Medical Services and Fraudulent Doctors

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Abstract:

This paper examines the motive behind the fraudulent behaviour of doctors. By making allowance for heterogeneous patients who suffer differently from the serious problem, the results show that it is actually the higher income earners who are defrauded and charged a higher price. Those who value medical services the most are willing to spend time 'shopping around' for the cheaper priced doctor. Such individuals are in the lower income bracket.

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1. Introduction

This article examines the market for medical services where the fraudulent behaviour and optimal strategy of a doctor is determined. Medical services are credence goods which is a term coined by Darby and Karni (1973). A credence good is one in which the usefulness to the buyer is better known to the seller rather than the buyer therefore resulting in asymmetric information. The sellers or providers of the credence good are termed “experts” because of their ability to diagnose and treat a customer’s problem. Examples of other experts include lawyers, legal and tax services, dentists and repair professionals such as mechanics. The information asymmetry that is created can lead to the doctor exaggerating the severity of the patient’s problem thereby recommending an unnecessarily expensive treatment. The situation is exaggerated further as even *ex post* the patient is unable to discern the correct level of treatment *ex ante*. Doctors constantly recommend complicated treatments when simpler treatments would have sufficed. Even after receiving the treatment the patient is unable to determine if the correct treatment was given. This would result in the patient paying an unnecessarily high fee to the doctor even though he could have given a much simpler and cheaper alternative.

Most of the work done on expert market employed a two-by-two model meaning that the patient (1) has either a mild or severe problem[1] that (2) requires two possible treatments to fix namely minor and serious. Such models have two possible equilibriums in which the expert fixes a price which is charged irrespective of the customer’s problem

[1] In Taylor (1995) and Emons (1997) the customer either has a problem or not. If there does not exist a problem no treatment is required, however if a problem does exist treatment will proceed after the diagnosis. These models are still considered as two-by-two as the no problem and problem condition of a customer is similar to the mild or severe problem.

or he will post a price list with different prices for different services. Fong Yuk-fai (2005) sees this as a limitation because in such models customers are assumed to be homogenous. This means that all customers who face the same problem are suffering to the same extent, and that the cost for providing a procedure is constant across different customers. This is not practical as customers in reality are heterogeneous and have different valuations for treatment. For example the common cold might have a more adverse effect on poorer individuals due to their worst state of health caused by poor eating habits. Using a one-shot monopolistic market his results showed that given this modification of two-by-two models the result is that experts will cheat selectively.

This article seeks to incorporate work done by Fong Yuk-fai (2005) but using a duopolistic market thereby making allowance for heterogeneous patients who are able to seek second opinions. The remainder of the paper is organized as follows. The proceeding section gives a brief outline of related literature on credence goods and various models used to analyze the fraudulent behaviour of an expert given varying assumptions. Section 3 presents the methodology employed in this study, while section 4 presents the results. Section 5 gives the conclusion and implications of the results.

2. Literature Review

Theoretical studies done on the services of experts are mostly built on two-by-two models in which there are two levels of severity of a customers problem and therefore one of two treatments are required. Such studies include Pitchik and Schotter (1987,1993), Wolinsky (1993), Taylor (1995), Emons (1997, 2001) and Alger and Salanie (2003). Earlier work in this area includes Darbi and Karni (1973) who were the first to introduce the concept of credence goods. They examined how the amount of fraud was affected by the experts' reputation, the market conditions and technological factors. Pitchik and Schotter (1987) further analysed the concept of fraudulent behaviour by experts using a more theoretical model. They used a fixed-price environment to derive the mixed-strategy equilibrium result that the expert cheats occasionally. The customer will randomize between accepting and rejecting the recommendation given in obtaining a major treatment.

Wolinsky (1993) used a competitive setting in which customers can seek second opinions which eliminates cheating by experts. Another modification included experts being concerned about maintaining a good reputation among clients so as to stay in business. The authors show that the experts concern about his reputation also eliminates the desire to cheat. In Biglaiser (1993) middlemen[2] are used to reduce the inefficiencies in a market with an adverse selection problem. By using a bargaining model Biglaiser shows that it can be welfare improving to have a middleman. These middlemen who act as experts are better able to differentiate the quality of goods. "Buyers have confidence that a middleman will not deceive them by selling a low-quality good, because maintaining a good reputation is important for his future profitability."

Taylor (1995) analyses a competitive market in which the owner of a durable good contracts an expert for diagnosis and treatment for the durable good. If the expert carries out ex ante pricing the owners have no incentive to take care of the good. In order to eliminate this moral hazard problem the expert can practice ex post pricing and long-term contracts such as health maintenance agreement. This health maintenance agreement

[2] Middlemen make profits by buying a good from one individual and selling it to someone else at a higher price. Such goods include cars, jewelry, stamps, antiques and coins.

refers to insurance policies where the provider of treatment insures the health of the good over an infinite horizon.

Alger and Salanie (2003) examined conditions leading to equilibrium over-consumption in a purely competitive model. Because consumers are not aware of what they want, they are reliant on the recommendation of experts. This asymmetric information allows the expert to defraud[3] the consumers by making false recommendations. This is in an effort to keep the customer uninformed, thus preventing them from seeking a second opinion. Therefore a competitive expert market does not perform efficiently.

Monopoly models have also been used to analyze the market for credence goods and the services of experts. The information asymmetry that is present between buyers and sellers makes it possible for sellers to engage in fraudulent behaviour. Observing this asymmetry information Emons (1997) examined if the market mechanism can correct this problem. His results showed that the market does detour fraudulent behaviour because the customer is able to infer the incentive of the expert by observing prices or market shares.

Fon Yuk-fai (2005) highlights the shortfall of two-by-two models as they do not account for heterogeneities among customers. He therefore modifies the model providing two new theories on expert cheating; namely heterogeneity of customers and the difference in cost of treatment for the customers' problems. His main results showed that experts cheat customers who value treatment highly and whose costs of repair are greater. In addition cheating is a substitute for price discrimination and it is this fear of cheating

[3] Defraud here refers to inefficient over-consumption by consumers.

which causes customers to withhold valuable information about their problem which hinders proper diagnosis.

This paper applies a theoretical methodology in explaining how expert cheating arises. This study follows closely the methodology used by Fon Yuk-fai (2005) by moving away from a two-by-two model and allowing for heterogeneity of patients. In addition to this I will be using a duopolistic model, which has not been done in previous literature. The two doctors compete with price but are constrained by limited capacity. This means that there are only a certain number of patients which can be examined in a particular day. In order to solve this model use is made of Levitan and Shubik (1972) methodology in finding the optimal price and the equilibrium mixed strategies. Although he assumes that the duopolist has zero production cost, this paper imposes a cost onto the doctor for treating each patient. The framework will offer guidance to patients in knowing why they are cheated by doctors and possible ways of preventing fraud.

3. Model

There is a continuum of patients with measure one. Each has a problem about which it is common knowledge that it may be either serious (*s*), with probability α, or minor (*m*), with probability 1- α. If problem $i \in \{m, s\}$ is left untreated, a patient (henceforth she) bears a loss of l_i, with $l_m < l_s$. However patients do not suffer equally from the same problem hence there are two types $(T \in \{H, L\})$ of patients. A fraction σ of them is of type H and suffers a loss l_s^H from the serious problem. The remaining fraction (1- σ) is of type L and suffers l_s^L from the same problem, where $l_s^L < l_s^H$. Both types suffer equally (l_m) from the minor problem. Patient types are observable to the doctor.

There are two doctors, Smith and Jones, whose task it is to diagnose and fix these problems. Both doctors provide costless diagnosis and costly treatment service at costs c_m for the minor problem and c_s for the serious problem. Both treatments are efficient to provide, i.e., $0 < c_m < l_m and 0 < c_s < l_s$. Each doctor is constrained to examine no more than k patients. We assume $k_1=k_2=k$; i.e. the doctors have equal capacity. The assumption is made that $k \leq a$; i.e a doctor has no more capacity than enough to supply the whole market. The two doctors decide simultaneously on: 1) the menu of treatments they provide 2) their prices 3) and recommendation policies. The doctor first observes the patient's problem and recommends a minor treatment at price p_m, recommends a serious treatment at the price p_s, or refuses to provide any treatment. Because there are heterogeneous patients who value the treatment differently, the doctors can charge different prices for the serious problem. Because capacities are limited a rationing rule is necessary so as to tell which patients are served at the low price for the serious treatment and which must buy from the high-priced doctor. The intensity rationing rule specifies that the customers able to buy from the doctor with the lower price are those who value the product most. In this pricing model with capacity constraint there is no pure-strategy equilibrium which is known as the Edgeworth paradox[4].

The ability to perform the serious treatment also includes the ability to perform the minor treatment, and the doctor will recommend the serious treatment when only the minor treatment is needed. There is no incentive to misrepresent in the other direction.

Following the recommendation stage if the patient accepts this recommendation, the doctor will fix the problem for the price he had quoted for that particular level of

[4] See Appendix I

treatment. If the patient does not accept the treatment she will visit the other doctor. It is assumed that, after the diagnosis but before treatment is agreed upon, the doctor is not yet committed to treat a patient. This means we can restrict attention to prices $p_s \geq c_s$ and $p_m \geq c_m$, as doctors would rather reject a patient than treat her at a price below cost. A patient incurs cost r per doctor that she samples, independently of whether or not she chooses to be treated by this doctor. This cost accounts for the time and effort incurred in going to a doctor. The utility to a patient who visited the two doctors is $B - p - 2r$ if she ended up being charged for the price p, and is $-2r$ if she was not treated. Patients are maximizers of expected utility. The reservation value B is assumed to be high enough so as to assure that participation is always desirable for patients. A doctors' profit is the sum of revenues minus costs over the patients he treated.

A pure strategy of the doctor in a recommendation subgame specifies whether he refuses to provide a treatment, charges p_s, or charges p_m, conditioned on the problem being $i, \mathit{for}\ i \in \{m,s\}$. A mixed strategy assigns probabilities of taking these actions, respectively denoted by $\rho_i, \beta_i,$ and $1 - \rho_{\mathrm{i}} - \beta_i$, conditioned on the problem being $i, \mathit{for}\ i \in \{m,s\}$. A pure strategy of the patient in the recommendation subgame specifies whether he accepts or rejects a recommended treatment at the price p_i, for $p_i \in \{\mathrm{p_m}, \mathrm{p_s}\}$. A mixed strategy assigns probabilities of accepting (γ_i) and rejecting $(1-\gamma_i)$ a treatment at the price p_i, for $p_i \in \{\mathrm{p_m}, \mathrm{p_s}\}$.

4. Result

The solution to this model consists of finding the optimal prices to charge for the serious problem. One doctor will charge a low price to treat the serious problem, while the other doctor will charge a higher price. Recalling that the patients are heterogeneous, a particular percentage value treatment more highly than the other. The intensity rationing rule stipulates that the patients who visit the lower price doctor are those who value his service the most. This would apply to lower income patients who are forced to look for the cheaper treatment. After ascertaining the equilibrium prices, a mixed strategy will be given.

4.1 Optimal price

If the doctors are competing via price, in a duopoly model, a period of price-undercutting can occur. Edgeworth suggested that there is a range over which price might fluctuate, which is dependent on the capacity.[5] Therefore the solution for the upper and lower bounds of the range has to be found[6]. The price at the bottom of the range is denoted as $\overline{p}_s$ while that at the top is $\hat{p}_s$. If one doctor chooses a price close to the bottom then the other doctor will be indifferent between charging this low price and raising the price. Indifference requires that the profit from charging the low price is equal to the profit from charging the high price i.e:

$$k\overline{p}_s - c(q) = (a - k - \hat{p}_s)\hat{p}_s - c(q) \tag{1}$$

[5] If Smith charged a price of zero, he can examine patients up to capacity k. This leaves Jones with a residual demand, and it would suit him to charge a monopoly price. After observing this Smith, can raise his price just under Jones' and a period of price cutting will follow.
[6] The solution for prices where the doctor is not faced with costs is shown in Appendix II.

In order to solve for the upper bound we have to differentiate the profit function of the high-priced doctor with respect to $\hat{p}_s$ and setting the derivative to zero.

$$\pi = a\hat{p}_s - k\hat{p}_s - \hat{p}_s^2 - c(q) \tag{2}$$

$$\frac{d\pi}{d\hat{p}_s} = a - k - 2\hat{p} + \frac{dc}{dq}\frac{\partial q}{\partial p} = 0 \tag{3}$$

$$a - k - 2\hat{p}_s + c' = 0 \tag{4}$$

$$\frac{a - k + c'}{2} = \hat{p}_s \tag{5}$$

Where c' is the marginal cost. In solving for the lower bound all that is required is to transpose equation (1) for $\bar{p}_s$ and making the relevant substitutions.

$$\bar{p}_s = \frac{1}{k}\left[(a - k - \hat{p}_s)\hat{p}_s - c(q) + c(q)\right] \tag{6}$$

$$\bar{p}_s = \frac{1}{k}\left[(a - k - \hat{p}_s)\hat{p}_s\right] \tag{7}$$

$$\bar{p}_s = \frac{1}{k}\left[a\left(\frac{a-k+c'}{2}\right) - k\left(\frac{a-k+c'}{2}\right) - \left(\frac{a-k+c'}{2}\right)\left(\frac{a-k+c'}{2}\right)\right] \tag{8}$$

$$\bar{p}_s = \frac{1}{k}\left(\frac{a^2 - k^2 - c'^2 - 2ak}{4}\right) \tag{9}$$

4.2 Mixed Strategies

The solution for the mixed strategies[7] follows closely that of Levitan and Schubik (1972) except that the profit function is adjusted to include costs. The number of patients

[7] The definition used in Levitan and Schubik (1972) is that a mixed strategy equilibrium is a pair of probability distributions over the respective strategy spaces with the property that for each player any strategy chosen with positive probability must be optimal against the other player's probability mixture.

seen by doctor Smith is a function of both prices:

$$\mathrm{x}_S = \begin{cases} \min(k, a - p_s^S) \text{ if } \; p_s^S < p_s^J \\ \max(0, \min(k, a - k - p_s^S) \text{ if } \; p_s^S > p_s^J \end{cases} \tag{10}$$

The expected number of patients is:

$$E(x_s^S) = (1 - \theta_J(p_s^S)) \min(k, a - p_s^S) + \theta_J(\mathrm{p}_s^S) \max(0, \min(k, a - k - p_s^S)) \tag{11}$$

Where $\theta_J(p)$ is the distribution function of the price of player Jones and p_s^S refers to the price charged by Smith. In reference to equation (10) if $p_s^S < p_s^J$ then a-p number of patients will demand his services. However due to his capacity constraint he is only able to examine k patients which is less than the demand of a-p. Therefore for $p_s^S < p_s^J$ the minimum number of patients he can see is k. On the other hand if $p_s^S > p_s^J$ then patients will prefer to visit Jones. After Jones has exhausted his capacity Smith will examine the remaining a-k-p number of patients. Given this information the profit function can be written as:

$$\Pi^S(p_s^S) = p_s^S[(1 - \theta_J(p_s^S))k + \theta_J(\mathrm{p}_s^S)(a - k - p_s^S)] - c(q) \tag{12}$$

Or

$$\frac{\Pi^S(p_s^S)}{p} = k - c(q) - \theta_J(p)[p + 2k - a] \tag{13}$$

Solving (13) for $\theta_J(p)$, we obtain:

$$\theta_J = \frac{k - c(q) - \pi_J / p}{p + 2k - a} \tag{14}$$

Appendix III shows the result of comparative statics that was done to see how this probability distribution changes with price. It is a positive value thus showing that as prices increase the probability assigned to charging such high prices also increases.

After evaluating the values of Π^S, p_s^S and p_s^J equation (14) gives the mixed strategy equilibrium. At the limit the low price doctor (Smith) will charge the lower bound price while the high price doctor (Jones) will charge the upper bound price. Recall that in calculating the optimal prices the assumption was made that the profit from charging the upper and lower bound prices was equal, therefore $\pi_S = \pi_J = k \cdot p$. This is an important assumption as if it is relaxed a period of price cutting may occur between the doctors. From equation (9) we calculated $\bar{p}_s = \frac{1}{k}\left(\frac{a^2 - k^2 - c'^2 - 2ak}{4}\right)$, therefore $\pi = \frac{1}{k} \cdot k\left(\frac{a^2 - k^2 - c'^2 - 2ak}{4}\right)$. We rewrite the profit function as: $\pi = \left(\frac{a^2 - k^2 - c'^2 - 2ak}{4}\right)$. Substituting into equation (14) we get the cumulative probability function:

$$\theta_J = \frac{p(k-c) - \left(\frac{a^2 - k^2 - c'^2 - 2ak}{4}\right)}{p(p + 2k - a)} \tag{15}$$

The cumulative distribution function gives the probability that the doctor charges a price less than or equal to p_i. Equation 15 assigns probabilities to varying prices and shows that this probability is dependent on price, the firm's capacity, cost and market demand.

5. Conclusion

There are limitations in using a two-by-two model to explain the fraudulent behaviour of experts. This paper therefore focused mainly on the behaviour of doctors and heterogeneous patients who suffer to varying degree from a serious medical problem. Given a duopoly market of doctors the patients are able to seek second opinions. The results show that it is the most intense patients who are charged a lower cost. Such individuals are the low income earners, who are forced to search for the lower costs. It is therefore the higher income group who are cheated and charged a higher price for treatment of the serious problem[8].

The implication is that low income patients who are in a duopoly market for doctors should search for the lower price doctor, thereby leaving those who can afford it to pay the higher priced doctor. This is beneficial to individuals living in developing countries which have high health care costs. The results also give the optimal low and high prices to be charged in mixed strategies by the doctor. The prices depend only on the doctor's capacity, market demand and the doctor's marginal cost.

[8] This result is contrary to Wolinsky (1993) whose results showed that the ability of customers to seek a second opinion eliminates cheating by experts. However this result is expected given that he used a competitive market structure, which is efficient compared to a duopoly market.

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Appendix I

Bertrand-Nash Equilibrium without Capacity Constraint

Players

Doctors Smith and Jones

Demand

$q = a - p_s$

Strategies

Smith: p_s^S

Jones: p_s^J

Without capacity constraint the unique Bertrand-Nash Equilibrium is $p_s^S = p_s^J = 0$

With capacity constraint this equilibrium no longer holds.

Case 1

If $p_s^S = p_s^J = 0$, Jones' best response is to raise price above zero. He retains most of his patients and earns positive profit. Deviation by Jones is therefore profitable.

Case 2

If $p_s^S = p_s^J > 0$, both doctors will have unused capacity and each has incentive to undercut the other by lowering price.

Case 3

If $p_s^S > p_s^J$, so long as p_s^J is less than the monopoly price, Jones would deviate to a price closer to but not exceeding p_s^S.

Appendix II

Optimal Prices without Cost

Indifference requires that the profit from charging the low price is equal to the profit from charging the high price i.e:

$$k\bar{p}_s = (a - k - \hat{p}_s)\hat{p}_s \tag{16}$$

In order to solve for the upper bound we have to differentiate the profit function of the high-priced doctor with respect to $\hat{p}_s$ and setting the derivative to zero.

$$\pi = a\hat{p}_s - k\hat{p}_s - \hat{p}_s^2 \tag{17}$$

$$\frac{d\pi}{d\hat{p}_s} = a - k - 2\hat{p} = 0 \tag{18}$$

$$a - k - 2\hat{p}_s = 0 \tag{19}$$

$$\frac{a-k}{2} = \hat{p}_s \tag{20}$$

In solving for the lower bound all that is required is to transpose equation (1) for $\bar{p}_s$ and making the relevant substitutions.

$$\bar{p}_s = \frac{1}{k}\left[(a - k - \hat{p}_s)\hat{p}_s\right] \tag{21}$$

$$\bar{p}_s = \frac{1}{k}\left[a\left(\frac{a-k}{2}\right) - k\left(\frac{a-k}{2}\right) - \left(\frac{a-k}{2}\right)\left(\frac{a-k}{2}\right)\right] \tag{22}$$

$$\bar{p}_s = \frac{1}{k}\left(\frac{a-k}{2}\right)^2 \tag{23}$$

Appendix III

Comparative Statics

In differentiating equation 14 with respect to price since the terms k and c in the numerator are not functions of price they can be excluded leaving:

$$\theta_J = \frac{-\pi_J / p}{p + 2k - a} \qquad \text{OR} \qquad (24)$$

$$\theta_J = -\pi_J p^{-1}(p + 2k - a)^{-1} \qquad (25)$$

$$\frac{\partial \theta_J}{\partial p} = \pi_J p^{-2}(p + 2k - a)^{-2} \qquad (26)$$

$$\frac{\partial \theta_J}{\partial p} = \frac{\pi_J}{p^2} \cdot (p + 2k - a)^2 \qquad (27)$$