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Working Paper

# Credence Goods Markets, Distributional Preferences and the Role of Institutions.[1]

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## Abstract

We study credence goods markets where an expert not only cares for her own monetary payoff, but also for the monetary payoff of her customer. We show how an expert with heterogeneous distributional preferences responds to monetary incentives in the absence of institutions, under liability and/or verifiability and identify optimal contracts for an expert with distributional preferences in each of these settings.

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# 1 Introduction

In this paper we study how a credence goods expert with heterogeneous distributional preferences responds to incentives in the absence of institutions, under liability and/or verifiability. We derive optimal contracts for each of these settings and find that distributional preferences have a large impact on an expert's behavior in the absence of institutions and in the verifiability case. However, distributional preferences have less impact in the presence of liability. We find that optimal contracts designed for an expert with distributional preferences are more efficient than standard (selfish) contracts if the expert is malevolent. Conversely, a customer forgoes a substantial part of his payoff if the expert is benevolent.

Darby and Karni (1973) add the concept of credence goods to Nelson (1970)'s categorization of ordinary goods, search goods and experience goods. In Nelson's framework, customers know which quality suits them best, but might have difficulties to infer the quality of the goods or services they receive. In the case of credence goods, customers only know that they have a need, but do not know what type of quality optimally satisfies it. They might even be unaware whether they have been treated correctly ex post. In either case, customers demanding credence goods have to rely on the services of an expert who has the ability to identify and satisfy their needs. This informational asymmetry provides an opportunity for shirking. Anecdotal and empirical evidence show that typical credence services such as car repairs, health care services and legal counseling are indeed prone to fraud. For example, Wolinsky (1993, 1995) cites a U.S. study indicating that more than half of all car repairs are unnecessary. Gruber et al. (1999) show that the relative frequency of caesarean deliveries responds to fee differentials. Iizuka (2007) suggests that Japanese doctors – who are allowed to sell pharmaceuticals at their office – tend to prescribe drugs with higher mark-ups.

Dulleck and Kerschbamer (2006) survey the credence goods literature and find that two institutions – liability against providing insufficiently low quality and verifiability of inputs – are of particular importance. They predict that both liability and verifiability are sufficient to contain fraud and show that credence goods markets are likely to break down if both institutions are missing. However, when Dulleck et al. (2011) test these theoretical predictions in laboratory experiments, they find that while liability performs roughly as predicted, there is less fraud than expected in the absence of institutions. Moreover, they find that verifiability has almost no effect on experts' behavior. In a complementary paper, Dulleck et al. (2009) show that experts have heterogeneous distributional preferences and argue that this explains the comparatively low level of fraud in the absence of liability and verifiability and the negligible impact of verifiability.[3]

The present paper goes one step further and searches for contracts that maximize a customer's expected monetary payoff (optimal contracts) when the expert has distributional preferences. For this purpose we introduce a parsimonious model that preserves the core incentive problems arising in credence goods markets – a unique combination of adverse selection and moral hazard – but abstracts from the structural assumptions of existing (signaling) models.

The paper proceeds as follows. Section 2 discusses the credence goods literature and the literature on distributional preferences. Section 3 introduces the model, specifies optimal contracts in the first-best case where the expert has no private information and introduces institutions formally. Section 4 studies the behavior of experts with distributional preferences in the second-best case where the expert has private information about the customer's needs and about her own actions. Section 5 derives optimal contracts for the second-best case. Results are discussed in section 6. Section 7 concludes.

## 2 Background and Related Literature

### 2.1 Credence Goods and the Role of Institutions

Credence goods markets have a unique informational structure. Experts have private information on the type of service that fits customers' needs best; therefore, customers face an adverse selection problem. In addition, customers might be unable to observe experts' behavior; therefore they might also face a moral hazard problem. Myerson (1982) introduces a generalized principal-agent model that allows to study situations where both adverse selection and moral hazard are present. In his framework, the principal's utility – which stochastically depends on the agents' actions – is verifiable.

[3] Dulleck et al. (2009) find that 25% of their subjects are altruistic, 14% are inequality averse and 18% are selfish. The remaining 43% behave selfish if their own monetary payoff is at stake. If their payoff is not at stake, 49% of the 43% are altruistic, 26% are inequality averse, 16% are spiteful. The remaining 9% cannot be assigned to either of these types. The authors show that altruism and inequality aversion can explain why not all customers are completely defrauded in absence of institutions, whereas inequality aversion and spite can account for the bad performance of verifiability.

Therefore, the principal can bring agents' incentives in line by conditioning transfers on her own utility level. This is not possible on credence goods markets, however, as a customers' utility level is assumed to be non-verifiable and/or non-monotonic in the experts' actions. For example, a car owner may have difficulties to prove that her car is not working due to an insufficient repair, and not due to reckless driving. Similarly, an inexperienced driver might be unaware that the car's performance is less than optimal. In the credence goods literature, these informational problems are overcome by the introduction of (market) institutions. Many institutions have already been discussed in the seminal paper by Darby and Karni (1973). They study warranties, service contracts and relational contracting, and suggest that a separation of diagnosis and treatment, capacity constraints and price choices can signal experts' intentions. As mentioned, Dulleck and Kerschbamer (2006) have established that liability and verifiability are sufficient to contain fraud if experts are selfish.[4] They survey the theoretical credence goods literature and find several strands that differ in the authors' assumptions on liability and verifiability and the resulting type of fraud. They find that three types of fraud are considered in the literature: experts might 'undertreat', that is, they provide low quality to consumers who need high quality; experts might 'overtreat', that is, they provide high quality to consumers who need low quality; and experts might 'overcharge', which means that they charge for a quality they did not provide. In the group of verifiability/non-liability models, overcharging is impossible due to verifiability, and the authors study how undertreatment and overtreatment can be avoided by choosing appropriate treatment prices (Darby and Karni, 1973; Richardson, 1999, Bonroy et al., 2010), capacity constraints (Emons, 1997; 2001) or specialization in certain treatments (Pesendorfer and Wolinsky, 2003 and Dulleck and Kerschbamer, 2009a). In many instances, verifiability makes it possible to avoid fraud completely. In the liability/non-verifiability strand of the literature, experts have the possibility to overcharge customers, while undertreatment is infeasible and experts have no incentive to overtreat. Experts choose to overcharge customers with positive probability such that customers are indifferent between accepting diagnosis and consulting a second expert or leaving the market (Pitchik and Schotter, 1987; 1993; Wolinsky, 1993; 1995; De Jaegher and Jegers, 2001; Fong, 2005; Sülze and Wambach, 2005, Alger and Salanie, 2006 and Liu, 2011). Marty (1999a, 1999b), Liu (2011) and Waibl (2011) study

[4] Additionally, customers have to be homogeneous and there have to be large economies of scope between diagnosis and treatment.

liability/non-verifiability settings where some experts are unconditionally honest. Other contributions include Taylor (1995), Ely and Välimäki (2003) and Park (2005), who study dynamic credence goods models.

Our model is most closely related to the model used by Dulleck et al. (2011). In this model, a customer (he) incurs a minor or a major problem, which can be diagnosed and treated by an expert (she). Diagnoses are costless and always correct. Minor treatments are less costly than major treatments, but only cure minor problems whereas major treatments cure both problems. Expert and customer play a dynamic game of incomplete information. The expert sets treatment prices. Observing these prices, the customer decides whether to accept the service or not. If he accepts, the expert learns the customer's problem, provides a treatment and charges one of the posted prices for it. Verifiability and liability are introduced as constraints on the expert's action space. Verifiability forces the expert to charge for the same treatment as provided; liability forces the expert to provide a major treatment if the customer has a major problem. Assuming that both parties are own-money maximizers, Dulleck et al. (2011) predict that equilibria without fraud can be obtained whenever liability or verifiability holds. In the liability case, the expert can be prevented from overcharging if the prices for minor and major treatments are identical. If the customer has the major problem, liability forces the expert to provide the major treatment. If the customer has the minor problem, it is in the expert's interest to maximize her profit by providing the cheaper minor treatment. In the verifiability case, the expert has an incentive to treat and charge honestly if price mark-ups (the differences between treatment prices and treatment costs) are identical for both treatments. Then the expert is indifferent between providing the appropriate treatment and maltreatment.

## 2.2 Distributional Preferences and their Implications on Market Behavior

The behavioral anomalies observed on experimental credence goods markets are consistent with experts having non-trivial distributional preferences.[5] These preferences are a prominent class of other-regarding preferences, where the utility of an agent not only depends on her own monetary payoff, but also on the monetary payoff of

[5] The behaviour observed by Dulleck et al. (2011) could also partly be explained by cultural norms. Norms that could play an important role on credence goods markets include honesty (Baiman and Lewis 1989), norms for solving the customer's problem (Dulleck and Kerschbamer, 2006) or norms for doing high-quality work (Beck et al., 2009). The role of norms is discussed in a companion paper (Erharter and Waibl, 2012).

other agents.[6] We consider a characterization of distributional preferences for a two-person context. The agent has preferences over her own monetary payoff ($m$ for 'my') and the monetary payoff of another person ($y$ for 'your'). We assume that these preferences can be represented by a piecewise-linear utility function where the agent's own payoff enters with a weight of one, and the other's payoff enters with a weight of $\gamma(m, y)$, where $\gamma(m, y) = b$ if her own monetary payoff is lower than the monetary payoff of the other agent (the agent is 'behind') and $\gamma(m, y) = a$ if her monetary payoff is higher than or equal to the payoff of the other agent (the agent is 'ahead').

$$U(m, y) = m + \gamma(m, y) \cdot y,$$

$$\text{where } \gamma(m, y) = \begin{cases} b \text{ if } m < y \\ a \text{ if } m \geq y \end{cases},$$

with $(a, b) \in (-1,1)$ and $b \leq a$.

The experimental evidence by Dulleck et al. (2009) and others (Andreoni and Miller, 2002; Fisman, Kariv and Markovits, 2007 and Iriberri and Rey-Biel, 2009) suggests that the other agent's payoff has in absolute terms a lower weight in an agent's utility function than the own payoff. Therefore, the agent is not willing to give up one monetary unit to increase or decrease the payoff of the other agent by one unit or less. Hence, it is reasonable to bound $(a, b)$ to $(-1,1)$. Moreover, it is reasonable to assume that the agent has a higher valuation for the other agent's payoff if he is ahead than if he is behind ($b \leq a$). This implies that the expert has convex better sets in payoff space. Both assumptions are consistent with the experimental data obtained by Dulleck et al. (2009). The assumption of a piece-wise linear utility function is restrictive but not uncommon. For example, the inequality aversion model by Fehr and Schmidt (1999) is piecewise linear and enjoys considerable empirical support. The distributional preferences most frequently discussed in the literature are summarized in Table 1.

[6] Other classes of other-regarding preferences include reciprocity (e.g. Rabin, 1993; Dufwenberg and Kirchsteiger, 2004; Cox et al., 2007; Segal and Sobel, 2007), type-dependent preferences (Levine, 1998) and guilt aversion (Charness and Dufwenberg, 2006; Battigalli and Dufwenberg, 2009).

**Table 1: Major Distributional Preferences in a Two-Person Context (see Kerschbamer 2011 for a similar classification)**

| preference type | $m < y$ | $m \geq y$ |
|---|---|---|
| selfish | $b = 0$ | $a = 0$ |
| altruistic | $b > 0$ | $a > 0$ |
| spiteful | $b < 0$ | $a < 0$ |
| compassionate | $b = 0$ | $a > 0$ |
| envious | $b < 0$ | $a = 0$ |
| inequality averse | $b < 0$ | $a > 0$ |

The utility of a selfish agent does neither increase nor decrease in the monetary payoff of the other agent. The utility of an altruistic agent increases in the monetary payoffs of the other agent (Andreoni and Miller 2002).[7] An agent is spiteful (Levine 1998) if her utility decreases in the payoffs of the other agent, while the utility of an envious agent decreases in the payoffs of the other agent if she is behind but is unaffected by the other's payoff if she is ahead (Bolton 1991, Kirchsteiger 1994, and Mui 1995). A compassionate agent has a positive attitude towards the payoff of the other agent if she is ahead, but does not care for the payoff of the other agent if she is behind.[8] An inequality averse agent incurs a disutility if she has either a lower or a higher monetary payoff than the other agent (Fehr and Schmidt 1999).[9] In the following we will refer to agents with $b > 0$ (altruism, compassion) as kind and to agents with $b < 0$ (spite, envy, inequality aversion) as unkind.

If distributional preferences affect market behavior, standard contracts designed to discipline self-regarding experts are typically no longer optimal. This issue has received increasing attention in the literature in recent years. Benabou and Tirole (2003), Fehr et al. (2007) and Bowles and Hwang (2008) argue that monetary

[7] Charness and Rabin (2002) and Engelmann and Strobel (2004) consider a preference for surplus maximization or efficiency, where an agent's utility increases in the (weighted or unweighted) sum of material payoffs. In a two-person context and with the assumption that $(a, b) < 1$ this concept cannot be distinguished from altruism.

[8] Andreoni and Miller (2002) and Engelmann and Strobel (2004) study maximin preferences. They assume that the utility of an agent increases in the lowest of all agents' payoffs. In a two-person context, this is identical to compassion.

[9] Bolton and Ockenfels (2000) introduce a model of inequality aversion where agents incur a disutility if their monetary payoff differs from the average payoff of all agents. In out two-person context, both assumptions are equivalent.

incentives might crowd-out non-monetary incentives such as altruism, reciprocity or an intrinsic motivation to perform a particular task. Another strand of literature examines the impact of inequality aversion on market behavior. Itoh (2004), Englmaier and Wambach (2005), Demougin et al. (2006), Desiraju and Sappington (2007), Dur and Glazer (2008), Bartling and von Siemens (2010b) and Neilson and Stowe (2010) study optimal employment contracts when workers are inequality averse and effort is not observable. Grund and Sliwka (2005) study inequality aversion in tournaments; Bartling and von Siemens (2010a) investigate the role of inequality aversion in partnerships. Cabrales and Calvó-Armengol (2008) and Kosfeld and von Siemens (2009, 2011) study labor market segregation when workers are inequality averse. The models studied differ in the reference group of the agents. Some authors contend that agents care only for the monetary payoff of their co-workers (e.g. Demoungin et al. 2006), while others assume that agents care solely for the monetary payoff of their boss (e.g. Englmaier and Wambach 2005, Dur and Glazer 2008). Shah (1998) suggests that spatial proximity can influence agents' reference group, while Cabrales and Calvó-Armengol (2008) argue that social distance affects the choice of referents. Although experimental evidence suggests that subjects' distributional preferences are heterogeneous (Fehr and Schmidt 1999, Kerschbamer 2011), most authors assume that other-regarding preferences are homogeneous and observable. Fehr et al. (2007) and von Siemens (2010) are notable exceptions.

## 3 A Parsimonious Credence Goods Model

Consider a customer (principal, he) and an expert (agent, she). The customer has either a low need $l$, or a high need $h$. The customer knows the prior probability of his needs, but not his actual needs. However, the expert learns the customer's needs at zero cost. Therefore, the customer's needs can be treated as expert's type $\theta_i \in \{\theta_l, \theta_h\}$, where type $\theta_l$ occurs with probability $f_l$ and $\theta_h$ occurs with probability $f_h = 1 - f_l$. If the customer has a low need, the expert can use a low treatment $x_l$ or a high treatment $x_h$ to satisfy the customer's need. If the customer has a high need, only a high treatment is sufficient to satisfy the customer's need. Expert's treatment cost for treatment $x_i$ is normalized to $x_i$. If the customer's need is satisfied, he receives a valuation of $v > x_h > x_l$, otherwise he gets a valuation of zero. The customer observes whether his needs have been satisfied, but does not necessarily know the expert's treatment choice. The expert receives a transfer $t \in \mathbb{R}$. We assume that players are risk neutral. To keep the analysis tractable, only the expert has distributional preferences, while the customer has self-regarding preferences.

The customer designs a mechanism that shapes the rules of interaction between the expert and himself. Formally, a mechanism specifies the set of messages the expert can send and commits the customer to demand a certain treatment and to pay a certain transfer upon receiving a specific message. Following Myerson (1979, 1982), it is sufficient to consider direct revelation mechanisms where the message space is the type space and where the expert has an incentive to reveal her type (the outcome of the diagnosis) truthfully and to follow the customer's treatment recommendation obediently. [10]

The timing of events is as follows: (i) nature draws expert's type, (ii) the customer designs a mechanism, specifying a treatment $x_i$ and a transfer $t_i$ for every type $\theta_i \in \{\theta_l, \theta_h\}$, (iii) the expert observes the mechanism, learns his type and decides whether to treat the customer or not. If he decides to treat the customer, he sends a message, otherwise the interaction ends. (iv) If the customer receives a message, she recommends a treatment as specified by the mechanism; (v) upon receiving the customer's recommendation, the expert provides a treatment, (vi) the expert receives the transfer specified by the mechanism and payoffs are realized.

The customer has utility function is

$$V(\theta_i, x_j, t_k) = \mathscr{v}(\theta_i, x_j) - t_k,$$

where $\mathscr{v}(\theta_i, x_j) = \mathscr{v}_{ij} = \begin{cases} v \text{ if } x_j \geq x_i \\ 0 \text{ else} \end{cases}$

The expert has utility function

$$U(\theta_i, x_j, t_k) = t_k - x_j + \gamma(\theta_i, x_j, t_k) \cdot [\mathscr{v}(\theta_i, x_j) - t_k]$$

where $\gamma(\theta_i, x_j, t_k) = \gamma_{ijk} = \begin{cases} b \text{ if } t_k - x_j \leq \mathscr{v}(\theta_i, x_j) - t_k \\ a \text{ else} \end{cases}$

and $\{a, b\} \in (-1,1)$ with $b \leq a$,

[10] This important result is reviewed in Appendix A.1.

where $\gamma(\theta_i, x_j, t_k)$ is the expert's distributional concern for the customer's payoff if she has type $\theta_i$, provides treatment $x_j$ and receives transfer $t_k$. If the expert refuses treatment, both players get an outside utility of zero.

In the first-best case, the customer can observe the expert's type and actions and can condition transfers on his observations. For each $i \in \{l, h\}$, the customer maximizes

$$(P0) \qquad \max_{x_i, t_i} \; v_{ii} - t_i \quad s.t.$$

$$(IR_i) \qquad t_i - x_i + \gamma_{iii}[v_{ii} - t_i] \geq 0,$$

where $(IR_i)$ is the expert's participation constraint, which requires that the expert's utility from treatment must be larger than or equal to her outside option. As $v > x_h > x_l$, the optimal contract specifies a low treatment for low problems, a high treatment for high problems and transfers that make the expert exactly indifferent between treating the customer and leaving the market. As $\gamma_{iii} \in (-1,1)$, every expert will accept a payoff that is slightly below half of the surplus. Hence $\gamma_{iii} = b$ for $i = \{l, h\}$ and transfers are given by $t_i = (x_i - bv)/(1 - b)$ for $i \in \{l, h\}$.

In the second-best case, the expert has private information about her type and possibly also about her actions. Therefore, the customer can condition his recommendation only on the expert's message. Transfers can be conditioned on the expert's message and possibly on her actions, depending on the institutional framework. Following Dulleck and Kerschbamer (2006), liability implies that the expert cannot undertreat and verifiability entails that the expert cannot overcharge. For the purpose of this paper, we let liability be a restriction on the expert's actions space $X^L \subset \{x_l, x_h\}$

$$\text{(Liability)} \qquad X^L = \begin{cases} \{x_h\} & \text{if } \theta_i = \theta_h \\ \{x_l, x_h\} & \text{else} \end{cases}.$$

Verifiability can be considered as a reformulation of the customer's transfer rule, where transfers are now directly conditioned on expert's actions instead of the expert's message

$$\text{(Verifiability)} \qquad t: \{x_l, x_h\} \to \mathbb{R}.$$

That is, the expert will get transfer $t_i$ when performing treatment $x_i$ for $i \in \{l, h\}$. We use the tie-breaking rule that the expert provides appropriate treatment when indifferent between treatments.

## 4 Institutions, Monetary Incentives and Expert's Behavior

In the second-best case, the expert has the possibility to make a wrong diagnosis and/or to choose an action different from the recommended one. In order to be treated and charged honestly, the customer's optimal contract has to satisfy at most 6 incentive constraints:

$$
\begin{array}{lll}
(IC_{lhh}) & t_l - x_l + \gamma_{lll}[v - t_l] & \geq t_l - x_l + \gamma_{lhh}[v - t_l] \\
(IC_{lhl}) & t_l - x_l + \gamma_{lll}[v - t_l] & \geq t_l - x_l + \gamma_{lhl}[v - t_l] \\
(IC_{llh}) & t_l - x_l + \gamma_{lll}[v - t_l] & \geq t_l - x_l + \gamma_{llh}[v - t_l] \\
(IC_{hll}) & t_h - x_h + \gamma_{hhh}[v - t_h] & \geq t_h - x_h + \gamma_{hll}[-t_h] \\
(IC_{hlh}) & t_h - x_h + \gamma_{hhh}[v - t_h] & \geq t_h - x_h + \gamma_{hlh}[-t_h] \\
(IC_{hhl}) & t_h - x_h + \gamma_{hhh}[v - t_h] & \geq t_h - x_h + \gamma_{hhl}[v - t_h]
\end{array}
$$

In words, incentive constraint $IC_{ijk}$ requires that given the need $\theta_i \in \{\theta_l, \theta_h\}$, the expert prefers to provide treatment $x_i$ and to charge transfer $t_i$ to providing treatment $x_j$ and charging transfer $t_k$. Depending on the institutional setting, more or less incentive constraints can be potentially binding. Moreover, the only incentive-compatible contracts might be those that specify uniform tariffs for both treatments and/or uniform treatments for both needs. The following lemmas record which provision and charging behavior is implementable in different institutional settings.

**Lemma 1 (Fraud in the Absence of Institutions).** In the absence of verifiability and liability, the expert overcharges whenever $t_l \neq t_\mathrm{h}$ (given $t_h \geq t_l$) and undertreats whenever $x_h > x_l + (\gamma_{hlh} - \gamma_{hhh})t_h + \gamma_{hhh}v$. Overtreatment is strictly dominated by overcharging.

***Proof.***

- Overcharging: As $b \leq a < 1$, the expert is never willing to give up one monetary unit in order to increase the payoff of the customer by one monetary unit. As overcharging is a mere redistribution of surplus, the expert overcharges whenever possible.

- Undertreatment: Assume that the expert always charges $t_h$. The expert undertreats whenever her utility from doing so is higher than the utility from appropriately providing high quality, $t_h - x_h + \gamma_{hhh}(v - t_h) < t_h - x_l + \gamma_{hlh}(-t_h)$. Rearranging terms gives $x_h > x_l + \gamma_{hlh}t_h + \gamma_{hhh}(v - t_h) = x_l + (\gamma_{hlh} - \gamma_{hhh})t_h + \gamma_{hhh}v$.
- To see that overtreatment is strictly dominated by overcharging, note that $t_h - x_l + \gamma_{llh}(v - t_h) > t_h - x_h + \gamma_{lhh}(v - t_h)$ as $x_h > x_l$ and hence $\gamma_{llh} \geq \gamma_{lhh}$.■

As follows from Lemma 1, incentive constraints $(IC_{lhl})$, $(IC_{llh})$, $(IC_{hlh})$ and $(IC_{hhl})$ can only be satisfied if there is a uniform transfer for both treatments. Then incentive constraints $(IC_{lhl})$ and $(IC_{lhh})$ and incentive constraints $(IC_{hll})$ and $(IC_{hlh})$ are equivalent. Moreover, the (remaining) incentive constraint preventing overtreatment $(IC_{lhh})$ is necessarily satisfied. The (remaining) incentive constraint preventing undertreatment can be satisfied but does not have to be. Note that Lemma 1 only considers the expert's incentive constraints. If the expert cannot get a non-negative utility even by defrauding the customer and/or if the customer cannot get a non-negative payoff either, then the market breaks down.

**Lemma 2 (Fraud under Liability).** Under liability, the expert overcharges if $t_l \neq t_h$. Overtreatment is strictly dominated by overcharging.

***Proof.*** Liability renders undertreatment infeasible. The result on overcharging and overtreatment follows from the arguments in the proof of Lemma 1.■

Under liability, incentive constraints $(IC_{hll})$ and $(IC_{hlh})$ are implied by the institution. Moreover, incentive constraint $(IC_{llh})$ can only be satisfied if there is a uniform transfer. The remaining incentive constraints preventing overtreatment, i.e. $(IC_{lhl})$ and $(IC_{lhh})$, and undercharging, i.e. $(IC_{hll})$, are necessarily satisfied.

In the absence of institutions and under liability, all experts exhibit the same charging behavior. This is the case because overcharging is a mere redistribution of income. Moreover, overcharging dominates overtreatment for all distributional types. In the absence of institutions, distributional types have different propensities to undertreat. Under liability, undertreatment is impossible. Hence all expert types have the same treatment behavior. Under verifiability, distributional types' treatment behavior is much more heterogeneous.

**Lemma 3 (Fraud under Verifiability).** Under verifiability, the expert overtreats whenever $t_h > \frac{1-\gamma_{lll}}{1-\gamma_{lhh}} t_l + \frac{x_h - x_l}{1-\gamma_{lhh}} + \frac{\gamma_{lll}-\gamma_{lhh}}{1-\gamma_{lhh}} v$ and undertreats whenever $t_h < \frac{1-\gamma_{hll}}{1-\gamma_{hhh}} t_l + \frac{x_h - x_l}{1-\gamma_{hhh}} - \frac{\gamma_{hhh}}{1-\gamma_{hhh}} v$.

***Proof.*** Overcharging is impossible due to verifiability. The expert prefers to overtreat if her utility from high treatment exceeds her utility from correctly providing low treatment. This is the case if $t_h - x_h + \gamma_{lhh}(v - t_h) > t_l - x_l + \gamma_{lll}(v - t_l)$. The expert prefers to undertreat if her utility from undertreatment exceeds her utility from correctly providing high treatment. This is the case if $t_l - x_l + \gamma_{hll}(-t_l) > t_h - x_h + \gamma_{hhh}(v - t_h)$. ∎

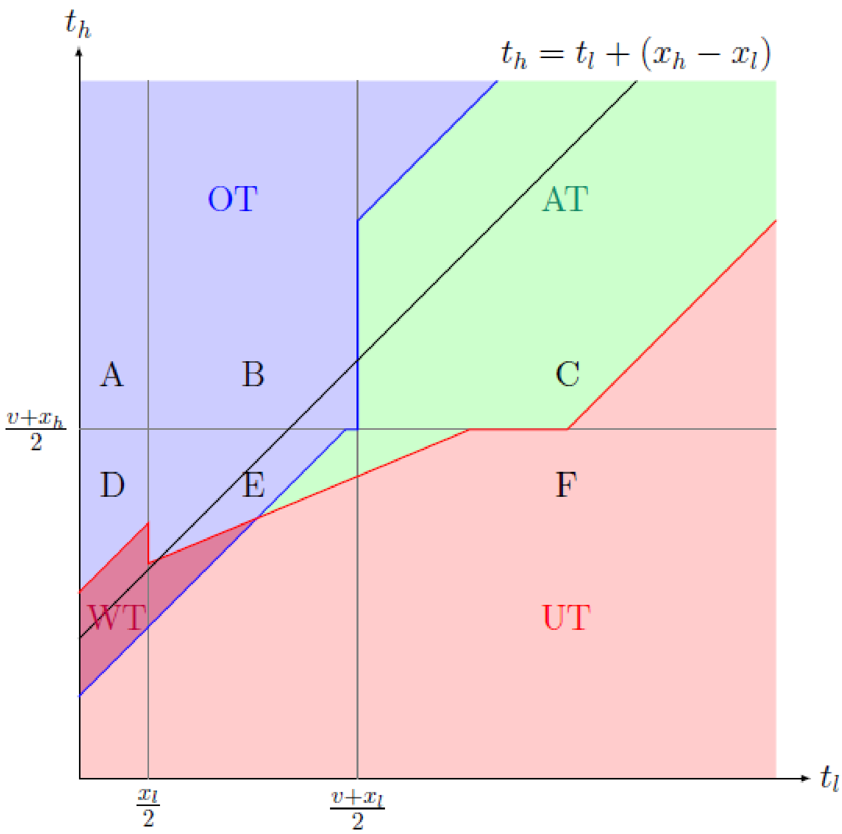
In the verifiability case, incentive constraints $(IC_{lhl}), (IC_{llh}), (IC_{hlh})$ and $(IC_{hhl})$ are implied by the institution. The incentive constraints preventing undertreatment $(IC_{hll})$ and overtreatment $(IC_{lhh})$ are potentially binding. Thus, it might be necessary to set a uniform treatment for both needs.

The behavior of experts with different distributional preferences under verifiability has already been studied by Dulleck et al. (2009). They suggest a neat representation of expert's behavior in price-space (or in our case: transfer space) as depicted in Figure 1.

Along the equal-payoff line $t_h = t_l + (x_h - x_l)$, the expert gets the same monetary payoffs from both treatments. Thus, a selfish expert provides appropriate treatment if $t_h$ is equal to $t_l + (x_h - x_l)$, undertreats if $t_h$ is smaller and overtreats if $t_h$ is larger than $t_l + (x_h - x_l)$. If the expert is altruistic, she will also provide appropriate treatment if $t_h$ is slightly smaller or larger than $t_l + (x_h - x_l)$. On the other hand, if the expert is spiteful, she might be willing to undertreat the customer even if $t_h$ is larger than $t_l + (x_h - x_l)$ and to overtreat the customer even if $t_h$ is smaller than $t_l + (x_h - x_l)$. Thus, there is a corridor along the equal payoff line where the expert always provides the wrong treatment. If the expert's valuation of the customer's payoff changes sign, all treatments might be feasible.

Figure 1 depicts the characteristic treatment behavior of an inequality averse expert. If the expert is always ahead, there is a corridor along the equal payoff-line where the expert provides appropriate treatment. If the expert is always behind, there is a corridor along the equal payoff line where she always provides the wrong treatment. If the expert is ahead when undertreating the customer but behind otherwise, there is a vector of transfers where the expert is indifferent between all kinds of treatments.

**Figure 1: The Behavior of an Inequality-Averse Agent under Verifiability (adopted from Dulleck et al. 2009)**




AT: appropriate treatment; OT: overtreatment; UT: undertreatment; WT: always wrong treatment; the figure depicts the behavioral pattern of an inequality averse expert with $a = 0.5, b = -0.5, v = 6, x_l = 2$ and $x_h = 4$; The derivation of Figure 1 is briefly discussed in Appendix A.2.;

**Lemma 4 (Fraud under Liability and Verifiability).** Under liability and verifiability, the expert overtreats whenever $t_h > \frac{1-\gamma_{lll}}{1-\gamma_{lhh}} t_l + \frac{x_h - x_l}{1-\gamma_{lhh}} + \frac{\gamma_{lll}-\gamma_{lhh}}{1-\gamma_{lhh}} v$.

***Proof.*** Undertreatment is impossible due to liability, overcharging is impossible due to verifiability. The result on overtreatment follows from Lemma 3. ■

In the case of liability and verifiability, the only remaining incentive constraint, $(IC_{lhh})$, prevents the expert from overtreating. Thus the treatment behavior of experts with different distributional preferences is more aligned than under verifiability alone.

## 5 Optimal Contracts

In the second-best case, where the expert has private information about the customer's problem and potentially also on her own provision behavior, the customer solves the optimization problem

$$(P1) \qquad \max_{x,t} f_l(\mathcal{v}_{ll} - t_h) + f_h(\mathcal{v}_{hh} - t_h) \quad s.t.$$

$$(IR_i) \qquad t_i - x_i + \gamma_{iii}[\mathcal{v}_{ii} - t_i] \geq 0 \qquad \text{for } i \in \{l,h\}.$$

$$(IC_{ijk}) \qquad t_i - x_i + \gamma_{iii}[\mathcal{v}_{ii} - t_i] \geq \; t_k - x_j + \gamma_{ijk}[\mathcal{v}_{ij} - t_k] \quad \text{for } (i,j,k) \in \{l,h\}.$$

Recall that $f_l$ and $f_h$ are the probabilities of having a low and a high problem respectively. A customer's valuation from treatment, $\mathcal{v}_{ij} \in \{0, v\}$, denotes his valuation given problem $i$ and treatment $j$. An expert's valuation of the customer's payoff, $\gamma_{ijk} \in \{a, b\}$, denotes her valuation given problem $i$, treatment $j$ and transfer $k$. In the following we derive optimal contracts for different institutional regimes and different preference types. These optimal contracts are summarized in Table 2 and illustrated in Figure 2.

In the **absence of institutions**, transfers have to be uniform for both treatments. Then the only potentially binding incentive constraint is the incentive constraint preventing undertreatment, $(IC_{hlh})$. If the customer gives up less than half of her payoff, the incentive constraint reduces to $b \geq (x_h - x_l)/2$. Then it is optimal for the customer to reduce transfers until one of the expert's participation constraints is binding. As $x_h > x_l$, this has to be the participation constraint for the high need. Hence, the optimal transfer is $t = t_l = t_h = (x_h - bv)/(1-b)$ and the expert provides appropriate treatment (type A contract in Table 2). If the expert is less benevolent, such that $b < (x_h - x_l)/2$ and $a \geq (x_h - x_l)/2$, appropriate treatment can still be obtained by setting transfer $t = t_l = t_h = (v + x_h)/2$. However, this can only be optimal for the customer if the probability of having a high need is not too small (type B contract).

Otherwise, it is optimal for the customer to accept undertreatment and to decrease transfers to $t = t_l = t_h = (x_l - bv)/(1-b)$ so that the expert's participation constraint for the low need is binding (type C contract). In particular, appropriate treatment is preferable to undertreatment if

$$v - \frac{v + x_h}{2} \geq f_l v - \frac{x_l - bv}{1-b} \text{ or } f_l \geq \frac{v - x_h}{2v} - \frac{x_l - bv}{(1-b)v} \equiv f_l^{BC}.$$

If the expert is less benevolent, such that $a < (x_h - x_l)/2$, it is optimal for the customer to accept undertreatment and to pay transfer $t = t_l = t_h = (x_l - bv)/(1-b)$ (type C contract), if this yields a non-negative utility. That is, undertreatment is optimal if $f_l v - (x_l - bv)/(1-b) \geq 0$ or $f_l \geq (x_l - bv)/(1-b)v \equiv f_l^{CO}$. Otherwise it is optimal for him to leave the market (type D 'contract').

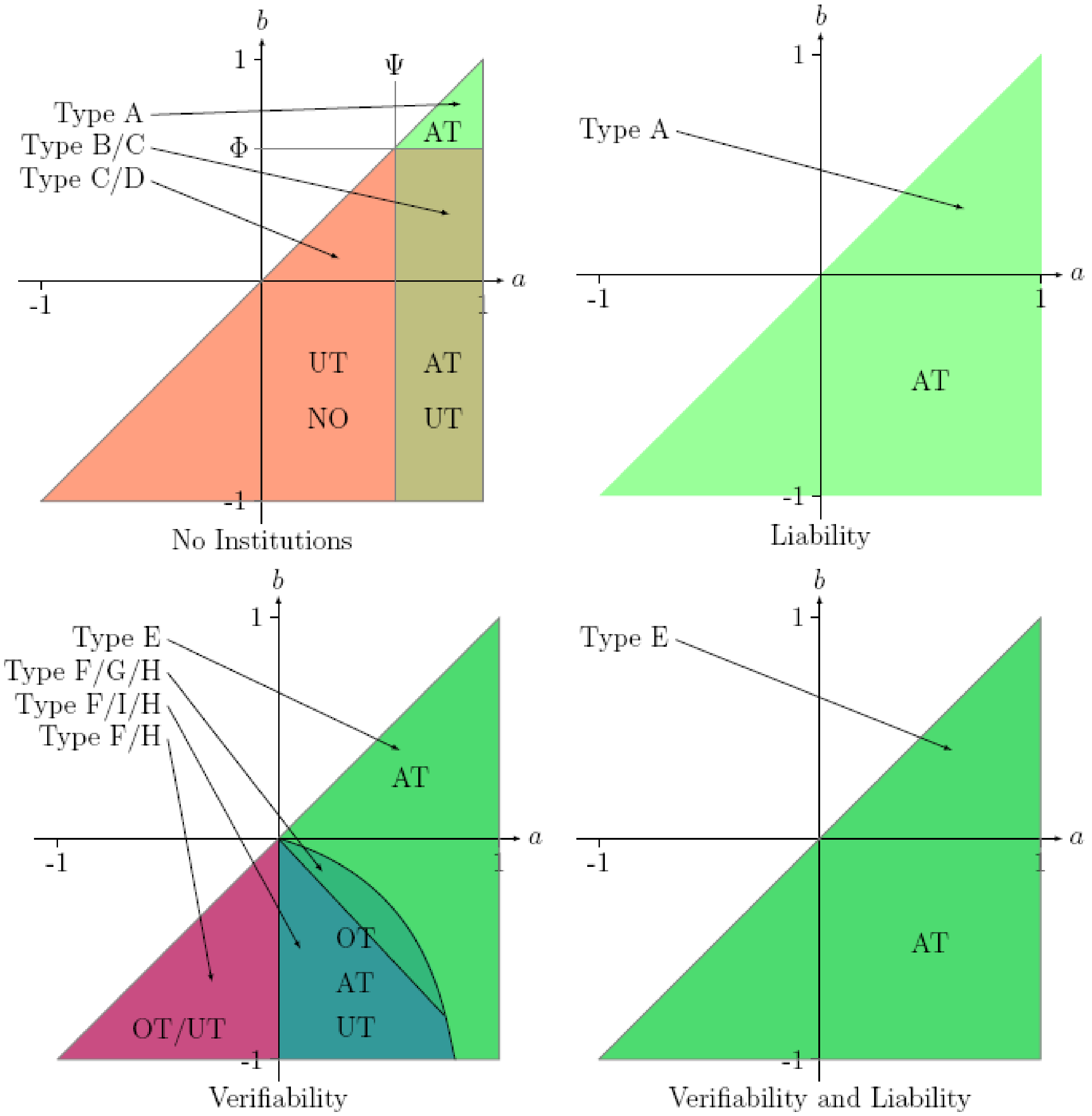
In the case of **liability**, overcharging again cannot be avoided. Accordingly there is still a uniform transfer. However, undertreatment is now ruled out. Hence, it is always optimal to require appropriate treatment and to decrease transfers until $t = t_l = t_h = (x_h - bv)/(1-b)$ (type A contract).

In the case of **verifiability**, overcharging is ruled out. Thus, two incentive constraints are potentially binding. Incentive constraint $(IC_{lhh})$ requires that the expert has no incentive to overtreat the customer, while $(IC_{hll})$ requires that the expert has no incentive to undertreat. Assume first that the expert provides appropriate treatment and that $t_l$ and $t_h$ can be lowered until the participation constraints are binding ($t_l = (x_l - av)/(1-b)$, $t_h = (x_h - av)/(1-b)$). Then the expert is behind in monetary terms if she either provides appropriate treatment or overtreats the customer ($\gamma_{lll} = \gamma_{hhh} = \gamma_{lhh} = b$). Assume that the expert is ahead in monetary terms when undertreating the customer ($\gamma_{hll} = a$). Inserting $t_l$ and $t_h$ into the incentive constraints shows that $(IC_{lhh})$ must always hold and simplifies $(IC_{hll})$ to $(a-b)x_l \geq -(1-a)bv$ or $a \geq b(v - x_l)/(bv - x_l)$. Hence, the expert provides appropriate treatment if she is sufficiently benevolent when ahead ($0 < a < 1$), even if she is malevolent when behind ($-1 < b < 0$). Note that this contract is equal to the first-best contract and thus has to be optimal (type E contract).

**Table 2: Optimal Contracts in the Second-Best Case where Expert's Problem Type is unknown.**

| Institution | Tag | Threshold | Optimal Contract |
|---|---|---|---|
| No Institutions | Type A | • $b \geq \frac{x_h - x_l}{2}$ | $t_l = t_h = \frac{x_h - bv}{1-b}$ and AT |
| | Type B | • $b < \frac{x_h - x_l}{2}$ and $a \geq \frac{x_h - x_l}{2}$ and $f_l \leq f_l^{BC}$ | $t_l = t_h = \frac{v + x_h}{2}$ and AT |
| | Type C | • $b < \frac{x_h - x_l}{2}$ and $a \geq \frac{x_h - x_l}{2}$ and $f_l > f_l^{BC}$ <br> • or $a < \frac{x_h - x_l}{2}$ and $f_l \geq f_l^{CO}$ | $t_l = t_h = \frac{x_l - bv}{1-b}$ and UT |
| | Type D | • $a < \frac{x_h - x_l}{2}$ and $f_l < f_l^{CO}$ | leave market |
| Liability | Type A | • none | $t_l = t_h = \frac{x_h - bv}{1-b}$ and AT |
| Verifiability | Type E | • $b \in (-1,1)$ and $a \in \left(\frac{b(v - x_l)}{bv - x_l}, 1\right)$ | $t_l = \frac{x_l - bv}{1-b}, t_h = \frac{x_h - bv}{1-b}$ and AT |
| | Type F | • $b \in (-1,1), a \in \left(-\frac{b(v + x_l)}{v - x_l}, \frac{b(v - x_l)}{bv - x_l}\right)$ and $f_l \in [f_l^{FG}, f_l^{FH}]$ | $t_l = \frac{-bv}{a-b}, t_h = \frac{v + x_h}{2}$ and AT |
| | Type G | • $b \in (-1,1), a \in \left(-\frac{b(v + x_l)}{v - x_l}, \frac{b(v - x_l)}{bv - x_l}\right)$ and $f_l < f_l^{FG}$ <br> • or $b \in (-1,0), a \in [0, -\frac{b(v + x_l)}{v - x_l}]$ and $f_l < f_l^{IG}$ <br> • or $b \leq a < 0$ and $f_l \leq f_l^{GH}$ | $t_l = 0, t_h = \frac{x_h - bv}{1-b}$ and OT |
| | Type H | • $b \in (-1,1), a \in \left(-\frac{b(v + x_l)}{v - x_l}, \frac{b(v - x_l)}{bv - x_l}\right)$ and $f_l > f_l^{FH}$ <br> • or $b \in (-1,0), a \in [0, -\frac{b(v + x_l)}{v - x_l}]$ and $f_l > f_l^{IH}$ <br> • or $b \leq a < 0$ and $f_l > f_l^{GH}$ | $t_l = \frac{x_l - bv}{1-b}, t_h = 0$ and UT |
| | Type I | • $b \in (-1,0), a \in [0, -\frac{b(v + x_l)}{v - x_l}]$ and $f_l \in [f_l^{IG}, f_l^{IH}]$ | $t_l = \frac{v + x_l}{2}, t_h = \frac{v + x_h}{2}$ and AT |
| Liability and Verifiability | Type E | • none | $t_l = \frac{x_l - bv}{1-b}, t_h = \frac{x_h - bv}{1-b}$ and AT |

**Figure 2: Optimal Contracts in the Second-best Case where Expert's (Problem) Type is unknown.**




AT: appropriate treatment; OT: overtreatment; UT: undertreatment; NO: no treatment/market breakdown;

$\Upsilon$: a $= \frac{x_h - x_l}{2}$, $\Phi: b = \frac{x_h - x_l}{2}$

If $0 < a < b(v - x_l)/(bv - x_l)$, it is still possible to obtain appropriate treatment, but this might no longer be optimal. Note first that undertreatment can only be avoided if the customer gives up at least half of the gains from trade in the high needs case. Thus, the expert is ahead when providing high treatment and when undertreating the customer ($\gamma_{hhh} = \gamma_{lhh} = \gamma_{hll} = a$). Assume that the expert is still behind when correctly providing low treatment ($t_l < (v - x_l)/2$ and thus $\gamma_{lll} = b$). In this case, incentive constraints $(IC_{hll})$ and $(IC_{lhh})$ reduce to

$$\gamma_{lll}[v - t_l] \geq \gamma_{hll}[-t_l] \Leftrightarrow t_l \geq -\frac{bv}{a-b}.$$

Hence, $t_l = -bv/(a-b)$ must be optimal. However, this transfer is bounded from below and above. The expert is behind when providing low treatment if $-bv/(a-b) < (v-x_l)/2$ or $a > -b(v-x_l)/(v+x_l)$. Furthermore, the expert's participation constraint when providing low treatment has to be satisfied. Hence, $-bv/(a-b) \geq (x_l - bv)/(1-b)$ or $a \leq -b(v-x_l)$. If these conditions hold, a contract with $t_l = -bv/(a-b)$, $t_h = (v+x_h)/2$ and appropriate treatment is feasible (type F contract). Yet, this contract is only optimal if neither low nor high needs are too frequent. When the probability of needing a low treatment is very large ($f_l \to 1$), it might be optimal for the customer to lower $t_l$ until the expert's participation constraint for the low need ($IR_l$) binds and to accept undertreatment. The contract with $t_l = (x_l - bv)/(1-b)$, $t_h = 0$ and undertreatment (type G contract) is optimal if

$$f_l v - \frac{x_l - bv}{1-b} > v - f_l \frac{-bv}{a-b} - f_h \frac{v+x_h}{2} \text{ or } f_l > \frac{b-a}{1-b} \frac{(1-3b)v + 2x_l - (1-b)x_h}{(3b-a)v + (a-b)x_h} \equiv f_l^{FH}.$$

Conversely, overtreatment might be optimal if the probability of needing a high treatment is very large ($f_h \to 1$). The contract with $t_l = 0$, $t_h = (x_h - bv)/(1-b)$ and overtreatment (type H contract) is optimal if

$$v - \frac{x_h - bv}{1-b} > v - f_l \frac{-bv}{a-b} - f_h \frac{v+x_h}{2} \text{ or } f_l < 1 - \frac{2}{1-b} \frac{(b-ab)v - (1-a)x_h}{(a+b)v + (a-b)x_h} \equiv f_l^{FG}.$$

If $-bv/(a-b) \geq (v-x_l)/2$, the expert only provides appropriate treatment if she gets at least half of the gains from trade for either need. Thus, the expert is always ahead in monetary terms and $\gamma_{hhh} = \gamma_{lhh} = \gamma_{hll} = \gamma_{lll} = a$. Therefore incentive constraints ($IC_{hll}$) and ($IC_{lhh}$) reduce to

$$\gamma_{lll}[v - t_l] \geq \gamma_{hll}[-t_l] \Leftrightarrow av \geq 0.$$

Thus, the contract with $t_l = (v - x_l)/2$, $t_h = (v - x_h)/2$ and appropriate (type I contract) is feasible if $a \geq 0$. This contract is optimal if $f_l^{IH} \leq f_l \leq f_l^{IG}$. The contract with $t_l = (x_l - bv)/(1-b)$, $t_h = 0$ and undertreatment (type G contract) is optimal if

$$f_l v - \frac{x_l - bv}{1-b} > v - f_l \frac{v + x_l}{2} - f_h \frac{v + x_h}{2} \text{ or } f_l > \frac{(1-3b)v - (1-b)x_h + 2x_l}{(1-b)(2v - x_h + x_l)} \equiv f_l^{IG}.$$

Conversely, the contract with $t_l = 0$, $t_h = (x_h - bv)/(1-b)$ and overtreatment (type H contract) is optimal if

$$v - \frac{x_h - bv}{1-b} > v - f_l \frac{v + x_l}{2} - f_h \frac{v + x_h}{2} \text{ or } f_l < 1 - \frac{2x_h - (1+b)v - (1-b)x_l}{(1-b)(x_h - x_l)} \equiv f_l^{IH}.$$

If $b \leq a < 0$, appropriate treatment is no longer feasible. The contract with $t_l = (x_l - bv)/(1-b)$, $t_h = 0$ and undertreatment (type G contract) is optimal if

$$f_l v - \frac{x_l - bv}{1-b} > v - \frac{x_h - bv}{1-b} \text{ or } f_l > \frac{(1-b)v - (x_h - x_l)}{(1-b)v} \equiv f_l^{GH}.$$

If $f_l \leq ((1-b)v - (x_h - x_l))/((1-b)v)$, the overtreatment contract with $t_l = 0$ and $t_h = (x_h - bv)/(1-b)$ (type H contract) is optimal.

In the case of **verifiability and liability**, undertreatment and overcharging are impossible. Hence, the only remaining incentive constraint, $(IC_{lhh})$, prevents overtreatment. As the constraint is relaxed when $t_h$ is small, $t_h$ can be decreased until the expert's participation constraint for the high need $(IR_h)$ is binding. Hence, $t_h = (x_h - bv)/(1-b)$. Furthermore, as even the most malevolent expert accepts a share of the surplus that is slightly smaller than the customer's share, $t_l$ can be smaller than $(v + x_h)/2$. Thus $\gamma_{lll} = \gamma_{lhh} = b$ and the incentive constraint simplifies to

$$t_l \geq \frac{x_h - bv}{1-b} - \frac{x_h - x_l}{1-b} = \frac{x_l - bv}{1-b}.$$

Hence, the first-best contract where $t_l = (x_l - bv)/(1-b)$, $t_h = (x_h - bv)/(1-b)$ and the expert provides appropriate treatment can be implemented (type E contract).

The intuition to Table 2 and Figure 2 can be summarized as follows: Separating contracts are more attractive to the customer if both needs are relatively frequent. As the probability of the low need increases ($f_l \rightarrow 1$), a contract that specifies undertreatment and a transfer that satisfies expert's participation constraint ($IR_l$) becomes more desirable. On the other hand, as the probability of the high need increases ($f_h \rightarrow 1$), overtreatment and a transfer that satisfies expert's participation constraint ($IR_h$) becomes more attractive. Moreover, it is easier to satisfy the expert's incentive constraints if the expert is benevolent. Hence, the optimality of separating contracts increases in valuation parameters $a$ and $b$.

## 6 Discussion

In the previous sections we have shown that distributional preferences have a large impact in the absence of institutions and in the verifiability case. On the other hand, the introduction of liability curtails expert's action space to the point where all distributional preference types have the same preferences over actions (if they do not leave the market).

Optimal contracts for a selfish expert are special cases of the optimal contracts derived in section 5. They are displayed in Table 3. Note that these contracts are qualitatively equivalent to the (signaling) contracts derived by Dulleck and Kerschbamer (2006) and Dulleck et al. (2011). In the case of liability, the authors find that appropriate treatment and a uniform transfer must be optimal. In the case of verifiability, the authors specify appropriate treatment and equal mark-ups over prices.

If offered to experts with distributional preferences, these contracts are less efficient than the contracts derived in section 5. In each institutional setting, malevolent (spiteful, envious and inequality averse) experts will prefer their outside option to the selfish contract. Hence the outcome is completely inefficient. Altruistic experts, however, would be willing to provide treatments for lower transfers. Hence, the outcome is sub-optimal for the customer. In the absence of institutions and in the case of verifiability, the customer is willing to accept undertreatment or overtreatment if the expert is malevolent. That is, the customer trades off optimality against efficiency. Consequently, the most malevolent expert type is not necessarily the type with the highest monetary payoff. While optimal contracts maximize customer's monetary payoff, efficient contracts maximize the sum of customer's and expert's payoff.

Table 3: Optimal Contracts in the Second-Best Case when the Expert is Selfish.

| Institution | Tag | Threshold | Optimal Contract |
|---|---|---|---|
| No Institutions | Type C | • $f_l \geq \frac{x_l}{v}$ | $t_l = t_h = x_l$ and UT |
| | Type D | • $f_l < \frac{x_l}{v}$ | leave market |
| Liability | Type A | • none | $t_l = t_h = x_h$ and AT |
| Verifiability | Type E | • none | $t_l = x_l,\ t_h = x_h$ and AT |
| Liability and Verifiability | Type E | • none | $t_l = x_l,\ t_h = x_h$ and AT |

Table 4: Examples for Efficient Contracts in the Second-Best Case.

| Institution | Tag | Threshold | Efficient Contract |
|---|---|---|---|
| No Institutions | Type A' | • $a \geq 0$ | $t_l = t_h = v$ and AT |
| | Type C' | • $a < 0$ and $f_l \geq \frac{x_l}{v}$ | $t_l = t_h = f_l v$ and UT |
| | Type D' | • $a < 0$ and $f_l < \frac{x_l}{v}$ | leave market |
| Liability | Type A' | • none | $t_l = t_h = v$ and AT |
| Verifiability | Type E' | • $a \geq 0$ | $t_l = v - \frac{x_h - x_l}{1-a}, t_h = v$ and AT |
| | Type G' | • $a < 0$ and $f_l \leq 1 - \frac{x_h - x_l}{v}$ | $t_l = 0, t_h = v$ and OT |
| | Type H' | • $a < 0$ and $f_l > 1 - \frac{x_h - x_l}{v}$ | $t_l = f_l v, t_h = 0$ and UT |
| Liability and Verifiability | Type E' | • none | $t_l = v - \frac{x_h - x_l}{1-a}, t_h = v$ and AT |

Efficient contracts are contracts where the gains from interaction are maximized. Efficient contracts for experts with distributional preferences are displayed in Table 4. Maximal efficiency is achieved if the expert provides appropriate treatment, and liability is sufficient to achieve this. Verifiability is only sufficient if the expert is benevolent when ahead ($a \geq 0$). When $a < 0$, appropriate treatment is infeasible in the absence of liability. If $f_l \leq 1 - (x_h - x_l)/v$, overtreatment is most efficient. If $f_l > 1 - (x_h - x_l)/v$, undertreatment is most efficient. Note that optimal contracts achieve the same efficiency level as efficient contracts in the presence of liability. However, in the absence of institutions and in the case of verifiability, the efficiency of optimal contracts is typically lower.

In this paper we have assumed that the customer has the power to design contracts. However, in many real world markets both customer and expert might hold bargaining power. In some cases, the bargaining power might even be completely on the expert's side. In this case, the expert claims the whole monetary surplus for herself, regardless of her distributional preferences. This leaves the customer indifferent between the contract and his outside option. In the absence of liability there will be more appropriate treatment if the expert choses contracts, than if the customer choses contracts. If the expert is not very altruistic ($b \ll 1$), both customer and expert can weakly increase their monetary payoff by introducing institutions. Ceteris paribus, the party with more bargaining power benefits more from the introduction of institutions. If the customer has all the bargaining power, the expert has the highest (expected) payoff if there is liability but no verifiability. Hence, all but the most altruistic expert should be willing to invest in liability. If liability is present, verifiability can only decrease expert's monetary payoff. Hence, no expert should be willing to invest into verifiability. Conversely, the customer gains more from the introduction of verifiability than from liability. Hence, he should be willing to invest into verifiability but not into liability. If the expert has all the bargaining power, the customer always gets an expected payoff of zero. Thus, the customer should not be willing to invest into institutions, while the expert should be willing to introduce liability.

## 6.1 Alternative Institutions

Where liability and/or verifiability are absent and their implementation is costly, other constraints might yield similar results (namely that certain parts of experts' action space are strictly dominated). One could be to increase the frequency of altruistic types entering the market. Many vocations require extensive training and it might be possible to screen agents' distributional types during education or apprenticeship. As potential experts might have an incentive to conceal their distributional types until they enter the market, this screening process has a dynamic component. Related problems are discussed by Ely and Välimäki (2003), who study perverse effects of reputation and Fong (2005), who considers dynamic screening of surgeons' ability. Another particularly promising approach is to shape agents' norms. Norms that could play an important role on credence goods markets include honesty (Baiman and Lewis 1989), the Hippocratic Oath (Dulleck and Kerschbamer, 2006) or norms for doing high-quality work (Beck et al., 2009). The process of internalizing norms is increasingly understood (Boyd and Richerson 1998, Ginitis 2003). If it would be possible to foster the internalization of specific norms in a systematic way, teaching norms to expert apprentices could be a viable substitute to liability and/or verifiability on credence goods markets. This possibility is explored in a companion paper (Erharter and Waibl, 2012).

### 6.2 Implications for actual Credence Goods Markets

Real world credence goods markets are highly complex. Many different factors such as capacity constraints, reputation and experts' competence can determine experts' behavior in specific settings. Therefore it is important to ask whether distributional preferences are likely to play a substantial role in any of these settings. Distributional preferences are less important in the presence of liability, as in this case all experts have the same treatment behavior (if they do not leave the market). Similarly, in the liability case factors such as capacity constraints or reputation have less impact on experts' behavior as well. However, distributional preferences become much more important when liability is absent. In particular, contracts designed for selfish experts might yield perverse incentives for inequality averse, envious and spiteful experts in this case. Economic experiments suggest that roughly one third of subjects exhibit such preferences (Dulleck et al., 2009). This fraction is large enough to affect policy outcomes. At the same time, two thirds of subjects seem to be selfish or benevolent. Therefore it might be ill-advised to tailor contracts to spiteful experts. We address the problem of designing optimal contracts when experts' distributional preferences are unknown in a companion paper (Erharter, 2012).

## 7 Conclusion

The present paper has studied credence goods markets where experts have non-trivial distributional preferences. Our investigation is motivated by experimental evidence suggesting that experts with distributional preferences do not respond to monetary incentives as predicted by standard theory (Dulleck et al., 2009, 2011). This evidence ties in with a growing theoretical and experimental literature arguing that monetary incentives can have unintended consequences if agents have other-regarding preferences. In this paper we have examined how experts with heterogeneous distributional preferences respond to monetary incentives in the absence of institutions, under liability and/or verifiability. Furthermore, we have identified optimal contracts for experts with distributional preferences in each of these settings. We have assessed the efficiency and optimality of these contracts in comparison to standard optimal contracts designed for selfish experts and in comparison to efficient contracts designed for experts with distributional preferences. The paper has introduced a parsimonious model that preserves the core problems arising in credence goods markets – a unique combination of adverse selection and moral hazard – but abstracts from the structural assumptions of existing models. This model connects the credence goods literature to the screening literature at large. Moreover, the model's parsimony and flexibility makes it a valuable tool for future research.

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## Appendix

### A.1 Mechanisms, Institutions and Revelation

#### A.1.1 Mechanisms

Let $\Theta = \{\theta_l, \theta_h\}$ be the expert's type space, $\mathcal{X} = \{x_l, x_h\}$ the expert's action space and $T = \mathbb{R}$ the space of possible transfers. The customer designs an **(indirect) mechanism** $(M, R, (\tilde{r}, \tilde{t}))$, where M is the space of all feasible messages the expert is allowed to send in order to inform the customer about her type (her diagnosis), and R is the space of all feasible treatment recommendations the customer can make to the expert upon receiving a diagnosis. The customer commits to use recommendation rule $\tilde{r}: M \to R$ and transfer rule $\tilde{t}: R \times M \to T$. Note that the customer's recommendation depends exclusively on the expert's message. The expert's treatment choice is unobservable and unverifiable. The customer observes whether his needs have been satisfied, but the mapping from treatments to customer's valuation is not one-to-one. Consequently transfers only depend on the expert's message and the customer's recommendation. As usual a mechanism is called feasible if all participation constraint(s) (IR) are satisfied and incentive-compatible or implementable if all incentive constraints (IC) hold.

A **direct mechanism** can be represented by a vector $(r, t)$, as $M = \Theta$ and $R = \mathcal{X} = \{x_l, x_h\}$. Consequently, $r: \Theta \to \mathcal{X}$ and $t: \mathcal{X} \times \Theta \to T$. According to the revelation principle, it is without loss of generality to focus on direct mechanisms. Myerson (1979) shows that the revelation principle applies even if an agent's utility depends on the entire allocation and/or on other agents' types. Moreover Myerson (1982) shows that the revelation principle in a 'generalized' principal-agent framework, where the principal faces adverse selection and moral hazard. As these results are of considerable importance for the present paper, we show them formally. Let the agent have the more general utility function $U(\theta, x, t) = t - u(\theta, x)$, where $u$ is strictly convex and strictly increasing in $x$ and monotonous (non-increasing or non-decreasing) in $\theta$. The agent's best responses to the indirect mechanism $\left(M, R, (\tilde{r}, \tilde{t})\right)$ are a best message $m^*(\theta)$ and a best decision $x^*(\tilde{r}(m^*(\theta)), \theta)$, both implicitly defined by

$$\tilde{t}\big(m^*(\theta)\big) - u(x^*(\tilde{r}(m^*(\theta)), \theta)) \geq \tilde{t}(\tilde{r}(\widetilde{m}), \widetilde{m}) - u(\tilde{x}(\tilde{r}(\widetilde{m}), \theta), \theta)$$

$\forall \widetilde{m} \in M$ and $\forall \tilde{x} \in \mathcal{X}$

A direct mechanism is incentive compatible if it is a best response for the agent to be honest and obedient. That is: $m^*(\theta) = \theta,\ x^*(r(\theta), \theta) = r(\theta)$.

**Proposition (Revelation Principle, Myerson (1982)).** Any allocation rule $A(\theta) = (x^*(\tilde{r}(m^*(\theta)), \theta), \tilde{t}(m^*(\theta)))$ obtained with an indirect mechanism $\left(M, R, (\tilde{r}, \tilde{t})\right)$ can also be implemented with an incentive-compatible direct mechanism $(r, t)$.

***Proof.*** $\left(M, R, (\tilde{r}, \tilde{t})\right)$ induces $A(\theta)$.

Simulation of allocation: by composition we can construct a direct mechanism $(r, t)$, where $r(\theta) = \tilde{r} \circ m^*(\theta)$ and $t(\theta) = \tilde{t} \circ (\tilde{r}(m^*(\theta)), m^*(\theta))$, that induces $A(\theta)$ as well. Denote $x(\theta) = x^*(r(\theta)) = x^*(\tilde{r}(m^*(\theta)), \theta)$.

Incentive-compatibility: since $m^*(\theta)$ and $x^*\left(\tilde{r}\left(m^*(\theta)\right), \theta\right)$ are best for the agent among all $\widetilde{m} \in M$ and $\tilde{x} \in X$ respectively, this holds in particular for $\widetilde{m} = m^*(\theta')$ and $\tilde{x} = \tilde{x}\left(\tilde{r}\left(m^*(\theta')\right), \theta\right)$. Thus

$$\tilde{t}\left(\tilde{r}\left(m^*(\theta)\right), m^*(\theta)\right) - u(x^*\left(\tilde{r}\left(m^*(\theta)\right), \theta\right), \theta)$$
$$\geq \tilde{t}\left(\tilde{r}\left(m^*(\theta')\right), m^*(\theta')\right) - u(\tilde{x}\left(\tilde{r}\left(m^*(\theta')\right), \theta\right), \theta);$$

Using the definition of $(r, t)$ and $x(\theta)$, this inequality can be transformed to

$$t(x(\theta), \theta) - u(x(\theta), \theta) \geq t(x(\theta'), \theta') - u(\tilde{x}(\theta'), \theta) \quad \forall (\theta, \theta') \in \Theta^2$$

which proofs that the direct mechanism $(r, t)$ is incentive compatible.■

### A.1.2 A General Formulation of Technical and Legal Institutions

For the purpose of this paper, we have defined liability as restriction of the expert's actions space and have assumed that verifiability allows the customer to condition transfers on expert's actions. More generally, technical and legal institutions could be viewed as restrictions of the expert's (material) payoff space. In that case, an institution specifies a fine $F \gg 0$ that is imposed on the agent with probability $\rho \in (0,1]$ if the agent chooses an action that is not in some subspace $X \subset \mathcal{X}$, where $X: \Theta \times R \to \mathcal{X}$. Note that if $r \in (0,1)$, institutions are stochastic. Agent's utility is given by

$$\widehat{U}(x, t, \theta) = U(x, t, \theta) - \lambda \cdot \rho F$$

$$\text{where } \lambda = \begin{cases} 0 & \text{if } \quad x \in X(\theta, r(\hat{\theta})) \\ 1 & \text{else} \end{cases}$$

This formulation corresponds to Hölmstrom (1979)'s concept of a "forcing contract". It allows for "imperfect" institutions that do not function all of the time and/or are more tolerant to small deviations from $X$ than to large deviations (if $\rho$ depends on $x$).

### A.2 Expert's behavior under Verifiability

Dulleck et al. (2009) suggest a neat representation of expert's behavior in the verifiability case. By assumption, the sign and extent of the expert's distributional preferences change only once, when the expert and the customer have equal payoffs. If the customer is not undertreated, payoffs are equal if $\pi_l = t_l - x_l = V_l = v - t_l$ and $\pi_h = t_h - x_h = V_h = v - t_h$. Rearranging terms yields the thresholds $t_l^{eq} = (v + x_l)/2$ and $t_h^{eq} = (v + x_h)/2$. If the customer is undertreated, payoffs are equal if $\pi_l = t_l - x_l = V_l = -t_l$. This yields the threshold $t_l^{eq'} = x_l/2$. Together, these three thresholds divide the payoff space into 6 sections. As outlined in Table 5, the expert has different distributional preferences in each of these sections.

**Table 5: Expert's Valuation of Customer's Payoff.**

| Section | $t_l$ | $t_h$ | $\gamma_{lll}$ | $\gamma_{lhh}$ | $\gamma_{hll}$ | $\gamma_{hhh}$ |
|---|---|---|---|---|---|---|
| A | $t_l < t_l^{eq'}$ | $t_h > t_h^{eq}$ | $b$ | $a$ | $b$ | $a$ |
| B | $t_l^{eq'} < t_l < t_l^{eq}$ | $t_h > t_h^{eq}$ | $b$ | $a$ | $a$ | $a$ |
| C | $t_l > t_l^{eq}$ | $t_h > t_h^{eq}$ | $a$ | $a$ | $a$ | $a$ |
| D | $t_l < t_l^{eq'}$ | $t_h < t_h^{eq}$ | $b$ | $b$ | $b$ | $b$ |
| E | $t_l^{eq'} < t_l < t_l^{eq}$ | $t_h < t_h^{eq}$ | $b$ | $b$ | $a$ | $b$ |
| F | $t_l > t_l^{eq}$ | $t_h < t_h^{eq}$ | $a$ | $b$ | $a$ | $b$ |

If $a \neq b$, expert's treatment behavior has to be specified separately for each section. If transfers are strictly above all thresholds ($t_l > t_l^{eq} > t_l^{eq'}$ and $t_h > t_h^{eq}$, section C in the table) the expert always gets a higher monetary payoff than the customer. Thus,

$\gamma_{lll} = \gamma_{lhh} = \gamma_{hll} = \gamma_{hhh} = a$. Inserting $a$ into the inequalities derived in Lemma 3, it turns out that the expert overtreats whenever $t_h > t_l + (x_h - x_l)/(1-a)$ and undertreats whenever $t_h < t_l + (x_h - x_l)/(1-a) - av/(1-a)$. If the expert is inequality averse, $a$ is positive. Hence, these inequalities cannot hold simultaneously. There can only be undertreatment or overtreatment, but not both. Moreover, there has to be a range of parameters where neither inequality holds. In that case, the expert prefers to provide appropriate treatment. The derivation of expert's behavior in sections A,B and D-F is analogous.

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Credence goods markets, distributional preferences and the role of institutions

**Abstract**
We study credence goods markets where an expert not only cares for her own monetary payoff, but also for the monetary payoff of her customer. We show how an expert with heterogeneous distributional preferences responds to monetary incentives in the absence of institutions, under liability and or verifiability and identify optimal contracts for an expert with distributional preferences in each of these settings.

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