Signaling by an Informed Service Provider *

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Abstract

We study a service provider, who at the time of offering a contract, is better informed than the potential client. A service provider that is hired to increase the client’s chance of a gain, an “enhancer”, may be better informed of whether the client has a big or small opportunity. A service provider that is hired to reduce the client’s chance of a loss, a “problem solver”, may be better informed of whether the client has a big or small problem. We show that an enhancer predominantly offers a contingent contract while a problem solver predominantly offers a flat fee due to their signaling incentives. This explains the differences in real world contracts and also provides a novel explanation for the existence of low-powered incentive contracts. We evaluate the policy intervention that limits the contingent part of the service providers’ contracts.

Keywords: Signaling by contract, contingent fee, service provider, informed principal.

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1 Introduction

Some service providers offer contingent contracts that will pay the service providers more if the outcomes turn out to be better for the clients. Some other service providers, despite having access to the same contractible future outcome, offer non-contingent contracts that pay the service provider the same regardless of the outcome. A notable example is that, in US tort and contract litigation, the plaintiff attorneys typically charge a contingent fee, usually a third of the settlement or judgement won in the litigation. However, the defense attorneys typically charge the clients an hourly rate regardless of the settlement or judgement amounts.\(^1\) A similar contrast exists in the debt service industry. Debt collection agencies, hired to collect hard-to-collect debts for creditors, typically charge the creditors a percentage of the debt eventually collected, which means that their pay is contingent on the service outcome. On the other hand, debt settlement companies, hired to negotiate down the debts for debtors, typically charge a percentage of the “unsecured balance”, the amount of debt initially owed by the debtors, plus other flat consultation or application fees.\(^2\) That is, their charges are independent of the service outcome. In this paper, we explain the different contract forms through how the service provider’s private information interacts with their service roles: whether they are hired to increase the chance of a good outcome or to decrease the chance of a bad outcome.

The difference between the two service roles can be best illustrated by the example of the attorneys. First, consider a plaintiff attorney (the service provider) and a plaintiff (the potential client). The plaintiff attorney can increase the chance that the client wins in a litigation, but the extent of which depends on the nature of the client’s case. If the client has a promising case, the increase in the probability of winning due to the attorney’s service is larger than if the client has an unpromising case. Because of the attorney’s past experiences and professional knowledge, the attorney is better informed about whether the case is promising or not for the client. In contrast, a defense attorney is hired to decrease the chance of a bad outcome: the chance that the defendant loses the litigation. The attorney may be better informed about the merit of the case brought against the defendant. The more merit the plaintiff’s claims have, the larger is

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\(^1\)In one major study, Kakalik and Pace (1986), 96 percent of individuals and 86 percent of organizations who were plaintiffs in tort litigation paid their attorneys on a contingent-fee basis; while 95 percent of the defense attorneys were paid on an hourly wage, and the rest were paid a retainer. These statistics is based on a data set collected by Civil Litigation Research Project (CLRP) for United States Department of Justice. Contingent fee is mainly prohibited in family and criminal cases.

\(^2\)See “Weighing the Benefits of Debt Settlement”, an online article at US News Money (July 16 2008).
the value brought by the attorney by fighting against them. In other words, a defendant needs an attorney more when he is in more serious trouble.

We call the service provider that is hired to increase the chance of a good outcome, such as the plaintiff attorney, an “enhancer” and the service provider that is hired to decrease the chance of a bad outcome, such as the defense attorney, a “problem solver”. There are many more examples of services providers in each categories. Enhancers include venture capitalists, promoters, talent agents, debt collectors, while problem solvers include doctors, debt settlers, car repairmen, etc. One might think that if we redefine a lack of a good outcome as a bad outcome, then there is no real difference in the roles of an enhancer and a problem solver. There is however a fundamental difference between an enhancer’s and a problem solver’s private information. For an enhancer, a client’s higher value of service is associated with a better expected outcome, whereas for a problem solver, a client’s higher value of service is associated with a worse expected outcome.

We build a signaling model where a monopoly service provider signals her private information about the client’s opportunity or problem through an offer of contract. The opportunity (problem) of a client is either big or small, characterized by the probability of the good (bad) outcome without the service. Since the future service outcome determines how much a contingent payment a service provider will receive, the contract functions differently as a signaling device. An enhancer can signal a high value of service by signaling a good future service outcome. On the contrary, a problem solver can signal a high value of service by signaling a bad future service outcome. The former leads to a contingent contract signaling a high value of service, while the latter leads to a flat-fee contract signaling a high value of service. The contrast is especially stark with the pooling equilibria: an enhancer offers a contingent contract while a problem solver offers a flat fee, which explains the puzzle that we observe with the contracts offered by attorneys or debt service firms.

Our paper then addresses the impacts of a policy intervention that limits the contingent part of the service providers’ contracts. For example, sixteen states in the United States have statutory contingent fee

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3We refer to the service provider as her and the client as him.
4This contrast in the fee structure of the plaintiff and defense attorneys is in fact very well recognized and documented. It is considered puzzling by Dana and Spier (1993) and is the motivation for Zamir and Ritov (2010) in behavioral economics. Emons and Fluet (2016) also has a model where the attorneys are better informed than the client. Defendants prefer their attorneys to work under a flat fee because then the attorneys will be willing to represent even the weakest case and this deters plaintiffs from suing.
caps that cap the contingent fee percentage that a plaintiff attorney can charge. We show that, aside from this policy’s obvious effect of reducing the incentive to exert hidden effort, it also increases the signaling costs of the service providers, which is translated into a benefit for the potential client.

This paper belongs to the informed-principal literature, pioneered by Myerson (1983) and Maskin and Tirole (1990, 1992). When a privately informed service provider offers a contract to a client, the service provider is essentially an informed principal in the terminology of principal-agent models. Common to all papers in this literature, the informed party’s contract or mechanism signals her private information. Our setting is different from the existing literature in several ways. First, our service provider privately knows the outside option of the potential client, while all of the informed principal literature, except for Myerson (1983) and Maskin and Tirole (1990, 1992), does not allow the principal to have private information about the outside option. Assuming common knowledge of the outside option precludes one from analyzing the case of a problem solver, because it implies that the client with the higher value of service is also the one with a better service outcome. Second, when moral hazard is considered in the literature, such as in Beaudry (1994), Inderst (2001), Chade and Silvers (2002), Wagner (2013), Karle and Staat (2016) and Bedard (2016), the moral hazard is on the side of the agent. In our discussion section, the moral hazard is on the side of the principal.

Our setup also has a connection with the credence good literature. A credence good is a product or service whose value is not obvious to the buyer or client even after consumption. Similar to the credence good literature, we assume that the expert has private information about the client’s outside option. Different from this literature, we assume that the expert also has private information on the service outcome. More importantly, most of this literature assumes that the expert offers prices/contracts before she learns the value of her service to the potential client and this precludes signaling incentive from the expert’s

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5Myerson (1983) and Maskin and Tirole (1990a, 1992) have very general models, but they do not offer a structured enough setup to study the form of contracts. Moreover, Maskin and Tirole do not allow moral hazard for the principal.
6Such papers study a variety of contracts: a warranty or a return policy (Spence 1977), output-based royalty in a licensing contract offered by an inventor (Gallini and Wright 1990), a franchising contract offered by a franchisor (Desai and Srinivasan 1995), and a financing contract offered to the creditors by a firm (Gertner et al. 1988).
7The different allocation of moral hazard creates different incentives. For example, Wagner, Mylovanov and Tröger (2015) constructs a mechanism where the principal shields information of her types from the agent while letting different types use different payment schemes to achieve the first best effort from the agent. This mechanism is not possible when the effort is exerted by the principal.
8See Dulleck and Kerschbamer (2006) for a literature review.
9The credence good literature typically assumes that, regardless of the client’s problem, the service outcome is that the client’s problem is fully fixed and the client suffers no loss.
contract offers so the expert is not an informed principal (See, e.g., Emons 1997, 2001, and Fong 2005). More broadly, this paper also relates to the literature that provides explanations for the existence of flat-fee contracts or low-powered incentive contracts despite the availability of output measures, which includes some of the previously mentioned papers on the informed principal. It also includes Holmstrom and Milgrom (1991), Benabou and Tirole (2016) and Dixit (1997). In this literature, it is optimal to offer low-powered incentive to a person because he or she engages in some form of multitasking. Our paper generates the low-powered incentive through the contract offerer’s incentive to signal her private information about the size of the contract receiver’s problem. Benabou and Tirole (2011) also generates a low-powered incentive through signaling: a low-powered incentive may work better than a high-powered incentive when it conveys the law maker’s private information that people in the society are likely to take the right action even without high-powered incentives, and thus put a societal pressure on each individual to take the right action. The low-powered incentives in the literature are designed to influence the actions of the recipient of the payments. In our paper, the low-powered incentives are used to signal the private information of the recipient of the payments and designed to increase the expected payments. In contrast to the literature, our intuition does not rely on any moral hazard.

The private information of our service provider allows better information on both the value of the service and the outcome of the service. The private information in Lewis and Sappington (1989) affects two elements as well, which are the marginal cost and the fixed cost of production. There are several main differences. First, Lewis and Sappington (1989) looks at one way that the two elements are associated, namely, a high marginal cost is associated with a low fixed cost. By contrast, central to our analysis is the contrast between two different ways the value of service and the service outcome are associated. Second, in Lewis and Sappington (1989), both elements will never be directly observable and the principal relies on the informed agent to report the private information. In our paper, one element, the service outcome, will be realized if the contract is accepted and the contract can be contingent on it. Third, Lewis and Sappington (1989) has a screening problem while we have a signaling problem. Their paper’s main point

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10 Liu (2011) considers an expert who privately knows whether she is selfish or conscientious at the time of offering the contract. However, since the service outcome is constant and commonly known in her model, unlike in our setup, the service contract cannot be made contingent on the service outcome. Another notable exception is Daughety and Reinganum (2013), which considers a service provider (plaintiffs attorney in their model) that, like in our paper, has private information that can be signaled. In their model, the plaintiffs attorney wants to signal that the lawsuit has a smaller expected gain so that the client will not incur search cost to bring in a second service provider to compete with her. In our paper, the defendant attorney wants to signal to the client that the expected loss is high to extract a higher expected payment for helping to avert it.
is that pooling can arise in a setting where there is typically separation.

The rest of the paper is organized as follows: Section 2 lays out the base model of pure signaling and characterizes the equilibrium. We first analyze the enhancer case, followed by the problem solver case. We then contrast the contract forms of these two cases. In Section 3, we study the impacts of a policy that caps the contingent fee for an enhancer. In Section 4, we discuss two robustness checks. One is to consider the alternative case where some type of client is inefficient to serve and the other is to allow for moral hazard by the service provider. Finally, Section 5 concludes.

2 Pure Signaling Model

2.1 The enhancer

Players. There are two players: a monopoly service provider and a potential client. Without the service from the service provider, the potential client has an uncertain probability $x \in \{l, h\}$ of receiving a good outcome and the complementary probability $1 - x$ of receiving a bad outcome, with $0 < l < h < 1$. The potential client can improve this probability $x$ if he hires a service provider, “the enhancer”. By providing a contractible service at a cost $c > 0$, the enhancer increases the chance of a good outcome by $\pi x$, where $\pi > 0$.

Information. The service provider is privately informed of whether the potential client has a big opportunity ($x = h$) or a small opportunity ($x = l$). We call the enhancer who is informed of a big opportunity type H and the enhancer who is informed of a small opportunity type L, denoted by $i = H, L$. We assume that $(1 + \pi)h < 1$ so the service does not completely eliminate the chance of a bad outcome. The common prior is that $x = h$ with probability $\lambda \in (0, 1)$.

Contract and timing. The realizations of the outcome are contractible. A contract, denoted by $(F, k) \in (-\infty, \infty) \times [0, \infty)$, has two parts, where $F$ is a fixed payment, payable to the enhancer regardless of outcome, and $k$ is a contingent bonus that is only payable if the client receives a good outcome. If $k = 0$, we call the contract a non-contingent or a flat-fee contract; otherwise we call it a contingent contract. We restrict $k$ to be non-negative. This is justified by the assumption that the enhancer can freely dispose of the
value created.\footnote{This is a common assumption in studies of incentive contracts, called “free disposal”. See, for example, Dewatripont and Tirole (1994). It is natural that a service provider can have a costless way of sabotaging the client (free disposal), even though to improve the client’s situation she has to incur a cost. Then, a contract with \( k < 0 \) will always be rejected and thus not offered in equilibrium.} The timing is the following: (1) Nature determines the client’s opportunity, \( x \in \{ h, l \} \), and reveals it to the enhancer. (2) The enhancer offers a take-it-or-leave-it contract to the client. (3) The client decides whether to accept the contract. (4) If the client accepts the contract, the service is provided. Then the outcome after service is realized and the payments exchange hands. If the client rejects the contract, then the outcome without the service is realized.\footnote{A more general mechanism is to allow the expert to offer a list of contracts to the client, while retaining the freedom to pick one out of the list if the list is accepted by the client (i.e., offering a “menu contract” in Maskin and Tirole (1992) and Bedard (2016)). This more general mechanism does not change the set of equilibrium contracts for an enhancer. We refer the interested readers to our supplementary appendix available at Lee’s website at https://sites.google.com/site/researchofrancesxu/.}

Payoffs and Equilibrium concept. Upon observing the contract offered by the service provider, the client forms a belief denoted by \( \rho \in [0, 1] \), which is the probability that he has a big opportunity. Both the client and the enhancer are risk-neutral. A good outcome brings a normalized payoff of 1 for the client and a bad outcome brings a payoff 0 for the client. Therefore, the value of the service to the client is \( \pi x \). We assume \( c < \pi l \) so providing the service is efficient regardless of the client’s opportunity.\footnote{We relax this assumption in Section 4.} We adopt the Perfect Bayesian Equilibrium (PBE) and use the Intuitive Criterion (Cho and Kreps 1987) to select the equilibrium (thereafter “ICS Equilibrium” for Intuitive-Criterion-satisfying equilibrium).\footnote{Intuitive Criterion narrows down the set of PBE only for a problem solver but not for an enhancer, but to be consistent, we impose the Intuitive Criterion for both the enhancer and the problem solver. See our supplementary appendix for details on the Intuitive Criterion.} The client maximizes the expected payoff from the outcome less payments to the enhancer. The enhancer maximizes the expected payments (fixed plus contingent) from the client less the cost of service.

Full information benchmarks. Hypothetically, if there were full information so that the client knows his values from the service, then any type of enhancer can make a take-it-or-leave-it offer to extract all the surplus by offering \( k^*_i \) and \( F^*_i \) (\( i = H, L \)) that satisfy \( \pi h = k^*_H (h + \pi h) + F^*_H \) and \( \pi l = k^*_L (l + \pi l) + F^*_L \). We call the achieved levels of payoffs the “first best full information payoffs” or simply “first best payoffs” for each type of the service provider, denoted by \( U^*_H \) and \( U^*_L \) respectively. We denote the ex-ante first best
payoff by $U^*_\lambda$. These levels serve as benchmarks:

$$U^*_H = \pi h - c,$$

$$U^*_L = \pi l - c,$$

$$U^*_\lambda = \lambda U^*_H + (1 - \lambda)U^*_L.$$

**Analysis.** Let $F(k|\rho)$ denote the maximum fixed fee the client is willing to pay when the client’s belief is $\rho$, the probability that client assigns to $x = h$. It equals the expected value of service minus the expected contingent payment.

$$F(k|\rho) = \frac{(\rho \pi h + (1 - \rho)\pi l) - k(\rho(h + \pi h) + (1 - \rho)(l + \pi l))}{\text{expected value of service}} - \frac{k(\rho(h + \pi h) + (1 - \rho)(l + \pi l))}{\text{expected contingent payment}}.$$

The belief $\rho = 1$ is a belief of type-H-for-sure and the belief $\rho = 0$ is a belief of type-L-for-sure. The first term above, the expected value of service, is higher when $\rho$ is higher. That is, a higher belief $\rho$ increases $\bar{F}(k|\rho)$ through the expected service value. However, since a client expects to pay out more in contingent fee to a type H, a higher belief $\rho$ reduces $\bar{F}(k|\rho)$ through the expected contingent payment, the intensity of which increases with $k$. As a result, there is a critical level of contingent fee, $\frac{\pi}{1 + \pi}$, at which $\bar{F}(k|\rho)$ is not affected by $\rho$, which implies $\bar{F}(k|1) = \bar{F}(k|0)$. For $k > \frac{\pi}{1 + \pi}$, $\bar{F}(k|1) < \bar{F}(k|0)$, so a contract with $k > \frac{\pi}{1 + \pi}$ allows type H to costlessly separate out from type L in a separating equilibrium.\(^\text{15}\) A continuum of separating equilibria where both types get their first best payoffs exist where type H offers $k_H \geq \frac{\pi}{1 + \pi}$ and $F_H = \bar{F}(k_H|1)$ and type L offers $k_L \leq \frac{\pi}{1 + \pi}$ and $F_L = \bar{F}(k_L|0)$. Because type H expects to benefit more from an increase in the contingent fee than type L,\(^\text{16}\) in a separating equilibrium type H offers a more contingent contract ($k_H > k_L$).

The pooling equilibrium is simply the extreme point of the set of separating equilibria, where both types of the enhancer offer the same contract with the critical level of contingent fee: $k = \frac{\pi}{1 + \pi}$ and $F = \bar{F}(\frac{\pi}{1 + \pi}|\lambda) = \bar{F}(\frac{\pi}{1 + \pi}|0) = \bar{F}(\frac{\pi}{1 + \pi}|1)$. Note that, in particular, a flat-fee pooling equilibrium does not exist. If

\(^{15}\)We allow the fixed fee to be potentially negative, which captures the practice of financing the plaintiff by plaintiff attorneys. Indeed, the results suggest that agreeing to finance a plaintiff signals that the plaintiff’s case is strong. The results can be modified in a straightforward way if fixed fee has to be non-negative for some applications when the service provider has limited liability.

\(^{16}\)This is reflected in a single-crossing condition in the contract space. Let $U_i(F, k)$ denote type $i$’s payoff when a contract $(F, k)$ is accepted by the client. Then $\frac{\partial U_H}{\partial k} / \frac{\partial U_H}{\partial \rho} = (1 + \pi)h > (1 + \pi)l = \frac{\partial U_L}{\partial k} / \frac{\partial U_L}{\partial \rho}$.
such a pooling equilibrium exists, type H has a profitable deviation to a higher contingent fee to separate out because type H benefits more from an increase in contingent fee than type L and the client knows that type H creates a higher value of service. We present the equilibrium characterization formally in Lemma A.4 in the Appendix.

The driving force for a contingent fee is that a higher-value enhancer also expects a better service outcome. This shows that the assumption that the value of the service is linear in the size of the opportunity is not crucial. In fact, as long as the value of service is weakly higher for a bigger opportunity, the qualitative results stay the same.

2.2 The problem solver

Brief model setup. A problem solver is hired to reduce the probability of a bad outcome. Without the problem solver, the client has an uncertain probability $x \in \{l, h\}$ of receiving the bad outcome where $0 < l < h < 1$. If the potential client engages the problem solver to provide a contractible service, the problem solver can decrease the chance of a bad outcome by $\pi x$ (the value of service). We assume $\pi < 1$ so that the chance of the bad outcome cannot be completely eliminated by the service. The problem solver knows whether the problem is big ($x = h$) or small ($x = l$). We call the service provider who is informed of a big problem type H and the service provider who is informed of a small problem type L, denoted by $i = H, L$. The rest of the model setup is the same as that for the enhancer case, with an “enhancer” replaced by a “problem solver”. The first best payoffs are the same, achieved by contracts $k^*_i$ and $F^*_i$ $(i = H, L)$ that satisfy $\pi h = k^*_H(1 - h + \pi h) + F^*_H$ and $\pi l = k^*_L(1 - l + \pi l) + F^*_L$. The maximum fixed fee the client is willing to pay, given a contingent fee $k$, is:

$$F(k|\rho) = (\rho \pi h + (1 - \rho)\pi l) - k(\rho(1 - h + \pi h) + (1 - \rho)(1 - l + \pi l)).$$

Analysis. Note that, after the service, a big-problem client is still the one with the higher probability of a bad outcome: $(1 - \pi)h > (1 - \pi)l$. This is the underlying difference from the enhancer case: in the problem solver case, type H has a lower chance of receiving the contingent fee even though her service is more valuable.

Type H values contingent fee less because she is less likely to receive it.\(^{17}\) As a result, there cannot be

\(^{17}\)This is reflected in a single-crossing condition as well. Let $U_i(F, k)$ denote type i’s payoff when a contract $(F, k)$ is accepted by the client. Then $\frac{\partial U_H}{\partial k} / \frac{\partial U_L}{\partial k} = 1 - (1 - \pi)h < 1 - (1 - \pi)l = \frac{\partial U_L}{\partial k} / \frac{\partial U_L}{\partial k}$. 

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any positive-contingent-fee pooling equilibrium. If both types are pooled together at a positive-contingent-fee contract, a type H can always profitably separate out by lowering the contingent fee slightly and increasing the fixed payment appropriately. By the Intuitive Criterion, such a deviation has to lead to a belief that the deviator is a type H and therefore is profitable for type H. Therefore, the contract has to be a flat-fee contract in a pooling equilibrium. At a flat-fee contract, type H cannot lower the contingent payment any further because of the free disposal assumption $k \geq 0$. The equilibrium fixed fee can be at any level that gives type L at least her first best payoff, while giving the client the incentive to accept under a pooled belief. We characterize the equilibria formally in Lemma A.6 in the Appendix.

In a separating equilibrium, unlike the case of an enhancer, a type-H problem solver cannot obtain the first best payoff and separate from a type-L problem solver. The client is willing to pay type H a higher level of fixed fee, given any level of $k$, because (1) he expects to pay out less in contingent payments, and (2) he knows that the value of service is higher with type H. Therefore, at any level of contingent fee, the maximum fixed fee acceptable to a client $F(k|\rho)$ is higher if the client’s belief $\rho$ is higher. In other words, at any level of contingent fee, a problem solver prefers a belief of type-H-for-sure ($\rho = 1$). In contrast to the case of an enhancer, this creates an incentive for type L to mimic type H at any non-negative-contingent-fee contract that gives type H her first best payoff. This in turn implies that type H has to incur some distortion to separate out from type L. Given the free disposal assumption $k \geq 0$, the least costly way for type H to separate out is to offer $k_H = 0$ and $F_H = F(0|0)$, that is, a flat-fee contract, which determines the separating ICS equilibrium. This is as if a type-H problem solver is declaring to the client that she knows that the problem is big and the service outcome is likely to be bad so she does not want her pay to depend on it. In this separating equilibrium, type H’s fixed fee is lower than the first best level of $F(0|1)$ in order to prevent type L from mimicking. Type L’s separating contract can be any contract that gives her the first best payoff under a belief of type-L-for-sure while being different from type H’s: $k_L > 0$ and

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18 This is where the Intuitive Criterion has a bite. Without it, the belief can be that the deviator is of type L and cause the deviation contract to be rejected by the client.

19 Wagner (2013) and Wagner, Mylovanov and Tröger (2015) both show that under a linear independence condition on the distribution of the ex-post verifiable outcomes there is no payoff and efficiency distortion in an informed principal problem. This condition is possible when the number of ex-post verifiable outcomes is large enough. We suspect that such a condition is not sufficient to eliminate payoff and efficiency distortion for our paper. Suppose there is a finite number of verifiable outcomes in our setup. Under the free disposal assumption, to induce the principal not to sabotage the client, the payment for a better outcome has to be higher than that for a worse outcome. This poses new difficulty for finding a solution of a payment scheme to allow both types to achieve first best payoff regardless of the agent’s belief. It is therefore very interesting for future research to look for a condition so that first best payoffs in our environment can be attained when the ex-post verifiable outcomes can be more than two.
Unlike the case of an enhancer, a type-H problem solver cannot obtain the first best payoff because he cannot separate with a negative contingent fee.

The driving force for a flat fee is that a higher-value problem solver expects a worse service outcome. This shows that the assumption that the value of the service is linear in the size of the problem is again not crucial. In fact, as long as the value of service, when viewed as a function of the problem size \( x \), is a weakly increasing and strictly concave function of \( x \), the qualitative results stay the same.

### 2.3 Contrasting an enhancer with a problem solver

The contrast between the two categories of service providers is sharp both in term of contract forms and payoffs.

**Proposition 1.** 1. (Contract form) In a separating equilibrium, a type-H enhancer offers a higher contingent fee than a type L enhancer, while a type-H problem solver offers a lower (zero) contingent fee than a type-L problem solver. In a pooling equilibrium, both types of enhancer offer a positive contingent fee, while both types of problem solver offer a flat fee.

2. (Payoff) Ex post, both types of enhancer receive their first best payoffs, while a type-H problem solver always receives less than her first best payoff. Ex ante, all equilibria are equally profitable for an enhancer at the first best level of \( U^*_x \). However, only one equilibrium achieves the ex-ante first best payoff for a problem solver—a flat-fee pooling equilibrium with \( k = 0 \) and \( F = F(0|\lambda) \).

The proof follows immediately from equilibrium characterizations in Lemma A.4 and Lemma A.6 in the Appendix.

Based on the ex-ante most profitable equilibrium, we can say that the contract form for the enhancer is predominantly contingent and the contract form for the problem solver is a flat fee.\(^{20}\) This fits the stylized facts that (1) plaintiff attorneys offer contingent contract and defense attorneys offer flat-fee contract; and

\(^{20}\)Only one out of the continuum of separating equilibria for an enhancer involves type L offering a flat-fee contract. After the service provider gains the private information, one concept is *interim pareto optimal*, which is the equilibrium for which there is no other equilibrium that gives both types of service provider a weakly higher payoff and at least one of them a strictly higher payoff. All separating ICS equilibria are interim pareto optimal and only one pooling ICS equilibrium is interim pareto optimal and it coincides with an ex-ante most profitable equilibrium. Therefore, the concept of interim pareto optimal equilibrium does not add much given that we are considering the ex-ante most profitable one.
debt collection agents charge a contingent fee and debt settlement agents charge a flat fee. For example, if a plaintiff attorney can increase the chance of a win for the plaintiff by 50%, the unique pooling equilibrium predicts that the attorney will charge a third of the future judgement or settlement awarded in the litigation regardless of her private information. On the other hand, the ex-ante most profitable equilibrium for a defense attorney predicts that the defense attorney charges a fixed payment independent of the outcome of the litigation regardless of her private information.  

The private information on the opportunity or the problem of the potential client implies that the service provider is better informed of both the service outcomes and the outside options of the potential client. This stands in contrast to most of the informed-principal literature. Not allowing private information on the outside option is equivalent to a subcase of our enhancer case because a higher value of service translates into a better service outcome when the outside option is certain. Without considering the private information of outside option, one cannot analyze the interesting case of a problem solver, from which we derive our insights on low-powered incentive.

Proposition 1 also implies that the client can expect to receive positive surplus only in the problem solver case (in any equilibrium other than the ex-ante most profitable one). The reason for this positive surplus for the client is different from the literature. In Beaudry (1994), the contract offerer cannot extract full surplus because of the moral hazard of the contract receiving party. There, a conflict exists between motivating effort with a high bonus and signaling a high productivity job with a low bonus (so a high share is retained by the employer). Here, there is no such conflict, because there is no moral hazard in the analysis so far.

Proposition 1 is based on the comparison of the ICS equilibria between the enhancer setup and the problem solver setup. Some other solution concepts in the literature are consistent with this contrast. For example, the set of “RSW allocation” (Maskin and Tirole 1992) and “assured allocation” (Balkenborg and Makris 2015) both coincide with the set of ICS equilibria for an enhancer and RSW allocation restricts

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21Suppose that $100,000 is at stake and the big-problem defendant has 40% chance of losing it in the litigation and the small-problem defendant has 20% chance of losing it. Also suppose the prior probability of a big problem is 20% and the attorney can reduce the losing probability by 50%. The fixed payment charged by the defense attorney is equal to $0.5(0.2 \times 0.4 + 0.8 \times 0.2)$100,000 = $12,000.

22Higher fixed wage is a way to signal a high-quality job. An employer with a high quality job who hopes to extract full surplus would rather instead increase both fixed wage and bonus to increase the agent’s incentive to exert hidden effort while maintaining the signaling ability of the contract.

23We will incorporate moral hazard in Section 4.2.
type-H problem solver’s contract to be flat as well. See our supplementary appendix for these details.

3 The impact of contingent fee caps on plaintiff attorneys

Our analysis of an enhancer can shed some light on the impact of imposing contingent fee caps. The analysis is highly relevant because interventions on plaintiff attorneys’ contingent fees are common. Sixteen states in Unites States have adopted statutory caps on contingency fees in personal injury cases; workers compensation cases, or both. There is also a federal cap applying to attorney fees in Social Security disability and veteran benefits claims and claims brought under the Federal Tort Claims Act (FTCA), as documented in Hyman, Black and Silver (2015). These contingent fee caps range from 10% to 50%. The stated intention of imposing the caps is to prevent excessive fees for the attorney and to benefit the plaintiffs (see Horowitz 1995). At first brush, it seems that any cap that only targets the contingent component of the contract should not affect the client in a risk-neutral setting without any moral hazard because the attorney can simply increase the fixed payment to compensate for the lack of a high contingent fee. Opponents of the contingent fee cap on the attorneys are typically worried that the higher fixed payment would discourage the plaintiffs from suing if they have a budget constraint.\footnote{Schneyer (1998) believes that contingent fee “expands access for those whose only substantial asset is the very claim they need a lawyer’s help to pursue” and these potential plaintiffs will be forced out by a contingent fee cap.}

We scrutinize the payoff and efficiency implications of the cap in this section.

Denote the contingent fee cap by $k$. That is, the policy mandates $k \leq \overline{k}$. For an enhancer, when the cap $\overline{k} \geq \frac{\pi}{1+\pi}$, the cap is essentially not binding. It does not affect the qualitative features of the equilibrium and it does not affect the payoffs. Lemma A.4 carries through with the only change being binding the equilibrium $k_H$ by $\overline{k}$. The interesting case is when $\overline{k} < \frac{\pi}{1+\pi}$. We know that setting a contingent fee above $\frac{\pi}{1+\pi}$ allows type H to separate out and to achieve her first best payoff. A low enough contingent fee cap takes away this option, so now it is costly to separate out. In a separating equilibrium, type H now lowers the fixed fee from the client’s maximum acceptable level to prevent type L from mimicking. Therefore, type H’s equilibrium contract, when separated, is $k_H = \overline{k}$ and $F_H = \overline{F}(\overline{k}|0)$, giving type H a payoff lower than her first best. Type L’s equilibrium contract, when separated, is any contract that gives her the first best payoff under a belief of type-L-for-sure while being different from type H’s. The payoff distortion for
type H is a gain for the client with a big opportunity. We present the new equilibrium characterizations in Lemma A.7 in the Appendix.

Note that even though type-H enhancer’s payoff is reduced, type H is still guaranteed a payoff strictly higher than that for type L because type H is more likely to receive the positive contingent fee, so type H will not be discouraged from serving the client. In other words, there is no efficiency loss. As a result, any payoff distortion for the enhancer is a transfer to her client.

**Proposition 2.** A high enough contingent fee cap on an enhancer \( \bar{k} \geq \frac{\pi}{1+\pi} \) has no impact. A lower contingent fee cap increases the payoff of a client with a big opportunity at the expense of his enhancer in a separating equilibrium, increasing the client’s ex-ante payoff.

Our results show that the concern that the contingent fee cap will translate into higher fixed fee and thus discourage plaintiff to sue is mitigated if the service provider has private information. Instead of increasing the fixed fee to \( F(\bar{k}|1) \), type H increases the fixed fee to \( F(\bar{k}|0) \) in a separating equilibrium when the cap \( \bar{k} < \frac{\pi}{1+\pi} \). Our results also suggests that the contingent fee cap may encourage plaintiffs to sue, especially those that have high opportunities, say, e.g., because the targeted defendants have deep pockets.\(^{25}\) These clients get a better payoff from pursuing the lawsuits when the contingent fee cap is imposed.

4 Discussion

4.1 Some clients are inefficient to serve

We have so far assumed \( \pi l > c \). It is possible that clients with certain characteristics are inefficient to serve. We look at the alternative case of \( \pi h > c \) and \( \pi l \leq 0 \) in this subsection for the setup in Section 2. In other words, a type-L service provider realizes that the opportunity or problem is so small that the service value will be less than the cost of service. We assume the indifference-breaking rule that a service provider will choose to not offer a contract when no contract can give her a positive payoff, which is consistent with an infinitesimally small fixed cost of offering a contract.

\(^{25}\) A full welfare analysis should take into account the broader welfare implication beyond the service provider-client pair. This awaits future research.
For an enhancer, in a separating equilibrium, the type-L enhancer will not offer a contract and will not perform the service. This is because there is no contract that is acceptable to the client and profitable for an enhancer if both sides know the opportunity is small. To prevent type L from mimicking type H, type H still has to offer a contingent fee because of type H’s higher chance of receiving the contingent fee.\textsuperscript{26} Because type H can always get its first best payoff by picking a high enough contingent fee, for a pooling contract to be acceptable to the client who is uninformed in equilibrium, the payoff for type L is at most $U_L^* \leq 0$. Type L will deviate to not offering a contract. Therefore, no pooling equilibrium exists. This gives rise to the formal characterization in Lemma A.8 in the Appendix.

For a problem solver, there is no separating equilibrium any more. If there is a separating equilibrium, then a type-L problem solver will not offer a contract and will not perform the service due to the separating nature of the equilibrium. As a result, type H will not offer a contract as well because any contract that gives type H a positive payoff will be mimicked by type L. Whether a pooling equilibrium exists or not depends on whether in expectation the service is still efficient to perform or not. As before, any pooling contract has to be a flat fee. If $U_H^* = \lambda U_H^* + (1 - \lambda)U_L^* > 0$, then a flat-fee pooling equilibrium exists for a problem solver as in Section 2. If $U_H^* \leq 0$, then no flat fee is both acceptable to the client and strictly profitable for a problem solver. This gives rise to the formal characterization in Lemma A.9 in the Appendix. Together, Lemma A.8 for the enhancer and Lemma A.9 for the problem solver imply the following contrast between the two cases.

**Proposition 3.**
1. (Contract form) There is no pooling equilibrium for an enhancer: Type H offers a contingent-fee contract, while type L does not offer a contract. There is no separating equilibrium for a problem solver: Type H and Type L both offer a flat fee if the service is ex-ante efficient to perform, and both offer no contract otherwise.

2. (Payoff) Ex post, both types of enhancer receive their first best payoffs, while a type-H problem solver always receives less than her first best payoff. Ex ante, all equilibria are equally profitable for an enhancer at the first best level of $\lambda U_H^*$. However, only one equilibrium achieves the ex-ante first best payoff for a problem solver—a flat-fee pooling equilibrium with $k = 0$ and $F = F(0|\lambda)$ when the service is ex-ante efficient to perform.

Overall, as expected, we get more cases of no service compared to Section 2 when both types’ services

\textsuperscript{26}The contingent fee cutoff is determined by $\pi h - (1 + \pi)hk + (1 + \pi)lk - c = 0$. That is, a separating $k_H \geq \frac{\pi h - c}{(1 + \pi)(h - l)}$. 

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are efficient to perform. The contrast in the contract form between an enhancer and a problem solver is even starker here than that in Section 2: whenever a contract is actually offered and accepted in equilibrium, it is always a contingent one for an enhancer and always a flat one for a problem solver.

With an enhancer, the equilibrium outcome is always efficient: type H serves and type L does not serve. With a problem solver, the equilibrium outcome is always inefficient. When $U^*_\lambda > 0$, type L serves even though the service is not efficient. When $U^*_\lambda \leq 0$, type H fails to serve even though the service would be efficient.

### 4.2 Signaling with moral hazard

In this section, we discuss how adding moral hazard to the side of the service provider would affect the results.\(^{27}\) This extension shows that the contrast in the contract forms between an enhancer and a problem solver extends, while the signaling incentive can conflict with the desire to commit to pay a hidden effort.

In addition to the contractible improvement/service provided at cost $c$, we now assume the service provider can further increase the probability of a good outcome by $w > 0$ with a non-contractible and unobservable effort costing $\delta w$, same for both type H and type L. We assume that $w$ is not too large so that after the hidden effort is exerted there is still a positive probability of bad outcome regardless of the client’s opportunity or problem. Specifically, $w < 1 - (1 + \pi)h$ (for the enhancer case) and $w < (1 - \pi)l$ (for the problem solver case). Since the payoff difference between a good and a bad outcome is normalized to 1, the client’s willingness to pay increases by $w$ if he expects hidden effort to be exerted.\(^{28}\) Assume that $\delta \in (0, 1)$ so it is efficient to exert this effort. The service provider maximizes the expected payments less the expected total cost of efforts. The rest of the setup is the same as in Section 2.

We characterize the equilibria in the supplementary appendix and discuss the intuitions here. If a

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\(^{27}\) The moral hazard here is on the side of the principal. This is in contrast with the informed principal literature so far where moral hazard is on the side of the agent.

\(^{28}\) The private information in our paper only concerns the base value of the service and not any parameter of the hidden effort. This is in contrast with Karle and Staat (2013). Karle and Staat (2013) shows that private information can make the contract more contingent through the existence of moral hazard on the side of the agent. In Karle and Staat (2013), the private information is not about the base value of the principal-agent relationship, but the productivity of the agent’s effort. It is less costly for the principal who has a high-productivity project than for the one with a low-productivity one to induce a higher effort level in the agent under limited liability. Therefore, more contingent payment to the agent (flatter payment to the principal) can signal a higher return on agent’s effort in Karle and Staat (2013). Signaling leads to overly high and thus inefficient effort choice for a high-return project. In our paper, the private information is related only to the base value of the project so, even when we do not have moral hazard, i.e., in our pure signaling setup in Section 2, we get that problem solver’s contract is different from the first best.
service provider offers a contract with a high enough contingent fee \((k \geq \delta)\), the contract can credibly commit the service provider to exerting the hidden effort. Under full information on the opportunity or the problem of the client, committing to effort is beneficial to the service provider, because it raises the willingness to pay of the client by more than the cost of the non-contractible effort. More specifically, effort creates a benefit of \(w\) at a cost of \(\delta w\), so the value of the effort to the relationship is \((1 - \delta)w\) which the service provider can fully extract under full information. Therefore, the first best full information payoffs are \(U^*_H = \pi h - c + (1 - \delta)w\) and \(U^*_L = \pi l - c + (1 - \delta)w\).

**The enhancer with moral hazard.** Without moral hazard, as shown in Section 2, any contingent fee \(k_H \geq \frac{\pi}{1 + \pi}\) allows type H to separate out from type L while reaching her full information payoff. Therefore, under moral hazard, type H can set \(k_H \geq \{\delta, \frac{\pi}{1 + \pi}\}\) to at least achieve her first best payoff. The real issue is type L’s incentive under moral hazard. As seen in Section 2, for type L the way to separate out in the enhancer case is to choose a low contingent fee because type L is less likely to benefit from the contingent fee. Type L wants to separate out from being pooled together with type H because at a high contingent fee the client is unwilling to pay a good fixed fee if the client expects to pay a lot in contingent payment to a type H. When the cost of hidden effort is low \((\delta < \frac{\pi}{1 + \pi})\), type L can signal and commit to effort at the same time by setting \(k_L \in [\delta, \frac{\pi}{1 + \pi})\). When the hidden effort is more costly \((\delta > \frac{\pi}{1 + \pi})\) and thus requires a higher contingent fee for commitment, a tension arises between type L’s signaling incentive and her incentive to commit to effort. Then, type L fails to reach her first best payoff: (a) For moderately high cost of hidden effort, type L still commits to effort by picking a high enough contingent fee, while signaling her type at a higher cost (in a separating equilibrium) or giving up signaling at all (in a pooling equilibrium). (b) When the cost of the hidden effort is very high, type L fails to commit to effort: she would rather be recognized as a type L without the intention to pay effort than committing to effort and pooling with type H. This lack of hidden effort results in inefficiency.

**The problem solver with moral hazard.** As shown in Section 2, a type-H problem solver can separate out by offering a low contingent fee. The lower the contingent fee, the less costly it is to separate from type L. This however is in tension with the need to commit to effort by choosing a high enough contingent fee. Moreover, type L has an incentive to mimic type H by lowering the contingent fee, so type L may also want to give up committing to effort.
The trade-off between committing to effort and signaling for type H lies in the comparison of (1) the net value of hidden effort and (2) the value of signaling type H versus being pooled with type L while charging a contingent fee just big enough to commit to effort. The higher the former is, the more incentive type H has to commit to effort. Recall from Section 2 that type L can always separate out with a high enough contingent fee. This means that type L can always achieve at least the first best payoff. However, type L sometimes can do even better by pooling with type H because type H’s service is more valuable to the client and the client expects to pay less contingent payments to type H and thus is more willing to pay a high fixed fee. Type L thus may get a payoff above her first best level in either a positive-contingent-fee pooling equilibrium when both are committing to effort or in a flat-fee pooling equilibrium when both are not committing to effort. The latter equilibrium happens when the net value of effort, \((1 - \delta)w\), is lower than type L’s net gain of pooling with type H.

The comparison in our Proposition 1 on the contract forms holds verbatim when the net value of the hidden effort is small enough. In this sense, our results in the base model without moral hazard is robust when we add a moderate amount of moral hazard.

**Proposition 4. (Contract form with moral hazard)**

When \((1 - \delta)w\) is sufficiently small, in a separating equilibrium, a type-H enhancer offers a higher contingent fee than a type L enhancer, while a type-H problem solver offers a lower (zero) contingent fee than a type-L problem solver. When \((1 - \delta)w\) is sufficiently small, in a pooling equilibrium, both types of enhancer offer a positive contingent fee, while both types of problem solver offer a flat fee.

A new dimension of contrast is on the effort. As explained above, the hidden effort creates a tension with the signaling incentive for a low-value enhancer, but not a high-value enhancer. However, the hidden effort creates a tension with the signaling incentive for both types of a problem solver.

5 Conclusion

In this paper we provide a potential explanation for service providers’ choices over offering a contingent fee versus a flat fee: the service providers have private information when offering the contract and they
also differ on whether they are enhancers or problem solvers. The private information concerns the characteristics of the potential clients, whether they have a big or small opportunity to be enhanced by an enhancer or whether they have a big or small problem to be mitigated by a problem solver. This private information allows the service provider to be better informed about both the service outcome of the potential client and the value of the service for the client. Solving the signaling problem for a monopoly service provider, we found that an enhancer’s contract is predominantly contingent while a problem solver’s contract is predominantly flat. This offers insights on why plaintiff attorneys’ contracts tend to be contingent and defense attorneys’ contracts tend to be non-contingent; and why debt collectors’ contracts tend to be contingent and debt negotiators’ contracts tend to be non-contingent. The problem solver’s case is particularly interesting because it provides a novel explanation for the low-powered incentive schemes even when there is a clear performance measure.

The signaling incentives of the service provider imply that a policy intervention that imposes a cap on the contingent fee component alone may benefit the potential client by increasing the signaling costs of the service provider even though the service provider still retains the freedom of setting any amount of fixed fee.

We take the view that conducting an initial consultation with the client prior to offering a contract is prevalent and often unavoidable due to several practical considerations. First, before offering a contract the service provider may want to know whether the cost of serving a potential client is too high. Given the same level of opportunity or problem, some client may be unreasonable, difficult to work with, or have personality issues, a dimension of uncertainty not modeled in this paper. The service provider can learn this information regarding the service cost through an initial consultation. The service provider would prefer not to offer a contract if the client is very costly to serve. Second, a potential client might be privately informed about the size of his opportunity or problem with some probability. Such an informed client will cause a screening problem for the service provider if the contract is offered prior to the service provider’s learning. Lastly, some service providers, such as attorneys, need to rule out potential conflicts of interests through an initial consultation. Once the service provider holds an initial consultation, it is typically unavoidable that she learns about the opportunity or the problem of the client as well. For these reasons, we think the informed principal problem we study is prevalent.
The paper is based on a model of a monopolist service provider. Extending the Diamond Paradox (Diamond 1971), it can be shown that even when the client has the option to search for a second opinion at a cost, it remains an equilibrium that the client chooses not to search and service providers offer contracts that are the same as those offered if they were the monopoly.

References


Appendix

A.1 Lemmas for Section 2

Recall that $\overline{F}(k|\rho)$ denotes the highest fixed fee the client will accept when the contingent fee is $k$ and the client’s belief is $\rho$. Recall $U_i(F,k)$ denote the type-$i$ service provider’s expected payoff when the contract $(F,k)$ is accepted by the client. Let $p_i$ denote the chance of a good outcome after type $i$’s service. That is, for an enhancer, $p_H = (1 + \pi)h$ and $p_L = (1 + \pi)l$; for a problem solver, $p_H = 1 - (1 - \pi)h$ and $p_L = 1 - (1 - \pi)l$. The following lemmas apply to both the enhancer and the problem solver (unless otherwise noted).

Lemma A.1. Fix a pair of contracts for type $i$ and type $-i$. Suppose type $i$ gets payoff $U_i(F_i,k_i) \geq U^*_i$. If type $i$ does not want to deviate to the contract type $-i$ is offering, then there exists some ICS belief system such that type $i$ does not have incentive to deviate to any contract.

Proof. WLOG, let $i = L$. Any deviation contract other than $(F_H,k_H)$ must be one of the following two cases. Either the Intuitive Criterion does not have a bite and the deviation belief can be set to be type-L-for-sure, to which type L has no incentive to deviate because type L already gets $U^*_L$ or more on the proposed equilibrium; or the Intuitive Criterion restricts the belief to be type-H-for-sure. In order for the Intuitive Criterion to restrict the belief to be type-H-for-sure, it must be that type L will get a strictly lower payoff deviating to it given any belief, which implies that type L does not want to deviate to that contract even if the belief following the deviation is type-H-for-sure. Therefore, type L has no incentive to deviate to any contract other than $(F_H,k_H)$ under this belief system.\footnote{Note that the above lemma also holds if we drop the Intuitive Criterion.}

Lemma A.2. In any equilibrium, type L's payoff is greater than or equal to $U^*_L$. In any separating equilibrium, type L's payoff is equal to $U^*_L$.

Proof. Regardless of the belief, the contract $(\overline{F}(0|0),0)$ will be accepted by the agent, and hence type L’s payoff must be bounded below by $U^*_L$. Since in a separating equilibrium, the client knows the type of type L, the highest payoff
type \( L \) can receive is \( U^*_L \), so it must be equal to \( U^*_L \).30

**Lemma A.3.** On any ICS equilibrium for an enhancer, \( U_H = U_H^* \) and \( U_L = U_L^* \).

**Proof.** The lower bound of the equilibrium payoff of type \( L \) is established by Lemma A.2. We consider the payoff of type \( H \). (1) We prove by contradiction, so suppose \( U_H < U_H^* \). Now let type \( H \) deviate to a contract \((F', k'_H)|1\), \( k'_H \) such that \( k'_H > \frac{\pi}{1 + \pi} \). This implies that (a) if the belief is type-H-for-sure then this deviation contract will be accepted and (b) it gives a payoff of \( U^*_H > U_H \) to type \( H \). If the belief is instead type-L-for-sure, the client’s payoff of accepting it would be \( \pi l - (\pi h - (1 + \pi)hk'_H) - (1 + \pi)lk'_H = -\pi(h - l) + k'_H(1 + \pi)(h - l) > 0 \). Therefore, regardless of the client’s belief, the deviation contract will be acceptable. This forms a contradiction because the deviation is profitable. Therefore, \( U_H \geq U_H^* \). (2) On any separating equilibrium \( U_H \leq U_H^* \). Therefore \( U_H = U_H^* \). By Lemma A.2, type \( L \) gets at least the first best payoff. Then, since a pooling equilibrium contract \((F, k)\) is acceptable to the client, we have \( U_H \leq U_H^* \). Therefore, \( U_H = U_H^* \). In a pooling equilibrium, since \( U_H = U_H^* \) and \( U_L \geq U_L^* \), the client’s IR constraint again implies that \( U_L = U_L^* \).

**Lemma A.4.** (The enhancer)

(i) There exists a continuum of separating ICS equilibria with a type-\( L \) enhancer offering \( k_L \in (0, \frac{\pi}{1 + \pi}] \), \( F_L = \mathcal{F}(k_L)|0 \) and a type-\( H \) enhancer offering \( k_H \in (\frac{\pi}{1 + \pi}, \infty) \), \( F_H = \mathcal{F}(k_H)|1 \), and \( k_H \neq k_L \). In these equilibria, \( U_i = U_i^* \) for \( i = H, L \) and \( k_H > k_L \).

(ii) There exists a unique pooling ICS equilibrium with both types of enhancer offering \( k = \frac{\pi}{1 + \pi} \) and \( F = \mathcal{F}(k)\). In this equilibrium, \( U_i = U_i^* \) for \( i = H, L \).

**Proof.** Separating equilibria. (Necessity.) First, it must be that type \( H \) does not want to mimic type \( L \) and vice versa.

\[
\begin{align*}
F_L + p_Hk_L - c \leq U_H^* \Rightarrow (\pi l - p_Lk_L) + p_Hk_L \leq \pi h \Rightarrow k_L \leq \frac{\pi}{1 + \pi} \\
F_H + p_Lk_H - c \leq U_L^* \Rightarrow (\pi h - p_Hk_H) + p_Lk_H \leq \pi l \Rightarrow k_H \geq \frac{\pi}{1 + \pi}
\end{align*}
\]

This shows that any separating equilibrium has to satisfy \( k_L \leq \frac{\pi}{1 + \pi} \) and \( k_H \geq \frac{\pi}{1 + \pi} \).

(Sufficiency.) The existence follows from Lemma A.1 because both types obtain their first best payoffs.

30 When menu contract is allowed, it still holds that type \( L \)’s equilibrium payoff is greater than or equal to \( U_L^* \), but we no longer know that it will be equal to \( U_L^* \) in a separating menu contract equilibrium. Since it will be established that \( U_H \geq U_H^* \) in the enhancer case, the ex-ante IR constraint would imply \( U_L = U_L^* \). However, in the problem solver case, it is possible that \( U_L > U_L^* \) in a separating menu contract equilibrium.
Pooling equilibria (Necessity.) First, we claim that if there exists a pooling equilibrium, then equilibrium $k = \frac{\pi}{1 + \pi}$. We derive contradictions for the following cases. Case 1. $k < \frac{\pi}{1 + \pi}$. This implies $\pi h - p_H k > \pi l - p_L k$. Then equilibrium payoff $U_H \leq \lambda (\pi h - p_H k) + (1 - \lambda)(\pi l - p_L k) + p_H k - c < \pi h - p_H k + p_H k - c = U_H^*$. This forms a contradiction to Lemma A.3, so this is not possible. Case 2. $k > \frac{\pi}{1 + \pi}$. This implies $\pi h - p_H k < \pi l - p_L k$. Then equilibrium payoff $U_L \leq \lambda (\pi h - p_H k) + (1 - \lambda)(\pi l - p_L k) + p_L k - c < \pi l - p_L k + p_L k - c = U_L^*$. This forms a contradiction to Lemma A.3 as well, so this is not possible either. Second, by Lemma A.3, $U_H = U_H^*$, then $k = \frac{\pi}{1 + \pi}$ directly implies $F = \bar{F}(\frac{\pi}{1 + \pi} | 1) = \bar{F}(\frac{\pi}{1 + \pi} | 0) = \bar{F}(\frac{\pi}{1 + \pi} | \lambda)$.

(Sufficiency.) The existence follows from Lemma A.1 because both types obtain their first best payoffs.

Lemma A.5. In any separating equilibrium for a problem solver, type H’s equilibrium contract $(F_H, k_H)$ solves

$$\max_{F, k} U_H(F, k)$$

subject to

$$U_H(F, k) \leq U_H(\bar{F}(k|1), k)$$

$$U_L(F, k) \leq U_L^*$$

One of the two constraints has to be binding.

Also, the solution to the above-mentioned maximization problem, $(F_H, k_H)$, forms a separating equilibrium, together with type L offering the contract $(\bar{F}(k_L|0), k_L)$ for any $k_L \neq k_H$.

Proof. (Necessity.) Suppose in equilibrium type H offers $(F_H, k_H)$ such that there exists $(\tilde{F}_H, \tilde{k}_H) \neq (F_H, k_H)$ such that $U_H(\tilde{F}_H, \tilde{k}_H) > U_H(F_H, k_H)$ and

$$U_H(\tilde{F}_H, \tilde{k}_H) \leq U_H(\bar{F}(\tilde{k}_H|1), \tilde{k}_H)$$

$$U_L(\tilde{F}_H, \tilde{k}_H) \leq U_L^*$$

According to the Intuitive Criterion, if the client observes a deviation to $(\tilde{F}_H, \tilde{k}_H)$, he must believe that the deviator is type H. This is because the equilibrium payoff of type L is $U_L = U_L^*$. Then, since $U_H(\tilde{F}_H, \tilde{k}_H) \leq U_H(\bar{F}(\tilde{k}_H|1), \tilde{k}_H)$, this deviation contract will be accepted by the client. That is, the deviation is profitable for type H, which is a contradiction. Therefore, the equilibrium contract must solve the maximization problem. Since $U_H(F, k)$ is increasing in $F$, at least one of the two constraints has to be binding.\footnote{This step will change if we allow for menu contracts. We do not know that $U_L = U_L^*$. All we know so far is that $U_L \geq U_L^*$. We modify the second constraint in the maximization problem to be $U_L(F, k) \leq U_L$. Solving it gives $F_H = U_L + c$ and $k_H = 0$.}

(Sufficiency.) Take a solution from the maximization problem $(F_H, k_H)$. We claim that given any ICS off-equilibrium belief, there is no profitable deviation for type H from $(F_H, k_H)$. Suppose not, and that there is a
profitable deviation for type H: \((\hat{F}, \hat{k})\).

Case 1. The belief following the deviation contract is type-H-for-sure. Since \((\hat{F}, \hat{k})\) is accepted by the client under a belief of type-H-for-sure, this deviation contract must satisfy the first constraint. Given that it is a profitable deviation, i.e., \(U_H(\hat{F}, \hat{k}) > U_H(F_H, k_H)\), and yet \((\hat{F}, \hat{k})\) does not solve the maximization problem, it must be that it violates the second constraint, i.e., \(U_L(\hat{F}, \hat{k}) > U_L^*\), which implies that type L will also profit from such a deviation. Then, by the Intuitive Criterion, the belief at \((\hat{F}, \hat{k})\) can be set to be type-L-for-sure. That is, it is without loss of generality to ignore this case and only consider the case when the belief following a deviation is type-L-for-sure, which is described below.

Case 2. The belief following the deviation contract is type-L-for-sure. For the deviation contract to be acceptable under such a belief, \(\hat{F} \leq \mathcal{F}(\hat{k}|0)\), which implies \(U_L(\hat{F}, \hat{k}) \leq U_L^*\). That is, it satisfies the second constraint of the maximization problem. \(\hat{F} \leq \mathcal{F}(\hat{k}|0)\) also implies \(U_H(\hat{F}, \hat{k}) \leq U_H(\mathcal{F}(|0), \hat{k}) \leq U_H(\mathcal{F}(\hat{k}|1), \hat{k})\). The second inequality is because \(p_L > p_H\) implies \(\mathcal{F}(\hat{k}|0) = \pi_l - p_L \hat{k} < \pi_h - p_H \hat{k} = \mathcal{F}(\hat{k}|1)\). That is, \((\hat{F}, \hat{k})\) also satisfies the first constraint of the maximization problem. This contradicts that \((F_H, k_H)\) solves the maximization problem. Therefore, type H has no profitable deviation.

Type L has no profitable deviation by Lemma A.1.

**Lemma A.6. (The problem solver)**

(i) There exists a continuum of separating ICS equilibria with a type-L problem solver offering \(k_L > 0\) and \(F_L = \mathcal{F}(k_L|0)\) and a type-H problem solver offering \(k_H = 0\) and \(F_H = \mathcal{F}(0|0)\). In these equilibria, \(U_H = U_L = U_L^*\) and \(k_H < k_L\).

(ii) There exists a continuum of pooling ICS equilibria with both types of problem solver offering \(k = 0\) and \(F \in [\mathcal{F}(0|0), \mathcal{F}(0|\lambda)]\). In these equilibria, \(U_L = U_H \in [U_L^*, U_H^*]\).

**Proof.** Separating equilibria. This proof is just a process of looking for the solution to the maximization problem in Lemma A.5, which is type H’s equilibrium contract. If we ignore the first constraint \(U_H(F, k) \leq U_H^*\), then \(U_H\) is maximized at \(k_H = 0\), \(F_H = \mathcal{F}(0|0)\) with \(U_H = U_L^* < U_H^*\), which satisfies the first constraint. Therefore, the second constraint is binding and the optimal contract gives type H a payoff of \(U_L^*\).

Pooling equilibria. (Necessity.) Suppose in a pooling equilibrium a contract \((F, k)\) with \(k > 0\) is offered. There exists a small enough circle around \((F, k)\) in the contract space such that any contract in that circle will be accepted by the client if that contract successfully signals type H. Formally, let \((F', k') \neq (F, k)\) be a contract in the circle around \((F, k)\) such that \(U_L(F, k) = U_L(F', k')\), \(k' < k\) and \(k' > 0\). Since \(p_H < p_L\), \(U_H(F, k) < U_H(F', k')\). By continuity, there exists \(\varepsilon > 0\) such that \(U_L(F, k) > U_L(F' - \varepsilon, k')\) and \(U_H(F, k) < U_H(F' - \varepsilon, k')\). Then type H has a
profitable deviation. This contradicts that \((F, k)\) is an ICS pooling equilibrium contract. Therefore, \(k = 0\) in a pooling equilibrium.

(Sufficiency.) Consider a pooling equilibrium with any \(F \in [\mathcal{F}(0\,|\,0), \mathcal{F}(0\,|\,\lambda)]\) and \(k = 0\). The client accepts because \(F \leq \mathcal{F}(0\,|\,\lambda)\). Since the equilibrium payoffs of both types are the same and at any deviation contract the payoff of type L is weakly higher than that of type H, Intuitive Criterion does not have a bite on the off-equilibrium belief, so we can specify that the off-the-equilibrium to be type-L-for-sure for any other contract. Since \(F \geq \mathcal{F}(0\,|\,0)\), we have \(U_i \geq U^*_L\) for \(i = L, H\), so both types have no incentive to deviate.

A.2 Lemmas for Section 3

Lemma A.7. (Contingent fee cap on an enhancer) Suppose a contingent fee cap policy mandates \(k \leq k \in [0, \frac{\pi}{\pi + h}]\).

(i) There exists a continuum of separating ICS equilibria with a type-L enhancer offering \(k_L \in [0, k]\), \(F_L = \mathcal{F}(k_L\,|\,0)\) and a type-H enhancer offering \(k_H = k\), \(F_H = \mathcal{F}(k\,|\,0)\). In these equilibria, \(U_L = U^*_L, U_H < U^*_H\), and \(k_H > k_L\).

(ii) There exists a continuum of pooling ICS equilibria with both types of enhancer offering \(k = k\) and \(F \in [\mathcal{F}(k\,|\,0), \mathcal{F}(k\,|\,\lambda)]\).

In these equilibria, \(U_L > U^*_L\) and \(U_H < U^*_H\).

The proof is a straightforward modification of Lemma A.4 and thus omitted.

A.3 Lemmas for Section 4.1

Lemma A.8. (i) There exists a continuum of separating ICS equilibria with a type-L enhancer not offering a contract and a type-H enhancer offering \(k_H \in [\frac{h-c}{k+\pi}, \infty)\), \(F_H = \mathcal{F}(k_H\,|\,1)\). In these equilibria, \(U_H = U^*_H\) and \(U_L = 0\).

(ii) There does not exist any ICS pooling equilibrium.

Lemma A.9. (i) There does not exist any ICS separating equilibrium.

(ii) If \(U^*_L > 0\), there exists a continuum of pooling ICS equilibria with both types of problem solver offering \(k = 0\) and \(F \in (0, \mathcal{F}(0\,|\,\lambda)]\). In these equilibria, \(U_L = U_H \in (0, U^*_L]\). If \(U^*_L \leq 0\), there exists a unique pooling equilibrium where both types of a problem solvers do not offer a contract.

These two lemmas follow from the discussion in Section 4.1.