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Inflation as a Strategic Response*

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Résumé / Abstract

Nous étudions dans ce document de recherche l'impact d'une augmentation des coûts des soins de santé et de l'inflation en général sur le contrat optimal d'assurance médicale et sur le gaspillage dans une économie où les agents-consommateurs possèdent une information privilégiée et où le principal-assureur doit encourir des coûts d'audit pour vérifier l'information des agents. Nous montrons dans cet article que les agents seront plus que pleinement assurés au sens où l'indemnité reçue est plus grande que la perte encourue. De plus, au fur et à mesure que le coût des soins de santé augmente, les agents réduisent leur probabilité de demander des soins de santé injustifiés, alors que le principal réduit sa probabilité d'audit. En conséquence, le gaspillage associé aux audits onéreux diminue. Nous montrons finalement qu'une augmentation dans le coût de la vie en général (que nous approximons par une augmentation des pertes de salaire encourues à cause de la maladie) réduit également le gaspillage associé aux audits, mais dans une mesure moindre qu'une augmentation du coût des soins de santé.

In this paper, we examine the effect of increases in health care costs and general inflation on optimal insurance policies and waste in a model of imperfect information with costly auditing. We show that in such a setting, individuals will buy more than full insurance. Moreover, as the cost of medical increases, consumers (i.e., patients) reduce their probability of filing injustified claims, at the same time as insurance providers audit with lower probability. As a result, waste associated with costly auditing is reduced. We also show that a general increase in the opportunity cost of illness (reflected through lost wages due to illness) also decreases the likelihood of false claims, of auditing and thus of waste, but not as much as health care costs increase.

Mots Clés : Fraude médicale, information asymétrique, théorie des contrats

Keywords: Health care fraud, asymmetric information, contract theory

JEL: D82, C72

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1 Introduction

As a result of a dramatic increase in health care spending in most OECD countries, great attention has been focussed on its potential corresponding welfare loss.[1] Consequently, much research has centered on the possible causes of this growth and potential means of reducing it. Generally, economists are unconcerned with an increase in a particular type of consumer spending as a percentage of GDP. However, given information asymmetry and insurance in the health care market, the fact that more resources are spent on health care is not necessarily without welfare consequences. First, given that most individuals are insured and illness is difficult to measure, consumers (patients) may wish to consume health care beyond efficient levels (the traditional moral-hazard problem). Furthermore, because patients, providers and insurers have different information, each may attempt to manipulate available information in order to maximize their individual benefit. More specifically, physicians who are paid for each service they provide (the traditional fee-for-service payment system) may encourage patients to consume care beyond efficient levels (known as supplier-induced-demand).[2] Thus, insurance and information asymmetry may lead to important losses in welfare. As a result, many reforms have been proposed and implemented which attempt to reduce the growth in health care spending.

Several reasons may account for the remarkable increase in health care spending. First, the proliferation of insurance has made the moral-hazard problem common place (Manning et al., 1987). Furthermore, given that health care is a normal good (or even possibly a luxury good), a general increase in economic well-being has lead to greater consumption of health care services (Newhouse, 1977; Blomqvist and Carter, 1997). Also, many believe that increased competition in the physicians' market has increased the prevalence and magnitude of supplier-induced-demand and thus contributed to the increased cost of physician services (McGuire and Pauly, 1991). Much of the increase in health care costs has, however, been attributed to increased technology (Goddeeris, 1984; Weisbrod, 1991).[3]

Because of the increase spending on health care, many authors have attempted to measure the welfare loss, of say, health care insurance (Newhouse, 1992; Blomqvist 1997). Most studies, have however, neglected one potential benefit (other than increased health) associated with higher costs or greater spending of health care. That is, there may be an important benefit associated with more expensive care when patients are insured and have private information: the benefits of reduced auditing.

[1] See Table 1 in appendix.

[2] See Arrow (1963), Evans (1974), Stano (1987) and Dranove (1988).

[3] Other potential contributors to the increased costs of health care are the Medical Arms Race (Dranove et al., 1992) and Unions (Sloan and Adamache, 1984) and the proliferation of malpractice litigation (Danzon, 2000).

Given that physicians, patients and insurance providers have private information, each may want to use such information asymmetry to extract rents. For example, physicians may want to over-treat their patients if they are paid via fee for service. Alternatively, physicians who are paid on a capitated basis may have an incentive to under-treat (Hillman et al., 1989; Stearns et al., 1992, Léger, 2000). Likewise, insured patients may want to over-report their illness in order to increase their compensation (whether it is in the form of medical treatment *or* lost wages in the case of workers-compensation). In the model presented below, we examine the later case where patients may have an incentive to lie about their illness severity in order to extract rents from the provider/insurer. As a result of this incentive, insurers may find it optimal to verify the patient's illness claim by auditing at a given cost. Because auditing is not costless, yet yields no direct benefit to either the patient or the insurer, it is, *ceteris paribus*, a resource loss. By including such auditing costs in a game between consumers and the insurer, we examine the effect of increased costs of health care (what we term *health care inflation*) and *general inflation* on the optimal insurance contract as well as its effect on the cost of auditing (the welfare loss associated with auditing).[4]

Several results are worth noting. First, unlike the traditional models, we show that patients are offered insurance contracts in which they are over-insured; in other words, where their indemnity is larger than their loss. This result comes from the fact that in a model of information asymmetry with auditing costs insurers, who are not able to commit ex ante to an auditing strategy, will want to 'over-insure' their customers to increase their incentive to audit them (given the higher potential losses associated with patient-cheating). Given that insurers have more incentive to audit their patients, patients in-turn will be forced to reduce the amount of false claims they make to leave insurers indifferent between auditing and not auditing. Thus, in the case of reported illness (justified *or* unjustified without auditing) the patient will receive a higher payoff *but* the probability that a patient files an unjustified claim (cheats) will decrease. We also show in the paper that an increase in the cost of medical treatment (both through a direct increase in the price of medical care or through increased losses due to lost wages as a result of illness) will lead to a decrease in the 'waste' associated with auditing. Thus, the potential welfare loss associated with higher medical care costs may be over-estimated as waste associated with insurance auditing is decreased.

The remainder of the paper will be organized as follows. In section 2 we introduce a principal-agent model with information asymmetry. In this section, we introduce a measure of waste associated with auditing and examine the effects of both general and health care inflation on waste. Conclusions are drawn in Section 3.

[4] Throughout the paper, we use the term 'health care inflation' for any increase in health care costs. That is, health care inflation may be a per unit increase in the price of treatment, or that technology and/or treatment norms are such that the per-episode cost of treatment has increased.

2 The Model

In the following section, we introduce a simple game between a consumer and a unique provider-insurer.[5] In the model, risk-averse consumers have VonNeumann-Morgenstern utility functions over final wealth where $U'(.) > 0$, $U''(.) < 0$ and $U'(0) = \infty$. The insurer is risk neutral. There are only two states of nature: sick and healthy. The consumer is sick with probability $\pi < \frac{1}{2}$.[6] If the consumer is sick, he must stop working and looses labor income w. If the consumer seeks care (whether sick or not), the cost of medical care is given by s. The health insurance market is perfectly competitive. That is, the premium paid by the consumer is exactly equal to the expected payment in case of an accident plus expenses due to fraud. The insurer may conduct an audit to confirm the agent's sickness. The cost of auditing is fixed at c. If, subsequent to an audit, it is discovered that the consumer has sought unnecessary medical treatment, the consumer suffers a utility loss of d.[7] It is important to note that a healthy consumer may seek medical care (in order to be compensated) and may continue to work. Furthermore, it is assumed that physicians are paid a fixed amount for providing care to patients (i.e. paid fee for service) and thus have no incentive to 'turn-in' patients who lie. The consumer and the insurer play a game of asymmetric information in which the consumer knows whether he suffered a loss (is sick), while the insurer does not.

The sequence of play is presented in figure 1.

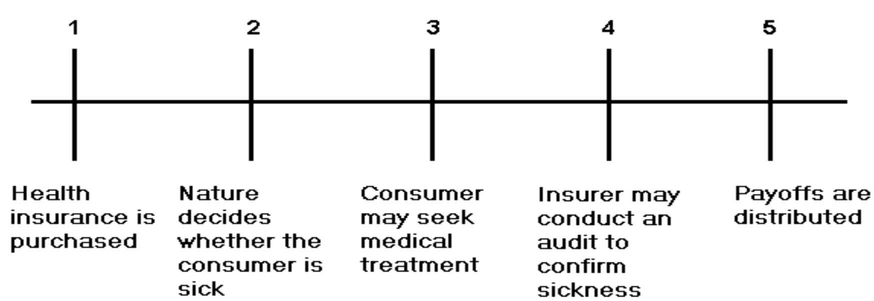

Figure 1: Sequence of play

[5]Throughout the paper, the masculine identifies the agent, while the feminine identifies the principal.

[6]This assumption is a technical condition of the model that guarantees mixed strategy equilibria (it its absence pure strategy equilibria would occur where consumers would always cheat and insurers would never audit).

[7]We can view this as a loss of reputation, a fine, an increase in future premiums or even prison time. The important part of the penalty is that it is exogenous to the model. Indeed, Becker (1968) showed that if fines were part of the insurance contract (where fines are paid to the insurer), the insurance provider would set fines te be very large essentially reducing the probability of consumer cheating and provider auditing to zero. In our model, the disutility of being caught may also be viewed as the forgone utility of being shun from the health insurance market after getting caught. In other words, d may be viewed as the present value of the agent remaining in autarcky for the rest of his life.

In stage 1, the insurer offers the consumer a contract that specifies a coverage h in case of a loss at a premium p. In stage 2, Nature decides whether the consumer is sick or not. This information is known exclusively by the consumer. In stage 3, the consumer decides whether to seek medical treatments or not. Subsequently, the insurer decides whether to audit or not audit the consumer. Finally, the payoffs are paid and the game ends. The payoffs to the players are given in table 1.

Table 1

Payoffs to the consumer and the insurer contingent on their actions and the state of the world.

State of the world	Action of Consumer	Action of Insurer	Payoff to Consumer	Payoff to Insurer
Healthy	*Don't Seek*	*Conduct Audit*	$U(Y-p)$	$p-c$
Healthy	Don't Seek	Don't Audit	$U(Y-p)$	p
Healthy	Seek Treatment	Conduct Audit	$U(Y-p)-d$	$p-c$
Healthy	Seek Treatment	Don't Audit	$U(Y-p-s+h)$	$p-h$
Sick	Seek Treatment	Conduct Audit	$U(Y-p-s-w+h)$	$p-h-c$
Sick	Seek Treatment	Don't Audit	$U(Y-p-s-w+h)$	$p-h$
Sick	*Don't Seek*	*Conduct Audit*	$U(Y-p-s-w)$	$p-c$
Sick	*Don't Seek*	*Don't Audit*	$U(Y-p-s-w)$	p

The contingent states in italics never occur in equilibrium.
They represent actions that are off the equilibrium path.

Stages two to five can be seen as a game of asymmetric information whose extensive form is given in figure 2.

We derive the perfect bayesian equilibrium by backward induction. The six elements of the Nash equilibrium are: (1) a strategy for the consumer when he is sick; (2) a strategy for the consumer when he is healthy; (3) a strategy for the insurer when the consumer seeks treatments; (4) a strategy for the insurer when the consumer does not seek treatments; and, (5)-(6) beliefs for the insurer at each information set. The unique Nash equilibrium of this game is presented in the following lemma.

Lemma 1 *For $h > \frac{c}{1-\pi}$, the unique Perfect Bayesian Nash Equilibrium*[8] *in mixed strategies is such that:*

1-The consumer always seeks treatment if sick;

2-The consumer randomizes between seeking treatments and not when he is healthy;

3-The insurer never audits a consumer that doesn't seek care;

4-The insurer randomizes between auditing and not auditing when the consumer seeks medical treatment.

[8] In this game the notions of Perfect Bayesian Nash Equilibrium and Sequential Equilibrium coincide. Since each player has only two possible actions, then there will be at most one mixed strategy that each player can play in equilibrium. See Myerson (1991) and Gibbons (1992) for details.

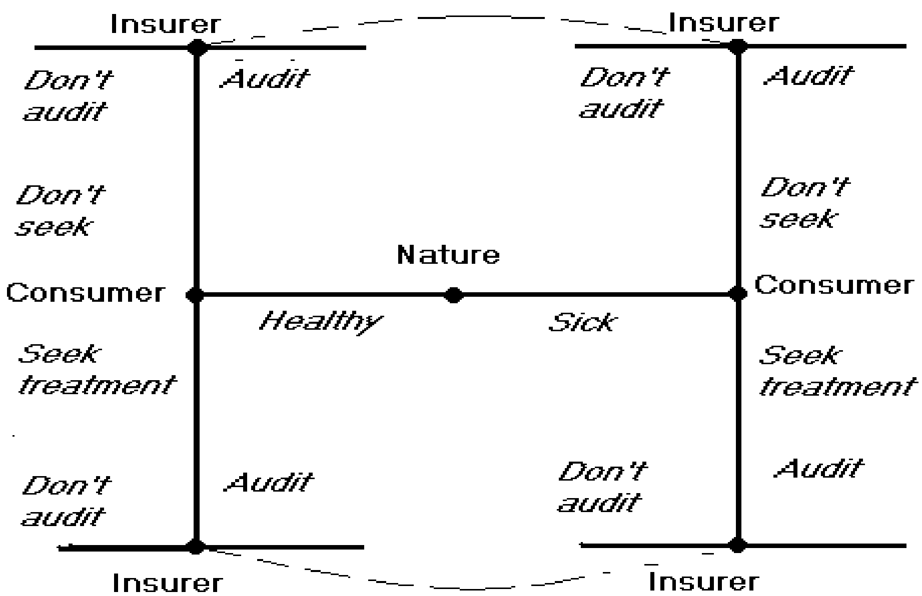

Figure 2: Extensive form of game.

Now, let ϕ be the probability of seeking treatment when a consumer is healthy, and ψ be the probability of auditing given that a consumer sought treatment. In equilibrium, ϕ and ψ are then given by :

$$\phi = \left(\frac{\pi}{1-\pi}\right)\left(\frac{c}{h-c}\right) \tag{1}$$

$$\psi = \frac{U\left(Y-p-s+h\right)-U\left(Y-p\right)}{U\left(Y-p-s+h\right)-U\left(Y-p\right)+d} \tag{2}$$

The insurer's beliefs are $\zeta(Healthy) = 1$ and $\zeta(Sick) = \frac{h-c}{h}$, where $\zeta(.)$ refer to the belief that the signal is truthful.

Proof: Standard; see Boyer (2000) and Léger (2000).•

The comparative statics of the Nash equilibrium are interesting. First, we note that as the probability of being sick increases, the probability that the consumer will commit fraud increases ($\frac{\partial\phi}{\partial\pi} > 0$). This results from the fact that, as π increases, it is easier for a healthy individual to pass himself off as being sick as the pool of sick individuals is larger. It also should be noted that the probability of committing fraud increases as the cost of auditing increases ($\frac{\partial\phi}{\partial c} > 0$). This result is also intuitive; since it is more costly for the insurer to audit a consumer, she will be less likely to audit, and as a consequence, the consumer will attempt to defraud the insurer with greater probability. Surprisingly, the consumer is less likely to cheat as health benefits increase ($\frac{\partial \phi}{\partial h} < 0$). This result is due to the fact that the insurer has a greater incentive to audit as health benefits (reimbursement h) increase. Consequently, the consumer reduces his probability of committing fraud.

The model also predicts that the probability that the insurer audits decreases as the consumer's net-of-premium wealth $(Y - p)$ increases (as long as the utility function does not display increasing absolute risk aversion), if and only if the level of health benefits is greater than the cost of health care services. In other words, $\frac{\partial \psi}{\partial (Y-p)} < 0$ if and only if $h > s$.[9] In other words, as the net benefit $(h - s)$ increases relative to net wealth $(Y - p)$, the incentive to commit fraud increases for the consumer. This in-turn increases the insurer's incentive to audit the consumer's health claims. Similarly, as the level of health benefit (h) increases or as the cost of medical care (s) decreases, the probability of auditing increases. This is due to the fact that gains from fraud increase as h increases or s decreases; which implies a greater need for audits to keep the consumer in check. Finally, the probability of auditing decreases as the penalty increases ($\frac{\partial \psi}{\partial d} < 0$), as the consumer's incentive to commit fraud decreases.

We can now infer the health insurance premium p that yields zero expected profits for the insurer. The equilibrium insurance premium is given by:

$$p = \pi h + (1-\pi) h \phi (1-\psi) + c\psi[\pi + (1-\pi)\phi] \tag{3}$$

where πh represents the expected treatment cost for a consumer who is truly sick. The two remaining terms in the sum represent the cost of fraud borne by society. More specifically, $(1-\pi)h\phi(1-\psi)$ represents the expected extra amount of money per policy that the insurer must pay for unnecessary treatments and $c\psi[\pi + (1-\pi)\phi]$ represents the expected cost of auditing.

The health insurance contract between the consumer and the insurer must incorporate the strategic behavior of all players. That is, the insurer will anticipate rationally the strategies of each player when offering the consumer an insurance policy. For example, the insurer knows that the sick consumer will always seek treatment. Furthermore, the insurer also knows that a healthy consumer will seek medical treatment with probability ϕ in order to extract rents. Thus, cheating will only occur with some positive probability when the consumer is healthy. As a result, the problem faced by the insurer becomes:

$$\begin{aligned} \max_{p,h} EU &= \pi U(Y - p + h - s - w) + (1-\pi)(1-\phi) U(Y-p) \\ &\quad + (1-\pi)\phi\left[(1-\psi)U(Y-p+h-s) + \psi U(Y-p) - \psi d\right] \end{aligned} \tag{4}$$

[9] As is shown further on, the level of health benefits is in fact greater than the cost of health care services.

subject to the constraints

$$p = \pi h + (1-\pi) h\phi (1-\psi) + c\psi[\pi + (1-\pi)\phi] \tag{5}$$

$$\phi = \left(\frac{\pi}{1-\pi}\right)\left(\frac{c}{h-c}\right) \tag{6}$$

$$\psi = \frac{U(Y-p-s+h) - U(Y-p)}{U(Y-p-s+h) - U(Y-p) + d} \tag{7}$$

$$\text{and subject to a Participation Constraint} \tag{8}$$

We disregard the participation constraint for now as it is redundant.[10] By choosing p and h, the insurer must take into account the impact of her decision on the subsequent game. By substituting (6) and (7) into (4) and (5), the above yields the simplified problem:

$$\max_{p,h} EU = \pi U(Y-p-s+h-w) + (1-\pi) U(Y-p) \tag{SP}$$

$$\text{Subject to } p = \pi \frac{h^2}{h-c} \tag{9}$$

The first order condition of the simplified problem yields a health benefit (h) such that:

$$\frac{U'\left(Y - \pi\frac{h^2}{h-c} - s - w + h\right)}{\pi U'\left(Y - \pi\frac{h^2}{h-c} - s - w + h\right) + (1-\pi) U'\left(Y - \pi\frac{h^2}{h-c}\right)} = \frac{h(h-2c)}{(h-c)^2} \tag{10}$$

The denominator on the left hand side of (10) represents the expected marginal utility of the consumer who purchases this contract. Because the left hand side of (10) is positive, h must be greater than $2c$ for the right hand side to be positive. This is to be expected as the premium is a convex function of coverage that reaches a minimum at $h = 2c$.[11] For all $c < h < 2c$ the premium decreases with coverage, while for $h > 2c$, price increases with coverage. Since the consumer prefers more coverage to less, the tangency between the utility function and the convex zero-profit constraint must lie on the upward sloping portion of the price function, which occurs when $h \geq 2c$. As a result, the optimal level of coverage is necessarily more than twice as large as the cost of auditing.[12] The solution to the problem does not offer much more by way of intuition. We note, however, that full insurance (i.e., $h = s + w$) is not a solution to this problem (unless $c = 0$, which is ruled out by assumption).

An interesting property of this optimal coverage is that the consumer's utility is maximized when he chooses a coverage greater than his possible loss ($h > s + w$). This is shown as proposition 1.

[10] The participation constraint states that the agent must be at least as well off with the contract then in autarchy. It is easy to show that autarchy is similar to choosing $h = 0$. Therefore the participation constraint binds only if $h < 0$, which does not occur.

[11] For all $h < c$, the price is a concave function of coverage. However, it does not make sense to have $h < c$ since this would imply that the price is negative. As a consequence, we shall only examine the case where $h > c$.

[12] It also implies that $\pi < \frac{1}{2}$ is a sufficient condition to yield an equilibrium in mixed strategies for the game, as stated in the assumptions.

Proposition 1 *The optimal benefit is greater than the loss ($h > s + w$).*

Proof. All the proofs are in the appendix.•

The consumer maximizes his expected utility by purchasing more insurance than is needed to exactly compensate him for his illness. This non-standard result is a consequence of the costly auditing the inability for the insurer to commit ex ante to an audit strategy. That is, the consumer receives 'too much' insurance to increase the insurer's potential benefit from auditing. To see why, note that the insurer has more to lose by not auditing as the benefits increase. Therefore, as the insurance contract pays larger benefits, the insurer has a greater incentive to ensure that the consumer is indeed sick. Knowing that the insurer has more incentive to verify the health status of the consumers, they will modify their behavior so that insurers remain indifferent between auditing and not auditing. If the insurer has more to gain by auditing, the consumer must reduce his probability of requesting compensation when he is in fact healthy. This is made clearer by examining the probability of requesting benefits when one is healthy, ϕ.That is, as h increases, ϕ decreases (i.e.: $\frac{\partial \phi}{\partial h} < 0$).

By increasing the benefits paid to the consumer in case of sickness, the probability of a false claim is reduced. A similar result is found by Picard (1996) and Boyer (1998) in a somewhat different setting. What is however surprising, is that the amount of health benefits (the reimbursement h) received by the consumer when sick is greater than the loss incurred; an atypical result in the literature. Boyer (1998) explains this over-compensation as representing a replacement-cost-new insurance contract. Khalil (1997) and Khalil and Parigi (1998) also obtain similar results. Using a similar framework to Baron and Myerson (1981), Khalil finds that an agent will over-produce a given output as a means of signalling that he will not cheat. Also, Khalil and Parigi find, using Gale and Hellwig's (1987) framework, that a banker will over-lend to an entrepreneur as a signal of his willingness to verify the entrepreneur's return on his project.

Although this over-compensation result is interesting in itself, it is not new in the literature. What is innovative of this paper is its examination of what happens to over-compensation when the amount of risk varies. This is the focus of the following section.

3 Inflation

3.1 Health Care and General Inflation

The goal of this section is to evaluate the effect of an increase in potential losses associated with illness. More specifically, we evaluate the effects of (i) an increase in the costs associated with treatment s (what we call *health care inflation*), and (ii) an increase in the time cost associated with lost wages w (what we call *general inflation)*, on the optimal insurance benefit h. We also evaluate the effects of both health care and general inflation on the waste associated with auditing. It is important to note that an increase in s can be viewed as a proxy for the general increase in health care costs, and, an increase in w can be viewed as a proxy for general economic growth.

The impact of an increase in health care costs on the optimal level of benefits is shown in the following proposition.

Proposition 2 *Insurance benefits h increase as the direct cost of illness s increases; that is* $\frac{\partial h}{\partial s} > 0$*. However, not by the full amount; that is* $\frac{\partial h}{\partial s} < 1$*.*

The impact of an increase of the opportunity cost of getting sick on the optimal level of benefits is shown in the following proposition.

Proposition 3 *Insurance benefits h increase as the opportunity cost of illness w increases; that is* $\frac{\partial h}{\partial w} > 0$*. However, not by the full amount; that is* $\frac{\partial h}{\partial w} < 1$*.*

It is interesting to see that increases in both the cost of health care and in the general level of prices, as proxied by the opportunity cost of being sick, increase the amount of health insurance purchased, but not by the full amount of the price increase. It is logical to expect that consumers will want to purchase more insurance as it becomes more costly to get sick, whether the increased cost comes from higher a medical bill or more lost wages. It is not as obvious why the increase should be less than proportional.

In a full information economy, consumers purchase full insurance. We should therefore expect to see a one-to-one correspondance between health benefits increases, and heath costs and/or lost wages increases. When consumers have proprietary information regarding the state of the world, and when the insurer cannot commit to an auditing strategy ex ante, we will have, as proposition 1 shows, consumers who are over-insured. When we have that $\frac{\partial h}{\partial s} < 1$ and that $\frac{\partial h}{\partial w} < 1$, it follows that consumers are over-insured less and less as medical costs and/or lost wages increase. This should be expected since over-insurance is only a way to signal that it is too costly for the insurance company to let consumers get away with filing false claims. As the cost of sickness increases, health benefits increase and thus the incentive for the insurer to make sure that the filed claim is truthful increases. It then becomes less important for the insurer to send a costly signal that not auditing is too costly since the rise in health care cost sends the same signal, but at a lower cost.

The interpretation of the impact of a rise in the cost of sickness, either through a rise in the cost of health care itself or a rise in lost wages, on health benefits is driven by the fact that consumers are over-insured in our model. In a model where the insurer is able to commit to an auditing strategy, such over-insurance should not be observed, and increases in health care cost may or may not lead to proportional increases in health benefits.

3.2 Impact on Waste

Although both the rise in the cost of medical care and in the cost of lost wages have similar impacts on health benefits (both induce greater health benfits, but not proportionnaly so), nothing is apparent about the real cost to society of such increases. More precisely, what we want to examine in this section the effects of both general and health care inflation on what we call the *waste associated with fraud*.

Because consumers have an incentive to lie about their illness, insurers will wish to minimize the costs associated with unjustified claims. The simple fact that some consumers will receive benefits from fraudulent claims is not, in and of itself, a waste - it is simply a redistribution of income and has no effect on total wealth. Rather, the real cost of fraud is the loss of wealth that occurs as a result of auditing at cost c.

More specifically, the real monetary cost of fraud ($Waste$) is given by:

$$Waste = Z = [(1-\pi)\,\phi + \pi]\,\psi c \tag{11}$$

The following proposition illustrates the impact of health care inflation (ds) and general inflation (dw) on waste Z.

Proposition 4 *Health care inflation and general inflation decrease waste Z.*

This result is interesting for several reasons. First, if the real cost of treatment has increased (that is, the increase in medical care prices is greater than the general increase in prices), than the burden imposed by health care inflation may be over-estimated. Given that insurance providers must pay more for a given illness realization and its corresponding treatment, they will be more likely to audit patients who file such an illness-treatment claim. Given this increased incentive to audit, patients will reduce the amount of false claims they make. As a result, the probability that patients will behave fraudulently and seek unjustified medical services will decrease. Similarly, increases in the opportunity cost of time associated with illness will also decrease the amount of fraudulent claims and subsequent audits.

Although both general and health care inflation decrease the probability of fraudulent claims and, consequently, reduce the amount of waste that is generated by audits, health care inflation decreases waste at a faster rate than does general inflation.

Proposition 5 *Health care inflation reduces the cost of fraud more than general inflation.*

This result is driven by the fact that health insurance compensates a consumer not only for costs related to medical care, but also for lost wages associated with an incapacity to work when sick.[13] From an insurance payment perspective, it is irrelevant whether the cost of health services increases by a dollar or whether the opportunity cost of being sick increases by a dollar. In both cases, the consumer's monetary loss of being sick is increased by a dollar and compensation should increase accordingly. That is, in the case of illness, the impact of an increase in health care costs on health benefits is identical to the impact of an increase in lost wages on health benefits; i.e. $\frac{\partial h}{\partial s} = \frac{\partial h}{\partial w}$.

Given that the difference between the reduction of waste associated with health care inflation and general inflation does not come from their respective impact on health benefits, the source of the difference must come from their impact on the Nash Equilibrium Strategies of the two players.

From the consumer's probability of committing health care fraud (ϕ), it is evident that neither the health care cost nor the opportunity cost of being unable to work has an impact on ϕ other than through health benefits. As a consequence, both types of inflation have the same impact on the consumer's probability of committing fraud, as the impact of both cost increases on health benefits is identical. As a result, the difference in the reduction of waste must be due to a reduction in the probability of auditing. That is, it must be the case that the probability of auditing is reduced by more following an increase in the direct health care cost (s) than following an increase in the indirect cost of illness (w).

With respect to the insurer's probability of auditing (ψ), only the cost of health care services has a direct impact on ψ (i.e., not an indirect impact on health care benefits, h). Hence, the opportunity cost of being sick (w) should not have an impact on the insurer's probability of auditing given that the opportunity cost is not incurred by consumers who may commit fraud. On the other hand, healthy fraudulent consumers must

[13] Another component of the cost of fraud is the disutility of getting caught. This waste is given by $Z' = (1-\pi)\,\phi\psi k$. It is also clear that an increase in s reduces waste more than an increase in w. In other words, $\frac{dZ'}{ds} < \frac{dZ'}{dw}$. To see why, note that we have $\frac{dZ'}{ds} < \frac{dZ'}{dw}$ if and only if

$$(1-\pi)\left(\frac{d\phi}{ds} - \frac{d\phi}{dw}\right)\psi k + (1-\pi)\left(\frac{d\psi}{ds} - \frac{d\psi}{dw}\right)\phi k < 0$$

Given that $\frac{d\phi}{ds} - \frac{d\phi}{dw} = 0$ and that $\frac{d\psi}{ds} < \frac{d\psi}{dw}$ (see the proof of proposition 5), it follows that an increase in health care inflation reduces waste associated with getting caught more than an increase in general inflation as measured by the opportunity cost of being sick.

seek health care services for which they have no need for if their claim is to be perceived as credible. As the implicit cost associated with falsely signalling a 'medical need' increases (i.e., when s increases), consumers will have a reduced incentive to commit fraud; as the increase in the reimbursement they receive (in the case of a successful fraudulent claim) is less than proportional to the increase in the medical cost itself. In other words, since consumers have less to gain by committing fraud as the cost of medical services increases (as compared to an increase in the opportunity cost w), the insurance provider will find it less necessary to audit. Waste is thus reduced more by an increase in medical cost (s) than by an increase in general cost (w).

4 Discussion and Conclusion

The goal of this paper was two-fold. First, we examine the type of health/disability insurance contract that should be offered in an economy where the insurer is unable to commit to an auditing strategy when a consumer files a claim. Second, we examine the impact of an increase in the cost of health care services on fraud.

Assuming that consumers who are truly sick cannot work, thereby losing labor earnings, and that consumers who fake an illness still work, we find that the optimal health insurance contract over-compensates consumers when the insurer cannot commit ex ante to an auditing strategy. This result is dependent on two important assumptions: the inability for the insurer to commit to an auditing strategy and a perfect insurance market. In our context, the perfect-health-insurance-market assumption implies that all premiums paid by the consumers are devoted to either (i) compensating the consumer, or, (ii) paying for audits. Realistically, however, premium paid by consumers include not only compensation and auditing costs, but also underwriting, management, marketing and financing costs. These costs have often been modelled as a proportional loading factor on the premium paid. In other words, the premium paid (PP) is in excess of the pure premium (p) by some factor (m): $PP = (1 + m)\,p$. By adding such a proportional loading factor to the pure premium, it can easily be shown that the amount of coverage is reduced. It is perhaps this type of loading factor that prevents insurance companies from offering a contract where agents are over-compensated for their losses.

In our model, over-compensation represents a costly message sent by the insurer to the consumer. This message signals to the consumer that the insurer has more to lose by not auditing a consumer's claim, and, therefore, that the consumer should reduce accordingly his likelihood of filing a false claim. It is clear from the equilibrium condition that the consumer's probability of filing a false claim decreases as the indemnity payment increases.

Examining the impact of an increase in health care costs, the model predicts a decrease in fraudulent claims. This result is driven by the fact that as the cost of treating a patient increases so does the indemnity payment. As a result, the insurer has more to lose by not auditing, and thus, the consumer commits less fraud. The model also predicts less fraud when the opportunity cost of being sick (w) increases. As previously mentioned, it is important to note that fraud is not, in and of itself, wasteful; as it is simply the redistribution of resources between agents. The real economic waste associated with fraud is the cost of auditing and the disutility of getting caught cheating. With respect to these costs, we show that an increase in the cost of health care services reduces waste more than an increase in the opportunity cost of being sick. In other words, health care cost inflation reduces fraud more than general inflation.

The general conclusion we can draw from the health care fraud model presented herein is that the real cost of health care cost inflation may be over-estimated in the economy since it does not incorporate the waste reduction aspect associated with less fraud. As we have shown, fraud is reduced when health care cost increases, provided that the cost of auditing remains unchanged. It follows that a beneficial aspect of higher medical cost may have been over-looked in the traditional health-care-cost inflation literature.

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5 Appendix: Table and Proofs

Table 1

Total Expenditure Health - Percentage of Gross Domestic Product

Year/Period	Canada	France	Italy	Belgium	Japan	Spain	U.K.	USA	Sweden
1960	5.4	4.2	3.6	3.4	3.0	1.5	3.9	5.1	4.7
1965	5.9	5.2	4.3	3.9	4.5	2.6	4.1	5.7	5.5
1970	7.0	5.8	5.2	4.1	4.6	3.7	4.5	7.1	7.1
1975	7.2	7.0	6.2	5.9	5.6	4.9	5.5	8.0	7.9
1980	7.2	7.4	7.0	6.4	6.5	5.6	5.7	8.9	9.4
1985	8.4	8.3	7.1	7.2	6.7	5.7	5.9	10.4	9.0
1990	9.2	8.8	8.1	7.4	6.1	6.9	6.0	12.4	8.8
1995	9.5	9.8	8.0	8.2	7.2	7.0	7.0	13.9	8.4

(Constructed using the *OECD Health Data 2000*)

Proofs

Proof of proposition 1. All we need to show is that the first order condition is positive at $h = s + w$:

$$U'\left(Y - \pi\frac{h^2}{h-c} - s + h\right)\left[1 - \pi\frac{h\,(h-2c)}{(h-c)^2}\right] - (1-\pi)U'\left(Y - \pi\frac{h^2}{h-c} + w\right)\pi\frac{h\,(h-2c)}{(h-c)^2} \geq 0 \tag{12}$$

Letting $h = s + w$ and simplifying, we find that (12) holds if and only if

$$1 - \frac{h\,(h-2c)}{(h-c)^2} \geq 0 \tag{13}$$

This clearly holds if $c > 0$. Therefore $h > s + w$.•

Proof of proposition 2 a) We first want to show that $\frac{dh}{ds} > 0$. Let Ω represent the first order condition rewritten as

$$\Omega = U'\left(Y - \pi\frac{h^2}{h-c} - s + h\right)\left[(h-c)^2 - \pi h\,(h-2c)\right] - (1-\pi)U'\left(Y - \pi\frac{h^2}{h-c} + w\right)h\,(h-2c) = 0 \tag{14}$$

Using total derivatives, we know that $\frac{\partial\Omega}{\partial h}dh + \frac{\partial\Omega}{\partial s}ds = 0$, where

$$\frac{d\Omega}{ds} = -\left[(h-c)^2 - \pi h\,(h-2c)\right]U''\left(Y - \pi\frac{h^2}{h-c} - s + h\right) \tag{15}$$

$$\begin{aligned}\frac{\partial\Omega}{\partial h} \;=\; & 2\,(1-\pi)\,(h-c)\left[U'\left(Y - \pi\frac{h^2}{h-c} - s + h\right) - U'\left(Y - \pi\frac{h^2}{h-c} + w\right)\right] \\ & + (1-\pi)\,h\,(h-2c)\,\pi\frac{h\,(h-2c)}{(h-c)^2}\left[U''\left(Y - \pi\frac{h^2}{h-c} + w\right) - U''\left(Y - \pi\frac{h^2}{h-c} - s + h\right)\right] \\ & + (1-\pi)\,h\,(h-2c)\,U''\left(Y - \pi\frac{h^2}{h-c} - s + h\right) \\ & + c^2\left[1 - \pi\frac{h\,(h-2c)}{(h-c)^2}\right]U''\left(Y - \pi\frac{h^2}{h-c} - s + h\right)\end{aligned} \tag{16}$$

Since $\frac{d\Omega}{ds} > 0$ and $\frac{\partial\Omega}{\partial h} < 0$,[14] it follows that $\frac{dh}{ds} > 0$, as we wanted to show.

b) We now want to show that this increase in health benefits is smaller than the increase in health care cost; i.e., $\frac{dh}{ds} < 1$. This occurs when

$$\frac{dh}{ds} = -\frac{\frac{\partial\Omega}{\partial s}}{\frac{\partial\Omega}{\partial h}} = -\frac{-\left[(h-c)^2 - \pi h(h-2c)\right]U''\left(Y - \pi\frac{h^2}{h-c} - s + h\right)}{\left[\begin{array}{c} 2(1-\pi)(h-c)\left[U'\left(Y-\pi\frac{h^2}{h-c}-s+h\right) - U'\left(Y-\pi\frac{h^2}{h-c}+w\right)\right] \\ +(1-\pi)h(h-2c)\pi\frac{h(h-2c)}{(h-c)^2}\left[U''\left(Y-\pi\frac{h^2}{h-c}+w\right) - U''\left(Y-\pi\frac{h^2}{h-c}-s+h\right)\right] \\ +(1-\pi)h(h-2c)U''\left(Y-\pi\frac{h^2}{h-c}-s+h\right) \\ +c^2\left[1-\pi\frac{h(h-2c)}{(h-c)^2}\right]U''\left(Y-\pi\frac{h^2}{h-c}-s+h\right) \end{array}\right]} < 1 \tag{17}$$

We know that $\frac{\partial\Omega}{\partial h} < 0$. Combining terms we find that $\frac{dh}{ds} < 1$ if and only if

$$\left[\begin{array}{c} 2(1-\pi)(h-c)\left[U'\left(Y-\pi\frac{h^2}{h-c}-s+h\right) - U'\left(Y-\pi\frac{h^2}{h-c}+w\right)\right] \\ +(1-\pi)h(h-2c)\pi\frac{h(h-2c)}{(h-c)^2}\left[U''\left(Y-\pi\frac{h^2}{h-c}+w\right) - U''\left(Y-\pi\frac{h^2}{h-c}-s+h\right)\right] \\ +\pi hc\frac{h^2-3hc+3c^2}{(h-c)^2}U''\left(Y-\pi\frac{h^2}{h-c}-s+h\right) \end{array}\right] < 0 \tag{18}$$

A sufficient condition for (18) to hold is that

$$\pi hc\frac{h^2 - 3hc + 3c^2}{(h-c)^2} > 0 \tag{19}$$

The reason is that the first two lines of (18) are negative since $h > s$, and that $U''(.) < 0$. The zeros of (19) are $h = 0$, $h = \frac{3}{2}c + \frac{1}{2}ic\sqrt{3}$, and $h = \frac{3}{2}c - \frac{1}{2}ic\sqrt{3}$. It is therefore clear that (19) holds for any real h. Hence, $\frac{dh}{ds} < 1$.•

Proof of proposition 3 a) We first want to show that $\frac{dh}{dw} > 0$. We already have $\frac{\partial\Omega}{\partial h}$ from (16). We must now find $\frac{\partial\Omega}{\partial w}$ as

$$\frac{d\Omega}{dw} = -(1-\pi)U''\left(Y - \pi\frac{h^2}{h-c} + w\right)h(h-2c) \tag{20}$$

Clearly $\frac{d\Omega}{dw} > 0$. Given that $\frac{\partial\Omega}{\partial h} < 0$, it follows that $\frac{dh}{dw} > 0$, as we wanted to show.

[14] $\frac{\partial\Omega}{\partial h}$ is negative since each line is negative:

$$\left[U'\left(A - \pi\frac{h^2}{h-c} - s + h\right) - U'\left(A - \pi\frac{h^2}{h-c}\right)\right]$$

is negative since $h > s$, as shown in proposition 1,

$$(1-\pi)h(h-2c)\pi\frac{h(h-2c)}{(h-c)^2}\left[U''\left(A - \pi\frac{h^2}{h-c}\right) - U''\left(A - \pi\frac{h^2}{h-c} - s + h\right)\right]$$

for the same reason, and

$$(1-\pi)h(h-2c)U''\left(A - \pi\frac{h^2}{h-c} - s + h\right) + c^2\left[1 - \pi\frac{h(h-2c)}{(h-c)^2}\right]U''\left(A - \pi\frac{h^2}{h-c} - s + h\right)$$

is clearly negative since $U''(.)$ is negative.

b) Similarly to proposition 2's part b) proof, we want to show that $\frac{dh}{dw} < 1$. Given that $\frac{\partial\Omega}{\partial h} < 0$, $\frac{dh}{dw} < 1$ occurs if and only if $\frac{\partial\Omega}{\partial w} - \frac{\partial\Omega}{\partial h} < 0$. Combining terms we find that $\frac{dh}{dw} < 1$ holds if and only if

$$\left[\begin{array}{c} 2(1-\pi)(h-c)\left[U'\left(Y-\pi\frac{h^2}{h-c}-s+h\right)-U'\left(Y-\pi\frac{h^2}{h-c}+w\right)\right] \\ +(1-\pi)h(h-2c)\pi\frac{h(h-2c)}{(h-c)^2}\left[U''\left(Y-\pi\frac{h^2}{h-c}+w\right)-U''\left(Y-\pi\frac{h^2}{h-c}-s+h\right)\right] \\ +\left(1-\pi\frac{h(h-2c)}{(h-c)^2}\right)c^2U''\left(Y-\pi\frac{h^2}{h-c}-s+h\right) \end{array}\right] < 0 \qquad (21)$$

A sufficient condition for (21) to hold is that $1-\pi\frac{h(h-2c)}{(h-c)^2} > 0$, which clearly holds for $c > 0$. Hence, $\frac{dh}{dw} < 1$.•

Proof of proposition 4 From waste Z given in (11), we find

$$\frac{dZ}{ds} = (1-\pi)\frac{d\phi}{ds}\psi c + [(1-\pi)\phi + \pi]\frac{d\psi}{ds} < 0 \qquad (22)$$

and

$$\frac{dZ}{dw} = (1-\pi)\frac{d\phi}{dw}\psi c + [(1-\pi)\phi + \pi]\frac{d\psi}{dw}c < 0 \qquad (23)$$

because $\frac{d\phi}{ds} < 0$, $\frac{d\psi}{ds} < 0$, $\frac{d\phi}{dw} < 0$ and $\frac{d\psi}{dw} < 0$.•

Proof of proposition 5 Using (22) and (23), we want to show that $\frac{dZ}{ds} < \frac{dZ}{dw}$. This occurs if and only if

$$(1-\pi)\left(\frac{d\phi}{ds} - \frac{d\phi}{dw}\right)\psi c + [(1-\pi)\phi + \pi]\left(\frac{d\psi}{ds} - \frac{d\psi}{dw}\right)c < 0 \qquad (24)$$

Since $\frac{d\phi}{ds} - \frac{d\phi}{dw} = \frac{\partial\phi}{\partial h}\frac{\partial h}{\partial s} - \frac{\partial\phi}{\partial h}\frac{\partial h}{\partial w} = \frac{\partial\phi}{\partial h}\left(\frac{\partial h}{\partial s} - \frac{\partial h}{\partial w}\right)$ and since $\frac{\partial h}{\partial s} - \frac{\partial h}{\partial w} = 0$, it follows that $\frac{d\phi}{ds} - \frac{d\phi}{dw} = 0$. To see why, note that

$$\frac{dh}{ds} = -\frac{-\left[(h-c)^2 - \pi h(h-c)\right]U''\left(Y-\pi\frac{h^2}{h-c}-s-w+h\right)}{\frac{\partial\Omega}{\partial h}} = \frac{dh}{dw} \qquad (25)$$

What remains is that $\frac{dZ}{ds} < \frac{dZ}{dw}$ if and only if $\frac{d\psi}{ds} - \frac{d\psi}{dw} < 0$

Rewriting $\frac{d\psi}{ds}$ and $\frac{d\psi}{dw}$ as

$$\frac{d\psi}{ds} = \frac{\partial\psi}{\partial s} + \frac{\partial\psi}{\partial h}\frac{\partial h}{\partial s} \quad \text{and} \quad \frac{d\psi}{dw} = \frac{\partial\psi}{\partial h}\frac{\partial h}{\partial w} \qquad (26)$$

we thus have

$$\frac{d\psi}{ds} < \frac{d\psi}{dw} \;\text{ iff }\; \frac{\partial\psi}{\partial s} + \frac{\partial\psi}{\partial h}\frac{\partial h}{\partial s} - \frac{\partial\psi}{\partial h}\frac{\partial h}{\partial w} < 0 \qquad (27)$$

Given that $\frac{\partial h}{\partial s} = \frac{\partial h}{\partial b}$ (see equation 25), all that is left to show is that

$$\frac{\partial\psi}{\partial s} = -\frac{U'(Y-p-s+h)d}{[U(Y-p-s+h) - U(Y-p) + d]^2} < 0 \qquad (28)$$

which is obvious. Hence $\frac{dZ}{ds} < \frac{dZ}{dw} < 0$. •

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