

Competitive Pressure in a Fixed Price Market for Credence Goods

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Abstract

We consider a market for credence goods. There are two types of experts: persons who never cheat and opportunistic experts who take advantage of the information asymmetry. The rejection strategy of the clients and the nonfraudulent behavior of the honest colleagues may prevent the cheating experts from always recommending a high price service. We compare price competition versus fixed prices. Intriguingly, the fixed price regime may perform better concerning the information problem than price competition. Therefore, a fraction of honest experts is more powerful in disciplining opportunistic experts than price competition.

Keywords: Credence Goods, Expert, Fraud, Perfect Bayesian Equilibrium.

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1 Introduction

In Europe health markets are characterized by a small degree of competition. Especially, markets for physicians' services lack competitive pressure, let alone price competition. Prices are fixed in a tariff which arises from a bargaining process between government and lobbyists. Quality competition is not very vital either, since the professions' representatives promote an overall high quality standard which, at least in some countries, is mostly met. Nevertheless, a moderate amount of *competition for clients* is present which naturally includes some kind of quality competition as well.¹ In this article, neither do we address the reason for this shortage, nor do we ask whether and how one should increase competition. We are rather interested in how this lack of price competition influences the market outcome and whether other forms of competition may mitigate the information problem.

In order to achieve this goal, we model 'weak' competition for clients in a regulated credence goods market and compare our findings with a similar set up in an unregulated market with price competition. As expected, price competition better prevents the experts from cheating than a fixed price setting without honest experts. Intriguingly, by introducing a fraction of honest experts, however, the fixed price regime is preferable in terms of handling the information problem. Accordingly, a fraction of honest experts is more powerful in disciplining opportunistic experts than intense competition. Honest experts can, therefore, mitigate the information problem even with poor competition.

We consider a two period game between sellers and consumers within a regulated market where prices are fixed. The strategic interaction between the expert and the client lasts at most two periods. The client wants an expert to solve her problem not knowing about the severity of her problem and the type of expert she is visiting. The expert sets up a diagnosis and proposes a problem solving strategy which can be a treatment or an advice. Given the expert's proposal, the consumer decides to accept or to reject it. An accepted proposal leads to the transaction, whereas in case of rejection, the client stays in the market for another period. In her second period, the consumer, bearing the switching costs, consults another expert. We restrict our analysis to one possible rejection such that a consumer wants the problem to be solved

¹In Switzerland, for instance, competition for clients is substantially restricted, because advertising is not allowed.

after two periods.² Accordingly, the client always accepts the advice in her second period expert.

We assume heterogeneity among experts: The first type of expert fully acts in the interest of his clients. The second type, however, maximizes profits regardless of the consumer demands. That is, he cheats whenever this is profitable for him. Honest experts are ‘pathologically’ honest, since they refuse to cheat even when it is possible to do so. In contrast, dishonest experts ‘potentially’ cheat, because they are sometimes honest.³ The assumption of heterogeneous experts can be justified by the current debate about physicians’ salaries. Although there is no unequivocal evidence of the existence of two types of physicians, *the minority of physicians who just want to make money* is often blamed for spoiling the reputation of the whole profession.⁴ Accordingly, the bargaining partners for the tariff assume that there are two types of experts. Furthermore, empirical evidence reveals at least strong differences between experts concerning their recommendation practice (see, e.g., Marty (1998)).

We compare our setup with Wolinsky’s (1995) who presents an analogous model with price competition. Wolinsky (1995) also considers a two period expert-customer game, however, he assumes endogenous price setting. The consumers offer prices which can be turned down by the experts. Wolinsky (1995) identifies unique and multiple equilibria depending on the search costs. In case of high search costs, the experts always reject a lower price. Consequently, all customers are served at a price equal to the marginal cost of the major problem in their first period. This unique equilibrium in pure strategies involves maximal fraud, since the consumers pay the experts as if they only had major problems. For low search costs, two types of equilibria exist. The previous equilibrium in pure strategies still occurs. As a distinction to the former case, there also exist two interior equilibria. Here, the expert mixes between accepting and rejecting a lower price offer, whereas the customer always sees another expert in case the expert rejects. This type of equilibrium is not unique, since there are two probabilities of rejecting which satisfy the equilibrium conditions. Accordingly,

²This assumption is not as severe as it looks like in the first place: the speed of convergence of the updated probability of having the minor problem is very high (see appendix).

³See Jaffe and Rusell (1976) for an analogous assumption in a credit market setting.

⁴Citation of a physicians’ representative in italics, e.g., *Tages-Anzeiger* 15/5/98. Moreover, a representative of the health insurances conjectures that about 10 % to 15 % are ‘black sheep’ (*Sonntagszeitung* 13/12/98).

Wolinsky (1995) obtains a triple equilibrium for low switching costs. He identifies a mark-up over cost embodied in the prices of the small service despite price competition. The main problem of Wolinsky's model is the multiplicity of the equilibria. Moreover, his equilibrium in pure strategies with maximal fraud is valid for the whole range of switching costs. The latter implies that this equilibrium can be sustained for each parameter constellation.

Prices are fixed in our setting. The competitive pressure arise from competition for clients. By introducing a fraction of honest experts, the profit maximizing experts can lose clients to their honest colleagues. This setup allows to overcome two weaknesses of Wolinsky's model. First, the equilibrium in pure strategies does not exist anymore for low switching costs. That is, the equilibrium in which experts always cheat and consumers always reject cannot be sustained for low switching costs. Second, our equilibria are unique, if the fraction of honest experts is large enough.

Intriguingly, the competitive pressure in a fixed price setup is not necessarily weaker than with price competition. Accordingly, the existence of honest experts may substantially strengthen the competitive pressure in the sense that the fraudulent experts cheat less frequently. Recall that the equilibrium with maximal fraud no longer exists for low switching costs. This feature is due to the heterogeneity of experts, which prevents the fraudulent experts from cheating all the time. Since the honest experts never cheat, the fraudulent experts cannot always play a tacit collusion strategy of permanent cheating. As long as changing the expert is not too expensive, it is never optimal for the clients to accept continuously, because the existence of honest experts makes it profitable to reject occasionally. Customers hope that they will end up with an honest expert in the second period. Consequently, a fixed price regime with a fraction of honest experts may be better at solving the information problem than pure price competition.

In our setup, we are also able to analyze the expert-client relationship in general and overcharging in particular. Specifically, we identify switching costs and prices as crucial variables for studying the information problem. Furthermore, we investigate the interaction between these variables, having regulated markets in mind.

The paper is organized as follows: In section 2 we present the model and its solution. Section 3 compares competition for clients versus price competition by contrasting our

results with Wolinsky's. The last section concludes. All proofs are relegated to the appendix.

2 The Model

2.1 The fixed price setup

We consider a market for a credence good. In such a market, sellers acting as experts determine the customer needs. Accordingly, customers never know *ex post* which extent of the good was needed. This holds true even if the success of the good is observable.

Time is divided into discrete periods. There is neither a beginning nor an end of time, i.e., the time goes from $-\infty$ to ∞ . At the beginning of each period a cohort of consumers enters the market. This continuum of consumers with measure 1 join the consumers left from the previous period. They have either a major or a minor problem. An exogenous fraction $w \in (0, 1)$ of each cohort suffers from a major problem whereas a fraction $(1 - w)$ has a minor one. Customers know that they have a problem but they do not know how serious it is. When their problem is solved they obtain utility of B . A treatment of the major problem also solves the minor problem but not vice versa.

The supply side of market consists of a continuum of experts with measure 1, who diagnose and repair problems. Experts belong to two groups. A fraction $g \in (0, 1)$ of experts (type g) fully act in the interest of their clients, so they will never cheat on their customers. In contrast, a fraction $(1 - g)$ of experts (type b) behave opportunistically, i.e., they may sell a major service to customers who only suffer from a minor problem. We capture this strategic decision by $x \in [0, 1]$ which denotes the probability of recommending a major service to customers who actually need a minor one. Accordingly, the goal of a type b expert is to maximize his profits regardless of the customer's needs.

Following Wolinsky (1995), we assume that the existence of a problem is both observable and verifiable, but the type of service provided by the expert is not observable to customers. That is, consumers neither know which service they need nor do they observe which treatment is actually performed. This means that payments can be conditioned on the resolution of a problem but not on the type of treatment. In addition,

it implies that an expert might be induced to misrepresent a minor service as a major one.

The minor problem can be solved with a single service, namely service L . p_L denotes the price of this service. Its marginal costs are normalized to zero so that p_L also denotes the mark-up of the minor service. In order to solve the major problem, the expert sells a set of services and earns a mark-up of $t + p_L > 0$. Accordingly, t can be interpreted as the mark-up of cheating. In the following, we call this set of services H . Naturally, experts never cheat if $t = 0$. The asymmetric information problem between client and expert therefore only arises if t is strictly positive. Due to the strong informational position of the experts, however, it is impossible for the government to assure that $t = 0$. In determine the set of services H , for instance, the expert enjoys a degree of discretionary influence to acquire additional profits.

We do not distinguish different cases concerning the observability.⁵ Fraudulent behavior may involve overtreatment or overcharging according as the services performed are observable or not. Observability makes cheating less attractive since the cheating expert has to bear higher marginal costs (c_H). As a result, fraudulent behavior is less likely. The structure of equilibria are, however, the same for both kinds of consumer information (see Marty (1999a)). For the ease of presentation, we assume that cheating does not entail additional costs to the expert. In doing so, the markup of cheating equals the price differential of the two services.⁶ Furthermore, we assume that the mark-up for the diagnosis is zero to exclude diagnosis from strategic considerations (see Emons (1997, 1999) for the interaction of diagnosis and repair).

We consider a two period game concerning the strategic interaction between expert and client. In the first period, a customer visits an expert who is either of type g or of type b . The customers have the possibility to reject a service. They never reject an L -service because this is the cheapest way to obtain utility B . Since the customers do not know the type of expert, they randomly reject a high service offer in period 1 with probability $y \in [0, 1]$. In case of rejection, they visit another expert which leads to switching costs of k for the consumers. Although they still do not know their own

⁵See Marty (1999a) for the different efficiency properties of observable and nonobservable services, respectively.

⁶This requires that the services are not observable or $c_H = c_L = 0$. Otherwise, the consumer has to pay $p_L + t + c_H$ for service H , not just $p_L + t$ as it is assumed in the following.

type of problem, they always follow the advice of an expert in the second period, since the game ends for the customers in the second period and we assume $B > k + p_H$. The latter assures that the consumer maximizes her utility by accepting in the second period. The assumption of the game ending after two periods prevents the customer from rejecting twice hoping to receive an L -advice in the third period. Alternatively, a two period game can be modeled by presuming that the switching costs k for a third opinion are large enough.⁷

Contrary to Marty (1999a), we assume that the expert cannot recognize a second period customer, so he has to form beliefs about the clients' 'age'.

The time structure of the model is summarized as follows:

- $t = 0$: the consumer identifies a problem not knowing if it is a minor or a major one, and sees an expert
- $t = 1.1$: the expert proposes either a minor or a major treatment.
- $t = 1.2$: the consumer decides whether to accept the advice or to see another expert.
- $t = 2.1$: in case of rejection, the second opinion expert proposes a treatment.
- $t = 2.2$: the consumer accepts.

The remainder of this section is organized as follows. In the first subsection, we outline the strategy space. The second subsection presents the equilibrium analysis. We first compute the perfect Bayesian equilibrium in mixed strategies, followed by the perfect Bayesian equilibrium in pure strategies. The section concludes with the benchmark case of only dishonest experts (type b).

2.2 Strategies

The experts have the strategies \tilde{H}/H , \tilde{L}/H , \tilde{L}/L , and \tilde{H}/L in both periods. The strategy \tilde{L}/H is to be read as follows: recommend service L to a customer who actually needs the service H . \tilde{L}/H is never chosen, because the problem is both observable and verifiable. Accordingly, all experts recommend a major service to a customer who has a major problem (strategy \tilde{H}/H). In addition, an expert of type g always chooses

⁷Customers compare the switching costs with the benefit from rejecting. This benefit, however, becomes smaller for each new period since the probability of having a minor problem given a major advice converges to zero as long as there are honest experts in the market. Accordingly, restricting the analysis to two period presupposes that this convergence is fast enough. See the appendix for comparative statics on this convergence.

\tilde{L}/L by assumption, i.e., she recommends a minor service to a customer with an L problem in both periods. A type b expert, on the contrary, chooses with probability x the strategy \tilde{H}/L , i.e., he tries to sell with probability x a major service to a customer with an L problem, since the mark-up for the service H is higher than for the L -service. As mentioned earlier, customers always accept a minor service recommendation since it is the cheapest way to solve their problem. In the first period, a major service is rejected with probability y . The incentive to reject an H -service in the first period is the prospect of getting an L -service recommendation in the second period. That is, some consumers are unlucky enough to end up with a type b expert who plays the strategy \tilde{H}/L paying for the expensive service.

We consider the perfect Bayesian equilibria of this game.⁸ Type b experts maximize their profits and the clients maximize utility, given all information available to them. Specifically, the players update information by applying Bayes' Rule and act optimally given their beliefs. Type g experts propose to solve the correct problem irrespectively of their profits.

2.3 Equilibrium analysis

2.3.1 Perfect Bayesian equilibrium in mixed strategies

We first consider the mixed strategy equilibrium of this game. In the first period, the customers reject a major service with probability y in order to set a type b expert indifferent between cheating and telling the truth when facing a client with a minor problem.

$$[1 - y (1 - b_c)] (p_L + t) = p_L \quad (1)$$

The profit of type b experts telling the truth is p_L . By cheating, an expert may obtain $p_L + t$. t is the additional mark-up which is earned for performing the major service. The profit of the expert, however, depends on the rejecting strategy (y) of his client. b_c is the type b experts' belief about the fraction of consumers who are in the second period and accept for sure. This belief is borne out in the equilibrium, i.e., $b_c = [(1 - g) x^* y^*] / [1 + (1 - g) x^* y^*]$. The value of b_c is obtained by considering the

⁸For a formal description of this equilibrium concept see Fudenberg and Tirole (1991) p.325

consumers with the minor problem. The fraction $(1 - g)x^*y^*$ of the consumers who start the same period ends up in the second period. Another cohort of consumers joins these second period consumers building together the consumer population that is in the market. Therefore, a fraction of b_c of the consumers is in their second period. According to equation (1), the customer randomizes over rejecting (y) and accepting $(1 - y)$ with

$$y^* = \frac{t}{p_L + t(1 - (1 - g)x^*)} \quad (2)$$

The type b expert chooses to propose the wrong service to a client who needs a minor problem with probability x such that the customer is indifferent between accepting and rejecting.

$$k = (g + (1 - g)(1 - x)) \cdot \text{prob}(L|\tilde{H}) t \quad (3)$$

where

$$\text{prob}(L|\tilde{H}) = \frac{(1 - w)(1 - g)x^*}{(1 - w)(1 - g)x^* + w} \quad (4)$$

Accordingly, the left hand side of (3) represents the cost of rejecting a service, whereas the right hand side denotes its benefit. $\text{prob}(L|\tilde{H})$ is the probability of suffering from a minor problem despite receiving an H -advice in the first period. $(g + (1 - g)(1 - x))$ is the probability for receiving an honest recommendation.

When the customer always accepts the recommendation of the expert then she takes the risk to be cheated in the first period. She avoids, however, the switching costs k and the risk of obtaining an H -advice again in the second period despite having already rejected it in the first period. The latter is happening either because she ends up with a type b expert who cheats or because she actually has a major problem. A customer who always rejects the advice in the first period has to incur switching costs but is cheated less frequently, since there exists a chance of meeting an honest expert in the second period.

It follows from (3) that the type b expert randomizes between cheating (x) and telling the truth $(1 - x)$ according to

$$x_{1,2}^* = \begin{cases} (t - k)/[2t(1 - g)] + \sqrt{A}/[2t(1 - g)(1 - w)] \\ (t - k)/[2t(1 - g)] - \sqrt{A}/[2t(1 - g)(1 - w)] \end{cases}, \quad (5)$$

where $A = (1 - w) [(t - k)^2 - w(t + k)^2]$.

The two probabilities $y^* \in [0, 1]^9$ and $x^* \in [0, 1]$ constitute a perfect Bayesian equilibrium in mixed strategies when at least one probability is strictly lower than 1. In order to establish a mixed equilibrium, A has to be positive, i.e., $k < [t(1 + w - 2\sqrt{w})]/(1 - w) = \bar{k}_1$ or $k > [t(1 + w + 2\sqrt{w})]/(1 - w) = \bar{k}_2$. For $k > \bar{k}_2$ the optimal mixing probability of x would be negative. Accordingly, only the first inequality is a candidate for a perfect Bayesian equilibrium in mixed strategies. It depends on the parameter constellation whether an equilibrium exists and whether it is unique or not. We can distinguish two cases depending on $k_1 \lesseqgtr (2g - 1)t$. In the first case, $k_1 < (2g - 1)t$, we obtain a unique equilibrium in mixed strategies for $k < [g(1 - g)(1 - w)t]/(1 - g + wg) = \hat{k}$. In the second case, $k_1 > (2g - 1)t$, the whole range of $k < \bar{k}_1$ involves Bayesian equilibria. They are, however, unique only for $k < \hat{k}$.

Proposition 1 *There exists a unique perfect Bayesian equilibrium in mixed strategies for*

$$k < \frac{g(1 - g)(1 - w)t}{(1 - g + wg)} = \hat{k}. \quad (6)$$

The type b experts choose strategy \tilde{H}/L with probability x_2^ and the clients reject an H -advice in the first period with probability y_2^* .¹⁰*

We observe a positive amount of fraud in the mixed strategy Nash equilibrium. Due to the switching costs $k > 0$ the equilibrium is inefficient.

2.3.2 Perfect Bayesian equilibrium in pure strategies

We only consider equilibria for $k > 0$. As long as $k < \bar{k}_1$, all equilibria involve mixed strategies. In contrast, equilibria in pure strategies arise for $k > \hat{k}$. For the special case $\hat{k} < k < \bar{k}_1$, it depends on whether $k \lesseqgtr (2g - 1)t$. A triple equilibria is obtained for

⁹ $y_{1,2}^* = [2(1 - w)t]/[(1 - w)(2p_L + t + k) \mp \sqrt{A}]$.

¹⁰See the appendix for the case $k = \hat{k}$.

$k > (2g - 1)t$ whereas a unique equilibrium in pure strategy arises for $k < (2g - 1)t$. In all equilibria in pure strategies, the type b experts always recommend the major service ($x_p = 1$) and all clients always accept this recommendation ($y_p = 0$). The switching cost k are then too high in order to prevent fraudulent behavior.

Proposition 2 *For $(2g - 1)t < \hat{k} < k \leq \bar{k}_1$, a triple equilibrium exists. The type b experts choose strategy \tilde{H}/L with probability x_1^* , x_2^* , or x_p^* , and the clients reject an H -advice in the first period accordingly ($y_{1,2,p}^*$).*

-insert figure 1 and 2 about here-

Figures 1 and 2 present the equilibria by displaying the optimal mixing strategy of the type b expert. In figure 1, we see the optimal mixing probability of the fraudulent expert as a function of the switching costs. The equilibrium is unique, because $\bar{k}_1 < (2g - 1)t$ or $g > (1 - \sqrt{w})/(1 - w)$. In figure 2, we obtain a correspondence between the mixing probability and the switching costs, since the equilibrium is not always unique.

2.3.3 Perfect Bayesian equilibrium with only type b experts

In order to build the benchmark case, let us consider the situation with profit maximizing experts only. We can see from inequality (6) that the equilibria in mixed strategies are no longer unique since $\hat{k} = 0$ for $g = 0$. We obtain a triple equilibrium for $g = 0$ and $k < \bar{k}_1$. Two equilibria are in mixed strategies, and one equilibrium is in pure strategies. In the equilibrium in pure strategies, type b experts always recommend a major service which the clients accept in the first period. The reason for this finding is a kind of collusion among the experts which makes the search for a second opinion useless. The profit maximizing experts do not fear losing clients to the type g 's. As a result, the clients have no longer any incentive to reject as long as the experts are always cheating. This contrasts with the case of a positive fraction of type g experts. Here, for $k < \hat{k}$, the customers sometimes reject although the type b experts always cheat.

-insert figure 3 about here-

In figure 3, the mixing probability of the experts in equilibrium is a correspondence of the switching costs. For $k < \bar{k}_1$, we identify a triple equilibrium.

3 Comparison with price competition

In order to compare our findings with Wolinsky's, we set $t = p_H - p_L$. In Wolinsky's setup, there is a single service H with price p_H . The markup of cheating with this service is $p_H - p_L$, due to the assumed nonobservability of the service performed. This allows overcharging. In Wolinsky's model, only profit maximizing experts, who behave opportunistically, are in the market. They face price competition since prices are endogenously determined. Wolinsky obtains similar results like those presented in figure 3. He also finds equilibria in pure and in mixed strategies, respectively. Furthermore, the pure strategy equilibrium arises for the whole range of switching costs like in our case without honest experts. For low and medium values of the switching costs, Wolinsky also obtains equilibria in mixed strategies. In contrast to our findings, the mixing strategy of the clients is always trivial with price competition, because the clients constantly reject a major service. The experts, on the other hand, are mixing between cheating and telling the truth with a probability strictly between zero and one. Nevertheless, Wolinsky identifies a triple equilibrium as well, since there exists two different, optimal mixing probabilities for the experts.

Like Wolinsky, we observe that the clients fully suffer from the information asymmetry for high switching costs. In this case, no kind of competition can prevent the opportunistic experts from always recommending the high price service. Furthermore, we identify equilibria in mixed strategies for low values of k too. The cut-off value of k , however, is lower in our setup. Accordingly, the lack of price competition excludes the equilibria in mixed strategies for medium values of k .

-insert figure 4 about here-

Figure 4 shows that the switching costs can be higher with price competition than with fixed prices in order to achieve an equilibrium in mixed strategies. For switching

costs higher than \bar{k}_1 , only unique equilibria in pure strategies arise. \bar{k}_p indicates the analogous threshold for price competition. The difference between the two cutoff values with and without price competition depends on the ex ante probability of suffering from a major problem.¹¹ Therefore, price competition is necessary in order to achieve the equilibria in mixed strategies in the sickle-shaped area between the two curves \bar{k}_1 and \bar{k}_p .

The second difference between the two types of competition concerns the behavior of the clients in the equilibrium in mixed strategies. Exogenous price setting may reduce the number of rejections. The sufficient condition $p_L > (1 - g)t$ ensures that the clients reject with probability less than one. Remember, that the clients reject each major service recommendation with endogenous prices. Since the switching costs are the only cause of inefficiency in a setup with overcharging, a lower rejection rate results in a more efficient outcome. Accordingly, a fixed price setting may be more efficient than price competition in this respect.

By introducing honest experts, the equilibrium in pure strategies no longer exists for low values of k . That is, the ‘collusion strategy’ of the opportunistic experts does not work anymore. Moreover, we obtain a unique equilibrium for a wide range of parameter constellations. The only exception is a parameter environment such that $(2g - 1)t < \hat{k} < k < \bar{k}_1$, where we observe a triple solution as if honest experts were not present.

-insert figure 5 and 6 about here-

In figure 5, we display \hat{k} , \bar{k}_1 and \bar{k}_p as functions of the fraction of type g experts. We reverse the usual order of the axis in order to compare this graph with figures 1 to 3. \bar{k}_1 and \bar{k}_p are constant functions of the fraction of type g experts, whereas \hat{k} is a nonmonotonic function of it. Recall that \hat{k} indicates the threshold value for which a rejection is profitable for the clients, although all type g experts are constantly cheating. That is, switching costs lower than \hat{k} make sure that the ‘collusion’ equilibrium cannot be sustained anymore. There is a value g^* such that \hat{k} is maximized.¹² This value

¹¹This gap is maximized for $w = 0.13$. The maximum is $0.3t$.

¹² $g^* = \frac{1-\sqrt{w}}{1-w}$. Notice that $\lim_{w \rightarrow 0} [g^*] = 0.5$.

of g is most powerful in disciplining the opportunistic experts. For values lower than g^* , every increase in the fraction of type g experts reduces the area for which the equilibrium with the maximum amount of fraud exists. We call this effect the direct effect: collusion is less possible the more honest experts are in the market. For values above g^* , however, the reverse holds true: a unique equilibrium in mixed strategies becomes less likely whereas the equilibrium with the maximum amount of fraud is more likely. We call this effect the indirect effect: collusion becomes easier the more honest experts are in the market. That is, cheating experts can exploit the fact that they are a minority compared to the honest experts. Note that the maximum amount of fraud is always defined relative to the fraction of type g experts. Naturally, an increase in g never increases the total amount of fraud since a type g expert can be replaced by a constantly cheating expert at most. This, however, cannot increase the absolute amount of fraud.

Additionally, \hat{k} defines the threshold for unique equilibria in mixed strategies. Switching costs higher than \hat{k} give rise to a unique equilibrium in pure strategies whereas switching costs between \hat{k} and \bar{k}_1 may cause multiple equilibria. We obtain a unique equilibrium if the fraction of type g experts is higher than g^* , i.e., when the indirect effect dominates. Otherwise, a triple equilibrium will arise in this interval.

Figure 6 analyses the threshold value g^* which is dependent on the ex ante probability w of the major problem. The lower w , the larger g^* which indicates that the direct effect becomes more important the smaller the fraction of customer suffering from a major service is. Accordingly, a major service recommendation is a stronger signal for being with an opportunistic expert when the major problem is not likely. The value g^* cannot be lower than 0.5 since the indirect effect may only predominate when the type b experts are the minority.

4 Discussion

By setting prices exogenously it is possible to reproduce the outcome of price competition among experts. For a medium size of the switching costs, however, price competition is better at solving the information problem. For low values of the switching costs, on the other hand, a fraction of ‘pathologically’ honest experts are more

efficient in solving the credence good problem than price competition. This is our main finding: a fraction of honest experts may create competitive pressure in credence good markets that even price competition is not able to generate.

Concerning the equilibria, the results with honest experts are more appealing in terms of uniqueness and behavior of the clients. Recall, that the equilibrium in pure strategies, which features the maximum amount of fraud, no longer exists for low switching costs. In addition, the clients do not always reject a major service advice which is more efficient.

It must be said that the nice results for the fixed price setup presupposes optimal price setting. Optimal price setting, however, needs a lot of information on the technology that is difficult to obtain. This additional information problem is not analyzed in our model. Price competition reveals information about the cost structure. Therefore, price competition would perform better if the whole information problem was considered.

By providing adequate incentives, experts behave honestly. In health markets, for instance, physicians working for an HMO face proper incentives. Accordingly, the fraction of honest experts could be increased when policy succeeds in promoting HMOs.

Collecting a second opinion is a driving force behind disciplining opportunistic experts. This holds true for all types of competition. Accordingly, an important tool for weakening the credence goods problem is to lower the switching costs. In practice, some health insurance companies provide second opinion diagnoses for free for certain operations which makes sense in view of our analysis.

5 Conclusion

The aim of this paper is to show how the type of competition influences the market outcome in credence goods markets. Intriguingly, competition for clients within a fixed price setup does not necessarily perform worse with respect to the information problem than price competition. Moreover, a fraction of honest experts in the market are much more powerful in disciplining opportunistic experts than intense competition. That is, for low switching costs, the equilibrium with a maximum amount of fraud does not exist anymore. Accordingly, a fraction of honest experts creates competitive pressure that even price competition is not able to generate.

Our model with two types of experts is characterized by a unique equilibrium for most parameter constellations. This feature is frequently missing in other credence goods models. Therefore, it improves some of them substantially. Specifically, we are able to restrict the ‘trivial’ equilibrium in which all opportunistic experts cheat and all clients accept to a plausible range of parameter constellations.

6 Appendix

Proposition 1 and 2

$$x_{1,2}^* = \begin{cases} \frac{(t-k)}{2t(1-g)} + \frac{\sqrt{A}}{2t(1-g)(1-w)} \\ \frac{(t-k)}{2t(1-g)} - \frac{\sqrt{A}}{2t(1-g)(1-w)} \end{cases} \quad y_{1,2}^* = \begin{cases} \frac{2(1-w)t}{(1-w)(2p_L+t+k)-\sqrt{A}} \\ \frac{2(1-w)t}{(1-w)(2p_L+t+k)+\sqrt{A}} \end{cases}$$

For establishing an equilibrium in mixed strategies $x_i \in (0, 1)$ and $y_i \in (0, 1)$, $i = 1, 2$.¹³

In order to avoid complex solutions, we need $A = (1-w)[(t-k)^2 - w(t+k)^2] \geq 0$.

That is, $k \leq \frac{t(1+w-2\sqrt{w})}{(1-w)} = \bar{k}_1$ or $k \geq \frac{t(1+w+2\sqrt{w})}{(1-w)} = \bar{k}_2$.

The second inequality implies a negative x^* , since

1) if $k > \bar{k}_2$ then $k > t$,

because $\frac{(1+w+2\sqrt{w})}{(1-w)} > 1 \Leftrightarrow 1+w+2\sqrt{w} > 1-w \Leftrightarrow 2\sqrt{w} > -2w$

2) a) if $k > t$ then $x_1^* < 0$,

because $(1-w)(k-t) > \sqrt{A} \Rightarrow \sqrt{(1-w)^2(k-t)^2} > \sqrt{(1-w)[(t-k)^2 - w(t+k)^2]}$
 $\Rightarrow (1-w)^2(k-t)^2 > (1-w)[(t-k)^2 - w(t+k)^2] \Rightarrow 4wkt(w-1) < 0$.

b) if $k > t$ then $x_2^* < 0$, because $t-k-\sqrt{A} < 0$.

Therefore, only the first inequality matters.

Here, x^* is always positive, since

1) if $k < \bar{k}_1$ then $k < t$, because $\frac{(1+w-2\sqrt{w})}{(1-w)} < 1 \Leftrightarrow 1+w-2\sqrt{w} < 1-w \Leftrightarrow 2w < 2\sqrt{w}$

2) $\frac{\partial x_1^*}{\partial k} = \frac{-(t-k+wt+wk)-\sqrt{A}}{2(1-g)t\sqrt{A}} < 0$ and $\frac{\partial x_2^*}{\partial k} = \frac{t-k+wt+wk-\sqrt{A}}{2(1-g)t\sqrt{A}} > 0$

3) $x_1^*(k=0) = \frac{1}{1-g} > 0$, and $x_2^*(k=0) = 0$

4) $x_1^*(k=\bar{k}_1) = x_2^*(k=\bar{k}_1) = \frac{\sqrt{w}-w}{(1-g)(1-w)} > 0$.

But sometimes, x^* is greater than 1:

1) $x_1^* < 1 \Rightarrow \frac{(t-k)(1-w)+\sqrt{A}}{2t(1-g)(1-w)} < 1$.

¹³We neglect boundary cases like for example $x_1 = 0$ and $y_1 \in (0, 1)$.

1.case: $k < (2g - 1)t = \tilde{k}$, then $x_1^* > 1$ for all parameters.

2.case: $k > (2g - 1)t = \tilde{k}$, then $x_1^* < 1$ if $k > \frac{g(1-g)(1-w)t}{(1-g+wg)} = \hat{k}$

2) $x_2^* < 1 \Rightarrow \frac{(t-k)(1-w)-\sqrt{A}}{2t(1-g)(1-w)} < 1$.

1. case: $k < (2g - 1)t = \tilde{k}$, then $x_2^* < 1$ if $k < \frac{g(1-g)(1-w)t}{(1-g+wg)} = \hat{k}$

2. case: $k > (2g - 1)t = \tilde{k}$, then $x_2^* < 1$ for all parameters.

It remains to show that $\bar{k}_1 = \frac{t(1+w-2\sqrt{w})}{(1-w)} > \hat{k} = \frac{tg(1-g)(1-w)}{(1-g+wg)}$

Therefore, we maximize \hat{k} subject to g :

$$\text{FOC: } \frac{(1-w)(1-2g+g^2-wg^2)}{(1-g+wg)^2} = 0 \Rightarrow g^* = \frac{1-\sqrt{w}}{1-w}$$

$$\text{SOC: } \frac{-2(1-w)w}{(1-g+wg)^3} < 0.$$

We obtain $\hat{k}(g^*) = \frac{(1+w-2\sqrt{w})}{(1-w)}$. That is, the maximized value of \hat{k} subject to g is \bar{k}_1 .

Furthermore, $\tilde{k}(g^*) = \frac{(1+w-2\sqrt{w})}{(1-w)}$. $\tilde{k}(g^* - \varepsilon) < \hat{k}$ and $\tilde{k}(g^* + \varepsilon) > \bar{k}_1$,

since $\frac{\partial \hat{k}}{\partial g} < \frac{\partial \tilde{k}}{\partial g} \iff \frac{(1-w)(1-2g+g^2-wg^2)}{(1-g+wg)^2}t < 2t \iff w(1+2g-2g^2+wg^2) + (1-g)^2 > 0$

As a result, \tilde{k} never lies between \bar{k}_1 and \hat{k} .

Accordingly, if $\tilde{k} < \bar{k}_1$,

we obtain an $x_1^* \in (0, 1)$ for $\hat{k} < k < \bar{k}_1$, and an $x_2^* \in (0, 1)$ for $0 < k < \bar{k}_1$.

In contrast, if $\tilde{k} > \bar{k}_1$,

$x_1^* \notin (0, 1)$, whereas $x_2^* \in (0, 1)$ for $k < \hat{k} (< \bar{k}_1)$.

Concluding, we obtain a unique solution for $k < \hat{k}$ and we obtain a double solution if $\tilde{k} < \bar{k}_1$ and $\hat{k} < k \leq \bar{k}_1$. For $\hat{k} < k = \bar{k}_1$, the double solution coincide.

Now, we show that if $\tilde{k} < \bar{k}_1$, then $g < \frac{1-\sqrt{w}}{1-w}$:

$$\tilde{k} = (2g - 1)t < \frac{t(1+w-2\sqrt{w})}{(1-w)} = \bar{k}_1 \Rightarrow (1-w)(2g-1) < (1+w-2\sqrt{w})$$

$$\Rightarrow 2g(1-w) < 2 - 2\sqrt{w} \Rightarrow g < \frac{1-\sqrt{w}}{1-w}.$$

Special case $k = \hat{k}$

Proposition 3 For $k = \frac{g(1-g)(1-w)}{(1-g+wg)} = \widehat{k}$, we distinguish two cases:

As long as (i) $\bar{k}_1 < (2g - 1)t$ and $p_L > (1 - g)t$ or (ii) $\bar{k}_1 > (2g - 1)t$ and $p_L \leq (1 - g)t$, a perfect Bayesian equilibrium in mixed strategies and one in pure strategies exist.

As long as $\bar{k}_1 > (2g - 1)t$ and $p_L > (1 - g)t$, two different perfect Bayesian equilibria in mixed strategies exist.

For $\bar{k}_1 < (2g - 1)t$ and $p_L \leq (1 - g)t$, a unique perfect Bayesian equilibrium in pure strategies is observed.

Notice that $y^*(x^* = 1) = \frac{t}{p_L + gt}$.

We distinguish two cases:

(i) $\bar{k}_1 < (2g - 1)t$

$x_1 \notin (0, 1)$ but $x_2 = 1$ with $y_2 \in (0, 1) \Leftrightarrow p_L > (1 - g)t$

(ii) $\bar{k}_1 > (2g - 1)t$

$x_2 \in (0, 1)$ and $x_1 = 1$ with $y_1 \in (0, 1) \Leftrightarrow p_L > (1 - g)t$

$x_2 \in (0, 1)$ but $x_1 = 1$ with $y_1 \notin (0, 1) \Leftrightarrow p_L \leq (1 - g)t$

Case with only profit maximizing experts ($g = 0$)

$$x_{1,2}^* = \begin{cases} \frac{(t-k)}{2t} + \frac{\sqrt{A}}{2t(1-w)} \\ \frac{(t-k)}{2t} - \frac{\sqrt{A}}{2t(1-w)} \end{cases} \quad y_{1,2}^* = \begin{cases} \frac{2(1-w)t}{(1-w)(2p_L+t+k)-\sqrt{A}} \\ \frac{2(1-w)t}{(1-w)(2p_L+t+k)+\sqrt{A}} \end{cases}$$

In order to establish an equilibrium $A = (1 - w)[(t - k)^2 - w(t + k)^2] \geq 0$

That is, $k \leq \frac{t(1+w-2\sqrt{w})}{(1-w)} = \bar{k}_1$ or $k \geq \frac{t(1+w+2\sqrt{w})}{(1-w)} = \bar{k}_2$.

The second inequality implies a negative x^* . Proof analogous to the case $g > 0$.

Therefore, only the first inequality matters.

Here, $x_{1,2}^* \in (0, 1)$, because

1) if $k < \bar{k}_1$ then $k < t$, because $\frac{(1+w-2\sqrt{w})}{(1-w)} < 1 \Leftrightarrow 1+w-2\sqrt{w} < 1-w \Leftrightarrow 2w < 2\sqrt{w}$

2) $\frac{\partial x_1^*}{\partial k} = \frac{-(t-k+wt+wk)-\sqrt{A}}{2t\sqrt{A}} < 0$ and $\frac{\partial x_2^*}{\partial k} = \frac{t-k+wt+wk-\sqrt{A}}{2t\sqrt{A}} > 0$

3) $x_1^*(k=0) = 1 > 0$, and $x_2^*(k=0) = 0$

4) $x_1^*(k=\bar{k}_1) = x_2^*(k=\bar{k}_1) = \frac{\sqrt{w-w}}{(1-w)} \in (0,1)$.

Comparative statics on the convergence of $\text{prob}[L/\tilde{H}]$

$\text{prob}[L/\tilde{H}]$ after one rejection: $\text{prob}[L/1\tilde{H}] = \frac{(1-w)(1-g)x^*}{(1-w)(1-g)x^*+w}$

$\text{prob}[L/\tilde{H}]$ after two rejections: $\text{prob}[L/2\tilde{H}] = \frac{(1-w)(1-g)^2(x^*)^2}{(x^*)^2[1-2g+g^2-w+2wg-wg^2]+w}$

$\text{prob}[L/\tilde{H}]$ after three rejections: $\text{prob}[L/3\tilde{H}] = \frac{-(1-w)(1-g)^3(x^*)^3}{(x^*)^3[1-3g+3g^2-g^3-w+3wg-3wg^2+wg^3]+w}$

$\partial \text{prob}[L/3\tilde{H}] / \partial g < 0$, i.e., the convergence is faster, the more type g experts are in the market.

$\partial \text{prob}[L/3\tilde{H}] / \partial w < 0$, i.e., the convergence is faster, the higher the probability for a major problem.

$\partial \text{prob}[L/3\tilde{H}] / \partial x^* > 0$, i.e., the convergence is faster, the smaller the probability of cheating.

Numeric example:

$1-w = \text{prob}[L]$	g	x^*	$\text{prob}[L/\tilde{H}]$	$\text{prob}[L/2\tilde{H}]$	$\text{prob}[L/3\tilde{H}]$
0.9	0.9	0.8	0.418	0.054	0.005
0.9	0.9	0.6	0.351	0.031	0.002
0.9	0.7	0.8	0.684	0.341	0.111
0.95	0.9	0.8	0.601	0.108	0.010

Since the twice updated probability (of having the minor problem) is very low, the assumption that the game ends after two period is not severe.

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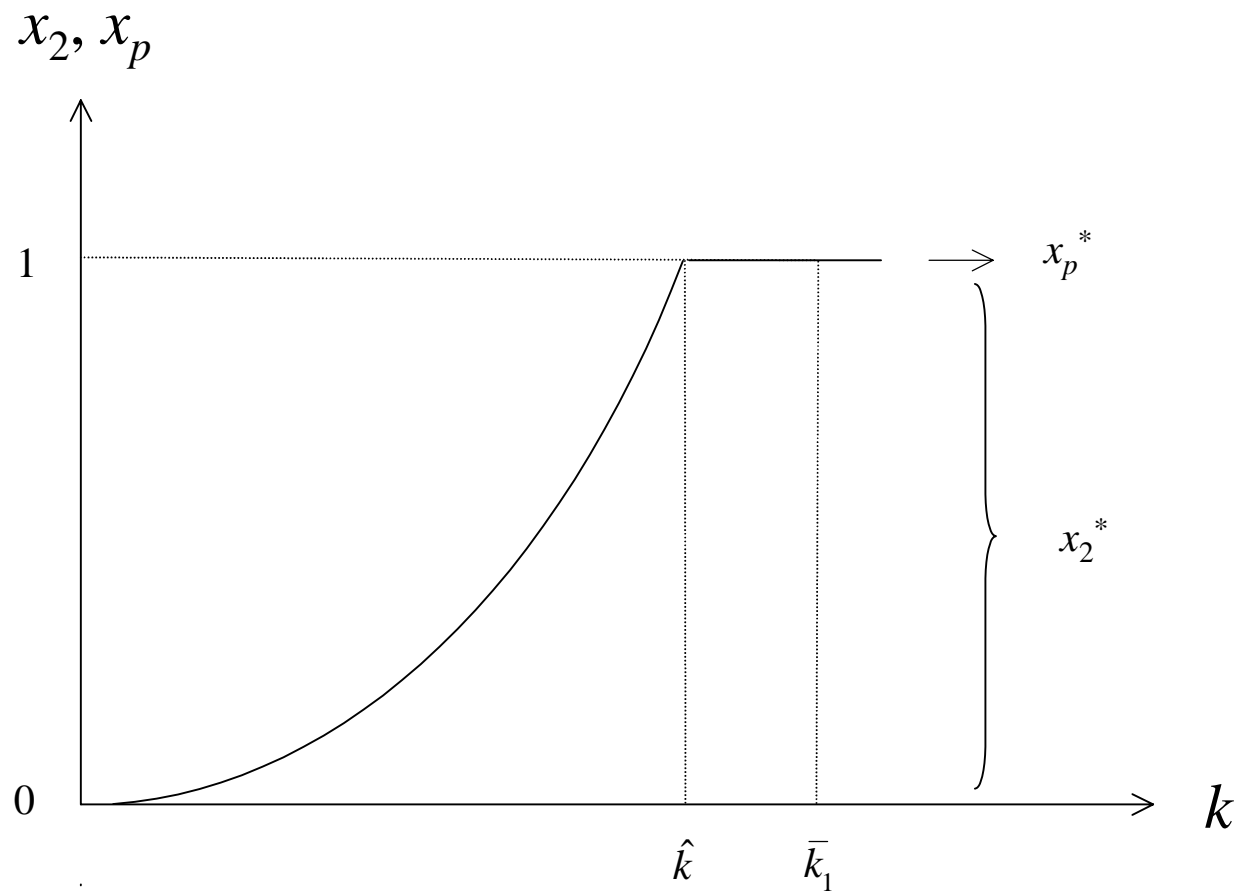


Figure 1: unique equilibrium for $\bar{k}_1 < (2g - 1)t$

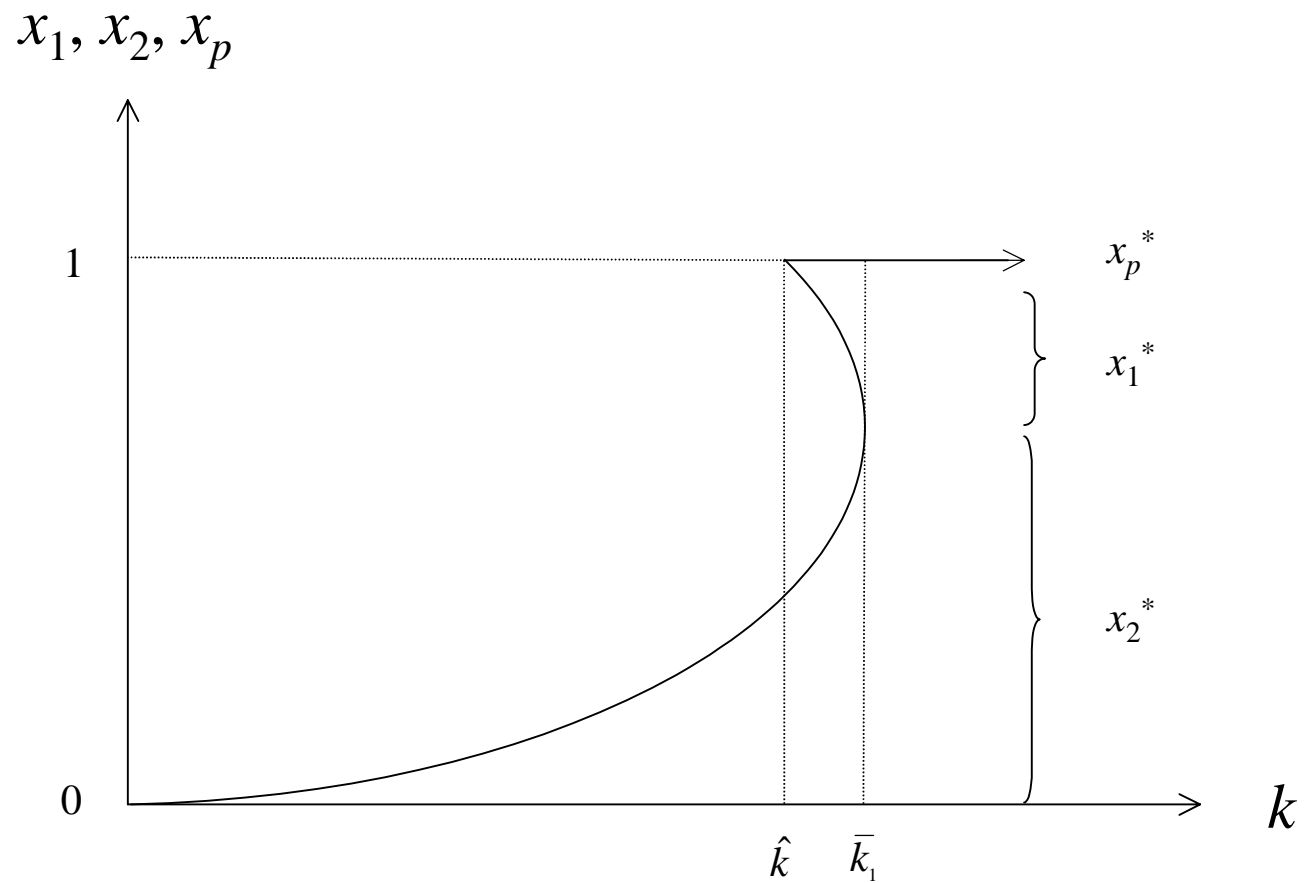


Figure 2: unique, double or triple equilibrium for $\bar{k}_1 > (2g - 1)t$

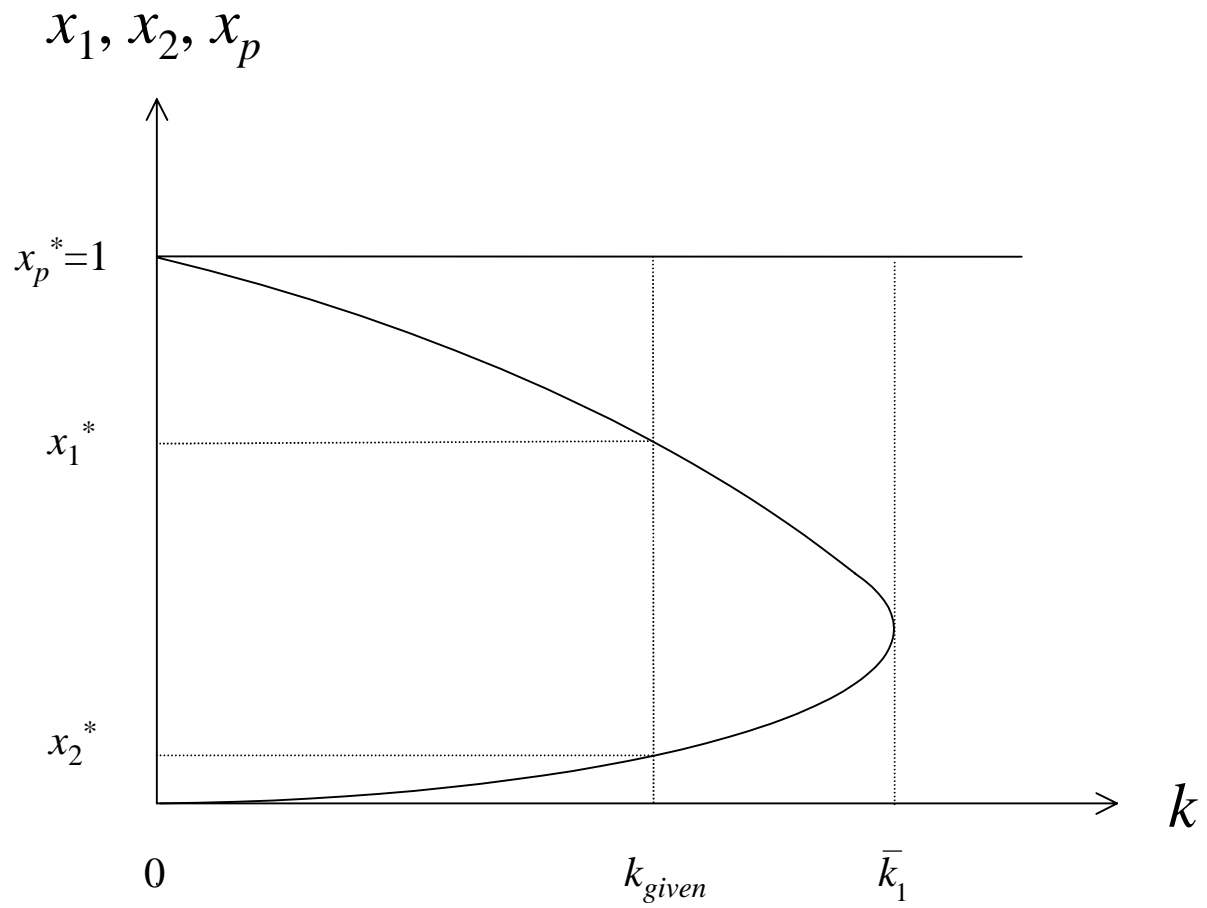


Figure 3: triple equilibrium for $g=0$ and $k < \bar{k}_1$

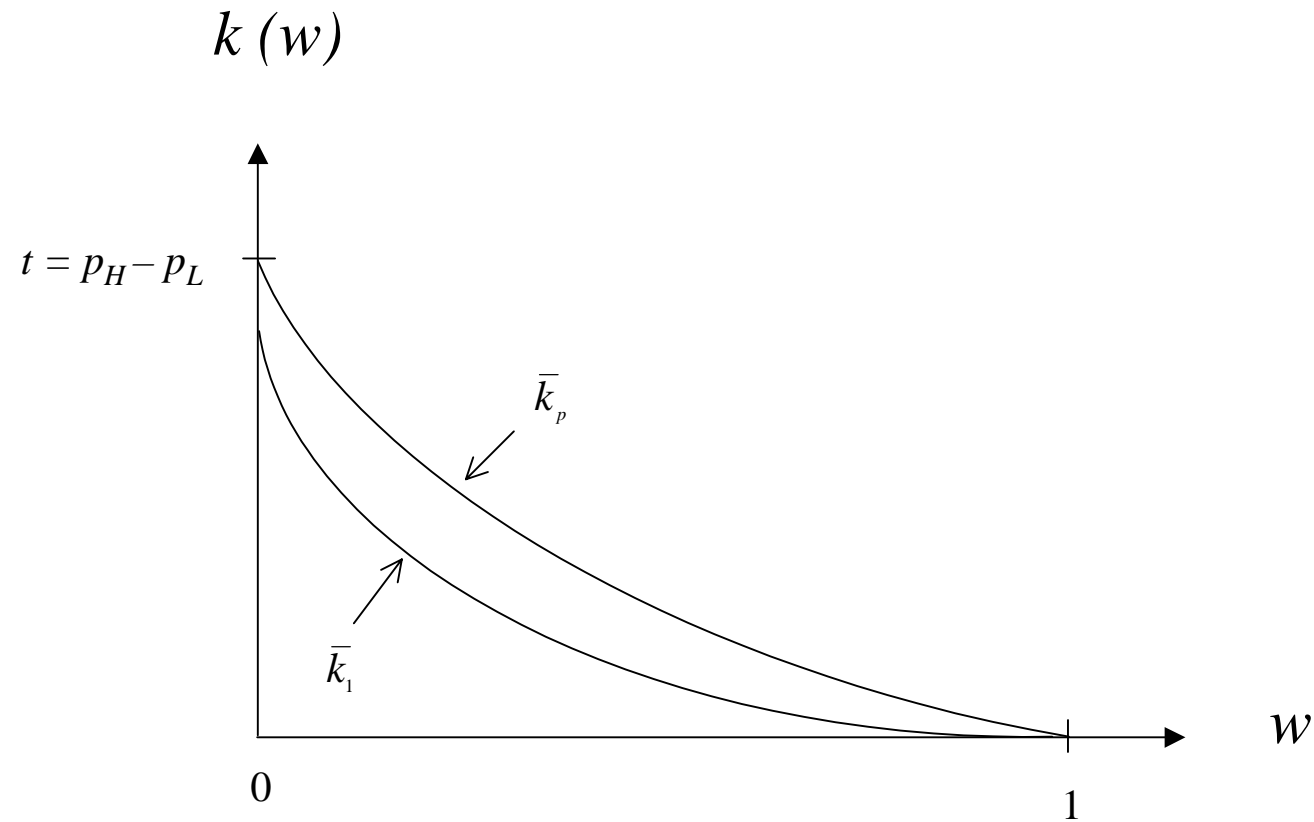


Figure 4: cut-off value of the switching costs as a function of the fraction of clients suffering from a major problem

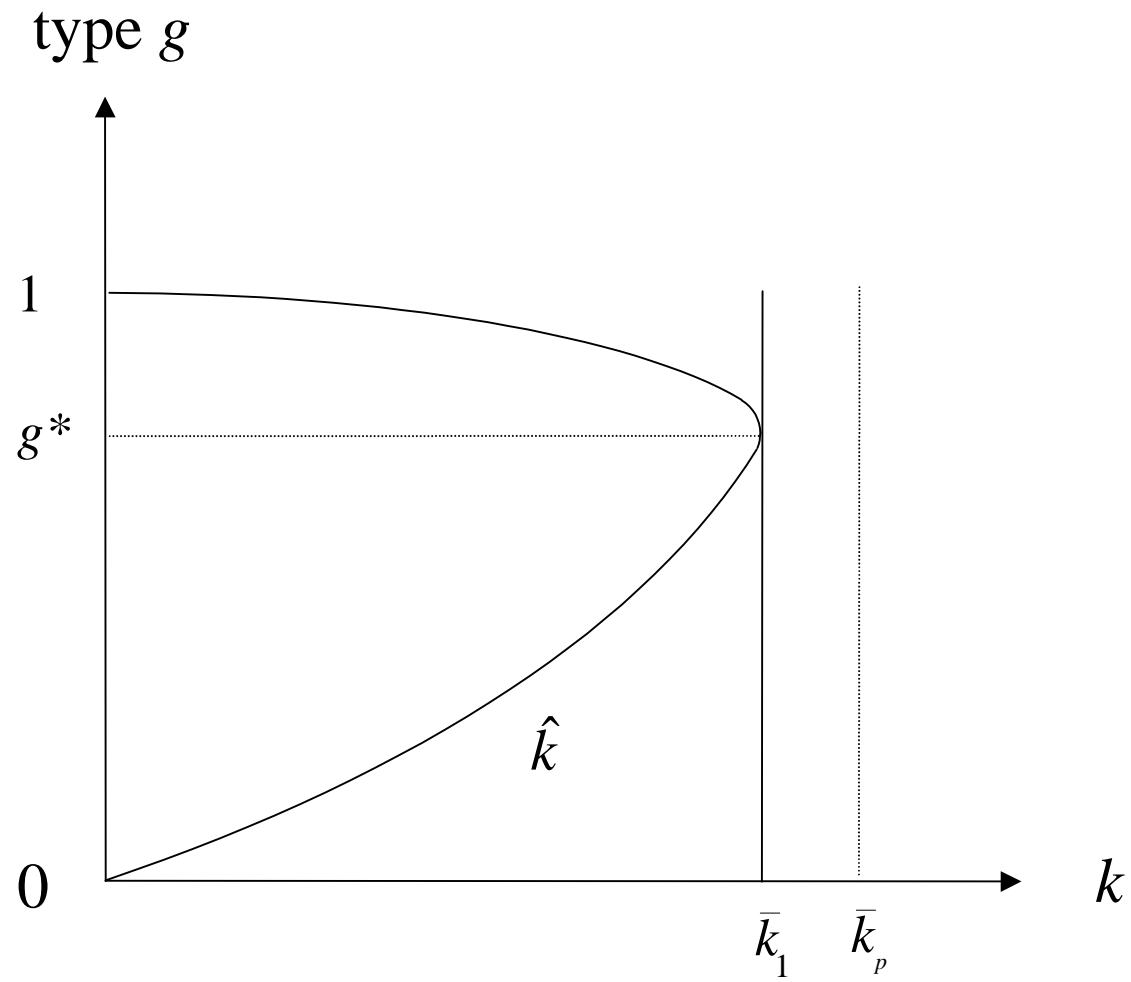


Figure 5: \hat{k} as a function of the fraction of type g experts

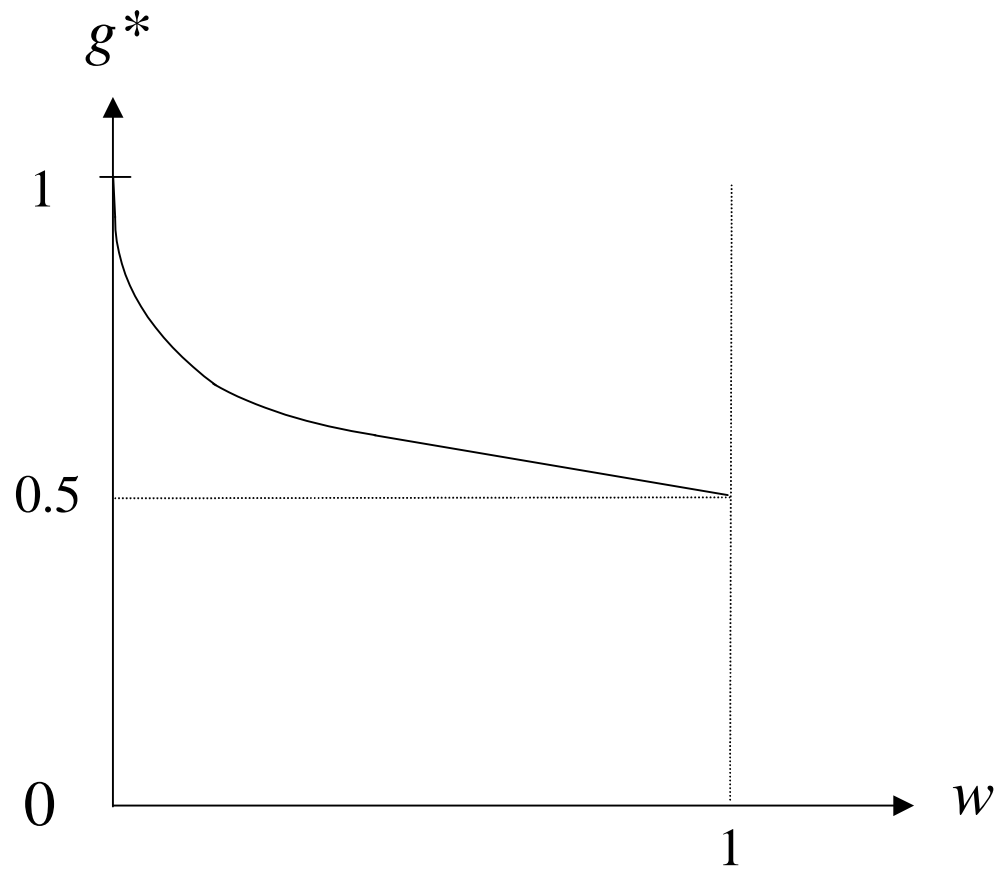


Figure 6: g^* as a function of w