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On the role of verifiability and commitment in credence goods markets

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ABSTRACT

A client has a problem, but does not know whether it is serious or minor. She consults an expert who can correctly diagnose and fix her problem. This paper characterizes the equilibrium pricing and recommendation strategies of an expert under the assumptions that i) the type of treatment is verifiable by the client, ii) the client has the option of rejecting any treatment recommendation, and iii) the expert is not liable for the outcome of the treatment. It is found, for any parameter configuration, that there exist equilibria in which the expert makes fraudulent recommendations resulting in inefficient treatment. The market outcome is compared with that under an alternative market environment in which the expert is liable for treatment outcome but the type of treatment performed is non-verifiable. It is shown that for some parameter configurations the equilibrium is more efficient when liability is in place than when the treatment is verifiable. These findings stand in sharp contrast to the received wisdom that the market outcome under verifiability of treatment is efficient while the market outcome under liability for outcome is not. Finally, this paper shows that the existence of some honest experts may induce more fraudulent behavior by opportunistic experts.

1. Introduction

Clients often have less information about the type of goods or services they require than the expert who provides them. In addition, even after the good or service is provided the client may not know whether it was appropriate. Goods or services with these characteristics are known as credence goods and are common in professional services markets. For example, a patient has limited information about her illness and relies upon a physician for diagnosis and treatment. The patient can verify whether the recommended treatment is performed but may lack the expertise to tell whether it is appropriate or necessary. A similar problem arises when a client relies on a mechanic to fix her car or when she needs a tradesperson to repair her house.

The literature on credence goods has taken two directions. The first assumes that the type of the goods or services provided is observable and verifiable, but the outcome is not, so experts cannot be held accountable for an unresolved problem. This assumption is termed *Verifiability* by Dulleck and Kerschbamer (2006).[4] Under the *Verifiability* assumption, an expert may provide goods or services which are either insufficient to fix the serious problem or unnecessary to fix the minor problem. The former is called Undertreatment and the latter is called Overtreatment in the literature (Dulleck and Kerschbamer, 2006; Emons, 1997, 2001), and both result in inefficiency. To illustrate the potential informational problem due to a lack of liability under the *Verifiability* setting, we continue with the examples above. A patient observes being prescribed a drug for a heart problem but does not know if surgery was required to treat the problem; a car owner observes that the radiator was replaced but does not know if replacing the thermostat would have stopped any overheating; the homeowner observes that the entire roof was replaced but does not know if repairing one small section would have stopped it from leaking.

The second direction assumes that the expert is liable to fix the client's problem once the good or service is accepted, but the type of good or service provided is unobservable or non-verifiable (Dulleck and Kerschbamer, 2006; Pitchik and Schotter, 1987; Wolinsky, 1993; Fong, 2005; Liu, 2011). This assumption is termed *Liability* in the literature. Under the *Liability* assumption, the expert may exaggerate the client's problem and recommend a major treatment or repair, but only performs a minor treatment or repair. To illustrate the informational problem due to lack of *Verifiability* under the *Liability* setting, consider the following situations. A car owner's check engine light is on and it is recommended by a mechanic to replace all engine sensors. After the repair, the car owner knows that the problem is fixed but it is difficult to tell whether the mechanic actually replaced the engine sensors. The mechanic may have solved

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[3] I worked on this paper while visiting the Schools of Economics and Finance at ESSEC Business School, France. I thank them for their hospitality.
[4] Alger and Salanie (2006) study the interesting case of partial verifiability.

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the problem by simply tightening a loose gas cap and so the client has been overcharged. Similarly, a homeowner observes that their electrical system is working after an expensive repair but does not observe what repairs were actually performed and cannot tell whether she has been overcharged.

Where *Verifiability* is assumed, the literature also usually assumes that the client commits to accepting the recommended treatment before the expert diagnoses the client's problem. This is termed the *Commitment* assumption by Dulleck and Kerschbamer (2006). Under the *Verifiability* and *Commitment* assumptions, the equilibrium is efficient and the expert makes honest recommendations. Although *Commitment* is a reasonable assumption in some circumstances, in many, if not most, real-life situations, the client has the option to reject a treatment recommendation, that is, there is *No-Commitment*.

The first contribution of this paper is to fully characterize the expert's equilibrium pricing and recommendation strategies under the assumptions of *Verifiability* and *No-Commitment*. This analysis is conducted under the assumptions that the cost of fixing the serious problem is greater than the cost of fixing the minor problem, and that the client's loss from the serious problem is at least as large as the loss from the minor problem. The first assumption is standard and the latter assumption is a substantial generalization of the assumption in Dulleck and Kerschbamer (2006) that the losses from the serious and minor problems are equal.

With the *Verifiability* and *No-Commitment* assumptions, it is found that for any parameter configuration, there exist equilibria which involve undertreatment or overtreatment. Specifically, both full undertreatment and partial undertreatment can arise in equilibrium. In the former, the expert always recommends the minor treatment irrespective of the client's problem. In the latter, the expert recommends the minor treatment with a positive probability less than one when the client's problem is serious and with probability one when the client's problem is minor. Full overtreatment and partial overtreatment are defined analogously and both can arise in equilibrium.

When the surplus of the serious problem is greater than (less than) that of the minor problem and the serious (minor) problem is sufficiently likely, the highest profit is achieved by the equilibrium involving full overtreatment (undertreatment). On the other hand, if the surplus of the serious problem is greater than (less than) that of the minor problem and the minor (serious) problem is sufficiently likely, the highest profit is achieved by the equilibrium involving partial overtreatment (undertreatment) or the equilibrium involving honest and efficient treatment.

The finding that overtreatment and undertreatment can arise under the *Verifiability* assumption, and for certain parameter ranges lead to the highest possible profit, stands in sharp contrast with the finding in the literature, according to which, under the *Verifiability* assumption, the expert is fully honest unless there is heterogeneity among consumers or diagnosis is costly (Dulleck and Kerschbamer, 2006, 2009). This new finding complements that in the literature and provides a better understanding of the *Verifiability* setting, as well as highlighting the importance of the *Commitment* assumption in this setting. When the client is committed to accept any treatment recommendations, the expert will post a price pair specifying equal mark-ups for both treatments. In addition, the profit-maximizing prices will yield the client a negative surplus from one treatment and a positive surplus from the other, rendering her just indifferent between visiting and not visiting the expert. Since the expert can fully extract the client's surplus from treatment ex ante, he has the incentive to implement the efficient treatment. In contrast, when the client has the freedom to reject treatment recommendations, the expert is constrained to recommend prices which yield the client a nonnegative surplus for each treatment. As a result, the expert faces a trade-off between efficiency maximization and rent extraction which results in inefficient treatment for some parameter range.

These results on overtreatment and undertreatment are more in keeping with certain empirical findings than the efficiency results of the existing theoretical literature. In health economics, supplier induced demand, overtreatment of minor illnesses, is a well-documented problem (Dranove, 1988; McGuire, 2000; Currie et al., 2011), while in a field experiment, Schneider (2012) found that undertreatment was very common among car mechanics.

The second contribution of this paper is to systematically compare the market outcomes under the *Liability* and *Verifiability* assumptions. Each of these commonly adopted assumptions capture relevant real-life situations and have very different implications. The literature found that under the assumptions of *Verifiability* and *Commitment*, honest recommendation and efficient treatment arise in equilibrium and are achieved by a pair of prices with equal mark-ups. By contrast, when *Liability* and *No-Commitment* are assumed, honest recommendation and efficient treatment cannot be jointly achieved (Wolinsky, 1993; Fong, 2005).

It is difficult to make a comparison between the market outcomes under the *Liability* and *Verifiability* assumptions based on the existing literature because the *Liability* assumption has been paired with the *No-Commitment* assumption while the *Verifiability* assumption has been paired with the *Commitment* assumption. It is not clear whether the differences in the implications of these two branches of the literature are the result of assuming *Liability* rather than *Verifiability* or the result of assuming *Commitment* rather than *No-Commitment*. As this paper pairs *Verifiability* with *No -Commitment*, a controlled comparison between the *Liability* and *Verifiability* assumptions is possible.

It is shown that under the *Liability* assumption the market outcome is more efficient and expert recommendations are more honest than under the *Verifiability* assumption when the problem associated with the greater surplus occurs with a large probability. In contrast, the market outcome is more efficient and expert recommendations are more honest under the *Verifiability* than under the *Liability* assumption when the problem associated with the greater surplus occurs with a small probability. Therefore, this paper provides a cautionary counterpoint to the received wisdom that the market outcome under *Verifiability* is unambiguously superior to that under *Liability* both in terms of efficiency and honesty (Dulleck and Kerschbamer, 2006, 2009).

Finally, given that undertreatment and overtreatment can be pervasive in models which assume *Verifiability* and *No-Commitment*, this paper also examines the role of honest experts in changing the range of parameters over which honest recommendations and efficient treatment are made by an opportunistic expert. It is found that when there is some possibility that the expert is honest, an opportunistic expert provides full overtreatment or full undertreatment over a larger range of parameter values than when there is no such possibility. This follows because the client believes that the appropriate treatment is more likely to be offered when there is a possibility that the expert is honest. Consequently, the client will accept treatment recommendations which would have been rejected if there was no such possibility. The client's trust allows the opportunistic expert to exploit the client more often. This extension complements the analysis by Liu (2011) performed under the assumption of *Liability*.

2. Model

A risk-neutral client has a problem which is either minor (m) or serious (s). The minor problem causes the client a loss v_m while the serious problem causes a loss v_s, with $v_m \leq v_s$. It is common knowledge that the problem is serious with probability $\theta \in (0, 1)$. The client does not know the nature of her problem and consults a risk-neutral monopolistic expert for diagnosis and treatment.

Upon consultation, the expert perfectly diagnoses the client's problem at zero cost. Furthermore, the expert recovers the loss from problem i, $i = m, s$, for the client by incurring a treatment cost c_i. If the expert incurs treatment cost c_s, both types of problem are successfully treated.[5] On the other hand, if the expert incurs treatment cost c_m, the minor problem is successfully treated but the serious problem is not and the client suffers loss v_s. It is assumed that $c_m < c_s$, so it is more costly to successfully treat the serious problem than the minor problem. In addition, it is assumed that it is efficient to have both types of problem successfully treated, that is, $c_i < v_i$, $i = m, s$. Let p_i denote the price the expert charges for treatment i. The expert's treatment is a credence good rather than an experience good because once the client's problem is successfully treated she suffers no loss and cannot infer from her experience the value of the expert's treatment, or the loss he has helped her prevent. It is assumed that the client can verify the treatment provided ex post. That is, the client can observe whether cost c_m or c_s was incurred by the expert. This assumption is termed *Verifiability*. Under this assumption and with *No-Liability*, the expert can recommend and provide the minor treatment when the problem is serious and let the client suffer the loss v_s. This type of fraudulent behavior is called undertreatment. The expert can also recommend and provide the serious treatment when the problem is minor. This is called overtreatment. The timing of the model is outlined in the following extensive form game.

Stage 1 The expert posts a price list (p_m, p_s).
Stage 2 Nature determines the client's problem.
Stage 3 The expert diagnoses the problem and learns whether it is minor or serious. After diagnosis, the expert either recommends treatment $i \in \{m, s\}$ at price p_i or refuses to treat the client.
Stage 4 Upon receiving a recommendation for treatment i, the client either accepts the treatment and pays p_i or refuses the treatment. If the client accepts the treatment recommendation, the expert incurs cost c_i in providing treatment i to the client.

The extensive form game has a proper subgame following each price list (p_m, p_s). However, each subgame is a Bayesian game in which the expert privately knows his diagnosis of the client's problem. Following the convention in economic analysis, we define the expert's type by his private information, namely the client's problem. Therefore, the appropriate equilibrium concept is Perfect Bayesian Equilibrium (PBE). Let γ_m and γ_s be the probabilities that the client accepts the recommended treatments m and s at prices p_m and p_s, respectively. Let β_o be the probability that the expert recommends the serious treatment when the problem is minor, i.e., attempts to overtreat, and β_u the probability that the expert recommends the minor treatment when the problem is serious, i.e., attempts to undertreat the client. As in Fong (2005), attention is restricted to undominated equilibrium, i.e., equilibrium in which players do not play weakly dominated strategies. It will become clear that unlike Fong's setting where *Liability* and *Non-verifiability* are assumed and equilibrium is unique, here there are multiple equilibria. For that reason, attention is further restricted to optimal equilibria, i.e., equilibria that maximize the expert's profit.

3. Analysis

In this section, optimal equilibria and the strategies the expert and the client play in these equilibria are fully characterized for all parameter values that satisfy, $v_s \geq v_m$, $c_s > c_m$, $v_s > c_s$ and $v_m > c_m$. The game is solved using backward induction. Firstly, each proper subgame that follows the posting of treatment prices (p_m, p_s) in Stage 1 is solved for its equilibrium. Secondly, the prices that maximize the expert's profit (optimal prices) are selected to complete the characterization of the optimal equilibria of the entire game.

3.1. Exogenous-price equilibria

In this subsection, Stages 2, 3, and 4 of the game are analyzed as a subgame, taking the prices charged in Stage 1 as exogenously given. Equilibria in the subgames are called "exogenous-price equilibria" and are characterized by a set of Lemmas 2–6 which are proved in the Appendix A. These exogenous-price equilibria are classified according to the level of honesty in the expert's recommendation strategy, and the prices for which each of these classes of equilibria exist are identified. Finally, characterization of the optimal equilibrium of the entire game is provided in Section 3.2.

To begin, it is established that it is without loss of generality to restrict attention to prices in the intervals $p_m \in [c_m, v_m]$ and $p_s \in [c_s, v_s]$.

Lemma 1. *(i) If the expert posts $p_m \notin [c_m, v_m]$ and $p_s \notin [c_s, v_s]$, the expert's profit is zero. (ii) If the expert posts $p_m \in [c_m, v_m]$ and $p_s \notin [c_s, v_s]$, the expert's highest attainable profit is $(1-\theta)v_m - c_m$. (iii) If the expert posts $p_m \notin [c_m, v_m]$ and $p_s \in [c_s, v_s]$, the expert's highest attainable profit is $\theta v_s + (1-\theta)v_m - c_s$.*

Lemma 1 suggests that it is not profitable to post any price $p_i \notin [c_i, v_i]$, $i \in \{m, s\}$, because treatment at such prices will either be not recommended or not accepted in equilibrium. In the following lemmas, it is formally shown that the profits reported in Lemma 1 can always be replicated by setting $(p_m, p_s) \in [c_m, v_m] \times [c_s, v_s]$ so it is without loss of generality to restrict attention to prices in this space.

Lemma 2. *(Full Undertreatment (FU)) Suppose $(p_m, p_s) \in [c_m, v_m] \times [c_s, v_s]$. There exists an "exogenous-price equilibrium" in which*

$$\gamma_m = 1, \gamma_s = 0,$$
$$\beta_o = 0, \beta_u = 1$$

if and only if $p_m \leq (1-\theta)v_m$ and $p_s > v_m$. The expert's expected profit in this equilibrium is $p_m - c_m$ and the upper bound on this profit is

$$\pi^*_{FU} = (1-\theta)v_m - c_m.$$

Lemma 2 characterizes the treatment prices which induce the expert to undertreat the serious problem with probability one. Inferring that the expert always undertreats and knowing that the minor treatment only fixes the client's minor problem, the client's maximum willingness to pay is $(1-\theta)v_m$. The key condition is that p_m must not exceed this willingness to pay. It immediately follows that the highest profit the expert can earn in this class of equilibria is $(1-\theta)v_m - c_m$. This equilibrium is supported by the client's off-the-equilibrium-path belief that she has a minor problem whenever the serious treatment is recommended. Given this belief, the client rejects the serious treatment because $p_s > v_m$, and hence it is optimal for the expert to undertreat the serious problem.

Lemma 3. *(Full Overtreatment (FO)) Suppose $(p_m, p_s) \in [c_m, v_m] \times [c_s, v_s]$. There exists an exogenous-price equilibrium in which*

$$\gamma_m = 0, \gamma_s = 1$$
$$\beta_u = 0, \beta_o = 1$$

if and only if $p_s \in [c_s, \theta v_s + (1-\theta)v_m]$ and $p_m \in [c_m, v_m]$. The expert's expected profit in this equilibrium is $p_s - c_s$ and the upper bound on this profit is

$$\pi^*_{FO} = \theta v_s + (1-\theta)v_m - c_s.$$

Lemma 3 characterizes the treatment prices which induce the expert to overtreat the minor problem with probability one. Inferring that the expert always overtreats and knowing that the serious treatment fixes both the minor and serious problems, the client's maximum willingness

[5] This assumption is common adopted in the literature, Dulleck and Kerschbamer (2006), and allows the results of this paper to be easily compared to the results in the existing literature. In addition, it seems a natural assumption to make in many circumstances. Once again consider the examples in the introduction, a coronary artery bypass graft treats all artery blockages, replacing the whole roof fixes any leaks, replacing the entire cooling system of a car solves any overheating problem. The alternative assumption that the serious treatment does not fix the minor problem is discussed in footnote 4 and at the end of Section 4.

to pay is $\theta v_s + (1-\theta)v_m$. The key condition is that p_s must not exceed this willingness to pay. It immediately follows that the highest profit the expert can earn in this class of equilibria is $\theta v_s + (1-\theta)v_m - c_s$. This equilibrium is supported by the client's off-the-equilibrium-path belief that she has the serious problem whenever the minor treatment is recommended. Given this belief, the client rejects the minor treatment for all positive p_m because the minor treatment does not successfully treat the serious problem. Therefore, it is optimal for the expert to overtreat the minor problem. Note that the full overtreatment equilibrium exists if and only if $\theta \geq \frac{c_s - v_m}{v_s - v_m}$. When $\theta < \frac{c_s - v_m}{v_s - v_m}$, the range $[c_s, \theta v_s + (1-\theta)v_m]$ is an empty set.

Lemma 4. *(Partial Undertreatment (PU)) Suppose $(p_m, p_s) \in [c_m, v_m) \times [c_s, v_s]$. There exists an "exogenous-price equilibrium" in which*

$$\gamma_m = \frac{p_s - c_s}{p_m - c_m}, \gamma_s = 1,$$
$$\beta_o = 0, \beta_u = \frac{(1-\theta)(v_m - p_m)}{\theta p_m}$$

if and only if $p_m - c_m \geq max\{p_s - c_s, (1-\theta)v_m - c_m\}$. The expert's expected profit in this equilibrium is $p_s - c_s$ and the upper bound on this profit is

$$\pi^*_{PU} = min\{v_m - c_m, v_s - c_s\}.$$

Lemma 4 characterizes the treatment prices which induce the expert to undertreat the serious problem with a positive probability less than one. In this mixed strategy equilibrium, the client accepts the serious treatment recommendation with probability one and accepts the minor treatment recommendation with a probability that yields the expert the same profit no matter which treatment the expert recommends. This profit is equal to $p_s - c_s$ because this is the profit the expert makes if he recommends the serious treatment. Given that the expert is indifferent between recommending the serious and the minor treatment regardless of the client's problem, it is optimal for him to undertreat the client with probability $\frac{(1-\theta)(v_m - p_m)}{\theta p_m}$ and overtreat the client with probability zero. For $\frac{(1-\theta)(v_m - p_m)}{\theta p_m}$ to be no greater than one, it is necessary to have $p_m \geq (1-\theta)v_m$. Upon being recommended the serious treatment, the client infers that she has the serious problem and it is her best response to accept the serious treatment with probability one because $p_s \leq v_s$. When recommended the minor treatment, the client infers that she has the minor problem with probability $\frac{1-\theta}{1-\theta+\theta\beta_u}$ and her expected benefit from accepting the minor treatment is $\frac{(1-\theta)v_m}{1-\theta+\theta\beta_u}$. Given β_u specified in Lemma 4, the client is just indifferent between accepting and rejecting the minor treatment recommendation. Hence it is optimal for her to accept the minor treatment with probability $\frac{p_s - c_s}{p_m - c_m}$. For this probability to be no larger than one, it is required that $p_m - c_m \geq p_s - c_s$. Since profit is increasing in p_s, profit is highest when the expert charges the highest p_s while satisfying $p_s \leq v_s$ and $p_m - c_m \geq p_s - c_s$. When $v_m - c_m \geq v_s - c_s$, it is optimal to set $p_s = v_s$ and the expert earns $v_s - c_s$. When $v_m - c_m < v_s - c_s$, the highest p_s is $v_m - c_m + c_s$ and at this price the expert's profit is $(v_m - c_m + c_s) - c_s = v_m - c_m$.

Lemma 5. *(Partial Overtreatment (PO)) Suppose $(p_m, p_s) \in [c_m, v_m] \times [c_s, v_s)$. There exists an "exogenous-price equilibrium" in which*

$$\gamma_m = 1, \gamma_s = \frac{p_m - c_m}{p_s - c_s},$$
$$\beta_o = \frac{\theta(v_s - p_s)}{(1-\theta)(p_s - v_m)}, \beta_u = 0$$

if and only if $max\{p_m - c_m, \theta v_s + (1-\theta)v_m - c_s\} \leq p_s - c_s$. The expert's expected profit in this equilibrium is $p_m - c_m$ and the upper bound on this profit is

$$\pi^*_{PO} = min\{v_m - c_m, v_s - c_s\}.$$

The explanation of Lemma 5 is analogous to that of Lemma 4 and is omitted.

Lemma 6. *(Honest and Efficient Treatment) (HE) Suppose $(p_m, p_s) \in [c_m, v_m] \times [c_s, v_s]$. There exists an "exogenous-price equilibrium" in which*

$$\beta_o = \beta_u = 0,$$
$$\gamma_m = \gamma_s = 1,$$

if and only if $p_m - c_m = p_s - c_s$. The expert's profit in this equilibrium is $p_m - c_m = p_s - c_s$ and the upper bound on this profit is

$$\pi^*_{HE} = min\{v_m - c_m, v_s - c_s\}.$$

Lemma 6 characterizes the treatment prices which induce the expert to recommend treatment honestly and treat efficiently. Believing that the expert recommends honestly, the client accepts any recommended treatment with probability one. Given equal markups and equal probabilities of acceptance, it is the expert's best response to recommend treatments honestly, which in turn is consistent with the client's belief. Since $p_s \leq v_s$ and $p_m \leq v_m$ the highest profit the expert can earn in this class of equilibria is $min\{v_m - c_m, v_s - c_s\}$.

In this subsection, it has been shown that different treatment price pairs lead to different equilibria and that depending on treatment prices these equilibria can exhibit undertreatment, overtreatment, or efficient treatment. In the next subsection, the entire game is solved for the optimal equilibria by selecting the treatment price pairs that maximize the expert's expected profit for various configurations of the parameters, v_s, v_m, c_s, c_m, and θ.

3.2. Optimal equilibria of the entire game

Lemmas 2 to 6 characterized the equilibria in each subgame following an exogenous price list $(p_m, p_s) \in [c_m, v_m] \times [c_s, v_s]$ and $p_m \leq p_s$. In Propositions 1 and 2 below the highest profit the expert can achieve in the entire game as well as his equilibrium pricing and recommendation strategies are presented for all parameter values. The analysis hinges on the relationship between the surpluses from successfully treating each problem and also the likelihood that the client has each problem.

Proposition 1. *Suppose $v_s - c_s < v_m - c_m$. (i) If $\theta \in \left[0, \frac{v_m - c_m - (v_s - c_s)}{v_m}\right]$, then the highest profit the expert can achieve is*

$$\pi^*_{FU} = (1-\theta)v_m - c_m.$$

The expert achieves this profit by charging $p_m = (1-\theta)v_m$ and $p_s > v_m$ in the Full Undertreatment equilibrium.

(ii) If $\theta \in \left(\frac{v_m - c_m - (v_s - c_s)}{v_m}, 1\right]$, then the highest profit the expert can achieve is

$$\pi^*_{HE} = \pi^*_{PU} = v_s - c_s.$$

The expert achieves this profit by charging $p_m = c_m + v_s - c_s, p_s = v_s$ in the Honest and Efficient equilibrium or by charging any $p_m \in (c_m + v_s - c_s, v_m]$ and $p_s = v_s$ in the Partial Undertreatment equilibrium. If $v_m = v_s$, the expert can also achieve this profit by charging $p_s = v_s = v_m$ in the Full Overtreatment equilibrium.

(iii) There is no other equilibrium in which the expert's profit is higher than in (i) or (ii).

Proposition 1 studies the case when the surplus from successfully treating the minor problem is larger than the surplus from successfully treating the serious problem. Given $v_s - c_s < v_m - c_m$, by Lemma 6, the maximum profit the expert can obtain in an honest equilibrium is $\pi^*_{HE} = v_s - c_s$. By Lemma 4, the expert also receives $v_s - c_s$ in the most profitable equilibrium involving Partial Undertreatment. Therefore, $\pi^*_{HE} = \pi^*_{PU}$.

By Lemma 3, the maximum profit the expert can achieve in an equilibrium involving Full Overtreatment is $\pi^*_{FO} = \theta v_s + (1-\theta)v_m - c_s$. Clearly, $\pi^*_{FO} \le \pi^*_{HE}$ given $v_m \le v_s$ and hence Full Overtreatment leads to lower profit.

Without loss of generality, the optimal equilibrium of the entire game depends on the comparison between $\pi^*_{HE} = v_s - c_s$ and $\pi^*_{FU} = (1-\theta)v_m - c_m$. When choosing between the Honest and Efficient equilibrium and the Full Undertreatment equilibrium, the expert faces a trade-off between maximizing the total surplus available for extraction and the degree of surplus extraction. In the Honest and Efficient equilibrium, the treatments are efficient and so maximize the total surplus available for extraction. However, the expert has to give up surplus $(1-\theta)[v_m - c_m - v_s + c_s]$ to the client because the client receives benefit v_m from the minor treatment while paying $p_m = c_m + v_s - c_s$ for it. By contrast, in the Full Undertreatment equilibrium, the treatments are inefficient and so do not maximize the total surplus available for extraction but the entire surplus is extracted by the expert. The loss of surplus is $\theta[v_s - c_s - c_m]$ which comes from the unresolved serious problem. When the minor treatment is offered for the serious problem, the expert pays a cost c_m but cannot fix the serious problem. This yields a surplus loss of $v_s - c_s - c_m$.

The Full Undertreatment equilibrium is more profitable than the Honest and Efficient equilibrium if and only if the loss in surplus in the Full Undertreatment equilibrium is at most the surplus given to the client in the Honest and Efficient equilibrium, that is

$$\theta[v_s - c_s - c_m] \le (1-\theta)[v_m - c_m - v_s + c_s]$$
$$\theta \le \frac{v_m - c_m - (v_s - c_s)}{v_m}.$$

Intuitively, when the problem is more likely to be minor, the loss in surplus due to undertreatment is reduced while the expert has to give up more surplus to the client in the Honest and Efficient equilibrium. As a result, the trade-off is in favor of the Full Undertreatment equilibrium. In the specific case of $v_s = v_m$, $\pi^*_{HE} = \pi^*_{PU} = \pi^*_{FO}$, so the same profit can also be achieved in the Full Overtreatment equilibrium.[6]

Proposition 1 is illustrated in Fig. 1. On the horizontal axis, to the left of point $v_m - c_m + c_s$, $v_s - c_s < v_m - c_m$ and so Proposition 1 applies. Below the line $\theta = \frac{(v_m - c_m)-(v_s - c_s)}{v_m}$, $\theta \le \frac{(v_m - c_m)-(v_s - c_s)}{v_m}$ and (i) of Proposition 1 applies. As a result there is full undertreatment, denoted by FU(V) where V stands for the *Verifiability* setting. Similar notation is used to denote other parameter cases. On the other hand, above this line, $\theta > \frac{(v_m - c_m)-(v_s - c_s)}{v_m}$ and (ii) of Proposition 1 applies resulting in honest recommendations and efficient treatment, denoted by HE(V), or partial undertreatment, denoted by PU(V).

Proposition 2. *Suppose $v_m - c_m \le v_s - c_s$. (i) If $\theta \in \left[0, \frac{c_s - c_m}{v_s - v_m}\right]$, then*

$$\pi^*_{HE} = v_m - c_m.$$

The expert achieves this profit by setting $p_m = v_m$, $p_s = c_s + v_m - c_m$ in the Honest and Efficient equilibrium or setting $p_m = v_m$ and any $p_s \in (c_s + v_m - c_m, v_s]$ in the Partial Overtreatment equilibrium.

(ii) If $\theta \in \left(\frac{c_s - c_m}{v_s - v_m}, 1\right]$, then

$$\pi^*_{FO} = \theta v_s + (1-\theta)v_m - c_s.$$

The expert achieves this by setting $p_m \in [c_m, v_m]$, $p_s = \theta v_s + (1-\theta)v_m$ in the Full Overtreatment equilibrium.

(iii) There is no other equilibrium in which the expert's profit is higher than in (i) or (ii).

Proposition 2 studies the case when the surplus from successfully treating the serious problem is larger than the surplus from successfully treating the minor problem. Depending on the likelihood of the serious problem, the expert either makes honest recommendations or overtreats the client in equilibrium. Given $v_m - c_m \le v_s - c_s$, by Lemma 6, the highest profit the expert can achieve in an honest equilibrium is $\pi^*_{HE} = v_m - c_m$. By Lemmas 5 and 4, $v_m - c_m$ is also the highest profit the expert can achieve in an equilibrium involving Partial Overtreatment. Therefore, $\pi^*_{HE} = \pi^*_{PO}$.

By Lemma 2, the highest profit the expert can achieve in an equilibrium involving Full Undertreatment is $\pi^*_{FU} = (1-\alpha)v_m - c_m$. Clearly, $\pi^*_{FU} \le \pi^*_{HE}$ and hence Full Undertreatment leads to lower profit.

The optimal equilibrium of the entire game depends on a comparison between $\pi^*_{HE} = v_m - c_m$ and $\pi^*_{FO} = \theta v_s + (1-\theta)v_m - c_s$. Similar to the case of $v_m - c_m > v_s - c_s$, the expert faces a trade-off between maximizing the total surplus available for extraction and the degree of surplus extraction. In the Honest and Efficient equilibrium, the treatment is efficient but the expert gives up surplus $\theta[v_s - c_s - v_m + c_m]$ to the client because the client is willing to pay v_s for fixing the serious problem but only pays $p_s = c_s + v_m - c_m$. In the Full Overtreatment equilibrium, the expert extracts the entire surplus from trade but the treatments are inefficient and so the total surplus is not maximized. The loss in surplus is $(1-\theta)(c_s - c_m)$ because the expert incurs a higher cost c_s to fix the minor problem when c_m would have been sufficient. The Full Overtreatment equilibrium is more profitable than the Honest and Efficient equilibrium if and only if the loss in surplus in the Full Overtreatment equilibrium is at most the rent given to the client in the Honest and Efficient equilibrium, that is when $\theta > \frac{c_s - c_m}{v_s - v_m}$.[7] Intuitively, when the problem is more likely to be serious, the loss in surplus due to overtreatment becomes smaller while the expert has to give up more surplus to the client in the Honest and Efficient equilibrium. As a result, the trade-off is in favor of the Full Overtreatment equilibrium.

Once again, consider Fig. 1. To the right of point $v_m - c_m + c_s$, $v_s - c_s \ge v_m - c_m$ and so Proposition 2 applies. Below the curve $\theta = \frac{c_s - c_m}{v_s - v_m}$, we have $\theta \le \frac{c_s - c_m}{v_s - v_m}$ and (i) of Proposition 2 applies. As a result there is either honest recommendations and efficient treatment (HE(V)), or partial overtreatment, denoted by PO(V). On the other hand, above this curve, $\theta > \frac{c_s - c_m}{v_s - v_m}$ and (ii) of Proposition 2 applies resulting in full overtreatment, denoted by FO(V).

Propositions 1–2 not only characterize the highest profits achievable by the expert under various parameter configurations, they also characterize how these profits are supported with different recommendation strategies. These are summarized below:

Corollary 1.

i) *For any parameter configuration, there always exist equilibria involving overtreatment or undertreatment.*
ii) *The highest possible profit can be achieved by honest recommendations and efficient treatment in equilibrium if and only if*

$$v_m - c_m \le v_s - c_s \text{ and } \theta \in \left[0, \frac{c_s - c_m}{v_s - v_m}\right]$$

or

$$v_s - c_s < v_m - c_m \text{ and } \theta \in \left(\frac{v_m - c_m - (v_s - c_s)}{v_m}, 1\right].$$

iii) *The most profitable equilibrium necessarily involves full overtreatment when*

$$v_m - c_m \le v_s - c_s \text{ and } \theta \in \left(\frac{c_s - c_m}{v_s - v_m}, 1\right],$$

[6] It has been assumed that $v_m \le v_s$, however, if $v_m > v_s$ the expert can achieve profit of $v_s - c_s$ by charging $p_s = v_s$ in the Full Overtreatment equilibrium.

[7] If it is assumed that treatments are problem specific and so the serious treatment can only fix the serious problem, then the client's maximum willingness to pay in the Full Overtreatment equilibrium is reduced to θv_s and hence $\pi^*_{FO} = \theta v_s - c_s$. As a consequence, the Full Overtreatment equilibrium yields the highest profit if and only if $\theta v_s - c_s \ge v_m - c_m$ or equivalently $\theta \ge \frac{c_s - c_m + v_m}{vs}$.

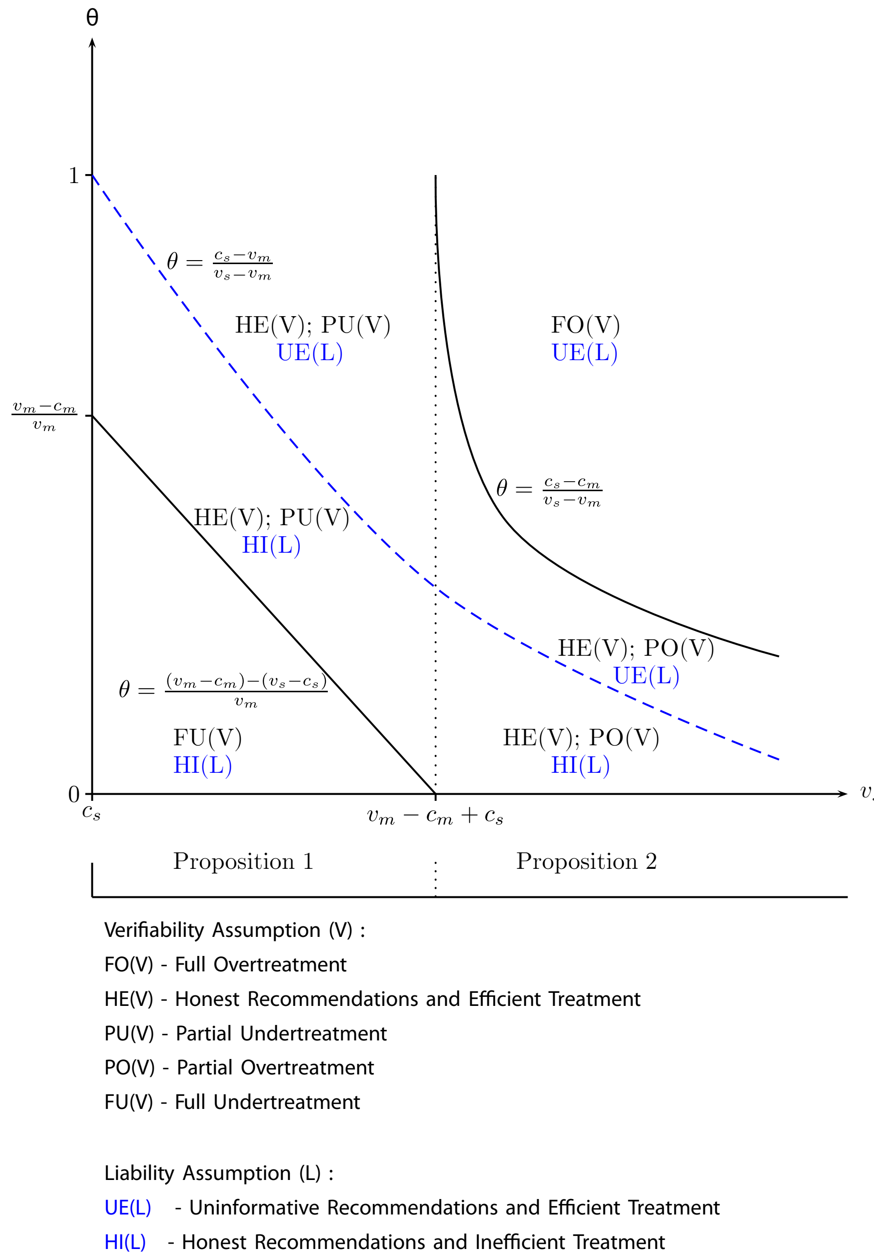

Fig. 1. Verifiability, Liability, and Efficiency.

whereas it necessarily involves full undertreatment when

$$v_s - c_s < v_m - c_m \text{ and } \theta \in \left[0, \frac{v_m - c_m - (v_s - c_s)}{v_m}\right].$$

The findings in Corollary 1 stand in sharp contrast with the received wisdom in the literature that efficiency and honesty are jointly achieved in equilibrium under the assumption of *Verifiability*, irrespective of whether *Commitment* or *No-Commitment* is assumed (Emons, 1997, 2001; Dulleck and Kerschbamer, 2006). By providing a comprehensive characterization of the optimal equilibrium, this paper points out that the assumption of *Commitment* is crucial. When the client can say “no” to the expert's recommendation, for any parameter configuration, there exist equilibria that involve overtreatment or undertreatment. In particular, if the likelihood of the problem associated with a greater surplus is large, the most profitable equilibrium necessarily involves full overtreatment or full undertreatment.

Note that standard refinements cannot be used to rule out equilibria with partial overtreatment or partial undertreatment. In fact, when the model is perturbed in certain ways, setting prices leading to partially dishonest recommendations generates more profit to the expert than setting prices leading to honest recommendations and efficient treatment. For example, conditional on the consumer having a serious problem, suppose with an arbitrarily small probability ε that the expert possesses hard evidence for the severity of the problem. Under this assumption, it is easy to show that when $v_s - c_s > v_m - c_m$, the expert's profit will be higher if he sets $(p_m, p_s) = (v_m, v_s)$ than if he sets $(p_m, p_s) = (v_m, v_m - c_m + c_s)$. With the latter price list, it is known that his profit is $v_m - c_m$ just like in the honest and efficient equilibrium. With the former price list, when the problem is serious and he has evidence for the serious problem, which happens with probability $\theta\varepsilon$, his profit is $v_s - c_s > v_m - c_m$ and otherwise his profit is $v_m - c_m$. Therefore, his expected profit is

$$(1 - \theta\varepsilon)(v_m - c_m) + \theta\varepsilon(v_s - c_s)$$

which is larger than $v_m - c_m$. A similar argument can be made for the parameter case of $v_m - c_m > v_s - c_s$.

4. Comparing outcomes under the Verifiability and Liability assumptions

In this section the results under the *Verifiability* assumption are compared to those under the *Liability* assumption. Under the *Liability* assumption the expert is liable for fixing the client's problem once she accepts his recommendation, therefore, undertreatment is ruled out. Nevertheless, the expert can lie about the treatment provided because treatment is not verifiable. For this reason, the expert does not have an incentive to overtreat as providing the serious treatment is more costly than providing the minor treatment. Many papers adopt the *Liability* assumption, for example, Pitchik and Schotter (1987), Wolinsky (1993), Sülzle and Wambach (2005), and Liu (2011), however, the one closest to the present paper is Fong (2005). In fact, the set-up in Fong (2005) is identical to that of the present paper except that it assumes *Liability* instead of *Verifiability*. The comparison between the results of this paper and that of Fong (2005) identifies the conditions under which the market outcome under *Verifiability* is superior to that under *Liability*.

According to Proposition 1 of Fong (2005), if the expected benefit is greater than the cost of the serious treatment, that is, if $\theta \in \left[\frac{c_s - v_m}{v_s - v_m}, 1\right)$, then the expert extracts the entire expected surplus from treatment by offering a single price equal to the expected benefit, i.e., $p = \theta v_s + (1-\theta)v_m$, and treatment is efficient. Although the client receives no information from the expert about the nature of her problem, she accepts treatment with probability one because the expert is liable and charges no more than her ex ante expected benefit from treatment. This leads to an efficient outcome because the expert always treats the client's problem with the appropriate treatment. On the other hand, if $\theta \in \left(0, \frac{c_s - v_m}{v_s - v_m}\right)$, then the expert offers different prices for each treatment, $p_s = v_s$ and $p_m = v_m$, and treatment is inefficient. Although expert recommendations are honest, inefficiency arises because the client rejects the serious treatment recommendation with a positive probability to remove the expert's incentive to overcharge, that is, charge p_s instead of p_m for fixing the minor problem.

Fong's results under the *Liability* assumption are illustrated in Fig. 1. Above the dashed curve, $\theta \in \left[\frac{c_s - v_m}{v_s - v_m}, 1\right)$, so recommendations are uninformative, but treatment is efficient. This parameter case is denoted by UE(L) where L stands for the *Liability* setting. On the other hand, below the dashed curve, $\theta \in \left(0, \frac{c_s - v_m}{v_s - v_m}\right)$, so recommendations are honest, but treatment is inefficient. This parameter case is denoted by HI(L). Inefficiency arises in this case because there is a positive probability that the serious problem is left unresolved. While there is a unique equilibrium outcome under *Liability*, Propositions 1 and 2 establish that under *Verifiability* there exist multiple equilibria that yield the expert the same highest profit but differ in their efficiency. In this case, the most efficient equilibrium under *Verifiability* is selected and compared with the equilibrium under *Liability*. This comparison is facilitated by examining Fig. 1.

First consider the region where both θ and $v_s - c_s$ are relatively high, denoted by FO(V);UE(L). Under *Verifiability*, the expert provides Full Overtreatment at price $p_s = \theta v_s + (1-\theta)v_m$. Under *Liability*, the expert fixes both problems at the same price $\theta v_s + (1-\theta)v_m$. Hence, in each scenario, the expert's recommendations are uninformative. Although the client's problem is always successfully treated under both *Verifiability* and *Liability*, the equilibrium is efficient under *Liability*, but is inefficient under *Verifiability*. This is because under *Verifiability*, the expert has to incur the serious treatment cost c_s to fix the minor problem even when the minor treatment cost c_m is sufficient. The additional cost creates a social loss of $(1-\theta)(c_s - c_m)$, which is avoided under *Liability* because the expert needs not commit to the treatment he has recommended and hence always chooses the appropriate treatment to fix each problem.

Second, consider the region where both θ and $v_s - c_s$ are relatively low, FU(V);HI(L). Under *Verifiability*, the expert provides Full Undertreatment at price $p_m = (1-\theta)v_m$. By contrast, under *Liability* the expert posts two prices ($p_s = v_s, p_m = v_m$) and makes honest recommendations. The market outcome is more efficient under *Liability* than under *Verifiability* because the serious problem is fixed with a positive probability under *Liability* but is left unresolved with probability one under *Verifiability*. In addition, the expert is honest under *Liability* but is dishonest under *Verifiability*.

Third, consider the regions where one of θ and $v_s - c_s$ is relatively high and the other is relatively low, that is, the region between the solid curve $\theta = \frac{c_s - c_m}{v_s - v_m}$ and the line $\theta = \frac{(v_m - c_M) - v_s - c_s)}{v_m}$. Under *Verifiability*, the Honest and Efficient equilibrium yields the same profit as the Partial Undertreatment or Partial Overtreatment equilibria but is more efficient and hence is selected. In the Honest and Efficient equilibrium, two prices are offered with $p_s - c_s = p_m - c_m$, recommendations are honest, and treatment is efficient. Under *Liability*, below the dashed curve $\theta = \frac{c_s - v_m}{v_s - v_m}$, recommendations are honest, but treatment is inefficient. By contrast, above the dashed curve, recommendations are uninformative, but treatment is efficient. So, treatment efficiency and honest recommendation cannot be jointly achieved under *Liability*.

The comparison between the market outcomes under *Liability* and *Verifiability* assumptions is summarized in the following proposition.

Proposition 3.

(i) *If θ and $v_s - c_s$ are both relatively high [region FO(V);UE(L)], then the market outcome under the Liability assumption is more efficient than under the Verifiability assumption even though recommendations are dishonest under both assumptions.*
(ii) *If θ and $v_s - c_s$ are both relatively low [region FU(V);HI(L)], then the market outcome under the Liability assumption is more efficient than under the Verifiability assumption. In addition, recommendations are honest under the Liability assumption but are dishonest under the Verifiability assumption.*
(iii) *If one of θ and $v_s - c_s$ is relatively high and the other is relatively low [remaining region], then the market outcome under the Verifiability assumption is efficient and recommendations are honest. By contrast, the market outcome under the Liability assumption is inefficient for relatively small v_s and recommendations are dishonest for relatively high v_s.*

Dulleck and Kerschbamer (2006) performed a similar comparison between the *Liability* and *Verifiability* assumptions. Their analysis was done for the special case in which the losses from the serious and minor problems were equal and showed that all the Bayesian equilibria under *Verifiability* involve honest recommendations and efficient treatment. This paper argues that their result does not hold for a wide range of parameters once the loss from the serious problem is allowed to be larger than the loss from the minor problem. Hence, our results stand in sharp contrast to the received wisdom that the market outcome under the *Verifiability* assumption is efficient (Dulleck and Kerschbamer, 2006) while the market outcome under the *Liability* assumption is not (Fong, 2005).

In the analysis above it has been assumed that the serious treatment fixes both problems while the minor treatment only fixes the minor problem. If it is assumed that treatments are problem specific and hence the serious treatment cannot fix the minor problem, then the observability of outcome coupled with the *Liability* assumption ensures that treatment is efficient and recommendations are honest. However, under the *Verifiability* assumption nothing qualitatively changes in the sense that both undertreatment and overtreatment may still arise in equilibrium. In terms of Fig. 1, the range of parameters over which there is full overtreatment becomes smaller because the curve $\theta = \frac{c_s - c_m}{v_s - v_m}$ is shifted upward to $\theta = \frac{c_s - c_m + v_m}{v_s}$ as discussed in footnote 4.

5. The possibility of an honest expert

In the sections above it is common knowledge that the expert was opportunistic in the sense that he would recommend treatments dishonestly if by doing so his profit was increased. However, it does not seem unrealistic to assume that the client believes that with some probability, $h \in [0, 1]$, the expert will recommend treatment honestly regardless of his profit from doing so.

This section investigates how introducing a probability of an expert being honest affects an opportunistic expert's incentives under the assumption of *Verifiability*. At the beginning of the game, Nature draws the expert's behavioral type which remains his private information. Then, the extensive form game described in Section 2 follows. In a separating equilibrium, the expert's behavioral type is revealed by his price list. Any separating equilibrium must yield the opportunistic expert the same profit as the game with complete information on the expert's behavioral type ($h = 0$). If the opportunistic expert makes less profit in a separating equilibrium than in the case of $h = 0$, the opportunistic expert can always deviate to the optimal price he would charge in the game with complete information on his behavioral type. Following this deviation, the harshest client belief is that she is dealing with an opportunistic expert. However, given this belief, the opportunistic expert will gain exactly the same profit as in the game with complete information on his behavioral type. As the opportunistic expert's incentive is not affected by the possibility that he is honest in separating equilibria, in this extension attention is focused on pooling equilibria in which different behavioral types of expert post the same price list.

As in Section 3, Perfect Bayesian equilibria are characterized, but for brevity only pure strategy equilibria are considered. Two cases are analyzed. The first is where $v_m - c_m \le v_s - c_s$.

Proposition 4. *Suppose $v_m - c_m \le v_s - c_s$.*
(i) If $\theta \in \left[0, \dfrac{c_s - c_m}{c_s - c_m + ((v_s - c_s) - (v_m - c_m))/(1-h)}\right]$, *then*

$$\pi^*_{HE} = v_m - c_m.$$

Both types of expert achieve this profit by setting $p_m = v_m$, $p_s = c_s + v_m - c_m$ in the Honest and Efficient equilibrium.
(ii) If $\theta \in \left(\dfrac{c_s - c_m}{c_s - c_m + ((v_s - c_s) - (v_m - c_m))/(1-h)}, 1\right]$, *then the opportunistic expert makes profit*

$$\pi^{o*}_{FO} = \frac{\theta v_s + (1-h)(1-\theta)v_m}{\theta + (1-h)(1-\theta)} - c_s$$

and the honest expert makes profit

$$\pi^{h*}_{FO} = \theta\left[\frac{(\theta v_s + (1-h)(1-\theta)v_m)}{\theta + (1-h)(1-\theta)} - c_s\right] + (1-\theta)[v_m - c_m].$$

Both types of expert achieve respectively these profits by setting $p_m = v_m, p_s = \frac{\theta v_s + (1-h)(1-\theta)v_m}{\theta + (1-h)(1-\theta)}$ in the Full Overtreatment equilibrium.

By definition the honest type truthfully reports the client's problem; so the descriptions of equilibria used in Proposition 4 are referring to the opportunistic type's strategy. Proposition 4 is essentially Proposition 2 with θ replaced with the conditional probability that the problem is serious given that the serious problem is recommended. Let $Pr(i|J)$ be the probability the problem is $i = s, m$ given treatment $J = S, M$ is recommended. In the overtreatment equilibrium, the opportunistic expert always recommends the serious treatment whereas the honest expert recommends truthfully. Given these recommendation strategies, the probability that the client has the serious problem when recommended the serious treatment is

$$Pr(s|S) = \frac{Pr(S|s)Pr(s)}{Pr(S|s)Pr(s) + Pr(S|m)Pr(m)} = \frac{\theta}{\theta + (1-h)(1-\theta)} > \theta,$$

where $Pr(J|i)$ is the probability that treatment J is recommended given the problem is i.

The optimal equilibrium of the entire game depends on the comparison between $\pi^*_{HE} = v_m - c_m$ and $\pi^{o*}_{FO} = Pr(s|S)v_s + Pr(m|S)v_m - c_s = \frac{\theta v_s + (1-h)(1-\theta)v_m}{\theta + (1-h)(1-\theta)} - c_s$. If $\theta > \frac{c_s - c_m}{c_s - c_m + ((v_s - c_s) - (v_m - c_m))/(1-h)}$, then $\pi^{o*}_{FO} > \pi^*_{HE}$ and the full overtreatment equilibrium yields both behavioral types the most profit.

Recall that overtreatment occurs when $\theta > \frac{c_s - c_m}{v_s - v_m}$, where the expert is opportunistic with probability 1 (Proposition 2). Now,

$$\frac{c_s - c_m}{c_s - c_m + \frac{(v_s - c_s) - (v_m - c_m)}{1-h}} < \frac{c_s - c_m}{v_s - v_m},$$

so in Fig. 1 the region in which the opportunistic expert always recommends the serious treatment, FO(V), is larger than where the expert is opportunistic with probability 1. The intuition is clear, the possibility that the expert is honest acts like an external benefit on the opportunistic expert as the client on observing a recommendation of the serious treatment now has a higher conditional probability that she in fact has the serious problem and the opportunistic expert exploits this by raising price and making more profit. This increases the range of parameters for which overtreatment yields more profit than honest and efficient treatment.

Now, the case where $v_m - c_m > v_s - c_s$ is considered.

Proposition 5. *Suppose $v_m - c_m > v_s - c_s$. (i) If $\theta \in \left[0, \frac{v_m - c_m - (v_s - c_s)}{v_m - c_m - (v_s - c_s) + (v_s - c_s + c_m)(1-h)}\right]$, then the opportunistic expert makes profit*

$$\pi^{o*}_{FU} = \frac{(1-\theta)v_m}{(1-\theta) + (1-h)\theta} - c_m,$$

and the honest expert makes profit

$$\pi^{h*}_{FU} = (1-\theta)\left(\frac{(1-\theta)v_m}{(1-\theta) + (1-h)\theta} - c_m\right) + \theta(v_s - c_s).$$

Both behavioral types of expert achieve these profits by setting $p_m = \frac{(1-\theta)v_m}{(1-\theta)+(1-h)\theta}$, $p_s = v_s$ in the Full Undertreatment equilibrium.
(ii) If $\theta \in \left(\frac{v_m - c_m - (v_s - c_s)}{v_m - c_m - (v_s - c_s) + (v_s - c_s + c_m)(1-h)}, 1\right]$, then $\pi^*_{HE} = v_s - c_s$.
Both behavioral types of expert achieve these profits by setting $p_m = c_m + v_s - c_s$, $p_s = v_s$ in the Honest and Efficient equilibrium.

Proposition 5 is essentially Proposition 1 with $(1 - \theta)$ replaced with $Pr(m|M)$, where

$$Pr(m|M) = \frac{(1-\theta)}{(1-\theta) + (1-h)\theta} > (1-\theta). \tag{1}$$

The optimal equilibrium of the game depends on the comparison between $\pi^*_{HE} = v_s - c_s$ and $\pi^{o*}_{FU} = \frac{(1-\theta)v_m}{(1-\theta)+(1-h)\theta} - c_m$. If $\theta \le \frac{v_m - c_m - (v_s - c_s)}{v_m - c_m - (v_s - c_s) + (v_s - c_s + c_m)(1-h)}$, then $\pi^{o*}_{FU} \ge \pi^*_{HE}$ and the full undertreatment equilibrium yields both behavioral types of expert the most profit.

Recall that undertreatment occurs when $\theta \le \frac{(v_m - c_m) - (v_s - c_s)}{v_m}$ where the expert is opportunistic with probability 1 (Proposition 1). Now,

$$\frac{v_m - c_m - (v_s - c_s)}{v_m - c_m - (v_s - c_s) + (v_s - c_s + c_m)(1-h)} > \frac{(v_m - c_m) - (v_s - c_s)}{v_m} \tag{2}$$

so in Fig. 1 the region in which the opportunistic expert always recommends the minor treatment, FU(V), is larger than where the expert is opportunistic with probability 1. The intuition is identical to that of Proposition 4. Specifically, the possibility that the expert is honest acts like an external benefit on the opportunistic expert as the client on observing a recommendation of the minor treatment now has a higher conditional probability that she in fact has the minor problem and the opportunistic expert exploits this by raising price and making more profit. This increases the range of parameters for which undertreatment yields more profit than honest and efficient treatment.

Although an honest expert recommends truthfully and treats efficiently, Propositions 4 and 5 together imply that the possibility that the expert can be honest increases the parameter range in which the opportunistic expert recommends dishonestly and treats inefficiently. This result complements that of Liu (2011) who shows that an opportunistic expert could be more fraudulent in the presence of a conscientious expert. In Liu the conscientious expert's payoff is a weighted sum of his profit and the client's benefit from treatment, and the conscientious expert makes recommendations strategically to maximize his payoff. Hence, Liu does not preclude the conscientious expert from making dishonest recommendations. By contrast, in our model the honest expert is a behavioral type who is constrained to make honest recommendations. In addition, while Liu assumes *Liability*, here *Verifiability* is assumed.

6. Conclusion

This paper examines the role of the *Verifiability* assumption in credence goods markets when clients can reject the expert's treatment recommendation. In contrast to the existing literature, where it is assumed that clients commit to an expert's recommendation before the client's problem is diagnosed, it is found that honest and efficient treatment may not occur in equilibrium. In particular, it is shown that where the surplus generated by the serious problem is large (small) and its probability of occurring is high (low) that the market equilibrium outcome is characterized by dishonest recommendations and overtreatment (undertreatment).

This inefficiency questions the received wisdom that the market outcome under *Verifiability* is unambiguously superior to that under *Liability*. Specifically, this paper shows that where the parameters are such that overtreatment occurs under *Verifiability* the market outcome is efficient under *Liability*.

The finding that inefficiency can arise in credence goods markets in the presence of *Verifiability* is not only of theoretical interest but also has policy implications. Policies that promote verifiability (e.g., forcing mechanics to return replaced parts) will unambiguously lead to an efficient market outcome only if clients commit upfront to accepting experts' recommendations. If clients are free to reject recommendations, overtreatment or undertreatment may still arise. In these circumstances, policies that promote liability (e.g., a medical authority detailing acceptable side-effects of treatment) can be more effective in improving market efficiency.

Finally, this paper analyzes how the possibility that the expert is honest affects the behavior of an opportunistic expert. It is found that the existence of some honest experts provides perverse incentives for an opportunistic expert and induces him to overtreat or undertreat the client more often than he would if there were no honest experts.

Appendix A

Proof of Lemma 1.

(i) If the expert does not post any price, then obviously he cannot recommend any treatment and earns zero profit. If $p_m \notin [c_m, v_m]$ and $p_s \notin [c_s, v_s]$, then either $p_i < c_i$ and it is not profitable for the expert to recommend treatment i, or $p_i > v_i$ and the client does not accept treatment i regardless of her belief of her problem. In either case, the expert's profit is zero.

(ii) From part (i) above, if $p_m \in [c_m, v_m]$ and $p_s \notin [c_s, v_s]$, then it is only profitable for the expert to recommend the minor treatment. If the minor treatment is accepted with a positive probability, the expert's best response is to always recommend the minor treatment. Knowing that the expert always recommends the minor treatment, for the client to accept this treatment with positive probability the price of the minor treatment must satisfy $p_m \le (1-\theta)v_m$. In this case, the expert's profit is $\gamma_m(p_m - c_m) \le (1-\theta)v_m - c_m$.

(iii) From part (i) above, if $p_m \notin [c_m, v_m]$ and $p_s \in [c_s, v_s]$, then it is only profitable for the expert to recommend the serious treatment. With a logic similar to that in part (ii) above, the price of the serious treatment must satisfy $p_s \le \theta v_s + (1-\theta)v_m$. In this case, the expert's profit is $\gamma_s(p_s - c_s) \le \theta v_s + (1-\theta)v_m - c_s$. Q.E.D.

Proof of Lemma 2. *Necessity:* If the expert recommends the minor treatment to treat both problems, i.e., setting $(\beta_o, \beta_u) = (0, 1)$, the cost of accepting the recommendation to the client is p_m, while the expected benefit is $(1-\theta)v_m$. For it to be optimal for the client to accept the recommended treatment with probability one ($\gamma_m = 1$), it is required that $p_m \le (1-\theta)v_m$. Since the serious treatment can fix the minor problem, for it to be undominated for the client to set $\gamma_s = 0$, it is required that $p_s > v_m$.

Sufficiency: Now it is checked that when $p_m \le (1-\theta)v_m$ and $p_s > v_m$, the strategy profile stated in the lemma constitutes an equilibrium. Firstly, it is clear that there is sufficient incentive for the client to set $\gamma_m = 1$ because the expected benefit of accepting the minor treatment, $(1-\theta)v_m$, outweighs the cost, p_m.

Secondly, recommending the serious treatment is off-the-equilibrium-path behavior and it can be assumed that the client believes that the problem is minor whenever the serious treatment is recommended. Therefore, it is optimal for the client to set $\gamma_s = 0$ as long as $p_s > v_m$.

Given that $\gamma_m = 1, \gamma_s = 0$, the expert's best response is to set $\beta_o = 0, \beta_u = 1$, i.e., he always recommends the minor treatment. The expert's expected profit is $p_m - c_m$ because the recommendation of the minor treatment is always accepted. Q.E.D.

Proof of Lemma 3. *Necessity:* It is obvious that $p_s \ge c_s$ is required or otherwise recommending the serious treatment is weakly dominated by refusing to treat the client's problem. Suppose $\theta v_s + (1-\theta)v_m < p_s$. If the expert recommends the serious treatment to treat both problems, i.e., $(\beta_u, \beta_o) = (0, 1)$, the expected benefit is $\theta v_s + (1-\theta)v_m < p_s$. The client's best response is not to accept, i.e., $\gamma_s = 0$, contradicting $\gamma_s = 1$.

Sufficiency: Suppose $\theta v_s + (1-\theta)v_m \ge c_s$. Since $(\beta_u, \beta_o) = (0, 1)$, the expected benefit is $\theta v_s + (1-\theta)v_m \ge c_s$. So for any $p_s \in [c_s, \theta v_s + (1-\theta)v_m]$, it is a best response for the expert to set $\gamma_s = 1$.

Recommending the minor treatment is off-the-equilibrium-path behavior and it can be assumed that the client believes that the problem is serious whenever the minor treatment is recommended. Therefore, it is optimal for the client to set $\gamma_m = 0$ as long as $p_m > 0$.

Given that, $\gamma_m = 0$, $\gamma_s = 1$, the expert's best response is to set $\beta_u = 0$, $\beta_o = 1$, that is, he always recommends the serious treatment. The expert's expected profit is $p_s - c_s$ because the recommendation of the serious treatment is always accepted. Q.E.D.

Proof of Lemma 4. Necessity: For γ_m and β_u to be no larger than one, it is necessary that $p_m - c_m \ge max\{p_s - c_s, (1-\theta)v_m - c_m\}$.

Sufficiency: Now it is checked that when $p_m - c_m \ge max\{p_s - c_s, (1-\theta)v_m - c_m\}$, the strategy profile stated in the lemma constitutes an equilibrium. Given that $\beta_o = 0$, whenever the client is recommended the serious treatment, the client infers that the problem is serious. Since $p_s \le v_s$, the best reply of the client is to set $\gamma_s = 1$.

Given that $\beta_o = 0, \beta_u = \frac{(1-\theta)(v_m - p_m)}{\theta p_m}$, whenever the client is recommended the minor treatment, her conditional probability that the problem is minor is

$$\frac{(1-\theta)}{(1-\theta)+\theta\beta_u} = \frac{(1-\theta)}{(1-\theta)+\theta\frac{(1-\theta)(v_m - p_m)}{\theta p_m}} = \frac{p_m}{v_m}.$$

The client's expected benefit from the minor treatment is

$$\frac{p_m}{v_m} v_m = p_m.$$

Therefore, the client is indifferent between accepting and rejecting the recommended minor treatment as both have an expected payoff of zero, and it's a best response for the client to set $\gamma_m = \frac{p_s - c_s}{p_m - c_m}$.

Given that $(\gamma_m, \gamma_s) = \left(\frac{p_s - c_s}{p_m - c_m}, 1\right)$, if the expert recommends the minor treatment, his expected profit is

$$(p_m - c_m)\frac{p_s - c_s}{p_m - c_m} = p_s - c_s.$$

If the expert recommends the serious treatment, his profit is $p_s - c_s$. Therefore, the expected profit of the expert is independent of the actual problem and the expert is indifferent between recommending either treatment. As a result, it's a best response for the expert to set $(\beta_o, \beta_u) = \left(0, \frac{(1-\theta)(v_m - p_m)}{\theta p_m}\right)$.

When $v_m - c_m > v_s - c_s$, the maximum p_s the expert can charge is v_s. So, the upperbound on his profit is $v_s - c_s$. When $v_m - c_m \le v_s - c_s$, the maximum p_s the expert can charge under the condition $p_m - c_m \ge p_s - c_s$ is bounded above by $v_m - c_m + c_s$. Hence, in this case, the upperbound on his profit is $v_m - c_m$. Q.E.D.

Proof of Lemma 5. *Necessity:* For γ_s and β_o to be no larger than one, it is necessary that $max\{p_m - c_m, \theta v_s + (1-\theta)v_m - c_s\} \le p_s - c_s$.

Sufficiency: Now it is checked that when $p_m - c_m \le p_s - c_s$, the strategy profile stated in the lemma constitutes an equilibrium. Given that $\beta_u = 0$, whenever the client is recommended the minor treatment, the client infers that the problem is minor. Since $p_m \le v_m$, the best reply of the client is to set $\gamma_m = 1$.

Given that the expert attempts to overtreat with probability β_o, when the expert recommends the serious treatment, the conditional probability that the problem is serious is

$$\frac{\theta}{\theta + (1-\theta)\beta_o} = \frac{\theta}{\theta + (1-\theta)\frac{\theta(v_s - p_s)}{(1-\theta)(p_s - v_m)}} = \frac{v_m - p_s}{v_m - v_s}.$$

The client's expected benefit from the serious treatment is

$$\frac{v_m - p_s}{v_m - v_s} v_s + \left(1 - \frac{v_m - p_s}{v_m - v_s}\right) v_m = p_s.$$

Therefore, the client is indifferent between accepting and rejecting the recommended serious treatment as both have an expected payoff of zero, and it's a best response for the client to set $\gamma_s = \frac{p_m - c_m}{p_s - c_s}$.

Given that $(\gamma_m, \gamma_s) = \left(1, \frac{p_m - c_m}{p_s - c_s}\right)$, if the expert recommends the minor treatment, his profit is $p_m - c_m$. If he recommends the serious treatment, his expected profit is

$$\gamma_s(p_s - c_s) = \frac{p_m - c_m}{p_s - c_s}(p_s - c_s) = p_m - c_m.$$

Therefore, the expert is indifferent between recommending either treatment because the expert makes a profit $p_m - c_m$ irrespective of his treatment recommendation. Consequently, it's a best response for the expert to set $\beta_o = \frac{\theta(v_s - p_s)}{(1-\theta)(p_s - v_m)}, \beta_u = 0$. When $v_m - c_m < v_s - c_s$, the maximum p_m the expert can charge is v_m. So, the upperbound on his profit is $v_m - c_m$. When $v_m - c_m \ge v_s - c_s$, the maximum p_m the expert can charge under the condition $p_m - c_m \le p_s - c_s$ is bounded above by $v_s - c_s + c_m$. Hence, in this case, the upperbound on his profit is $v_s - c_s$. Q.E.D.

Proof of Lemma 6. *Necessity:* Honest recommendations require $\beta_o = \beta_u = 0$ and efficient treatments further require $\gamma_m = \gamma_s = 1$. Suppose $p_m - c_m \ne p_s - c_s$. Then $\gamma_m(p_m - c_m) \ne \gamma_s(p_s - c_s)$. This implies that the expert's best response would be always to recommend one of the two treatments. This constitutes a contradiction.

Sufficiency: Suppose $p_m - c_m = p_s - c_s$. If $\gamma_m = \gamma_s = 1$, then $\gamma_m(p_m - c_m) = \gamma_s(p_s - c_s)$ and the expert is indifferent between recommending either treatment. Therefore, it is his best response to set $\beta_o = \beta_u = 0$. Given that $\beta_o = \beta_u = 0$, and our assumption that $(p_m, p_s) \in [c_m, v_m] \times [c_s, v_s]$, it is also the client's best response to set $\gamma_m = \gamma_s = 1$. Q.E.D.

Proof of Proposition 1. The proof consists of two main steps. First, the lemmas in the main text are utilized to show that the equilibrium profit is achievable with the strategies specified in the lemmas. Then it is shown that there does not exist any other equilibrium that leads to a higher profit.

Step 1. According to Lemma 2, $(1-\theta)v_m - c_m$ can be achieved by setting $p_m = (1-\theta)v_m$ and $p_s > v_m$ and there is Full Undertreatment in equilibrium. According to Lemmas 4 and 6, $v_s - c_s$ can be achieved by setting $p_s = v_s$ and $p_m \in [v_s + c_m - c_s, v_m]$. When $p_m \in (v_s + c_m - c_s, v_m]$, there is Partial Undertreatment and when $p_m = v_s + c_m - c_s$, there is Honest and Efficient Treatment in equilibrium. Notice that $\theta v_s + (1-\theta)v_m - c_s$ is dominated by $v_s - c_s$ if $v_s > v_m$ and equal to it if $v_s = v_m$. Finally, the equilibrium profit is $max\{(1-\theta)v_m - c_m, v_s - c_s\}$, with $(1-\theta)v_m - c_m < v_s - c_s$ if and only if $\theta > [v_m - c_m - (v_s - c_s)]/v_m$.

Step 2. It is shown that there does not exist an equilibrium that yields a profit greater than $max\{(1-\theta)v_m - c_m, v_s - c_s\}$. Consider an arbitrary equilibrium with (p_m, p_s) in which $\gamma_m \in [0, 1]$ and $\gamma_s \in [0, 1]$. Suppose $(p_m - c_m)\gamma_m \le (p_s - c_s)\gamma_s$. The expert weakly prefers recommending a serious treatment to recommending a minor treatment. Hence, his profit is $(p_s - c_s)\gamma_s$. Due to the *Verifiability* assumption, the client's highest willingness to pay is v_s upon being recommended a serious treatment. Hence $(p_s - c_s)\gamma_s \le v_s - c_s \le max\{(1-\theta)v_m - c_m, v_s - c_s\}$. Now, suppose $(p_m - c_m)\gamma_m > (p_s - c_s)\gamma_s$. It is necessary to require $\beta_u = 1$ and $\beta_o = 0$. Given the expert's strategy, the client's maximum willingness to pay is $(1-\theta)v_m$ upon being recommended a minor treatment. So, the expert's profit is at most $(1-\theta)v_m - c_m \le max\{(1-\theta)v_m - c_m, v_s - c_s\}$. Q.E.D.

Proof of Proposition 2. First, it is shown that these profits can be achieved by charging the specified prices. According to Lemmas 5 and 6, $v_m - c_m$ can be achieved by setting $p_m = v_m$ and $p_s \in [v_m + c_s - c_m, v_s]$. In particular, when $\theta \ge (c_s - v_m)/(v_s - v_m)$, according to Lemma 3, $\theta v_s + (1-\theta)v_m - c_s$ can be achieved by setting $p_m \in [c_m, v_m]$ and $p_s = \theta v_s + (1-\theta)v_m$. When $p_s \in (c_s + v_m - c_m, v_m]$, there is Partial Overtreatment and when $p_s = c_s + v_m - c_m$, there is Honest and Efficient Treatment in equilibrium. Note that the equilibrium profit is $max\{v_m - c_m, \theta v_s + (1-\theta)v_m - c_s\}$, where $v_m - c_m < \theta v_s + (1-\theta)v_m - c_s$ if and only if $\theta > (c_s - c_m)/(v_s - v_m)$.

Next, it is shown that there does not exist an equilibrium that yields a profit greater than $max\{v_m - c_m, \theta v_s + (1-\theta)v_m - c_s\}$. Consider an arbitrary equilibrium with (p_m, p_s) in which $\gamma_m \in [0, 1]$ and $\gamma_s \in [0, 1]$. Suppose $(p_m - c_m)\gamma_m \ge (p_s - c_s)\gamma_s$. The expert weakly prefers recommending a minor treatment to recommending a serious treatment. Consequently, his profit is $(p_m - c_m)\gamma_m$. Due to the *Verifiability* assumption, the client's highest willingness to pay is v_m upon being recommended a minor treatment. As a result, $(p_m - c_m)\gamma_m \le v_m - c_m \le max\{v_m - c_m, \theta v_s + (1-\theta)v_m - c_s\}$. Now, suppose $(p_m - c_m)\gamma_m < (p_s - c_s)\gamma_s$. It is necessary to require $\beta_o = 1$ and $\beta_u = 0$. Given the expert's strategy, the client's maximum willingness to pay is $\theta v_s + (1-\theta)v_m$ upon being recommended a serious treatment. So, the expert's profit is at most $\theta v_s + (1-\theta)v_m - c_s \le max\{v_m - c_m, \theta v_s + (1-\theta)v_m - c_s\}$. Q.E.D.

Proof of Proposition 4. The proof has two steps. Step 1 considers the case $\theta \in \left[0, \frac{c_s - c_m}{c_s - c_m + ((v_s - c_s) - (v_m - c_m))/(1-h)}\right]$. Step 2 considers $\theta \in \left(\frac{c_s - c_m}{c_s - c_m + ((v_s - c_s) - (v_m - c_m))/(1-h)}, 1\right]$. Let $Pr(s|p_i)$, $i = m, s$, denote the client's belief that she has a serious problem following a recommendation of price p_i. Throughout the proof we assume that the client believes that the expert is the opportunistic type following any price deviation.

Step 1. First, consider the client's strategy. Given $v_m - c_m \le v_s - c_s$, $p_s = c_s + v_m - c_m \le v_s$. Hence, it is optimal for the client to accept both prices with probability one.

Next, consider the opportunistic expert's recommendation strategy following the equilibrium price list. Since opportunistic expert will make the same profit from recommending p_m or p_s, honest recommendation is his best response.

Lastly, it is shown that neither behavioral type of the expert has a profitable deviation in price. Notice that

$$\frac{c_s - c_m}{c_s - c_m + \frac{(v_s - c_s) - (v_m - c_m)}{1-h}} < \frac{c_s - c_m}{v_s - v_m}.$$

According to Proposition 2, for $\theta < \frac{c_s - c_m}{c_s - c_m + ((v_s - c_s) - (v_m - c_m))/(1-h)}$, the highest profit the opportunistic type can make is $v_m - c_m$ given the client's off-equilibrium belief. So, the opportunistic type does not have a profitable price deviation. Suppose that the honest type has a profitable price deviation to (p_m', p_s'). It is necessary that $p_s' > c_s + v_m - c_m$ and $p_m' \le v_m$. Given the client's off-equilibrium belief that this price deviation is made by the opportunistic type, the client will reject p_s' anticipating that the opportunistic type will always recommend p_s'. Consequently, the honest expert's profit following (p_m', p_s') is at most $(1 - \theta)(v_m - c_m)$ which contradicts the hypothesis that the price list (p_m', p_s') is more profitable than the equilibrium price list.

Step 2. First, consider the client's strategy. Given the two behavioral types of expert's equilibrium recommendation strategy, the client's posterior belief of having the serious problem upon a recommendation of p_s is

$$\begin{aligned} Pr(s|p_s) &= \frac{Pr(p_s|s)Pr(s)}{Pr(p_s|s)Pr(s) + Pr(p_s|m)Pr(m)} \\ &= \frac{\theta}{\theta + (1-h)(1-\theta)}. \end{aligned}$$

Hence, the client's expected valuation from a serious treatment is

$$\frac{\theta v_s + (1-h)(1-\theta)v_m}{\theta + (1-h)(1-\theta)} = p_s.$$

So, it is the client's best response to accept p_s with probability one. When the expert recommends $p_m = v_m$, the client infers that she has the minor problem and her expected valuation from a minor treatment is v_m. Hence, it is the client's best response to accept p_m.

Now, consider the opportunistic expert's recommendation strategy following the equilibrium price list. Regardless of the client's problem, the opportunistic expert prefers to recommend p_s if and only if

$$\begin{aligned} \frac{\theta v_s + (1-h)(1-\theta)v_m}{\theta + (1-h)(1-\theta)} - c_s &\ge v_m - c_m \\ \theta &\ge \frac{c_s - c_m}{c_s - c_m + \frac{(v_s - c_s) - (v_m - c_m)}{1-h}}. \end{aligned} \tag{3}$$

Finally, it is shown that neither behavioral type of the expert has a profitable deviation in price. Given our assumption that the client believes the expert is opportunistic following any price deviation, according to Proposition 2 the maximum profit that can be achieved by the opportunistic type from a price deviation is

$$\mathrm{Max}\{\theta v_s + (1-\theta)v_m - c_s, v_m - c_m\}.$$

It has been shown that the opportunistic type's equilibrium profit is at least $v_m - c_m$ in Eq. (3). Because $\frac{\theta}{\theta + (1-h)(1-\theta)} > \theta$, the opportunistic expert's equilibrium profit is also greater than $\theta v_s + (1 - \theta)v_m - c_s$. The argument for no profitable price deviation for the honest type is similar to step 1 and hence is ignored. Q.E.D.

Proof of Proposition 5. The proof has two steps. Step 1 considers case (i). Step 2 considers case (ii). Again, throughout the proof it is assumed that the client believes that the expert is the opportunistic type following any price deviation.

Step 1. First, consider the client's strategy. Given the two behavioral types of expert's equilibrium recommendation strategy, the client's posterior belief of having the minor problem upon a recommendation of p_m is

$$Pr(m|p_m) = \frac{Pr(p_m|m)Pr(m)}{Pr(p_m|m)Pr(m) + Pr(p_m|s)Pr(s)} = \frac{1-\theta}{1-\theta + (1-h)\theta}.$$

Hence, the client's expected valuation from a minor treatment is

$$\frac{(1-\theta)v_m}{1-\theta + (1-h)\theta} = p_m.$$

So, it is the client's best response to accept p_m with probability one. When the expert recommends p_s, the client infers that she has the serious problem and her expected valuation from a minor treatment is v_s. Hence, it is the client's best response to accept p_s.

Now, consider the opportunistic expert's recommendation strategy following the equilibrium price list. Regardless of the client's problem, the opportunistic expert prefers to recommend p_m if and only if

$$\begin{aligned} \frac{(1-\theta)v_m}{1-\theta + (1-h)\theta} - c_m &\ge v_s - c_s \\ \theta &\le \frac{v_m - c_m - (v_s - c_s)}{v_m - c_m - (v_s - c_s) + (v_s - c_s + c_m)(1-h)}. \end{aligned} \tag{4}$$

Finally, it is shown that neither behavioral type of the expert has a profitable deviation in price. Given our assumption that the client believes the expert is opportunistic following any price deviation, according to Proposition 1 the maximum profit that can be achieved by the opportunistic type from a price deviation is

$$\mathrm{Max}\{(1-\theta)v_m - c_m, v_s - c_s\}.$$

It has been shown that the opportunistic type's equilibrium profit is at least $v_s - c_s$ in Eq. (4). Because $\frac{(1-\theta)}{1-\theta+(1-h)\theta} > 1-\theta$, the opportunistic expert's equilibrium profit is also greater than $(1 - \theta)v_m - c_m$. Suppose that the honest type has a profitable price deviation to (p_m', p_s'). It is necessary that $p_m' > \frac{(1-\theta)v_m}{(1-\theta)+(1-h)\theta}$ and $p_s' \le v_s$. But given the client's off-equilibrium belief, she will reject p_m'

because the opportunistic expert will always recommend p_m' which exceeds the client's expected benefit from a minor treatment.

Step 2. First, consider the client's strategy. Given $v_m - c_m > v_s - c_s$, $p_m = c_m + v_s - c_s \le v_m$. Hence, it is optimal for the client to accept both prices with probability one.

Next, consider the opportunistic expert's recommendation strategy following the equilibrium price list. Since opportunistic expert will make the same profit from recommending p_m or p_s, honest recommendation is his best response.

Lastly, it is shown that neither behavioral type of the expert has a profitable deviation in price. Notice that

$$\frac{v_m - c_m - (v_s - c_s)}{v_m - c_m - (v_s - c_s) + (v_s - c_s + c_m)(1-h)} > \frac{v_m - c_m - (v_s - c_s)}{v_m}.$$

According to Proposition 1, for $\theta > \frac{v_m - c_m - (v_s - c_s)}{v_m - c_m - (v_s - c_s) + (v_s - c_s + c_m)(1-h)}$, the highest profit the opportunistic type can make is $v_s - c_s$ given the client's off-equilibrium belief. So, the opportunistic type does not have a profitable price deviation. The argument for no profitable deviation for the honest type is similar to Step 1 and is ignored. Q.E.D.

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