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Pay or Pain?

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Deductibles in Health Insurance: Pay or Pain?*

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Abstract

We study a health-insurance market where individuals are offered coverage against both medical expenditures and losses in income. Individuals vary in their level of innate ability. If there is private information about the probability of illness and an individual's innate ability is sufficiently low, we find that competitive insurance contracts yield screening partly in the form of co-payment, *i.e.*, a deductible in pay, and partly in the form of reduced medical treatment, *i.e.*, a deductible in pain.

Keywords: health insurance, adverse selection, deductibles

JEL Codes: I11, D82

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1 Introduction

Individuals face an inevitable risk of falling ill. Illness entails a loss in income earnings and induces expenditures on medical treatment. Traditionally, individuals are thought to hedge against the potential loss in income, *e.g.* caused by permanently impaired health, by holding a disability insurance, and to hedge against medical expenditures by holding a medical insurance. We argue that the two types of insurance protect against the consequences of the same risk, namely the risk of losing health, and, therefore, that the concept of health insurance should be expanded so as to include both types of insurance. One consequence of taking this wider view of health insurance is that insurees may prefer insurance contracts offering cash compensation in part, instead of full restoration of health, if ill.[1] In this paper, we discuss how this expanded concept of health insurance affects the performance of a private health-insurance market with *asymmetric information*. In particular: if information about the probability of falling ill is private to the individual, will low-risk individuals get both less medical treatment and less cash compensation than they would in a world of symmetric information?

Empirically, insurance against income loss and medical expenditures are part of a (public) social insurance in a number of European countries. If individuals' entitlements are commensurate with their contributions, *i.e.,* no redistribution, then our findings would apply also to the design of information-constrained Pareto efficient social-insurance contracts.

In our model, individuals differ along two dimensions: ability and risk. Information about ability is assumed to be symmetrically distributed, while information about risk (*i.e.*, the probability of getting ill) is private to the individual. Some individuals are robust: they have a low probability of getting ill. Others are frail: they have a high such probability. Individuals can recover partially or fully from an illness if they receive partial or complete medical treatment, respectively. Individuals have preferences over consumption and health. Their problem is to decide *ex ante* how much income to transfer between the two possible states of the world, healthy or ill, and if ill, how to allocate income between consumption and health (*i.e.*, medical treatment). The insurance contracts thus need to be specified along *three dimensions*: (i) consumption if healthy, (ii) con-

[1] See our companion paper, Asheim *et al.* (2000). Arguments in favor of insurance contracts providing less than full treatment have also been put forward by other authors, such as Byrne and Thomson (2000) and Graboyes (2000).

sumption if ill, and (iii) treatment if ill. A proper analysis of the market for health insurance will have to take this feature of the contracts involved into account. Our analysis thus contrasts with the text-book setting where insurance usually covers medical expenditures only and individuals differ with respect to their risk of falling ill only.

When there is asymmetric information on risk, it follows from the analysis of Rothschild and Stiglitz (1976) that contracts can be differentiated in terms of the premium paid by the insured and the level of coverage provided; see, *e.g.*, Zweifel and Breyer (1997, chs. 5 and 6) for a health-insurance exposition. Rothschild and Stiglitz show that, under certain conditions, a separating equilibrium exists in which each insurer offers a menu of insurance contracts. Frail individuals (*i.e.*, those with a high probability of getting ill) are offered full insurance coverage, while robust individuals (with a low such probability) are offered partial coverage only. In this standard set-up, partial coverage means a reduction in the compensation paid for medical expenditures. As argued above, health insurance involves three-dimensional contracts. It is therefore necessary to extend the Rothschild-Stiglitz analysis to such a three-dimensional case. This is what we set out to do in the following analysis.

The paper is organized as follows. The model is outlined in Section 2, where insurance contracts satisfying the self-selection constraints are characterized. Individuals' choice between consumption and medical treatment if ill is shown not to change relative to a situation with symmetric information. This implies that insurers do not need to place any restrictions on how individuals allocate the insurance indemnity if ill. Our three-dimensional problem is consequently reduced to one of only two dimensions: (i) consumption if healthy, and (ii) consumption if ill. In Section 3, analogously to Rothschild and Stiglitz (1976), we find separating contracts in which frail individuals obtain their first-best level of coverage, while robust individuals are constrained in order for insurers to induce self-selection. In Section 4, we study the comparative statics with respect to individuals' level of innate ability and investigate what level of treatment and cash compensation these separating contracts lead to if illness occurs. The insurers screen individuals through deductibles, and robust individuals face a deductible in their level of insurance coverage. Robust individuals with a sufficiently high level of innate ability will have a deductible in the form of co-payment only, *i.e., deductible in pay.* Robust individuals with a sufficiently low level of innate ability, on the other hand, will have part of the deductible in the form of a reduction in the level of treatment provided, *i.e., deductible in pain.* Frail individuals are, in contrast, offered their first-best optimal level of insurance coverage. In particular, frail individuals with a sufficiently high level of ability receive complete treatment if ill, while those with a sufficiently low ability receive their optimal level of (partial) treatment and cash payment if ill. Our findings and their implications are discussed in Section 5.

2 The model

We model a setting where individuals have preferences over consumption (c) and health (h). Each individual faces uncertainty with respect to her state of health. There are two such (jointly exhaustive and verifiable) states. In state 1, the individual is healthy and holds a level of health normalized to 1: $h_1 = 1$. In state 2 she is ill and suffers a complete loss in health; *i.e.*, without any treatment, her health is zero: $h_2 = 0$. If the individual is ill, her health may be restored with certainty through medical treatment, $t \in [0, 1]$. Thus, after treatment, her health if ill is $h_2 = t$. Treatment leading to full recovery costs C, while treatment at a level t costs tC. Consumption in the two states are denoted c_1 and c_2, respectively.

The individuals know their objective probability of falling ill, which is either high or low: The probability of falling ill is π_j for type-j individuals, where $j = F, R$ denotes frail (high risk) and robust (low risk) individuals, respectively, and $0 < \pi_R < \pi_F < 1$. Individuals maximize the von Neumann-Morgenstern expected utility function:

$$(1 - \pi_j)u(c_1, 1) + \pi_j u(c_2, t), \tag{1}$$

where $u(c, h)$ is a Bernoulli utility function. We assume that $u : \mathcal{R}^2_+ \to \mathcal{R}$ is twice continuously differentiable, strictly increasing, and strictly concave. In particular, it satisfies: $\forall(c, h) \in \mathcal{R}^2_{++}$, $u_c > 0$, $u_h > 0$, $u_{cc} < 0$, and $u_{hh} < 0$, where partial derivatives are denoted by subscripts. A concave utility function implies that the individual is risk averse. We also assume that $u_{ch} > 0$, hence, in addition to being an important factor of well-being in its own right, health affects an individual's ability to enjoy consumption. Moreover, $u_c(c, h) \to \infty$ as $c \downarrow 0$ whenever $h > 0$, and $u_h(c, h) \to \infty$ as $h \downarrow 0$ whenever $c > 0$, and $u_c(c, h) \to \infty$ or $u_h(c, h) \to \infty$ as $c \downarrow 0$ and $h \downarrow 0$. Note that our assumptions on u imply normality.

Introducing health as an argument in the utility function bears resemblance to the literature on insurance with state-dependent utility; see, *e.g.*, Arrow (1974), Hirshleifer and Riley (1979), Viscusi and Evans (1990), and Frech (1994). In these discussions, health is an unalterable characteristic of the state and they therefore fit well with the insurance being purely a disability insurance. Our formulation can be seen as filling the gap between a pure disability insurance, where the reduced health following illness is inevitable and thus a formulation with state-dependent utility appropriate, and a pure medical insurance where the insurance coverage is used to its full extent on medical treatment in order to restore health as fully as possible to its pre-illness level.

Individuals are risk averse and, consequently, willing to insure against the uncertainty they face. They are assumed to earn income according to their levels of productivity, which we refer to as 'ability'. If healthy, an individual has a level of ability equal to A, while if ill and receiving a level of treatment equal to t, she has a level of ability equal to tA; *i.e.*, ability is proportional to health. Information about an individual's A is symmetrically distributed.

Buying insurance is the only way that an individual can transfer income across the two states. Her budget constraints in states 1 and 2 are respectively given by:

$$c_1 + P = A \tag{2}$$

and

$$c_2 + P + tC = tA + I, \tag{3}$$

where P is the total insurance premium and I the insurance benefit.

The insurance market is competitive, with risk-neutral, profit-maximizing insurers earning zero expected profits. Insurance is thus offered at an actuarially fair premium:

$$P = \pi_j I, \;\; j = F, R. \tag{4}$$

Individuals cannot buy more than one insurance contract. Information about which disease an individual suffers from and, consequently, the associated costs of treatment, is known by both insurer and insuree. The insurers know the proportions of frail and robust individuals, while information about the individuals' risk type is asymmetric. To simplify, we assume that individuals can neither influence the probability of falling ill nor the costs associated with the illness, *i.e.,* there is no moral hazard.

Combining equations (2), (3), and (4), we get:

$$(1 - \pi_j)(A - c_1) + \pi_j (tA - tC - c_2) = 0, \; j = F, R. \tag{5}$$

which gives the constraint on individuals' choice of consumption (c_1, c_2) and treatment (t).

3 Separating equilibrium

For reasons similar to those in Rothschild and Stiglitz (1976), a Nash equilibrium, if it exists, is separating.[2] The insurers face informational constraints in the design of insurance contracts. In order to induce individuals to reveal their probabilities of falling ill, insurers offer a menu of insurance contracts, each designed with a particular type of individual in mind, from which individuals can choose. Insurers face a self-selection constraint in that frail individuals may mimic robust individuals in order to obtain insurance at a lower premium. Each contract is thus designed so that individuals for which it is intended will be induced to actually choose this contract. Individuals are consequently induced to reveal information about their risk through their choice of contract. Since there are two risk types only, two types of contracts are offered, each specifying both price and quantity of insurance.

Individuals can be characterised by their *ex ante* choice of consumption in the two possible states of the world, as well as their level of medical treatment if ill. Insurers thus have to design contracts in three dimensions, *i.e.*, a contract for type j is: $\{c_{1j}, c_{2j}, t_j\}$, $j = F, R$. In order to ensure that an equilibrium exists, we assume that there are relatively few robust individuals.

We first characterise the contract intended for *frail* individuals. Robust individuals do not wish to mimic frail individuals and we can, therefore, ignore the self-selection constraint on robust individuals. The contract offered frail individuals constitutes the solution to the following program:

$$\max_{c_1, c_2, t} (1 - \pi_F) u(c_1, 1) + \pi_F u(c_2, t)$$

subject to:

$$\begin{aligned} (1 - \pi_F)(A - c_1) + \pi_F (tA - tC - c_2) &= 0, \\ t &\leq 1, \end{aligned}$$

where the second constraint reflects that individuals cannot more than fully restore health. (In addition, of course, there is also a non-negativity constraint

[2] Rothschild and Stiglitz (1976) show that, if a Nash equilibrium exists, it is never a pooling equilibrium since pooling contracts are not robust to competition.

on t that never binds because of the assumptions we have made on u.) Let the multipliers associated with the constraints be respectively μ_F and ϕ_F, and write the Lagrangian as follows:

$$\begin{aligned}\mathcal{L} &= (1-\pi_F)u(c_1, 1) + \pi_F u(c_2, t) \\ &+\mu_F \left[(1-\pi_F)A + \pi_F tA - (1-\pi_F)c_1 - \pi_F(c_2 + tC)\right] + \phi_F \left[1 - t\right].\end{aligned}$$

The Lagrangian first-order necessary conditions are:

$$\frac{\partial \mathcal{L}}{\partial c_1} = (1-\pi_F)u_c(c_{1F}, 1) - \mu_F(1-\pi_F) \leq 0 \tag{6}$$

$$\frac{\partial \mathcal{L}}{\partial c_2} = \pi_F u_c(c_{2F}, t_F) - \mu_F \pi_F \leq 0 \tag{7}$$

$$\frac{\partial \mathcal{L}}{\partial t} = \pi_F u_h(c_{2F}, t_F) + \mu_F \pi_F \left[A - C\right] - \phi_F \leq 0. \tag{8}$$

Since c_1, c_2, and t are positive (which follows from the properties of u), we have from the complementary-slackness conditions that the marginal conditions will hold as equalities. From equations (6) and (7), we get:

$$u_c(c_{1F}, 1) = u_c(c_{2F}, t_F), \tag{9}$$

i.e., frail individuals' marginal utility from consumption is equal across states. Combining equations (7) and (8), we find:

$$\frac{u_h(c_2, t_F)}{u_c(c_2, t_F)} + A = C + \frac{\phi_F}{\mu_F}\frac{1}{\pi_F}. \tag{10}$$

The left-hand side here is the marginal willingness to pay for treatment, and is given by the sum of marginal willingness to pay for health, $[u_h(c_2, t_F)/u_c(c_2, t_F)]$, and the additional earnings capacity generated by a marginal increase in treatment, A. Hence, frail individuals choose consumption and treatment if ill such that marginal willingness to pay for treatment equals the marginal costs of treatment, C, plus the marginal imputed costs associated with the treatment constraint. The insurers' zero-profit condition obviously binds, hence $\mu_F > 0$. The marginal imputed costs incurred by restraining the individuals' level of treatment, t_F, is given by ϕ_F. According to the complementary-slackness condition, this Lagrange multiplier may take a positive or zero value. If $t_F < 1$, then $\phi_F = 0$, and it follows that:

$$\frac{u_h(c_{2F,}t_F)}{u_c(c_{2F,}t_F)} + A = C \text{ if } t_F < 1.$$

I.e., marginal willingness to pay for treatment is equal to costs of treatment.[3] Note that there are no distortions in the contract designed for frail individuals, since self-selection constraints have no effect. The equilibrium insurance contract offered to frail individuals is, therefore, *first-best efficient*.[4]

Next, we identify the contract intended for *robust* individuals. In this case, the introduction of a self-selection constraint on frail individuals is necessary. The equilibrium contract for robust individuals solves the following program:

$$\max_{c_1,c_2,t}(1-\pi_R)u(c_1,1)+\pi_R u(c_2,t)$$

subject to:

$$\begin{aligned}(1-\pi_R)(A-c_1)+\pi_R(tA-tC-c_2) &= 0,\\ (1-\pi_F)u(c_1,1)+\pi_F u(c_2,t) &\leq (1-\pi_F)u(c_{1F},1)+\pi_F u(c_{2F},t_F)\\ t &\leq 1.\end{aligned}$$

The second constraint is the self-selection constraint: Frail individuals should not wish to pass themselves as being robust. Thus, the contract for robust individuals must be such that frail individuals would not derive a higher level of utility by choosing the contract intended for the robust than by choosing the contract intended for them. The self-selection constraint will always bind.

With Lagrangian multipliers for the three constraints being denoted μ_R, λ_R, and ϕ_R, the Lagrangian is now:

$$\begin{aligned}\mathcal{L} = \; &(1-\pi_R)u(c_1,1)+\pi_R u(c_2,t)\\ &+\mu_R\left[(1-\pi_R)A+\pi_R tA-(1-\pi_R)c_1-\pi_R(c_2+tC)\right]\\ &+\lambda_R\left[(1-\pi_F)u(c_{1F},1)+\pi_F u(c_{2F},t_F)\;-(1-\pi_F)u(c_1,1)-\pi_F u(c_2,t)\right]\\ &+\phi_R\left[1-t\right].\end{aligned}$$

Again, since c_1, c_2, and t are positive, it follows from the complementary-slackness conditions that the marginal conditions will hold as equalities. Thus, the first-order necessary conditions are:

[3] An alternative interpretation is that marginal willingness to pay for health in terms of consumption (i.e. u_h/u_c) is set equal to an individual's personal 'net' costs of treatment, $C-A$.

[4] See Asheim *et al.* (2000), where the probability of getting ill is assumed to be public information, for more on first-best contracts.

$$\frac{\partial \mathcal{L}}{\partial c_1} = (1-\pi_R)u_c(c_{1R},1) - \mu_R(1-\pi_R) - \lambda_R(1-\pi_F)u_c(c_{1R},1) = 0 \quad (11)$$

$$\frac{\partial \mathcal{L}}{\partial c_2} = \pi_R u_c(c_{2R},t_R) - \mu_R\pi_R - \lambda_R\pi_F u_c(c_{2R},t_R) = 0 \quad (12)$$

$$\frac{\partial \mathcal{L}}{\partial t} = \pi_R u_h(c_{2R},t_R) + \mu_R\left[\pi_R A - \pi_R C\right] - \lambda_R\pi_F u_h(c_{2R},t_R) - \phi_R = 0. \quad (13)$$

Rearranging equations (11)-(13), we get:

$$1 - \frac{\mu_R}{u_c(c_{1R},1)} - \frac{(1-\pi_F)}{(1-\pi_R)}\lambda_R = 0 \quad (14)$$

$$1 - \frac{\mu_R}{u_c(c_{2R},t_R)} - \frac{\pi_F}{\pi_R}\lambda_R = 0 \quad (15)$$

$$1 + \frac{\mu_R(A-C)}{u_h(c_{2R},t_R)} - \frac{\pi_F}{\pi_R}\lambda_R - \frac{\phi_R}{\pi_R u_h(c_{2R},t_R)} = 0. \quad (16)$$

From equations (14) and (15), we have:

$$\frac{1}{u_c(c_{1R},1)} - \frac{1}{u_c(c_{2R},t_R)} = \frac{\lambda_R}{\mu_R}\frac{\pi_F - \pi_R}{\pi_R(1-\pi_R)}, \quad (17)$$

which implies that marginal utility of consumption differs across states for robust individuals. In particular,

$$u_c(c_{2R},t_R) > u_c(c_{1R},1). \quad (18)$$

In addition, from equations (15) and (16), we get:

$$\frac{u_h(c_2,t_R)}{u_c(c_2,t_R)} + A = C + \frac{\phi_R}{\mu_R}\frac{1}{\pi_R}. \quad (19)$$

Thus, marginal willingness to pay for treatment equals marginal costs of treatment, C, plus marginal imputed costs associated with the treatment constraint. The insurers' zero-profit condition binds, hence $\mu_R > 0$. The marginal imputed costs incurred in restraining the individuals' level of treatment, t_R, is ϕ_R. Again, according to the complementary-slackness condition, the Lagrange multiplier may take a positive or zero value. If $t_R < 1$, then $\phi_R = 0$:

$$\frac{u_h(c_2,t_R)}{u_c(c_2,t_R)} + A = C \text{ if } t_R < 1, \quad (20)$$

implying that robust individuals in this case allocate their income between consumption and health such that their marginal willingness to pay for treatment equals cost of treatment. The allocation of income between consumption and health if ill, is therefore *first-best efficient*. However, the allocation of income *across* states is *not* first-best efficient with respect to consumption [cf. eq.(18)] or with respect to consumption if healthy and treatment if ill. The problem of asymmetric information consequently prevents robust individuals from achieving their optimal level of insurance coverage and, thus, their optimal allocation of income across states. This implies an *efficiency loss*. This efficiency loss occurs because, by 'distorting' the contract, frail individuals are discouraged from mimicking the robust ones.

It follows from the above discussion that neither frail nor robust individuals' choice between consumption and treatment if ill is changed compared to the case of symmetric information. Consequently, our three-dimensional problem, *i.e.,* (i) consumption if healthy, (ii) consumption if ill, and (iii) treatment if ill, *reduces to one of only two dimensions*, namely that of (i) and (ii): how to allocate consumption between the two states.

Rationing of robust (low-risk) individuals as a way of separating risk groups is, of course, in line with Rothschild and Stiglitz (1976). Frail individuals obtain their first-best allocation of consumption between the two states of the world. Robust individuals, on the other hand, are restrained in their level of insurance coverage compared to a situation with symmetric information and will have to accept a strictly positive deductible. The interesting question is whether this deductible is in pay or in pain, *i.e.*, does the self-selection constraint restrict robust individuals' consumption if ill, their treatment if ill, or a bit of both? This is the topic of the next section.

4 Pay or pain?

Individuals' decisions regarding both the appropriate level of insurance coverage and the allocation of the insurance indemnity if ill, depend on their levels of innate ability. In a world of symmetric information, Asheim *et al.* (2000) show that individuals may *ex ante* prefer not to fully insure.[5] In particular, individuals with a sufficiently low level of ability will, if ill, choose not to fully recover from an illness, but rather spend some of the indemnity on consumption. The implications of the individual's level of innate ability on her choice

[5]By full insurance we mean that utility is constant across states, i.e. $u(c_1, h_1) = u(c_2, h_2)$.

of insurance contracts, in the present context of asymmetric information about the probability of getting ill, is discussed more closely in the following. In order to simplify the analysis, we assume that individuals have either a high or a low level of innate ability.

Proposition 1

(i) *If individuals have a level of ability equal to, or larger than, total cost of treatment, i.e., if* $A \geq C$*, then both robust and frail individuals obtain complete treatment if ill:* $t_R = t_F = 1$.

(ii) *If individuals of both risk types have a level of ability less than, or equal to, expected cost of complete treatment, i.e., if* $A \leq \pi_R C$*, then both robust and frail individuals choose less than complete treatment if ill:* $0 < t_R, t_F < 1$.

Proof. (i) Since, by our assumptions on u, $u_h/u_c > 0$, equations (10) and (19) can hold in the case when $A \geq C$ only if $\phi > 0$, which implies $t = 1$.

(ii) Note that $A \leq \pi_R C$ implies $A \leq \pi_F C$. Write the budget constraint in equation (5) as

$$(1 - \pi_j)\, c_1 + \pi_j c_2 = (1 - \pi_j)\, A + \pi_j t\, (A - C)\,,\ j = F, R,$$

where the right-hand side is decreasing in t when $A \leq \pi_j C$. It follows from the properties of u that c_1, c_2 and t are positive. Suppose $t = 1$. Now, the right-hand side above reduces to: $A - \pi_j C$. Thus, with $A \leq \pi_j C$, there is nothing left for consumption and the right-hand side will have to be increased through a reduction in t. ■

In the subsequent analysis, we assume that individuals have one of two ability levels: low (A_L) and high (A_H), such that $A_L \leq \pi_R C$ and $A_H \geq C$. It follows that $A_L/\pi_F < A_L/\pi_R < C \leq A_H$, since $0 \leq \pi_R < \pi_F < 1$.[6]

The implications of the ability level for the insurance contracts when there is asymmetric information on risk can be summarized as follows:

[6] At intermediate levels of ability, *i.e.*, where $A \in (\pi_R C, C)$, there is a possibility for cases where the constraint on treatment ($t \leq 1$) is binding for one of the risk types only. No extra insight would be gained from incorporating such hybrid situations into the analysis.

Proposition 2

(a) *Among high-ability individuals ($A_H \geq C$):*

(i) *Frail individuals face no deductibles, are fully insured, and receive their first-best level of insurance coverage, just like in the case of symmetric information.*

(ii) *Robust individuals are restrained in their level of insurance coverage and have to make a co-payment. Their deductible is in pay only.*

(iii) *In particular, frail individuals' marginal utility from consumption is equal across states, while that of robust individuals is not: $0 = u_{c_{2F}} - u_{c_{1F}} < u_{c_{2R}} - u_{c_{1R}}$. Both risk-types recover completely if ill: $t_R, t_F = 1$; hence, $0 = c_{1F} - c_{2F} < c_{1R} - c_{2R}$.*

(b) *Among low-ability individuals ($A_L \leq \pi_R C$):*

(i) *Frail individuals face no deductibles and obtain their first-best levels of cash compensation and treatment. However, even though not constrained in their level of insurance coverage, they are not fully insured; this corresponds to the case of symmetric information.*

(ii) *Robust individuals are restrained in their level of insurance coverage. They have part of the deductible in pain. Consequently, both cash compensation and the level of treatment provided for in the insurance contract are reduced relative to a situation with symmetric information.*

(iii) *In particular, both risk-types are less than fully insured and receive less than complete treatment: $0 < t_R < t_F < 1$ and $0 < c_{1F} - c_{2F} < c_{1R} - c_{2R}$.*

Proof. From the first-order conditions of the optimization problem in Section 3, we see that frail individuals' marginal utility from consumption is equal across states [cf. eq.(9)], whereas robust individuals' marginal utility from consumption is not [cf. eq.(17)]. Frail individuals consequently achieve their first-best level of insurance coverage, as stated in (a)(i) and (b)(i) of the Proposition, while robust individuals do not. For robust individuals, $u_c(c_2, t) > u_c(c_1, 1)$ by equation (18). For high-ability individuals, $t = 1$ by Proposition 1. Thus, $u_{c_{2R}} > u_{c_{1R}}$ and $c_{2R} < c_{1R}$. By part (a)(i) and Proposition 1, $u_{c_{2F}} = u_{c_{1F}}$ and $c_{1F} = c_{2F}$. This completes the proof of parts (a) and (b)(i).

Parts (b)(ii) and (b)(iii) remain to be established. For low-ability individuals (both robust and frail), $t < 1$ and $c_1 > c_2$ by Proposition 1. For robust low-ability individuals, $u_c(c_2, t) = u_c(c_1, 1)$ in first-best and $u_c(c_2, t) > u_c(c_1, 1)$ under asymmetric information [cf. eq.(18)]. Since u is strictly concave, it follows from the zero-profit condition that c_{1R} is higher and $u(c_{2R}, t_R)$ is lower than they would have been in first-best. It now follows from the normality of c and h that both c_{2R} and t_R are lower than they would have been in first best.

The consumption of frail low-ability individuals, c_{1F}, is, due to their higher cost of insurance, smaller than what robust low-ability individuals would have got in first-best, which in turn is smaller than c_{1R}, *i.e.*, $c_{1F} < c_{1R}$. It now follows from the frail low-ability individuals' self-selection constraint that $u(c_{2F}, t_F) > u(c_{2R}, t_R)$. By normality, this implies that $c_{2F} > c_{2R}$ and $t_F > t_R$. ■

Considering the outcome for low-ability individuals, we note a sharp contrast between the cases of symmetric and asymmetric information. When the insurers know each insuree's probability of getting ill, robust (*i.e.* low-risk) individuals get higher consumption and more treatment than the frail ones. This is turned around when information about this probability is private: In order to obtain self-selection, insurers have to offer a contract for the robust which is such that they obtain lower consumption and less treatment if ill then do the frail individuals.

Note that the contracts described are *information constrained Pareto-efficient.* Like in the Rothschild-Stiglitz model (see Crocker and Snow, 1985), the separating equilibrium is efficient whenever it exists.

5 Discussion

Analyzing a competitive health-insurance market under asymmetric information, we have identified separating insurance contracts that induce individuals to reveal information by means of deductibles. The analysis takes place in a standard adverse selection situation in which the insuree has more information about risk than do the insurer, and where the insurer offers a menu of contracts. However, our analysis deviates from the standard adverse selection situation in two related ways. Firstly, we assume that individuals' utility of consumption is state-dependent. This implies that individuals may choose not to fully insure in a world of symmetric information, and thus, that their optimal level of insurance coverage is even lower in a world of asymmetric information. Secondly, the consequences of the insured-against event are made endogenous: individuals can choose their level of recovery, and thus also their loss in income, if ill.

The *novelty* of this paper lies in the integration of medical insurance and disability insurance in a setting where adverse selection is a problem. By integrating the two types of insurance, we show that the separating scheme may involve two types of deductibles: a deductible in the form of reduced medical treatment and a monetary deductible. Thus, besides defining the price of the insurance and the extent of cash insurance coverage (as in the Rothschild-Stiglitz model), insurers also define the level of medical treatment. The separating insurance contracts consequently include deductibles in kind (*i.e.* in pain) and in cash (*i.e.* in pay).

Our findings may be of relevance to the practical design of health-insurance contracts. Indeed, one may observe empirically that insurance contracts specify both quantity and quality of care, rather than providing a cash compensation. Individuals will consequently have access to a pre-determined level (or quality) of treatment, rather than just a cash payment. There are obviously many reasons for this, one of which being transaction costs associated with having to search for the appropriate supplier of medical treatment when ill. Thus, it is not counter-intuitive that individuals *ex ante* may find it optimal to specify their preferred level of treatment if ill, thus restricting the allocation of income when ill between consumption and health. If so, our analysis suggests that, under asymmetric information, robust individuals with low ability will achieve less treatment and less cash compensation than they would have achieved under symmetric information.

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