Social Norms and Cheating: An Application to Credence Goods Markets*

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November 13, 2024

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Abstract

In credence goods markets, consumers possess less information than experts about whether the products or services fit their needs. This information asymmetry can lead to fraudulent practices, such as mistreatment and overcharging. This paper explores how behavioral factors shape market outcomes in credence goods markets by focusing on two psychological preferences of the expert: an intrinsic cost to cheating (Cheating Aversion) and a social-image concern (Perceived Cheating Aversion). I develop a formal social-norm-based framework to define cheating and analyze equilibrium behavior, consumer surplus, and efficiency of credence goods games within two institutional settings: (i) verifiability, and (ii) liability.

Keywords: social norm, cheating, credence goods, social image, psychological game theory.

JEL Codes: D90, D91

*I am deeply grateful for guidance and support from my advisor Martin Dufwenberg. I also thank Andreas Blume, Inga Deimen, Laurent Mathevet, Charles Noussair, and Ina Taneva for their helpful comments and advice. In addition, I greatly benefited from useful suggestions at the University of Arizona theoretical seminar and the Institute for Behavioral Economics seminar. All errors are my own.

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1 Introduction

This paper explores markets for credence goods – products or services whose necessity or suitability consumers cannot easily assess, even after consumption (Darby and Karni, 1973). Consumers are less informed than experts about whether the service provided by the experts meets their needs. For instance, a patient relies on a physician for diagnosis and treatment but may not know if the prescribed treatment is truly necessary. Similar challenges arise when a customer depends on a mechanic for repairs, or a client on a financial expert for investment decisions.

Information asymmetry in credence goods markets creates strong incentives for experts to exploit consumers. Fraudulent behavior has been documented across various industries.[1] Nonetheless, evidence suggests that experts do not always exploit these opportunities to the full extent. In some cases, they act honestly even when it goes against their financial interests. For instance, Gottschalk et al. (2020) find that many dentists provide appropriate care. Hennig-Schmidt et al. (2011) and Hennig-Schmidt and Wiesen (2014) show that medical students frequently prioritize patients' well-being over financial gain. These findings imply that financial incentives are not the sole determinants of expert behavior; psychological costs associated with cheating also play a significant role in decision-making.

Empirical evidence shows that individuals have an intrinsic aversion to cheating and are concerned about their social image, particularly, how others perceive their honesty, in self-reporting contexts.[2] This paper investigates how these two behavioral factors shape equilibrium behavior and consumer welfare in credence goods settings.

I focus on two key psychological motivations: *Cheating Aversion*, the intrinsic cost from engaging in cheating, and *Perceived Cheating Aversion*, the psychological cost of being perceived as a cheater. Unlike traditional models, player's utility here depends not only on the terminal node but also on the plans and beliefs of others. This induces a psychological game, requiring the tools of psychological

[1] For example, mechanics may charge for repairs they haven't performed (Kerschbamer et al., 2016; Bindra et al., 2021); doctors might misdiagnose patients to recommend more expensive treatments (Das et al., 2016; Gottschalk et al., 2020); financial advisors may suggest high-commission products over cheaper alternatives that serve the same purpose (Mullainathan et al., 2012); and taxi drivers might take longer routes to increase fares (Balafoutas et al., 2013).

[2] Lab experiments, such as *Cheating Game* (Fischbacher and Föllmi-Heusi, 2013), *Deception Game* (Gneezy, 2005), and *Matrix Task* (Mazar et al., 2008), show that people often refrain from cheating to the fullest extent, indicating psychological costs associated with dishonesty. Furthermore, Abeler et al. (2019)'s meta-study on cheating games suggests that models incorporating social image concerns and/or intrinsic cheating costs, as developed by Dufwenberg and Dufwenberg (2018), Gneezy et al. (2018), and Khalmetski and Sliwka (2019), best explain the observed behavior.

game theory (Geanakoplos et al., 1989; Battigalli and Dufwenberg, 2009) for the analysis.

I incorporate these behavioral considerations into the model of Dulleck and Kerschbamer (2006). I consider a one-shot game between an expert and a consumer. The consumer faces a problem that could be either minor or major, but he only knows the prior probability of each scenario, not the actual nature of the problem. The expert, after diagnosing the issue, can choose to provide either a cheap treatment or an expensive one. The cheap treatment addresses only the minor problem, while the expensive treatment resolves both minor and major problems. The consumer's (material) payoff depends on whether the problem is successfully resolved and on the amount paid. The expert's (material) payoff is based on the price charged and the cost of the treatment delivered.

I analyze credence goods games within two distinct institutional environments – (i) *verifiability* and (ii) *liability*, which have led the literature in two different directions. *Verifiability* refers to the consumer's ability to verify the treatment post-administration, a condition often seen as necessary for experts to charge for services (Emons, 1997; Dulleck and Kerschbamer, 2006). However, even with verifiability, experts may exploit consumers through over- or under-treatment.[3] In contrast, *liability* requires experts to provide treatments that sufficiently addresses the consumer's issue (Pitchik and Schotter, 1987; Wolinsky, 1993; Liu, 2011). While liability eliminates under-treatment, it does not prevent overcharging or over-treatment.[4]

A key challenge in this paper is to formally define "cheating." [5] Here, I define cheating as the violation of a prescriptive rule with the intent to gain an unfair advantage over another party. To explore this, I introduce the concept of *social norms*, which are widely accepted rules that guide decision-making in social contexts and are shared within a society or group (Elster, 1989; Benabou and Tirole, 2011; Bicchieri, 2016). This paper emphasizes the injunctive aspect of social norms—what individuals *ought to do* in specific situations—as moral reference points for honesty.

Formally, I model a social norm as a partial strategy, specifying a choice for a subset of information sets that individuals might encounter.[6] This approach reflects the idea that a social norm

[3]For example, a homeowner may see a full roof replacement but not realize they were over-treated, or a driver may be uncertain if a minor tire repair was sufficient.

[4]For instance, a patient might experience pain relief after a root canal but still question its necessity or cost.

[5]The *Oxford English Dictionary* defines "cheating" as "to defraud; to deprive of by deceit," "to deceive" or "to deal fraudulently." Economists often use "cheating" to refer to non-cooperative behavior, while in psychology, cheating is seen as a moral wrongness, where cheaters break rules and cause an unfair distribution of benefits and burdens (Morris 1968). Philosophical perspectives emphasize prescriptive rule-breaking and the pursuit of unfair advantages as central to the definition of cheating (Green 2004).

[6]López-Pérez 2008 and Bicchieri and Sontuoso 2020 define a social norm as a correspondence that assigns one or more actions from each available action set.

may prescribe behavior only in certain situations for some individuals, while leaving other scenarios unspecified, subject to individual discretion and potential disagreement. In the context of credence goods, I focus on a social norm that requires the expert to recommend and provide appropriate treatment and charge the corresponding price.[7] *Cheating* is defined as a violation of social norms, with its severity determined by two factors: the benefit gained by the norm-breaker and the harm caused to others. *Perceived cheating* refers to how others perceive an individual's cheating. The substantial information asymmetry in credence goods markets creates an environment of imperfect information, where a truthful expert may be perceived as a cheater, while an expert who violates the social norm may still be seen as honest.

The key results indicate that incorporating psychological concerns about cheating and perceived cheating mitigate unethical behavior and enhance efficiency in both *verifiability* and *liability* institutional settings. Under *verifiability*, relatively low sensitivity to these concerns benefits consumers, while high sensitivity may result in a mere transfer of money from the consumer to the expert, ultimately harming the consumer. In contrast, under *liability* condition, psychological concerns have no impact on consumer utility, and high sensitivity only serves to benefit the expert.

Most previous models addressing remedies for fraudulent behavior and inefficiency in credence goods markets assume that experts are purely profit-maximizing (Pesendorfer and Wolinsky, 2003; Inderst and Ottaviani, 2012a,b; Dulleck and Kerschbamer, 2006; Frankel and Schwarz, 2014). This paper contributes to the literature by exploring how the expert's psychological factors influence market outcomes, particularly focusing on cheating aversion and social-image concerns.

A few studies have considered the role of behavioral concerns among experts in credence goods markets. For instance, Liu (2011) examines a market with conscientious type of expert whose utility comes from profit and resolving the consumer's problem, while Fong et al. (2014) discusses the impact of "honest" experts who are bound to make truthful recommendations. Beck et al. (2013) and Kerschbamer et al. (2017) use lab experiments to test theories of guilt aversion and prosocial/antisocial preferences, respectively. These studies do not consider the role of social image – how experts are perceived by others. To the best of my knowledge, this paper is the first to

[7] There is realistic evidence supporting this social norm. For example, the famous Hippocratic Oath requires new physicians to swear upon a number of healing gods to commit themselves to a set of professional ethical principles: "I swear by Apollo Healer ... I will use those dietary regimens which will benefit my patients according to my greatest ability and judgment, and I will do no harm or injustice to them." The NADA/ATD Code of Ethics aims to strengthen dealers' personal commitment to providing quality service and upholding high ethical standards.

analyze the impact of social-image concerns and intrinsic cheating costs on market outcomes in credence goods settings.

The most closely related work is Fong et al. (2014), which compares credence goods markets under the institutional settings of verifiability and liability. Their main finding suggests that, under certain parameter configurations, experts behave more honestly and market outcomes are more efficient under liability compared to verifiability. There are two key differences between our models: (i) in their main analysis, the expert is assumed to be purely selfish,[8] whereas in this paper, the expert has psychological concerns about (perceived) cheating; (ii) in their model, the expert has the option to refuse treatment, whereas my model assumes that the expert must provide a treatment once the consumer opts to enter the market. I find that when the expert has low psychological concerns, the result of Fong et al. (2014) holds. However, if the expert has sufficiently high concerns, verifiability consistently outperforms liability in terms of efficiency and honesty.

Another contribution of this paper is the development of a formal approach to modeling cheating in environments governed by social norms. Dufwenberg and Dufwenberg (2018) implicitly assume that "telling the truth" serves as the moral reference point and model cheating based on payoff consequences in self-reporting contexts. My framework extends their analysis by capturing a broader range of cheating behaviors, analyzed through the lens of established social norms.

In the next section, I introduce a social-norm-based framework to define cheating in general contexts. Section 3 outlines the model of the Credence Goods Game with verifiability (CGG-V). Section 4 presents the equilibrium results for CGG-V. In Section 5, I introduce the model of the Credence Goods Game with liability (CGG-L), and analyze the resulting equilibria. Finally, Section 6 concludes the paper.

2 Social Norms and Cheating

2.1 A General Framework

Consider a finite multi-stage game with perfect recall, chance moves, and imperfect information. Following Battigalli and Dufwenberg (2009) (henceforth BD09), I model the extensive game form

[8] In Section 5, Fong et al. (2014) discuss how the market outcome changes under verifiability when there is an "honest" type of expert. However, unlike my model, they assume that the honest expert is compelled to make truthful recommendations.

as a tuple, $G = \langle I, \bar{H}, \iota, \sigma_0, (\mathcal{T}_i, \pi_i)_{i \in I} \rangle$, with the following components:

- I is the set of players, and I_0 includes both players and chance.
- $\bar{H}$ is the set of all feasible histories, partitioned into non-terminal histories (H) and terminal histories (Z). For each player $i \in I$, $\mathcal{I}_i$ is the partition of $\bar{H}$ into information sets that specifies i's information at each history.
- $\iota(h) \subseteq I_0$ is the set of active players at history $h \in H$, $A_i(h)$ is the set of feasible actions for player $i \in \iota(h)$, and H_i is the set of information sets where i is active.
- σ_0 is chance's probability function, specifying a probability measure $\sigma_0(\cdot|h) \in \Delta(\mathcal{A}_0(h))$ for each $h \in H_0$.
- $\mathcal{T}_i$ is the partition of terminal histories (Z) containing the terminal information for player i. Write $\mathcal{T}_i(z)$ for i's terminal information set including $z \in Z$.
- $\pi_i : Z \to \mathbb{R}$ is the material payoff function for each player $i \in I$.

The extensive form $G = \langle I, \bar{H}, \iota, \sigma_0, (\mathcal{T}_i, \pi_i)_{i \in I} \rangle$ induces a set of pure strategies for chance, S_0, and for each player $i \in I$, a set of pure strategies, S_i. Denote the strategy profile by $S = \prod_{i \in I_0} S_i$, with $S_{-i} = \prod_{j \in I_0 \setminus i} S_j$. Let $\zeta : S \to Z$ denote the **path function**, which maps each strategy profile $s \in S$ to the terminal node $\zeta(s)$ reached by that strategy.

2.2 (Social) Norms

Norms are rules that guide decision-making in social contexts, with social norms being those widely accepted and shared within a society or group. In principle, social norms prescribe how individuals are expected to behave in particular situations.

López-Pérez (2008) and Bicchieri and Sontuoso (2020) formally define a norm as a nonempty correspondence that applies to any information set in a material game, viewing it as a prescription for how one ought to behave in all possible scenarios. However, social norms typically govern behavior in specific contexts and for particular individuals, rather than universally applying to all players in every situation. This allows for individual discretion in circumstances where norms do not dictate a prescribed action.

In this paper, I interpret a social norm as a guideline that prescribes how one should behave in certain situations. I focus on the case where the norm applies to a single player. I define a social norm as a (partial) strategy and provide a formal definition within the extensive game framework $G = \langle I, \bar{H}, \iota, \sigma_0, (\mathcal{T}i, \pi_i)i \in I \rangle$.

Definition 2.1: A **social norm** n_i is defined as a (partial) strategy for player i, expressed as $n_i = (n_{i,\mathbf{h}})_{\mathbf{h} \in \mathcal{H}_i \subseteq H_i}$, where $n_{i,\mathbf{h}}$ denotes the action prescribed by n_i if the information set $\mathbf{h}$ is reached.

A social norm prescribes the actions that player i should take at the information sets in $\mathcal{H}_i$, while allowing flexibility in i's behavior at the remaining information sets within the set $H_i \setminus \mathcal{H}_i$. Note when $\mathcal{H}_i = H_i$, n_i is a pure strategy of player i.

Definition 2.2: For any strategy $s_i \in S_i$, I define a **norm-consistent strategy** $s_i^{n_i} \in S_i$ as follows: (i) $\forall \mathbf{h} \in \mathcal{H}_i \subseteq H_i$, $s_{i,\mathbf{h}}^{n_i} = n_{i,\mathbf{h}}$, and (ii) $\forall \mathbf{h} \in H_i \setminus \mathcal{H}_i$, $s_{i,\mathbf{h}}^{n_i} = s_{i,\mathbf{h}}$.

For every s_i, there is a corresponding norm-consistent strategy $s_i^{n_i}$, aligns with n_i. In this strategy, player i follows the prescribed actions of n_i in the relevant situations, while adhering to their original strategy s_i for the remaining cases. This norm-consistent strategy establishes a reference point for defining cheating.

2.3 Cheating

I define cheating from a consequentialist perspective, where cheating is understood as a violation of a social norm. The extent of cheating is assessed based on both the gain to the norm-breaker and the harm inflicted on others. In the following discussion, I assume the social norm and any potential cheating apply only to one specific player – player i.

Specifically, I define player i's **"gain"**, $\mathcal{G}_i$, and j's **"loss"**, $\mathcal{L}_j$, resulting from i's social-norm deviation as follows:

$$\mathcal{G}_i(z, s, n_i) = [\pi_i(z) - \pi_i(\zeta(s_i^{n_i}, s_{-i}))]^+ \quad (1)$$

and

$$\mathcal{L}_j(z, s, n_i) = [\pi_j(\zeta(s_i^{n_i}, s_{-i})) - \pi_j(z))]^+ \quad (2)$$

where $i \neq j$. $\mathcal{G}_i$, represents the positive difference between the payoff i actually secures and the payoff she would have received by adhering to the norm n_i. $\mathcal{L}_j$, represents the positive difference between the payoffs j would have received if i followed the norm and what j actually receives.

Definition 2.3: The **extent of cheating** by player i is defined as:

$$\psi(\underbrace{\mathcal{L}_1(z,s,n_i)}_{\text{player 1's loss}},\cdots,\underbrace{\mathcal{L}_{i-1}(z,s,n_i)}_{\text{player } i-1\text{'s loss}},\underbrace{\mathcal{G}_i(z,s,n_i)}_{\text{player } i\text{'s gain}},\underbrace{\mathcal{L}_{i+1}(z,s,n_i)}_{\text{player } i+1\text{'s loss}},\cdots\underbrace{\mathcal{L}_{|I|}(z,s,n_i)}_{\text{player } |I|\text{'s loss}})$$

where $|I|$ is the total number of players. The function $\psi : \mathbb{R}_+^{|I|} \to \mathbb{R}_+$ satisfies the following conditions:

(i) $\psi(\mathbf{0}) = 0$

(ii) ψ is strictly increasing, i.e., $\mathbf{d'} > \mathbf{d}$ (component wise) implies $\psi(\mathbf{d'}) > \psi(\mathbf{d})$ $\forall \mathbf{d'}, \mathbf{d} \in \mathbb{R}_+^{|I|}$

(iii) ψ is continuous

These conditions imply that: (i) there is no cheating if player i follows the norm or if there is no gain for i and no loss for others from i's norm deviation, (ii) the extent of cheating increases as the gains for i or the losses for others increase, and (iii) changes in the degree of cheating vary smoothly with changes in the gains and losses.

Definition 2.3 extends the work of Dufwenberg and Dufwenberg (2018), who model cheating based on the payoff consequences in a self-reporting context. They study a game known as the die-roll game (Fischbacher and Föllmi-Heusi (2013)), where an individual privately observes a state, reports the outcome, and is paid based on their report. DD18 define cheating as the positive difference between what the decision-maker receives and what they would have received had they made a truthful-telling report.

However, their definition has limitations. First, the reference point of "truth-telling" may not extend to contexts beyond self-reporting, as cheating can occur without explicit lying. Second, their model is restricted to a single-player setting, where externalities are irrelevant. In reality, cheating often arises from strategic interactions among multiple players, with the consequences imposed on others playing a critical role. My definition addresses these limitations by considering broader deviations from social norms, allowing for cheating in multi-player settings, and emphasizing the role of externalities in cheating.

2.4 Players' Utilities

A key assumption is that, in environments with well-defined social norms, individuals incur intrinsic costs when engaging in cheating and experiences discomfort when perceived as cheaters by others. The former is captured by *Cheating Aversion* (CA), an internal aversion to cheating itself, while the latter reflects *Perceived Cheating Aversion* (PCA), the disutility arising from others' perceptions of one's dishonesty. Notably, one may suffer from PCA even when the cheating is undetectable.

To model perceived cheating and derive (expected) utility function, I introduce a conditional **first-order** and **second-order** belief system, following BD09. The **first-order beliefs** of player $j \in I$ are defined as a system of conditional probabilities regarding the strategies of others: $\mu_j^1 = (\mu_j^1(\cdot|\mathbf{h}))_{\mathbf{h}\in\mathcal{I}_j} \in \Delta^{\mathcal{I}_j}(S_{-j})$, where $\mathbf{h} \in \mathcal{I}_j$ represents a specific information set of j.[9] The **second-order beliefs** of player $j \in I$ are a system of conditional probabilities about joint beliefs concerning others' strategies and first-order beliefs: $\mu_j^2 = (\mu_j^2(\cdot|\mathbf{h}))_{\mathbf{h}\in\mathcal{I}_j} \in \Delta^{\mathcal{I}_j}(S_{-j} \times \prod_{k\in I\setminus\{j\}} \Delta(S_k))$.

Assumption 2.1 (First-Order Beliefs) For each player $j \in I$:

(i) At an information set $\mathbf{h} \in \mathcal{I}_j$, j assigns probability 1 to $S_{-j}(\mathbf{h})$ – the event of the others using strategies consistent with $\mathbf{h}$;

(ii) j updates beliefs via Bayes' rule whenever possible;

(iii) j's beliefs about past and unobserved actions of other players are independent of j's chosen action.

Assume the second-order beliefs satisfy properties analogous to those outlined in Assumption 2.1. Let Δ_j^1 and $\Delta_j^2 \subseteq \Delta^{\mathcal{I}_j}(S_{-j} \times \Delta_j^1)$ denote the space of first-order and second-order beliefs for player j, respectively. Let $\mu_i = (\mu_i^1, \mu_i^2)_{i\in I}$ represent a two-level hierarchy of beliefs. I maintain the assumption of **coherence** between one's first- and second-order beliefs, that is to say, $\mu_i^1 = \mathrm{marg}_{S_{-i}}(\mu_i^2)$. In other words, higher-order beliefs assign the same conditional probabilities to lower-order events.

Player j's terminal belief, $\mu_j^1(\cdot|\mathcal{T}_j(z))$, is used to define perceived cheating. Since the social norm governs only the behavior of i, both cheating and perceived cheating pertain solely to i. Next, we formally define i's perceived cheating from the perspective of j, where $j \in I$ and $j \neq i$.

Definition 2.4 Given a terminal node z, a social norm n_i, j's strategy, s_j, and j' first-order beliefs, μ_j^1, i's **perceived cheating** is defined as:

$$\sum_{s'_{-j}\in S_{-j}} \mu_j^1(s'_{-j}|\mathcal{T}_j(z)) \cdot \psi(z', s', n_i)$$

where $s' = (s_j, s'_{-j})$, $\zeta(s') = z'$, and $z' \in \mathcal{T}_j(z)$.

Here, $\mu_j^1(s'_{-j}|\mathcal{T}_j(z))$ represents the probability that j assigns to the strategy s'_{-j} used by other players, and z' denotes the terminal node j believes they are at, given the terminal information set $\mathcal{T}_j(z)$. When strategy profile (s_j, s'_{-j}) is played, the extent of cheating from j's perspective is quantified by $\psi(z', s', n_E)$.

Definition 2.4 models i's perceived cheating as j's expectation of i's behavior. Under imperfect information, i may be perceived as cheating even when adhering to the norm, while, conversely, i could appear to comply with the norm despite actually violating it. These nuances highlight the importance of modeling players' beliefs.

[9] When j is inactive at $\mathbf{h}$, $\mu_j^1(\cdot|\mathbf{h})$ is still well defined and interpreted as j's "virtual" conditional beliefs.

I now formally define utility functions in a setting with two personal players,[10] where player i's behavior is governed by a social norm n_i, and player j's behavior is unconstrained. For simplicity, assume that j's utility function corresponds directly to their material payoff: $u_j(z) = \pi_j(z)$. The utility function for player i is composed of three main elements: material payoff, concern for CA, and concern for PCA.

Definition 2.5 (Player i's Utility Function)

$$u_i(z, s, n_i, \mu_j^1) = \underbrace{\pi_E(z)}_{\text{material payoff}} - \underbrace{\theta^{CA} \cdot \psi(z, s, n_i)}_{\text{cheating aversion}} - \underbrace{\theta^P \cdot \sum_{s'_{-j} \in S_{-j}} \mu_j^1(s'_{-C} | \mathcal{T}_j(z)) \cdot \psi(z', s', n_i)}_{\text{perceived cheating aversion}} \quad (3)$$

In this expression, the first term represents i's material payoff. The second term quantifies the cost associated with CA, reflecting i's intrinsic aversion to norm violations and the third term captures disutility due to j's perception of the i's dishonesty. The parameters $\theta^{CA} \geq 0$ and $\theta^P \geq 0$ reflect i's sensitivities to *cheating* and *perceived cheating*. Higher values of θ^{CA} or θ^P indicate that i places more weight on *cheating aversion* or maintaining her social image relative to her material payoff.

To calculate i's expected utility, she has to consult her second-order beliefs about j' strategies and first-order beliefs. Given i's strategy s_i and second-order beliefs μ_i^2 at information set $\mathbf{h}$, i's conditional expected utility u_i is defined as:

$$E_{s_i, \mu_i^2}[u_E | \mathbf{h}] := \int_{S_{-i} \times \Delta_j^1} u_i(\zeta(s_i, s_{-i}), (s_i, s_{-i}), \mu_j^1, n_i) \cdot \mu_i^2(\cdot | \mathbf{h})(ds_{-i}, d\mu_j^1) \quad (4)$$

In the following section, this general framework for defining cheating and the utility function will be applied to analyze behavior in credence goods games.

3 Credence Goods Game – Verifiability

3.1 Setup

Players. Consider a scenario involving a consumer (C/he) and an expert (E/she). The consumer faces a problem. It is common knowledge that there is a probability α $(0 < \alpha < 1)$ that the consumer's problem is major $(\omega = \omega_h)$, and a probability $1 - \alpha$ that it is minor $(\omega = \omega_l)$. Although the consumer knows these probabilities, he does not know whether his specific problem is major or minor.

The expert, who can diagnose the problem at no cost,[11] has two treatment options: a cheap treatment $(t = t_l)$ and an expensive one $(t = t_h)$. The treatment costs to the expert are c_l and c_h, where $0 < c_l < c_h$. The expert sets a price menu (p_l, p_h) prior to learning the consumer's problem.

[10] In a two-personal-player setting, there are three total players when nature is included.

[11] The zero-cost assumption is standard in much of the credence goods literature. Some studies, however, explore scenarios where the expert must exert costly but unobservable effort to diagnose the problem or improve diagnostic precision, introducing a moral hazard problem. See, for example, Pesendorfer and Wolinsky (2003), Dulleck and Kerschbamer (2005), Bester and Dahm (2018), and Inderst and Ottaviani (2012a), among others.

Upon observing the menu, the consumer decides whether to seek treatment (In) or leave the problem untreated (Out). If the consumer chooses In, the expert diagnoses the problem and recommends either the cheap treatment ($r = r_l$) at price p_l or the expensive treatment ($r = r_h$) at price p_h. The consumer then decides to accept (A) or reject (R) the recommendation. If accepted, the expert administers a treatment, and the consumer pays the price asked by the expert at the recommendation stage. If the consumer opts for Out or R, the problem remains untreated.

Material Payoff. Both treatments effectively address the minor problem, but only the expensive treatment (t_h) can resolve the major problem. The consumer has three possible final outcomes:[12] if a minor or major problem is resolved, the outcome is v; if a minor problem is untreated, the outcome is λ, where $0 \leq \lambda < v$; if a major problem is untreated or unresolved, the outcome is 0.

The consumer's material payoff equals the final outcome minus the price paid. The expert's material payoff is the price charged minus the cost incurred.

In line with the credence goods literature, I assume $0 < c_l < v - \lambda$ and $0 < c_h < v$, indicating that resolving either problem is efficient. The price menu (p_l, p_h) must be selected from $P = \{(p_l, p_h) \mid p_l \in [c_l, v], p_h \in [c_h, v], \text{ and } p_l \leq p_h\}$, ensuring prices cover the expert's costs but do not exceed the consumer's maximum willingness to pay.

Information. Initially, the consumer does not know his problem type, though the probabilities are common knowledge. If the consumer chooses In, the expert perfectly diagnoses the problem. When the consumer accepts a treatment and gains v, he knows the problem has been resolved but does not know the original problem type or the specific treatment provided with certainty. If the consumer opts for Out or R, or if the treatment fails to resolve the problem, he can infer the nature of the problem from his payoff.[13] The values of the parameters α, c_l, c_h, λ, v, and the prices p_l and p_h are all common knowledge.

Institutional Environment. This section analyzes the credence goods game under the condition of *verifiability* (CGG-V). Verifiability means the consumer can observe and confirm the treatment provided after it has been completed.[14] Even though verifiability prevents overcharging, the consumer may still be vulnerable to under-treatment and over-treatment.

Game Tree. The game tree for CGG-V is shown in Figure 1. The expert begins by selecting a price menu for both treatments. Nature then determines the consumer's problem type. The consumer decides whether

[12] This assumption generalizes that of Dulleck and Kerschbamer (2006), where the consumer's reservation values for unresolved major and minor problems are assumed equal.

[13] If he receives 0, it implies a major problem; if he receives λ, it implies a minor problem. In the case of an unresolved problem post-treatment, it indicates the problem was major but only a minor treatment was attempted.

[14] For example, a consumer can verify that a mechanic replaced a part by requesting to keep the replaced part. A patient may check if a specific medical treatment was given by reviewing medical records. Similarly, a homeowner can inspect repairs or compare before-and-after photos to verify completed work.

to participate based on the price menu. If the consumer opts for *In*, the expert offers a recommendation. The consumer then chooses to proceed with the treatment or exit the market. Under *verifiability*, the expert must administer a treatment consistent with her recommendation, ensuring treatment (t) aligns with the recommendation (r). Consequently, the decision nodes following the consumer's choice A are degenerate.

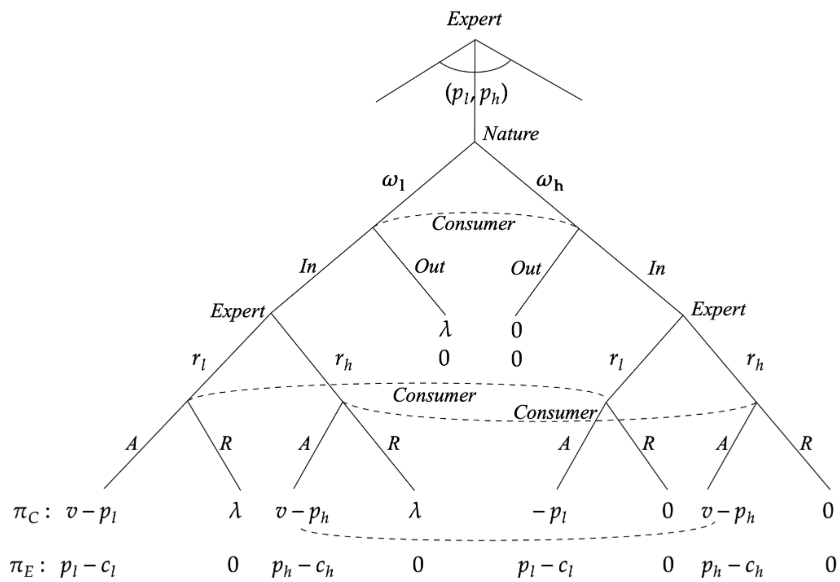

Figure 1. Credence Goods Game with *Verifiability*

Note: the numerical values at the terminal nodes represent the monetary payoffs for the expert (first row) and the consumer (second row). The black dot lines represent the consumer's information sets.

The notation from section 2 is used in the following discussion.[15]

3.2 Social Norm, Cheating, and Perceived Cheating

Social Norm. In credence goods markets, social norms primarily govern the expert's behavior. I propose a social norm, denoted by n_E, which mandates that the expert recommend and administer the appropriate treatment for any price menu (p_l, p_h).[16] Under *verifiability* condition, this norm can be understood as ensuring truthful recommendations.

[15] Let $I = \{C, E\}$ denote the set of personal players, and $I_0 = \{0, C, E\}$ include all players. In the extensive game form shown in Figure 1, let S denote the set of pure strategies and S_i the set of pure strategies for each $i \in I_0$. For $i \in I$, $\mathcal{I}_i$ represents the set of player i's information sets, $\mathcal{T}_i(z)$ denotes i's terminal information set containing z, μ_i^1 and μ_i^2 denote player i's first-order and second-order belief systems.

[16] While there exists evidence supporting social expectations around treatment recommendations and provisions, imposing a shared agreement on prices would be overly restrictive.

Formally, the social norm n_E specifies the expert's actions at each information set $\mathbf{h} \in \mathbf{H} = \{((p_l, p_h), \omega, In) | (p_l, p_h) \in P, \omega \in \{\omega_l, \omega_h\}\}$. It requires the expert to recommend r_l when the problem is ω_l and r_h when the problem is ω_h, regardless of the price menu. The norm defined by:

$$n_E = (n_{E,\mathbf{h}})_{\mathbf{h} \in \mathbf{H}}$$

where $n_{E,((p_l,p_h),\omega_l,In)} = r_l$ and $n_{E,((p_l,p_h),\omega_h,In)} = r_h$ for every $(p_l, p_h) \in P$.

To compare actual behavior with norm-prescribed behavior, I define a **norm-consistent strategy** $s_E^{n_E} \in S_E$ for each $s_E \in S_E$ as follows: (i) $\forall \mathbf{h} \in \mathbf{H}$, $s_{E,\mathbf{h}}^{n_E} = n_{E,\mathbf{h}}$, and (ii) for the initial history $\mathbf{h} = h_0$, $s_{E,\mathbf{h}}^{n_E} = s_{E,\mathbf{h}}$. This $s_E^{n_E}$ preserves the prices specified by the original strategies s_E, while ensuring that the expert's actions otherwise align with the norm n_E, providing a reference point for evaluating cheating in relation to s_E.

Cheating. The expert's cheating is assessed by comparing her actual strategy with the norm-consistent strategy. The extent of the expert's cheating depends on two components: the expert's gain from deviating from the norm and the consumer's loss due to this deviation. To be more specific, the expert's gain is the the additional payoff she receives by not following n_E. The consumer's loss is is the reduction in the consumer's payoff compared to what it would have been if the expert had adhered to n_E. I use a linear function to capture the extent of cheating, where these two components contribute equally.[17]

Definition 3.1 Given a terminal node z, a strategy profile $s = (s_E, s_{-E})$, and the norm n_E, the extent of **cheating** by the expert is defined as

$$\psi(z, s, n_E) = \underbrace{[\pi_E(z) - \pi_E(\zeta(s_E^{n_E}, s_{-E}))]^+}_{\text{Expert's gain}} + \underbrace{[\pi_C(\zeta(s_E^{n_E}, s_{-E})) - \pi_C(z)]^+}_{\text{Consumer's loss}} \quad (6)$$

where $\pi_E(z)$ and $\pi_C(z)$ are the actual payoffs for the expert and the consumer at terminal node z, and $\pi_E(\zeta(s_E^{n_E}, s_{-E}))$ and $\pi_C(\zeta(s_E^{n_E}, s_{-E}))$ are the payoffs they would have received if the expert had followed $s_E^{n_E}$.

Under *verifiability*, cheating can only occur during the recommendation stage, where the expert may propose a treatment inconsistent with n_E. The extent of this cheating depends on the expert's actions, nature's move, and the consumer's strategy. For example, suppose the problem is ω_l, and

[17] This functional form is mathematically straightforward and satisfies the three conditions outlined in Definition 2.3.

the expert recommends r_h, which the consumer accepts. In this scenario, the expert is considered to be cheating. However, the extent of the expert's cheating depends on the consumer's strategy. If the consumer plans to accept either recommendation, the extent of cheating would be $|\Delta p - \Delta c| + \Delta p$, where $\Delta p = p_h - p_l$ and $\Delta c = c_h - c_l$. Conversely, if the consumer plans to accept r_h but reject r_l, then the magnitude of cheating would be $|v - p_l - \lambda|$. This example highlights that what could happen at unreached information sets matter to the definition of cheating.

Perceived Cheating. A key characteristic of credence goods markets is that the consumer is not perfectly informed about his initial problem or the expert's treatment provision. Despite this uncertainty, consumers can infer potential cheating based on the final outcome and his beliefs. The consumer's ex post expectation of the expert's cheating is referred to as the expert's *perceived cheating.*

Definition 3.2 Given a terminal node z, the consumer's strategy s_C, the norm n_E, and the consumer's first-order beliefs μ_C^1, the expert's **perceived cheating** is defined as:

$$\sum_{s'_{-C} \in S_{-C}} \mu_C^1(s'_{-C}|\mathcal{T}_C(z)) \cdot \psi(z', s', n_E)$$

where $s' = (s_C, s'_{-C})$, $\zeta(s') = z'$, and $z' \in \mathcal{T}_C(z)$. Here, $\mu_C^1(s'_{-C}|\mathcal{T}_C(z))$ represents the probability that the consumer assigns to the strategy s'_{-C}, and z' is the terminal node the consumer believes they are at, conditional on the terminal information set $\mathcal{T}_C(z)$. The perceived extent of cheating is determined by taking the expectation of $\psi(z', s', n_E)$, representing the consumer's perspective on potential norm violations.

In CGG-V, cheating by the expert can take two forms: under-treatment and over-treatment. Under-treatment is often easily detected by the consumer if the problem remains unresolved. However, the consumer cannot distinguish between an expert truthfully treating a major problem and an expert over-treating a minor one. This leads to situations where a truthful expert might still be perceived as cheating, while an expert who engages in over-treatment may appear honest.

3.3 Utility.

The consumer's utility is straightforward and depends solely on his monetary payoff:

$$u_C(z) = \pi_C(z) \quad (7)$$

The expert's motivation extends beyond material gain; she also faces intrinsic costs related to cheating and discomfort from damage to her social image. The expert's utility is represented as:

$$u_E(z, s, n_E, \mu_C^1) = \underbrace{\pi_E(z)}_{\text{material payoff}} - \underbrace{\theta^{CA} \cdot \psi(z, s, n_E)}_{\text{cheating aversion}} - \underbrace{\theta^P \cdot \sum_{s'_{-C} \in S_{-C}} \mu_C^1(s'_{-C} | \mathcal{T}_C(z)) \cdot \psi(z', s', n_E)}_{\text{perceived cheating aversion}} \quad (8)$$

In this utility function, the first term represents the expert's material payoff. The second term captures the cost associated with CA, while the third term accounts for the disutility due to PCA. The parameters $\theta^{CA} \geq 0$ and $\theta^P \geq 0$ indicate the expert's sensitivities to *cheating* and *perceived cheating*, both of which are assumed to be common knowledge. When $\theta^{CA} = \theta^P = 0$, the expert is purely selfish.

The expert's utility is influenced by the consumer's strategy, nature's move, and the consumer's first-order beliefs. To evaluate her actions, the expert must consult her second-order beliefs about others' strategies as well as the consumer's first-order beliefs. The expert's conditional expectation of utility u_E, given strategy s_E and second-order beliefs μ_E^2 at information set $\mathbf{h}$, is defined as:

$$E_{s_E, \mu_E^2}[u_E | \mathbf{h}] := \int_{S_{-E} \times \Delta_C^1} u_E(\zeta(s_E, s_{-E}), (s_E, s_{-E}), \mu_C^1, n_E) \cdot \mu_E^2(\cdot | \mathbf{h})(ds_{-E}, d\mu_C^1) \quad (9)$$

The utility maximization can be analyzed using standard techniques, relying on the dynamic consistency of subjective expected utility maximizers.

3.4 Sequential Equilibrium.

For the solution concept, I adopt the Sequential Equilibrium framework discussed by BD09, which extends the classic concept to psychological games involving higher-order beliefs. I interpret SE as a profile of strategies and beliefs that represent a "commonly understood" approach to playing the game by utility-maximizing players.

In CGG-V, the highest-order beliefs related to players' utility functions are second-order. Therefore, I define SE for assessments that include beliefs up to the second order only. Formally, an **assessment** is a profile of behavior strategies and two hierarchy level beliefs $(\sigma, \mu) = ((\sigma_i)_{i \in I_0}, (\mu_i^1, \mu_i^2)_{i \in I})$. The equilibrium assessment must be **consistent** and satisfy **sequential rationality**.

Consistency requires that: (i) μ^1 is derived from the σ, implying players' first-order beliefs are correct, and (ii) second-order beliefs, μ^2, assign probability one to first-order beliefs, μ^1, implying that unexpected moves are explained as mistakes.[18] **Sequential rationality** requires that players update their beliefs across different information sets and that each player maximizes their "local" utility at each information set where he is active.

Given an assessment (σ, μ), I rewrite the expected utility of $i \in \{C, E\}$, conditional on $\mathbf{h}$ and $a_i \in A_i(\mathbf{h})$ as

$$E_{(\sigma,\mu)}[u_i|\mathbf{h}, a_i] := \sum_{s_{-i}\in S_{-i}} \prod_{j\neq i} Pr_{\sigma_j}(s_j|\mathbf{h}) \sum_{s_i\in S_i(\mathbf{h},a_i)} Pr_{\sigma_i}(s_i|\mathbf{h}, a_i) u_i(\zeta(s), s, \mu, n_E) \quad (10)$$

where $Pr_{\sigma_j}(s_j|\mathbf{h})$ denote the probability measure over j's strategies conditional on $\mathbf{h}$ derived from behavior strategy σ_j under the assumption of independence across histories.

In the following analysis, the expert's strategy is denoted as $\sigma_E = (\sigma_E^{h_0}, (\sigma_E^{ll}, \sigma_E^{hl}))$, which comprises a price policy and a recommendation policy. The price policy $\sigma_E^{h_0}$ specifies a distribution over price menus at the initial history h_0, while the recommendation policy $(\sigma_E^{ll}, \sigma_E^{hl})$ defines the probabilities that the expert recommends r_l, conditional on the problem being either ω_l or ω_h, for each price pair (p_l, p_h). The consumer's strategy is represented by $\sigma_C = (\sigma_C^{In}, (\sigma_C^l, \sigma_C^h))$, consisting of an entry policy and an acceptance policy. The entry policy σ_C^{In} defines the probability that the consumer chooses "*In*", while the acceptance policy (σ_C^l, σ_C^h) specifies the probabilities of accepting recommendations r_l and r_h, for each price pair (p_l, p_h).

Finally, I define the sequential equilibrium notion as below:

Definition 3.3 Assessment $((\sigma_i)_{i\in\{C,E,0\}}, (\mu_i^1, \mu_i^2)_{i\in\{C,E\}})$ is a **Sequential Equilibrium (SE)** if it is consistent and

(i) for every (p_l, p_h),

$$\sigma_E^{ll}(p_l, p_h) > 0 \Rightarrow E_{(\sigma,\mu)}[u_E|((p_l, p_h), In, \omega_l), r_l] \geq E_{(\sigma,\mu)}[u_E|((p_l, p_h), In, \omega_l), r_h],$$
$$\sigma_E^{hl}(p_l, p_h) > 0 \Rightarrow E_{(\sigma,\mu)}[u_E|((p_l, p_h), In, \omega_h), r_l] \geq E_{(\sigma,\mu)}[u_E|((p_l, p_h), In, \omega_h), r_h],$$

(ii) for every (p_l, p_h),

$$\sigma_C^{In}(p_l, p_h) > 0 \Rightarrow E_{(\sigma,\mu)}[u_C|(p_l, p_h), In] \geq E_{(\sigma,\mu)}[u_C|(p_l, p_h), Out)],$$
$$\sigma_C^l(p_l, p_h) > 0 \Rightarrow E_{(\sigma,\mu)}[u_C|(\mathbf{h}((p_l, p_h), In, \cdot, r_l), A] \geq E_{(\sigma,\mu)}[u_C|(\mathbf{h}((p_l, p_h), In, \cdot, r_l), R],$$
$$\sigma_2^h(p_l, p_h) > 0 \Rightarrow E_{(\sigma,\mu)}[u_C|(\mathbf{h}((p_l, p_h), In, \cdot, r_h), A] \geq E_{(\sigma,\mu)}[u_C|(\mathbf{h}((p_l, p_h), In, \cdot, r_h), R],$$

[18] These conditions reflect the "trembling-hand" interpretation of deviations from Kreps and Wilson's (1982) definition of Sequential Equilibrium (SE). Specifically, if player i reaches a history with zero probability under μ_{-i}^1, instead of revising beliefs about others' strategies, i assumes they made errors in executing their strategies, and the probability of further deviations is assumed to be zero.

where $\mathbf{h}((p_l,p_h),In,\cdot,r_l)$ represents the consumer's information set that includes the histories $((p_l,p_h),In,\omega_l,r_l)$ and $((p_l,p_h),In,\omega_h,r_l)$, and $\mathbf{h}((p_l,p_h),In,\cdot,r_h)$ is defined analogously.

(iii) $\sigma_E^{h_0}(p_l^*,p_h^*)>0 \Rightarrow (p_l^*,p_h^*)\in argmax_{(p_l,p_h)}E_{(\sigma,\mu)}[u_E|h_0,(p_l,p_h)]$

In an SE, both the expert and the consumer maximize their conditional expected utility based on the assessment $((\sigma_i)_{i\in\{C,E,0\}},(\mu_i^1,\mu_i^2)_{i\in\{C,E\}})$ at each information set where they are active. Their beliefs are correct on the equilibrium path. Any unexpected moves are explained as mistakes, and the probability of further deviations is assumed to be zero.

4 Results for CGG-V

This section presents the SE results of the CGG-V model, focusing on the comparative statics of psychological concerns on equilibrium behavior, market efficiency, and the utilities of both the consumer and the expert. Section 4.1 outlines the key insights. Section 4.2 provides SE analysis in scenarios with exogenously set price menus. This analysis forms the foundation for solving the SE in CGG-V and offers insights into outcomes under fixed pricing. Section 4.3 provides a comprehensive characterization of the SE in the CGG-V model for all parameter values satisfying $0<c_l<c_h<v$, $c_l<v-\lambda\leq v$, $\theta^{CA}\geq 0$, and $\theta^P\geq 0$.

4.1 Key Insights

The primary results depend on the relationship between the surplus generated by resolving each type of problem and the likelihood of the consumer encountering each issue. First, I consider the scenario where the problem associated with the higher total surplus occurs with high probability.

Result 1. Suppose the problem whose resolution generates greater total surplus occurs with a substantial probability.[19]

(i) When psychological concerns are low,[20] the SE outcome results in under- or over-treatment, leading to inefficient problem solving and zero consumer surplus.

[19] The total surpluses from resolving minor and major problems are $v-\lambda-c_l$ and $v-c_h$, respectively. If $\lambda\leq\Delta c$, resolving a minor problem yields a higher total surplus; otherwise, resolving a major problem yields a higher total surplus. In the former case, "substantial probability" requires that the probability α satisfies $\alpha<\frac{\Delta c-\lambda}{v-\lambda}$; conversely, in the latter case, it requires $\alpha>\frac{\Delta c}{\lambda}$.

[20] Low psychological concerns imply that both θ^{CA} and θ^P are small enough. See Propositions 1 and 3 for specific conditions.

(ii) When psychological concerns are at a moderate level,[21] the SE outcome involves honesty and can achieve efficiency and yield a positive consumer surplus under certain condition.

(iii)When psychological concerns are high,[22] the SE outcome achieves honesty and efficiency; however, consumer surplus remains zero.

Result 1 provides a three-interval characterization for cases where the problem with higher total surplus is highly likely. At low levels of psychological concerns, the expert's monetary gain from cheating outweighs psychological costs, leading to under- or over-treatment, and zero consumer surplus. As concerns increase, the expert begins to align with social norms, and moderate levels of sensitivity can yield positive consumer welfare and efficiency. However, when concerns become very strong, the expert sets the maximum permissible price, achieving honesty but reducing consumer surplus to zero again. This result is formally detailed in Propositions 1 and 3. To better illustrate this, consider Example 1:

Example 1. Let $v = 100$, $\lambda = 30$, $c_l = 40$, $c_h = 80$, and $\alpha = 0.1$.[23]

(i) Suppose $\theta^{CA} = \theta^P = 0$ (ii) Suppose $\theta^{CA} = \theta^P = 0.05$ (iii) Suppose $\theta^{CA} = \theta^P = 0.25$

In Example 1(i), the SE price menu is $(63, 100)$. The SE outcome involves under-treatment.The expected utilities for the expert and the consumer are 23 and 27, respectively. In (ii), the SE price menu is $(67.5, 100)$. The SE outcome involves honesty. The expected utilities for the expert and the consumer are 23.15 and 29.25, respectively. In (iii), the SE price menu is $(70, 100)$. The SE outcome involves honesty. The expected utilities for the expert and the consumer are 29 and 27, respectively.

Next, we consider the case in which the problem generating the greater total surplus is unlikely to occur.

Result 2. Suppose the problem whose resolution generates a greater total surplus occurs with a low probability.[24] In this scenario, the SE outcome ensures honesty and efficiency across all levels

[21] Moderate psychological concerns imply that either θ^{CA} or θ^P is large but remains below a specified threshold. See Propositions 1 and 3 for specific conditions.

[22] High psychological concerns imply that either θ^{CA} or θ^P is sufficiently large. See Propositions 1 and 3 for specific conditions.

[23] The total surplus of resolving a minor, $v - \lambda - c_l = 30$, is higher than that of resolving a major problem, $v - c_h = 20$. The likelihood of a minor problem occurs is substantial as $\alpha = 0.1 < \frac{\Delta c - \lambda}{v - \lambda} = \frac{2}{9}$.

[24] If resolving a minor problem yields a higher total surplus, then "low probability" requires that the probability α satisfies $\alpha \geq \frac{\Delta c - \lambda}{v - \lambda}$. Conversely, if resolving a major problem yields a higher total surplus, then "low probability" requires that $\alpha \leq \frac{\Delta c}{\lambda}$.

of psychological concerns. However, higher levels of psychological concerns may result in a direct monetary transfer from the consumer to the expert.

Result 2 suggests that when the problem with higher total surplus is unlikely, the expert behaves honestly, the market remains efficient, and the consumer achieves the most favorable outcome when the expert is purely self-interested. High psychological concerns play a detrimental role on the consumer. This result is formally detailed in Propositions 2 and 4. To illustrate this further, consider Example 2:

Example 2. Suppose $v = 100$, $\lambda = 30$, $c_l = 40$, $c_h = 80$, and $\alpha = 0.9$.[25]

(i) Suppose $\theta^{CA} = \theta^P = 0$ (ii) Suppose $\theta^{CA} = \theta^P = 0.05$ (iii) Suppose $\theta^{CA} = \theta^P = 0.25$

In Example 2, the SE outcome is honest across all cases. In (i), with the SE price menu $(60, 100)$, expected utilities are 20 for the expert and 4 for the consumer. In (ii), with the price menu $(67.5, 100)$, utilities are 20.75 and 3.25, respectively. In (iii), with the price menu $(70, 100)$, utilities are 21 for the expert and 3 for the consumer. Here, the consumer and expert share a fixed "pie," with high psychological concerns favoring the expert at the consumer's expense.

4.2 SE For A Subgame $\Gamma(p_l, p_h)$ of CGG-V

For each price menu (p_l, p_h), a corresponding subgame $\Gamma(p_l, p_h)$ of CGG-V is well-defined. This subsection characterizes fixed-price SEa,[26] classified into five types: *honesty with efficient problem-solving*, *under-treatment*, *over-treatment*, *honesty with a potential untreated* ω_l, and *honesty with a potential untreated* ω_h, as outlined in Lemmas 1 through 5. For clarity, detailed proofs are provided in Appendix B.

Lemma 1. An *honesty with efficient problem-solving equilibrium* exists,[27] where the expert makes a honest recommendation and the consumer accepts both recommendations, if and only if $\theta^{CA} \geq \frac{\Delta p - \Delta c}{|\Delta p - \Delta c| + \Delta p}$, and $\theta^{CA} + \theta^P \geq \frac{\Delta c - \Delta p}{|\Delta c - \Delta p| + v - \Delta p}$.

Proof. See Appendix. □

[25] The total surplus of resolving a minor, $v - \lambda - c_l = 30$, is higher than that of resolving a major problem, $v - c_h = 20$. The likelihood of a minor problem occurs is substantial as $\alpha = 0.9 > \frac{\Delta c - \lambda}{v - \lambda} = \frac{2}{9}$.

[26] In a fixed-price setting, SE requires consistency and adherence to conditions (i) and (ii) of Definition 3.3.

[27] In an honesty with efficient problem-solving equilibrium, $\sigma_E^{ll} = 1, \sigma_E^{hl} = 0, \sigma_C^{In} = 1, \sigma_C^{l} = 1$, and $\sigma_C^{h} = 1$

Lemma 1 outlines the necessary and sufficient conditions for the existence of the *honesty with efficient problem-solving equilibrium.* When the expert is purely selfish ($\theta^{CA} = \theta^P = 0$), only price menus with equal markups ($\Delta p = \Delta c$) can sustain an *honest and efficient problem-solving equilibrium.* Incorporating high psychological concerns about (perceived) cheating broadens the range of price menus that can induce honesty.

If $\Delta p < \Delta c$, the low-cost treatment is more profitable for the expert, but the consumer can easily detect under-treatment, leading the expert to incur both CA and PCA. Hence, both θ^{CA} and θ^P are crucial in deterring under-treatment. When $\Delta p > \Delta c$, providing the high-cost treatment becomes more lucrative, requiring a high θ^{CA} to prevent over-treatment. In this scenario, θ^P is irrelevant, as the consumer believes the expert's recommendation is correct, eliminating PCA.

Lemma 2. (i) A *full under-treatment equilibrium* exists, where the expert always recommends r_l and the consumer accepts both recommendations,[28] if and only if $p_l \leq (1-\alpha)(v-\lambda)$, $\Delta p \leq \Delta c$, and $0 \leq \theta^{CA} + \theta^P \leq \frac{\Delta c - \Delta p}{v + \Delta c - 2\Delta p}$. [29]

(ii) A *partial under-treatment equilibrium* exists, where the expert always recommends r_l, the consumer accepts r_h, but sometimes rejects r_l, if and only if $(1-\alpha)(v-\lambda) < p_l < v - \lambda$, $\Delta p \leq \Delta c$, and $0 \leq \theta^{CA} + \theta^P \leq \frac{\Delta c - \Delta p}{v + \Delta c - 2\Delta p}$.

Proof. See Appendix. □

Lemma 2 highlights the expert's tendency to provide *under-treatment.* For an *under-treatment equilibrium* to be sustained, θ^{CA} and θ^P must be limited. In a *full under-treatment equilibrium*, the expert consistently recommends r_l. The consumer, believing the state to be ω_h when r_h is recommended, will accept p_h as long as $p_h \leq v$. This equilibrium is maintained only if $p_l - c_l - (\theta^{CA} + \theta^P)(|\Delta c - \Delta p| + v - \Delta p) \geq p_h - c_h$, implying that the markup on the minor treatment must at least equal or exceed that of the major treatment ($p_l - c_l \geq p_h - c_h$). In a *partial under-treatment equilibrium*, the expert always recommends r_l for ω_l and sometimes recommends p_h for ω_h. The consumer infers ω_h from r_h but remains uncertain when r_l is recommended. The more sensitive the expert is to (perceived) cheating, the more likely the consumer is to accept r_l.

[28] With the consumer's off-equilibrium path belief that the state is ω_h when r_h is recommended,

[29] When $\theta^C = \theta^P = 0$, there is another type of undertreatment equilibrium with $\sigma_E^{ll} = 1$, $\sigma_E^{hl} = 1$, $\sigma_C^{In} = 1$, $\sigma_C^l = 1$, and $\sigma_C^h = 0$, supported by the consumer's off-equilibrium path belief that the state is ω_l whenever p_h is recommended, for $p_l \leq (1-\mu_h)(v-\lambda)$, and $v - \lambda < p_h \leq v$.

Lemma 3. (i)A *full over-treatment equilibrium* exists, where the expert always recommends r_h and the consumer accepts both recommendations,[30] if and only if $p_h \leq v-(1-\alpha)\lambda$, $\Delta p \geq \Delta c$, and $0 \leq \theta^{CA}+\theta^{P}(1-\alpha) \leq \frac{\Delta p-\Delta c}{2\Delta p-\Delta c}$..

(ii) A *partial over-treatment equilibrium* exists, where the expert always recommends r_h, the consumer accepts r_l, but sometimes rejects r_h, if and only if $v-(1-\alpha)\lambda < p_h \leq v$, $\Delta p \geq \Delta c$, and $0 \leq \theta^{C}+\frac{\theta^{P}(v-p_h)}{\lambda} \leq \frac{\Delta p-\Delta c}{2\Delta p-\Delta c}$.

Proof. See Appendix. □

Lemma 3 illustrates the cheating through *over-treatment.* In a *full over-treatment equilibrium*, the expert always recommends r_h. If the consumer believes the state is ω_l when r_l is recommended, then a price of $p_l \leq v-\lambda$ will be accepted. The expert opts for over-treatment if $p_h - c_h - (\theta^{CA} + \theta^{P}(1-\alpha))(|\Delta p-\Delta c|+\Delta p) \geq p_l - c_l$. In a *partial over-treatment equilibrium*, the consumer learns a minor problem from recommendation r_l, but remains uncertain when the recommendation is r_h. The higher the values of θ^{CA} and θ^{P}, the more likely the consumer is to accept r_h.

Lemma 4. An *honesty with a potential untreated ω_l equilibrium*, where the expert behaves honestly and the consumer accepts r_h but sometimes rejects r_l, only exists for $p_l = v-\lambda$ and when the level of psychological concerns is high enough.

Proof. See Appendix. □

Lemmas 4 describes equilibria where the expert adheres to the norm, but the consumer rejects r_l with positive probability. In this equilibria, p_l reaches the consumer' maximum willingness to pay $v-\lambda$. Strong psychological concerns about cheating or perceived cheating increase the likelihood that the consumer accepts the expert's recommendations.

Lemma 5. An *honesty with a potential untreated ω_h equilibrium*, where the expert behaves honestly and the consumer accepts r_l but sometimes rejects r_h, only exists for $p_h = v$ and when the level of psychological concerns is high enough.

Proof. See Appendix. □

Lemma 5 describes equilibria where the expert adheres to the norm, but the consumer rejects certain recommendations with positive probability. In these equilibria, at least one price reaches the

[30] with the consumer's off-equilibrium path belief that the state is ω_l when r_l is recommended,

consumer' maximum willingness to pay under complete information. Strong psychological concerns about cheating or perceived cheating increase the likelihood that the consumer accepts the expert's recommendations.

This subsection demonstrates that different treatment price pairs and sensitivities to (perceived) cheating lead to varying equilibria, which can involve honesty with efficiency, under-treatment, or over-treatment. High sensitivities to CA and PCA reduce cheating and enhance efficiency, with CA playing a more critical role than PCA in promoting honesty and ensuring efficient problem-solving.

4.3 SE For CGG-V

I now characterize the SE for CGG-V in Propositions 1 through 4. The results hinge on the relationship between the surpluses generated from successfully treating each problem and the likelihood of the consumer having each type of problem. In Propositions 1 and 2, I focus on a setting where the total surplus from resolving a minor problem exceeds that from resolving a major one.

Proposition 1. Suppose $\lambda \leq \Delta c$ and $\alpha < \frac{\Delta c - \lambda}{v - \lambda}$. There exist two thresholds, $\underline{\theta}^1$ and $\underline{\theta}^2$, where $0 < \underline{\theta}^1, \underline{\theta}^2 < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$, such that:

(i) When $0 \leq \theta^{CA} + \theta^P < \underline{\theta}^1$ and $v > c_l + c_h$, or when $0 \leq \theta^{CA} + \theta^P < \underline{\theta}^2$ and $v \leq c_l + c_h$, the SE outcome is *full under-treatment*, with the price menu $(p_l, p_h) = ((1-\alpha)(v-\lambda), v)$.[31]

(ii) When $\underline{\theta}^1 < \theta^{CA} + \theta^P < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$ and $v > c_l + c_h$, the SE outcome is *honesty with a potential untreated* ω_l, with the price menu $(p_l, p_h) = (v - \lambda, v)$. The consumer rejects r_l with probability $\frac{\Delta c - \lambda - (\theta^{CA} + \theta^P)(\Delta c + v - 2\lambda)}{v - \lambda - c_l - (\theta^{CA} + \theta^P)(\Delta c + v - 2\lambda)}$.[32]

(iii) When $\underline{\theta}^2 < \theta^{CA} + \theta^P < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$ and $v \leq c_l + c_h$, the SE outcome is *honesty with efficient problem-solving*, with the price menu (p_l, p_h) where $p_l = \frac{(1 - \theta^{CA} - \theta^P)(v - \Delta c)}{1 - 2(\theta^{CA} + \theta^P)}$ and $p_h = v$.[33]

(iv) When $\theta^{CA} + \theta^P \geq \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$, the SE outcome is *honesty and efficient problem-solving*, with the price menu $(p_l, p_h) = (v - \lambda, v)$.

[31] When $\theta^{CA} = \theta^P = 0$, the price menu (p_l, p_h) where $p_l = (1-\alpha)(v-\lambda)$ and $p_l < p_h \leq v$, can also support a full under-treatment equilibrium.

[32] When $\theta^{CA} + \theta^P = \underline{\theta}^1(\Delta c, \lambda, v, \alpha)$, the expert is indifferent between setting $(p_l, p_h) = ((1-\alpha)(v-\lambda), v)$ and under-treating the consumer, or setting $(p_l, p_h) = (v - \lambda, v)$ and adhering to the norm, knowing that the consumer will reject r_l with probability $\frac{\Delta c - \lambda - \underline{\theta}^1(\Delta c, \lambda, v, \alpha)(\Delta c + v - 2\lambda)}{v - \lambda - c_l - \underline{\theta}^1(\Delta c, \lambda, v, \alpha)(\Delta c + v - 2\lambda)}$.

[33] When $\theta^{CA} + \theta^P = \underline{\theta}^2(\Delta c, \lambda, v, \alpha)$, the expert is indifferent between setting $(p_l, p_h) = ((1-\alpha)(v-\lambda), v)$ and under-treating the consumer, or setting $(p_l, p_h) = (\frac{(1 - \underline{\theta}^2(\Delta c, \lambda, v, \alpha))(v - \Delta c)}{1 - 2(\underline{\theta}^2(\Delta c, \lambda, v, \alpha))}, v)$ and adhering to the norm.

Proof. See Appendix. □

Proposition 1 analyzes a scenario where the total surplus from resolving a minor problem is at least as high as that from a major one, and the consumer faces a high likelihood of a minor problem. The equilibrium outcome is associated with either honesty or full under-treatment, depending on the expert's sensitivity to cheating and perceived cheating.

A purely selfish expert, or one with low sensitivity to cheating, will consistently under-treat the consumer to extract the full surplus without incurring significant psychological costs. The consumer accepts this under-treatment as the likelihood of a major problem is low. An expert with higher sensitivity tends to follow the norm, weighing the certainty of securing a transaction with reduced profit from minor treatments against the risk of having r_l rejected to maximize potential gains from both treatments. The expert takes this risk only if the value of solving the consumer's problem, v, is high enough; otherwise, she avoids the risk and leaves the consumer with a positive surplus. An expert with strong psychological concerns will set the highest permissible price menu, behaving honestly but reducing the consumer's surplus to zero.

The main takeaway from Proposition 1 is that high sensitivities to cheating and perceived cheating deter the expert's unethical behavior and improve efficiency. However, this does not necessarily benefit the consumer. A consumer aware of the expert's strong sensitivity understands that the expert will adhere to the social norm, which gives the expert an opportunity to charge the highest prices and capture the entirety of the consumer's surplus. Additionally, θ^{CA} and θ^{P} play symmetric roles in mitigating under-treatment. As the consumer can recognize when under-treatment occurs, he and the expert share a mutual understanding regarding the expert's fraud.

Proposition 2. Suppose $\lambda \leq \Delta c$ and $\alpha \geq \frac{\Delta c - \lambda}{v - \lambda}$:

(i) When $\theta^{CA} = \theta^{P} = 0$, there exists an SE outcome involving *honesty with efficient problem-solving* under the price menu $(p_l, p_h) = (v - \Delta c, v)$.[34]

(ii) When $0 < \theta^{CA} + \theta^{P} < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$ and $v > c_l + c_h$, the SE outcome is *honesty with a potential untreated minor problem*, with the price menu $(p_l, p_h) = (v - \lambda, v)$. The consumer rejects r_l with probability $\frac{\Delta c - \lambda - (\theta^{CA} + \theta^{P})(\Delta c + v - 2\lambda)}{v - \lambda - c_l - (\theta^{CA} + \theta^{P})(\Delta c + v - 2\lambda)}$.

(iii) When $0 < \theta^{CA} + \theta^{P} < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$ and $v \leq c_l + c_h$, the SE outcome is *honesty with efficient*

[34] Another SE outcome is *honesty with a potential untreated minor problem*, with the price menu $(p_l, p_h) = (v - \lambda, v)$. The consumer rejects r_l with probability $\frac{\Delta c - \lambda}{v - \lambda - c_l}$.

problem-solving, with the price menu (p_l, p_h) where $p_l = \frac{(1-\theta^{CA}-\theta^P)(v-\Delta c)}{1-2(\theta^{CA}+\theta^P)}$ and $p_h = v$.

(iv) When $\theta^{CA} + \theta^P \geq \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$, the SE outcome is *honesty with efficient problem-solving*, with the price menu $(p_l, p_h) = (v - \lambda, v)$.

Proof. See Appendix. □

Proposition 2 explores a scenario where the total surplus from resolving a minor problem is at least as high as that from resolving a major problem, but the likelihood of the consumer facing a minor problem is low. In this case, the price mechanism effectively deters fraudulent behavior. A selfish expert may set a price menu of $(v - \Delta c, v)$, adhering to the norm and leaving the consumer with a positive surplus. However, the expert's psychological concerns on cheating result in a pure monetary transfer from the consumer to the expert. The consumer achieves the highest expected utility when the expert is purely selfish in this scenario.

Figure 2 illustrates the expected utilities for the expert and the consumer in the equilibria discussed in Proposition 1 and 2. The four cases are categorized based on the relationship between α and $\frac{\Delta c - \lambda}{v - \lambda}$, as well as the comparison between v and $c_l + c_h$.

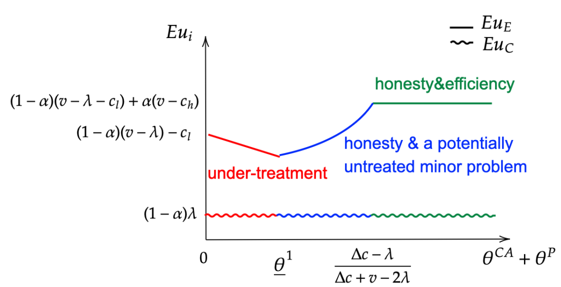

Fig 2. (a) $\alpha < \frac{\Delta c - \lambda}{v - \lambda}$ *and* $v > c_h + c_l$

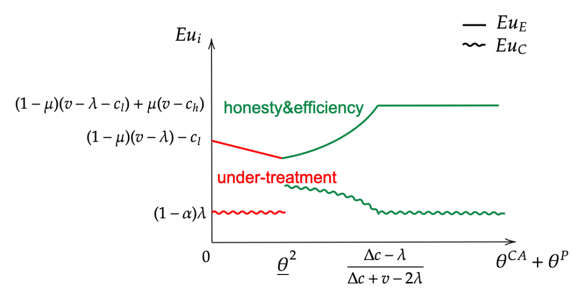

Fig 2. (b) $\alpha < \frac{\Delta c - \lambda}{v - \lambda}$ *and* $v \leqslant c_h + c_l$

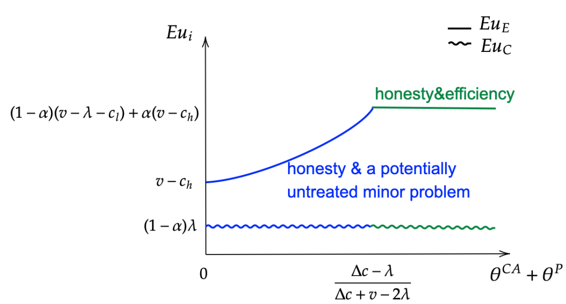

Fig 2. (c) $\alpha \geqslant \frac{\Delta c - \lambda}{v - \lambda}$ *and* $v > c_h + c_l$

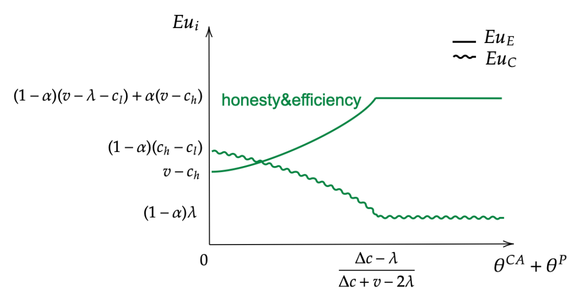

Fig 2. (d) $\alpha \geqslant \frac{\Delta c - \lambda}{v - \lambda}$ *and* $v \leqslant c_h + c_l$

Figure 2. Players' Expected Utilities In Equilibrium Across Different Values of $\theta^{CA} + \theta^P$ in VNL

Note: The solid line represents the expert's expected utility, while the wavy line represents the consumer's expected utility.

In Propositions 3 and 4, I study a setting where the total surplus from resolving a major problem exceeds that from resolving a minor one.

Proposition 3. Suppose $\lambda > \Delta c$, and $\alpha > \frac{\Delta c}{\lambda}$. There exist two thresholds, $\underline{\theta}^3(\theta^P)$ and $\underline{\theta}^4(\theta^P)$, which are decreasing in θ^P and satisfy $0 \leq \underline{\theta}^3(\theta^P), \underline{\theta}^4(\theta^P) < \frac{\lambda-\Delta c}{2\lambda-\Delta c}$, such that:

(i) When $0 \leq \theta^{CA} < \underline{\theta}^3(\theta^P)$ and $v > \lambda + \frac{c_l+c_h}{2}$, or when $0 \leq \theta^{CA} < \underline{\theta}^4$ and $v \leq \lambda + \frac{c_l+c_h}{2}$, the SE outcome is *full over-treatment*, with the price menu $(p_l, p_h) = (v-\lambda, v-(1-\alpha)\lambda)$.[35]

(ii) When $\underline{\theta}^3(\theta^P) < \theta^{CA} < \frac{\lambda-\Delta c}{2\lambda-\Delta c}$ and $v > \lambda + \frac{c_l+c_h}{2}$, the SE outcome is *honesty with a potential untreated major problem*, with the price menu $(p_l, p_h) = (v-\lambda, v)$. The consumer rejects r_h with probability $\frac{\lambda-\Delta c-\theta^{CA}(2\lambda-\Delta c)}{v-c_h-\theta^{CA}(2\lambda-\Delta c)}$.[36]

(iii) When $\underline{\theta}^4(\theta^P) < \theta^{CA} < \frac{\lambda-\Delta c}{2\lambda-\Delta c}$ and $v \leq c_l + c_h$, the SE outcome is *honesty and efficient problem-solving*, with prices $p_l = v-\lambda$ and $p_h = v-\lambda+\frac{(1-\theta^{CA})\Delta c}{1-2\theta^{CA}}$.[37]

(iv) When $\theta^{CA} \geq \frac{\lambda-\Delta c}{2\lambda-\Delta c}$, the SE outcome is *honesty and efficient problem-solving*, with the price menu $(p_l, p_h) = (v-\lambda, v)$.

Proof. See Appendix. □

Proposition 3 examines a scenario where the total surplus from resolving a major problem exceeds that of a minor one, and the likelihood of the consumer facing a major problem is high. In this context, the equilibrium outcome involves either honesty or full over-treatment.

An expert with low sensitivity to cheating is inclined to over-treat, and the consumer, anticipating a high probability of a major problem, accepts the over-treatment. An expert with relatively high but limited sensitivities will follow the norm. If v is sufficiently high, she will attempting to exploit the consumer's surplus at the risk of having r_h rejected. Otherwise, she will secure a

[35] When $\theta^{CA} = \theta^P = 0$, a price menu (p_l, p_h) where $p_h = v$ and $c_l \leq p_l < p_h$ can also support a full over-treatment equilibrium.

[36] When $\theta^{CA} = \underline{\theta}^3$, the expert is indifferent between setting $(p_l, p_h) = (v-\lambda, v-(1-\alpha)\lambda)$ and over-treating the consumer, or setting $(p_l, p_h) = (v-\lambda, v)$ and adhering to the norm, knowing that the consumer will reject r_h with probability $\frac{\lambda-\Delta c-\underline{\theta}^3(\Delta c,\lambda,v,\alpha,\theta^P)(2\lambda-\Delta c)}{v-c_h-\underline{\theta}^3(\Delta c,\lambda,v,\alpha,\theta^P)(2\lambda-\Delta c)}$.

[37] When $\theta^{CA} = \underline{\theta}^4(\Delta c, \lambda, v, \alpha, \theta^P)$, the expert is indifferent between setting $(p_l, p_h) = (v-\lambda, v-(1-\alpha)\lambda)$ and over-treating the consumer, or setting $(p_l, p_h) = (v-\lambda, v-\lambda+\frac{(1-\underline{\theta}^4(\Delta c,\lambda,v,\alpha,\theta^P))\Delta c}{1-2\underline{\theta}^4(\Delta c,\lambda,v,\alpha,\theta^P)})$ and adhering to the norm.

transaction with by forgoing some profit from the major treatment, leaving the consumer with positive surplus. When θ^{CA} exceeds the threshold $\frac{\lambda-\Delta c}{2\lambda-\Delta c}$, the *honesty and efficient problem-solving equilibrium* is sustained, but with the highest price menu $(v-\lambda, v)$, which drives the consumer surplus down to zero.

Proposition 3 reinforces the key insight from Theorem 1: high sensitivities to cheating and perceived cheating curb unethical behavior and enhance efficiency, but this does not necessarily lead to a direct gain for the consumer.

Proposition 4. Suppose $\lambda > \Delta c$, and $\alpha \leq \frac{\Delta c}{\lambda}$.

(i) When $\theta^{CA} = 0$, there exists a SE outcome involving *honesty with efficient problem-solving* under the price menu $(p_l, p_h) = (v-\lambda, v-\lambda+\Delta c)$.[38]

(ii) When $0 < \theta^{CA} < \frac{\lambda-\Delta c}{2\lambda-\Delta c}$, and $v > \lambda + \frac{c_l+c_h}{2}$, the SE outcome involves *honesty with a potential untreated minor problem* under the price menu $(p_l, p_h) = (v-\lambda, v)$. The consumer rejects r_h with probability $\frac{\lambda-\Delta c-\theta^{CA}(2\lambda-\Delta c)}{v-c_h-\theta^{CA}(2\lambda-\Delta c)}$.

(iii) When $0 < \theta^{CA} < \frac{\lambda-\Delta c}{2\lambda-\Delta c}$, and $v \leq \lambda + \frac{c_l+c_h}{2}$, the SE outcome involves *honesty and efficient problem-solving*, with a price menu (p_l, p_h) where $p_l = v-\lambda$ and $p_h = v-\lambda+\frac{(1-\theta^{CA})\Delta c}{1-2\theta^{CA}}$.

(iv) When $\theta^{CA} \geq \frac{\lambda-\Delta c}{2\lambda-\Delta c}$, the SE outcome involves *honesty with efficient problem-solving*, with the price menu $(p_l, p_h) = (v-\lambda, v)$.

Proof. See Appendix. □

Proposition 4 discusses a situation where the total surplus from resolving a major problem is greater than that from a minor one, however, the likelihood of getting a major problems for the consumer is low. In this case, the price mechanism effectively prevents the over-treatment. A selfish expert would set a price menu of $(v-\lambda, v-\lambda+\Delta c)$, and comply with the norm. Expert's high sensitivity towards cheating leads to a higher price menu and harms the consumer.

Notice that θ^{CA} plays a more significant role in mitigating over-treatment than θ^{P} when the total surplus from resolving a minor problem exceeds that from resolving a major one. The reason is that the fraudulent behavior – over-treatment – cannot be figured out by the consumer. As a result, the expert experiences less impact from perceived cheating aversion compared to cheating aversion.

[38] Another SE outcome is *honesty with a potential untreated major problem*, with the price menu $(p_l, p_h) = (v-\lambda, v)$. The consumer rejects r_h with probability g.

Figure 3 illustrates the expected utilities for the expert and the consumer in the equilibria discussed in Theorem 3 and 4. The four cases are categorized based on the relationship between α and $\frac{\Delta c}{\lambda}$, as well as the comparison between v and $\lambda + \frac{c_l + c_h}{2}$.

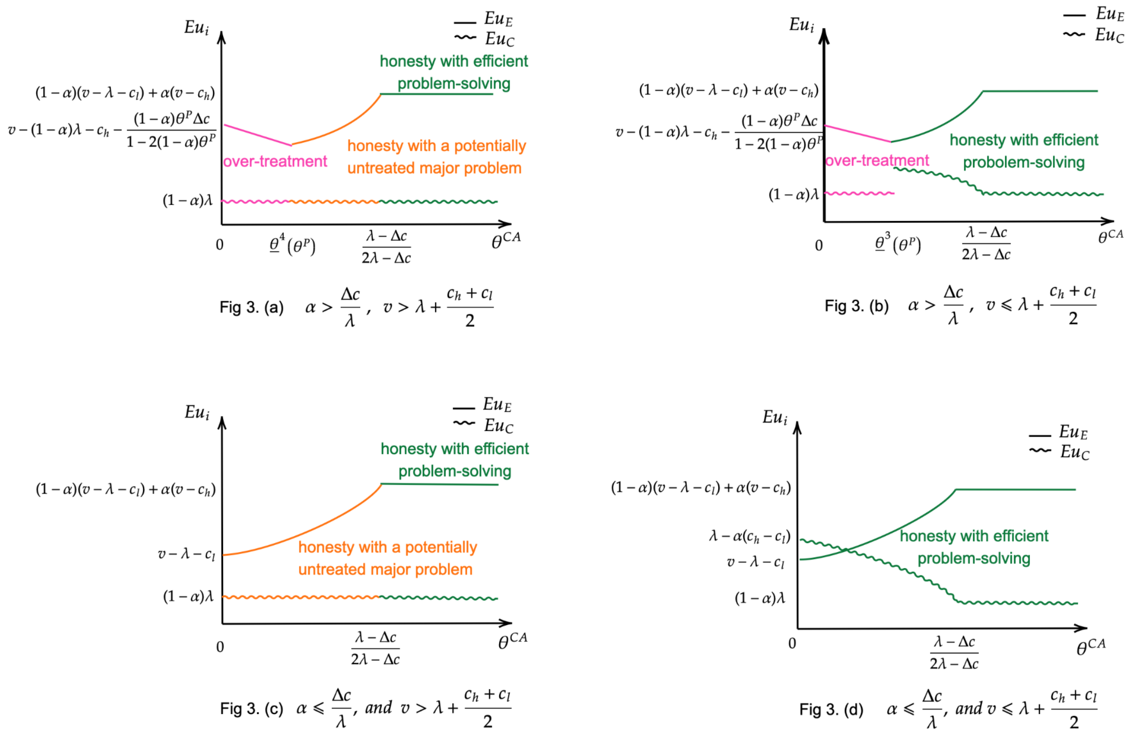

Figure 3. Players' Expected Utilities In Equilibrium Across Different Values of θ^{CA} in VNL

Note: The solid line represents the expert's expected utility, while the wavy line represents the consumer's expected utility.

To summarize my findings for CGG-V: high sensitivities to cheating and perceived cheating can reduce the expert's fraudulent behavior and enhance efficiency, but this does not always benefit the consumer and may, in some cases, harm him. When the likelihood of the problem associated with the larger total surplus is high, moderate sensitivity levels maximize the consumer's expected utility. Conversely, when the likelihood of the larger-surplus problem is low, the consumer achieves the highest utility when the expert is selfish. Furthermore, when the total surplus from resolving a minor problem is greater, both θ^{CA} and θ^P are equally influential in shaping market outcomes. Otherwise, θ^{CA} plays the dominant role.

5 Credence Goods Game – Liability

In this section, I analyze an alternative Credence Goods Game in an institutional setting defined by *Liability* (CGG-L). In this framework, the expert is responsible for resolving the consumer's problem, but the consumer neither observes nor can verify the treatment provided. This prevents the expert from administering a cheaper treatment when a more expensive one is necessary, thereby eliminating the possibility of under-treatment.

5.1 Setup, Social Norm, and (Perceived) Cheating

The basic structure of CGG-L closely resembles that of CGG-V, with one key distinction: the expert's available action set after the consumer accepts a recommendation. If the problem is minor, the expert can choose between administering a low-cost treatment (t_l) or a high-cost treatment (t_h). However, if the problem is major, the expert is obligated to provide t_h, causing the decision node to degenerate. Figure 4 illustrates the game tree for the CGG-L scenario.

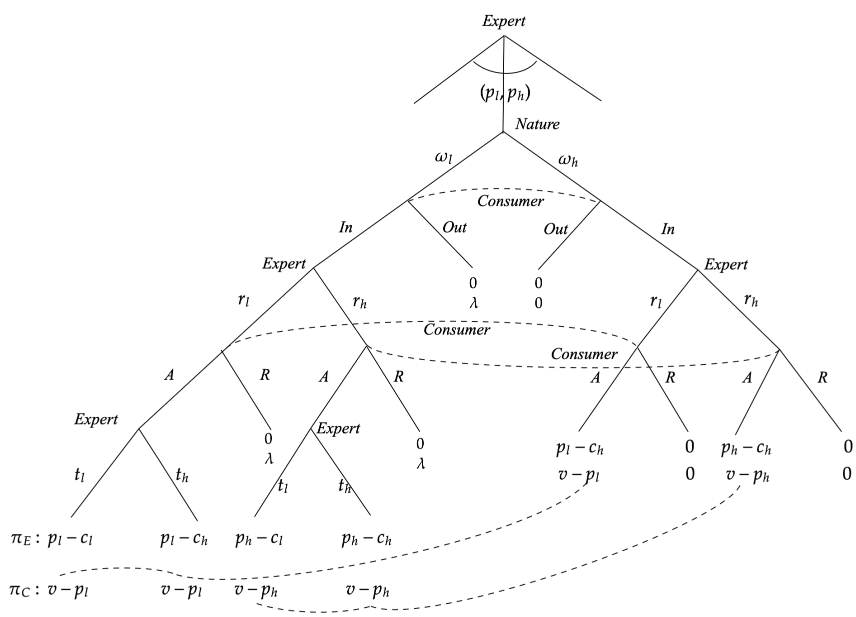

Figure 4. Credence Goods Game with *Liability* but No *Verifiability*

Note: the numerical values at the terminal nodes represent the monetary payoffs for the expert (first row) and the consumer (second row). The black dot lines represent the consumer's information sets.

To simplify the notation, I retain the symbols and meanings used in CGG-V for the CGG-L setting. In the CGG-L setting, I consider a social norm, n_E, which mandates that the expert both provide an accurate recommendation and administer the treatment corresponding to that recommendation for each $(p_l, p_h) \in P$. This social norm n_E specifies the expert's action at each information set $\mathbf{h} \in \mathbf{H} = \{((p_l, p_h), \omega, In), ((p_l, p_h), \omega_l, In, r) \mid (p_l, p_h) \in P,\ \omega \in \{\omega_l, \omega_h\}, \text{and } r \in \{r_l, r_h\}\}$. Formally,

$$n_E = (n_{E,\mathbf{h}})_{\mathbf{h} \in \mathbf{H}} \qquad (11)$$

where $n_{E,((p_l,p_h),\omega_l,In)} = r_l$, $n_{E,((p_l,p_h),\omega_h,In)} = r_h$, $n_{E,((p_l,p_h),\omega_l,In,r_l)} = t_l$, and $n_{E,((p_l,p_h),\omega_l,In,r_h)} = t_h$ for every (p_l, p_h). This norm not only enforces honest recommendations but also requires the expert to administer what she recommends.

Based on the norm n_E, we construct a **norm-consistent strategy** $s_E^{n_E} \in S_E$ following the approach used in the CGG-V model. Similarly, the concepts of **cheating**, **perceived cheating**, and the expert's utility function remain the same as in the CGG-V model.

5.2 SE For a Subgame $\Gamma^L(p_l, p_h)$ of CGG-L

I first solvie the SE for each subgame $\Gamma^L(p_l, p_h)$ of CGG-L, where $p_l \in [c_l, v - \lambda]$, $p_h \in [c_h, v]$, and $p_l \leq p_h$. Once the SEa for these subgames are determined, the expert's expected utility is maximized by selecting the optimal prices, thereby completing the equilibrium characterization for the entire game.

Lemmas 4 and 6 classify three types of equilibria: *honest recommendation with efficient problem-solving*, *honest recommendation with a potential untreated* ω_h and *over-charging*, specifying the price ranges and the conditions on θ^{CA} and θ^P required for each equilibrium to exist.

Note that σ_E^{ll} and σ_E^{hl} represent the probabilities that the expert recommends r_l for problems ω_l and ω_h, respectively. σ_C^{In} is the probability that the consumer chooses to enter the market ("In"), while σ_C^l and σ_C^h are the probabilities that the consumer accepts r_l and r_h, respectively. To describe the expert's behavior at the treatment provision stage, let σ_E^{lll} and σ_E^{lhl} denote the probabilities that the expert provides the cheap treatment t_l for a minor problem, given her recommendations r_l and r_h, respectively. The expert's choice for a major problem is not specified, as she is restricted to providing t_h.

Lemma 6. **(*Honest Recommendation and Efficient Problem-Solving*)** There exists an *honest recommendation and efficient problem-solving equilibrium* in which

$$\sigma_E^{ll} = 1, \sigma_E^{hl} = 0, \sigma_E^{lll} = 1, \sigma_C^{In} = 1, \sigma_C^{l} = 1, \text{ and } \sigma_C^{h} = 1$$

if and only if $p_l \leq v - \lambda$, $p_h \leq v$, $p_l \leq p_h$, and $\theta^{CA} \geq \frac{1}{2}$.[39]

Proof. See Appendix. □

Lemma 6 establishes the conditions under which the expert provides honest recommendations and the consumer's problem is always resolved efficiently. When the expert is purely selfish, no price menu can be sustained as an honest equilibrium. To prevent overcharging, the expert must possess a sufficient level of sensitivity to cheating aversion. It is important to note that the value of θ^P is irrelevant since overcharging can never be detected by the consumer in LNV setting.

Lemma 7. **(*Honest Recommendation with A Potential Untreated* ω_h)** There exists an *honest recommendation with a potential untreated* ω_h where:

$$\sigma_E^{ll} = 1,\ \sigma_E^{hl} = 0,\ \sigma_E^{ll} = 1,\ \sigma_E^{lll} = 1,\ \sigma_E^{lhl} = 1,\ \sigma_C^{In} = 1,\ \sigma_C^{l} = 1, \text{ and } \sigma_C^{h} \in (0,1)$$

if and only if $p_l \leq v - \lambda$, $p_h = v$, $\frac{p_l - c_h - \sigma_C^h (v - c_h)}{(1-\sigma_C^h)(p_l - c_h)} \leq \theta^{CA} \leq \frac{1}{2}$, and $2\theta^{CA}\sigma_C^h(v - p_l) + (\theta^{CA} + \theta^P)(v - \lambda - p_l) \geq \sigma_C^h(v - c_l) - (p_l - c_l)$.

Proof. See Appendix. □

Lemma 7 describe equilibria where the expert recommends honestly, but the consumer rejects certain r_h with positive probability. In these equilibria, at least one price reaches the consumer's highest willingness to pay under complete information. Strong psychological concerns about cheating or perceived cheating increase the likelihood of accepting the expert's recommendations.

Lemma 8. **(*Overcharging*)** (i) There exists an *full overcharging equilibrium* in which

$\sigma_E^{ll} = 0, \sigma_E^{hl} = 0, \sigma_E^{lll} = 1, \sigma_E^{lhl} = 1, \sigma_C^{In} = 1, \sigma_C^{l} = 1$, and $\sigma_C^{h} = 1$ with the consumer's off-equilibrium path belief that the state is ω_l when r_l is recommended,

if and only if $p_l \leq v - \lambda$, $p_h \leq v - (1-\alpha)\lambda$, $p_l \leq p_h$, and $\theta^{CA} + (1-\alpha)\theta^P \leq \frac{1}{2}$.

(ii)There exists an *partial overcharging equilibrium* in which

[39]To support $\sigma_E^{lhl} = 1$, the condition $\frac{1}{2} \leq \theta^C \leq max\{1, \frac{\Delta c}{\Delta p}\}$ must hold. Conversely, for $\sigma_E^{lhl} = 0$, the requirement is $\theta^C \geq max\{1, \frac{\Delta c}{\Delta p}\}$.

$$\sigma_E^{ll} = \frac{\lambda(1-\alpha)-(v-p_h)}{(1-\alpha)(p_h+\lambda-v)}, \sigma_E^{hl} = 0, \sigma_E^{lll} = 1, \sigma_E^{lhl} = 1, \sigma_C^{In} = 1, \sigma_C^{l} = 1, \text{ and}$$
$$\sigma_C^h = \frac{p_l - c_l + (\theta^{CA}+\theta^P)|v-\lambda-p_l|}{p_h - c_l - (\theta^{CA} + \frac{\theta^P(v-p_h)}{\lambda}) \cdot 2\Delta p + (\theta^{CA}+\theta^P)|v-\lambda-p_l|}$$

if and only if $p_l \leq v - \lambda$, $v - (1-\alpha)\lambda < p_h < v$, $p_l \leq p_h$, $\theta^{CA} + \frac{\theta^P(v-p_h)}{\lambda} \leq \frac{1}{2}$.

Proof. See Appendix. □

Lemma 8 identifies the conditions under which the expert overcharge the consumers. In a *full overcharging equilibrium*, the expert always recommends r_h but provides t_l. If the consumer believes the state is ω_l when r_l is recommended, a price of $p_l \leq v - \lambda$ would be accepted. The expert chooses to overcharge if $p_h - c_l - (\theta^{CA} + \theta^P(1-\alpha)) \cdot 2\Delta p \geq p_l - c_l$. In a *partial overcharging equilibrium*, the consumer learns a minor problem from recommendation r_l, but remains uncertain when the recommendation is r_h. The higher the values of θ^{CA} and θ^P, the more likely the consumer is to accept r_h.

5.3 SE For CGG-L

I now characterize the equilibria for the CGG-L in Theorem 5.

Proposition 5. There exist a threshold, $\underline{\theta}^5(\theta^P)$, which is decreasing in θ^P and satisfy $0 \leq \underline{\theta}^5(\theta^P) < \frac{1}{2}$, such that:

(i) When $0 \leq \theta^{CA} < \underline{\theta}^5(\Delta c, \lambda, v, \alpha, \theta^P)$, the SE outcome is *full over-charging*, with the price menu $(p_l, p_h) = (v - \lambda, v - (1-\alpha)\lambda)$.[40]

(ii) When $\underline{\theta}^5(\Delta c, \lambda, v, \alpha, \theta^P) < \theta^{CA} < \frac{1}{2}$, the SE outcome is *honesty with a potential untreated* ω_h, with the price menu $(p_l, p_h) = (v-\lambda, v)$. The consumer rejects r_h with probability $\frac{(1-2\theta^{CA})\lambda}{v-c_l-2\theta^{CA}\lambda}$.[41]

(iii) When $\theta^{CA} \geq \frac{1}{2}$, the SE outcome is *honest recommendation with efficient problem-solving*, with the price menu $(p_l, p_h) = (v - \lambda, v)$.

Proposition 5 demonstrates that the equilibrium outcome in the CGG-L model results in either honest recommendations or full overcharging. An expert with low sensitivity to cheating and perceived cheating will always recommend the high-cost treatment r_h but only provide the necessary

[40] When $\theta^{CA} = \theta^P = 0$, a price menu (p_l, p_h) where $p_h = v$ and $c_l \leq p_l < p_h$ can also support a full over-treatment equilibrium.

[41] When $\theta^{CA} = \underline{\theta}^5(\Delta c, \lambda, v, \alpha, \theta^P)$, the expert is indifferent between setting $(p_l, p_h) = (v - \lambda, v - (1-\alpha)\lambda)$ and over-treating the consumer, or setting $(p_l, p_h) = (v - \lambda, v)$ and adhering to the norm, knowing that the consumer will reject r_h with probability $\frac{\lambda - \Delta c - \underline{\theta}^3(\Delta c, \lambda, v, \alpha, \theta^P)(2\lambda - \Delta c)}{v - c_h - \underline{\theta}^3(\Delta c, \lambda, v, \alpha, \theta^P)(2\lambda - \Delta c)}$.

one. When the price is set at $p_h = v - (1-\alpha)\lambda$, the consumer becomes indifferent to whether he is treated or not, anticipating no meaningful information disclosure.

High levels of sensitivity to cheating encourage the expert to reveal truthful information. However, inefficiencies can arise, as the consumer may need to reject r_h with a positive probability in order to ensure honesty, particularly when θ^{CA} and θ^P are moderate. Once θ^{CA} exceeds $\frac{1}{2}$, regardless of θ^P, honest recommendations with efficient problem-solving are achieved at the highest price menu $(v - \lambda, v)$.

In CGG-L, while cheating aversion and perceived cheating aversion promote truthful information revelation, this can come at the cost of inefficiency. Moreover, the consumer's expected payoff remains unimproved.

Proof. See Appendix. □

Figure 5 illustrates the expected utilities for the expert and the consumer in the equilibria discussed in Proposition 5. The two cases are categorized based the value of θ^P.

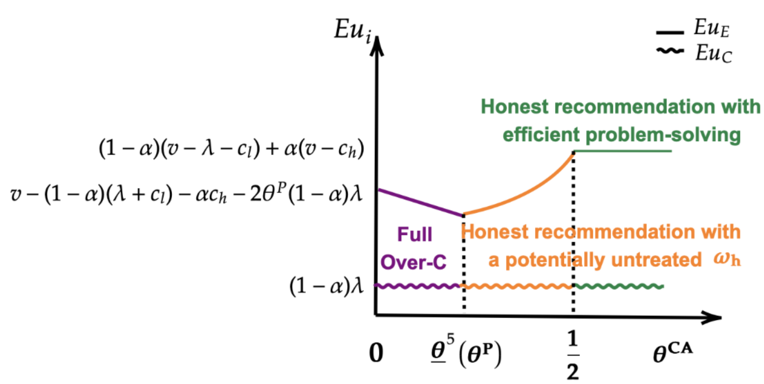

Figure 5. Players' Expected Utilities In Equilibrium Across Different Values of θ^{CA} in LNV

Note: The solid line represents the expert's expected utility, while the wavy line represents the consumer's expected utility.

6 Conclusion

This paper develops a framework for defining cheating based on social norm. Cheating is a violation of a prescriptive rule with the intent to gain an unfair advantage. Social norms, as widely accepted behavioral guides, serve as moral reference points for honesty in specific situations. This normative approach provides a structured basis for analyzing dishonest behavior in various contexts. I place a particular emphasis on credence goods markets.

In examining credence goods markets, I analyze how psychological concerns regarding cheating and perceived cheating influence the expert's behavior, consumer welfare, and market efficiency. The results suggest that high sensitivity to cheating can improve consumer outcomes in fixed-price environments by encouraging honest behavior. However, when experts have pricing power, heightened concerns may backfire, leading to reduced consumer surplus. Specifically, when the likelihood of the problem associated with larger total surplus is significant, moderate sensitivity to (perceived) cheating concerns maximizes consumer welfare. In contrast, when the problem associated with larger surplus is unlikely to occur, the consumer is best off when the expert is purely selfish.

The comparison between *verifiability* and *liability* reveals that when the expert has sufficiently strong sensitivity to cheating and perceived cheating, market outcomes are more efficient and recommendations are more honest under verifiability than under liability.

These findings carry significant policy implications. First, incentivizing experts to adhere to social norms of honesty, either through reputational mechanisms or psychological interventions, are likely to promote ethical behavior and improve market efficiency. Furthermore, regulatory frameworks that foster transparency and verifiability are more likely to yield efficient market outcomes, particularly when experts exhibit strong sensitivities to cheating and concerns about their social image.

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Appendix A Definition

Definition 1. *Assessment* $((\sigma_i)_{i\in I_0}, (\mu_i^1, \mu_i^2)_{i\in I})$ *is* ***consistent*** *if*

(i) μ^1 *is derived from* σ*:*

$$\forall i \in I, s_{-i} \in S_{-i}, \mathbf{h} \in \mathcal{I}_i,\ \mu_i^1(s_{-i}|\mathbf{h}) = \textstyle\prod_{j\neq i} Pr_{\sigma_j}(s_j|\mathbf{h})$$

where $Pr_{\sigma_j}(s_j|\mathbf{h})$ *denote the probability measure over* j*'s strategies conditional on* $\boldsymbol{h}$ *derived from behavior strategy* σ_j *under the assumption of independence across histories.*

(ii) μ^2 *assigns probability one to first-order beliefs:*

$$\forall i \in I,\ \forall \mathbf{h} \in \mathcal{I}_i,\ \mu_i^2(\cdot|\mathbf{h}) = \mu_i^1(\cdot|\mathbf{h}) \times \delta_{\mu_{-i}^1}$$

where $\delta_{\mu_{-i}^1}$ *is the Dirac measure assigning probability 1 to* $\{\mu_{-i}^1\} \subseteq \Delta_{-i}^1$*.*

Appendix B Omitted Proofs

Lemma 1. An *honesty with efficient problem-solving equilibrium* exists, where the expert makes a honest recommendation and the consumer accepts both recommendations, i.e.,

$$\sigma_E^{ll} = 1, \sigma_E^{hl} = 0, \sigma_C^{In} = 1, \sigma_C^{l} = 1, \text{ and } \sigma_C^{h} = 1$$

if and only if $\theta^{CA} \geq \frac{\Delta p - \Delta c}{|\Delta p - \Delta c| + \Delta p}$, and $\theta^{CA} + \theta^{P} \geq \frac{\Delta c - \Delta p}{|\Delta c - \Delta p| + v - \Delta p}$.

Proof. " $\Rightarrow''$: Suppose a price menu $(p_l, p_h) \in P$ induces an equilibrium with $\sigma_E^{ll} = 1$, $\sigma_E^{hl} = 0$, $\sigma_C^{In} = 1$, $\sigma_C^{l} = 1$, and $\sigma_C^{h} = 1$. Given the consumer's strategy and his beliefs that the experts always tells the truth, the expert recommends r_l at history (ω_l, In) if $E_{(\sigma,\mu)}[u_E|(\omega_l, In), p_l] = p_l - c_l \geq E_{(\sigma,\mu)}[u_E|(\omega_l, In), p_h] = p_h - c_h - \theta^{CA} \cdot (|\Delta p - \Delta c| + \Delta p) - \theta^{P} \cdot 0$, i.e., $\theta^{CA} \geq \frac{\Delta p - \Delta c}{|\Delta p - \Delta c| + \Delta p}$.

Similarly, she would like to recommend r_h at history (ω_h, In) if $E_{(\sigma,\mu)}[u_E|(\omega_h, In), p_h] = p_h - c_h \geq E_{(\omega_h,In)}[u_E|(\omega_h, In), p_l] = p_l - c_l - (\theta^{C} + \theta^{P}) \cdot (|\Delta c - \Delta p|, v - \Delta p)$, i.e., $\theta^{CA} + \theta^{P} \geq \frac{\Delta c - \Delta p}{|\Delta c - \Delta p| + v - \Delta p}$.

Given the expert's strategy, the consumer's best response are $\sigma_C^{In} = 1$, $\sigma_C^{l} = 1$, and $\sigma_C^{h} = 1$ if $(1-\alpha)(v - p_l) + \alpha(v - p_h) \geq (1-\alpha)(v - \lambda)$, $p_l \leq v - \lambda$ and $p_h \leq v$. For any $(p_l, p_h) \in P$, these conditions hold.

" $\Leftarrow''$: Suppose $(p_l, p_h) \in P \cap \{(p_l, p_h)|(\theta^{CA} + \theta^{P}) \cdot (|\Delta c - \Delta p|, v - \Delta p) \leq \Delta p - \Delta c \leq \theta^{CA} \cdot (|\Delta p - \Delta c|, \Delta p)\}$. If $\sigma_C^{l} = 1$, and $\sigma_C^{h} = 1$, we have $E_{(\sigma,\mu)}[u_E|(\omega_l, In), p_l] \geq E_{(\sigma,\mu)}[u_E|(\omega_l, In), p_h]$, and $E_{(\sigma,\mu)}[u_E|(\omega_h, In), p_h] \geq E_{(\sigma,\mu)}[u_E|(\omega_h, In), p_l]$. Therefore, $\sigma_E^{ll} = 1$ and $\sigma_E^{hl} = 0$ are the expert's best responses. Foreseeing this, $\sigma_C^{In} = 1$, $\sigma_C^{l} = 1$, and $\sigma_C^{h} = 1$ are the consumer's best response. □

Lemma 2. (i) A *full under-treatment equilibrium* exists, where the expert always recommends r_l and the consumer accepts both recommendations, i.e.,

$$\sigma_E^{ll} = 1,\ \sigma_E^{hl} = 1,\ \sigma_C^{In} = 1,\ \sigma_C^{l} = 1, \text{ and } \sigma_C^{h} = 1$$

with the consumer's off-equilibrium path belief that the state is ω_h when r_h is recommended, if and only if $p_l \leq (1-\alpha)(v - \lambda)$, $\Delta p \leq \Delta c$, and $0 \leq \theta^{CA} + \theta^{P} \leq \frac{\Delta c - \Delta p}{v + \Delta c - 2\Delta p}$. [42]

(ii) A *partial under-treatment equilibrium* exists, where the expert always recommends r_l, the consumer accepts r_h, but sometimes rejects r_l, i.e.,

$$\sigma_E^{ll} = 1,\ \sigma_E^{hl} = 1 - \frac{p_l - (1-\alpha)(v-\lambda)}{\alpha p_l},\ \sigma_C^{In} = 1,\ \sigma_C^{l} = \frac{p_h - c_h + (\theta^{CA} + \theta^{P})(v - p_h)}{p_l - c_l - (\theta^{CA} + \theta^{P})[(\Delta c + v - 2\Delta p) - (v - p_h)]}, \text{ and } \sigma_C^{h} = 1$$

[42]When $\theta^{C} = \theta^{P} = 0$, there is another type of under-treatment equilibrium with $\sigma_E^{ll} = 1$, $\sigma_E^{hl} = 1$, $\sigma_C^{In} = 1$, $\sigma_C^{l} = 1$, and $\sigma_C^{h} = 0$, supported by the consumer's off-equilibrium path belief that the state is ω_l whenever p_h is recommended, for $p_l \leq (1 - \mu_h)(v - \lambda)$, and $v - \lambda < p_h \leq v$.

if and only if $(1-\alpha)(v-\lambda) < p_l < v-\lambda$, $\Delta p \leq \Delta c$, and $0 \leq \theta^{CA} + \theta^P \leq \frac{\Delta c - \Delta p}{v + \Delta c - 2\Delta p}$.

Proof. (i) " $\Rightarrow''$: Suppose a price menu $(p_l, p_h) \in P$ induces a full under-treatment equilibrium. Given the consumer's strategy, $\sigma_C^{In} = 1$, $\sigma_C^l = 1$, and $\sigma_C^h = 1$, and his beliefs that the experts always under-treat, the expert recommends r_l at history (ω_l, In) if $p_l - c_l \geq p_h - c_h - \theta^{CA} \cdot (|\Delta p - \Delta c| + \Delta p)$. And the expert would like to recommend r_l at history (ω_h, In) if $p_l - c_l - (\theta^C + \theta^P) \cdot (|\Delta c - \Delta p| + v - \Delta p) \geq p_h - c_h$, i.e., $\Delta p \leq \Delta c$, and $\theta^{CA} + \theta^P \leq \frac{\Delta c - \Delta p}{v + \Delta c - 2\Delta p}$.

Given $\sigma_E^{ll} = \sigma_E^{hl} = 1$, and the consumer's off-equilibrium path of the problem being ω_h when r_h is recommended, the consumer's best response are $\sigma_C^{In} = \sigma_C^l = \sigma_C^h = 1$ if $(1-\alpha)(v-p_l) - \alpha p_l \geq (1-\alpha)\lambda$, $p_l \leq (1-\mu_h)(v-\lambda)$ and $p_h \geq v$.

" $\Leftarrow''$: Suppose $(p_l, p_h) \in \{(p_l, p_h) | p_l \leq (1-\alpha)(v-\lambda), p_h \leq v, \text{ and } 0 \leq \theta^C + \theta^P \leq \frac{\Delta c - \Delta p}{v + \Delta c - 2\Delta p}\}$. If $\sigma_C^l = 1$, and $\sigma_C^h = 0$, we have $E_{(\sigma,\mu)}[u_E | (\omega_l, In), p_l] \geq E_{(\sigma,\mu)}[u_E | (\omega_l, In), p_h]$, and $E_{(\sigma,\mu)}[u_E | (\omega_h, In), p_l] \geq E_{(\sigma,\mu)}[u_E | (\omega_h, In), p_h]$. Therefore, $\sigma_E^{ll} = 1$ and $\sigma_E^{hl} = 0$ are the expert's best responses. Foreseeing this, $\sigma_C^{In} = 1$, $\sigma_C^l = 1$, and $\sigma_C^h = 0$ are the consumer's best response.

(ii) " $\Rightarrow''$: To guarantee $\sigma_C^l = \frac{p_h - c_h + (\theta^{CA} + \theta^P)(v - p_h)}{p_l - c_l - (\theta^{CA} + \theta^P)[(|\Delta c - \Delta p| + v - \Delta p) - (v - p_h)]} \in (0,1)$ and $\sigma_E^{hl} = 1 - \frac{p_l - (1-\alpha)(v-\lambda)}{\alpha p_l} \in [0,1]$, the conditions $\theta^{CA} + \theta^P \leq \frac{\Delta c - \Delta p}{|\Delta c - \Delta p| + v - \Delta p}$, and $(1-\alpha)(v-\lambda) \leq p_l \leq v - \lambda$ must be true. For $\sigma_C^h = 1$ to be the consumer's best response, $p_h \leq v$ must hold.

" $\Leftarrow''$: Suppose $(p_l, p_h) \in \{(p_l, p_h) | (1-\alpha)(v-\lambda) < p_l < v - \lambda,\ p_h \leq v,\ \Delta p \leq \Delta c, \text{ and } 0 \leq \theta^{CA} + \theta^P \leq \frac{\Delta c - \Delta p}{v + \Delta c - 2\Delta p}\}$. If $\sigma_C^l = \frac{p_h - c_h + (\theta^{CA} + \theta^P)(v - p_h)}{p_l - c_l - (\theta^{CA} + \theta^P)[(|\Delta c - \Delta p| + v - \Delta p) - (v - p_h)]}$, and $\sigma_C^h = 1$, we have $E_{(\sigma,\mu)}[u_E | (\omega_l, In), p_l] = \sigma_C^l (p_l - c_l) > E_{(\sigma,\mu)}[u_E | (\omega_l, In), p_h] = p_h - c_h - \theta^{CA} \cdot \sigma_C^l [(|\Delta p - \Delta c| + \Delta p)]$, and $E_{(\sigma,\mu)}[u_E | (\omega_h, In), r_l] = \sigma_C^l (p_l - c_l) - (\theta^{CA} + \theta^P)[(|\Delta c - \Delta p| + v - \Delta p)] = E_{(\sigma,\mu)}[u_E | (\omega_h, In), r_h] = p_h - c_h$. Therefore, $\sigma_E^{ll} = 1$ and $\sigma_E^{hl} \in [0,1]$ are the expert's best responses.

Given the expert's strategy, the consumer knows the problem must be major when p_h is recommended and the problem is minor with probability $\frac{1-\alpha}{1-\alpha+\alpha\sigma_E^{hl}}$ when p_l is recommended. When $\sigma_E^{hl} = 1 - \frac{p_l - (1-\alpha)(v-\lambda)}{\alpha p_l}$, the consumer is indifferent between accepting or rejecting r_l. Hence, $\sigma_C^l = \frac{p_h - c_h + (\theta^{CA} + \theta^P)(v - p_h)}{p_l - c_l - (\theta^{CA} + \theta^P)[(|\Delta c - \Delta p| + v - \Delta p) - (v - p_h)]}$ is a best response of the consumer. Combining the conditions $p_h \leq v$, it is easy to show that $\sigma_C^h = 1$, and $\sigma_C^{In} = 1$ are the consumer's best responses.

□

Lemma 3.(i) A *full over-treatment equilibrium* exists, where the expert always recommends r_h and the consumer accepts both recommendations, i.e.,

$$\sigma_E^{ll}=0,\ \sigma_E^{hl}=0,\ \sigma_C^{In}=1,\ \sigma_C^{l}=1, \text{ and } \sigma_C^{h}=1$$

with the consumer's off-equilibrium path belief that the state is ω_l when r_l is recommended, if and only if $p_h \leq v-(1-\alpha)\lambda$, $\Delta p \geq \Delta c$, and $0 \leq \theta^{CA}+\theta^P(1-\alpha) \leq \frac{\Delta p-\Delta c}{2\Delta p-\Delta c}$.[43]

(ii) A *partial over-treatment equilibrium* exists, where the expert always recommends r_h, the consumer accepts r_l, but sometimes rejects r_h, i.e.,

$$\sigma_E^{ll}=1-\frac{\alpha(v-p_h)}{(1-\alpha)(p_h+\lambda-v)},\ \sigma_E^{hl}=0,\ \sigma_C^{In}=1,\ \sigma_C^{l}=1, \text{ and}$$
$$\sigma_C^{h}=\frac{p_l-c_l+(\theta^{CA}+\theta^P)(v-p_l-\lambda)}{p_h-c_h+(\theta^{CA}+\theta^P)(v-p_l-\lambda)-(\theta^{CA}+\theta^P\cdot\frac{v-p_h}{\lambda})\cdot(2\Delta p-\Delta c)}$$

if and only if $v-(1-\alpha)\lambda < p_h \leq v$, $\Delta p \geq \Delta c$, and $0 \leq \theta^C+\frac{\theta^P(v-p_h)}{\lambda} \leq \frac{\Delta p-\Delta c}{2\Delta p-\Delta c}$.

Proof. (i) " $\Rightarrow$": Suppose a price menu $(p_l,p_h)\in P$ induces a full over-treatment equilibrium. Given the consumer's strategy, $\sigma_C^{In}=1$, $\sigma_C^l=1$, and $\sigma_C^h=1$, and his beliefs that the experts always overtreat, the expert would recommends r_h at history (ω_l, In) when $p_h-c_h-(\theta^{CA}+\theta^P(1-\alpha))\cdot(|\Delta p-\Delta c|+\Delta p)\geq p_l-c_l$, i.e., $\Delta p\geq\Delta c$, and $\theta^{CA}+\theta^P(1-\alpha)\leq\frac{\Delta p-\Delta c}{2\Delta p-\Delta c}$. These two conditions imply it is optimal for the expert to recommend r_h at history (ω_h, In) as $p_h-c_h-\theta^P(1-\alpha)\cdot(|\Delta p-\Delta c|+\Delta p) > p_l-c_l-(\theta^C+\theta^P)(|\Delta c-\Delta p|+v-\Delta p)$.

Given $\sigma_E^{ll}=\sigma_E^{hl}=0$, and the consumer's off-equilibrium path of the problem being ω_l when p_l is recommended, we need $p_l\leq v-\lambda$ and $p_h\leq v-(1-\alpha)\lambda$ to be satisfied such that it is optimal for the consumer to use the strategy $\sigma_C^{In}=1$, $\sigma_C^l=1$, and $\sigma_C^h=1$. As $(p_l,p_h)\in P$, these conditions hold.

" $\Leftarrow$": Suppose $(p_l,p_h)\in P\cap\{(p_l,p_h)|p_l\leq v-\lambda,\ p_h\leq v-(1-\alpha)\lambda, \text{ and } 0\leq\theta^{CA}+\theta^P(1-\alpha)\leq\frac{\Delta p-\Delta c}{2\Delta p-\Delta c}\}$. If $\sigma_C^l=1$, and $\sigma_C^h=1$, we have $E_{(\sigma,\mu)}[u_E|(\omega_l,In),r_h]\geq E_{(\sigma,\mu)}[u_E|(\omega_l,In),r_l]$, and $E_{(\sigma,\mu)}[u_E|(\omega_h,In),r_h] > E_{(\sigma,\mu)}[u_E|(\omega_h,In),r_l]$. Therefore, $\sigma_E^{ll}=0$ and $\sigma_E^{hl}=0$ are the expert's best responses. Given the off-eq path belief of the problem being minor when r_l is recommended, $\sigma_C^l=1$ is the consumer's best responses as $p_l\leq v-\lambda$. Given $\sigma_E^{ll}=\sigma_E^{hl}=0$, under the condition of $p_h\leq v-(1-\alpha)\lambda$, we are able to show $\sigma_C^{In}=1$ and $\sigma_C^h=1$ are the consumer's best responses.

(ii) " $\Rightarrow$": The condition $v-(1-\alpha)\lambda<p_h<v$ is necessary for $\sigma_E^{ll}=1-\frac{\alpha(v-p_h)}{(1-\alpha)(p_h+\lambda-v)}\in(0,1)$. The conditions $\Delta p\geq\Delta c$, and $0\leq\theta^{CA}+\frac{\theta^P(v-p_h)}{\lambda}\leq\frac{\Delta p-\Delta c}{2\Delta p-\Delta c}$ are necessary for $\sigma_C^h=\frac{p_l-c_l+(\theta^{CA}+\theta^P)(v-p_l-\lambda)}{p_h-c_h+(\theta^{CA}+\theta^P)(v-p_l-\lambda)-(\theta^{CA}+\theta^P\cdot\frac{v-p_h}{\lambda})\cdot(2\Delta p-\Delta c)}\in[0,1]$. Given the consumer's off-equilibrium path belief of the problem being minor when r_l is recommended, it is the consumer's best response to accept r_l when $p_l\leq v-\lambda$.

[43]When $\theta^C=\theta^P=0$, there are other overtreatment equilibria for $p_l\geq c_l$, and $p_h\leq v-(1-\mu_h)\lambda$, supported by the consumer's off-equilibrium path belief that the state is ω_h whenever r_l is recommended.

" $\Leftarrow$": Suppose $(p_l, p_h) \in \{(p_l, p_h) | p_l \leq v - \lambda,\ v - (1-\alpha)\lambda < p_h < v,\ \Delta p \geq \Delta c$, and $0 \leq \theta^{CA} + \frac{\theta^P (v-p_h)}{\lambda} \leq \frac{\Delta p - \Delta c}{2\Delta p - \Delta c}\}$. If $\sigma_C^l = 1$, and $\sigma_C^h = \frac{p_l - c_l + (\theta^{CA}+\theta^P)(v-p_l-\lambda)}{p_h - c_h + (\theta^{CA}+\theta^P)(v-p_l-\lambda) - (\theta^{CA}+\theta^P \cdot \frac{v-p_h}{\lambda}) \cdot (2\Delta p - \Delta c)}$, $\sigma_E^{ll} = 1 - \frac{\alpha(v-p_h)}{(1-\alpha)(p_h+\lambda-v)}$, we have $E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_l] = E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_h]$, and $E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_h] > E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_l]$. Therefore, $\sigma_E^{ll} = 1 - \frac{\alpha(v-p_h)}{(1-\alpha)(p_h+\lambda-v)} \in [0,1]$, and $\sigma_E^{hl} = 0$ are the expert's best responses.

Given the expert's strategy, the consumer knows the problem must be minor when r_l is recommended and the problem is major with probability $\frac{(1-\alpha)(1-\sigma_E^{ll})}{(1-\alpha)(1-\sigma_E^{ll})+\alpha}$ when r_h is recommended. When $\sigma_E^{ll} = 1 - \frac{\alpha(v-p_h)}{(1-\alpha)(p_h+\lambda-v)}$, the consumer is indifferent between accepting or rejecting r_l. Hence, $\sigma_C^h = \frac{p_l - c_l + (\theta^{CA}+\theta^P)(v-p_l-\lambda)}{p_h - c_h + (\theta^{CA}+\theta^P)(v-p_l-\lambda) - (\theta^{CA}+\theta^P \cdot \frac{v-p_h}{\lambda}) \cdot (2\Delta p - \Delta c)}$ is a best response of the consumer. Combining the conditions $p_l \leq v - \lambda$, it is easy to show that $\sigma_C^l = 1$, and $\sigma_C^{In} = 1$ are the consumer's best responses.

$\square$

Lemma 4. An *honesty with a potential untreated ω_l equilibrium* exists, where the expert behaves honestly and the consumer accepts r_h but sometimes rejects r_l, i.e.,

$$\sigma_E^{ll} = 1, \sigma_E^{hl} = 0, \sigma_C^{In} = 1, \sigma_C^l \in (0,1),$$

if and only if either: (i) $p_l = v - \lambda$, $\Delta p < \Delta c$, $\theta^{CA} \geq \frac{p_h - c_h - \sigma_C^l (v-\lambda-c_l)}{2p_h - c_h - (v-\lambda) - \sigma_C^l (p_h - c_h)}$, and $\theta^{CA} + \theta^P \geq \frac{\sigma_C^l (v-\lambda-c_l) - (p_h-c_h)}{\sigma_C^l (\Delta c - p_h + 2(v-\lambda)) + v - p_h}$, or (ii) $p_l = v - \lambda$, $\Delta p \geq \Delta c$, $\theta^{CA} \geq \frac{p_h - c_h - \sigma_C^l (v-\lambda-c_l)}{2p_h - c_h - (v-\lambda) - \sigma_C^l (v-\lambda-c_l)}$.

Proof. " $\Rightarrow$": Suppose $(p_l, p_h) \in P$ induces an equilibrium with $\sigma_E^{ll} = 1$, $\sigma_E^{hl} = 0$, $\sigma_C^{In} = 1$, $\sigma_C^l \in (0,1)$, and $\sigma_C^h = 1$. Given the expert's strategy, the consumer is indifferent between accepting and rejecting r_l only when $p_l = v - \lambda$.

When $\Delta p < \Delta c$, the expert recommends r_l at (ω_l, In) if $E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_l] = \sigma_C^l (p_l - c_l) \geq E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_h] = p_h - c_h - \theta^{CA}[(\sigma_C^l(|\Delta p - \Delta c| + \Delta p) + (1-\sigma_C^l)(p_h - c_h + p_h - (v-\lambda))]$, i.e., $\theta^{CA} \geq \frac{p_h - c_h - \sigma_C^l (v-\lambda-c_l)}{2p_h - c_h - (v-\lambda) - \sigma_C^l (p_h - c_h)}$; and she would like to recommend r_h at history (ω_l, In) if $E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_h] = p_h - c_h \geq E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_l] = \sigma_C^l (p_l - c_l) - (\theta^{CA}+\theta^P)[(\sigma_C^l(|\Delta c - \Delta p| + v - \Delta p) + (1-\sigma_C^l)(v - p_h)]$, i.e.,$\theta^{CA} + \theta^P \geq \frac{\sigma_C^l (v-\lambda-c_l) - (p_h-c_h)}{\sigma_C^l (\Delta c - p_h + 2(v-\lambda)) + v - p_h}$.

When $\Delta p \geq \Delta c$, $E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_h] \geq E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_l]$ is always true. The expert recommends r_l at (ω_l, In) if $\sigma_C^l (p_l - c_l) \geq p_h - c_h - \theta^{CA}[(\sigma_C^l(|\Delta p - \Delta c| + \Delta p) + (1-\sigma_C^l)(p_h - c_h + p_h - (v-\lambda))]$, i.e., $\theta^{CA} \geq \frac{p_h - c_h - \sigma_C^l (v-\lambda-c_l)}{2p_h - c_h - (v-\lambda) - \sigma_C^l (v-\lambda-c_l)}$.

" $\Leftarrow$": Suppose $(p_l, p_h) \in P \cap \{(p_l, p_h)|\ p_l = v - \lambda,\ \Delta p < \Delta c,\ \theta^{CA} \geq \frac{p_h - c_h - \sigma_C^l(v-\lambda-c_l)}{2p_h - c_h - (v-\lambda) - \sigma_C^l(p_h - c_h)}$, and $\theta^{CA} + \theta^P \geq \frac{\sigma_C^l(v-\lambda-c_l)-(p_h-c_h)}{\sigma_C^l(\Delta c - p_h + 2(v-\lambda)) + v - p_h}\}$. If $\sigma_C^l \in (0,1)$, and $\sigma_C^h = 1$, we have $E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_l] \geq E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_h]$, and $E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_h] \geq E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_l]$. Therefore, $\sigma_E^{ll} = 1$, and $\sigma_E^{hl} = 0$ are the expert's best responses.

Given $\sigma_E^{ll} = 1$, the consumer is indifferent between accepting or rejecting r_l when $p_l = v - \lambda$. Hence, $\sigma_C^l \in (0,1)$ is a best response of the consumer. Combining the conditions $p_h \leq v$, we can show that $\sigma_C^h = 1$, and $\sigma_C^{In} = 1$ are the consumer's best responses.

Now, consider the other case: $(p_l, p_h) \in \{(p_l, p_h)|\ p_l = v - \lambda,\ p_h \leq v,\ \Delta p \geq \Delta c$, and $\theta^{CA} \geq \frac{p_h - c_h - \sigma_C^l(v-\lambda-c_l)}{2p_h - c_h - (v-\lambda) - \sigma_C^l(v-\lambda-c_l)}\}$. Given $\sigma_C^l \in (0,1)$, and $\sigma_C^h = 1$, we can show that $E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_l] \geq E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_h]$, and $E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_h] \geq E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_l]$. Hence, $\sigma_E^{ll} = 1$, and $\sigma_E^{hl} = 0$ are the expert's best responses.

Similarly, $\sigma_C^l \in (0,1)$, $\sigma_C^h = 1$, and $\sigma_C^{In} = 1$ are the consumer's best responses, given the conditions outlined above and the prices $p_l = v - \lambda$ and $p_h \leq v$.

$\square$

Lemma 5. An *honesty with a potential untreated ω_h equilibrium* exists, where the expert behaves honestly and the consumer accepts r_l but sometimes rejects r_h, i.e.,

$$\sigma_E^{ll} = 1,\ \sigma_E^{hl} = 0,\ \sigma_C^{In} = 1,\ \sigma_C^l = 1, \text{ and } \sigma_C^h \in (0,1)$$

if and only if either: (i)$p_h = v$, $\Delta p > \Delta c$, $\theta^{CA} + \theta^P \geq \frac{p_l - c_l - \sigma_C^h(v-c_h)}{2p_l - c_l - \sigma_C^h(p_l - c_l)}$ and $\sigma_C^h \theta^{CA} \cdot (2v - 2p_l - \Delta c) + (1-\sigma_C^h)\theta^P(v-\lambda-p_l) \geq \sigma_C^h(v-c_h) - (p_l - c_l)$, or (ii) $p_h = v$, $\Delta p \leq \Delta c$, and $\theta^{CA} + \theta^P \geq \frac{p_l - c_l - \sigma_C^h(v-c_h)}{2p_l - c_l - \sigma_C^h(v-c_h)}$.

Proof. " $\Rightarrow$": Suppose $(p_l, p_h) \in P$ induces an equilibrium with $\sigma_E^{ll} = 1$, $\sigma_E^{hl} = 0$, $\sigma_C^{In} = 1$, $\sigma_C^l = 1$, and $\sigma_C^h \in (0,1)$. Given $\sigma_E^{ll} = 1$, $\sigma_E^{hl} = 0$, the consumer is indifferent between accepting and rejecting r_h only when $p_h = v$.

When $\Delta p > \Delta c$, the expert recommends r_l at (ω_l, In) if $E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_l] = p_l - c_l \geq E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_h] = \sigma_C^h(p_h - c_h) - \theta^{CA}(\sigma_C^h(|\Delta p - \Delta c| + \Delta p) - (\theta^{CA} + \theta^P)(1 - \sigma_C^h)(v - \lambda - p_l)$, i.e., $\sigma_C^h \theta^{CA}(2v - 2p_l - \Delta c) + (1 - \sigma_C^h)\theta^P(v - \lambda - p_l) \geq \sigma_C^h(v - c_h) - (p_l - c_l)$,; and she would like to recommend r_h at history (ω_h, In) if $E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_h] = \sigma_C^h(p_h - c_h) \geq E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_l] = p_l - c_l - (\theta^{CA} + \theta^P)[(\sigma_C^h(|\Delta c - \Delta p| + v - \Delta p) + (1 - \sigma_C^h)(2p_l - c_l)]$, i.e., $\theta^{CA} + \theta^P \geq \frac{p_l - c_l - \sigma_C^h(v-c_h)}{2p_l - c_l - \sigma_C^h(p_l - c_l)}$.

When $\Delta p \leq \Delta c$, $E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_l] \geq E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_l]$ always holds. The expert recommends r_h at (ω_h, In) if $\sigma_C^h(p_h - c_h) \geq p_l - c_l - (\theta^{CA} + \theta^P)[(\sigma_C^h(\Delta c - \Delta p + v - \Delta p) + (1 - \sigma_C^h)(2p_l - c_l)]$, i.e., $\theta^{CA} + \theta^P \geq \frac{p_l - c_l - \sigma_C^h(v-c_h)}{2p_l - c_l - \sigma_C^h(v-c_h)}$.

" $\Leftarrow$": Suppose $(p_l, p_h) \in \{(p_l, p_h)|\ p_l \leq v-\lambda,\ p_h = v,\ \Delta p > \Delta c,\ \theta^{CA}+\theta^P \geq \frac{p_l-c_l-\sigma_C^h(v-c_h)}{2p_l-c_l-\sigma_C^h(p_l-c_l)}$ and $\sigma_C^h\theta^{CA}\cdot(2v-2p_l-\Delta c)+(1-\sigma_C^h)\theta^P(v-\lambda-p_l) \geq \sigma_C^h(v-c_h)-(p_l-c_l)\}$, we have $E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_l] \geq E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_h]$, and $E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_h] \geq [u_E|(\omega_h, In), r_l]$. Therefore, $\sigma_E^{ll} = 1$, and $\sigma_E^{hl} = 0$ are the expert's best responses.

When $p_h = v$, the consumer is indifferent between accepting or rejecting r_h. Hence, $\sigma_C^h \in (0,1)$ is a best response. Combining the conditions $p_l \leq v - \lambda$, $\sigma_C^l = 1$, and $\sigma_C^{In} = 1$ are also the consumer's best responses.

If $(p_l, p_h) \in \{(p_l, p_h)|\ p_l = v - \lambda,\ p_h \leq v,\ \Delta p \leq \Delta c$, and $\theta^{CA} + \theta^P \geq \frac{p_l-c_l-\sigma_C^h(v-c_h)}{2p_l-c_l-\sigma_C^h(v-c_h)}\}$. Given $\sigma_C^l \in (0,1)$, and $\sigma_C^h = 1$, $E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_l] \geq E_{(\sigma,\mu)}[u_E|(\omega_l, In), r_h]$, and $E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_h] \geq E_{(\sigma,\mu)}[u_E|(\omega_h, In), r_l]$ hold. Thus, the expert's optimal strategy is $\sigma_E^{ll} = 1$ and $\sigma_E^{hl} = 0$.

Given the expert's strategy, the conditions outlined above and the prices $p_l = v - \lambda$, $p_h \leq v$, we can show that $\sigma_C^l = 1$, $\sigma_C^h \in (0,1)$, and $\sigma_C^{In} = 1$ are the consumer's best responses.

□

To determine the price menu for the SE in CGG-V, I begin by calculating the expert's maximum equilibrium utility for each type of equilibrium outlined in the five lemmas above.

Corollary 1. (i) If $\lambda \leq \Delta c$, the expert's highest utility among the *HE* is

$$E\bar{u}_1^{HE} = \begin{cases} (1-\alpha)(\frac{(1-\theta^C-\theta^P)(v-\Delta c)}{1-2(\theta^C+\theta^P)} - c_l) + \mu_h(v-c_h) & \theta^C + \theta^P < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda} \\ (1-\mu_h)(v-\lambda-c_l) + \mu_h(v-c_h) & \theta^C + \theta^P \geq \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda} \end{cases}$$

(ii) If $\lambda > \Delta c$, the expert's highest utility among the *HE* is

$$E\bar{u}_1^{HE} = \begin{cases} (1-\alpha)(v-\lambda-c_l) + \alpha(v-\lambda+\frac{(1-\theta^C)\Delta c}{1-2\theta^C} - c_h) & \theta^C < \frac{\lambda-\Delta c}{2\lambda-\Delta c} \\ (1-\alpha)(v-\lambda-c_l) + \alpha(v-c_h) & \theta^C \geq \frac{\lambda-\Delta c}{2\lambda-\Delta c} \end{cases}$$

Corollary 2. (i) If $\lambda \leq \Delta c$ and $\alpha \leq \frac{\Delta c-\lambda}{v-\lambda}$, the expert's highest utility among the *FU* equilibrium is

$$E\bar{u}_1^{UE} = \begin{cases} p_l^* - c_l - \alpha(\theta^{CA}+\theta^P)(2p_l^* - v + \Delta c)) & \theta^C + \theta^P \leq \frac{\Delta c - v + p_l^*}{\Delta c - v + 2p_l^*} \\ p_l^* - c_l - \alpha(\theta^{CA}+\theta^P)\frac{v-\Delta c}{1-2(\theta^C+\theta^P)} & \frac{\Delta c - v + p_l^*}{\Delta c - v + 2p_l^*} < \theta^C + \theta^P \leq \frac{\Delta c}{\Delta c + v} \end{cases}$$

where $p_l^* = (1-\alpha)(v-\lambda)$.

(ii) If $\lambda > \Delta c$ and $\mu_h \leq \frac{v-2\lambda+c_h-2c_l}{2(v-\lambda)}$, the expert's highest utility among the FU equilibrium is

$$E\bar{u}_1^{UE} = \begin{cases} p_l^* - c_l - \mu_h(\theta^C+\theta^P)(v+\Delta c - \frac{2\Delta c - 2(\theta^C+\theta^P)(v+\Delta c)}{1-2(\theta^C+\theta^P)}) & \theta^C+\theta^P \leq \frac{p_l^*-c_l-\frac{v-c_h}{2}}{2p_l^*-c_l} \\ p_l^* - c_l - \mu_h(\theta^C+\theta^P)(2p_l^*-c_l) & \frac{p_l^*-c_l-\frac{v-c_h}{2}}{2p_l^*-c_l} < \theta^C+\theta^P \leq \frac{p_l^*-c_l}{2p_l^*-c_l} \end{cases} \quad ()$$

where $p_l^* = (1-\mu_h)(v-\lambda)$.

(iii) If $\lambda \leq \Delta c$, and $v \geq c_h + c_l$, the expert's highest utility in PUE is

$$E\bar{u}_1^{PU} = \begin{cases} v - c_h + \frac{(1-\mu_h)(\theta^C+\theta^P)(v-c_h)(\Delta c+v-2\lambda)}{v-\lambda-c_l-(\theta^C+\theta^P)(\Delta c+v-2\lambda)} & \theta^C+\theta^P < \frac{\Delta c-\lambda}{\Delta c+v-2\lambda} \\ \frac{(1-\mu_h)(v-\lambda-c_l)[(p_h'-c_h)+(\theta^C+\theta^P)(v-p_h')]}{v-\lambda-c_l(\theta^C+\theta^P)(\Delta c-p_h'+2(v-\lambda))} + \mu_h(p_h'-c_h) & \frac{\Delta c-\lambda}{\Delta c+v-2\lambda} \leq \theta^C+\theta^P \leq \frac{\Delta c}{\Delta c+v} \end{cases} \quad ()$$

where $p_h' = v - \lambda + \frac{\Delta c-(\theta^C+\theta^P)(\Delta c+v)}{1-2(\theta^C+\theta^P)}$.

(iv) If $\lambda > \Delta c$, the expert's highest utility in PUE equilibria is $E\bar{u}_1^{PUE} = \frac{(1-\mu_h)(v-\lambda-c_l)[(p_h'-c_h)+(\theta^C+\theta^P)(v-p_h')]}{v-\lambda-c_l(\theta^C+\theta^P)(\Delta c-p_h'+2(v-\lambda))} + \mu_h(p_h'-c_h)$ if $\theta^C+\theta^P \leq \frac{\Delta c}{\Delta c+v}$.

In a PUE, the expert's highest utility is achieved by setting at least one of the two prices to be the highest level that ensures the consumer is indifferent between "*In*" and "*Out*". The expert with a higher $\theta^C+\theta^P$ tend to set a menu with lower prices.

Corollary 3. (i) If $\lambda \leq \Delta c$, and $\alpha \geq \frac{\lambda+2c_h-c_l-v}{2\lambda}$, the expert's highest utility among the OE is

$$E\bar{u}_1^{OE} = \begin{cases} p_h^* - c_h - \frac{(1-\mu_h)(\theta^C+\theta^P)\Delta c}{1-2(\theta^C+(1-\mu_h)\theta^P)} & \theta^C+\theta^P(1-\mu_h) \leq \frac{p_h^*-c_h+\mu_h\lambda-\Delta c}{2(p_h^*-c_h+\mu_h\lambda)} \\ p_h^* - c_h - \mu_h(\theta^C+\theta^P)(2p_h^*-c_h-v+\lambda) & \frac{p_h^*-c_h+\mu_h\lambda-\Delta c}{2(p_h^*-c_h+\mu_h\lambda)} < \theta^C+\theta^P(1-\mu_h) \leq \frac{p_h^*-c_h}{p_h^*-c_h+\mu_h\lambda} \end{cases}$$

where $p_h^* = v - (1-\mu_h)\lambda$.

(ii) If $\lambda > \Delta c$, and $\alpha \geq \frac{\Delta c}{\lambda}$,[44] the expert's highest utility among the OE is

$$E\bar{u}_1^{OE} = \begin{cases} p_h^* - c_h - (1-\mu_h)(\theta^C+\theta^P)(2\mu_h\lambda-\Delta c) & \theta^C+\theta^P(1-\mu_h) \leq \frac{\mu_h\lambda-\Delta c}{2\mu_h\lambda-\Delta c} \\ p_h^* - c_h - \frac{(1-\mu_h)(\theta^C+\theta^P)\Delta c}{1-2(\theta^C+(1-\mu_h)\theta^P)} & \frac{\mu_h\lambda-\Delta c}{2\mu_h\lambda-\Delta c} < \theta^C+\theta^P(1-\mu_h) \leq \frac{p_h^*-c_h+\mu_h\lambda-\Delta c}{2(p_h^*-c_h+\mu_h\lambda)} \\ p_h^* - c_h - (1-\mu_h)(\theta^C+\theta^P)(2p_h^*-c_h-v+\lambda) & \frac{p_h^*-c_h+\mu_h\lambda-\Delta c}{2(p_h^*-c_h+\mu_h\lambda)} < \theta^C+\theta^P(1-\mu_h) \leq \frac{p_h^*-c_h}{p_h^*-c_h+\mu_h\lambda} \end{cases}$$

(iii) If $\lambda \leq \Delta c$, the expert's highest utility in PO equilibrium is $E\bar{u}_1^{PO} = (1-\mu_h)(v - \frac{(1-\theta^C)\Delta c}{1-2\theta^C} -$

[44]See appendix for the case of $\lambda > \Delta c$, and $\alpha \geq \frac{\Delta c}{\lambda}$

$c_l) + \frac{\mu_h[p_l'-c_l+(\theta^C+\theta^P)(v-p_l'-\lambda)](v-c_h)}{v-c_h+(\theta^C+\theta^P)(v-p_l'-\lambda)-\theta^C(2v-2p_l'-\Delta c)}$ if $\theta^C \leq \frac{v-c_h}{2v-c_h-c_l}$.

(iv) If $\lambda > \Delta c$, the expert's highest utility in PO equilibria is

$$E\bar{u}_1^{POE} = \begin{cases} (1-\alpha)(v-\lambda-c_l) + \mu_h[(\Delta p' + v - \lambda - c_h) - \theta^P \cdot \frac{\lambda - \Delta p'}{\lambda}(2\Delta p' - \Delta c)] & \theta^C < \frac{\lambda-\Delta c}{2\lambda-\Delta c} \\ (1-\alpha)(v - \frac{(1-\theta^C)\Delta c}{1-2\theta^C} - c_l) + \frac{\alpha[p_l'-c_l+(\theta^C+\theta^P)(v-p_l'-\lambda)](v-c_h)}{v-c_h+(\theta^C+\theta^P)(v-p_l'-\lambda)-\theta^C(2v-2p_l'-\Delta c)} & \frac{\lambda-\Delta c}{2\lambda-\Delta c} \leq \theta^C \leq \frac{v-c_h}{2v-c_h-c_l} \end{cases}$$

where $p_l' = v - \frac{(1-\theta^C)\Delta c}{1-2\theta^C}$, and $\theta^C + \frac{\theta^P(\lambda-\Delta p')}{\lambda} = \frac{\Delta p'-\Delta c}{2\Delta p'-\Delta c}$.

In a PO, the expert's highest utility is achieved by setting at least one of the two prices to be the highest level that ensures the consumer is indifferent between "*In*" and "*Out*". The expert with a higher $\theta^C + \theta^P$ tend to set a menu with lower prices.

The expert's expected utility in a partial overtreatment equilibrium equals $u_1^{PO} = (1-\mu_h)(p_l - c_l)+\mu_h\sigma_2^h[(p_h-c_h)-\theta^P \cdot \frac{v-p_h}{\lambda}(|\Delta p-\Delta c|+\Delta p)]$, where $\sigma_2^h = \frac{p_l-c_l+(\theta^C+\theta^P)(v-p_l-\lambda)}{p_h-c_h-(\theta^C+\theta^P \cdot \frac{v-p_h}{\lambda})(|\Delta p-\Delta c|+\Delta p)+(\theta^C+\theta^P)(v-p_l-\lambda)}$. Under the constraints of $p_l \leq v-\lambda$, $v-(1-\mu_h)\lambda < p_h \leq v$, $\Delta p > \Delta c$, and $0 \leq \theta^C + \frac{\theta^P(v-p_h)}{\lambda} \leq \frac{\Delta p-\Delta c}{|\Delta p-\Delta c|+\Delta p}$, the highest utility for the expert in PO equilibrium is attained by setting $p_h = v$, and $p_l = v - \frac{(1-\theta^C)\Delta c}{1-2\theta^C}$ if $\theta^C \leq \frac{v-c_h}{2v-c_h-c_l}$ and no solution if $\theta^C > \frac{v-c_h}{2v-c_h-c_l}$. And the expert's highest utility in PO equilibria is $(1-\mu_h)(v - \frac{(1-\theta^C)\Delta c}{1-2\theta^C} - c_l) + \mu_h(v-c_h)$ if $\theta^C \leq \frac{v-c_h}{2v-c_h-c_l}$.

Corollary 4. If $\lambda \leq \Delta c$, the expert's highest utility among the HIE_{ω_l} is

$$E\bar{u}_1^{\text{HIE}_{\omega_l}} = sup(Eu^{\text{HIE}_{\omega_l}}) =$$
$$\begin{cases} (1-\mu_h)\frac{(v-c_h)(v-\lambda-c_l)}{v-\lambda-c_l-(\theta^C+\theta^P)(\Delta c+v-2\lambda)} + \mu_h(v-c_h) & \theta^C+\theta^P \leq \frac{\Delta c-\lambda}{\Delta c+v-2\lambda} \\ (1-\mu_h)(v-\lambda-c_l) + \mu_h(v-\lambda+\frac{\Delta c-(\theta^C+\theta^P)(\Delta c+v)}{1-2(\theta^C+\theta^P)} - c_h) & \frac{\Delta c-\lambda}{\Delta c+v-2\lambda} < \theta^C+\theta^P < \frac{\Delta c}{\Delta c+v} \end{cases}$$

Corollary 5. If $\lambda > \Delta c$, the expert's highest utility among the HIE_{ω_h} is

$$E\bar{u}_1^{\text{HIE}_{\omega_h}} = sup(Eu^{\text{HIE}_{\omega_h}}) = \begin{cases} (1-\mu_h)(v-\lambda-c_l) + \mu_h\frac{(v-\lambda-c_l)(v-c_h)}{v-c_h-\theta^C(2\lambda-\Delta c)} & \theta^C < \frac{\lambda-\Delta c}{2\lambda-\Delta c} \\ (1-\mu_h)(v - \frac{(1-\theta^C)\Delta c}{1-2\theta^C} - c_l) + \mu_h(v-c_h) & \frac{\lambda-\Delta c}{2\lambda-\Delta c} < \theta^C < \frac{v-c_h}{2v-c_h-c_l} \end{cases}$$

In an OE, the expert's highest utility is achieved by setting p_h to be the highest price such that the consumer is willing to choose "*In*". Although the cheap treatment would not be provided on the equilibrium path, the choice of p_l matters to the expert's cheating. An expert with high θ^C or θ^P may set $p_l > v-\lambda$ to ensure the consumer will always reject the cheap treatment, thus reducing the disutility from cheating and perceived cheating.

Proposition 1. Suppose $\lambda \leq \Delta c$ and $\alpha < \frac{\Delta c - \lambda}{v - \lambda}$. There exist two thresholds, $\underline{\theta}^1$ and $\underline{\theta}^2$, where $0 < \underline{\theta}^1, \underline{\theta}^2 < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$, such that:

(i) When $0 \leq \theta^{CA} + \theta^P < \underline{\theta}^1$ and $v > c_l + c_h$, or when $0 \leq \theta^{CA} + \theta^P < \underline{\theta}^2$ and $v \leq c_l + c_h$, the SE outcome is *full under-treatment*, with the price menu $(p_l, p_h) = ((1-\alpha)(v-\lambda), v)$.[45]

(ii) When $\underline{\theta}^1 < \theta^{CA} + \theta^P < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$ and $v > c_l + c_h$, the SE outcome is *honesty with a potential untreated* ω_l, with the price menu $(p_l, p_h) = (v - \lambda, v)$. The consumer rejects r_l with probability $\frac{\Delta c - \lambda - (\theta^{CA} + \theta^P)(\Delta c + v - 2\lambda)}{v - \lambda - c_l - (\theta^{CA} + \theta^P)(\Delta c + v - 2\lambda)}$.[46]

(iii) When $\underline{\theta}^2 < \theta^{CA} + \theta^P < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$ and $v \leq c_l + c_h$, the SE outcome is *honesty with efficient problem-solving*, with the price menu (p_l, p_h) where $p_l = \frac{(1 - \theta^{CA} - \theta^P)(v - \Delta c)}{1 - 2(\theta^{CA} + \theta^P)}$ and $p_h = v$.[47]

(iv) When $\theta^{CA} + \theta^P \geq \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$, the SE outcome is *honesty and efficient problem-solving*, with the price menu $(p_l, p_h) = (v - \lambda, v)$.

To prove Proposition 1, I first calculate that the expert's highest equilibrium utility in five type of equilibria displayed in the above lemmas. I then show that no other equilibrium yields a higher utility for the expert.

Proof. Suppose (p_l, p_h) induces an honest and efficient equilibrium. The expert's expected utility equals $Eu_1^{HE} = (1-\alpha)(p_l - c_l) + \mu_h(p_h - c_h)$. Under the constrains of $(p_l, p_h) \in P$, $\theta^C \geq \frac{\Delta p - \Delta c}{|\Delta p - \Delta c| + \Delta p}$, and $\theta^C + \theta^P \geq \frac{\Delta c - \Delta p}{|\Delta c - \Delta p| + v - \Delta p}$, the highest utility for the expert in this type of equilibrium is attained by setting $p_h = v$, and $p_l = \frac{(1 - (\theta^C + \theta^P))(v - \Delta c)}{1 - 2(\theta^{CA} + \theta^P)}$ if $\theta^C + \theta^P < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$, and $p_l = v - \lambda$ if $\theta^C + \theta^P \geq \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$. Hence, the expert's highest utility among the *HE* is

$$E\bar{u}_1^{HE} = \begin{cases} (1-\mu_h)\left(\frac{(1-\theta^C-\theta^P)(v-\Delta c)}{1-2(\theta^C+\theta^P)} - c_l\right) + \mu_h(v - c_h) & \theta^C + \theta^P < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda} \\ (1-\mu_h)(v - \lambda - c_l) + \mu_h(v - c_h) & \theta^C + \theta^P \geq \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda} \end{cases}$$

Let us consider a full under-treatment equilibrium induced by (p_l, p_h). The expert's expected utility $Eu_1^{FU} = (p_l - c_l) - \alpha(\theta^{CA} + \theta^P)(p_l - c_l + p_l)$ is strictly increasing in p_l as $0 \leq \theta^C + \theta^P \leq \frac{p_l - c_l}{2p_l - c_l} < \frac{1}{2}$. Under the conditions of $p_l \leq (1-\alpha)(v - \lambda)$, the highest utility for the expert in *FU*

[45] When $\theta^{CA} = \theta^P = 0$, the price menu (p_l, p_h) where $p_l = (1-\alpha)(v-\lambda)$ and $p_l < p_h \leq v$, can also support a full under-treatment equilibrium.

[46] When $\theta^{CA} + \theta^P = \underline{\theta}^1(\Delta c, \lambda, v, \alpha)$, the expert is indifferent between setting $(p_l, p_h) = ((1-\alpha)(v-\lambda), v)$ and under-treating the consumer, or setting $(p_l, p_h) = (v - \lambda, v)$ and adhering to the norm, knowing that the consumer will reject r_l with probability $\frac{\Delta c - \lambda - \underline{\theta}^1(\Delta c, \lambda, v, \alpha)(\Delta c + v - 2\lambda)}{v - \lambda - c_l - \underline{\theta}^1(\Delta c, \lambda, v, \alpha)(\Delta c + v - 2\lambda)}$.

[47] When $\theta^{CA} + \theta^P = \underline{\theta}^2(\Delta c, \lambda, v, \alpha)$, the expert is indifferent between setting $(p_l, p_h) = ((1-\alpha)(v-\lambda), v)$ and under-treating the consumer, or setting $(p_l, p_h) = (\frac{(1 - \underline{\theta}^2(\Delta c, \lambda, v, \alpha))(v - \Delta c)}{1 - 2(\underline{\theta}^2(\Delta c, \lambda, v, \alpha))}, v)$ and adhering to the norm.

equilibrium is attained by setting $p_h > v$, and $p_l = (1-\alpha)(v-\lambda)$ if $0 \leq \theta^C + \theta^P < \frac{(1-\mu_h)(v-\lambda)-c_l}{2(1-\mu_h)(v-\lambda)-c_l}$, and $p_l = \frac{c_l(1-\theta^{CA}-\theta^P)}{1-2\theta^{CA}-2\theta^P}$ if $\frac{(1-\alpha)(v-\lambda)-c_l}{2(1-\mu_h)(v-\lambda)-c_l} \leq \theta^C + \theta^P < \frac{(v-\lambda)-c_l}{2(v-\lambda)-c_l}$. Hence, the expert's highest utility among full undertreatment equilibria is

$$E\bar{u}_1^{FU} = \begin{cases} (1-\alpha)(v-\lambda) - c_l - \alpha(\theta^C+\theta^P)(2(1-\alpha)(v-\lambda)-c_l) & \theta^{CA}+\theta^P < \frac{(1-\alpha)(v-\lambda)-c_l}{2(1-\alpha)(v-\lambda)-c_l} \\ \frac{c_l(\theta^{CA}+\theta^P)}{1-2\theta^{CA}-2\theta^P} - \mu_h(\theta^{CA}+\theta^P)(\frac{c_l}{1-2\theta^{CA}-2\theta^P}) & \frac{(1-\alpha)(v-\lambda)-c_l}{2(1-\alpha)(v-\lambda)-c_l} \leq \theta^{CA}+\theta^P \leq \frac{(v-\lambda)-c_l}{2(v-\lambda)-c_l} \end{cases}$$

The expert's expected utility in a partial under-treatment equilibrium with (p_l, p_h) equals $u_1^{PU} = (1-\mu_h)\sigma_2^l(p_l - c_l) + \mu_h(p_h - c_h)$, where $\sigma_2^l = \frac{p_h - c_h + (\theta^C+\theta^P)(v-p_h)}{p_l - c_l - (\theta^C+\theta^P)[(|\Delta c - \Delta p| + v - \Delta p) - (v - p_h)]}$. If $v > c_h + c_l$, the highest utility for the expert in PU equilibrium is attained by setting $p_l = (v-\lambda)$ and $p_h = v$ if $\theta^C + \theta^P < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$ and $p_l = v - \lambda$, $p'_h = v - \lambda + \frac{\Delta c - (\theta^C+\theta^P)(\Delta + v)}{1-2(\theta^C+\theta^P)}$ otherwise. And the expert's highest utility in PU equilibria is

$$E\bar{u}_1^{PU} = \begin{cases} v - c_h + \frac{(1-\mu_h)(\theta^C+\theta^P)(v-c_h)(\Delta c+v-2\lambda)}{v-\lambda-c_l-(\theta^C+\theta^P)(\Delta c+v-2\lambda)} & \theta^C+\theta^P < \frac{\Delta c-\lambda}{\Delta c+v-2\lambda} \\ \frac{(1-\mu_h)(v-\lambda-c_l)(p'_h-c_h)+(\theta^C+\theta^P)(v-p'_h)}{v-\lambda-c_l(\theta^C+\theta^P)(\Delta c-p'_h+2(v-\lambda))} + \mu_h(p'_h - c_h) & \frac{\Delta c-\lambda}{\Delta c+v-2\lambda} \leq \theta^C+\theta^P < \frac{\Delta c}{\Delta c+v} \end{cases}$$

If $v \leq c_h + c_l$, the highest utility for the expert in PU equilibrium is attained by setting $p_h = v$, and $p_l = (1-\mu_h)(v-\lambda)$ if $\theta^C + \theta^P < \frac{\Delta c - \mu_h v - (1-\mu_h)\lambda}{\Delta c + v - 2(\mu_h v + (1-\mu_h)\lambda)}$, and $p_l = (1-\mu_h)(v-\lambda)$, $p''_h = (1-\mu_h)(v-\lambda) + \frac{\Delta c - (\theta^C+\theta^P)(\Delta c + v)}{1-2(\theta^C+\theta^P)}$ otherwise. And the expert's highest utility in PU equilibria is

$$E\bar{u}_1^{PU} = \begin{cases} v - c_h + \frac{(1-\mu_h)(\theta^C+\theta^P)(v-c_h)(\Delta c+(1-2\mu_h)v-2(1-\mu_h)\lambda)}{v-\lambda-c_l-(\theta^C+\theta^P)(\Delta c+(1-2\mu_h)v-2(1-\mu_h)\lambda))} & \theta^C+\theta^P < \frac{\Delta c-\mu_h v-(1-\mu_h)\lambda}{\Delta c+v-2(\mu_h v+(1-\mu_h)\lambda)} \\ \frac{(1-\mu_h)(v-\lambda-c_l)(p''_h-c_h)+(\theta^C+\theta^P)(v-p''_h)}{v-\lambda-c_l(\theta^C+\theta^P)(\Delta c-p''_h+2(1-\mu_h)(v-\lambda))} + \mu_h(p''_h - c_h) & \frac{\Delta c-\mu_h v-(1-\mu_h)\lambda}{\Delta c+v-2(\mu_h v+(1-\mu_h)\lambda)} \leq \theta^C+\theta^P < \frac{1}{2} \end{cases}$$

The expert's expected utility in a fully overtreatment equilibrium equals $u_1^{FO} = (p_h - c_h) - (1-\mu_h)(\theta^C+\theta^P)(2p_h - v - c_h + \lambda)$. If $c_h \geq v - \lambda$, the highest utility for the expert in FO equilibrium is attained by setting $p_l > v - \lambda$, $p_h = v - (1-\mu_h)\lambda$ if $\theta^C + \theta^P(1-\mu_h) \leq \frac{v-(1-\mu_h)\lambda-c_h}{v-(1-2\mu_h)\lambda-c_h}$, and no such equilibrium otherwise. Hence, the expert's highest utility among fully overtreatment equilibria is $v - (1-\mu_h)\lambda - c_h - (1-\mu_h)(\theta^C+\theta^P)(v-(1-2\mu_h)\lambda - c_h)$ if $\theta^C + \theta^P(1-\mu_h) \leq \frac{v-(1-\mu_h)\lambda-c_h}{v-(1-2\mu_h)\lambda-c_h}$. If $c_h < v - \lambda$, the highest utility for the expert in FO equilibrium is attained by setting $p_l > v - \lambda$, $p_h = v - (1-\mu_h)\lambda$ if $\theta^C + \theta^P(1-\mu_h) \leq \frac{v-(1-\mu_h)\lambda-c_h}{v-(1-2\mu_h)\lambda-c_h}$, and $p_l > v - \lambda$, $p_h^* = \frac{(\theta^C+\theta^P(1-\mu_h))(v-\lambda+c_h)-c_h}{2(\theta^C+\theta^P(1-\mu_h))-1}$

otherwise. Hence, the expert's highest utility among fully overtreatment equilibria is

$$\bar{u}_1^{FO} = \begin{cases} v-(1-\mu_h)\lambda-c_h-(1-\mu_h)(\theta^C+\theta^P)(v-(1-2\mu_h)\lambda-c_h) & \theta^C+\theta^P(1-\mu_h)\leq\frac{v-(1-\mu_h)\lambda-c_h}{v-(1-2\mu_h)\lambda-c_h} \\ p_h^*-c_h-(1-\mu_h)(\theta^C+\theta^P)(2p_h^*-v+\lambda-c_h) & \frac{v-(1-\mu_h)\lambda-c_h}{v-(1-2\mu_h)\lambda-c_h}<\theta^C+\theta^P(1-\mu_h)<1 \end{cases}$$

The expert's expected utility in a partial overtreatment equilibrium equals $u_1^{PO}=(1-\mu_h)(p_l-c_l)+\mu_h\sigma_2^h[(p_h-c_h)-\theta^P\cdot\frac{v-p_h}{\lambda}(|\Delta p-\Delta c|+\Delta p)]$, where $\sigma_2^h=\frac{p_l-c_l+(\theta^C+\theta^P)(v-p_l-\lambda)}{p_h-c_h-(\theta^C+\theta^P\cdot\frac{v-p_h}{\lambda})(|\Delta p-\Delta c|+\Delta p)+(\theta^C+\theta^P)(v-p_l-\lambda)}$. Under the constraints of $p_l\leq v-\lambda$, $v-(1-\mu_h)\lambda<p_h\leq v$, $\Delta p>\Delta c$, and $0\leq\theta^C+\frac{\theta^P(v-p_h)}{\lambda}\leq\frac{\Delta p-\Delta c}{|\Delta p-\Delta c|+\Delta p}$, the highest utility for the expert in PO equilibrium is attained by setting $p_h=v$, and $p_l=v-\frac{(1-\theta^C)\Delta c}{1-2\theta^C}$ if $\theta^C\leq\frac{v-c_h}{2v-c_h-c_l}$ and no solution if $\theta^C>\frac{v-c_h}{2v-c_h-c_l}$. And the expert's highest utility in PO equilibria is $(1-\mu_h)(v-\frac{(1-\theta^C)\Delta c}{1-2\theta^C}-c_l)+\mu_h(v-c_h)$ if $\theta^C\leq\frac{v-c_h}{2v-c_h-c_l}$.

When $\alpha<\frac{\Delta c-\lambda}{v-\lambda}$ and $v>c_h+c_l$, $E\bar{u}_1^{FU}=\max\{E\bar{u}_1^H,E\bar{u}_1^{FU},E\bar{u}_1^{PU},E\bar{u}_1^{FO},E\bar{u}_1^{PO}\}$ for $0\leq\theta^C+\theta^P<\underline{\theta}^a$, where $(1-\mu_h)(v-\lambda)-c_l-\mu_h\underline{\theta}^a(2(1-\mu_h)(v-\lambda)-c_l)=v-c_h+\frac{(1-\mu_h)(v-c_h)\underline{\theta}^a(\Delta c+v-2\lambda)}{v-\lambda-c_l-\underline{\theta}^a(\Delta c+v-2\lambda)}$; $E\bar{u}_1^{PU}=\max\{E\bar{u}_1^H,E\bar{u}_1^{FU},E\bar{u}_1^{PU},E\bar{u}_1^{FO},E\bar{u}_1^{PO}\}$ for $\underline{\theta}^a<\theta^C+\theta^P<\frac{\Delta c-\lambda}{v-\lambda}$; and $E\bar{u}_1^H=\max\{E\bar{u}_1^H,E\bar{u}_1^{FU},E\bar{u}_1^{PU},E$ for $\theta^C+\theta^P\geq\frac{\Delta c-\lambda}{v-\lambda}$.

When $\alpha<\frac{\Delta c-\lambda}{v-\lambda}$ and $v\leq c_h+c_l$, $E\bar{u}_1^{FU}=\max\{E\bar{u}_1^H,E\bar{u}_1^{FU},E\bar{u}_1^{PU},E\bar{u}_1^{FO},E\bar{u}_1^{PO}\}$ for $0\leq\theta^C+\theta^P<\underline{\theta}^b$, where $(1-\mu_h)(v-\lambda)-c_l-\mu_h\underline{\theta}^b(2(1-\mu_h)(v-\lambda)-c_l)=(1-\mu_h)(\frac{(1-\underline{\theta}^b)(v-\Delta c)}{1-2\underline{\theta}^b}-c_l)+\mu_h(v-c_h)$; and $E\bar{u}_1^H=\max\{E\bar{u}_1^H,E\bar{u}_1^{FU},E\bar{u}_1^{PU},E\bar{u}_1^{FO},E\bar{u}_1^{PO}\}$ for $\theta^C+\theta^P>\frac{\Delta c-\lambda}{v-\lambda}$.

The final step is to demonstrate that there is no other equilibrium that provides the expert with a higher expected utility than any of the five equilibria identified above. Consider an arbitrary equilibrium with (p_l,p_h) in which $\sigma_2^{In}\in[0,1]$, $\sigma_2^l\in[0,1]$, and $\sigma_2^h\in[0,1]$. Suppose $E_{(\sigma,\mu)}[u_1|(\omega_l,In),p_l]\geq E_{(\sigma,\mu)}[u_1|(\omega_l,In),p_h]$, and $E_{(\sigma,\mu)}[u_1|(\omega_h,In),p_l]\geq E_{(\sigma,\mu)}[u_1|(\omega_h,In),p_h]$. The expert weakly prefers recommending a cheap treatment to recommending an expensive one. Hence, her expected utility is weakly lower than $\sigma_2^{In}[(p_l-c_l)\sigma_2^l-\mu_h(\theta^C+\theta^C)(\sigma_2^h(v-p_h)-\sigma_2^l(2p_l-c_l-\sigma_2^h(p_h-c_h)))]\leq p_l-c_l-\mu_h(\theta^C+\theta^C)$. The consumer's highest willingness to pay is $(1-\mu)(v-\lambda)$ upon being recommended a serious treatment. $(1-\mu_h)(v-\lambda)-c_l-\mu_h(\theta^C+\theta^P)(2(1-\mu_h)(v-\lambda)-c_l)$. $\square$

Proposition 2. Suppose $\lambda\leq\Delta c$ and $\alpha\geq\frac{\Delta c-\lambda}{v-\lambda}$:

(i) When $\theta^{CA}=\theta^P=0$, there exists an SE outcome involving *honesty with efficient problem-*

solving under the price menu $(p_l, p_h) = (v - \Delta c, v)$.[48]

(ii) When $0 < \theta^{CA} + \theta^P < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$ and $v > c_l + c_h$, the SE outcome is *honesty with a potential untreated minor problem*, with the price menu $(p_l, p_h) = (v - \lambda, v)$. The consumer rejects r_l with probability $\frac{\Delta c - \lambda - (\theta^{CA} + \theta^P)(\Delta c + v - 2\lambda)}{v - \lambda - c_l - (\theta^{CA} + \theta^P)(\Delta c + v - 2\lambda)}$.

(iii) When $0 < \theta^{CA} + \theta^P < \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$ and $v \leq c_l + c_h$, the SE outcome is *honesty with efficient problem-solving*, with the price menu (p_l, p_h) where $p_l = \frac{(1 - \theta^{CA} - \theta^P)(v - \Delta c)}{1 - 2(\theta^{CA} + \theta^P)}$ and $p_h = v$.

(iv) When $\theta^{CA} + \theta^P \geq \frac{\Delta c - \lambda}{\Delta c + v - 2\lambda}$, the SE outcome is *honesty with efficient problem-solving*, with the price menu $(p_l, p_h) = (v - \lambda, v)$.

Proof. Suppose (p_l, p_h) induces an honest equilibrium. The expert's expected utility equals $Eu_1^H = (1 - \mu_h)(p_l - c_l) + \mu_h(p_h - c_h)$. Under the constrains of $p_l \leq v - \lambda$, $p_h \leq v$, $\theta^C \geq \frac{\Delta p - \Delta c}{|\Delta p - \Delta c| + \Delta p}$, and $\theta^C + \theta^P \geq \frac{\Delta c - \Delta p}{|\Delta c - \Delta p| + v - \Delta p}$, the highest utility for the expert in this type of equilibrium is attained by setting $p_l = v - \lambda$, and $p_h = v - \lambda + \frac{(1 - \theta^C)\Delta c}{1 - 2\theta^C}$ if $\theta^C < \frac{\lambda - \Delta c}{2\lambda - \Delta c}$, and $p_l = v - \lambda$, $p_l = v$ if $\frac{\lambda - \Delta c}{2\lambda - \Delta c} \leq \theta^C < \frac{1}{2}$. Hence, the expert's highest utility among the honest equilibria is

$$E\bar{u}_1^H = \begin{cases} (1 - \mu_h)(v - \lambda - c_l) + \mu_h(v - \lambda + \frac{(1 - \theta^C)\Delta c}{1 - 2\theta^C} - c_h) & \theta^C < \frac{\lambda - \Delta c}{2\lambda - \Delta c} \\ (1 - \mu_h)(v - \lambda - c_l) + \mu_h(v - c_h) & \frac{\lambda - \Delta c}{2\lambda - \Delta c} \leq \theta^C < \frac{1}{2} \end{cases} \qquad ()$$

The expert's expected utility in a fully overtreatment equilibrium equals $u_1^{FO} = (p_h - c_h) - (1 - \mu_h)(\theta^C + \theta^P)(2p_h - v - c_h + \lambda)$, which is strictly increasing in p_h if $\theta^C + \theta^P < \frac{1}{2(1 - \mu_h)}$ and decreasing in p_h if $\theta^C + \theta^P \geq \frac{1}{2(1 - \mu_h)}$. Under the conditions of $p_h \leq (1 - \mu_h)(v - \lambda)$ and the off-equilibrium path belief of the state being ω_l when r_l is recommended, the highest utility for the expert in *FO* equilibrium is attained by setting $p_l > v - \lambda$, and $p_h = (1 - \mu_h)(v - \lambda)$ if $\theta^C + \theta^P < \frac{1}{2(1 - \mu_h)}$, and $p_h = c_h$ otherwise. Hence, the expert's highest utility among fully overtreatment equilibria is

$$\bar{u}_1^{FO} = \begin{cases} v - (1 - \mu_h)\lambda - c_h - (1 - \mu_h)(\theta^C + \theta^P)(v - (1 - 2\mu_h)\lambda - c_h) & \theta^C + \theta^P < \frac{1}{2(1 - \mu_h)} \\ 0 & \frac{1}{2(1 - \mu_h)} \leq \theta^C + \theta^P < \frac{1}{2} \end{cases} \qquad ()$$

The expert's expected utility in a partial overtreatment equilibrium equals $u_1^{PO} = (1 - \mu_h)(p_l - c_l) + \mu_h \sigma_2^h [(p_h - c_h) - \theta^P \cdot \frac{v - p_h}{\lambda}(|\Delta p - \Delta c| + \Delta p)]$, where $\sigma_2^h = \frac{p_l - c_l + (\theta^C + \theta^P)(v - p_l - \lambda)}{p_h - c_h - (\theta^C + \theta^P \cdot \frac{v - p_h}{\lambda})(|\Delta p - \Delta c| + \Delta p) + (\theta^C + \theta^P)(v - p_l - \lambda)}$.

[48] Another SE outcome is *honesty with a potential untreated minor problem*, with the price menu $(p_l, p_h) = (v - \lambda, v)$. The consumer rejects r_l with probability $\frac{\Delta c - \lambda}{v - \lambda - c_l}$.

Under the constraints of $p_l \leq v-\lambda$, $v-(1-\mu_h)\lambda < p_h \leq v$, $\Delta p > \Delta c$, and $0 \leq \theta^C + \frac{\theta^P(v-p_h)}{\lambda} \leq \frac{\Delta p - \Delta c}{|\Delta p - \Delta c| + \Delta p}$, the highest utility for the expert in PO equilibrium is attained by setting $p_h = v$, and $p_l = v - \frac{(1-\theta^C)\Delta c}{1-2\theta^C}$ if $\theta^C < \frac{1}{2}$ and no solution if $\theta^C \geq \frac{1}{2}$. And the expert's highest utility in PO equilibria is $(1-\mu_h)(v - \frac{(1-\theta^C)\Delta c}{1-2\theta^C} - c_l) + \mu_h(v-c_h)$ if $\theta^C < \frac{1}{2}$.

When $\alpha \geq \frac{\Delta c - \lambda}{v-\lambda}$ and $v > c_h + c_l$, $E\bar{u}_1^{PU} = \max\{E\bar{u}_1^H, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $0 \leq \theta^C + \theta^P < \frac{\Delta c - \lambda}{v - \lambda}$, and $E\bar{u}_1^H = \max\{E\bar{u}_1^H, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $\theta^C + \theta^P \geq \frac{\Delta c - \lambda}{v-\lambda}$.

When $alpha \geq \frac{\Delta c - \lambda}{v-\lambda}$ and $v \leq c_h + c_l$, $E\bar{u}_1^H = \max\{E\bar{u}_1^H, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for all θ^C, θ^P.

□

Proposition 3. Suppose $\lambda > \Delta c$, and $\alpha > \frac{\Delta c}{\lambda}$. There exist two thresholds, $\underline{\theta}^3(\theta^P)$ and $\underline{\theta}^4(\theta^P)$, which are decreasing in θ^P and satisfy $0 \leq \underline{\theta}^3(\theta^P), \underline{\theta}^4(\theta^P) < \frac{\lambda - \Delta c}{2\lambda - \Delta c}$, such that:

(i) When $0 \leq \theta^{CA} < \underline{\theta}^3(\theta^P)$ and $v > \lambda + \frac{c_l + c_h}{2}$, or when $0 \leq \theta^{CA} < \underline{\theta}^4$ and $v \leq \lambda + \frac{c_l + c_h}{2}$, the SE outcome is *full over-treatment*, with the price menu $(p_l, p_h) = (v-\lambda, v-(1-\alpha)\lambda)$.[49]

(ii) When $\underline{\theta}^3(\theta^P) < \theta^{CA} < \frac{\lambda - \Delta c}{2\lambda - \Delta c}$ and $v > \lambda + \frac{c_l + c_h}{2}$, the SE outcome is *honesty with a potential untreated major problem*, with the price menu $(p_l, p_h) = (v-\lambda, v)$. The consumer rejects r_h with probability $\frac{\lambda - \Delta c - \theta^{CA}(2\lambda - \Delta c)}{v - c_h - \theta^{CA}(2\lambda - \Delta c)}$.[50]

(iii) When $\underline{\theta}^4(\theta^P) < \theta^{CA} < \frac{\lambda - \Delta c}{2\lambda - \Delta c}$ and $v \leq c_l + c_h$, the SE outcome is *honesty and efficient problem-solving*, with prices $p_l = v - \lambda$ and $p_h = v - \lambda + \frac{(1-\theta^{CA})\Delta c}{1-2\theta^{CA}}$.[51]

(iv) When $\theta^{CA} \geq \frac{\lambda - \Delta c}{2\lambda - \Delta c}$, the SE outcome is *honesty and efficient problem-solving*, with the price menu $(p_l, p_h) = (v-\lambda, v)$.

Proof. When $\mu_h < \frac{\Delta c - \lambda}{v - \lambda}$ and $v \leq c_h + c_l$, $E\bar{u}_1^{FU} = \max\{E\bar{u}_1^H, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $0 \leq \theta^C + \theta^P < \underline{\theta}^b$, where $(1-\mu_h)(v-\lambda) - c_l - \mu_h \underline{\theta}^b(2(1-\mu_h)(v-\lambda) - c_l) = (1-\mu_h)(\frac{(1-\underline{\theta}^b)(v-\Delta c)}{1-2\underline{\theta}^b} - c_l) + \mu_h(v-c_h)$; and $E\bar{u}_1^H = \max\{E\bar{u}_1^H, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $\theta^C + \theta^P > \frac{\Delta c - \lambda}{v - \lambda}$.

[49] When $\theta^{CA} = \theta^P = 0$, a price menu (p_l, p_h) where $p_h = v$ and $c_l \leq p_l < p_h$ can also support a full over-treatment equilibrium.

[50] When $\theta^{CA} = \underline{\theta}^3$, the expert is indifferent between setting $(p_l, p_h) = (v-\lambda, v-(1-\alpha)\lambda)$ and over-treating the consumer, or setting $(p_l, p_h) = (v-\lambda, v)$ and adhering to the norm, knowing that the consumer will reject r_h with probability $\frac{\lambda - \Delta c - \underline{\theta}^3(\Delta c, \lambda, v, \alpha, \theta^P)(2\lambda - \Delta c)}{v - c_h - \underline{\theta}^3(\Delta c, \lambda, v, \alpha, \theta^P)(2\lambda - \Delta c)}$.

[51] When $\theta^{CA} = \underline{\theta}^4(\Delta c, \lambda, v, \alpha, \theta^P)$, the expert is indifferent between setting $(p_l, p_h) = (v-\lambda, v-(1-\alpha)\lambda)$ and over-treating the consumer, or setting $(p_l, p_h) = (v-\lambda, v-\lambda + \frac{(1-\underline{\theta}^4(\Delta c, \lambda, v, \alpha, \theta^P))\Delta c}{1-2\underline{\theta}^4(\Delta c, \lambda, v, \alpha, \theta^P)})$ and adhering to the norm.

When $\mu_h \geq \frac{\Delta c - \lambda}{v-\lambda}$ and $v > c_h + c_l$, $E\bar{u}_1^{PU} = \max\{E\bar{u}_1^{H}, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $0 \leq \theta^C + \theta^P < \frac{\Delta c-\lambda}{v-\lambda}$, and $E\bar{u}_1^{H} = \max\{E\bar{u}_1^{H}, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $\theta^C + \theta^P \geq \frac{\Delta c-\lambda}{v-\lambda}$.

When $\mu_h \geq \frac{\Delta c-\lambda}{v-\lambda}$ and $v \leq c_h + c_l$, $E\bar{u}_1^{H} = \max\{E\bar{u}_1^{H}, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for all θ^C, θ^P.

The final step is to demonstrate that there is no other equilibrium that provides the expert with a higher expected utility than any of the five equilibria identified above. Consider an arbitrary equilibrium with (p_l, p_h) in which $\sigma_2^{In} \in [0,1]$, $\sigma_2^l \in [0,1]$, and $\sigma_2^h \in [0,1]$. Suppose $E_{(\sigma,\mu)}[u_1|(\omega_l, In), p_l] \geq E_{(\sigma,\mu)}[u_1|(\omega_l, In), p_h]$, and $E_{(\sigma,\mu)}[u_1|(\omega_h, In), p_l] \geq E_{(\sigma,\mu)}[u_1|(\omega_h, In), p_h]$. The expert weakly prefers recommending a cheap treatment to recommending an expensive one. Hence, her expected utility is weakly lower than $\sigma_2^{In}[(p_l - c_l)\sigma_2^l - \mu_h(\theta^C + \theta^C)(\sigma_2^h(v - p_h) - \sigma_2^l(2p_l - c_l - \sigma_2^h(p_h - c_h)))] \leq p_l - c_l - \mu_h(\theta^C + \theta^C)$. The consumer's highest willingness to pay is $(1-\mu)(v-\lambda)$ upon being recommended a serious treatment. $(1-\mu_h)(v-\lambda) - c_l - \mu_h(\theta^C + \theta^P)(2(1-\mu_h)(v-\lambda) - c_l)$. □

Proposition 4. Suppose $\lambda > \Delta c$, and $\alpha \leq \frac{\Delta c}{\lambda}$. (i) When $\theta^{CA} = 0$, there exists a SE outcome involving *honesty with efficient problem-solving* under the price menu $(p_l, p_h) = (v-\lambda, v-\lambda+\Delta c)$.[52]

(ii) When $0 < \theta^{CA} < \frac{\lambda-\Delta c}{2\lambda-\Delta c}$, and $v > \lambda + \frac{c_l+c_h}{2}$, the SE outcome involves *honesty with a potential untreated minor problem* under the price menu $(p_l, p_h) = (v-\lambda, v)$. The consumer rejects r_h with probability $\frac{\lambda-\Delta c-\theta^{CA}(2\lambda-\Delta c)}{v-c_h-\theta^{CA}(2\lambda-\Delta c)}$.

(iii) When $0 < \theta^{CA} < \frac{\lambda-\Delta c}{2\lambda-\Delta c}$, and $v \leq \lambda + \frac{c_l+c_h}{2}$, the SE outcome involves *honesty and efficient problem-solving*, with a price menu (p_l, p_h) where $p_l = v-\lambda$ and $p_h = v-\lambda+\frac{(1-\theta^{CA})\Delta c}{1-2\theta^{CA}}$.

(iv) When $\theta^{CA} \geq \frac{\lambda-\Delta c}{2\lambda-\Delta c}$, the SE outcome involves *honesty with efficient problem-solving*, with the price menu $(p_l, p_h) = (v-\lambda, v)$.

Proof. When $\mu_h < \frac{\Delta c-\lambda}{v-\lambda}$ and $v > c_h + c_l$, $E\bar{u}_1^{FU} = \max\{E\bar{u}_1^{H}, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $0 \leq \theta^C + \theta^P < \underline{\theta}^a$, where $(1-\mu_h)(v-\lambda) - c_l - \mu_h\underline{\theta}^a(2(1-\mu_h)(v-\lambda) - c_l) = v - c_h + \frac{(1-\mu_h)(v-c_h)\underline{\theta}^a(\Delta c+v-2\lambda)}{v-\lambda-c_l-\underline{\theta}^a(\Delta c+v-2\lambda)}$; $E\bar{u}_1^{PU} = \max\{E\bar{u}_1^{H}, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $\underline{\theta}^a < \theta^C + \theta^P < \frac{\Delta c-\lambda}{v-\lambda}$; and $E\bar{u}_1^{H} = \max\{E\bar{u}_1^{H}, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $\theta^C + \theta^P \geq \frac{\Delta c-\lambda}{v-\lambda}$.

When $\mu_h < \frac{\Delta c-\lambda}{v-\lambda}$ and $v \leq c_h + c_l$, $E\bar{u}_1^{FU} = \max\{E\bar{u}_1^{H}, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $0 \leq \theta^C + \theta^P < \underline{\theta}^b$, where $(1-\mu_h)(v-\lambda) - c_l - \mu_h\underline{\theta}^b(2(1-\mu_h)(v-\lambda) - c_l) = (1-\mu_h)(\frac{(1-\underline{\theta}^b)(v-\Delta c)}{1-2\underline{\theta}^b} - c_l) + \mu_h(v - c_h)$; and $E\bar{u}_1^{H} = \max\{E\bar{u}_1^{H}, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $\theta^C + \theta^P > \frac{\Delta c-\lambda}{v-\lambda}$.

[52] Another SE outcome is *honesty with a potential untreated major problem*, with the price menu $(p_l, p_h) = (v-\lambda, v)$. The consumer rejects r_h with probability g.

When $\mu_h \geq \frac{\Delta c-\lambda}{v-\lambda}$ and $v > c_h + c_l$, $E\bar{u}_1^{PU} = \max\{E\bar{u}_1^H, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $0 \leq \theta^C + \theta^P < \frac{\Delta c-\lambda}{v-\lambda}$, and $E\bar{u}_1^H = \max\{E\bar{u}_1^H, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for $\theta^C + \theta^P \geq \frac{\Delta c-\lambda}{v-\lambda}$.

When $\mu_h \geq \frac{\Delta c-\lambda}{v-\lambda}$ and $v \leq c_h + c_l$, $E\bar{u}_1^H = \max\{E\bar{u}_1^H, E\bar{u}_1^{FU}, E\bar{u}_1^{PU}, E\bar{u}_1^{FO}, E\bar{u}_1^{PO}\}$ for all θ^C, θ^P.

The final step is to demonstrate that there is no other equilibrium that provides the expert with a higher expected utility than any of the five equilibria identified above. Consider an arbitrary equilibrium with (p_l, p_h) in which $\sigma_2^{In} \in [0,1]$, $\sigma_2^l \in [0,1]$, and $\sigma_2^h \in [0,1]$. Suppose $E_{(\sigma,\mu)}[u_1|(\omega_l, In), p_l] \geq E_{(\sigma,\mu)}[u_1|(\omega_l, In), p_h]$, and $E_{(\sigma,\mu)}[u_1|(\omega_h, In), p_l] \geq E_{(\sigma,\mu)}[u_1|(\omega_h, In), p_h]$. The expert weakly prefers recommending a cheap treatment to recommending an expensive one. Hence, her expected utility is weakly lower than $\sigma_2^{In}[(p_l - c_l)\sigma_2^l - \mu_h(\theta^C + \theta^C)(\sigma_2^h(v - p_h) - \sigma_2^l(2p_l - c_l - \sigma_2^h(p_h - c_h)))] \leq p_l - c_l - \mu_h(\theta^C + \theta^C)$. The consumer's highest willingness to pay is $(1-\mu)(v-\lambda)$ upon being recommended a serious treatment. $(1-\mu_h)(v-\lambda) - c_l - \mu_h(\theta^C + \theta^P)(2(1-\mu_h)(v-\lambda) - c_l)$. □

Lemma 6. (***Honest Recommendation and Efficient Problem-Solving***) There exists an *honest recommendation and efficient problem-solving equilibrium* in which

$$\sigma_E^{ll} = 1, \sigma_E^{hl} = 0, \sigma_E^{lll} = 1, \sigma_C^{In} = 1, \sigma_C^l = 1, \text{ and } \sigma_C^h = 1$$

if and only if $p_l \leq v - \lambda$, $p_h \leq v$, $p_l \leq p_h$, and $\theta^{CA} \geq \frac{1}{2}$.[53]

Proof. □

Lemma 7. (***Honest Recommendation with A Potential Untreated*** ω_h) There exists an *honest recommendation with a potential untreated* ω_h where:

$$\sigma_E^{ll} = 1,\ \sigma_E^{hl} = 0,\ \sigma_E^{ll} = 1,\ \sigma_E^{lll} = 1,\ \sigma_E^{lhl} = 1,\ \sigma_C^{In} = 1,\ \sigma_C^l = 1, \text{ and } \sigma_C^h \in (0,1)$$

if and only if $p_l \leq v - \lambda$, $p_h = v$, $\frac{p_l - c_h - \sigma_C^h(v-c_h)}{(1-\sigma_C^h)(p_l - c_h)} \leq \theta^{CA} \leq \frac{1}{2}$, and $2\theta^{CA}\sigma_C^h(v - p_l) + (\theta^{CA} + \theta^P)(v - \lambda - p_l) \geq \sigma_C^h(v - c_l) - (p_l - c_l)$.

Proof. □

Lemma 8. (***Overcharging***) (i) There exists an *full overcharging equilibrium* in which

[53] To support $\sigma_E^{lhl} = 1$, the condition $\frac{1}{2} \leq \theta^C \leq max\{1, \frac{\Delta c}{\Delta p}\}$ must hold. Conversely, for $\sigma_E^{lhl} = 0$, the requirement is $\theta^C \geq max\{1, \frac{\Delta c}{\Delta p}\}$.

$\sigma_E^{ll} = 0, \sigma_E^{hl} = 0, \sigma_E^{lll} = 1, \sigma_E^{lhl} = 1, \sigma_C^{In} = 1, \sigma_C^{l} = 1$, and $\sigma_C^{h} = 1$ with the consumer's off-equilibrium path belief that the state is ω_l when r_l is recommended,

if and only if $p_l \leq v - \lambda$, $p_h \leq v - (1-\alpha)\lambda$, $p_l \leq p_h$, and $\theta^{CA} + (1-\alpha)\theta^P \leq \frac{1}{2}$.

(ii)There exists an *partial overcharging equilibrium* in which

$$\sigma_E^{ll} = \frac{\lambda(1-\alpha) - (v - p_h)}{(1-\alpha)(p_h + \lambda - v)}, \sigma_E^{hl} = 0, \sigma_E^{lll} = 1, \sigma_E^{lhl} = 1, \sigma_C^{In} = 1, \sigma_C^{l} = 1, \text{ and}$$
$$\sigma_C^{h} = \frac{p_l - c_l + (\theta^{CA} + \theta^P)|v - \lambda - p_l|}{p_h - c_l - (\theta^{CA} + \frac{\theta^P(v - p_h)}{\lambda}) \cdot 2\Delta p + (\theta^{CA} + \theta^P)|v - \lambda - p_l|}$$

if and only if $p_l \leq v - \lambda$, $v - (1-\alpha)\lambda < p_h < v$, $p_l \leq p_h$, $\theta^{CA} + \frac{\theta^P(v-p_h)}{\lambda} \leq \frac{1}{2}$.