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Credence Goods Monopolists

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Journal of Economic Literature Classification Numbers: D45, D82, L15.
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1. Introduction

The term credence goods refers to goods and services for which consumers never discover their need and their quality. Sellers not only provide the credence good, but they also act as experts determining the customers' requirements, simply because consumers are unfamiliar with good in question. This peculiarity, which often occurs in medical, legal, and financial advice services, as well as in a wide variety of repair professions, is aggravated by the following facts: typically, consumers never discover the veracity of a diagnosis, or even whether the treatments they authorized were really performed. Therefore, such services have been termed credence goods (Darby and Karni (1973)).

This asymmetry of information gives sellers several opportunities to exploit consumers. The seller may choose to take advantage of a buyer by recommending unnecessary expensive repairs—a problem which has been dubbed 'demand inducement' in the health economics literature. If, in contrast, other activities are more profitable, sellers may not perform urgently needed repairs. Since chances of consumers finding out about such fraudulent behavior are slim, how should they view the recommendations of an expert who has a vested interest in providing treatment?

To give a few anecdotes where fraud was covered up: In Switzerland patients with the minimum level of schooling are twice as likely to have their womb or gallstones removed than patients with a university degree; for hip-joint operations the probability is even 150% higher.[1)] Ordinary children are 80% more likely to have their tonsils out than children of medical doctors (**K**tip 05/22/1996). Perhaps a third of current health-care spending in the US goes on irrelevant tests, unproven procedures, and unnecessarily pricey drugs and devices (Economist 02/13/1999). Even in China overprescription is routine; hospitals use these profits to subsidize underfunded operations (Economist 11/07/1998). Further empirical evidence from the market for physician services suggests that fee-for-service doctors tend to overprescribe while salaried doctors tend to shirk (Gaynor (1994)). In the auto-repair business a survey of 62 automobile repair shops conducted by DOT found that 53% of the service charges were for needless repairs (New York Times 5/8/1979). Other examples include the life-insurance industry where a New York investigation found the sale of unsuitable policies, high-pressure selling, and unbridled sales expenses (Newsweek 2/7/1994), as well as the market for legal advice where the anecdotal evidence is perhaps best summarized by the joke of the longevity study which found that the average lawyer lives twice as long as the average school teacher: Life span for lawyers was computed using billing hours.

There are several mechanisms to discipline experts. One often mentioned mechanism is reputation. This mechanism requires 'watchdog agencies' to verify service quality and repeated relationships to penalize cheating experts. Another mechanism is the separation of diagnosis and treatment. For example, patients often see a general practitioner first and are then referred to a specialist.

This 'separation' mechanism is, however, ineffective when it is cheaper to provide diagnosis and repair jointly rather than separately. This is, e.g., the case for the choice and the execution of a legal defense or a taxicab route; fixing the gadget is cheaper when it is disassembled for diagnosis, rather than to put everything back together and repeat the process elsewhere for the actual repair. Evidently, such economies of scope between diagnosis and repair also make the related mechanism of calling upon a second opinion unattractive. There are also economies to the consumer in terms of time costs.

In this paper we analyze whether the market mechanism may solve the fraudulent expert problem when there are 1. one-shot relationships so that reputation cannot work for lack of punishment possibilities and 2. profound economies of scope between diagnosis and treatment: in our setup repair is possible only after diagnosis. If a customer were to choose the services of a second expert, he would incur the cost of a further diagnosis making the ‘separation’ as well as the ‘second opinion’ mechanisms unattractive.

For expositional convenience we consider a credence good monopolist.[2)] The analysis of the monopoly case enables us to highlight the incentive issues involved without obscuring the main points by strategic competition considerations. Our monopolist has to make a sunk investment in capacity before actually performing diagnosis and repair. This implies that the expert may have to ration her clientele due to insufficient capacity or that she may end up with idle capacity. The expert charges separate prices for diagnosis and repair.

Our results rest on the following basic reasoning. If there were no information asymmetry, welfare is maximized when the seller is honest and sets capacity to the level allowing her to satisfy the entire demand by means of non-fraudulent services. If in our setup with asymmetric information consumers infer the seller’s behavior from ex ante observations, the seller cannot gain by cheating: consumers will detect fraud beforehand and their willingness-to-pay is lower than if the seller were honest. Consequently, the best the seller can hope for is to appropriate the surplus generated by honest behavior. To achieve this, she has to persuade consumers of her non-fraudulent services.

We consider two signals, capacity and the pair of prices for diagnosis and repair. Whether or not both signals are necessary and sufficient to ensure honest behavior depends on whether or not consumers can observe the level of services carried out.

When the expert’s diagnosis and repair services are observable, buyers know how much diagnosis and repair they get, yet they have no idea how much they need. We start the analysis of this scenario with the case where consumers only observe prices. In equilibrium the expert picks the capacity level allowing her to serve the whole market with honest behavior. The expert charges per repair a price equal to its cost. This price gives the expert proper incentives concerning repair. Per diagnosis she charges a price enabling her to appropriate all gains from trade. Consequently, the equilibrium with observable services and unobservable capacity is efficient. One signal, prices, is sufficient when services are observable. Since observable capacity plays an important role later on, we briefly describe how the result changes when consumers observe in addition the second signal. Now the expert can commit herself to a certain capacity level to convince consumers of her honest repair policy. Not surprisingly, the expert picks the efficient capacity and the set of prices supporting non-fraudulent services expands.

Then we turn to the case in which the expert's diagnosis and repair services are unobservable so that consumers neither know how much service they need nor how much service they actually get. With unobservable services the expert has yet another possibility to cheat: She can charge for diagnoses and repairs she never performed. To give an example: The Association of Swiss Health Insurers reckons that 10% - 15% of the revenue of medical doctors and hospitals (800 million Swiss Francs per year) is generated by this kind of fraudulent billing policy (Sonntagszeitung 12/13/1998). Here we start with the case of observable capacity and prices. In equilibrium the expert charges each customer for a diagnosis *and* a repair. She commits herself to the capacity level allowing her to efficiently serve the market: there is nothing she can do with this capacity but to provide honest services. Accordingly, in equilibrium the expert overcharges but provides efficient service. Finally, we consider the case where services and capacity are unobservable. Here the market mechanism no longer solves the fraudulent expert problem. The expert charges each customer and at the same time provides no service. Consumers anticipate this and do not consult the expert in the first place.

There is a small theoretical literature on credence goods. In a classic article Darby and Karni (1973) introduce the term credence good and discuss how reputation combined with market conditions and technological factors affect the amount of fraud. Pitchik and Schotter (1987) describe a mixed-strategy equilibrium. While the expert randomizes between either reporting truthfully or not, the customer randomizes between acceptance and rejection of a treatment recommendation. Wolinsky (1993) analyzes the multiple opinion mechanism. His equilibrium is characterized by too much search. Consumers go first to experts committed to diagnosis only and are then referred to the other experts where they get a second diagnosis and the actual repair. Taylor (1995) considers experts who may recommend unnecessary treatments. His experts never diagnose a product as healthy; ex post contracting, free diagnostic checks, consumer procrastination in obtaining checkups, and long-term maintenance agreements may occur in Taylor's equilibria.

The major difference between the paper at hand and Pitchik and Schotter (1987), Wolinsky (1993), and Taylor (1995) is that they all (implicitly) assume unnecessary repairs to be costless whereas our expert needs resources for unnecessary treatments. This implies that overtreatment is always profitable in their setup. In contrast, the profitability of overtreatment in our model depends on demand conditions and is determined endogenously. Moreover, they assume the problem of undertreatment away while we solve both, the problems of over- and undertreatment simultaneously.

Closest to the paper at hand is our paper (Emons (1997)). There we consider experts engaging in Bertrand-Edgeworth competition. We show that a market equilibrium exists in which experts are honest and all the surplus goes to consumers. While the first paper deals only with the case of observable services together with observable capacity (and prices), here we consider different scenarios: observable services and unobservable capacity, unobservable services and observable capacity, and unobservable services and unobservable capacity. The two papers are related in their basic result: if consumers rationally process ex ante information, the market mechanism can solve the fraudulent expert problem. Experts are honest in order to maximize the consumers' surplus. In the competitive setup honesty is necessary in order to survive; in the monopoly case non-fraudulent service generates the highest profit for the credence goods monopolist. The papers are complements: while the first paper shows for one informational scenario that a competitive market can solve the fraudulent expert problem, this paper shows that competition is not necessary and, more importantly, checks the robustness of this result concerning the amount of observable signals.[3)]

The remainder of the paper is organized as follows. In section 2. we analyze observable services. Section 2.1. contains the basic model. Section 2.2. deals with unobservable capacity; in section 2.3. we briefly describe observable capacity. Section 3. is about unobservable services. After describing the model, in section 3.2. we analyze observable and in section 3.3. unobservable capacity. Section 4. concludes. Proofs are relegated to the Appendix.

2. Observable Expert Services

2.1. The Model

We consider a durable good that is up for diagnosis and potential repair. The good has a remaining capacity which we normalize to 1 monetary unit. During its remaining life, our 'one-hoss shay type' durable either makes available total remaining services 1 or delivers services 0.

The product can be either in good or in bad shape. If the product is in good condition, it makes available services 1 with probability $q_h \in (0, 1)$; when it is in bad shape, the corresponding probability is q_ℓ with $0 < q_\ell < q_h$. In both cases the product may fail but it is more likely to do so when it is in bad shape. Let p denote the probability that the product is in bad shape. The consumer does not know in which of the two conditions his product is, nor can he infer this ex post since both types may break down.

By diagnosing the product the expert identifies its true condition. When the product is in bad condition, the expert can fix it so that it is in good shape afterwards. A repair is possible only after diagnosis. The expert makes a prior sunk capacity decision choosing $L \geq 0$ units capacity, say hours of time. Since we normalize the expert's reservation wage to 1, L also measures the expert's sunk cost. The capacity L can only be allocated between diagnosis and repair: d is the time an expert needs per diagnosis and r the time per repair; given our normalization, d and r also measure the minimum average costs of diagnosis and repair. With non-fraudulent behavior, the expert's capacity L in units of time translates into the capacity $L/(d + pr)$ in terms of customers.

Consumers are risk neutral and care only about monetary flows. The maximum surplus the expert's services generate is $W := p(q_h - q_\ell) - (d + pr)$, where the first term is the expected benefit from diagnosing and repairing the product and the second term is the associated cost. Throughout the paper we will assume $W \geq 0$.

After diagnosis the expert knows the condition of the product. When the product is in bad shape, she can repair it. Yet she can also 'repair' a good product meaning that she unnecessarily works r units of time on the product—leaving it at least in good shape. Similarly, when the product is in good or bad condition, the expert can recommend not to fix it. Ex post the consumer has no way of finding out whether the expert cheated. The only possibility for the consumer not to be defrauded is to infer the expert's incentives from the ex ante observable signals prices and/or capacity.[4)]

The expert picks prices $(D, R) \geq 0$ that she charges for diagnosis and repair. Moreover, she chooses a repair policy conditional on the product's condition. This policy is given by the probability of repair. Let α denote the probability of repair given that the product is in good shape and β the probability of treatment if the product is in bad shape. These two conditional probabilities determine the unconditional ex ante probability of repair $\gamma = (1 - p)\alpha + p\beta$.

Let $\eta \in \{0, 1\}$ denote the probability that a consumer goes to the expert. Then a consumer's utility is given by

$$U = \begin{cases} (1 - p)q_h + pq_\ell, & \text{if } \eta = 0; \\ (1 - p(1 - \beta))q_h + p(1 - \beta)q_\ell - D - \gamma R, & \text{if } \eta = 1. \end{cases}$$

If $\eta = 0$, the consumer ends up with the reservation utility. If $\eta = 1$, the probability of having a good product increases and, at the same time, the probability of having a bad product decreases by $p\beta$. The consumer pays for a diagnosis in any case; with probability $\gamma \geq p\beta$ he is charged for a repair.

We distinguish three scenarios. If $\alpha = 0$ and $\beta = 1$, we have *efficient repair*: the expert fixes all bad and no good products. If $\alpha > 0$ and $\beta = 1$, we have *too much repair*: the expert not only fixes all bad but also good products. Finally, if $\alpha = 0$ and $\beta < 1$, we have *too little repair*: the expert fixes no good and not all bad products. As can be easily checked, consumers prefer efficient to too little/too much repair. If the expert is indifferent between honest and fraudulent behavior, she behaves honestly. Note that the expert's repair policy defines her capacity in terms of customers $L/(d + \gamma r)$.[4)]

There is a continuum of identical consumers with total mass 1.[6)] Accordingly, η also measures the expert's clientele. If $\eta \leq L/(d + \gamma r)$, the expert has enough capacity to treat her entire clientele with her repair policy; otherwise, she rations her customers. The number of customers treated by the expert is thus $\min\{\eta; L/(d + \gamma r)\}$; her expected profit amounts to $\min\{\eta; L/(d + \gamma r)\}(D + \gamma R) - L$. The specification of the game depends on whether or not consumers observe the expert's capacity choice. We will present the two different formulations, the solution concept, and the analyses in the following two subsections.

2.2. Unobservable Capacity

We model unobservable capacity with the following three stage game. In stage one the expert chooses D and R. In stage two consumers observe these prices and have beliefs about the repair policy and the capacity. According to these beliefs consumers evaluate the expected utility with the expert and pick $\eta \in \{0, 1\}$ so as to maximize expected utility. In the third stage the expert observes the consumers' decisions and picks her repair policy α, β and her capacity L so as to maximize her expected profits. We confine our attention to symmetric consumer strategies. We focus on subgame perfect equilibria. This game has a unique equilibrium in which the expert efficiently serves the whole market and appropriates the surplus W.

Proposition 1: *In the unique subgame perfect equilibrium in stage one the expert charges $D = p(q_h - q_\ell) - pr$ and $R = r$. In stage two consumers believe that $\alpha = 0$, $\beta = 1$, $L = d + pr$, and choose $\eta = 1$. In stage three the expert picks $\alpha = 0$, $\beta = 1$, and $L = d + pr$.*

This result is driven by the following ideas. Surplus is maximized by non-fraudulent repair. For honest services the consumer is willing to pay up to $R = q_h - q_\ell - D/p$. In order to extract this rent, the expert has to persuade consumers of her honesty. If $R > (<) r$, the expert will choose excessive (insufficient) capacity along with the corresponding fraudulent repair policy, i.e., she will repair everything (nothing). Only by charging $R = r$, is she indifferent between repair and the outside job and thus installs the efficient capacity and repairs honestly. She sets $D = p(q_h - q_\ell) - pr$ so as to extract the rent W.

2.3. Observable Capacity

Let us now briefly look at the case of observable capacity. This scenario is important when we look next at unobservable expert services. Since the result follows from Emons (1997) when experts are on the short side of the market, we give no formal proof.

When consumers observe the capacity choice, the expert can commit herself to a certain capacity level. This in turn may induce a repair policy that the expert would not have chosen had the capacity level been different. Accordingly, observable capacity is a tool that may help to convince consumers of the expert's honesty. We formulate these ideas by changing our game as follows. In the first stage the expert picks prices (D, R) *as well as* capacity L. In the second stage a consumer observes (D, R, L) and chooses η. In the third stage the expert picks her repair policy α and β.

Proposition 2: *In a subgame perfect equilibrium in stage one the expert sets* $L = (d + pr)$. *Furthermore, she charges prices* $D \in [dw; p(q_h - q_\ell)]$ *and* $R = q_h - q_\ell - D/p$ *where* $w := p(q_h - q_\ell)/(d + pr)$. *In stage two consumers believe that* $\alpha = 0$, $\beta = 1$, *and choose* $\eta = 1$. *In stage three the expert picks* $\alpha = 0$ *and* $\beta = 1$.

The equilibrium capacity is tied down uniquely at the level where the expert can just serve the whole market non-fraudulently. She repairs honestly and appropriates the entire surplus W. The set of prices supporting non-fraudulent behavior expands compared to section 2.2. Any pair of prices such that the returns to repair doesn't exceed the returns to diagnosis will induce honesty. These prices may give an incentive to diagnose more at the expense of repairs. This is, however, impossible because the expert checks already the whole market. In particular, prices equalizing the returns give proper incentives—the equal compensation principle of the principal-agent literature.

3. Unobservable Expert Services

So far we have assumed that diagnosis and repair are observable and verifiable. This assumption is appropriate for, say, dentists whose customers suffer any (un-) necessary drilling. It is however inappropriate for a customer sending his notebook to the service-center and getting it back without being able to tell whether a technician has actually worked on the computer. With unobservable services the expert has yet another possibility to defraud her customers: She can claim to have checked and fixed the computer without even having looked at it, thus collecting service fees from an unlimited number of customers.

3.1 The Model

Our previous model is easily extended to cope with unobservable services. First, we introduce a diagnosis policy which we capture by the probability of diagnosis $\delta \in [0,1]$. Since a repair is possible only after a diagnosis, the ex ante probability of repair has to be modified to $\delta\gamma$. If the expert is indifferent between working and not working, she works; if she is indifferent between underdiagnosis and underrepair, she diagnoses too little but efficiently repairs all products she has a look at. The expert's billing policy is denoted by $\Delta,\ \Gamma \in [0,1]$, the probabilities that she charges for a diagnosis or a repair. Since consumers cannot observe the expert's services, her billing policy is independent of her actual diagnosis and repair policies. Nevertheless, since consumers know that repair is possible only after diagnosis, $\Delta \geq \Gamma$.

3.2. Observable Capacity

Here we start with the case where consumers observe the expert's capacity. Observable capacity turns out to be such a strong commitment device that in equilibrium the expert provides efficient diagnosis and repair; yet, unless the repair fee is zero, she overcharges. We consider the following game. In stage one the expert chooses (D, R, L). In stage two consumers observe these choices. They have beliefs about the diagnosis, repair, and billing policies. According to these beliefs consumers evaluate the expected utility with the expert and pick η. In stage three the expert chooses $(\delta, \alpha, \beta, \Delta, \Gamma)$.

Proposition 3: *In a subgame perfect equilibrium in stage one the expert sets $L = (d+pr)$. Furthermore, she charges $D \in [0, p(q_h - q_\ell)]$ and $R = p(q_h - q_\ell) - D$. In stage two consumers believe that $\delta = 1,\ \alpha = 0,\ \beta = 1,\ \Delta = 1,\ \Gamma = 1$, and choose $\eta = 1$. In stage three the expert picks $\delta = 1,\ \alpha = 0,\ \beta = 1,\ \Delta = 1$, and $\Gamma = 1$.*

Since consumers cannot observe the expert's services, her billing policy is independent of her actual diagnosis and repair policy. It is, therefore, a (weakly) dominant strategy to charge each customer for a diagnosis and repair. If the expert has positive capacity, there is nothing she can do with it but to diagnose and repair. Thus, if with honest services the number of customers does not exceed her capacity, the expert diagnoses and repairs efficiently. If, on the other hand, she has more customers than she can handle with honest services, only a fraction of her clientele gets treatment.

With honest services the consumers' willingness-to-pay is $p(q_h - q_\ell)$. Accordingly, if the expert has capacity $L \geq (d + pr)$ and charges prices such that $D+R \leq p(q_h - q_\ell)$, consumers are happy and consult the expert. The consumers' willingness-to-pay is lower if $L < (d + pr)$ because they do not get treatment for sure. Finally, if the expert sets $L = (d + pr)$ and charges prices such that $D + R = p(q_h - q_\ell)$, she appropriates the entire surplus W.[7)]

3.3. Unobservable Capacity

Let us now briefly consider the case of unobservable capacity. To do so we change the game of section 3.2. as follows: The expert chooses capacity in stage 3 instead of stage 1; in stage 2 consumers have beliefs about this capacity choice. It is straightforward to see that in any equilibrium of this game the expert has zero capacity and, accordingly, provides no services. Whatever the prices and the number of customers, in stage 3 it is a dominant strategy for the expert to charge each customer for a diagnosis and a repair, ii) to set capacity to zero, and iii) to diagnose and repair nothing. A positive capacity level would increase costs without generating additional revenue.

With unobservable capacity the expert will thus always pick $L = 0$. Since consumers anticipate this behavior, they will not consult the expert in the first place so that we have no trade. Consequently, if services and capacity are unobservable, the market mechanism cannot solve the fraudulent expert problem.

4. Discussion and Conclusions

We have analyzed a credence good provided by an expert. If consumers rationally process all the information about market conditions, they can infer the seller's incentives: In three out of four constellations the market does indeed solve the fraudulent expert problem. Only when services and capacity are unobservable do we end up with no-trade.

A few more remarks seem to be in order. First note that the possibility of charging separate prices for diagnosis and repair is crucial for our results. If we restrict the price of diagnosis to be zero and allow only the repair fee to be positive, as is common practice at full-repair shops in the US, our model makes the following predictions: With observable services and capacity there is always overtreatment because repair is (infinitely) more profitable than diagnosis. With observable services and unobservable capacity the price of a repair must exceed its average cost to cover the free diagnosis; but then repair is also more profitable than the outside job and the expert will overtreat. Only when services are unobservable and capacity is observable there exists an equilibrium with free diagnosis and non-fraudulent services. In this scenario capacity alone serves as an incentive device and efficient services go along with a whole range of prices, including the pricing policy of American full-repair shops.

Closely related is our second remark. Our expert commits to prices. The scenario in which the expert cannot commit to the repair price can easily be analyzed in our framework: With the bad news that the product needs repair, the expert announces the repair price. Then the consumer decides whether or not to accept. The expert will always suggest repair and charge consumers their reservation price given this fraudulent recommendation $R = p(q_h - q_\ell)$; this price is independent of the price for the diagnosis which is sunk at this stage. Consumers anticipate this and are only willing to see the expert if diagnosis is free. The corresponding repair policies follow from the preceding paragraph.

Third, when services are observable, consumers need not observe capacity to infer the expert's incentives (though observable capacity does not hurt). The price mechanism is thus sufficient. In contrast, when services are not observable, the price mechanism alone can no longer solve the fraudulent expert problem; here consumers must observe prices *and* capacity.

Fourth, note that the positive result of Proposition 3 depends crucially on our assumption of zero variable costs up to capacity: once capacity is installed, there is nothing the expert can do with it but work honestly. In contrast, if there were positive variable costs of repair, the expert might try to slash these costs by undertreatment. The most obvious example for our cost structure is the small, owner-operated firm. Our model may thus help to explain why many credence goods are provided by owner-operated firms. If services are provided by employees, the prediction depends on whether wages constitute a variable cost or not. If wages are a fixed cost in the short run, our cost structure is a reasonable approximation of a firm with employees; if, however, wages are a variable cost, capacity alone can no longer induce the seller to provide efficient services. In such a situation partnerships might be an attempt to mimic the cost structure necessary for capacity to work as a commitment device.

Our next remarks concern the interpretation of capacity. A legal practice of two lawyers has (approximately) double the capacity of a one-woman-firm. A plumber with 20 employees has a much higher capacity than her colleague working with an apprentice only. If capacity is, say, an X-ray machine (the opportunity cost of which is its price), even an ordinary patient has an idea whether this machine can handle 5 or 50 patients a day. The important ratio clientele/capacity may be proxied simply by how crowded the shop typically is.

Empirical tests of the theory are extremely difficult due to the very nature of the problem: it is fraud that we are looking for. Nevertheless, Marty (1998) shows using 8000 bills of Swiss general practitioners that busy doctors charge significantly less per patient than doctors with insufficient demand, indicating that there is indeed demand inducement. Keeler and Fok (1996) study the impact of an insurance reform in California that, after higher reimbursements for cesarean deliveries, equalized fees for vaginal and cesarean delivery, a relative price shift of 21%. They found a 0.7% nonsignificant drop of cesarean rates. This result, which doesn't appear consistent with Proposition 2, can be explained by other incentive devices such as medical malpractice suits which certainly discipline medical doctors in California. Interestingly enough, despite their empirical result Keeler and Fok (1996) recommend the equalization of fees as called for by Proposition 2 'because it need not hurt providers and may improve patient trust'.

In a simple framework we were able to work out conditions under which the market mechanism can solve the fraudulent expert problem. For a lot of skilled trades offering services of credence quality the market mechanism actually seems to do a fairly good job just as our model predicts; at least we couldn't find any anecdotes of, say, cheating plumbers, electricians, or cobblers.[8)] In other professions, as the examples in the Introduction suggest, there is, however, fraud. The majority of these examples is from the medical profession where the market certainly does not operate in such an unhampered way as is assumed in our model; prices are often set by a regulator rather than the seller, insurers pay for the services, distorting consumers' incentives to gather and process the necessary information, etc. Accordingly, these examples of fraud do not contradict our analysis. Perhaps our results may help to find out what goes wrong in these professions so that better mechanism can be designed to induce honest services. Since expert services are often subject to licensing and regulation, a more thorough understanding of these markets will be helpful for public policy purposes. For credence goods sellers the following strategy recommendations follow from our analysis: With the cost structure given in the paper it is possible to convince rational consumers of the quality of your services and to make a lot of money. Therefore, try to mimic this cost structure by setting up, e.g., a partnership; moreover, try to commit to a sunk capacity, in particular if your services are unobservable

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Endnotes

1) The higher operation probabilities could of course to some extent be due to the fact that the less educated tend to be less healthy.

2) We do not need a monopolist in the market structure sense. High information and search costs to consumers, which do definitely exist with credence goods, often provide a source of imperfect competition. An example is Chadwick's analysis of funeral provisions in England in the 19th century, when there were about 600-700 undertakers in London to provide 120 funerals per day. Chadwick argues that supply-side competitiveness was thwarted by demand-side characteristics such as high search costs and led to monopoly-like conditions over each funeral service; see, e.g., Ekelund and Hébert (1997, p. 217-218). Moreover, note that since we deal with a credence goods monopolist, the 'separation' and the 'second opinion' mechanisms described in the preceding paragraph cannot work simply for lack of a second expert.

3) Other related theoretical papers include Milgrom and Roberts (1986), Demski and Sappington (1987), Glazer and McGuire (1991), Pitchik and Schotter (1993), Dana and Spier (1993), Wolinsky (1995), Dulleck (1998), Pesendorfer and Wolinsky (1998), and Emons (1999). For an experimental study mimicking a market for expertise, see Plott and Wilde (1982). There is also a small empirical literature on credence goods. Ekelund et al. (1995) and Mixon (1995) show that sellers of credence goods provide more informational cues such as certification and licensing in the *Yellow Pages* than do sellers of search goods.

4) The fraudulent expert problem may disappear if consumers were to purchase long term insurance contracts that fully cover all repairs *and* forgone services during the entire product life; such covenants are commonly known as service or health maintenance plans. With these contracts experts have correct incentives since they bear all marginal costs. The problem of too little repair may be solved by a short term warranty for lost services: if the product fails, the expert pays the consumer a sufficiently large amount of money. Yet, warranties as well as maintenance plans easily fail to do the job when there is consumer moral hazard; see, e.g., Emons (1988, 1989).

5) If the consumer is indifferent between consulting and not consulting the expert, he opts for $\eta = 1$. If a consumer is rationed by the expert, he ends up with his reservation utility.

6) We make the continuum assumption not only for notational convenience. With a finite number of consumers we run into the following problem. Suppose the expert expects a clientele with $(1 - p)$ good and p bad products. With a finite number of customers, however, the actual realization of her clientele will be different from the expected one. Accordingly, at the end of the day she will realize that she has either too little or excess capacity and she will start behaving fraudulently (suggesting that it is

better to see an expert in the morning rather than late afternoon). With a continuum of customers we do not encounter this difficulty. Yet, if a finite number of customers is modelled appropriately, our qualitative results still hold in expectation. Moreover, note that if L measures capacity per year, say, finiteness is less of a problem than if L is capacity per day because the number of customers is larger.

7) If $D = p(q_h - q_\ell)$ and $R = 0$, trivially any $\Gamma \in [0, 1]$ is optimal for the expert. She may thus set $\Gamma = p$ so that in this particular equilibrium she does not overcharge. Our result is related to Taylor's (1995) insurance result in that only needed repairs are performed, and consumers pay the ex ante expected surplus. Taylor assumes warranties to induce performance, we use indifference which the seller creates herself by her capacity choice.

8) See also Plott and Wilde (1982, p. 99) who were 'amazed' by how well the market did in their experiments. They conclude that markets as social control devices cannot be dismissed a priori.

Appendix

Proof of Proposition 1: We solve the game by backwards induction.

Stage 3) Given D, R, η, the triple (L, α, β) generates profits $\min\{L/(d+\gamma r); \eta\}[D+\gamma R]-L$. If $(D+\gamma R)/(d+\gamma r) < 1$, the alternative job is more attractive and the expert sets $L = 0$; if the inequality is reversed, the expertise business is more attractive and the expert sets $L = \eta[d+\gamma r]$ so as to satisfy the entire demand. A capacity in excess of demand is a waste of money. Next we determine the expert's optimal repair policy. If $R < r$, repair does not cover minimum average cost and the expert sets $\alpha = \beta = \gamma = 0$. If $R = r$, price equals minimum average costs. The expert is indifferent and sets $\alpha = 0,\ \beta = 1$, and thus $\gamma = p$ so that she repairs efficiently. If $R > r$, the expert sets $\alpha = \beta = \gamma = 1$ because repair is more profitable than the outside job.

Stage 2) If the prices are such that $L = 0$, consumers set $\eta = 0$. Now consider those prices with $L = \eta[d+\gamma r]$ so that the entire demand is satisfied. If $R \geq r$, which implies $\gamma \in \{p, 1\}$, the consumer's expected utility amounts to $q_h - D - \gamma R$. The consumer buys, i.e., sets $\eta = 1$, if prices do not exceed $R = [p(q_h - q_\ell) - D]/\gamma$. For $R < r$ and thus $\gamma = 0$ the consumer's utility is $\bar{U} - D$. He purchases if and only if $D = 0$.

Stage 1) Prices with $R < r$ give rise to zero profits. If for $R \geq r$ the expert charges the maximum prices $R = [p(q_h - q_\ell) - D]/\gamma$, she makes revenue $p(q_h - q_\ell)$. For $R = r$ the expert generates this revenue with capacity $L = d + pr$ while for $R > r$ she needs capacity $L = d + r$. Consequently, the expert maximizes her profits by charging $D = p(q_h - q_\ell) - pr$ and $R = r$. Q.E.D.

Proof of Proposition 2: We solve the game by backwards induction.

Stage 3) Given (D, R, L, η), the policies $(\delta, \alpha, \beta, \Delta, \Gamma)$ generate profits $\min\{L/\delta(d+\gamma r); \eta\}\cdot\ [\Delta D + \Gamma R] - L$. Independently of (δ, α, β), the billing policy $\Delta = \Gamma = 1$ maximizes profits. These choices are unique unless L, η, D, and/or R is zero. Then any Δ and/or $\Gamma \in [0, 1]$ is optimal. Let us now determine the optimal diagnosis and repair policy. If $\eta > L/(d + pr)$, the expert has more customers than she can handle with honest services. She sets $\delta = L/\eta(d+pr) < 1$ and $\alpha = 0$ and $\beta = 1$. If $\eta \leq L/(d+pr)$, with honest services the expert has at least as much capacity as customers. She sets $\delta = 1, \alpha = 0, \beta = 1$; overcapacity idles.

Stage 2) If $1 \leq L/(d + pr)$, a customer gets honest services but is overcharged. His utility is thus $q_h - D - R$. The consumer buys, i.e., sets $\eta = 1$, if $D + R \leq p(q_h - q_\ell)$. If $1 > L/(d + pr)$, the expert undertreats and overcharges. A consumer's utility is $q_h - (1 - \delta)p(q_h - q_\ell) - D - R$. The consumer buys if $\delta p(q_h - q_\ell) \geq D + R$.

Stage 1) If the expert sets $L \geq (d + pr)$ and charges reservation prices $D + R = p(q_h - q_\ell)$, $\eta = 1$ and the expert's profit is $p(q_h - q_\ell) - L$. By setting $L = (d + pr)$ the expert maximizes this profit and appropriates the entire surplus W. If she picks

$L < (d + pr)$ and charges the corresponding reservation prices $D + R = \delta p(q_h - q_\ell)$, $\eta = 1$ and her profit amounts to $\delta p(q_h - q_\ell) - L = \delta[p(q_h - q_\ell) - (d+pr)] < W$. Q.E.D.

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