid by the insured (Legal and Plisson, 2008). The empirical results

obtained from US as French data (Chiappori and Salanié, 2000; Finkelstein and McGarry, 2006) do not deny the absence of moral hazard behavior, whenever the econometric strategy used in those studies rarely allows the isolation of the confounding influence of behavioral factors like risk aversion, impatience, altruism or institutional morality.

While the contribution of the individual's socio-demographic attributes is weak to explain the insufficient long-term care insurance take-up rate, the existence of behavioral bias, like those described by the behavioral economics literature, can bring a better support to the explanation of this stylized fact (Legal and Plisson, 2008; Courbage and Roudaut, 2008). Using the 2011 French data of the PATER[1] survey, Fontaine, Plisson and Zerrar (2014) show that if the impatience reduces the subjective perception of the risk of long-term dependency, the risk aversion and the degree of altruism has a positive influence on the purchase of long-term care insurance. In the same way, Boyer *et al.* (2017) in Canada, and Zerrar (2016) in France, have demonstrated that over-confident people underestimate their risk of dependency, which reduced their willingness to subscribe a private long-term care insurance. Likewise, the experience of a close victim in the family to the Alzheimer disease tends to reduce the inertia bias and stimulate subscription (Coe et al., 2015). Non-observable for the insurer, these characteristics constitute a source of informational quasi-rent for insured, since they directly depend on their health preventive behavior and their health state.

Crowding-out effect and self-prevention behavior are two other factors which contribute to the weak attraction of long-term care insurance contracts. Each individual can decide to invest in some self-protection effort to reduce the risk (stimulate his cognitive capacities, adopt regular sports practice, make frequent health check-ups, etc.) or make self-insurance decision to reduce the severity of the disease and its expected financial loss (become homeowner and benefit of home equity, invest in a life insurance or accumulate savings). In their seminal paper, Ehrlich and Becker (1972) have analyzed the nature of the link between self-prevention actions and the demand for private insurance. The equilibrium properties of their model demonstrate that the nature of the link is indeterminate in the case of self-protection but a substitution between self-prevention and demand for insurance is obtained in the self-insurance case. However, in the case of an equity (actuarial) insurance

[1] 2011 French survey on heritage, risk and time preferences (PATER)

premium, the indetermination of the self-protection case can be raised and replaced by a complementarity property which demonstrates the absence of *ex-ante* moral hazard. In this way, using the data from the 2011 French survey on heritage, risk and time preferences, Zerrar (2016), find a negative relation between the financial capital accumulation and the demand for long-term care insurance. This result does not reject the substitutability property of Ehrlich and Becker (1972) model of self-insurance. It was recently confirmed by the experimental design realized in Canada by Pannequin, Corvos and Montmarquette (2016). In the case of self-protection, Courbage and Coulon (2004) realized econometric estimations with the 2010/2011 wave of the British Household Panel Survey. Their results demonstrate the existence of a complementarity between each kind of self-protection decision, like sports activities, no smoking, regular participation to breast and cervical tests for women, and private health insurance. However, no econometric application was made recently to test the complementarity or the substitutability property in the specific case of long-term care insurance. The econometric results obtained by Courbage and Roudaut (2008) from the SHARE (Survey of Health, Ageing, and Retirement in Europe) data, stimulate an econometric application in this direction. These authors reveal that individuals with a high body mass index, or those who report an abusive alcohol consumption, have a higher probability to invest in a long-term care insurance, so that substitutability and not complementarity seems to prevail between the demand for long-term care insurance and self-protection.

Behavior in terms of self-protection and private insurance demand can also be influenced by public authorities that develop policies to stimulate preventive care attitudes. In France, the law for the protection of employment established in June 2013, generalize the Inter-professional National Agreement (INA) that was signed between the employers and syndicates in January 2013. By this law, all private employer is required to offer, since the first of January 2016, a complementary private health care insurance with a minimal level of health protection to his workers. Moreover, the insurance company involved in the agreement, has to invest at least 2% of the collected insurance premium in prevention and solidarity actions. In this new environment, insurance companies have developed a supply of health insurance coupled with, in often cases, a supply of free health prevention programs to their policyholders. On the insurance company point of view, the adoption of these programs by their customers delivers precious information (via connected objects) on their health state,

their level of self-prevention effort, and as a result reduces the asymmetry of information. When the law, like in France, does not permit a 'pay as you behaved system' for health insurance, the insurer can observe the health profile of their customer and reduce their risk by offering some incentives to their customer to participate in some health care program. On the firm point of view, this new health service is favorable to a better satisfaction on the job by workers, reducing the cost of absenteeism and increasing the efficiency of the labor force[2]. On the worker point of view, if the main objective is to reduce the risk of illness and its potential severity, this free health care preventive service can also generate a windfall effect that could affect the nature of the optimal trade-off between self-protection (or self-insurance) decision and the demand for insurance. In this sense, the main purpose of our paper is precisely to introduce this 'prevention program option' in a simple model of insurance where the individual has to choose between self-prevention and private insurance. We concentrate our analysis in this paper by studying the equilibrium properties of the optimal decision of an individual who choose an effort level of self-protection and an optimal level of insurance coverage. We demonstrate that if the accession to the program always increases the optimal level of health care effort by individuals, the properties of complementarity between self-protection and insurance demand obtain by Ehrlich and Becker (1972) canonical model are now being questioned in the presence of a free health care prevention program. We demonstrate that the relation between self-protection effort and insurance demand is undetermined in the general case, but self-protection effort and private insurance are substitutes and no longer complements when the insurance premium is fair. So, the externality provided by the free health prevention program, led not to observe a reduction in effort (no moral hazard) but an under consumption of insurance in the self-protection case that we study[3]. This result stigmatized the risk of a mismatch between the health individual profile and the level of health insurance coverage chosen by the individual.

Because the supply of complementary health care insurance by insurers often integrate a long-term care risk coverage dimension, the new institutional context since 2016 in France could transform the usual effect of asymmetric information in this particular segment of the

[2] In Canada the Interdepartmental plan of preventive health action was instituted from 2017 to 2021. Its third axis is focusing attention on the development of health preventive actions at the firm level with an effort to reduce the health risk by better working conditions.

[3] The case of self-insurance is addressed by Lesueur (2018).

insurance sector. In this way, as the general equilibrium properties of our model generates an undetermined effect of participation in health care programs on the insurance coverage level, this result motivates an econometric strategy with original data to identify a net negative or positive effect.

The structure of the paper is the following. In the second section, we present a simple model of insurance where the individual decides about the level of self-protection effort and the level of insurance coverage. Using the Ehrlich and Becker (1972) properties as a benchmark, we present the new results of the model when the individual combines an individual effort and benefit of an individual health monitoring through his participation in a health care program. In the third section, we describe our original data from a survey of 1200 customers of a French mutualist group. One originality of the data is that they gathered information concerning behavioral bias and individuals' preferences (risk perception, time consistency, degree of altruism and degree of social integration), which will be used in the econometric part of the paper. The fourth section presents the econometric strategy that is retained to test the equilibrium properties of our model and to control the sources of endogeneity bias. The fifth section presents and discuss the econometric results and the last section concludes.

2. Theoretical Foundations

In a first step, we present the equilibrium properties of a simple model of insurance where the insured choose the level of self-protection effort and the level of long-term care insurance coverage. We study in a second step the impact of participation in a health care program by the insured on the equilibrium properties of the model.

2.1. A Simple Model of Self-protection Versus Insurance Coverage Choice

We consider a simple canonical insurance model where individuals with an initial wealth R, face a risk of Alzheimer's disease at old age with a probability p, ($0<p<1$), associated with a high financial cost of long-term care L. To prevent this risk, each individual can choose ex-ante an optimal trade-off between a self-protection effort (e, $0<e<1$) to reduce the risk, or a level of long-term care insurance to cover the loss ($0<\beta<1$). When an individual purchase a long-term care insurance, the amount of insurance benefit and the insurance premium are

proportional to the level of coverage he has chosen (βL). The insurance premium depends on a loading factor $\lambda \geq 0$, so that: $Pa = \beta(1+\lambda)pL$. Each level of preventive care effort is costly and the cost function $C(e)$ is convex so that $C'(e)>0$ and $C''(e)>0$.

The net wealth of an individual is W_A in case of dementia disease and W_{NA} if he has no disease.

$$W_A = R - C(e) - \beta(1+\lambda)pL - (1-\beta)L$$
$$W_{NA} = R - C(e) - \beta(1+\lambda)pL$$

We suppose that individual risk aversion preferences are defined by a Von Neumann Morgenstern utility function $u(W)$ with $u'(W)>0$ and $u''(W)<0$ so that the Expected Utility function of a representative risk-averse individual is:

$$E(U)_A = pu\left[R - C(e) - \beta(1+\lambda)pL - (1-\beta)L\right] + (1-p)u\left[R - C(e) - \beta(1+\lambda)pL\right]$$

In the self-protection case that we address, individuals can invest in costly intellectual activities each day to stimulate their memory, in order to reduce their risk of long-term care dependency when older. In that case, the level of effort made by an individual, reduces his long-term risk, but has no effect on the loss L. In that way, $p'(e)<0$, $p''(e)>0$ and $L'(e)=0$. The insurance premium (P_a) is affected by the level of self-protection effort so that: $Pa = \beta(1+\lambda)p(e)L$. Each individual determines the levels of effort and insurance coverage that maximize its expected utility:

$$E(U)_A = p(e)u\left[R - C(e) - \beta(1+\lambda)p(e)L - (1-\beta)L\right] + (1-p(e))u\left[R - C(e) - \beta(1+\lambda)p(e)L\right]$$
$$\exists\,(e^*, \beta^*) = \arg\max E(U)_A$$

Let us now study the two first order conditions of this maximization problem:

$$\frac{\partial E(U)_A}{\partial e} = 0 \Leftrightarrow p'(e^*)\left[u(W_A) - u(W_{NA})\right] = \left[C'(e^*) + \beta(1+\lambda)Lp'(e^*)\right]\left[p(e^*)u'(W_A) + (1-p(e^*))u'(W_{NA})\right] \quad (1)$$

By (1), the optimal level of self-protection effort is obtained when its marginal return is equal to the marginal cost of effort. A sufficient condition to satisfy the second order condition

is $C'(e^*)+\beta(1+\lambda)Lp'(e^*)\leq 0$ (cf. Appendix 2), by which the marginal return of the self-protection is always at least equal to its marginal cost.

Using now the first order condition on 'β' we get:

$$\frac{\partial E(U)_A}{\partial \beta}=0 \Leftrightarrow -\frac{1-p(e)}{p(e)}\frac{u'(W_{NA})}{u'(W_A)}=\frac{(1+\lambda)p(e)-1}{(1+\lambda)p(e)}<0 \qquad (2)$$

By (2), the optimal level of long-term care insurance coverage is obtained when the relative price of insurance equals the implicit price of self-protection effort, that is, the marginal disposition of an individual to pay for transferring one unit of wealth from the good state (healthy state) to the bad state (disease state). This condition is always satisfied when the loading factor $\lambda<\frac{1-p(e)}{p(e)}$.

Here again notice that the second order condition is always satisfied so that $\frac{\partial^2 E(U)_A}{\partial \beta^2}<0$ (cf. Appendix 2).

Gathering conditions (1) and (2), we can define the implicit function (3):

$$\vartheta(e^*,\beta^*)=-\left[C'(e^*)+\beta(1+\lambda)Lp'(e)\right]u'(W_A)+p'(e^*)(1+\lambda)\left[u(W_A)-u(W_{NA})\right]=0 \qquad (3)$$

In order to evaluate the substitution or complementarity between self-protection effort and insurance coverage at equilibrium we can use the implicit function theorem by which:

$$\frac{de^*}{d\beta^*}=-\frac{\frac{\partial \vartheta}{\partial \beta^*}}{\frac{\partial \vartheta}{\partial e^*}}$$

We can now restore one of the standard results of Ehrlich and Becker (1972) model concerning the nature of the link between optimal self-protection effort and optimal insurance coverage level.

$$\frac{\partial \vartheta}{\partial e^*} = -\left[C''(e^*) + \beta(1+\lambda)Lp''(e)\right]u'(W_A) + \left[C'(e^*) + \beta(1+\lambda)Lp'(e)\right]^2 u''(W_A)$$
$$- p'(e^*)(1+\lambda)\left[C'(e^*) + \beta(1+\lambda)Lp'(e)\right]\left[u'(W_A) - u'(W_{NA})\right] + p''(e)(1+\lambda)\left[u(W_A) - u(W_{NA})\right] < 0$$

So, the sign of $\frac{de^*}{d\beta^*}$ =sign of $\frac{\partial \vartheta}{\partial \beta^*}$

$$\frac{\partial \vartheta}{\partial \beta^*} = -p'(e)(1+\lambda)^2 p(e)L\left[u'(W_A) - u'(W_{NA})\right] +$$
$$+\left[C'(e) + \beta(1+\lambda)Lp'(e)\right]Lu''(W_A)\left[p(e)(1+\lambda) - 1\right] > 0 \text{ ou} < 0$$

As the Ehrlich and Becker (1972) seminal paper, our simple model demonstrates that the nature of the relation between self-protection effort and the level of insurance coverage is undetermined so that in the general case, we cannot conclude to a substitution or a complementarity between these two kinds of actions to reduce the risk of long-term care dependency. Ehrlich and Becker (1972) demonstrated that this indetermination can be resolved in the particular case where the insurance premium is fair. In that case, the loading factor λ is zero and the first order condition (2) is reduced to $u'(W_{NA}) = u'(W_A)$, so that a fixed level of wealth $\bar{W}$ is guaranteed to the insured in the two states of nature. The implicit function $\vartheta(e^*, \beta^*)$is now simplified to:

$$\vartheta(e^*, \beta^*) = -\left[C'(e^*) + \beta Lp'(e)\right]u'(\bar{W}) = 0 \qquad \text{(3b)}$$

Where:

$$\frac{\partial \vartheta}{\partial e^*} = -\left[C''(e^*) + \beta Lp''(e)\right]u'(\bar{W}) < 0$$

And

$$\frac{\partial \vartheta}{\partial \beta^*} = -u'(\bar{W})Lp'(e) > 0$$

Under these new conditions, $\frac{de^*}{d\beta^*} > 0$ which means a strict complementarity between self-protection effort and insurance coverage. Denying the existence of moral hazard, this result shows that a positive level of costly self-protection can exist meanwhile full-insurance coverage is chosen. As we can see from (3b): $\exists e^{**} > 0, \quad \text{so that } C'(e^{**}) = -\beta Lp'(e^{**})$

The intuitive interpretation of this result is interesting to develop by reminding the two opposite effects expected from the insurance coverage on the self-protection effort. Indeed, the insured anticipates a reduction of the price of the insurance when its self-prevention effort increases. At the equilibrium, for a level of insurance coverage, his expected marginal income is $-\beta L p'(e)$. Whatever his level of risk aversion, this level of marginal income is just sufficient to cover the marginal cost of self-prevention effort so that there is no incentive for him nor to reduce the demand for insurance, nor to reduce the level of effort.

In an econometric study, using the data from the *British Household Panel Survey* (BHPS), Courbage and De Coulon (2004) do not deny this equilibrium property between self-prevention and insurance coverage. Controlling for the endogeneity of the choice of insurance coverage, their econometric results show a statistically significant positive link between insurance coverage level and individual preventive actions like sporting activities or healthy life nutritional choice, rejecting moral hazard hypothesis.

2.2. The Influence of the Participation to a Health Care Prevention Program

Now we suppose that, in line with the ANI recommendation, the insurer associates a free health care prevention program to his offer of long-term care insurance contract. In most of the health care prevention program offered by insurers, and for whom we gave some examples in the introduction of this paper, the insured participation to an individualized medical follow-up is stimulated in exchange for non-monetary advantage like freely meeting information about nutrition or physical activities, or a reduced rate for membership of fitness clubs in partnership with the insurer. The objective of these kinds of programs is at first to develop literacy about health risk and, in a second phase, to reduce the cost of the self-prevention effort incurred by the insured. When these programs are supplied in collective health insurance contracts, the participation is also stimulated by peer pressure effect on the work place. This effect contributes to a reduction in the self-prevention effort cost. For all these reasons we choose to identify the intensity of the membership to a health care prevention program by a parameter '*b*' which reduces the marginal cost of effort at equilibrium, so that: $\frac{dC'(e^*)}{db} = C''_{e^*b} < 0$. All other things being equal, an insured who combines individual self-protection effort and participation to a freely health care prevention

program offered by his insurer, benefits of some economies of scope that reduced the marginal cost of effort.

In order to evaluate the effect of this participation, we apply here again the properties of the implicit function theorem with this new hypothesis in our model.

$$\frac{de^*}{db} = -\frac{\frac{\partial \vartheta}{\partial b}}{\frac{\partial \vartheta}{\partial e^*}} \qquad \text{and} \qquad \frac{d\beta^*}{db} = -\frac{\frac{\partial \vartheta}{\partial b}}{\frac{\partial \vartheta}{\partial \beta^*}} \quad \text{with} \quad C''_{e^*b} < 0$$

From the implicit function (3) we know that $\frac{\partial \vartheta}{\partial e^*} < 0$ and $\frac{\partial \vartheta}{\partial \beta^*} > ou < 0$

And now $\frac{\partial \vartheta}{\partial b} = -C''_{e^*b}(e^*)u'(W_A) > 0$ (4)

So, whatever λ>0: $\frac{de^*}{db} > 0$ and $\frac{d\beta^*}{db}$ is undetermined.

Participation in a freely health care prevention program increases the level of effort but has no determined effect on the choice of the level of insurance coverage.

However, remember that when the insurance premium is fair (*λ=0*), the implicit function is (3b): $\vartheta(e^*, \beta^*) = -\left[C'(e^*) + \beta Lp'(e^*)\right]u'(\bar{W}) = 0$

Under this new condition $\frac{\partial \vartheta}{\partial e^*} < 0$ but now $\frac{\partial \vartheta}{\partial \beta^*} > 0$ (5)

Gathering (4) and (5) and applying implicit function properties we obtain:

$\frac{de^*}{db} > 0$ and $\frac{d\beta^*}{db} < 0$ which means that now, self-protection effort and long-term care insurance coverage are substitutes and not complements.

So, when the insured participates in a health care prevention program freely offered by his insurer, and if the insurance premium is fair, his level of effort increases so that the program stimulates good health care decision, but at the same time, his demand for long-term care insurance decreases. We observe a kind of crowding out effect by which the externality generated by freely offers of health prevention program reduces the level of insurance coverage. In that case, we can have some mismatch between the health risk profile of the individual and his choice about the level of coverage in long-term care insurance. Even though we test this theoretical property using real data in the rest of the paper, it is possible to relate

it with the results of Qin and Liu (2013) and Dillender (2017) who show that the US health care safety net system[4] discourages private insurance coverage.

Qin and Liu (2013) evaluates at 587 dollars, per inhabitant and per year, the social cost of these public health services that is incurred at the federal level. Under an expected utility framework, they determine the optimal level of health consumption by individuals in three states: the uninsured state, the private insurance coverage state and the safety net health care state free of charge. They demonstrate the existence of a threshold level of risk under which a crowding out effect is generated by the health care safety net option which reduces the level of private insurance coverage. This equilibrium property is not denied by their econometric results on US data, and they evaluate at 46% the negative contribution of this crowding out effect at 46% on the private health insurance subscription probability.

3. The Data

We use data from a survey of customers aged 40 or more of a French mutualist group, conducted in 2016. The sample is representative of policyholders by age, gender and the type of complementary health care insurance contract (collective or individual). Individuals are mainly asked about the preparation of the old age, their preferences, and their expectations for potential new services to improve health, well-being and healthy behaviors. Questionnaire also collects principal socio-demographic information as gender, age, occupation, working status, marital status or income.

In the specific part of the questionnaire related to the preparation for the old age, respondents are asked about their saving behaviors (life-insurance, retirement saving plan, home purchase saving plan). As in Zerrar (2016), we define these behaviors as self-insurance behaviors because savings can be converted to care if LTC dependency occurs. Moreover, several questions are directly related to the dependency risk. We know if individuals have an LTC insurance, know a close relation who needs care, and if they make some self-protection effort by seeking to stimulate their intellectual abilities. However, this latter information is

[4] The Health Care Safety Net system was established in 1946 in the United States by the Hill-Burton Act and was reinforced by the Bush administration in 2002 that create the Health Center Initiative. This system provided charitable health care to the poor and uninsured people, and patients with immediate medical needs. By this Act, the hospital emergency department are required to provide a 'reasonable volume of services to persons unable to pay.'

only known for individuals who declare considering they will possibly be LTC dependent in the future. This later filter question identifies extreme myopia or denial[5] but has for consequences that about one third of the original observations is removed from the final sample.

As previously said, the originality of the data is that we also have information on individuals' preferences and behavioral bias. In another part of the questionnaire, risk-aversion, short-term and long-term impatience, family and social altruism, and positive reciprocity (DellaVigna, 2009; Fontaine, Plisson, Zerrar, 2014; Fehr and Gächter, 2000) are measured with self-evaluations on likert scales or by proxy questions based on Arrondel and Masson scoring PATER methodology (Arrondel and Masson, 2014). The principle of the latter is to multiply the number of simple questions which concern different aspects of daily living but refer to the same latent dimension of individuals' preferences. For example, 'You get vaccinated when it is not mandatory' or 'Homeownership is being rest assured that you will never sleep on the streets' both refer to the same latent dimension of risk aversion even if they concern different subjects. According to Arrondel and Masson (2014), qualitative vague and global questions are good predictors of saving and economic behaviors. Qualitative survey questions are often used to measure unobserved time and risk preferences (Ameriks *et al.*, 2007), are strongly correlated with experimental measurements, and sometimes have better prediction properties (Pinger, 2017). In this way, we can control for the unobservable heterogeneity of individual preferences, that is, confounding factors in the study of insurance purchase and prevention behaviors. We also have information on health status (subjective well-being and disease in the past 12 months) and the relationships of the respondents with their family and friends (frequency of contact and meeting), which indicate the degree of social integration. Several questions refer to the structure of the family (number of people and children, and the presence of a grandparent or a child in the household). In addition, other questions focus directly on potential future informal care providers, as if individuals are currently non-professionally helped (financially or for some tasks of daily living as housework, cooking and eating, personal hygiene, etc.). Finally, a special part of the questionnaire aims to study the different services, which could be proposed by the mutualist group in the future and be interesting for the policyholders. Among them, we can cite the protection of private data,

[5] This perception of this risk, however, does not prevent a likely probability distortion (Boyer *et al.* 2017; Zerrar, 2016).

a follow-up of principal health indicators (e.g. the evolution of Body Mass Index in time), a package to facilitate connection with medical practitioners and particularly, a prevention program. Respondents had to indicate if they are interested in these types of services and their preferences for financing them (an increase in social security contribution, public tax, or individual premium).

Table 1. presents principal characteristics of the final sample, composed of 843 observations. The sample is well balanced for gender and type of complementary health care insurance contract with 54.57% of women and 51.84% of collective contracts. Although we lose observations because of the filter question on LTC risk perception, the final sample is still representative of policyholders.

Table 1. Summary statistics.

	All
Gender (Female=1) (%)	54.57
Age (mean)	59.68
Collective contract (%)	51.84
Obs	843

4. The Econometric Strategy

Identify and measure adverse selection and moral hazard behaviors is an empirical puzzle. In most analysis in the literature, self-protection behaviors are not observable or measurable. Hence, the presence of asymmetric information is often studied through the coverage-risk correlation (Chiappori and Salanié, 2000; Cohen and Siegelman, 2010). One exception is in the case of health insurance, for which detailed health expenses are used as dependent variable instead of a particular disease appearance (Buchmueller *et al*., 2004). But this strategy cannot take prevention actions done in the absence of any medical practitioner into account. Because these studies use risk realization as a proxy of behaviors, they only consider ex-post moral hazard, and often use panel data or quasi-natural experiments to disentangle it from adverse selection. Moreover, although theoretical models assume agents' rationality, any correlation (whatever the sign) between risk realization and coverage can arise from (rational and non-rational) preferences, totally different from asymmetric information phenomena (Cohen and Siegelman, 2010; Finkelstein and McGarry, 2006; Cutler, Finkelstein

and McGarry, 2008). This emphasizes the importance of controlling for behavioral bias and individuals' preferences (DellaVigna, 2009).

The first step of our analysis is to study empirically the theoretical predictions of Ehrlich and Becker (1972) model with the following recursive bivariate probit (Heckman, 1978):

$$\begin{cases} effort_i = \alpha_1' X_{1i} + \beta' assurance_i + \varepsilon_{1i} \\ assurance_i = \alpha_2' X_{2i} + \delta_1' Z_{1i} + \varepsilon_{2i} \end{cases} \quad (6)$$

With both error terms supposed to be drawn from a bivariate normal distribution as:

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix} | X_1, X_2 \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right). \quad (7)$$

The originality of our strategy is the use of a measure of self-protection behavior with the survey question 'Do you seek to maintain or develop your intellectual abilities?' as a binary dependent variable for the first equation, instead of a measure of risk realization. We use the purchase of LTC insurance, as a proxy of the choice of LTC insurance coverage, for the second binary dependent variable of the second equation. The recursive structure of the model allows the measure of the causal impact of the insurance purchase on self-protection effort, hence, to measure *ex ante* moral hazard behaviors, under agents' rationality hypothesis (Rowell, Nghiem, Connelly, 2017). Econometric results are in table 4.

As pointed by Chiappori and Salanié (2000) and Finkelstein and McGarry (2006), the set of control explanatory variables must contain all observable information for insurers, used to risk classification. All other relevant information for risk classification, i.e. residual private information only known by the policyholder, is not controlled in equations (unobservable heterogeneity) and is then caught by the error terms. From the econometric point of view, this structure allows testing and controlling potential endogeneity of LTC insurance purchase. The correlation between the two errors terms (ρ) measures the correlation between the two decisions, once the impact of included factors has been taken into account (Greene, 2011). Then, the correlation can be interpreted as a measure of adverse selection/advantageous selection.

As previously said, our data contain detailed information on individual preferences (risk aversion, impatience, altruism and positive reciprocity), potential sources of future informal care and self-insurance behaviors. Therefore, we estimate two different specifications. The

first considers information strictly observed by the insurer and used for risk classification to study asymmetric information on LTC insurance market under agents' rationality assumption (table 4 column 1). The second integrates additional sources of information, only known by the policyholder (individual preferences, self-insurance behaviors, social contact or risk perception), which can give a better explanation for this phenomenon (table 4 column 2).

The second step of our analysis is to study the causal impact of the participation in a prevention program proposed by the mutualist group both on LTC insurance purchase and self-protection effort. As explained in the previous theoretical part of the paper, the presence of a prevention program can change the nature of the trade-off between self-protection decision and the demand for insurance. We therefore use a multivariate probit model, with a recursive structure again (Cappellari and Jenkins, 2003):

$$\begin{cases} effort_i = \alpha_1' X_{1i} + \gamma' insurance_i + \beta_1' participation_i + \varepsilon_{1i} \\ insurance_i = \alpha_2' X_{2i} + \beta_2' participation_i + \delta_1' Z_{1i} + \varepsilon_{2i} \\ participation_i = \alpha_3' X_{3i} + \delta_2' Z_{2i} + \varepsilon_{3i} \end{cases} \quad (8)$$

With error terms supposed to be drawn from a multivariate normal distribution as:

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{pmatrix} | X_1, X_2, X_3 \sim N\left(\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho_{12} & \rho_{13} \\ \rho_{12} & 1 & \rho_{23} \\ \rho_{13} & \rho_{23} & 1 \end{pmatrix} \right). \quad (9)$$

The potential participation in a prevention program is measured through the interest of the individual for the following service 'Tomorrow, we guarantee the protection of your personal data, and from them, we propose prevention recommendations.' The question is associated with an example: 'You have diabetes and your connected watch indicates a high blood sugar level, we address you some recommendations to live well with your disease.' The two other binary dependent variables are the same as in the first model (benchmark). Again, the recursive structure allows testing and controlling potential endogeneity of both LTC insurance purchase and participation in a prevention program. Correlations between the error terms catch all other private information for the policyholder which can take part in the trade-off. The model is estimated with two different specifications, as for the previous model: the first considers information strictly observed by the insurer (table 4 column 3) and the second integrates additional sources of information and individuals' preferences (table 4 column 4).

In each equation, X_j are sets of explanatory variables. We control for age, gender, education, income, the presence of the spouse in the household and health status in all equations. These variables are the principal information used by insurers for risk classification and then constitutes proxies of the insurance premium (Finkelstein and McGarry, 2006; Courbage and Roudaut, 2008; Soika, 2017). Because insurers have detailed information on health with the insurance application, we also add a proxy of cognitive skills, measured by the following question 'On a scale from 0 to 10, indicate your ability to concentrate on reading a book, looking for a TV show, a movie or a radio program,' in the LTC insurance purchase equation. The body Mass Index is included in the third equation because it is the principal health indicator which can encourage an individual to participate in a program.

For others non-observable variables by the insurer (second and fourth specifications), we consider potential sources of self-insurance behaviors (life-insurance, a retirement saving plan, a home purchase saving plan) and an indicator of home ownership in the LTC insurance equation. We also include a dummy indicator of knowing a close relation who is LTC dependent, as a principal source of LTC risk perception (Tennyson and Yang, 2014; Coe, Skira, Van Houtven, 2015) and two other additional variables on potential future informal care (the number of children and if the individual is non-professionally helped). The degree of social integration, i.e frequencies of contact with another member of the family and with friends, is introduced in both self-protection effort and LTC insurance equations. Because a prevention program can be composed of seminars, and therefore be a potential meeting place, we add a dummy indicator of the search for social links in the third equation. Moreover, these programs require health data sharing and familiarity with technological tools (e.g. connected objects as watches or smartphones) which contain several personal information. Some individuals can be less disposed to adopt these practices, whatever the final objective. We measure this type of behavior with the survey question: 'On a scale from 0 to 10, do you consider as intrusive or useful the appearance, on your screens of laptops or tablets, of products advertisements related to your previous purchases?' This additional score is in the participation in prevention program equation. Furthermore, because the participation can be encouraged by social norm or peer pressure, we control for the type of complementary health care insurance contract (collective or individual) in the same equation. A brief presentation of explanatory variables is in table 2.

For Individuals preferences, several variables measure the same latent preference. Due to multicollinearity, we choose different sets of preference variables, but which always refer to the same six latent dimensions in each equation: risk aversion, short-term and long-term impatience, social altruism, family altruism and positive reciprocity. They are presented in table 3.

Finally, for specifications where non-observable variables are not considered, the need for instruments is a major concern (Z_{1i} and Z_{2i}), particularly for the insurance purchase. As pointed by Rowell, Nghiem and Connelly (2017), a credible instrument cannot be observed or collected by the insurer: any relevant information would be used for risk classification and insurance pricing, hence, would not 'exogenously' explain the insurance purchase. However, in a theoretical framework, literature on econometrics suggests that, contrary to classical linear simultaneous equations models, an exclusion restriction is not necessary to identification due to non-linearity in recursive multiple equation probit models (Heckman, 1978; Wilde, 2000). Even so, we decide to include two additional variables that we think can be easily collected by insurers: homeownership in the insurance equation and the non-participation in solidarity actions proposed by the mutualist group in the prevention program equation (see table 2.).

Table 2. Explanatory variables.

NAME	TYPE	IN EQUATION			PROPORTION or MEAN
		Effort	Insurance	Program	
OBSERVABLE EXPLANATORY VARIABLES					
Gender (reference: men)	Binary	✓	✓	✓	54.57
Spouse (a presence of a spouse in the household)	Binary	✓	✓	✓	81.02
Age	Categorical	✓	✓	✓	
- *40–50 y.o*					24.20
- *51–65 y.o*					42.11
- *65+ (reference)*					33.69
Income	Categorical	✓	✓	✓	
- *Fewer than 21600 euros (reference)*					27.28
- *21600–30000euros*					21.83
- *30000–42000euros*					26.33
- *More than 42000 euros*					24.56
Education	Categorical	✓	✓	✓	
- *Low (none or primary)*					4.86
- *Quite low (lower secondary)*					48.75
- *Medium (secondary)*					18.86
- *High (tertiary) (reference)*					27.53
Subjective health	Categorical	✓	✓	✓	
- *Bad*					9.61
- *Medium (reference)*					29.89
- *Quite good*					44.96
- *Good*					15.54
Subjective cognitive skills [0;3]	Quantitative		✓		2.28 (0.57)
Homeownership	Binary		✓		85.41
Body Mass Index	Quantitative			✓	25.91 (4.36)
Non-participation in solidarity actions proposed by the mutualist group	Binary			✓	17.37
Type of complementary health care insurance contract (reference: individual)	Binary			✓	51.84
NON-OBSERVABLE EXPLANATORY VARIABLES					
Frequency of contact with a family member [0 Never – 4 Almost every day]	Quantitative	✓	✓		2.99 (0.81)
Frequency of contact with friends [0 Never – 4 Almost every day]	Quantitative	✓	✓		2.39 (1.01)
Know an LTC dependent person	Binary		✓		52.64
home purchase saving plan	Binary		✓		46.60
life-insurance	Binary		✓		59.83
Retirement saving plan	Binary		✓		22.78
Number of children	Quantitative		✓		2.29 (1.31)
Non-professionally helped	Binary		✓		9.90
Search of social links	Binary			✓	76.85
Publicity is useful [0;10]	Quantitative			✓	2.39 (2.61)
DEPENDENT VARIABLES					
Self-protection effort	Binary				83.16
LTC insurance purchase	Binary				17.56
Prevention program participation	Binary				54.90

Table 3. Individuals' preference variables.

NAME	TYPE	IN EQUATION			PROPORTION or MEAN
		Effort	Insurance	Program	
Risk aversion					
On a scale from 0 to 10, you are risk loving, love adventure and new challenges, or you are a prudent person who minimize risks (Likert)	Quantitative	✓	✓	✓	5.97 (2.37)
You get vaccinated when it is not mandatory.	Binary			✓	19.80
You are the kind of person to encourage children to be risk taking (e.g. for their careers).	Binary		✓		93.67
Homeownership is being rest assured that you will never sleep on the streets.	Binary	✓			88.79
Short-term impatience					
You start to read a book. First pages are not very interesting then you stop immediately rather than insist for a while.	Binary	✓			30.28
In a queue, you lose patience and try to pass, instead of patiently await.	Binary		✓		23.36
When you want a good, you follow your desire and buy it	Binary			✓	29.06
Long-term impatience					
Not ready to give up on some pleasures (smoking, drinking, eating junk food, etc.) to increase life expectancy.	Binary	✓		✓	21.56
Retirement needs to be prepared for a long way in advance	Binary	✓			31.15
Generally, you prepare holidays at the last moment.	Binary		✓		15.53
You are the kind of person to encourage children to be foresighted and save for the future	Binary			✓	94.46
On a scale from 0 to 10, you live from day to day or you are forward-looking and foresighted (Likert)	Quantitative			✓	7.19 (2.03)
Family altruism					
You have to financially help children throughout their lives	Binary	✓	✓		89.83
You have to manage more carefully wealth and property when you inherit it	Binary			✓	13.89
Social altruism					
Helps other people although there is no personal interest.	Binary	✓			31.91
Often makes charitable giving to associations	Binary		✓	✓	19.13
Positive reciprocity					
Is in favor of the common good instead of personal material good	Binary	✓	✓	✓	91.31
Accepts to help LTC dependent person for one day, without remuneration	Binary		✓		88.17

5. Econometric Results

5.1. Main Results

First of all, whatever the presence of a prevention program, the subscription to LTC insurance has a significant negative impact on self-protection effort in all specifications which do not include non-observable information for insurers (1 and 3). We then identify the presence of *ex-ante* moral hazard on French LTC insurance market under the assumption of agents' rationality. Likewise, correlations between the error terms of the self-protection effort equation and the LTC insurance equation reveal a significant positive relation between the two decisions, after the impact of explanatory variables taken into account. Thus, we also identify an advantageous selection effect: individuals who have private information in favor of the insurance purchase decision have a higher tendency to make some self-protection effort (Hemenway, 1990, 1992; De Donder and Hindriks, 2009). These results are in line with some of the findings of Finkelstein and McGarry (2006) and Browne and Zhou-Richter (2014). On the other hand, participation in a prevention program has no effect both on self-protection effort and insurance purchase.

However, results are totally different when agents' rationality assumption does not hold (specifications 2 and 4). When we control for individuals' preferences (accounting for behavioral bias) and some additional private information, considering that agents are no longer rational, the LTC insurance purchase is not significant in the self-protection effort equation. Hence, previous *ex ante* moral hazard effect found in specifications 1 and 3 is rather driven by behaviors that cannot be explained by a strategic willingness to take advantage of an information rent due to the impossibility to perfectly observe behaviors.

Regarding the results of individuals' preference variables which take part in the trade-off, both self-protection and insurance purchase decisions are impacted by impatience (short term and long term). Globally, as expected, short-term impatience impacts negatively the two decisions, although the effect is significant only at 10% for the insurance. But agents with a higher level of long-term impatience more likely make some self-protection effort and less likely purchase insurance: this can be interpreted as a better preparation for old age which makes the insurance purchase less necessary due to a lower probability of occurrence. We find the same type of relation with positive reciprocity: agents who exhibit a high level of reciprocity make some self-protection effort in order to minimize the potential cost for the

society but they less likely purchase insurance. We also observe that social altruism and risk aversion increase the probability of both self-protection effort and insurance purchase (although the latter is only significant in specification 4). Interestingly, the participation in a prevention program seems to attract agents precisely with the opposite characteristics: they are less risk-averse, have a higher level of short-term impatience and a lower level of long-term impatience, and exhibit a lower degree of family altruism.

As regards error terms correlations, the positive correlation between these two decisions is no longer significant. In the absence of a prevention program (specification 2), previous advantageous selection effect can then be explained by the degree of social integration (frequency of contact with friends), self-insurance behaviors (purchase of a life insurance or a retirement saving plan) and risk perception (knowing a close relation who needs care). Furthermore, considering the presence of a prevention program proposed by the mutualist group (specification 4), the participation impacts positively both insurance purchase and self-protection effort. Hence, in this specific case, we can give an additional interpretation of the advantageous selection. Since the participation in a prevention program gives additional information to insurers and allows a better observation of the potential risk of a policyholder, the previous advantageous selection, unobservable for the insurer, is then revealed. In other words, the previous advantageous selection is unobservable for insurers and only identified by the correlation of unobservable information caught by the error terms, whereas now, this additional information is disclosed to the insurer through participation in a prevention program. Although this advantageous selection passes through another channel, we found a complementary relation between insurance coverage and self-protection effort decisions. The supply of free prevention programs then seems to encourage advantageous selection.

Finally, under the most plausible assumption of a non-fair premium, these results are not contradictory with Ehrlich and Becker (1972) and the theoretical predictions of the models in the presence of a prevention program in section 2. Indeed, in this last case, theoretical predictions show that the participation in a prevention program increases the level of self-protection effort but has no determined effect on the choice of the level of insurance coverage. We empirically lift this indeterminacy and find that the participation in a prevention

program also encourages insurance decision, hence a complementary relation between self-protection and insurance coverage.

5.2. Other Covariates Results

The results of other explanatory variables reveal important trends and enable a better understanding of the link between self-protection and insurance purchase. Regarding education, low educated are less likely to do self-protection effort but do not behave differently from high educated for the insurance purchase. A higher level of education can improve the capacity to understand the consequences of some risky behaviors like smoking or alcohol consumption on health. This can therefore explain why we find the opposite concerning the prevention program: low and middle educated are more likely to participate because they more need medical recommendations. This result echoes previous analyses showing that education has a positive effect on health for elderly people, notably by health behaviors (Brunello *et al*., 2015; Fletcher, 2015).

While gender and having a spouse in the household are not relevant to explain insurance purchase decision, they both impact self-protection behaviors as women and couples are more likely to make some effort. This finding echoes the literature on the economics of the family showing that interactions among household members tend to produce coordinated decisions by couples (Legendre, Pédrant, Sabatier, 2018).

As regards health indicators variables (subjective health status, subjective measurement of cognitive skills and the Body Mass Index), individuals with bad health are more likely to participate in a prevention program. However, for the insurance purchase, the results are less evident: globally unhealthiest individuals are less likely to purchase but when it comes to cognitive skills (strongly linked to the dependency risk) the inverse occurs. It seems that agents arbitrate by evaluating and separating elements of their health relating (or not) to the dependency risk. On the contrary, heath has globally no effect on the self-protection effort.

As expected, age has a positive effect on both self-protection effort and insurance purchase since LTC dependency is an old age risk. This finding is in line with most of the analysis in the literature (e.g. Fontaine, Plisson, Zerrar, 2014). Surprisingly, it affects the participation negatively. Nevertheless, it is encouraging for potential long-term effects of this

type of prevention for both insurers and policyholders: adopt healthy behaviors as early as possible can durably reduce the probability and likely cost of the dependency. Likewise, as expected, income has a negative effect on self-protection effort and participation (when individuals' preferences are controlled), that can be interpreted has a larger share of the budget which can be devoted to health expenses. It has no effect on insurance decision, since we control for self-insurance behaviors.

Concerning the latter, the purchase of a life-insurance or a retirement saving plan is associated with a higher probability of LTC insurance purchase. However, the opposite is observed for homeownership, as in Boyer *et al*. (2017). Even if testing the complementary/substitutability property of the relation between self-insurance and insurance purchase needs to be further analyze, these preliminary findings are globally in favor of a complementary relation, at the opposite of the results of Zerrar (2016). Contradictory to the theoretical predictions of Ehrlich and Becker (1972), the positive association of the purchase of both LTC insurance and a life-insurance was already found by Courbage and Roudaut (2008). Furthermore, regarding the sources of potential informal help in LTC insurance purchase equation, conversely with Courbage and Roudaut (2008) and Mellor (2001), we find some evidence of the presence of intra-family moral hazard (Pauly, 1990). Indeed, even if the number of children is not significant, be non-professionally helped for daily-living activities (often by children) is negatively associated with the insurance purchase (but only significant at 10% in specification 4).

Finally, results for the participation in a prevention program gives additional useful information. First, the type of complementary health care insurance contract (collective or individual) is not significant: the participation does not seem to be driven by social norm or peer pressure. Hence, the participation in a prevention program would not only concern individuals who take-up the contract proposed by the employer's company, but all workers. Secondly, two elements tend to nuance previous conclusions on the potential effectiveness of these prevention programs. Individuals who search for social links are more likely interested, which could be in contradiction with the original purpose. Furthermore, although expected, participation seems conditional to be disposed to share personal data and be familial with technological tools.

6. Conclusion

In this article, we propose a theoretical model to study the equilibrium properties of the trade-off between self-protection and insurance decisions. Starting from the framework of Ehrlich and Becker (1972) as a benchmark, we introduce the hypothesis of a free prevention program, proposed by the insurance company. We show that the presence of these types of programs changes the trade-off properties: as in the benchmark, the relation is undetermined for the general case, but becomes substitution and no longer complementary for the particular case of a fair premium. We test empirically the theoretical properties of the general case, using survey data on policyholders of a French mutualist group, in the case of long-term care insurance. The originality of the data is that we have several information on individuals' preferences and additional private information (self-insurance, potential future informal care) only known by the policyholder. Using this information, we use multivariate probit models to study asymmetric information in two cases: with or without assuming agents' rationality (DellaVigna, 2009; Cohen and Siegelman, 2010). First, we show that ex-ante moral hazard found under agents' rationality is driven by behavioral bias and individuals' preferences like short-term impatience, altruism or reciprocity, rather than strategic behaviors. Moreover, advantageous selection is explained by self-insurance behaviors and a better risk perception. Secondly, this advantageous selection, initially unobservable for the insurer, is revealed by participation in a prevention program if the insurance company offers this type of service.
Our contribution is twofold. We give a better explanation of precedent analyses which find some evidence of moral hazard and advantageous selection for different insurance market (Finkelstein and McGarry, 2006; Soika, 2017; Rowell, Nghiem and Connelly, 2017). In addition, we lift the theoretical indeterminacy and show that self-protection and insurance coverage choice are complementary in the general case (non-fair premium).

These conclusions have practical policy implications. Since we find a complementary relation between self-protection and the participation in a prevention program, we are optimistic about the efficiency of such programs due to the absence of crowing-out effect. Furthermore, as public authorities try to develop preventive leaning policies, public information (or information provided in prevention programs) about the consequences and cost of LTC risk could encourage individuals to limit the impact of behavioral bias. Then, this could reduce one of the barriers of the development of the LTC insurance market.

A possible extension of this work would be to test predictions of the theoretical models in the case of health insurance: the presence of 'real' moral hazard behaviors is more plausible when the potential health loss due to risk occurrence is not irrevocable. Furthermore, interactions between prevention programs and insurance purchase might be taken into account in designing of a sustainable public Long-Term Care scheme (Klimaviciute and Pestieau, 2018).

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Table 4. Econometric results

	SPECIFICATION 1		SPECIFICATION 2		SPECIFICATION 3			SPECIFICATION 4		
	Self protection	**LTC insurance**	**Self protection**	**LTC insurance**	**Self protection**	**LTC insurance**	**Prevention program**	**Self protection**	**LTC insurance**	**Prevention program**
LTC insurance	-1.600		0.700		-1.329			0.559		
	(0.432)***		(0.551)		(0.536)**			(0.440)		
Prevention program					0.722	0.171		0.886	0.813	
					(0.733)	(1.056)		(0.437)**	(0.314)***	
Observable Explanatory Variables										
Woman	0.339	0.075	0.279	0.053	0.290	0.012	0.001	0.345	0.052	-0.117
	(0.106)***	(0.108)	(0.139)**	(0.137)	(0.114)**	(0.116)	(0.098)	(0.143)**	(0.141)	(0.115)
Spouse in Household	0.156	-0.035	0.305	-0.075	0.196	-0.075	-0.021	0.322	0.031	-0.048
	(0.138)	(0.142)	(0.180)*	(0.188)	(0.149)	(0.154)	(0.131)	(0.189)*	(0.203)	(0.161)
Age										
40-50 y.o. (ref: 65+)	-1.017	-0.948	-0.654	-0.822	-1.047	-1.019	0.345	-0.757	-1.103	0.340
	(0.145)***	(0.162)***	(0.288)**	(0.203)***	(0.156)***	(0.216)***	(0.136)**	(0.264)***	(0.221)***	(0.168)**
51-65 y.o.	-0.415	-0.435	-0.221	-0.459	-0.475	-0.406	0.335	-0.285	-0.625	0.267
	(0.125)***	(0.115)***	(0.203)	(0.151)***	(0.148)***	(0.187)**	(0.114)***	(0.201)	(0.161)***	(0.139)*
Income										
21600-30000 (ref: less than 21600)	-0.176	-0.012	-0.364	0.017	-0.252	0.004	-0.173	-0.370	0.098	-0.159
	(0.146)	(0.147)	(0.202)*	(0.193)	(0.171)	(0.172)	(0.139)	(0.218)*	(0.206)	(0.170)
30000-42000	-0.222	-0.324	-0.350	-0.236	-0.253	-0.244	-0.108	-0.295	-0.007	-0.335
	(0.151)	(0.155)**	(0.217)	(0.197)	(0.170)	(0.175)	(0.138)	(0.226)	(0.210)	(0.169)**
More than 42000	-0.264	-0.101	-0.394	0.019	-0.297	-0.069	-0.134	-0.333	0.127	-0.390
	(0.171)	(0.175)	(0.230)*	(0.222)	(0.195)	(0.198)	(0.158)	(0.253)	(0.236)	(0.190)**
Education										
Low education (ref: high education)	-0.983	-0.248	-0.779	-0.031	-0.905	-0.080	0.340	-0.927	-0.216	0.306
	(0.248)***	(0.298)	(0.327)**	(0.371)	(0.272)***	(0.333)	(0.250)	(0.331)***	(0.397)	(0.304)
Quite low education	-0.309	0.101	-0.215	0.323	-0.469	0.031	0.504	-0.297	0.066	0.280
	(0.149)**	(0.150)	(0.178)	(0.187)*	(0.191)**	(0.253)	(0.129)***	(0.190)	(0.200)	(0.151)*
Medium education	-0.145	0.091	-0.206	0.289	-0.223	0.130	0.324	-0.243	0.131	0.284
	(0.165)	(0.172)	(0.187)	(0.197)	(0.192)	(0.219)	(0.142)**	(0.193)	(0.208)	(0.162)*
Subjective health										
Bad Health (ref: medium health)	0.429	-0.332	0.360	-0.508	0.391	-0.375	0.231	0.292	-0.820	0.353
	(0.219)*	(0.205)	(0.261)	(0.255)**	(0.251)	(0.244)	(0.173)	(0.271)	(0.287)***	(0.200)*
Quite good health	0.091	-0.047	-0.009	-0.120	0.050	-0.005	0.086	-0.036	-0.118	0.100
	(0.120)	(0.123)	(0.152)	(0.152)	(0.131)	(0.136)	(0.113)	(0.157)	(0.158)	(0.132)
Very good health	0.079	0.373	-0.155	0.186	0.036	0.470	-0.000	-0.075	0.272	-0.149
	(0.156)	(0.162)**	(0.202)	(0.209)	(0.168)	(0.173)***	(0.150)	(0.212)	(0.216)	(0.181)

Subjective cognitive skills	-0.177 (0.089)**		-0.218 (0.116)*	-0.166 (0.097)*		-0.307 (0.120)**
Homeowner	-0.252 (0.140)*		-0.315 (0.198)	-0.264 (0.155)*		-0.467 (0.200)**
Body Mass Index				0.027 (0.012)**		0.025 (0.013)*
Non-participation in solidarity actions				-0.295 (0.132)**		-0.197 (0.150)
Collective health care insurance contract				-0.013 (0.107)		0.134 (0.113)
Non-Observable Explanatory Variables						
Frequency of contact with family		-0.011 (0.082)	0.082 (0.088)		-0.072 (0.085)	0.071 (0.091)
Frequency of contact with friends		0.123 (0.077)	0.189 (0.074)**		0.166 (0.075)**	0.189 (0.079)**
Know an LTC dependent person			0.192 (0.134)			0.246 (0.141)*
Self-insurance behaviors						
Home purchase saving plan			-0.046 (0.138)			-0.050 (0.140)
Life-insurance			0.476 (0.147)***			0.519 (0.161)***
Retirement saving plan			0.274 (0.159)*			0.315 (0.163)*
Potential future caregivers						
Number of children			0.021 (0.050)			0.017 (0.052)
Non-professionally helped			-0.394 (0.244)			-0.454 (0.262)*
Search of social links						0.310 (0.138)**
Publicity is useful						0.134 (0.025)***
Individuals' preferences[a]						
Risk aversion		n.s.	n.s.		(+) *	(+) * (-) **
Short-term impatience		(-) *	(-) *		(-) ***	n.s. (+) **
Long-term impatience		(-) **	(+) **		(-) **	(+) *** (-) ***

Family altruism			n.s.	n.s.				n.s.	n.s.	(-)*
Social altruism			(+) **	(+) **				(+) ***	n.s.	n.s.
Positive reciprocity			(+) *	(-) **				n.s.	(-)**	n.s.
Constant	1.587 (0.220)***	0.060 (0.311)	0.349 (0.535)	-0.268 (0.587)	1.348 (0.469)***	-0.046 (0.502)	-0.997 (0.378)***	-0.111 (0.528)	0.020 (0.618)	-2.646 (0.563)***
Rho12 (Effort-Insurance)	0.765 (0.191)***		-0.581 (0.337)		0.655 (0.262)**			-0.436 (0.285)		
Rho13 (Effort-Program)					-0.280 (0.466)			-0.420 (0.274)		
Rho23 (Insurance-Program)					-0.025 (0.659)			-0.379 (0.201)*		
Log-likelihood	-712.24		-484.24		-1138.40			-799.48		
Wald test (84)	147.47		173.13		167.18			303.74		
p-value Wald test	0.000		0.000		0.000			0.0000		
N	843		667		766			616		

[a] For clarity, results for individuals' preferences are summarized by indicating the sign of the effect and its significance.

(.) standard errors. * p<0.1; ** p<0.05; *** p<0.01