



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.

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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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⁴ Alger and Salanie (2006) study the interesting case of partial verifiability.

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

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