Comparing Alternative Reimbursement Methods in a Model of Public Health Insurance*

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Abstract

I compare *in-kind reimbursement* and *reimbursement insurance*. I explicitly consider *out*patient and *in*patient care in a model where illness has a negative impact on labor productivity. Consumers are heterogeneous with respect to intensity of preferences for treatment which is their private information. Then the social planner has a choice of two kinds of reimbursement structure: pooling (uniform) and self-selecting allocations.

Analyzing pooling allocations I show that reimbursement insurance weakly dominates in-kind reimbursement. While considering self-selecting allocations I show that the two reimbursement methods are, from a social welfare point of view, equivalent.

Keywords: health insurance, in-kind transfers, reimbursement insurance, adverse selection.

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1. Introduction

Risk averse consumers demand health insurance. They insure against the financial risk associated with buying medical care. I will study alternative health insurance reimbursement methods to find out which kind of payment is socially preferable.

In an ideal world, the optimal insurance contract from the social planner's point of view would pay lump-sum transfers contingent on the health status. If illness occurs consumers would receive a cash payment related to the severity of disease, so that consumer's sovereignty would be completely preserved. In reality we normally do not observe this type of reimbursement.

Instead of a cash payment, we generally observe either *in-kind* reimbursement or reimbursement insurance (later on reimbursement *on treatment cost*). Generally, when reimbursement is in-kind, consumers are payed directly in medical services. Payment is contingent on disease as it would be for cash reimbursement, but, in the case of in-kind, consumers are not free to choose the quantity of treatment they prefer. On the contrary, when reimbursement is on treatment cost, insurance payment depends on consumers' expenditures upon health care. In this case instruments as coinsurance and deductible are used to limit overconsumption.

The representation of these reimbursement plans that I choose in the model is not able to capture all their complex features but provides a treatable framework. To be as simple as possible I assume that when reimbursement is in-kind (IK), access to care is free and consumers receive a quantity of treatment determined by the insurer. Imposing a ceiling on treatment available to consumers, insurance is able to prevent high demand for care. This implies that in-kind reimbursement allows cost-containment. At the same time an evident disadvantage of IK reimbursement is the cost on social welfare due to the imposition of a consumption constraint to the insured people.

Concerning physician's fee, an important consequence of free access to care is that, with IK reimbursement, health care providers are payed directly by the insurer.

Considering public health insurance systems which use to reimburse in-kind, we generally refer to National Health Service type organizations. Great Britain, Germany, Italy[1] and, only for inpatient care, also France[2] are an example.

[1] In Italy outpatient care reimbursement is rather complicate, but we can say that at least GP services are provided in-kind.

[2] In some cases, in France, third party payer principle may take place also for outpatient care. However it occurs only for chronic or very serious diseases or, more often, as the consequence of

Conversely, when reimbursement is on treatment cost (TC) I assume that consumers are free to choose the quantity of treatment they desire. A consequence is that, not internalizing the entire health care cost, they demand an excessive quantity of it (overconsumption). This is an ex-post moral-hazard problem.

Concerning again physician's fee, with treatment cost reimbursement health care providers generally are payed by consumers. The latter, after the insurance claim, receive a partial reimbursement from the insurer. As an example this reimbursement is used, only for outpatient care, in France[3].

Figure 1 summarizes the trade-off, characterizing the two reimbursement methods, between consumers' freedom in choosing treatment quantity and consumers' incentive to not overconsume.

The importance of a uniform consumption constraint (in a sense which will be clarified later) directly depends on the level of heterogeneity characterizing the population. This suggests that it could exist a threshold value in consumers' heterogeneity such that when heterogeneity is not too high in-kind reimbursement is better, while, when heterogeneity is sufficiently high, treatment cost reimbursement is preferable.

To my knowledge this institutional comparison between alternative reimbursement methods is still an unexplored issue.

Moreover this work provides a treatable framework for systems which use a mix of in-kind and treatment cost reimbursement: outpatient care are reimbursed on treatment cost and inpatient care are reimbursed in-kind. This is just the reimbursement plan used in France. In fact, in the case of outpatient care consumers share a part of treatment costs, but they maintain an important level of freedom in choosing treatment quantity. On the other side, for inpatient care, access to care is free and treatment quantity is normally decided by the public insurance.

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complementary private insurance purchase.

[3] The French system for outpatient care leave complete freedom to consumers: they choose the provider (both generalist and specialist) and the number of examinations. Moreover consumers directly pay for the services and the treatment prescribed. Later they ask for reimbursement to the Social Insurance Administration and they are paid back approximately from the 60 to the 80% of their expenses.

Concerning French consumers' freedom, the office based doctors convention introduced a *voluntary* scheme in 1987 which offered the possibility to doctors of becoming "médecin référants". Patients who join this scheme have a moral commitment not to visit a specialist directly. The aim of this scheme was essentially to check the efficacy of a possible cost containment measure. But most doctors where reluctant (up to the end of 1997, only the 12,5 per cent of them had joined the scheme) because of the fear that they may be more controlled by the health insurance system. In fact in this scheme they are obliged to keep detailed patient records.

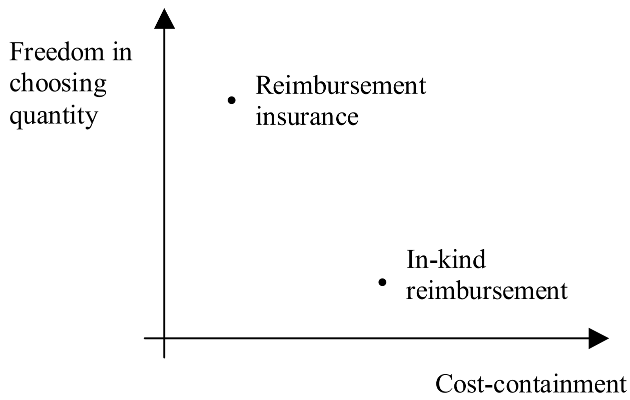

Figure 1.1: trade-off between consumers' freedom and cost-containment.

Concerning the related literature, first, I have to mention the models on moral-hazard in health insurance, one of the seminal papers being Zeckhauser (1970). The way I treat treatment cost reimbursement represents a particular case of the more general reimbursement schedule of his model. Second, concerning in-kind reimbursement, I relate to the literature on in-kind transfers and optimal taxation (among others Cremer and Gahvari (1997)). In that literature the self-selecting property of in-kind transfers in second-best economies has been analyzed. Third, more generally I refer to the literature on income taxation with uncertainty in which taxation is used to insure consumers against various types of wage and health risks (as an example, Varian (1980) and Cremer and Gahvari (1995)).

In the next pages I compare IK and TC reimbursement in a model of public health insurance[4]. I assume that consumers are heterogeneous with respect both to their state of health and to their preferences for treatment consumption. The public insurer plays the role of the social planner and he is fully informed on

[4] A public health insurance has been analyzed for the first time in Blonqvist and Horn (1984). The authors show that, if individuals differ in their earning ability and also in the probability of falling ill, then a public health insurance is an efficient tool to redistribute welfare when income taxation is linear.

Together with their focus on public health insurance, Blonqvist and Horn (1984) presents another similarity with respect to this paper: in both the models consumers' utilities are state-dependent.

consumers' state of health. In the first part of the work I constrain the insurance plan to be uniform in the sense that tastes heterogeneity is not taken into account. Analyzing pooling allocations I find that TC dominates IK reimbursement. This means that, contrary to intuition, there is no trade-off between TC and IK depending on consumers' heterogeneity. In the second part, I consider self-selecting allocations, i.e. allocations where consumers can choose insurance plans which takes into account their preference for treatment. In this case I show that the two reimbursement methods are, from a social welfare point of view, equivalent.

2. The model

Let us consider a representative consumer and three possible states of health. Consumer can be healthy, not seriously ill and seriously ill. When not seriously ill, consumer needs *out*patient care, while when seriously ill, consumer needs *in*patient care. More precisely, with probability p_1, consumer is in good health and has a full earning ability, his marginal labor productivity is w_1 (ability is normalized to equal the wage rate). With probability p_2, consumer is ill and, as a consequence, he partially looses his earning ability; his marginal labor productivity falls to $w_2 < w_1$. Finally, with probability $p_3 = 1 - p_1 - p_2$, consumer is seriously ill and looses all his earning ability (he is hospitalized); in this case marginal labor productivity fall to $w_3 = 0$.[5]

Consumer's preferences are state-dependent and twice separable:

$$U_i^j (C, X, L) = u(C_i) - v(L_i) - H_i + \theta_i^j \phi_i (X_i)$$

$i = 1, 2, 3$ indicates health status as stated above, C is an aggregated consumption good taken as numeraire, X is health care consumption and L is labor supply. H_i is a fixed, state dependent, utility loss which can be partially recovered through health care consumption. The term $\theta_i^j \phi_i (X_i)$ indicates utility from health care consumption. In particular $\phi_i (X_i)$ is health improvement from treatment consumption, while the parameter θ_i^j $(0 < \theta_i^l \leq \theta_i^h; \quad i = 2, 3; \quad j = l, h)$ represents intensity of preferences for treatment, i.e. heterogeneity in consumers' tastes. With probability μ_l consumer has low preference for health care consumption (he is low-type), while, with probability $\mu_h = 1 - \mu_l$ he has high preference for health care consumption (he is high-type), and this for both states of illness (bidimensional heterogeneity).

[5] As I will show in section 5.1, illness severity plays an important role also with respect to consumers' tastes on consumption levels.

Standard hypothesis on utility functions hold: $u'(C_i) > 0$, $u''(C_i) < 0$; $v'(L_i) > 0$, $v''(L_i) > 0$. $H_1 = 0 < H_2 < H_3$. The function $\phi(X)$ is such that: $\phi_1(X) = 0 \ \ \forall X$; $\phi_i(0) = 0$, $\phi_i'(X) > 0$, $\phi_i''(X) < 0$, $i = 2, 3$. Moreover, $H_i > \theta_i^j \phi_i(X_i)$, $\forall i = 2, 3$, $\forall j = l, h$ and $\forall X$, such that consumer's utility is always greater when in good health than when ill.

The social planner will be concerned with making comparisons of utility levels across consumers' types. Thus, I assume full comparability of consumers' utilities.

The timing of the model is as follows: at t_1 (interim) consumer learns his type and at t_2 (ex-post) the health-risk is realized and consumer learns his state of health too. As it is shown in figure 2, the social planner decides interim, while consumer decides ex-post.

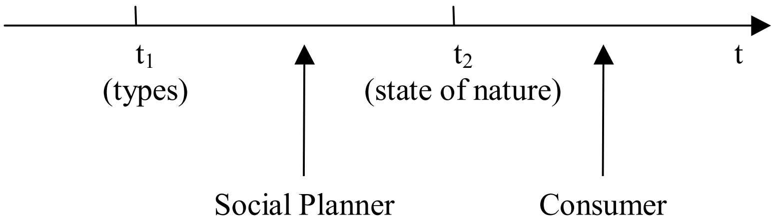

Figure 2: timing.

In this model I focus on the relationship between consumer and public insurance, the health care provider is not explicitly considered. The situation described here fits both the case of a public provider (vertically integrated with the public insurer) and of a private one in a competitive market. In both cases, assuming a linear technology, the health care unitary cost is constant. This allows us to say that consumer and the public insurer face the same treatment price (q). Moreover, I assume that the provider behaves as a perfect agent for his patient.

Concerning the informational structure of public insurance, in the model consumer has potentially two private informations: his health status (captured by the marginal labor productivity w_i) and his type θ_i^j (high/low taste for treatment). I assume that consumers' health status is observable. This means that, concerning this aspect of the examination (as opposed to treatment purchase), collusion between patient and physician is impossible: physician acts as a perfect agent for insurance. As a consequence reimbursement can be contingent to the health status. Conversely, I assume that, in each state of health, preference for treatment is not observable and public insurance can reimburse consumers according to a pooling allocation or a self-selecting one.

The structure of the work is as follow. In the first part I will show the first-best, then I will compare the alternative insurance plans when the Government implements pooling allocations. In particular the considered plans are: cash, in-kind, treatment costs reimbursement and, finally, a mix of the two previous methods. In the second part I will analyze the same reimbursement methods when the social planner implements self-selecting allocations. To summarize, the considered cases are:

Pooling allocations:
- first-best
- uniform plans:
  - cash reimbursement
  - in-kind reimbursement
  - treatment cost reimbursement
  - mix of reimbursement types

Self-selecting allocations:
- cash reimbursement
- in-kind reimbursement
- treatment cost reimbursement
- mix of reimbursement types

3. First-best

I assume that, exhibiting an illness certification provided by a physician, patient is entitled to receive reimbursement.

First-best is represented by a contract contingent both to the health status and to preference for treatment, that is a plan characterized by five non-uniform monetary transfers $(P, R_2^l, R_2^h, R_3^l, R_3^h)$. Consumption in the three states of health is:

$C_1 = w_1 L_1 - P$
$C_2^l = w_2 L_2^l + R_2^l - qX_2^l$
$C_2^h = w_2 L_2^h + R_2^h - qX_2^h$
$C_3^l = R_3^l - qX_3^l$
$C_3^h = R_3^h - qX_3^h$

where P is premium payed by healthy consumer, R_2^j $(j = l, h)$ is net from premium reimbursement for outpatient care and R_3^j $(j = l, h)$ is reimbursement for inpatient care. With cash reimbursement consumer decides to purchase the quantity of treatment he prefers. Note that in state of nature 3 cash transfer R_3^j must be enough to let consumer purchase both health care and aggregated consumption.

The social planner maximizes the utilitarian[6] social welfare function $SW = \mu_l EU(\theta^l) + \mu_h EU(\theta^h)$, where $EU(\theta^l)$ is low-type consumer's expected utility and $EU(\theta^h)$ is high-type consumer's expected utility. Expected utility of low-type and high-type individuals are respectively multiplied for the proportion of low-type and high-type consumers in the population[7]: low and high type consumers have the same weight for the social planner. Note that, when healthy, the two consumer' types are identical. The social planner solves:

$$\begin{cases} \underset{P,R_i^j,L_i^j,X_i^j}{Max} \quad p_1 \left[u(w_1 L_1 - P) - v(L_1)\right] + \\ \quad +p_2 \sum_{j=l,h} \mu_j \left[u\left(w_2 L_2^j + R_2^j - qX_2^j\right) - H_2 + \theta_2^j \phi_2\left(X_2^j\right) - v(L_2^j)\right] + \\ \quad +p_3 \sum_{j=l,h} \mu_j \left[u\left(R_3^j - qX_3^j\right) - H_3 + \theta_3^j \phi_3\left(X_3^j\right)\right] \\ \\ s.t.: \quad p_1 P = p_2(\mu_l R_2^l + \mu_h R_2^h) + p_3(\mu_l R_3^l + \mu_h R_3^h) \end{cases} \tag{3.1}$$

Two remarks can be useful. First, premium is fair. Second, because of the way the heterogeneity parameter θ_i^j enters the utility functions, social welfare is increasing with respect to heterogeneity. This is equivalent to say that high-type consumers have the highest weight in this economy. As a consequence an utilitarian social welfare function redistributes from low to high-type individuals[8].

[6]Concerning the choice of the social welfare function it is interesting to say that the maximin principle of Rawls is less applicable to cases which deals with health and the allocation of health care. In fact while the need for Rawls' primary goods (e.g. food and clothing) are more or less the same for all, there is a much more unequal distribution of the need for health care reflecting the "natural lottery". There are consequently much wider variations in the resources required to meet such unequal distribution of needs. In particular the crucial issue for the maximin criterion is the severity of the worst off. As long as it is feasible to improve the health of this individual, resources would be directed to him irrespective of the forgone improvement for the others.

For an interesting discussion on this subject see J.A.Olsen: "Theory of justice and their implication for priority setting in health care", Journal of Health Economics 16, 1997, 625-639.

[7]Considering a large number of representative consumers, μ_j is equivalent, ex-post, to the proportion of the j-type.

[8]For this reason, in the social welfare function, giving a higher (than μ_l) weight to low-type

>From FOCs we find the full-insurance result[9]:

$$C_1 = C_2^l = C_2^h = C_3^l = C_3^h \quad (= C) \tag{3.2}$$

Moreover it is:

$$L_1^* : \quad w_1 u'(C) = v'(L_1) \tag{3.3}$$

$$L_2^* : \quad w_2 u'(C) = v'(L_2) \tag{3.4}$$

$$X_2^{*j} : \quad \theta_2^j \phi_2' \left(X_2^j\right) = qu'(C), \qquad j = l, h. \tag{3.5}$$

$$X_3^{*j} : \quad \theta_3^j \phi_3' \left(X_3^j\right) = qu'(C), \qquad j = l, h. \tag{3.6}$$

As we expected, in every state of health labor supply and treatment quantity are determined such that marginal benefit equals marginal cost, as a consequence $MRS_{L_2,X_2} = \dfrac{q}{w_2}$. Moreover in state of health 2 it is: $L_2^{*l} = L_2^{*h}$ and $X_2^{*h} > X_2^{*l}$, and in state of health 3 it is $X_3^{*h} > X_3^{*l}$. Concerning the monetary transfers, not surprisingly one finds: $R_i^h > R_i^l,\ i = 2, 3$.

Note that the choice of X_i^j and L_i can be decentralized because consumers face prices w_i and q. As a consequence the social planner can obtain first-best offering the first-best contract and letting consumers choose (ex-post) labor supply and treatment quantity.

Here I briefly introduce the structure of in-kind and treatment cost reimbursement with full information on consumers' preferences. The two reimbursement plans will be treated in detail in the case of asymmetric information in section 4.2 and 4.3, 7.3 and 7.4.

In-kind reimbursement

Recall that, when reimbursement is in-kind, access to care is free and consumers receive the package of care $\bar{X}_i^j$ which is determined by insurance. I assume that the transfer $\bar{X}_i^j$ has to be entirely consumed: no intermediate levels of consumption are possible. This interpretation of in-kind reimbursement, which represents a good approximation of reality, will become important analyzing self-selecting allocations (section 7.3). Individuals' consumption in the three states of health is:

consumers would be more equitable. In fact it would allow to redress the relative importance of the two consumers types. I leave it for future research.

[9] Here utilities are state-dependent and separable. Then, for any given income level, ill health does not alter the marginal utility of income. As a consequence full insurance is optimal. Moreover the full insurance condition concerns only aggregate consumption.

$C_1 = w_1 L_1 - P^{IK}$
$C_2^j = w_2 L_2^j + R_2^{IKj}, \qquad \left(X_2^j = \bar{X}_2^j\right)$
$C_3^j = R_3^{IKj}, \quad \left(X_3^j = \bar{X}_3^j\right)$

where $j = l, h$. Note that seriously ill consumers are obliged to consume according to the transfer R_3^{IKj}. This means that in-kind reimbursement imposes a double constraint on seriously ill consumers: aggregate consumption and treatment quantity. In section 4.2 it will be clear that this double constraint concerns also not seriously ill consumers.

Reimbursement on treatment cost

With reimbursement insurance the social planner uses a cost-sharing parameter $\alpha_i^j \leq 1$ $(i = 2, 3,\ j = l, h)$ [10] to reduce health care overconsumption. As it was said before, the moral-hazard problem due to the subsidization of health care corresponds to the main disadvantage of reimbursement on treatment cost.

As in the case of cash reimbursement, consumers choose their preferred treatment quantity, the difference is that here the social planner modifies treatment consumption prices. Consumption in the three states of health is:

$C_1 = w_1 L_1 - P^{TC}$
$C_2^j = w_2 L_2^j + R_2^{TCj} - \alpha_2^j q X_2^j$
$C_3^j = R_3^{TCj} - \alpha_3^j q X_3^j$

It is evident that under perfect information in-kind and treatment cost reimbursement are both equivalent to first-best. In fact, with both reimbursements methods the social planner can use four additional "instruments" (respectively $\bar{X}_i^j$ with in-kind and α_i^j with treatment cost reimbursement, $i = 2, 3,\ j = l, h$) such that it can do at least as well. Actually when monetary transfers contingent to preference for treatment are available, these additional instruments are useless. Concerning treatment cost reimbursement, obviously with full information the social planner sets $\alpha_i^j = 1$ such that prices are not distorted.

This result is stated in the following proposition:

Proposition 1 *Under perfect information, cash, in-kind and treatment cost reimbursement are equivalent.*

This result is in line with Arrow's intuition. In fact, in his seminal paper (Arrow (1963), page 962), he says that, in an hypothetically perfect market, the

[10] With full information considering either α_i^j or simply α_i is equivalent.

existing different methods of treatment costs coverage should be equivalent.

In figure 3 ill consumers' first-best allocation is shown. As the reader can see, the slope of low-type utility function is higher than high-type one, this happens because $\frac{dC_i}{dX_i} = -\theta_i^j \frac{\phi_i'\left(X_i^j\right)}{u'\left(C_i^j\right)}$.

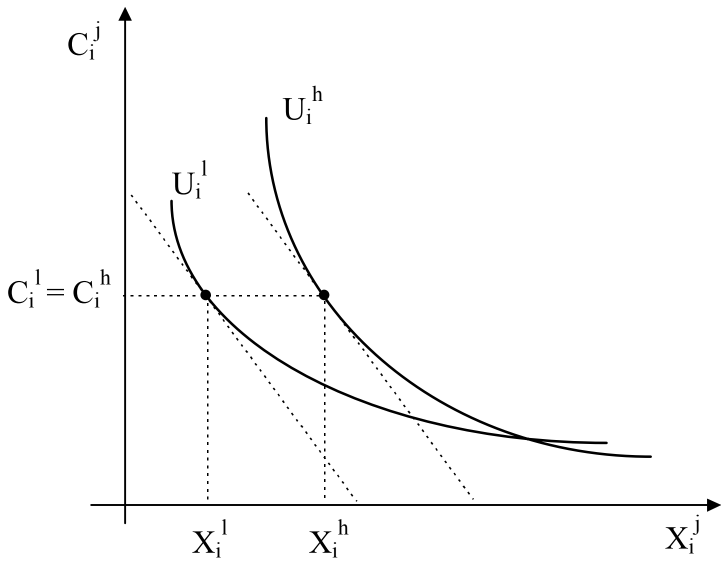

Figure 3: ill consumers' first-best allocation.

When θ^j is not observable, first-best allocations cannot be implemented. In fact, in state of health 2, first-best payment implies: $C_2^l = C_2^h$, $X_2^h > X_2^l$ and $L_2^h = L_2^l$[11]. And in state of health 3: $C_3^l = C_3^h$, $X_3^h > X_3^l$. This means that low-type consumers would mimic high-type ones.

4. Uniform plans

Dealing with low-types incentive constraints the public insurance has a choice of two kinds of reimbursement structure. Those in which the insurer is unable to distinguish (ex-post or ex-ante) among individuals: this corresponds to a pooling allocation. And those in which the high-type and the low-type can (ex-post)

[11] In particular it is: $R_i^{IKl} = R_i^{IKh} = R_i^j - qX_i^j = R_i^j - q\bar{X}_i^j$.

be identified as a result of the action undertaken by the different groups: this corresponds to a self-selecting allocation.

The reimbursement plans that we observe in the European public health insurance systems are essentially uniform: public insurance does not offer contracts which differ according to their recipients' taste. In fact the same plan is proposed to consumers with the same illness without caring about their (different) preferences for treatment. A possible reason for implementing pooling allocations is just the presence of an hidden incentive constraint as the one treated in this work: facing off the lack of information on consumer's type, in the real world public insurance chooses to provide uniform reimbursements. Maybe this choice is due to the presence of political constraints and/or administrative costs. Anyway, to investigate on this interesting issue is not in the aim of this work.

4.1. Cash reimbursement

This plan is defined by three monetary transfers: (P^C, R_2^C, R_3^C). Ill consumers receive reimbursement and choose in the market the preferred treatment quantity. Consumption in the three states of health is:

$C_1 = w_1 L_1 - P^C$
$C_2^j = w_2 L_2^j + R_2^C - qX_2^j$
$C_3^j = R_3^C - qX_3^j$

Note that the only difference with respect to first-best is that here we add the uniformity constraint $R_i^h = R_i^l = R_i^C$.

Recalling that consumer maximizes ex-post, with cash reimbursement consumers' programs are as follow. *Good health*:

$$\max_{L_1} u(w_1 L_1 - P^C) - v(L_1)$$

Then in state of health 1 labor supply is defined according to the following equation:

$$L_1^* : \quad w_1 u'(C_1) = v'(L_1) \tag{4.1}$$

Outpatient care:

$$\max_{L_2^j, X_2^j} u\left(w_2 L_2^j + R_2^C - qX_2^j\right) - H_2 + \theta_2^j \phi_2\left(X_2^j\right) - v(L_2^j)$$

Then in state of health 2 labor supply and purchased treatment quantity are respectively defined according to equations:

$$L_2^{*j} : \quad w_2 u'(C_2^j) = v'(L_2^j), \qquad j = l, h, \tag{4.2}$$

$$X_2^{*j}: \quad \theta_2^j \phi_2' \left(X_2^j\right) = qu' \left(C_2^j\right), \qquad j = l, h. \tag{4.3}$$

Inpatient care:

$$\max_{X_3^j} u\left(R_3^C - qX_3^j\right) - H_3 + \theta_3^j \phi_3 \left(X_3^j\right)$$

Then in state of health 3 purchased treatment quantity is chosen according to equation:

$$X_3^{*j}: \quad \theta_3^j \phi_3' \left(X_3^j\right) = qu' \left(C_3^j\right), \qquad j = l, h. \tag{4.4}$$

The social planner solves the following program:

$$\begin{cases} \underset{P^C, R_2^C, R_3^C}{Max} \quad p_1 \left[u(w_1 L_1^* - P^C) - v(L_1^*)\right] + \\ \qquad +p_2 \sum_{j=l,h} \mu_j \left[u\left(w_2 L_2^{*j} + R_2^C - qX_2^{*j}\right) - H_2 + \theta_2^j \phi_2 \left(X_2^{*j}\right) - v(L_2^{*j})\right] + \\ \qquad +p_3 \sum_{j=l,h} \mu_j \left[u\left(R_3^C - qX_3^{*j}\right) - H_3 + \theta_3^j \phi_3 \left(X_3^{*j}\right)\right] \\ \\ s.t.: \qquad p_1 P^C = p_2 R_2^C + p_3 R_3^C \end{cases}$$

where labor supplies L_i^* and treatment quantities X_i^{*j} verify consumer's FOCs (4.1), (4.2), (4.3) and (4.4).

>From FOCs we find:

$$u'(C_1) = E\left[u'\left(C_2\right)\right] = E\left[u'\left(C_3\right)\right]^{12} \tag{4.5}$$

As equation (4.5) shows, low and high-type consumers choose different aggregated consumptions. Full insurance is preserved only in average. This distortion from the full insurance represents the cost the uniformity constraint imposes.

Totally differentiating equations (4.2) and (4.3) one finds that $\frac{dL_2}{dX_2} > 0$ and $\frac{dX_2}{d\theta_2} > 0$. Then, not surprisingly, it is: $X_2^h > X_2^l$ and $L_2^h > L_2^l$. As a consequence we are not able to say neither if C_2^h is higher or lower than C_2^l nor which not seriously ill consumers' type is characterized by the higher utility level[13]. In the same way, totally differentiating equation (4.4), one finds that $\frac{dX_3}{d\theta_3} > 0$ so that

[12] $E\left[u'\left(C_i\right)\right] = \mu_l \, u'\left(C_i^l\right) + \mu_h \, u'\left(C_i^h\right)$.

[13] In fact it is: $U_2^h - U_2^l = u\left(C_2^h\right) - u\left(C_2^l\right) + \theta_2^h \phi_2\left(X_2^h\right) - \theta_2^l \phi_2\left(X_2^l\right) + v\left(L_2^l\right) - v\left(L_2^h\right) \lesseqgtr 0$, where U_2^h and U_2^l respectively are h-type and l-type not seriously ill consumer's utility and $X_2^h > X_2^l$, $L_2^h > L_2^l$, $C_2^h \lesseqgtr C_2^l$.

$X_3^h > X_3^l$. Then $C_3^l > C_3^h$. But, again, we cannot a priori say which seriously ill consumers' type is characterized by the higher utility level[14].

4.2. In-kind reimbursement

This plan is characterized by three monetary transfers[15] and by two packages of care: $(P^{IK}, R_2^{IK}, R_3^{IK}, \bar{X}_2, \bar{X}_3)$.

Individuals' consumption in the three states of health is:

$C_1 = w_1 L_1 - P^{IK}$

$C_2 = w_2 L_2 + R_2^{IK}, \quad \left(X_2^j = \bar{X}_2\right)$

$C_3 = R_3^{IK}, \quad \left(X_3^j = \bar{X}_3\right)$

With respect to first-best I added both the uniformity constraint $R_i^h = R_i^l = R_i^{IK}$ and the consumption constraint $\bar{X}_i^j = \bar{X}_i$. That is one more constraint with respect to (uniform) cash reimbursement. This allows us to say that, with in-kind reimbursement, consumers cannot be better off. In session 5 it will be clear that consumers are always worse off (proposition 2).

Healthy consumers' program is the same I showed in the previous case and equation (4.1), where P^{IK} substitute P, still holds.

Outpatient care:

$$\max_{L_2} u\left(w_2 L_2 + R_2^{IK}\right) - H_2 + \theta_2^j \phi_2\left(\bar{X}_2\right) - v(L_2)$$

Then, in state of health 2, labor supply is:

$$L_2^*: \quad w_2 u'(C_2) = v'(L_2) \tag{4.6}$$

Note that here, because of the separability of preferences, both types of not seriously ill consumers have the same labor supply L_2^*. As a consequence $C_2^h = C_2^l = C_2$. This means that imposing the constraint on treatment quantity, in-kind reimbursement yields to the same aggregate consumption for both consumers' types. The same holds for inpatient care. In fact consumers are constrained to R_3^{IK} and $\bar{X}_3$ and their utility is: $u(R_3^{IK}) - H_3 + \theta_3^j \phi_3(\bar{X}_3)$. In other words in-kind reimbursement imposes the following two constraints to ill consumers: $C_i^h = C_i^l = C_i$ and $\bar{X}_i^h = \bar{X}_i^l = \bar{X}_i$.

[14] In fact it is: $U_3^h - U_3^l = u\left(C_3^h\right) - u\left(C_3^l\right) + \theta_3^h \phi_3\left(X_3^h\right) - \theta_3^l \phi_3\left(X_3^l\right) \lesseqgtr 0$, where U_3^h and U_3^l respectively are h-type and l-type seriously ill consumer's utility and $C_3^h < C_3^l$, $X_3^h > X_3^l$.

[15] In fact, being the health status observable, the social planner is always able to use the monetary transfers R_i. Note that the transfer R_2^{IK} can be, and presumably is, negative (the social planner can collect resources also from not seriously ill consumer).

With in-kind reimbursement, in both states of illness it is:

$$U_i^h - U_i^l = \phi_i\left(\bar{X}_i\right)\left(\theta_i^h - \theta_i^l\right) > 0 \qquad i = 2,3$$

where U_i^h and U_i^l respectively are high-type and low-type utility. This inequality means that high-type utility is always larger than low-type utility: with in-kind reimbursement low-type consumers are always worse off[16]. The difference between the two utility levels is proportional to heterogeneity.

The public insurance program is:

$$\begin{cases} \underset{P^{IK},R_i^{IK},\bar{X}i}{Max} & p_1\left[u(w_1L_1^* - P^{IK}) - v(L_1^*)\right] + \\ & +p_2\left[u(w_2L_2^* + R_2^{IK}) - H_2 + \widetilde{\theta}_2\phi_2\left(\bar{X}_2\right) - v(L_2^*)\right] + \\ & +p_3\left[u\left(R_3^{IK}\right) - H_3 + \widetilde{\theta}_3\phi_3\left(\bar{X}_3\right)\right] \\ s.t.: & p_1P^{IK} = p_2\left(R_2^{IK} + q\bar{X}_2\right) + p_3\left(R_3^{IK} + q\bar{X}_3\right) \end{cases}$$

where $\widetilde{\theta}_i = \sum_{j=l,h} \mu_j\theta_i^j$. In fact, to implement the pooling allocation, the Government maximizes the utility of a representative consumer: the mean θ-type consumer. Not surprisingly, from FOCs with respect to P^{IK}, R_2^{IK} and R_3^{IK} we find the full-insurance condition:

$$C_1 = C_2 = C_3 = \bar{C} \tag{4.7}$$

Moreover treatment packages are determined according to:

$$\bar{X}_2: \qquad \widetilde{\theta}_2\phi_2'\left(\bar{X}_2\right) = qu'(\bar{C}) \tag{4.8}$$

$$\bar{X}_3: \qquad \widetilde{\theta}_3\phi_3'\left(\bar{X}_3\right) = qu'(\bar{C}) \tag{4.9}$$

Obviously neither type of ill and seriously ill consumers receive the optimal quantity of treatment (determined respectively by equation (3.5) for outpatient care and by equation (3.6) for inpatient care) because $\bar{X}_2$ and $\bar{X}_3$ are determined according to the mean-θ-type consumer.

It is evident that, when there is no heterogeneity $\left(\theta_2^l = \theta_2^h,\ \theta_3^l = \theta_3^h\right)$, we are back to first-best.

[16] While with cash reimbursement it was $U_i^h - U_i^l \lesseqgtr 0$.

4.3. Reimbursement on treatment cost

As I said before α_i represents the coinsurance parameter, it is different for outpatient and inpatient care. The uniform plan is characterized by three monetary transfers[17] and by the two coinsurance parameters: $\left(P^{TC}, R_2^{TC}, R_3^{TC}, \alpha_2, \alpha_3\right)$. Individuals' consumption in the three states of health is:

$C_1 = w_1 L_1 - P^{TC}$
$C_2^j = w_2 L_2^j + R_2^{TC} - \alpha_2 q X_2^j$
$C_3^j = R_3^{TC} - \alpha_3 q X_3^j$

With respect to first-best the uniformity constraints on the monetary transfers $(R_i^h = R_i^l = R_i^{TC})$ and on the coinsurance parameters $(\alpha_i^j = \alpha_i)$ has been added.

Consumers' programs are the following. Healthy consumers' decision is the same I showed in the previous cases and equation (4.1) still holds.

Outpatient care:

$$\max_{L_2^j, X_2^j} u\left(w_2 L_2^j + R_2^{TC} - \alpha_2 q X_2^j\right) - H_2 + \theta_2^j \phi_2\left(X_2^j\right) - v(L_2^j)$$

As a consequence labor supply is determined, again, according to equation (4.2), moreover treatment quantity is:

$$X_2^{*j}: \quad \theta_2^j \phi_2'\left(X_2^j\right) = \alpha_2 q u'\left(C_2^j\right), \quad j = l, h \tag{4.10}$$

Inpatient care:

$$\max_{X_3^j} u\left(R_3^{TC} - \alpha_3 q X_3^j\right) - H_3 + \theta_3^j \phi_3\left(X_3^j\right)$$

As a consequence treatment quantity is:

$$X_3^{*j}: \quad \theta_3^j \phi_3'\left(X_3^j\right) = \alpha_3 q u'\left(C_3^j\right), \quad j = l, h \tag{4.11}$$

[17] As in the case of in-kind reimbursement, the transfer R_2^{TC} can be negative.

The public insurance program is:[18]

$$\begin{cases} \underset{P^{TC},R_i^{TC},\alpha_i}{Max} \quad p_1\left[u(w_1L_1^* - P^{TC}) - v(L_1^*)\right] + \\ \quad +p_2 \sum_{j=l,h} \mu_j \left[u\left(w_2 L_2^{*j} + R_2^{TC} - \alpha_2 q X_2^{*j}\right) - H_2 + \theta_2^j \phi_2\left(X_2^{*j}\right) - v(L_2^{*j})\right] + \\ \quad +p_3 \sum_{j=l,h} \mu_j \left[u\left(R_3^{TC} - \alpha_3 q X_3^{*j}\right) - H_3 + \theta_3^j \phi_3\left(X_3^{*j}\right)\right] \\ \\ s.t.: \quad p_1 P^{TC} = p_2\left(1-\alpha_2\right) q \sum_{j=l,h} \mu_j X_2^{*j} + p_2 R_2^{TC} + \\ \qquad +p_3\left(1-\alpha_3\right) q \sum_{j=l,h} \mu_j X_3^{*j} + p_3 R_3^{TC} \end{cases}$$

>From FOCs with respect to P^{TC}, R_2^{TC} and R_3^{TC} one finds the following equation:

$$E\left[u'(C_i)\right] = u'(C_1)\left[1 + (1-\alpha_i)qE\left[\frac{\partial X_i}{\partial R_i^{TC}}\right]\right] \quad i = 2,3 \tag{4.12}$$

It is interesting to remark that equation (4.12) would be equivalent to (4.5) for $\alpha_i = 1$, $i = 2,3$. However it is easy to show that, because of consumers' heterogeneity, this will never be the case at the optimal treatment cost reimbursement policy[19]. Then α_i, $i = 2,3$ are always different from 1 for positive level of heterogeneity.

Obviously when there is no heterogeneity it is optimal to impose $\alpha_i = 1$, $i = 2,3$ and first-best is obtained.

>From FOCs with respect to the coinsurance parameters one finds:

$$\left[-\left(1-\alpha_i\right)E\left(\frac{\partial X_i}{\partial \alpha_i}\right) + E\left(X_i\right)\right]u'\left(C_1\right) = E\left[X_i u'\left(C_i\right)\right] \tag{4.13}$$

The interpretation of equation (4.13) is as follows: the left hand side represents consumers' marginal cost and the right hand side consumers' marginal benefit

[18] As it is normally the case in health insurance models, I do not impose any constraint on the coinsurance parameters α_i, $i = 2,3$, and I will verify ex-post if they are less or higher than unity.

[19] In fact, from equation (4.14) below, which describes the optimal coinsurance parameter, we know that $\alpha_i = 1$ implies $u'(C_1) = \dfrac{E\left[X_i u'(C_i)\right]}{E\left(X_i\right)}$, $i = 2,3$; and from equations (4.12) that $\alpha_i = 1$ implies $u'(C_1) = E\left[u'(C_i)\right], i = 2,3$. This means that it must be $E\left[u'(C_i)\right]E\left(X_i\right) = E\left[X_i u'(C_i)\right]$, which is impossible because C_i depends also on X_i.

from a negative variation of α_i (a fall in treatment price). When α_i decreases, consumers out of pocket expenses decrease as well, while insurance reimbursement expenses increases. As a consequence insurance premium must increase as well. Marginal cost is measured by marginal variation of insurance premium (in bracket) multiplied for marginal utility of consumption in state "good health". In fact premium is paid by healthy consumers. In the right hand side the positive income effect from a negative variation of α_i is measured by the product of treatment quantity and consumption marginal utility in the illness status. Mean values appear because a uniform plan is implemented. To find the optimal coinsurance parameters, equation (4.13) can be rewritten as:

$$\alpha_i = 1 - \frac{u'(C_1)E(X_i) - E\left[X_i u'(C_i)\right]}{u'(C_1)E\left[\dfrac{\partial X_i}{\partial \alpha_i}\right]} \tag{4.14}$$

The coinsurance parameters are positively correlated to treatment demand mean derivatives with respect to α_i; these terms are a measure of moral hazard. Moreover $\frac{\partial X_i}{\partial \alpha_i}$ is related to price elasticity of demand for treatment so that equation (4.14) reminds us the inverse elasticity rule in Ramsey taxation: the commodity whose demand is more inelastic is subsidized more.[20]

Verifying ex-post if it is optimal to impose a subsidy $(\alpha_i < 1)$ or a tax $(\alpha_i > 1)$, we find[21] that a *sufficient condition* to subsidize treatment is:

$$u'\left(C_1\right) < \mu_l u'\left(C_i^l\right) + \mu_h u'\left(C_i^h\right) \quad i = 2, 3 \tag{4.15}$$

while a *necessary condition* to tax treatment is the opposite of (4.15).

The right hand side of the previous inequality is average marginal utility of consumption in the illness status. Marginal utility being decreasing, the interpretation of (4.15) is the following: it is optimal to subsidize treatment if healthy individuals consumption is larger than a particular mean of the ill individuals one. This means that the social planner may impose a tax on treatment.

4.4. Mix of reimbursement types

Consider now a reimbursement which pays on treatment cost for outpatient care and which pays in-kind for inpatient care. The mix of reimbursement types (MT)

[20] As it will be clarified in section 5.1, elasticity is higher for outpatient care. Then we expect that $\alpha_2 > \alpha_3$.

[21] >From (4.14) the following yields:
$\alpha_i < 1 \Leftrightarrow cov(X_i, u'(C_i)) + E\left(X_i\right)\left[E\left(u'\left(C_i\right)\right) - u'\left(C_i\right)\right] > 0$, where $cov(X_i, u'(C_i))$ is positive.

is characterized by the following instruments: $(P^{MT}, R_2^{MT}, R_3^{MT}, \alpha_2, \bar{X}_3)$. Consumption levels are:

$C_1 = w_1 L_1 - P^{MT}$
$C_2^j = w_2 L_2^j + R_2^{MT} - \alpha_2 q X_2^j$
$C_3 = R_3^{MT}, \quad \left(X_3^j = \bar{X}_3\right)$

As before, healthy consumers choose their labor supply according to FOC (4.1). Not seriously ill consumers choose simultaneously their labor supply and treatment quantity such that they respectively verify FOCs (4.2) and (4.10). As with in-kind reimbursement, seriously ill consumers' utility is $u(R_3^{MT}) + \theta_3^j \phi_3 \left(\bar{X}_3\right)$.

The public insurance program is:

$$\begin{cases} \underset{P^{MT}, R_i^{MT}, \alpha_2, \bar{X}_3}{Max} \quad p_1 \left[u(w_1 L_1^* - P^{MT}) - v(L_1^*)\right] + \\ \quad +p_2 \sum_{j=l,h} \mu_j \left[u\left(w_2 L_2^{*j} + R_2^{MT} - \alpha_2 q X_2^{*j}\right) - H_2 + \theta_2^j \phi_2 \left(X_2^{*j}\right) - v(L_2^{*j})\right] + \\ \quad +p_3 \left[u\left(R_3^{MT}\right) - H_3 + \widetilde{\theta}_3 \phi_3 \left(\bar{X}_3\right)\right] \\ \\ s.t.: \quad p_1 P^{MT} = p_2 \left(1 - \alpha_2\right) q \sum_{j=l,h} \mu_j X_2^{*j} + p_2 R_2^{MT} + p_3 \left(R_3^{MT} + q\bar{X}_3\right) \end{cases}$$

>From FOCs with respect to P^{MT} and R_3^{MT} one finds that: $C_1 = C_3 = R_3^{MT}$. As we expected, full-insurance concerns only healthy and seriously ill consumers' aggregated consumption. Moreover FOCs with respect to R_2^{MT}, α_2 and $\bar{X}_3$ determine respectively equations (4.12), (4.14) and (4.9).

5. Comparing the alternative uniform reimbursement plans

>From proposition 1 the following corollary holds.

Corollary 1 *In the case of pooling allocations if consumers are homogeneous, in-kind, treatment cost and a mix of types reimbursement are identical and equivalent to uniform cash payment.*

In fact when consumers are homogeneous the uniformity constraint has no consequence on social welfare and we are back to first-best.

Reintroducing heterogeneity, the following result holds.[22]

[22] In the following the ranking among reimbursement schemes will be stated with the symbols $\succeq$ and $\approx$ respectively for weak dominance and equivalence.

Proposition 2 *In the case of pooling allocations a first reimbursement methods ranking is the following: treatment cost reimbursement $\succeq$ cash reimbursement $\succeq$ in-kind reimbursement.*

Proof. (i) Uniform cash weakly dominates uniform in-kind reimbursement. In fact, recalling the discussion in session 4.2, cash reimbursement is characterized only by the uniformity constraint while in-kind reimbursement has one more constraint on treatment consumption. Once the monetary transfers R_2 and R_3 have been fixed it is always better to let consumers choose treatment, being consumption prices not distorted. (ii) Uniform treatment cost weakly dominates uniform cash reimbursement. In fact cash reimbursement is characterized by three monetary transfers (P^C, R_2^C, R_3^C) while treatment cost is characterized by three monetary transfers and by two tax/subsidies on treatment price[23] (P^{TC}, R_2^{TC}, R_3^{TC}, α_2, α_3), i.e. treatment cost has two more instruments. Moreover, for $\alpha_2 = \alpha_3 = 1$, treatment cost is equivalent to cash reimbursement. As a consequence treatment cost is at least as well as cash reimbursement. ■

Remark that the parameters α_2 and α_3 that we have introduced as the source of moral-hazard in treatment cost reimbursement, actually do not represent a cost. In fact the distortion they impose on treatment price has a positive effect on social welfare. The reason is that α_2 and α_3 are used to smooth consumption between different consumers' types in the same health status, such that TC optimal allocation can approach full insurance. In other words α_2 and α_3 allow to indirectly and partially avoid the consequences of the uniformity constraint[24].

Comparing uniform mix of types with uniform in-kind and uniform treatment cost reimbursement one finds:

Proposition 3 *In the case of pooling allocations a second reimbursement methods ranking is the following: treatment cost reimbursement $\succeq$ a mix of types $\succeq$ in-kind reimbursement.*

Proof. A mix of types pays on treatment cost for outpatient care and in-kind for inpatient care. From proposition 2 we saw that treatment cost dominates

[23] See the discussion at the end of section 4.3.

[24] In fact, loosely speaking, if we consider for example inpatient care, α_3 (< 1) lets $\Delta C_3 = C_3^l - C_3^h = \alpha_3 q \left(X_3^h - X_3^l\right)$ be lower with respect to $\Delta C_3\,(\text{cash}) = q\left(X_3^h - X_3^l\right)$. (The same argument holds for ΔC_2) Note that for $\alpha_3 = 0$ it would be $C_3^l = C_3^h$, but in this case moral-hazard would be too costly. This is the standard trade-off between moral-hazard and optimal risk spreading.

in-kind. Then, considering MT with respect to TC, seriously ill consumers are worse off, while not seriously ill consumers are indifferent. As a consequence TC weakly dominates MT. On the other side, considering MT with respect to IK, not seriously ill consumers are better off, while seriously ill consumers are indifferent. As a consequence MT weakly dominates IK. One can conclude that treatment cost weakly dominates a mix of types which weakly dominates in-kind. ■

To find a more general result, that is a ranking of cash and MT, I will introduce in the next section an assumption on the structure of consumers' heterogeneity.

5.1. Unidimensional heterogeneity

Regarding heterogeneity, empirical evidence shows that, in the case of serious illness, the price elasticity of demand for treatments is small[25]. A reasonable interpretation is that patients, for such an illness, have the sentiment that there is only one appropriate treatment. Moreover, this allows us to say that, in the case of inpatient care, heterogeneity is small and, as a consequences, a uniform consumption constraint will have a low impact on social welfare. Given these considerations I set $\theta_2^h - \theta_2^l \geq \theta_3^h - \theta_3^l \geq 0$, so that heterogeneity is lower in the case of serious illness.

The particular case of unidimensional heterogeneity ($\theta_2^h - \theta_2^l > \theta_3^h - \theta_3^l = 0$) is interesting because it can represent a good approximation of reality.

Considering the uniform mix of reimbursement types in the particular case with no heterogeneity on serious illness the following remark holds:

Remark 1 *In the case of pooling allocations if seriously ill consumers are homogeneous, a mix of types is equivalent to treatment cost reimbursement.*

In fact, if seriously ill consumers are homogeneous, from corollary 1 we know that all the reimbursement methods are equivalent to cash. This implies that, concerning inpatient care, treatment cost and a mix of types are equivalent. While concerning outpatient care, treatment cost and a mix of types are the same by definition.

As a result it is possible to define a complete ranking of the four reimbursement methods when seriously ill consumers are homogeneous:

[25] Results from the RAND Health Insurance Experiment show that health care price elasticities belong to the range [-0.1 , -0.2]. In particular, concerning serious illness treatment consumption, results show that "there are no significant differences among the coinsurance plans in the use of inpatient care services." (Manning and others (1987), page 258)

Proposition 4 *In the case of pooling allocations if seriously ill consumers are homogeneous (unidimensional heterogeneity), the complete reimbursement methods ranking is as follows: treatment cost reimbursement $\equiv$ mix of types $\succeq$ cash reimbursement $\succeq$ in-kind reimbursement.*

5.2. Bidimensional heterogeneity

With bidimensional heterogeneity ($\theta_2^h - \theta_2^l \geq \theta_3^h - \theta_3^l \geq 0$) it exists a trade-off between cash reimbursement and a mix of reimbursement types such that it can be either -cash dominates a mix of types- or the opposite. In fact, from proposition 2, cash weakly dominates in-kind, as a consequence seriously ill consumers are better off with cash reimbursement. At the same time treatment cost weakly dominates cash, as a consequence not seriously ill consumers are better off with the mix of reimbursement types.

Indeed, concerning this problem, one can make the following remark: the social welfare function used in the model suggests that uniform mix of types weakly dominates uniform cash reimbursement. In fact, first of all, in reality inpatient care are less frequent than outpatient ones: $p_3 < p_2$. Second, I assumed that heterogeneity is lower in the case of serious illness. A simple way to represent this situation it is to normalize $\theta_2^l = \theta_3^l = 1$ such that $\theta_i^h - 1$ measures heterogeneity. Then it is $\theta_2^h \geq \theta_3^h \geq 1$. In this way, the heterogeneity structure gives even more weight to not seriously ill consumers. As a consequence, a mix of types, giving more utility to not seriously ill consumers, should reach the higher level of social welfare. After the previous considerations we expect that, when heterogeneity is bidimensional, the complete reimbursement methods ranking is as follows: treatment cost reimbursement $\succeq$ a mix of types $\succeq$ cash reimbursement $\succeq$ in-kind reimbursement. Notice that this is not a general result because it depends on a more assumption ($p_3 < p_2$) and on a specific normalization ($\theta_2^l = \theta_3^l = 1$).

As we said in the introduction, it seems natural to expect that the trade-off between in-kind and treatment cost reimbursement is affected by the degree of heterogeneity (see figure 1). Proposition 2 shows that this is not the case. The reason is that treatment cost makes use of two more instruments and imposes no constraints on consumption. This result is strictly related to a crucial assumption of the model: the health status is observable. This assumption implies that the social planner can always use monetary transfers contingent on the health status.

6. Self-selecting allocations

Dealing with self-selecting allocations, the previous ranking of reimbursement methods may be substantially affected. With this respect, a first important fact is that now the constraint on treatment quantity imposed by in-kind reimbursement becomes a useful instrument. Directly providing (indivisible) in-kind health services, the social planner can observe the treatment consumed by ill individuals, as we shall see.

As both the health status (captured by consumers' marginal labor productivity w_i) and the pre-tax revenue ($w_i L_i$) are observable, labor supply is known and is always part of the contracts proposed by the social planner to consumers.[26]

Consider now treatment quantity. Except when reimbursement is in-kind, treatment quantity is not observable by the social planner and mimicking on health care consumption arises.[27] Obviously, if treatment consumption X_i^j is not observable, then consumer's aggregate consumption ($C_i^j = w_i L_i^j + R_i^{jTC} - (\alpha_i^j) q X_i^j$) is not observable too. With in-kind reimbursement, on the contrary, treatment quantity is observable. This follows from the interpretation of in-kind transfer $\bar{X}_i^j$ as an indivisible package of care (see section 3).

The social planner's programs addressed in this section are standard cases of mechanism design under adverse selection. Looking for the optimal mechanism of each reimbursement scheme, I will then employ the well known Revelation Principle[28]. Hence, I will study direct mechanisms in which consumers (truthfully) announce their type θ and the insurer offers an allocation which specifies all the relevant variables in the contractual relationship with consumers.

Notice that for each reimbursement method we shall look for the social planner's optimal allocations attainable *within each* reimbursement scheme. This means that, as we shall make clearer, the available reimbursement plans will

[26] See the conclusions for an extension of the model, in line with the Optimal Taxation literature (Stiglitz (1987), among others), with asymmetric information (also) on the health status.

[27] In the case of cash reimbursement it is evident that insurance has no way to control consumers' treatment purchase. On the contrary, in the case of treatment cost reimbursement, consumers present the physician's invoice and then receive reimbursement from the insurance. As a consequence, in this case we can say that treatment quantity is ex-post observable. However, in the real world this information is generally not used by the insurance (which, in fact, implements *linear* commodity tax on treatment, represented in this model by the parameter α_i^j). For this reason in the model treatment quantity is not observable with treatment cost reimbursement as well. I will come back to these considerations later (see note (31)).

[28] Myerson (1979), among others.

not necessarily allow to obtain the second-best optimum. The reason is obviously that some of them are instrument-constrained.

To have consumers truthfully report their type, the social planner has to maximize his objective function under (also) the incentive compatibility constraints. As it has been shown at the end of section 3, the low-type consumers are the mimickers. Standard mechanism design techniques with discrete types (see Fundenberg and Tirole (1991), pages 246-250) show that it is optimal to make the mimikers' incentive compatibility constraints binding thus implying that all the other constraints are satisfied.[29] As a consequence, to recover the separating allocations I will add two incentive constraints to the social planner's program: one for the low-type not seriously ill consumers and another for the low-type seriously ill consumers.

6.1. Cash reimbursement

Separating cash reimbursement is characterized by four monetary transfers $\left(P, R_2^j, R_3\right)$ and by consumers' labor supplies (L_i^j), $j = l, h$, $i = 1, 2$. In particular insurance offers the following contracts: (P, L_1) for healthy consumers, the couple of contracts $\left(L_2^l, R_2^l\right)$ and $\left(L_2^h, R_2^h\right)$ respectively for low and high-type not seriously ill consumers and the uniform transfer R_3 for both seriously ill consumers' types as, in this case, the only variable the social planner can control is the monetary transfers and then no separation can be obtained in the seriously ill state.

Notice that this means the social planner cannot discriminate between the two seriously ill consumers' type and is obliged to offer a pooling contract. Thus, only low-type *not* seriously ill incentive constraint appears in the insurance program.

With respect to treatment, not seriously and seriously ill consumers will respectively choose treatment quantity according to equations (6.1) and (6.2):

$$X_2^{*j}: \quad \theta_2^j \phi_2' (X_2) - qu' \left(w_2 L_2^j + R_2^j - qX_2\right) = 0 \tag{6.1}$$

$$X_3^{*j}: \quad \theta_3^j \phi_3' (X_3) - qu' \left(R_3^j - qX_3\right) = 0 \tag{6.2}$$

while the mimicker will choose the preferred quantity according to the following equation:

$$X_2^{*lh}: \quad \theta_2^l \phi_2' (X_2) - qu' \left(w_2 L_2^h + R_2^h - qX_2\right) = 0 \tag{6.3}$$

[29] A formal proof of this result is standard and then omitted. A complete proof is available from the author.

The social planner program then is:

$$\begin{cases} \underset{P,R_2^j,R_3,L_i^j}{Max} \quad p_1\left[u(w_1L_1-P)-v(L_1)\right]+ \\ +p_2\sum_{j=l,h}\mu_j\left[u\left(w_2L_2^j+R_2^j-qX_2^{*j}\left(\theta_2^j,L_2^j,R_2^j\right)\right)-H_2+\theta_2^j\phi_2\left(X_2^{*j}\left(\theta_2^j,L_2^j,R_2^j\right)\right)+\right. \\ \left.-v\left(L_2^j\right)\right]+p_3\sum_{j=l,h}\mu_j\left[u\left(R_3-qX_3^{*j}\right)-H_3+\theta_3^j\phi_3\left(X_3^{*j}\right)\right] \\ \\ s.t.: \qquad p_1P=p_2\left(\mu_lR_2^l+\mu_hR_2^h\right)+p_3R_3 \quad (\gamma) \\ \\ \quad u\left(w_2L_2^l+R_2^l-qX_2^{*l}\left(\theta_2^l,L_2^l,R_2^l\right)\right)+\theta_2^l\phi_2\left(X_2^{*l}\left(\theta_2^l,L_2^l,R_2^l\right)\right)-v(L_2^l)\geq \\ \quad u\left(w_2L_2^h+R_2^h-qX_2^{*lh}\left(\theta_2^l,L_2^h,R_2^h\right)\right)+\theta_2^l\phi_2\left(X_2^{*lh}\left(\theta_2^l,L_2^h,R_2^h\right)\right)-v(L_2^h) \quad (\lambda) \end{cases}$$

where $\gamma \neq 0$ and $\lambda \geq 0$ are respectively the budget constraint Lagrange multiplier and the incentive constraint Khun Tucker multiplier.

$>$From FOCs with respect to P and L_1 one respectively finds:

$$u'(C_1)-\gamma=0 \tag{6.4}$$

$$w_1u'(C_1)-v'(L_1)=0 \tag{6.5}$$

which imply $\gamma > 0$. Moreover, as we expected, healthy consumer's allocation is such that marginal benefit equals marginal cost of labor supply.

$>$From FOC with respect to R_2^l one finds:

$$\frac{p_2\mu_l+\lambda}{p_2\mu_l}u'\left(C_2^l\right)-\gamma=0 \tag{6.6}$$

such that, using equation (6.4), $C_2^l > C_1$.

$>$From FOC with respect to L_2^l it follows:

$$w_2u'\left(C_2^l\right)-v\left(L_2^l\right)=0 \tag{6.7}$$

and there is no distortion for the low-type not seriously ill consumer.

$>$From FOC with respect to R_2^h one finds:

$$u'\left(C_2^h\right)-\frac{\lambda}{p_2\mu_h}u'\left(C_2^{lh}\right)-\gamma=0 \tag{6.8}$$

where C_2^{lh} is the mimicker's aggregate consumption. From equations (6.4) and (6.8) it follows that $C_2^h < C_1$.

>From FOC with respect to L_2^h one finds:

$$\frac{w_2 u'\left(C_2^h\right) - v\left(L_2^h\right)}{w_2 u'\left(C_2^{lh}\right) - v\left(L_2^h\right)} - \frac{\lambda}{p_2 \mu_h} = 0 \tag{6.9}$$

Substituting (6.8) in (6.9) and rearranging one finds:

$$\frac{p_2 \mu_h - \lambda}{p_2 \mu_h} v'\left(L_2^h\right) - \gamma w_2 = 0 \tag{6.10}$$

Such that it must be $p_2 \mu_h - \lambda > 0$. Moreover, using (6.6) and (6.7), (6.10) shows that $L_2^l < L_2^h$. Concerning high-type distortion, for the (6.3) the mimicker will choose $X_2^{lh} < X_2^h$, then $C_2^{lh} > C_2^h$. As a consequence, (6.9) does not contradict that $p_2 \mu_h - \lambda > 0$ only if $w_2 u'\left(C_2^{lh}\right) - v\left(L_2^h\right) < w_2 u'\left(C_2^h\right) - v\left(L_2^h\right) < 0$, and then $w_2 u'\left(C_2^h\right) < v\left(L_2^h\right)$. This means that high-type not seriously ill consumer is forced to supply too much labor and to under-consume (with respect to aggregate consumption).

Finally, from the FOC with respect to R_3 one finds the same result obtained for uniform cash reimbursement:

$$E\left[u'\left(C_3\right)\right] = u'\left(C_1\right)$$

High-type consumers, having a higher preference for treatment, choose an higher treatment quantity with respect to low-type consumers. Seriously ill consumers' pooling allocation in the case of cash reimbursement is represented in figure 4.

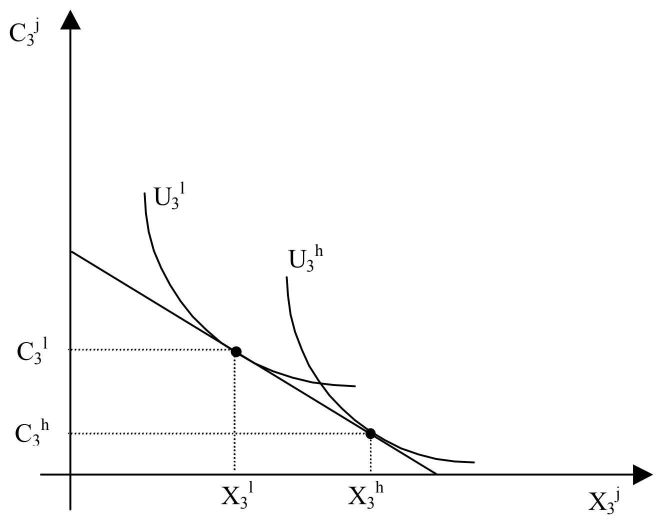

Figure 4: seriously ill consumers' allocation with cash reimbursement.

Note that the two point in figure 4 are incentive compatible (no type prefers the consumption bundle of the other type) but, obviously, no one of the two incentive constraints is binding (recall that in the seriously ill state no separation can be obtained because a unique instrument can be used, the monetary transfer). This anticipates that cash will be easily dominated by other reimbursement schemes.

The following proposition summarizes the previous results concerning the separating cash allocation:

Proposition 5 *The optimal cash self-selecting allocation is such that: contracts* $\left(L_2^l, R_2^l\right)$ *and* $\left(L_2^h, R_2^h\right)$ *verify* $L_2^l < L_2^h$ *and* $C_2^l > C_2^h$. *There is no distortion for low-type consumer. On the contrary high type consumer is forced to supply too much labor and to consume too less aggregate consumption* $(w_2 u'(C_2^h) < v'(L_2^h))$. *Both seriously ill types receive a monetary transfer* R_3 *and choose treatment and aggregate consumption such that* $X_3^l < X_3^h$ *and* $C_3^l > C_3^h$.

6.2. In-kind reimbursement

In-kind reimbursement is characterized by five monetary transfers (P, R_2^j, R_3^j), by consumers' labor supplies (L_i^j) and by the transfers $\bar{X}_i^j,\ i = 2, 3,\ j = l, h$. As I anticipated in section 3, it is reasonable to assume that the in-kind transfer $\bar{X}_i^j$ is an indivisible package of care[30] such that the social planner can observe treatment consumption. As a consequence, with in-kind reimbursement, aggregate consumption, treatment quantity and labor supply are all observable. The contracts proposed in the three states then are (C_1, L_1), (C_2^l, X_2^l, L_2^l), (C_2^h, X_2^h, L_2^h), (C_3^l, X_3^l) and (C_3^h, X_3^h). It is interesting to notice that in-kind represents the unconstrained direct mechanism in the sense that, given the agent's type announcement, all the relevant variables are chosen by the social planner. As a consequence we can anticipate that the in-kind optimal allocation corresponds to the allocation which weakly dominates the others.

[30] Letting consumers choose the preferred treatment quantity under the constraints $X_i^j \leq \bar{X}_i^j$, the in-kind reimbursement self-selecting allocation would be very similar to the cash reimbursement one. The only difference would be that with IK C_i^j is observable.

The social planner's program then is[31]

$$\begin{cases} \underset{C_i^j, L_i^j, \bar{X}_i^j}{Max} & p_1 \left[u(C_1) - v(L_1) \right] + \\ & +p_2 \sum_{j=l,h} \mu_j \left[u\left(C_2^j\right) - H_2 + \theta_2^j \phi_2 \left(\bar{X}_2^j\right) - v\left(L_2^j\right) \right] + \\ & +p_3 \sum_{j=l,h} \mu_j \left[u\left(C_3^j\right) - H_3 + \theta_3^j \phi_3 \left(\bar{X}_3^j\right) \right] \\ s.t.: & p_1 \left(w_1 L_1 - C_1\right) = p_2 \sum_{j=l,h} \mu_j \left(C_2^j - w_2 L_2^j\right) + p_3 \sum_{j=l,h} \mu_j C_3^j + \\ & \quad + p_2 \sum_{j=l,h} \mu_j q \bar{X}_2^j + p_3 \sum_{j=l,h} \mu_j q \bar{X}_3^j \qquad (\gamma) \\ & u\left(C_2^l\right) + \theta_2^l \phi_2 \left(\bar{X}_2^l\right) - v\left(L_2^l\right) \geq u\left(C_2^h\right) + \theta_2^l \phi_2 \left(\bar{X}_2^h\right) - v\left(L_2^h\right) \quad (\lambda_2) \\ & u\left(C_3^l\right) + \theta_3^l \phi_3 \left(\bar{X}_3^l\right) \geq u\left(C_3^h\right) + \theta_3^l \phi_3 \left(\bar{X}_3^h\right) \quad (\lambda_3) \end{cases}$$

where $\gamma \neq 0$ and $\lambda_{2,}\lambda_3 \geq 0$ respectively are the budget constraint Lagrange multiplier and the incentive constraints Khun Tucker multipliers.

$>$From FOCs with respect to C_1 and L_1 one finds respectively equations (6.4) and (6.5).

$>$From FOC with respect to C_2^l it follows:

$$\frac{p_2 \mu_l + \lambda_2}{p_2 \mu_l} u'\left(C_2^l\right) - \gamma = 0 \tag{6.11}$$

and then (6.4) and (6.11) imply $C_2^l > C_1$. From FOC with respect to L_2^l :

$$\frac{p_2 \mu_l + \lambda_2}{p_2 \mu_l} v'\left(L_2^l\right) - w_2 \gamma = 0 \tag{6.12}$$

(6.5) and (6.12) together yield $L_2^l > L_1$. Moreover (6.11) and (6.12) imply equation (6.7). As a consequence there is no distortion for low-type consumer concerning labor supply. Finally from FOC with respect to $\bar{X}_2^l$ one finds:

$$\frac{p_2 \mu_l + \lambda_2}{p_2 \mu_l} \theta_2^l \phi_2' \left(\bar{X}_2^l\right) - q\gamma = 0 \tag{6.13}$$

[31] The monetary transfers R_i^j will be derived later from the optimal allocation.

>From (6.11) and (6.13) it follows that $\theta_2^l \phi_2' \left(\bar{X}_2^l\right) - qu' \left(C_2^l\right) = 0$. As a consequence there is no distortion for low-type consumer concerning treatment quantity.

Regarding high-type consumers, from FOCs with respect to C_2^h :

$$\frac{p_2 \mu_h - \lambda_2}{p_2 \mu_h} u' \left(C_2^h\right) - \gamma = 0 \tag{6.14}$$

Comparing the previous equation to (6.4) one finds $C_2^h < C_1$.

FOCs with respect to L_2^h and $\bar{X}_2^h$ respectively yield:

$$\frac{p_2 \mu_h - \lambda_2}{p_2 \mu_h} v' \left(L_2^h\right) - w_2 \gamma = 0 \tag{6.15}$$

$$p_2 \mu_h \theta_2^h \phi_2' \left(\bar{X}_2^h\right) - \lambda_2 \theta_2^l \phi_2' \left(\bar{X}_2^h\right) - p_2 \mu_h q \gamma = 0 \tag{6.16}$$

Comparing (6.15) to (6.5) it is evident that $L_2^h > L_1$.

While from (6.14) and (6.15) it follows that $w_2 u' \left(C_2^h\right) - v \left(L_2^h\right) = 0$. This implies that there is no distortion for high-type not seriously ill consumer concerning labor supply.

I showed that $C_2^h < C_2^l$ and $L_2^h > L_2^l$, as a consequence, it must be $R_2^h < R_2^l$. Moreover, from the binding incentive constraint it follows $\bar{X}_2^h > \bar{X}_2^l$.

Solving (6.14) and (6.16) together yield to $\theta_2^h \phi_2' \left(\bar{X}_2^h\right) < qu' \left(C_2^h\right)$ (see Stiglitz (1987) page 1005). This means that high-type not seriously ill consumer is forced to consume too much treatment and too less aggregate consumption.

Concerning seriously ill consumers, from FOC with respect to C_3^l one finds:

$$\frac{p_3 \mu_l + \lambda_3}{p_3 \mu_l} u' \left(C_3^l\right) - \gamma = 0 \tag{6.17}$$

such that, comparing with (6.4), $C_3^l > C_1$ holds. From FOC with respect to $\bar{X}_3^l$ one finds:

$$\frac{p_3 \mu_l + \lambda_3}{p_3 \mu_l} \theta_3^l \phi_3' \left(\bar{X}_3^l\right) - q\gamma = 0 \tag{6.18}$$

>From (6.17) and (6.19) it follows that $\theta_3^l \phi_3' \left(\bar{X}_3^l\right) - qu' \left(C_3^l\right) = 0$. As a consequence there is no distortion for low-type consumer concerning treatment quantity.

>From FOC with respect to C_3^h :

$$\frac{p_3 \mu_h - \lambda_3}{p_3 \mu_h} u' \left(C_3^h\right) - \gamma = 0 \tag{6.19}$$

Comparing the previous equation to (6.4) it follows that $C_3^h < C_1$.

As before, recalling that $C_3^h < C_3^l$, from the binding incentive constraint it must be $\bar{X}_3^h > \bar{X}_3^l$.

FOC with respect to $\bar{X}_3^h$ yields:

$$p_3\mu_h\theta_3^h\phi_3'\left(\bar{X}_3^h\right) - \lambda_3\theta_3^l\phi_3'\left(\bar{X}_3^h\right) - p_3\mu_h q\gamma = 0 \tag{6.20}$$

Solving (6.19) and (6.20) together yield to $\theta_3^h\phi_3'\left(\bar{X}_3^h\right) < qu'\left(C_3^h\right)$ (again as in Stiglitz (1987) page 1005). This means that high-type seriously ill consumer is forced to consume too much treatment and too less aggregate consumption. Seriously ill consumers' self-selecting allocation in the case of in-kind reimbursement is represented in the following figure:

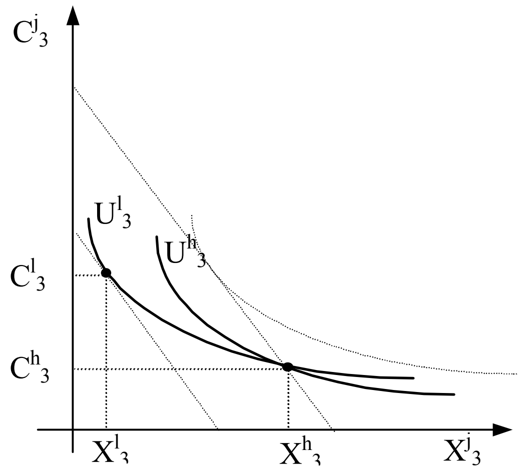

Figure 5: seriously ill consumers' self-selecting allocation with in-kind reimbursement.

Note that in-kind self-selecting allocation devotes more resources to high-type than to low-type consumers just as the first-best allocation does (see figure 3).

Proposition 6 summarizes the previous results.

Proposition 6 *The optimal in-kind self-selecting allocation is such that: contracts* $(C_2^l, \bar{X}_2^l, L_2^l)$ *and* $(C_2^h, \bar{X}_2^h, L_2^h)$ *verify* $C_2^l > C_2^h$, $\bar{X}_2^l < \bar{X}_2^h$ *and* $L_2^l < L_2^h$.0 *The monetary transfers are such that* $R_2^l > R_2^h$. *There is no distortion for low-type consumer. High type consumer is forced to consume too much treatment and too less aggregate consumption* ($\theta_2^h\phi_2'(\bar{X}_2^h) < qu'(C_2^h)$). *Contracts* (C_3^l, X_3^l) *and*

(C_3^h, X_3^h) *verify* $C_3^l > C_3^h$ *and* $\bar{X}_3^l < \bar{X}_3^h$. *There is no distortion for low-type consumer and high type consumer is forced to consume too much treatment and too less aggregate consumption* $(\theta_3^h \phi_3'(\bar{X}_3^h) < qu'(C_3^h))$.

It is important to notice that in-kind reimbursement exactly corresponds to the direct mechanism in this adverse selection setting. Consumers announce their type and receive the second-best (due to asymmetric information) allocation. All the other relevant decisions are taken by the social planner. Interestingly, I shall show in the next section that treatment cost reimbursement turns out to be an indirect mechanism with which the social planner is able to implement the very same in-kind allocation.

6.3. Reimbursement on treatment cost

Treatment cost reimbursement is characterized by five monetary transfers (P, R_2^j, R_3^j), by consumers' labor supplies (L_i^j) and by four cost-sharing parameters (α_i^j), $i = 2, 3$ $j = l, h$. In particular insurance contracts are: (P, L_1) for healthy consumers, $(L_2^l, R_2^l, \alpha_2^l)$ and $(L_2^h, R_2^h, \alpha_2^h)$ respectively for low and high-type not seriously ill consumers and finally (R_3^l, α_3^l) and (R_3^h, α_3^h) respectively for low and high-type seriously ill consumers. Contrary to the case of cash reimbursement, here also the low-type seriously ill consumers are mimickers.

Concerning treatment, not seriously and seriously ill consumers will respectively choose treatment quantity according to equations (6.21) and (6.22):

$$X_2^{*j}: \quad \theta_2^j \phi_2'(X_2) - \alpha_2^j qu'\left(w_2 L_2^j + R_2^j - \alpha^j q X_2\right) = 0 \tag{6.21}$$

$$X_3^{*j}: \quad \theta_3^j \phi_3'(X_3) - \alpha_3^j qu'\left(R_3^j - \alpha_3^j q X_3\right) = 0 \tag{6.22}$$

while the mimickers will choose the preferred treatment quantity according to the following equations[32]:

[32] In the Optimal Taxation literature, a standard assumption is that only linear commodity taxes are implementable because transactions are anonymous. This means that the quantity consumed by every consumer is not observable.

In the setting I analyze here with treatment cost reimbursement, the situation is different. In fact consumers ask for reimbursement after their purchase has been done. As a consequence treatment quantity is ex-post verifiable. Then, with this reimbursement method, the linear taxation (subsidization) used by the insurer (the parameters α_i^j) corresponds to an ad hoc restriction of the insurance instruments. Anyway, in the real word, the Health Authorities frequently use linear subsidization of treatment.

$$X_2^{*lh}: \quad \theta_2^l \phi_2' (X_2) - \alpha_2^h q u' \left(w_2 L_2^h + R_2^h - \alpha_2^h q X_2 \right) = 0 \tag{6.23}$$

$$X_3^{*lh}: \quad \theta_3^l \phi_3' (X_3) - \alpha_3^h q u' \left(R_3^h - \alpha_3^h q X_3 \right) = 0 \tag{6.24}$$

The social planner's program then is

$$\begin{cases}
\underset{P, R_i^j, \alpha_i^j, L_i^j}{Max} \quad p_1 \left[u(w_1 L_1 - P) - v(L_1) \right] + \\
\quad + p_2 \sum_{j=l,h} \mu_j \left[u \left(w_2 L_2^j + R_2^j - \alpha_2^j q X_2^{*j} \left(\theta_2^j, L_2^j, R_2^j, \alpha_2^j \right) \right) - H_2 + \right. \\
\quad \left. + \theta_2^j \phi_2 \left(X_2^{*j} \left(\theta_2^j, L_2^j, R_2^j, \alpha_2^j \right) \right) - v(L_2^j) \right] + \\
\quad + p_3 \sum_{j=l,h} \mu_j \left[u \left(R_3^C - q X_3^{*j} \left(\theta_3^j, R_3^j, \alpha_3^j \right) \right) - H_3 + \theta_3^j \phi_3 \left(X_3^{*j} \left(\theta_3^j, R_3^j, \alpha_3^j \right) \right) \right] \\
\\
s.t.: \quad p_1 P = p_2 \left[\mu_l \left(R_2^l + \left(1 - \alpha_2^l \right) q X_2^{*l} \right) + \mu_h \left(R_2^h + \left(1 - \alpha_2^h \right) q X_2^{*h} \right) \right] + \\
\quad + p_3 \left[\mu_l \left(R_3^l + \left(1 - \alpha_3^l \right) q X_3^{*l} \right) + \mu_h \left(R_3^h + \left(1 - \alpha_3^h \right) q X_3^{*h} \right) \right] \qquad (\gamma) \\
\\
u \left(w_2 L_2^l + R_2^l - \alpha_2^l q X_2^{*l} \left(\theta_2^l, L_2^l, R_2^l, \alpha_2^l \right) \right) + \theta_2^l \phi_2 \left(X_2^{*l} \left(\theta_2^l, L_2^l, R_2^l, \alpha_2^l \right) \right) - v(L_2^l) \geq \\
u \left(w_2 L_2^h + R_2^h - \alpha_2^h q X_2^{*lh} \left(\theta_2^l, L_2^h, R_2^h, \alpha_2^h \right) \right) + \theta_2^l \phi_2 \left(X_2^{*lh} \left(\theta_2^l, L_2^h, R_2^h, \alpha_2^h \right) \right) - v(L_2^h) \quad (\lambda_2) \\
u \left(R_3^l - \alpha_3^l q X_3^{*l} \left(\theta_3^l, R_3^l, \alpha_3^l \right) \right) + \theta_3^l \phi_3 \left(X_3^{*l} \left(\theta_3^l, R_3^l, \alpha_3^l \right) \right) \geq \\
u \left(R_3^h - \alpha_3^h q X_3^{*h} \left(\theta_3^l, R_3^h, \alpha_3^h \right) \right) + \theta_3^l \phi_3 \left(X_3^{*lh} \left(\theta_3^l, R_3^h, \alpha_3^h \right) \right) \quad (\lambda_3)
\end{cases}$$

Where $\gamma \neq 0$ and $\lambda_{2,}\lambda_3 \geq 0$ respectively are the budget constraint Lagrange multiplier and the incentive constraints Khun Tucker multipliers.

$>$From FOCs with respect to P and L_1 one respectively finds equations (6.4) and (6.5).

$>$From FOC with respect to R_2^l one finds equation (6.6), such that, using the (6.4), $C_2^l > C_1$ holds. Moreover, from FOC with respect to L_2^l one finds again equation (6.7): there is no distortion for low-type not seriously ill consumer concerning labor supply.

$>$From FOC with respect to α_2^l it follows:

$$X_2^l \left[p_2 \mu_l u' \left(C_2^l \right) + \lambda_2 u' \left(C_2^l \right) - \gamma p_2 \mu_l \right] + \gamma p_2 \mu_l \frac{\partial X_2^l}{\partial \alpha_2^l} \left(1 - \alpha_2^l \right) = 0 \tag{6.25}$$

such that, substituting (6.6), $\alpha_2^l = 1$ holds: low-type not seriously ill consumer's treatment price is not distorted.

$>$From FOC with respect to R_2^h equation (6.8) follows, such that, using the (6.4), $C_2^h < C_1$ holds.

>From FOC with respect to L_2^h one finds again equation (6.9). As in session 7.2, it follows that $L_2^l < L_2^h$. Moreover $w_2 u'\left(C_2^h\right) < v\left(L_2^h\right)$ holds. That is, also with non-uniform treatment cost, high-type not seriously ill consumer supplies too much labor and consumes too less aggregate consumption.

Rearranging together FOCs with respect to α_2^h and R_2^h it follows:

$$\alpha_2^h = 1 + \frac{\lambda_2 u'\left(C_2^{lh}\right)\left(X_2^h - X_2^{lh}\right)}{\gamma p_2 \mu_h \frac{\partial X_2^h}{\partial \alpha_2^h}} \tag{6.26}$$

where $\frac{\partial X_2^h}{\partial \alpha_2^h} < 0$, $\gamma > 0$ and, from (6.21) and (6.23), $X_2^h - X_2^{lh} > 0$. (6.26) shows that $\alpha_2^h < 1$: high type not seriously ill consumer's treatment price is subsidized.

Concerning seriously ill consumers, from FOC with respect to R_3^l one finds equation (6.17), such that, again, $C_3^l > C_1$. Moreover, FOC with respect to α_3^l yields:

$$X_3^l\left[p_3\mu_l u'\left(C_3^l\right) + \lambda_3 u'\left(C_3^l\right) - \gamma p_3 \mu_l\right] + \gamma p_3 \mu_l \frac{\partial X_3^l}{\partial \alpha_3^l}\left(1 - \alpha_3^l\right) = 0 \tag{6.27}$$

such that, substituting (6.17), $\alpha_3^l = 1$ holds: low-type seriously ill consumers' treatment price is not distorted.

While, from FOC with respect to R_3^h one finds:

$$u'\left(C_3^h\right) - \frac{\lambda_3}{p_3 \mu_h} u'\left(C_3^{lh}\right) - \gamma = 0 \tag{6.28}$$

Comparing the previous equation to (6.4), one finds $C_3^h < C_1$.

Finally, from FOCs with respect to α_3^h and R_3^h together it follows:

$$\alpha_3^h = 1 + \frac{\lambda_3 u'\left(C_3^{lh}\right)\left(X_3^h - X_3^{lh}\right)}{\gamma p_3 \mu_h \frac{\partial X_3^h}{\partial \alpha_3^h}} \tag{6.29}$$

where $\frac{\partial X_3^h}{\partial \alpha_3^h} < 0$, $\gamma > 0$ and, from (6.22) and (6.24), $X_3^h - X_3^{lh} > 0$. (6.29) shows that $\alpha_3^h < 1$: high-type seriously ill consumer's treatment price is subsidized. Totally differentiating (6.22) it is easy to verify that $\frac{dR_3^j}{d\alpha_3^j} > 0$. As a consequence $R_3^l > R_3^h$.

Seriously ill consumers' self-selecting allocation in the case of treatment cost reimbursement is represented in figure 6 by the points A and B. In the figure low-type consumer is indifferent between the allocation he can reach with the budget constraint defined by $\left(R_3^l, \alpha_3^l = 1\right)$ and the allocation he can reach with the budget constraint defined by $\left(R_3^h, \alpha_3^h < 1\right)$.

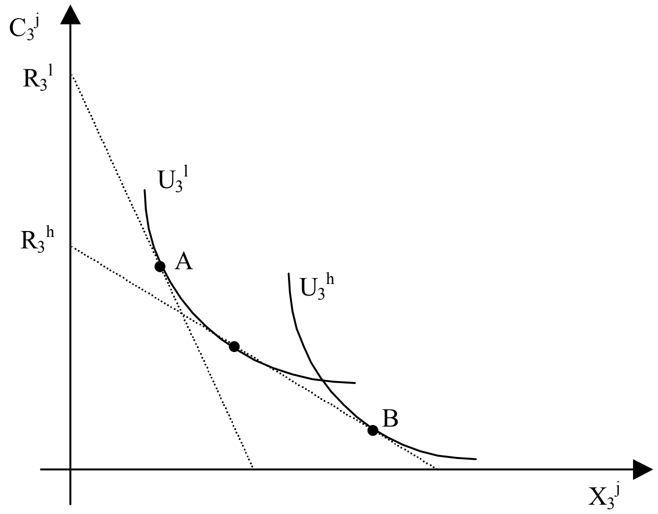

Figure 6 : seriously ill consumers' self-selecting allocation with treatment cost reimbursement.

Proposition 7 summarizes the previous results.

Proposition 7 *The optimal treatment cost self-selecting allocation is such that: contracts* $(L_2^l, R_2^l, \alpha_2^l)$ *and* $(L_2^h, R_2^h, \alpha_2^h)$ *verify* $L_2^l < L_2^h$, $C_2^l > C_2^h$ *and* $\alpha_2^h < \alpha_2^l = 1$. *There is no distortion for low-type consumer. On the contrary treatment consumed by high-type consumer is subsidized and high type consumer is forced to supply too much labor and to consume too less aggregate consumption* $(w_2 u'(C_2^h) < v'(L_2^h))$. *Contracts* (R_3^l, α_3^l) *and* (R_3^h, α_3^h) *verify* $C_3^l > C_3^h$, $R_3^l > R_3^h$ *and* $\alpha_3^h < \alpha_3^l = 1$. *There is no distortion for low-type consumer and treatment consumed by high-type consumer is subsidized.*

Treatment cost represents an indirect mechanism in this adverse selection problem. In fact consumers choose aggregate consumption and treatment after the social planner has decided the parameters of the insurance contract. Considering seriously ill consumers and looking at figures 5 and 6 we see that with treatment cost the in-kind allocation cannot be implemented because it is not incentive compatible. In other words, using treatment cost, the social planner could obtain an allocation with the same characteristics of the second-best one, but this would imply an additional cost. Actually this is not a problem and the second-best allocation can be obtained with treatment cost too. In fact, referring to the Taxation Principle in the mechanism design literature, we know that the social planner can offer a non linear schedule $C_3(X)$ which corresponds to the optimal non-linear tariff[33]. In particular this non-linear tariff allows to eliminate the "undesired" parts from the consumers' budget constraints such that only the points corresponding to the second-best allocation will be chosen at the equilibrium. Figure 7 shows an example of optimal non-linear tariff which implements the second-best.

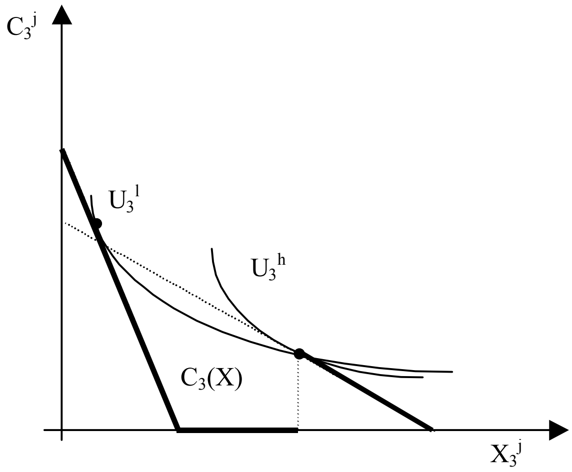

Figure 7: implementing the second-best with treatment cost reimbursement.

Concerning not seriously ill consumers, as before, the social planner implements the optimal non-linear tariff $C_2(X)$ such that only the second-best allocation is chosen at the equilibrium. Such non-linear tariff also depends on labor supply (L_2^j).[34]

[33]Note that this schedule is the non-linear equivalent of the pooling schedule $C_3(X) = R_3^{TC} - \alpha_3 X$ which has been analyzed in section 4.3 when I treated uniform treatment cost reimbursement.

[34]There is another possible interpretation of the self-selecting treatment cost allocation. Consider seriously ill consumers and the mechanism $\{R(\theta), \alpha(\theta)\}$ where consumers announce both their type and the quantity of treatment they want to buy. The monetary transfer is $R(\theta) = C + \alpha(\theta)qX$. Notice that here there is no possibility of misrepresenting the quantity of treatment to purchase. In fact in equilibrium only two quantities of treatment are possible: X_i^l and X_i^h. This means that low-type incentive constraints are similar to the in-kind program

7. Comparing the alternative separating reimbursement plans

Sections 6.2 and 6.3 show that in-kind and treatment cost reimbursement are, from a social welfare point of view, equivalent. The first corresponds to the direct mechanism while the second corresponds to a payoff equivalent indirect mechanism. Both allow to implement the second-best allocation.

Consider now the other reimbursement plans. Let start from a mix of reimbursement types and recall that it pays on treatment cost for outpatient care and in-kind for inpatient care. From the previous consideration it follows that a mix of types allows to implement the second-best allocation too. As a consequence a mix of reimbursement types is, again from a social welfare point of view, equivalent to in-kind and treatment cost reimbursement.

On the contrary, concerning cash reimbursement, as it has been said analyzing uniform plans (Proposition 2) this reimbursement method uses one instrument less with respect to treatment cost. As a consequence cash is weakly dominated by treatment cost reimbursement. The following proposition establishes the reimbursement methods ranking in the case of self-selecting allocations.

Proposition 8 *In the case of self-selecting allocations the reimbursement methods ranking is as follows: in-kind reimbursement* $\approx$ *treatment cost reimbursement* $\approx$ *mix of types* $\succeq$ *cash reimbursement.*

8. Conclusion

This work presents an institutional comparison of alternative health insurance reimbursement methods. In the model I compare in-kind reimbursement (IK) and reimbursement insurance (in the paper treatment cost reimbursement (TC)) in a model of public health insurance. Moreover the model provides a treatable framework for systems which use a mix of in-kind and treatment cost reimbursement (as an example the French system): outpatient care are reimbursed on treatment cost and inpatient care are reimbursed in-kind.

The model explicitly considers serious and not serious illness which both have a negative (but different) impact on labor productivity. Not seriously ill consumers need outpatient care, while seriously ill ones need inpatient care. A key feature of the model is consumers' heterogeneity with respect to intensity of preferences for

ones (see the previous section) and the second-best allocation is implemented. As it is evident, following this interpretation treatment cost becomes a *direct mechanism* too.

treatment. Public insurance is fully informed on consumers' health status but it cannot observe preference for treatment. In this setting low-type consumers want to mimic high type consumers. Facing low-type consumers incentive constraints, public insurance can choose to implement a pooling allocation or a separating one.

In the first part of the work I analyze pooling allocations. The main result is that TC weakly dominates the mix of IK and TC payment which weakly dominates IK reimbursement.

In the second part of the paper I analyze self-selecting allocations. Intuitively, with these allocations the rationale for in-kind reimbursement should be stronger: the self-selecting property of in-kind transfers should partially prevents from mimicking. The result confirms this intuition: in-kind reimbursement corresponds to the direct mechanism and then it is not dominated by any other reimbursement method. Treatment cost corresponds to an indirect mechanism which is able to implement the second-best allocation too and then, from a social welfare point of view, it is equivalent to in-kind reimbursement. Not surprisingly also a mix of types reimbursement turns out to be equivalent to in-kind and treatment cost.

Finally, the structure of the model may allow to consider also a setting with asymmetric information with respect to the health status along the lines of the Optimal Taxation literature (Stiglitz (1987)). In that case consumers can mimic a worst state of health in order to work less and to get a better reimbursement. Different health status corresponds to different earning ability so that there would exist three groups of individuals: healthy, not seriously ill and seriously ill consumers ($w_1 > w_2 > w_3 = 0$). As usual, $w_i L_i$ is observable but earning ability and labor supply separately are not. Note that this means that seriously ill individuals are not able to mimic. If provider behaves as a perfect agent for consumer, when consumer wants to mimic, physicians certifies a false state of health allowing consumers to ask for a better reimbursement. It is reasonable to think that consumers are interested in mimicking a worse state of health such that they are able to work less and to obtain a larger reimbursement. In particular this means that the sense of mimicking goes from healthy to ill individuals: an healthy consumer can mimic a not seriously ill or a seriously ill one and a not seriously ill consumer can mimic a seriously ill one. Consumers' possibility to mimic depends on the insurance plan structure. Thus, consequences of mimicking will be different for different reimbursement types. In particular we expect that, weakening the incentive constraint, in-kind reimbursement will partially prevent from mimicking. To be more realistic, this setting should also explicitly take into account the health care provider, eventually considering collusive behavior between patient and physician. These topics are left for future research.

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