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are first best contracts impossible***

par

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Adverse selection in health insurance: are first best contracts impossible ?

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Abstract

In this note, we intend to characterize conditions such that adverse selection is irrelevant in health insurance. We show that a condition is that policyholders health status is sufficiently reduced by illness.

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1 Introduction

Health risks have two major effects : a pecuniary one and a health related one. Moreover if the pecuniary risk is assurable health status is usually unassurable but health status modifies the utility provided by the indemnity. Cook and Graham (1977) defined irreplaceable commodities as goods which modify the utility provided by wealth. Health appears to be a perfect example of such a good. Rey (2003) characterizes optimal insurance contracts when the utility is bivariate with perfect information.

Indeed a crucial information to determine risk on health insurance markets is family history which is known only by insured people thus creating an adverse selection problem. In this note we focus on the implications of adverse selection in such a framework. We want to determine if first best contracts are no longer an equilibrium.

We show that when over-insurance is not forbidden by institutional constraint, first best indemnisation functions are larger than pecuniary loss if the marginal utility of wealth is decreasing in health otherwise the indemnity is lower than the pecuniary losses. The first part of this result provides an explanation for disability pension in health insurance contracts. The intuition is that illness reduce health status and then increases (decreases) the marginal utility of wealth in the bad state of nature when marginal utility is decreasing (increasing) in health.

Next, we give sufficient conditions such that first best contracts are optimal with asymmetric information. Indeed high risks prefer higher (resp. lower) indemnity than low risks when marginal utility of wealth is decreasing in health (resp. increasing). This difference is increasing in health loss then it may be the case that the health loss is sufficiently high to allow first contracts to verify incentive compatibility.

The first section presents the framework and the second section discusses about first best contracts and adverse selection

2 The Framework

2.1 Policyholders

We assume that there exists a large number of policyholders. Their preferences are described by a bivariate utility function $U(W, H)$ with W being the initial wealth and H being the health status. U is increasing and concave in each term $U_1 > 0, U_{11} < 0, U_2 > 0, U_{22} < 0$.

There exists two types of policyholders denoted by $i \in \{L, H\}$ for high and low risk with $p_H > p_L$. We assume that all policyholders have the same initial wealth ω and health status h . They face two states of nature: an illness state with a financial loss L and health loss δh_i . We assume that low risk policyholders face an unmalignant risk : $\delta h_L < \delta h_H$.

2.2 Insurers

We assume that there exists a continuum of risk neutral insurers. They provide insurance contracts in a competitive market without transaction costs. They cannot identify risk type.

A contract is defined by a set of transfers contingent on the state of nature: a payment I in case a decease occurs and a payment P otherwise. I can be viewed as an indemnity net of the premium, P being the premium.

3 Optimal health insurance contracts

Let us assume perfect symmetric information. Contracts are solutions of the following problem

$$\begin{aligned} \max_{P,I} \quad & p_i U(\omega - L + I, h - \delta h_i) + (1 - p_i) U(W - P, h) \\ \text{s.t.} \quad & (1 - p_i)P - p_i I = 0 \quad \forall i = \{H, L\} \end{aligned} \tag{1}$$

The equilibrium contract has the following properties.

Proposition 1 *If $U_{12} < 0$ the optimal contract imply overinsurance and if $U_{12} > 0$ policyholders receive underinsurance. Low risk's contract provide a smaller (resp. higher) coverage than high risk's one if $U_{12} < 0$ (resp $U_{12} > 0$)*

Proof. First order conditions are:

$$\frac{\partial \mathcal{L}}{\partial P} = -(1 - p_i)U_1(\omega - P, h) + \mu(1 - p_i) = 0 \tag{2}$$

$$\frac{\partial \mathcal{L}}{\partial I} = p_i U_1(\omega - L + I, h - \delta h_i) - \mu p_i = 0 \tag{3}$$

simplifying the first equation implies $U_1(\omega - P, h) = \mu$.

Replacing λ in the second equation gives $U_1(\omega - L + I, h - \delta h_i) = U_1(\omega - P, h)$.

Assuming that $U_{12} < 0$ then $U_1(\omega - P, h - \delta h_i) > U_1(\omega - P, h) = U_1(\omega - L + I, h - \delta h_i)$.

Since $U_{11} < 0$, U_1 is decreasing then $\omega - P_i < \omega - L + I_i$ which implies $I_i + P_i > L$.

The same proof holds for $U_{12} > 0$ but for reverse inequalities.

Fully differentiating first conditions give us

$$\frac{dI}{d\delta h_i} = \frac{(1 - p_i)U_{12}(\omega - L + I, h - \delta h_i)}{(1 - p_i)U_{11}(\omega - L + I, h - \delta h_i) + p_i U_{11}(\omega - P, h)}.$$

Then if $U_{12} < 0$, $I_H > I_L$ otherwise $I_L > I_H$. ■

Since $U_{12} < 0$, the marginal utility of wealth is decreasing with health status then high risk policyholders value more the state of nature in which their health status is reduced. It implies that they want to be more than compensated for their health-care expenditure. In such a case, the indemnity has to be viewed as a disability pension. With the reverse hypothesis, they value less wealth in case of illness and then prefer a contract with a deductible. Low risk policyholders prefer a lower indemnity than high risk if the marginal utility of wealth is decreasing in health. Indeed, since their health status loss is smaller then they prefer a lower indemnity to compensate the uninsurable health risk. The reverse intuition applies to reverse hypothesis on marginal utility of wealth.

Let us assume that the information is asymmetric. Separating equilibrium implies that insurers offer to low risks a contract verifying the following condition

$$\begin{aligned} & p_H U(\omega - L + I_H, h - \delta h_H) + (1 - p_H) U(\omega - P_H, h) \\ & \geq p_H U(\omega - L + I_L, h - \delta h_H) + (1 - p_H) U(\omega - P_L, h) \end{aligned} \quad (4)$$

From proposition 1, we know that if $U_{12} = 0$, then first best contracts exhibit full insurance. It is straightforward to show that this constraint is never verified in such a case. Then, as in Rothschild-Stiglitz paper, optimal contracts are solution of the constrained maximisation problem.

Proposition 2 *The first best set of contracts can be a separating equilibrium for a sufficiently large high risk's after-effect and not too different illness probabilities.*

Proof. The incentive compatibility condition when first best contracts are offered is

$$\begin{aligned} & p_H U(\omega - L + I_H^*, h - \delta h_H) + (1 - p_H) U(\omega - P_H^*, h) \\ & \geq p_H U(\omega - I_L^*, h - \delta h_H) + (1 - p_H) U(\omega - P_L^*, h) \end{aligned} \quad (5)$$

This is equivalent to the following inequalities :

$$\begin{aligned} & p_H [U(\omega - L + I_H^*, h - \delta h_H) - U(\omega - L + I_L^*, h - \delta h_H)] \\ & \geq (1 - p_H) [U(\omega - P_L^*, h) - U(\omega - P_H^*, h)] \end{aligned} \quad (6)$$

By developping both sides of the inequality around ω we obtain

$$\begin{aligned} [I_H^* - I_L^*] U_1(\omega, h - \delta h_H) & > [I_H^* - I_L^*] U_1(\omega, h) - \delta h_H [I_H^* - I_L^*] U_{12}(\omega, h) \\ & \geq \left[\frac{p_H (1 - p_L) I_H^* - (1 - p_H) p_L I_L^*}{p_H (1 - p_L)} \right] U_1(\omega, h) \end{aligned} \quad (7)$$

Then a sufficient condition for the incentive constraint to be slack is

$$\begin{aligned} & [I_H^* - I_L^*] U_1(\omega, h) - \delta h_H [I_H^* - I_L^*] U_{12}(\omega, h) \\ & \geq \left[\frac{p_H (1 - p_L) I_H^* - (1 - p_H) p_L I_L^*}{p_H (1 - p_L)} \right] U_1(\omega, h) \end{aligned} \quad (8)$$

After rearranging we obtain the following condition

$$\delta h_H \geq - \frac{(p_H - p_L) I_L^*}{p_H (1 - p_L) [I_H^* - I_L^*]} \frac{U_1(\omega, h)}{U_{12}(\omega, h)} \quad (9)$$

Indeed, from proposition 1, we can show that $\frac{dI^*}{d\delta H}$ and U_{12} have opposite signs implying that $- [I_H^* - I_L^*] U_{12}(\omega, h)$ is always positive. If $U_{12} > 0$, $I_H^* < I_L^*$ when both types have the same probability of accident and we can show from proposition 1 that $\frac{dI^*}{dp} < 0$ then there exists for all p_H a value of δh_H verifying this condition. Let us assume now that $U_{12} < 0$ implying that $I_H^* > I_L^*$. Starting from the case $p_H = p_L$, an increase in p_H

induces a decrease in I_H^* since $\frac{dI^*}{dp} < 0$. Then there exists a value \bar{p}_H of p_H such that $I_H^* = I_L^*$. Then $\forall p_H < \bar{p}_H$, it exists a corresponding value of δh_H such that first best contracts can be implemented at equilibrium with asymmetric information. ■

Due to differences in health loss high risk policyholders' optimal indemnity is higher (resp. lower) than low risks' when marginal utility of wealth is decreasing in health (resp. increasing). When both types have the same risk but health loss, it is straightforward to show that high risks prefer a lower indemnity for the same premium per unit than low risk. This implies that no envy exists between types. However, risks are not only different in health loss but also in illness probability. Increasing p_H decreases high risks' indemnity then it increases attractiveness of the low risks' contract. However this negative effect can be balanced by an increase in the health loss. Then there exists for each p_H a value of high risks' health loss such that first best contracts are implementable. However health loss can not exceed health status implying that such result is not always true.

4 Conclusion

In this note we want to determine if adverse selection in health insurance implies, as in other insurance markets, that first best contracts are not eligible for an equilibrium. In order to deal with this issue we consider a framework taking into account the effect of health status on utility *via* a bi-dimensionnal utility function.

We showed that optimal contracts can exhibit over- or under-insurance depending on the marginal utility of wealth sensibility to health variation. Moreover we characterized sufficient conditions such that first best contracts are no longer cancelled when

adverse selection problems appear. Indeed if health loss is sufficiently large high risk policyholders prefer a larger indemnity than low risks. This provides an incentive to high risks not to choose the contract designed for low risks. However if the marginal utility of wealth is decreasing in health, another necessary condition is that risks should not be too different. Indeed since the indemnity is decreasing in the probability of illness then when risks are too different high risk policyholders always prefer low risks contracts whatever the health loss is. Except from this case and the case $U_{12} = 0$, the result we obtain is in contradiction with Rothschild-Stiglitz's one.

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