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INSURANCE IN A MARKET FOR CREDENCE GOODS

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INSURANCE IN A MARKET FOR CREDENCE GOODS

Abstract

We study the impact of insurance on the amount of fraud in a physician-patient relationship. In a market for credence goods, where prices are regulated by an authority, physicians act as experts. Due to their informational advantage, physicians have an incentive to cheat by inducing inappropriate treatment levels. It is shown that a higher coinsurance rate may lead to either less fraud in the market and a lower probability of patients searching for second opinions or more fraud and more searches. We also show that a higher coinsurance rate corresponds with a higher level of physicians specialising.

JEL Classification: D43, D82, G22, I11.

Keywords: insurance fraud, credence goods, supplier induced demand.

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1 Introduction

This paper deals with the provision of expert services in a physician-patient framework. We label physicians as experts when patients do not know the exact medical services they need and physicians therefore determine how much and which type of service will be demanded. The literature refers to such services or goods as credence goods. We can observe this feature also in markets for legal and repair services where customers ex post often cannot determine if they were served appropriately or not.

We study the impact of insurance arrangements on the degree of fraud in such a market. In particular we ask whether a higher coinsurance rate on the side of the patients makes fraud in this market more or less likely. In our model physicians diagnose patients. As patients do not have any information about the degree of illness, physicians can claim that the illness is very severe even if only a small treatment is necessary. The choice variable of the patients is to accept or reject the diagnosis, in which case they go to another physician. As a first intuition one would suggest that an increase in the coinsurance rate will lead to more patients searching for a second opinion if they are faced with a diagnosis for a large treatment. The reasoning would be that a higher coinsurance rate gives patients a larger financial incentive to search as they have to pay a larger fraction of the medical bill. More patients searching for second opinions gives physicians an incentive to diagnose more honestly. However, this intuition is only partially correct.

In particular, we show:

If the coinsurance rate increases, patients are ceteris paribus more willing to reject a high diagnosis and to search for a second opinion, which is in agreement with the intuition just given. However, in equilibrium, there are two possible consequences of an increase in the coinsurance rate: Either patients search less and physicians diagnose more honestly or patients search more and physicians diagnose less honestly.

The driving effect behind these results is that when physicians have to decide whether to diagnose honestly or not, they have to take two considerations into account: First the reaction of patients. If patients are less willing to accept a high diagnosis, this makes fraudulent behaviour less attractive. Second, the behaviour of other physicians. If other physicians behave relatively dishonest, and patients often reject their first diagnosis, the chance is high that a patient coming to a physician is already on his second visit. In this case the patient would accept a high diagnosis as a confirmation of the first diagnosis. This in turn makes fraudulent behaviour more attractive.

In equilibrium the interaction of the two effects can go in both directions: Either all other physicians diagnose more honestly in which case each individual physician is also better off diagnosing more honestly, and patients thus have less incentives to search for a second opinion. Or, all other physicians recommend more often a higher treatment, patients search more often, which increases the chance that a patient is on his second visit when coming to a physician. This in turn increases the incentive to recommend the high treatment.

We derive two further results in this framework. First, if physicians can specialise, then an increase in the coinsurance rate will make specialisation more likely. The reason is that specialisation is a possible response to the informational asymmetry in this market (see Wolinksy, 1993). If a physician is not able to do special treatments, he will only refer the patient if the required treatment is truly severe. Now, if the coinsurance rate is larger, the problem of dishonest diagnosis is more severe from the point of view of the patient, thus favouring specialisation. Second, while our main analysis assumes risk neutral patients, we also investigate risk aversion. It can be shown that the main results on the equilibrium behaviour remain to hold. However, there is an interesting new result on the partial equilibrium behaviour. Risk averse patients might ceteris paribus be less willing to search for a second opinion if the coinsurance rate increases. The reason is that a second opinion comes with an income risk, which is larger if the coinsurance rate is larger.

Related literature:

I: Models on credence goods:

Several papers deal with credence goods in markets for e.g. medical services (see for example Wolinsky 1993, 1995; Emons 1997, 2001). However, to our knowledge the only contributions considering the possibility of insurance in such a context are Dionne (1980, 1984). Although Dionne studies the reaction of patients to changes in the insurance structure, he does not analyse how exactly physicians modify their behaviour and the resulting effect this has on patients' behaviour.

II: Models on insurance fraud

Insurance fraud is a well studied research topic. Most dominant in this line of research are costly state verification models (see e.g. Townsend, 1979; Mookherjee and Png, 1989; Fagart and Picard, 1999) and costly state falsification models (see e.g. Lacker and Weinberg, 1989; Crocker and Morgan, 1998). In the former case the insurer can validate claims only at a cost, while in the latter case the insured can manipulate claims at a cost to him. While much attention has been given to the incentive of the insured to betray the insurer, only little has been done to investigate in how far third parties have an incentive to manipulate a claim (see e.g. Brundin and Salanié, 1997). In this literature it is assumed that the third party colludes with the insured. Apart from the papers by Dionne mentioned above no work has been done on insurance fraud where the third party has an informational advantage compared to the insured.

The remainder of this paper is structured as follows: We present the assumptions of the model in Section 2, where we also determine patients' and physicians' optimisation problems and the equilibrium outcome. Our main results on the impact of insurance on the degree of fraud are derived. As extensions we discuss the possibility of physicians specialising in medical treatment and risk averse patients in Section 3. Section 4 concludes the paper.

2 The model

The framework we use is a simplified version of the model by Wolinsky (1993) where we additionally introduce insurance.

There is a continuous number of patients in the market, indexed by $s \in [0, 1]$. A patient becomes ill with probability q. Conditional of being ill, she suffers a big (small) medical problem with probability p, $(1-p)$ with $p \in (0, 1)$. Although a patient notices when having a problem she cannot specify its gravity.

There are $I \geq 2$ identical physicians in the market who can offer diagnosis and treatment. The physicians' intention is to maximise the profit per patient. When treating a patient with a big problem, a physician incurs costs H whereas the costs for treating a small problem are L with $L < H$. In the remainder we label the treatment of a big problem H and of a small problem L.

We assume that physicians charge exogeneously fixed prices H for the H treatment and $L + e$ for the minor problem L. e stands for an additional charge (*"mark-up"*) on the L treatment that ensures that there is an incentive to provide the L treatment honestly. There are two reasons for the fixed price assumption. First, with physicians setting prices the model would have many equilibria one of which has the structure just given (see Wolinsky, 1993). Second, in existing markets for medical services we can indeed observe in many countries fixed prices arising from a bargaining process on a central level between lobbyists and government.[2]

The interaction between patients and physicians proceeds as follows:

1. A patient s who is ill chooses a physician. If she is faced with an H diagnosis, she accepts this with probability $y(s) \in [0, 1]$. With probability $(1 - y(s))$ she visits another physician for a second opinion which she accepts with certainty.[3] Visiting a physician, a patient has to incur search and waiting costs k.

2. Physicians diagnose those patients visiting and give a treatment recommendation. Their recommendation policy is described by $x_i \in [0, 1]$, that is with probability x_i a patient having an L problem receives a recommendation for an H treatment from physician i. A patient with an H problem always obtains an H recommendation. If patients accept they get treatment with prices according to the diagnosis. Otherwise, they leave to get a second opinion.

Payoffs are as follows:

A patient who is treated obtains utility $B - \tau P - nk$ where B is the benefit of treatment, P is the price, τ is the coinsurance rate and $n \in \{1, 2\}$ is the number of physicians the patient visits. We assume that B is large enough such that any patient will undergo treatment eventually. Note that k encompassed all the costs the patient has to bear fully himself. This might be search and waiting costs, but also non-monetary costs of undergoing a diagnosis like pain.[4]

A physician who treats a patient with diagnosis L makes a profit of e. If the diagnosis is H and the patient indeed suffers an H illness, his profit is zero. Finally,

[2] A similar assumption has been made by Pitchik and Schotter, 1987.

[3] The model could be generalized to allow rejections of second opinions also (see Wolinsky, 1993).

[4] The model could be extended to allow for monetary costs of diagnosis which is partially borne by the insurance. This would not modify the general results of this analysis.

if the reported diagnosis is H, but the patient only suffers a minor L illness, then the physicians profit is $H - L$.

We concentrate on symmetric equilibria where all physicians choose the same recommendation policy x and all patients have the same acceptance rate y.

2.1 Patients' optimisation problem

A patient's expected utility is maximised when expected costs C_P are minimised through optimal choice of acceptance policy y. C_P is composed as follows:

$$\begin{aligned} C_P &= k + (1-p)(1-x)\tau(L+e) + [p + (1-p)x]y\tau H \\ &\quad +[p + (1-p)x](1-y) \\ &\quad \cdot \left[k + \frac{(1-p)x(1-x)\tau(L+e) + [p + (1-p)x^2]\tau H}{p + (1-p)x}\right] \end{aligned} \tag{1}$$

The search costs k have to be paid for the first visit to a physician in any case. With probability $(1-p)(1-x)$ a patient gets a correct L diagnosis - which is accepted with certainty - and incurs treatment costs $\tau(L+e)$. With probability $[p+(1-p)x]$ a patient gets an H diagnosis and accepts with probability y from the first physician leading to a payment of τH. The remaining part of (1) describes the situation when a patient gets an H recommendation from the first physician - which is the case with probability $[p + (1-p)x]$ - but declines with probability $(1-y)$ and consults a second physician which leads to costs k again. The following fraction weights the payments for an L and an H treatment by the second physician with their conditional probabilities given that the first physician diagnosed an H problem. A patient will accept an H diagnosis with probability one (zero) whenever

$$\tau H < (>) k + \frac{(1-p)x(1-x)\tau(L+e) + [p + (1-p)x^2]\tau H}{p + (1-p)x} \tag{2}$$

When both sides are equal, the patient is indifferent between accepting or rejecting. When accepting the patient incurs τH, when declining she faces expected costs described on the right-hand side of (2).

Lemma 1 *Consider a symmetric recommendation policy $x \in [0,1]$. If τ is sufficiently large, the patients' best response correspondence is*

$$y^*(x) \in \begin{cases} \{1\} & \text{if } x \in [0, x_1) \cup (x_2, 1] \\ [0,1] & \text{if } x \in \{x_1, x_2\} \\ \{0\} & \text{if } x \in (x_1, x_2) \end{cases}$$

with

$$x_{1,2} = \frac{1}{2}\left(1 - \frac{k}{(H-L-e)\tau}\right) \pm \sqrt{\frac{1}{4}\left(1 - \frac{k}{(H-L-e)\tau}\right)^2 - \frac{p}{1-p}\frac{k}{(H-L-e)\tau}} \quad (3)$$

The proof is relegated to the appendix.

Lemma 1 shows that if physicians diagnose relatively honestly (i.e. x is small) patients will accept the high diagnosis with probability one, as it is then quite likely that she is indeed an H patient. Interestingly, if physicians cheat very often (i.e. x close to one), patients will also accept the high diagnosis. The reason is that searching for a second opinion does not help very much - also the second physician is expected to lie about the true diagnosis. Looking for a second opinion is a good strategy only for intermediate values of x. In this case the patient has a good chance to be treated honestly by the second physician while the chance that the first physician lied is not negligible.

In the appendix we give a sufficient and necessary condition for the coinsurance payment τ for Lemma 1 to hold. In particular we show that if $\tau \leq \frac{k}{H-L-e}$ the agent will always accept any diagnosis. In that case, search costs k are large compared to the potential financial gain of visiting a second physician $\tau(H-L-e)$ which makes searching around unattractive. Consequently, in that case the only equilibrium is where all physicians always give an H diagnosis, i.e. $x = 1$, and the patient always accepts (i.e. $y = 1$). In the following we concentrate on the case where k is small enough (and τ is large enough).

In Figure 1 we plotted the patients' reaction correspondence.

We now come to our first proposition concerning the impact of insurance on the behaviour of the market participants.

Proposition 1 *Ceteris paribus, the higher the coinsurance rate τ the more likely a patient declines an H diagnosis from the first consulted physician and chooses $y = 0$.*

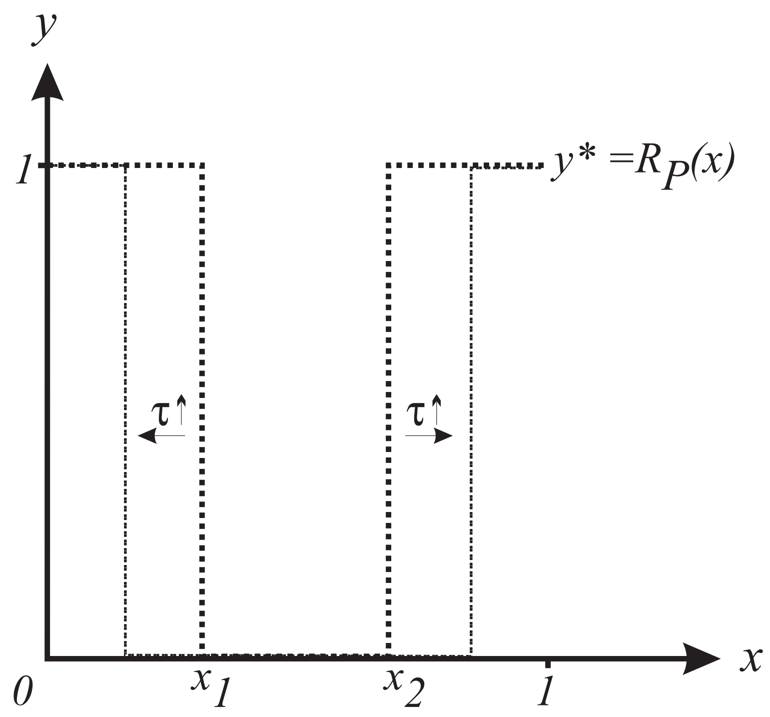

Figure 1: Patients' reaction correspondence

Proof. Setting the equal sign in expression (2) and taking the partial derivative of x with respect to τ gives:

$$\frac{\delta x}{\delta \tau} = -\frac{(H-L-e)(1-x)x}{(1-2x)(H-L-e)\tau - k} \tag{4}$$

The numerator of this derivative is positive. The whole fraction is positive (negative) if $(1-2x)(H-L-e)\tau - k > (<)0$, where the critical value is given by

$$x_K = \frac{1}{2}\left(1 - \frac{k}{(H-L-e)\tau}\right) \tag{5}$$

Comparing (5) with the two solutions $x_{1,2}$ in Lemma 1 shows that $x_1 < x_K < x_2$ leading to $\frac{\delta x_1}{\delta \tau} < 0$ and $\frac{\delta x_2}{\delta \tau} > 0$. Hence an increase in τ indicates a change in patients' reaction correspondence as shown in Figure 1. The values x_1 and x_2 for which a patient is indifferent are closer to the extrema 0 and 1 - that is there is a broader range of x-values between x_1 and x_2 for which the patients' best response is $y = 0$ as stated in Proposition 1.•

Proposition 1 is intuitively clear - if the patient has more to gain from obtaining a second opinion, she is ceteris paribus more likely to decline an H recommendation.

In Figure 1 we indicated that an increase in τ shifts the two points where the patient is indifferent to the outside. Intuitively one would suggest that such an increase in search for second opinions triggers a decrease in false recommendation, as physicians should fear more patients leaving. However, as we will see in the next section, in a full equilibrium analysis this argument does not necessarily hold.

2.2 Physicians' optimisation problem

We consider the situation of a physician j who wants to maximise his expected profit per patient π_j by choosing x_j, that is

$$\pi_j \quad = \quad (1-x_j)e + x_j \left(\frac{y+x(1-y)}{1+x(1-y)}\right)(H-L) \tag{6}$$

The individual recommendation policy of physician j is denoted by x_j whereas x stands for the market level of fraud from all physicians. Since we consider fixed prices $(H, L{+}e)$ it is only possible to make profit with L patients. With a correct diagnosis the profit is the mark-up e while the expected profit of an incorrect H diagnosis is $(H-L)$ with probability $[y+x(1-y)]/[1+x(1-y)]$. The fraction $\frac{1}{1+x(1-y)}$ of all patients are on their first visit when consulting a specific physician, hence they accept an H diagnosis with probability y. The remaining $\frac{x(1-y)}{1+x(1-y)}$ patients are on their second (and last) visit to a physician and therefore accept either diagnosis with certainty.

The physician will choose $x_j = 1$ $(x_j = 0)$ whenever

$$e \quad < (>) \quad \left(\frac{y+x(1-y)}{1+x(1-y)}\right)(H-L) \tag{7}$$

He is indifferent between an honest diagnosis of an L patient and an incorrect recommendation of an H treatment when both sides of expression (7) are equal. With a correct L diagnosis a patient stays with certainty with the first physician, which leads to a net profit of $L+e-L=e$. When receiving an H diagnosis the patient only stays with probability $\frac{y+x(1-y)}{1+x(1-y)}$ which results in the payoff $(H-L)$ for the physician.

Lemma 2 *If $e < \frac{H-L}{2-y}$, the symmetric physicians' best response correspondence is given by:*

$$x^*(y) \in \begin{cases} \{1\} & \text{if } y \in \left[\frac{e}{H-L}, 1\right] \\ \left\{0, \frac{e-y(H-L)}{(1-y)(H-L-E)}, 1\right\} & \text{if } y \in \left[0, \frac{e}{H-L}\right] \end{cases}$$

If $e \geq \frac{H-L}{2-y}$ *the symmetric physicians' best response correspondence is given by:*

$$x^*(y) \in \begin{cases} \{1\} & \text{if } y \in \left[\frac{e}{H-L}, 1\right] \\ \{0\} & \text{if } y \in \left[0, \frac{e}{H-L}\right] \end{cases}$$

The proof is relegated to the appendix.

If the patients accept an H recommendation sufficiently often (i.e. y is large), then physicians prefer to cheat ($x = 1$). If on the other hand, patients tend to go for a second opinion (i.e. y is close to zero), then physicians prefer to diagnose honestly ($x = 0$). If e, the markup on the L treatment, is small, then there also exists a region where all physicians are indifferent between cheating or not.

Figure 2 gives a graphical interpretation of Lemma 2. The black dotted line shows those best response strategies that always exist in equilibrium. The grey line is only part of the symmetric best response equilibrium strategies if $e < \frac{H-L}{2-y}$.

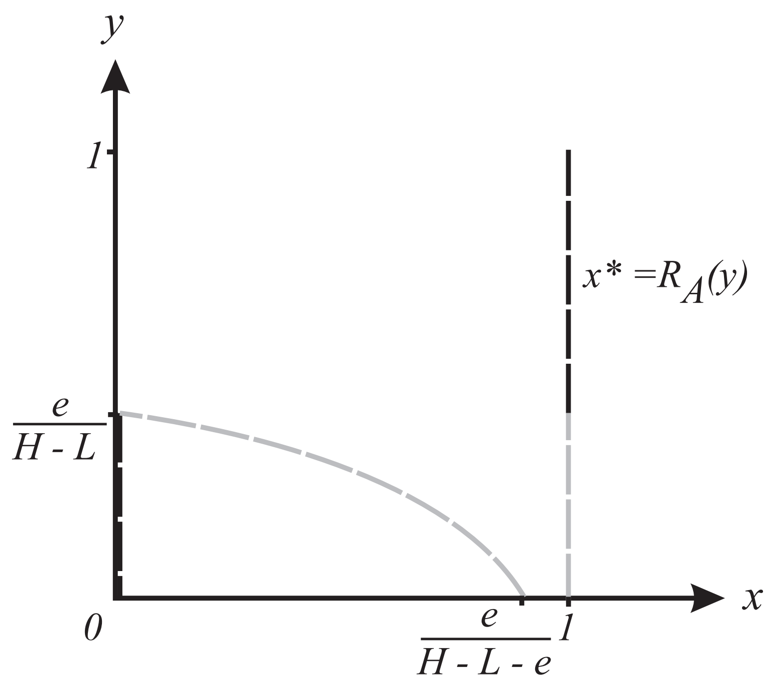

Figure 2: Physicians' equilibrium strategy

In this paper we want to investigate the effect of insurance on the level of fraud. Therefore the interesting case for us is when $e < \frac{H-L}{2-y}$. Only then equilibria where physicians do false recommendations with a positive probability smaller than one are possible.

2.3 Equilibrium discussion

Joining the results from the two sections above gives us a situation as illustrated in Figure 3.

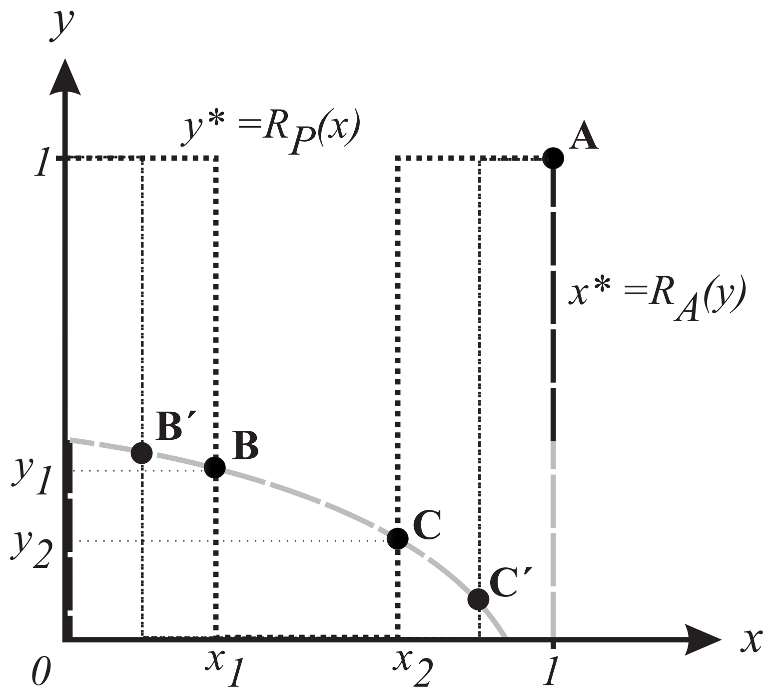

Figure 3: Equilbria in a market with fraud

We can describe the equilibrium outcomes as follows:

Lemma 3 *In the described game there exists always an equilibrium in pure strategies where physicians defraud every L patient by diagnosing an H problem ($x = 1$). Patients always accept an H diagnosis on their first visit ($y = 1$).*
Additionally for a sufficiently small k and $e < \frac{1}{2}(H - L)$ there are two equilibria in mixed strategies where physicians defraud L patients with positive probability and patients accept an H diagnosis with positive probability from the first physician.

Proof. We get three equilibria as can be seen in Figure 3. Equilibrium A is in pure strategies: Patients always accept an H diagnosis from the first consulted physician. Physicians always recommend an H diagnosis to every L patient.

The two additional equilibria are in mixed strategies. In B the overall market level of fraud is relatively low at x_1 while in C the market level of x is relatively high at x_2. In both cases the patient is just indifferent between accepting an H diagnosis and searching for a second opinion.[5]

Note that the intersection point C can also lie on the x axis between x_1 and x_2. This would indicate an equilibrium where physicians randomize between a correct L diagnosis and defrauding whereas patients always decline an H diagnosis on their first visit. •

We now turn to comparative static of the analysis. The impact of an increase in the coinsurance rate on the outcome in the market is shown in our main proposition.

Proposition 2 *An increase in the coinsurance rate τ leads to three possible equilibrium outcomes with the following proporties:*
At outcome B', there is less fraud in the market. Additionally, more patients accept an H diagnosis from the first physician they consult (see Figure 3).
At outcome C', there is more fraud in the market and less patients accept an H diagnosis from the first physician.
Outcome A is still an equilibrium outcome.

Proof. The intuition of Proposition 2 can be immediately observed in Figure 3. As demonstrated in Proposition 1 an increase in τ leads to a direct change of patients' reaction correspondence - again illustrated by the thin line in Figure 3. There is no direct influence of a variation of τ on physicians' symmetric best response correspondence, but there is an indirect reaction due to the implicit change of patients' behaviour. In the mixed equilibria, the physicians' indirect reaction to a variation of τ is given by[6]

$$\frac{\delta y}{\delta \tau} = -\frac{(H-L-e)^2(1-x)(1-y)x}{[(1-2x)(H-L-e)\tau - k][(H-L-e)x-(H-L)]} \quad (8)$$

The numerator is positive whereas the whole fraction is positive or negative depending on the denominator. Since $(H-L-e)x-(H-L)$ is negative we get the same critical value x_K as in (5) that is $\frac{\delta y}{\delta \tau} > 0$ if $x < x_K$ and $\frac{\delta y}{\delta \tau} < 0$ if $x > x_K$. Hence we distinguish

[5]The same equilibrium outcome could be attained if a proportion y_1 (or y_2) of patients with an H illness always decline an H recommendation, while a proportion $(1-y_1)$ (or $(1-y_2)$) accepts any recommendation. A similar statement holds for the physicians.

[6]This is obtained by totally differentiating expressions (2) and (7) and solving for $\frac{\delta y}{\delta \tau}$.

two situations:

1. $x > x_K$: If there is already a relatively high level of fraud in the market, say x_2, the denominator is negative in $\frac{\delta x}{\delta \tau}$ and positive in $\frac{\delta y}{\delta \tau}$. Therefore $\frac{\delta x}{\delta \tau} > 0$ and $\frac{\delta y}{\delta \tau} < 0$. An increase in τ leads to an increase in x and more L patients get defrauded as before. In addition less patients accept an H diagnosis from the first diagnosing physician.

2. $x < x_K$: If the existing level of fraud in the market is relatively low, say x_1, the denominator is positive in $\frac{\delta x}{\delta \tau}$ and negative in $\frac{\delta y}{\delta \tau}$, leading to $\frac{\delta x}{\delta \tau} < 0$ and $\frac{\delta y}{\delta \tau} > 0$. An increase in τ leads to a decrease in x and less L patients get defrauded as before. In addition more patients accept an H recommendation from the first physician. •

Intuitively one would presume that an increase in the coinsurance rate will lead to patient's more willingness to search for a second opinion. This in turn makes it less attractive for physicians to provide a false diagnosis. That is y and x will both decrease. This does not hold in equilibrium.

Starting from a situation where physicians are just indifferent between diagnosing honestly and fraudulently, a decrease in y makes it strictly better to behave honestly (i.e. to set $x = 0$). But for $x = 0$ it is a best response of the patients to stay with their first physician (i.e. $y = 1$). One way to achieve the balance of these effects is when patients decrease their willingness to search for a second opinion while physicians behave more honestly (i.e. y increases and x decreases). This is shown in Figure 3 at points B and B'. However, there exists a second possibility to balance these effects. Patients continue to search harder for a second opinion (higher y) while physicians behave more fraudulently (higher x) as is shown in Figure 3 at points C and C'. More fraudulent behaviour might be attractive as physicians have a larger chance of having a patient who already has had his first opinion. So this patient will accept the second diagnosis for sure.

From a social welfare point of view equilibrium outcome A is optimal. The only inefficiency in this model arises from the search of the patients. In outcome A patients always accept the first diagnosis, which minimizes total search costs. Physicians also prefer outcome A. Patients when diagnosed with an H treatment are indifferent between accepting this treatment and searching for a second opinion. Thus for them the optimal outcome for a given insurance premium arises when the probability of fraudulent diagnosis is lowest. This is equilibrium B. The insurance premium in turn depends on the total amount of fraud in the market. Although in outcome B physicians diagnose more honestly, patients are also more willing to accept wrong recommendations. So at first glance it is not obvious whether total fraud is minimized in outcome B or C. Formally, the number of wrong treatments is given by $xy + x(1-y)x$. The first term describes those who are fraudulently diagnosed at their first visit (with probability x) and accept this diagnosis (with probability y). The second term are those who reject the first diagnosis (with probability $1-y$) but are wrongly diagnosed also at their second visit (with probability x), which they then accept. Using the equilibrium condition for $x^*(y)$ from Lemma 2 for an equilibrium in mixed strategies this expression transforms to $x(1-y)\frac{e}{H-L-e}$. From this it follows that in outcome B the total amount of fraud is minimized, as x and $1-y$ are lower than in outcome C.

3 Extensions

3.1 Specialisation of physicians

Wolinsky (1993) shows that one institutional response to dishonest behaviour could be the specialisation of physicians. If some physicians specialise on the L treatment, a patient visiting such a physician can be assured that if she obtains an H recommendation, this diagnosis is correct. The physician has no incentive to give a false recommendation as he does not profit from it.

In this subsection we consider the consequences of insurance on the specialisation of physicians.

Following Wolinsky, we assume that in this specialisation equilibrium all physicians just charge their costs.[7] So a patient without insurance visiting a physician who can only provide L treatments must pay the search costs k and treatment costs L in case her illness is not severe. Otherwise she has to go to a specialist for H treatments in which case she has to pay treatment costs H and search costs k once more. Wolinsky (1993) shows that in this framework specialisation can be an equilibrium, whenever

[7] A similar result holds if prices for the treatments differ from costs.

this expected payment by the patient is lower than $H + k$. This latter payment is the bill of a patient who directly goes to someone who can provide both treatments and charges H in any case.

Now we introduce insurance. To verify whether the specialisation equilibrium can be sustained we compare the costs $C_H = k + \tau H$ a patient incurs when directly going to someone who can do both treatments and expected costs $C_{LH} = k + (1-p)\tau L + p(\tau H + k)$ when first consulting an L expert and possibly heading to an H expert afterwards. A patient is better off going first to an L physician when $C_H > C_{LH}$, that is

$$k \;<\; \tau \frac{(1-p)}{p}(H - L) \tag{9}$$

If search costs are small, the probability of a large illness is small, the difference between the payments is large and the coinsurance rate is not too small the specialisation equilibrium will be sustainable. This observation allows us to derive the impact of insurance on the likelihood of specialisation:

Proposition 3 *The higher the coinsurance rate τ the higher is the level of specialisation in the physicians' market.*

Proof. Inequality (9) determines the critical search costs k^c which are such that only for values of k smaller than k^c a specialisation equilibrium exists. It directly follows from inequality (8) that compared to a situation with lower coinsurance the critical value for k to sustain the equilibrium described above is reduced. Thus more specialisation equilibria are possible. •

If patients have to pay more by themselves they are more critical concerning the price of treatment, while for small values of τ it is only the search costs which matters for them. The higher coinsurance rate makes patients more aware of fraud by physicians which in turn makes specialisation more likely.

3.2 Risk aversion

So far we only considered in line with the literature risk neutral patients. But the existence of insurance makes it necessary to also investigate in how far results change if patients are risk averse. As the reaction correspondence of the physicians is not modified by risk aversion, the equilibrium result, i.e. x decreases and y increases or the other way around, does not change. The intersection points will either move to the left or to the right. However, in contrast to the risk neutral case a risk averse agent might have ceteris paribus less incentives to search for a second opinion if the coinsurance rate increases.

Consider a risk averse patient who received an H recommendation from the first physician she visited. To concentrate on the effects on insurance on patient behavior, simplify notation by writing α $(1-\alpha)$ as the probability of receiving an L (H) diagnosis from a second physician. The utility of the patient of being treated is given by $U(B-\tau P-nk)$ where U is a concave function. The other parameters are as before.

For a patient who is indifferent between accepting the first diagnosis and searching for a second opinion it holds:

$$U(B-\tau H-k)=\alpha U(B-\tau(L+e)-2k)+(1-\alpha)U(B-\tau H-2k) \qquad (10)$$

When accepting the H treatment from the first physician, the patient gets the utility described on the left-hand side. When declining and searching for a second opinion the patient receives utility $U(B-\tau(L+e)-2k)$ when getting an L recommendation from the second physician and $U(B-\tau H-2k)$ when again obtaining an H recommendation. We will show that for given values of α an increase in τ can make accepting more attractive if the patient is risk averse.

Derivating (10) with respect to τ yields

$$-U'(\hat{B})H\left\{\begin{array}{c}>\\=\\<\end{array}\right\}-\alpha U'(\hat{B}+\tau(H-L-e)-k)(L+e)-(1-\alpha)U'(\hat{B}-k)H \qquad (11)$$

with $\hat{B}=B-\tau H-k$.

For a risk neutral patient with constant marginal utility we get

$$-H \quad < \quad -\alpha(L+e)-(1-\alpha)H \qquad (12)$$

so as previously shown a risk neutral patient prefers to get a second opinion if the coinsurance rate increases.

Now consider a risk averse patient. If the utility function displays decreasing absolute risk aversion the following inequality holds

$$-\frac{U'''}{U''} \;>\; -\frac{U''}{U'} \tag{13}$$

Applying Pratt's theorem (Pratt, 1964) it follows that a person with "utility" function $-U'$ is more risk averse than someone with utility function U. A comparison with equation (10) then gives

$$-U'(\hat{B}) \;>\; -\alpha U'(\hat{B} + \tau(H - L - e) - k) - (1 - \alpha)U'(\hat{B} - k) \tag{14}$$

because a more risk averse person prefers to get the safe bet whenever a less risk averse person is indifferent between a safe and a risky bet. Now, if $\hat{B} - k$ is sufficiently small, then also expression (11) might hold with a larger sign, showing that a risk averse patient might be less willing to search for a second opinion if the coinsurance rate increases.

We formulate this result as Proposition 4:

Proposition 4 *Ceteris paribus an increase in τ may result in patients' accepting more H recommendations from the first physician if patients are risk averse and have decreasing absolute risk aversion.*

Proof: The proof is given by example. Take $U(x) = ln(x)$ and set $B = 100$, $H = 90$, $L = 40$, $e = 10$, $k = 5$ and $\tau = 0,8$. α is determined by (10), which yields $\alpha = 0,24$. In this case, expression (11) reads $-3,913 > -4,040$ which proves the claim. •

A patient who rejects a recommendation and searches for a second opinion faces an income risk. She does not know whether the next diagnosis is L in which case her payment is τL or H, in which case she has to pay τH. If τ increases, this income risk increases. Although the expected income gain of search increases, the increase in risk might make it unattractive to search further.[8]

[8] Here it is assumed that the premium the patient pays does not depend on the coinsurance rate. An increase in the coinsurance rate is most likely to be accompanied by a decrease in premium which also alters risk aversion. We ignore this effect here.

4 Conclusion

Supplier induced demand is beside moral hazard one of the main informational problems in the market for health services. Supplier induced demand refers to the situation where physicians can and do treat more than is medically necessary, because they have better information available than do the patients. Moral hazard describes the case where patients demand more than necessary, due to the fact that they are insured and thus pay only a small fraction of the bill. In both cases it is argued that a higher degree of coinsurance weakens the problems created. If patients have to pay more, they consume less which reduces moral hazard. If patients have to pay more they also have a higher incentive to control their physician, which in turn reduces the potential for supplier induced demand. We investigate this latter effect and show that this conclusion does not hold in general.

In particular, we analyse the effect insurance arrangements have in a market for credence goods. The model is such that physicians as experts have an incentive to make dishonest treatment recommendations. Patients do not know their exact illness. However they can search for a second opinion if they do not believe the first diagnosis. It is shown that a higher coinsurance rate makes it ceteris paribus more likely that a patient searches for a second opinion.

However, taking into account the equilibrium reaction by the physicians on their degree of fraudulent behaviour, patients not necessarily search more often if the coinsurance rate increases. We show that as an equilibrium consequence either patients ask less often for a second opinion and physicians diagnose more honestly, or patients search more often and physicians diagnose more fraudulently.

It is also shown that a higher coinsurance rate tends to make specialisation more likely. Specialisation of physicians can be seen as one institutional answer to fraudulent behaviour. Specialised physicians have less possibilities to diagnose wrongly, because they do not profit from it. Then, if patients have more financial incentives to go against dishonest behaviour, specialisation is more likely to occur.

Finally we consider risk averse patients. The equilibrium results as outlined above do not change. However, ceteris paribus a risk averse patient might be less willing to search for a second opinion if the coinsurance rate increases. The reason is that going for a second opinion entails an income risk as the recommended treatment is uncertain. This income risk increases if the coinsurance rate increases, which makes search less attractive.

This paper concentrated on the effects of insurance on fraud in a market for credence goods. An interesting extension would be to study the optimal insurance contract in such an environment. This will be taken up in future research.

Appendix

Proof of Lemma 1.

Take $x \in [0,1]$ as given, i.e. an L patient receives a correct diagnosis with probability $(1-x)$ and an incorrect H diagnosis with probability x. Rearranging (2) (with an equal sign instead of the inequality) yields

$$-[(1-p)(H-L-e)\tau]x^2 + [(1-p)(H-L-e)\tau - (1-p)k]x - pk = 0 \quad (15)$$

which can be solved for

$$x^2 - \left(1 - \frac{k}{(H-L-e)\tau}\right)x + \frac{p}{1-p}\frac{k}{(H-L-e)\tau} = 0 \quad (16)$$

This gives the two solutions corresponding to Lemma 1:

$$x_{1,2} = \frac{1}{2}\left(1 - \frac{k}{(H-L-e)\tau}\right) \pm \sqrt{\frac{1}{4}\left(1 - \frac{k}{(H-L-e)\tau}\right)^2 - \frac{p}{1-p}\frac{k}{(H-L-e)\tau}} \quad (17)$$

Rearranging the term under the square roots gives a necessary and sufficient condition for $x_{1,2} \in [0,1]$:

$$\tau \geq \frac{k}{H-L-e}\left(\frac{1+p}{1-p} + \sqrt{\left(\frac{1+p}{1-p}\right)^2 - 1}\right) \quad (18)$$

From this it can be seen, that in order to get two real solutions in (17) it must at least hold that

$$\tau \geq \frac{k}{H-L-e} \quad (19)$$

That is, the deductible τ has to be (weakly) higher than the relation between search and diagnosis cost and the absolute difference in prices of the H and the L treatment.

From expression (15) it follows that for both $x < x_1$ and $x > x_2$ a patient strictly prefers to stay with the first physician and chooses $y = 1$. For $x \in (x_1, x_2)$ it is better to leave the first physician by setting $y = 0$ when receiving an H diagnosis. •

Proof of Lemma 2.

Depending on the patients' symmetric strategy y we distinguish three situations:

a) $y = 1$:

Patients play the pure strategy and always accept an H diagnosis from the first physician. Setting $y = 1$ in (6) and rearranging yields

$$-e + H - L > 0 \tag{20}$$

Obviously it is always a physicians' best response to set $x = 1$ meaning to recommend every patient an H treatment.

b) $y = 0$:

Now patients always decline an H diagnosis from the first physician. But it is not possible for a physician to distinguish between patients coming for the first and second time. Rearranging (6) yields

$$-e + \frac{x}{1+x}(H - L) \left\{ \begin{array}{c} > \\ = \\ < \end{array} \right\} 0 \tag{21}$$

where x is the recommendation policy of the other physicians. We consider three cases:

1. When $x = 0$ all other physicians always recommend honestly an L treatment to an L patient what solves (21) for

   $$-e < 0 \tag{22}$$

   Hence for the individual physician j it is also optimal to choose $x_j = 0$. When $x = 0$ no L patient receives an H diagnosis from an other physician which implies that when an L patient visits physician j it is his first visit to a physician. If physician j would recommend an H treatment it would be declined with certainty and physician j would make no profit.

2. When $x = 1$ all other physicians always defraud L customers by recommending an H treatment. $x_j = 1$ is a best response when

$$\begin{aligned} -e + \frac{1}{2}(H - L) &\geq 0 \\ e &\leq \frac{1}{2}(H - L) \end{aligned} \tag{23}$$

When (23) holds physician j sets $x_j = 1$ and also defrauds every L patient of his clientele. This is because now there are sufficiently many L patients in the market who are on their second visit and therefore accept an H diagnosis with certainty.

When $e > \frac{1}{2}(H - L)$, then $x = 1$ cannot be a candidate for a symmetrical physicians' best response to $y = 0$ since unilateral deviation to $x_j = 0$ would lead to a higher payoff for physician j.

3. When $x \in (0, 1)$ all other physicians defraud their patients with an L problem with positive probability. For a symmetric best response, physician j must also be indifferent between diagnosing honestly and giving a false recommendation. From (7) this holds if

$$x = \frac{e}{H - L - e} \tag{24}$$

A solution exists if $e < \frac{1}{2}(H - L)$. If $e > \frac{1}{2}(H - L)$ then no $x \in (0, 1)$ is a candidate for a best response to $y = 0$ due to the same argumentation as above.

c) $y \in (0, 1)$:

Patients mix between accepting and declining an H diagnosis from the first physician. Rearranging (7) (with an equal sign) yields

$$x(1 - y)(H - L - e) - e + y(H - L) = 0 \tag{25}$$

From partial derivation we get

$$\frac{dx}{dy} = -\frac{(H - L) - x(H - L - e)}{(1 - y)(H - L - e)} < 0 \tag{26}$$

An increase in y leads to a decrease in x. With a higher y a physician needs less L patients on their second visit to be indifferent between honest behaviour and defrauding L patients.

For the best responses x to $y \in (0, 1)$ we again distinguish three cases:

1. Suppose all other physicians choose $x = 0$. There exists a y so that (25) holds with $x = 0$:

$$y = \frac{e}{H - L} \tag{27}$$

Therefore for low values of y ($y \in (0, \frac{e}{H-L}]$) $x_j = 0$ is a best response as long as all other physicians choose $x = 0$.

2. Suppose all other physicians choose $x = 1$. From (25) we get that $x_j = 1$ is a best response whenever it holds that

$$(1 - y)(H - L - e) - e + y(H - L) = H - L - e - (1 - y)e > 0 \tag{28}$$

This holds as long as $e < \frac{H-L}{2-y}$.

3. Suppose all other physicians randomise with some $x \in [0, 1)$. From (25) we get indifference for physician j to diagnose honestly or not if it holds:

$$x = \frac{e - y(H - L)}{(1 - y)(H - L - e)} \tag{29}$$

The so determined x lies between zero and one as long as $e < \frac{H-L}{2-y}$. Because of (26) the x in (29) is decreasing in y and reaches $x = 0$ for $y = \frac{e}{H-L}$. •

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