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Experts vs. discounters: Consumer free-riding and experts withholding advice in markets for credence goods[☆]

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ABSTRACT

This paper studies the incentives for credence goods experts to invest effort in diagnosis if effort is both costly and unobservable, and if they face competition by discounters who are not able to perform a diagnosis. The unobservability of diagnosis effort and the credence characteristic of the good induce experts to choose incentive compatible tariff structures. This makes them vulnerable to competition by discounters. We explore the conditions under which honestly diagnosing experts survive competition by discounters; we identify situations in which experts misdiagnose consumers in order to prevent them from free-riding on experts' advice; and we discuss policy options to solve the free-riding consumers–cheating experts problem.

1. Introduction

Buying a technologically advanced good, like a PC, a home cinema system or even a new fridge is not an easy task. These goods come in different makes, some offering a multitude of options many customers may never need. Customers in these cases may lack precise knowledge on the available equipment, most likely they are not sure which options of these goods are necessary for them. Such goods are usually sold through two channels. On the one hand, specialized dealers – experts – offer advice to a customer to pick the option that best fits his needs. On the other hand, chain stores – discounters – offer the goods without much advice.

With the discounter channel, a consumer needs to rely on a trial and error process to find out which quality of the good matches his needs best. With experts, consumers face the risk that the expert might not invest effort to diagnose the consumer's need and might just suggest the quality that maximizes her profits. On the other hand, what if the consumer expects the expert to give proper advice? For an economically educated customer, a natural reaction would be to simply take this advice and visit a discount seller who offers no advice but the recommended quality at a lower price.

Similar situations are ubiquitous. For instance, when your car's ignition doesn't work you can go to a backyard garage and ask to replace the battery or the generator; alternatively, you can visit a mechanic who is able to identify which maintenance needs to be done by exerting costly (but unobservable) effort. Once the diagnosis has been made, you can again either issue the repair or, with some excuse, turn down the offer and buy the suggested treatment at a cheaper place.

In this article we address this two-sided incentive problem, a moral hazard problem on the experts' side – providing honest diagnosis – and a free-riding problem on the consumers' side.

Goods and services where an expert knows more about the quality a consumer needs than the consumer himself were first studied by Darby and Karni (1973) and are called credence goods. In the literature on credence goods (see Dulleck and Kerschbamer, 2006 for a recent survey) most contributions ignore consumers' option to free-ride on a given advice. This is done by either assuming that diagnosis needs no special effort (cf., e.g. Pitchik and Schotter, 1987; Sülzle and Wambach, 2005, and Fong, 2005) or that diagnosis effort is observable and verifiable so that a (fair) diagnosis fee can be imposed on the consumer (see, for instance, Wolinsky, 1993 and 1995, Emons, 1997 and 2001, or Alger and Salaniè, 2006). In this article, we study the

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incentives for experts to invest effort in diagnosis and to suggest the right quality of a credence good in a setting where diagnosis effort is both costly and unobservable, and where experts face competition by discounters who are not able to perform a diagnosis.

The basic features of our model are as follows. On the demand side, there are many consumers in the market. Each consumer needs either a good of an expensive high quality ($\bar{c}$) or a good of a cheap low quality ($\underline{c}$). Each consumer knows that he has a need, but he does not know which quality is sufficient to satisfy it.

On the supply side of the market there are two types of providers: experts and discounters. Experts have the ability to perform diagnoses at a cost before providing goods but discounters can only provide the good a consumer requests without knowing what he actually needs.

Depending on how likely the consumer needs the high quality good and how costly diagnosis is, the efficient way to serve a consumer is one of the following:

- Policy A — performing a costly diagnosis and providing the quality matching the needs of the customer;
- Policy B — performing no diagnosis and blindly providing high quality — this policy guarantees that the customer's need is satisfied; and
- Policy C — performing no diagnosis and beginning with the low quality good and, if this policy fails, then following up with the high quality good.

Intuitively Policy A is the efficient solution if the cost of diagnosis is sufficiently low and if the likelihood to need the high quality good is neither close to zero nor close to one i.e., diagnosis will provide much information.

If diagnosis was contractible, then experts would dominate the market whenever Policy A is the efficient solution. However, diagnosis is unobservable and costly to the experts and they have to convince consumers that they are going to perform it. This makes them vulnerable to competition by discounters. We show that when the diagnosis is unobservable, even when Policy A is the efficient way to serve consumers, experts may not be able to commit themselves to using it when they compete with discounters. To get the intuition observe that with unobservable diagnosis effort the most attractive option for an expert who gets visited by a consumer is one of the following:

- *strategy a* — performing a costly diagnosis and providing the quality matching the need of the customer (Policy A);
- (*cheating*) *strategy b* — abstaining from diagnosis and blindly recommending the expensive, high quality; and
- (*cheating*) *strategy c* — abstaining from diagnosis and blindly recommending the cheap, low quality.

To convince consumers that she is going to adopt *strategy a*, an expert has to design her tariff structure in such a way that strategies b and c are unattractive for her. Since the final success of service is observable and verifiable in our model, the incentive to adopt *cheating strategy c* is easily removed by the expert offering a costly service for the case the recommended quality of the good does not deliver. To prevent her temptation to apply *cheating strategy b* the mark-up for the high quality good must be set to zero and diagnosis has to be provided for free. This means that diagnosis costs must be earned only through the mark-up on low quality goods. However, if the mark-up for the low quality good exceeds consumers' switching costs of going to a discounter, then consumers will abandon the expert upon being recommended to consume the low quality good. This defection will in turn destroy the expert's incentive to adopt *strategy a*. As a result, when the switching cost is sufficiently low, then there does not exist an equilibrium in which experts always honestly perform the diagnosis before recommending one of the qualities.

However, under certain conditions there exists an equilibrium in which experts perform diagnosis with probability strictly between zero and one. In such an equilibrium experts randomize between *strategy a* and *cheating strategy c* in order to keep consumers less than perfectly informed on their true needs. As a result, even if the mark-up for the low quality good is higher than the search cost, consumers still decide to stay with the expert since only an expert offers some insurance against failure.

Our analysis is related to several strands of previous literature. First, to the literature on credence goods. The credence goods paper closest to ours is Pesendorfer and Wolinsky (2003). As in the present paper they consider a market in which an expert must exert costly but unobservable effort to identify the service quality that meets a consumer's needs best. Their main focus is on the role of a specific mechanism – the gathering of multiple opinions – in disciplining experts' behavior. A crucial assumption in the Pesendorfer/Wolinsky analysis is that the final success of service is not contractible. Otherwise, the incentive problem stemming from the unobservability of diagnosis effort could easily be solved by an appropriate choice of diagnosis and good prices as well as of warranty payments for the case of an insufficient quality of the product. In contrast, in our model the success of a recommended product quality is observable and verifiable and the problem analyzed here stems from the existence of discounters who cannibalize the experts' market.

Our analysis is also related to the papers by Bouckaert and Degryse (2000) and Emons (2000) on competition between safe and risky repair experts. In these articles consumers face the choice between visiting an expensive expert directly and first trying to solve the problem using a cheap expert. While the expensive expert can solve the problems of all consumers, the cheap expert's repair technology is not always successful. If the cheap risky expert fails, a consumer ends up with the expensive safe expert paying for the service twice. There are several distinctions between these two papers and the setting considered here. First of all, these papers abstract completely from both, experts' incentive to provide a serious diagnosis and their incentive to provide the appropriate good. Also, there is no other asymmetric information involved in the models. Finally, this literature also abstracts from the possibility of warranties for cheap sellers. Thus, when translated to the language of the present paper, this literature studies price competition between two discounters, one selling only the low quality $\underline{c}$, the other selling only the high quality $\bar{c}$.[1]

Our analysis also has close parallels in the literature on vertical restraints and retail price maintenance (RPM). The classical RPM literature (the seminal paper is Telser, 1960; other entries include Marvel and McCafferty, 1984, Klein and Murphy, 1988, and Shaw, 1994) studies situations in which sales at the retail level depend both on retail prices and on the amount of "special services" the retailers provide jointly with the product. Since these services have a public good characteristic none of the retailers has an incentive to offer them. In this situation RPM, used as a price floor, can alleviate the problem because it prevents price competition and channels competition into non-price dimensions such as service. The present paper can be seen as complementary to the existing RPM literature in that it provides (i) a new motivation for the use of RPM (in the traditional RPM literature, the special service consists of demonstration or certification activities for a homogeneous product; by contrast, in the present context there are different types or qualities of a good or service and the special service consist in helping the consumer to identify the quality that fits his needs best), and (ii) a new formalization of the special-service free-rider story which is more in line with the original Telser argument envisioning competition between retailers providing

[1] Other papers on competition between safe and risky providers include Glazer and McGuire (1996) and Krishna and Winston (2003). In the former article consumers do not know their success probability with the risky provider while the risky provider learns this probability by diagnosing the consumer and the main focus is on optimal referral from the risky to the safe provider. The latter article endogenizes quality choice – where quality is modeled as the probability with which the product will satisfy the consumer – as well as the initial entry decision.

special services and charging high prices and retailers providing no service and charging low prices (in the existing formal literature on RPM there is only one type of retailer and the problem is to induce this type of retailer to provide the desired service[2]).

The rest of the paper is organized as follows. Section 2 presents our model of competition between experts and non-experts, characterizes the efficient diagnosis and provision policy and shows that the efficient solution could be sustained in equilibrium if experts' diagnosis effort was observable and verifiable. In Section 3 we turn to our model with unobservable diagnosis effort and identify the main reasons for the inefficiencies. We study both pure and mixed strategy equilibria and show that inefficiencies prevail in both cases. Section 4 discusses potential cures for the cheating experts and free-riding consumers problem. We show that contingent diagnostic fees are able to solve the problem while vertical restraints of a monopolistic manufacturer and regulation that prevents discounters from selling high quality goods are not. Section 5 concludes.

2. The model

On the demand side of our model there is a continuum of mass one of ex ante identical consumers. Each consumer (he) needs either a high quality good $\bar{c}$ or a low quality good $\underline{c}$. Each consumer knows that he has a need, but he does not know which quality is sufficient to satisfy it. He only knows that he has an ex ante probability of h that only high quality is sufficient and a probability of $(1 - h)$ that the low quality is sufficient. Each consumer gets a per period utility of v from the good when it does deliver, and zero if it fails to satisfy. Failure is assumed to be verifiable. This means that payments and additional post sale services can be conditioned on success. We also assume that quality is observable and verifiable so that payments can also be conditioned on the quality provided.

Each consumer can visit one or more sellers. The consumer incurs a search cost s per seller he samples, independently of whether or not he chooses to be served by this seller. This cost represents the time and effort incurred in searching for a seller. As will become clear below, the variable s can also be interpreted as the remorse felt by a consumer if he decides to visit a second seller after having received advice from the first one.

On the supply side there are two types of sellers, experts and discounters, and there are at least two of each kind. Each seller (she) can serve arbitrarily many consumers. Experts have the ability to perform diagnoses at a cost c before providing goods but discounters can only provide the quality a consumer requests without knowing what he actually needs. The cost of the high quality is $c-$ and the cost of the low quality is $\underline{c}$, with $\bar{c} > \underline{c}$.[3]

The interaction between consumers and sellers is modelled as follows. Time is divided into two periods. Before the first period begins, experts and discounters simultaneously announce their tariffs. A tariff by a discounter specifies a price $\underline{q}$ for the low quality and a price $\bar{q}$ for the high quality. A tariff by an expert specifies a diagnosis fee p for the recommendation, a price $\underline{p}$ for the low quality and a price $\bar{p}$ for the high quality. An expert's tariff might also specify post sale services or transfers at cost t for the case that the recommended quality is insufficient. At the beginning of period 1 consumers enter the market and – upon observing the tariffs available in the market – each consumer decides which provider (if any) he visits. When a consumer visits a discounter, he specifies which quality he wants. The discounter then provides the desired quality and charges the price posted for it. When a consumer consults an expert, he has to pay the diagnosis fee p in advance. In exchange, the expert makes a recommendation. The consumer doesn't observe whether the expert's recommendation is based on a serious diagnosis or not. After learning the recommended quality, the consumer decides whether to buy it from the expert or not. If he refuses, he either leaves the market or continues to search for another provider by spending an additional search cost s. If the consumer accepts, the expert provides the recommended quality at the price posted for it. The first period ends with each consumer either having left the market or having bought a good. If the quality a consumer got is sufficient for the intended use he leaves the market. Otherwise he loses v in this period and either buys $\bar{c}$ from the same provider or continues search in the second period. If a consumer does not buy a good for two periods, the consumer leaves the market. There is no discounting.

Consumers are minimizers of expected cost. The total cost to a consumer who visited n (= 1, 2, 3,..) different sellers and got a sufficient quality in period r (= 1, 2, 3; period 3 here stands for the case where the consumer's need is not satisfied for two periods[4]) is $ns + (r - 1)v$ plus the sum paid for diagnosis and goods in the course of his search, minus possible transfers for insufficient quality. By assumption, if a consumer is indifferent between visiting a provider and not visiting a provider, he decides for a visit. Also, if a customer who decides for a visit is indifferent between visiting an expert and visiting a discounter, he decides for the expert and if he is indifferent between two or more experts (or two or more discounters), he randomizes (with equal probability) among them.

Sellers maximize expected profit. The profit a discounter derives from a customer who visited her is simply the price of the quality sold minus cost. The profit an expert derives from a customer depends on whether she incurs the diagnosis cost c or not, on whether the consumer accepts the recommendation or not, and on whether the quality provided is sufficient to satisfy the consumer's need or not. By assumption, an expert recommends the appropriate quality if she is indifferent between recommending the appropriate and recommending the wrong quality, and this fact is common knowledge among all market participants.[5]

Throughout the paper we restrict attention to situations where the following two conditions hold

$$v > \bar{c} + s$$

$$\bar{c} - \underline{c} \geq s$$

The first of these inequalities states that it is always efficient to buy sufficient quality even in period two. The second inequality rules out the uninteresting cases, where consumers will never visit more than one seller. Throughout the paper we also assume that providers are able to commit to the posted prices but cannot commit to serve customers. This implies that we can restrict attention to prices satisfying the following two conditions:[6]

$$\underline{p}, \underline{q} \geq \underline{c}$$

$$\bar{p}, \bar{q} \geq \bar{c}.$$

This assumption is important for our results. Without it experts could commit to a price-structure implying (sizeable) gains if the

[2] An exception is Bolton and Bonano (1988). The situation studied there is quite different, however, since consumers are assumed to be able to benefit from a given retailer's services only if they purchase the good from him. Thus, free-riding in the provision of costly services is not an issue there.

[3] For convenience, both the quality of the good and the associated cost are denoted by c.

[4] As is easily verified, our analysis and results would remain unaffected if we assumed instead that $r \in \{1, 2, x\}$, where period $x \geq 3$ stands for the case where the consumer does not buy a good for two periods.

[5] Introducing some guilt disutility associated with recommending a wrong quality would yield the same qualitative results as this common knowledge assumption provided the effect is small enough to not outweigh the pecuniary incentives.

[6] Note that imposing these two conditions has the same effect as leaving the prices unrestricted and adding another option – rejection – to those the expert has after diagnosing a customer.

consumer needs the low quality good and (sizeable) losses if he needs the high quality good (see the discussion preceding condition (3) below for details). Such a price-structure would solve the consumer-free-riding-problem, however at the cost of making experts vulnerable to arbitrage; that is, an arbitrageur could buy the high quality good in an expert shop and offer it to other providers at a slightly higher price. We find the alternative assumption in which an expert's price posting means a commitment to provide the good even if its price does not cover the cost also implausible for other reasons: An expert can always invoke unexpected delays in the supply of the good to avoid serving a customer, or she can claim that for this particular and very rare problem no suitable solution exists. Finally, competition policy rules often prohibit selling goods at prices below cost. This is the case in more than twenty US states, see for example California's Unfair Practices Act, Bus. and Prof. Code Sections 17043, 17044.[7]

To keep the analysis simple we finally assume that experts cannot charge a negative diagnosis fee:[8]

$$p \geq 0$$

The equilibrium concept we employ is that of perfect Bayesian equilibrium.[9] Our focus will be on symmetric equilibria.

Throughout our analysis we use the following notation. We use the term Δ to denote the mark-up an expert charges on the diagnosis (that is, $\Delta = p - c$). Similarly, we will use the term $\underline{\Delta}$ for the mark-up the expert charges on the low quality good, and the term $\bar{\Delta}$ for the mark-up she charges on the high quality good (that is, $\underline{\Delta} = \underline{p} - \underline{c}$ and $\bar{\Delta} = \bar{p} - \bar{c}$).

Let us begin with a characterization of the efficient diagnosis and provision policy. Since searching for a seller is costly, efficiency requires that consumers are treated by the first provider they visit (that is, separation of diagnosis and provision is inefficient). Thus, the three policies listed in the introduction are candidates for the efficient solution. The efficient policy is the policy that minimizes generalized cost. The generalized cost for Policy A is $s + c + (1 - h)\underline{c} + h\bar{c}$, the generalized cost for Policy B is $s + \bar{c}$, and the generalized cost for Policy C is $s + \underline{c} + h(v + \bar{c})$.[10] Fig. 1 displays the efficient policy for different (c, h) combinations, holding v, $\bar{c}$, $\underline{c}$ and s fixed. The letter in a region indicates the efficient policy for the respective parameter combination.

Before turning to our model with unobservable diagnosis effort we first show that the efficient solution could be sustained in equilibrium if experts' diagnosis effort was observable and verifiable. We record this result as

Lemma 1. *If experts' diagnosis effort is observable and verifiable then in any equilibrium the market will be efficient.*

Proof. Consumers who visit a discounter face no incentive problem. Everything is as if discounters just provide normal goods. Thus, if the parameters of the model are such that we are in Region B (Region C, respectively) then in any equilibrium $\bar{q} = \bar{c}$ ($\underline{q} = \underline{c}$ and $\bar{q} = \bar{c}$, respectively) by the usual price-undercutting argument. With discounters who offer these prices and experts who are unwilling to make losses, consumers will choose the efficient policy.[11] Remain consumers in Region A. To remove consumers incentive to switch to discounters after receiving advice, prices have to be such that $\underline{\Delta}, \bar{\Delta} \in [0, s]$. To remove an expert's incentive to recommend the wrong quality, prices and transfers have to be such that $(\underline{\Delta} - \bar{\Delta}) \in [0, t]$. If prices and transfers did not satisfy this latter condition then customers would correctly infer that experts have an incentive to provide the wrong quality and they would adjust their willingness to pay accordingly. With prices that induce non-fraudulent behavior we are again back to the normal good case; that is, Bertrand competition yields prices such that underbidding yields losses and charging more implies a loss of customers. Putting these conditions together yields prices p, $\underline{p}$ and $\bar{p}$ and transfers t fulfilling the following properties: $\Delta + (1 - h)\underline{\Delta} + h\bar{\Delta} = 0$; $(\underline{\Delta} - \bar{\Delta}) \in [0, t]$; $\underline{\Delta}, \bar{\Delta} \in [0, s]$; and $\Delta \geq -c$. With experts' prices and transfers satisfying these conditions and discounters who are unwilling to make losses consumers will again choose the efficient policy. □

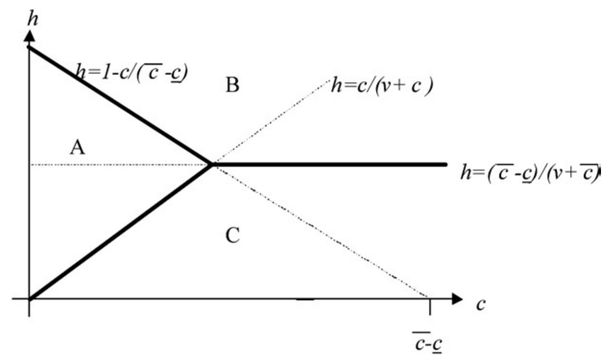

Fig. 1. Efficient policies.

3. Unobservable diagnosis: cheating experts and free-riding consumers

We now turn to our basic model with unobservable diagnosis effort. Obviously, if the parameters of the model are such that we are either in Region B or in Region C of Fig. 1, then the equilibrium behavior of market participants does not depend on whether the experts' diagnosis effort is observable or not. In both cases only discounters are active and they charge marginal cost prices. Our main focus in the rest of the paper will therefore be on parameter constellations in Region A. We begin by focusing on pure strategy equilibria.

3.1. Pure strategies: reliable experts–free-riding consumers

An important question in Region A is whether experts can design their price and transfer structure in an incentive compatible way. The answer turns out to be yes, but at the cost of being vulnerable to competition by discounters. To see this, observe that with unobservable diagnosis effort the most attractive options for an expert who gets visited by a consumer and who expects to be able to induce the consumer to accept the quality she recommends are the three

[7] Article VI of the GATT imposes a similar rule for international trade. We are not the only ones with the opinion that our partial commitment assumption is more realistic than assuming full commitment. Wolinsky (1993, p. 382 f.), Fong (2005, p. 119), Alger and Salanie (2006, p. 860), and Liu (2006, p. 9) make the same assumption and provide several reasons for it.

[8] If experts charge a negative diagnosis fee, consumers might have an incentive to engage in 'diagnosis shopping'. To remove this incentive p must exceed $-s$. Our stronger assumption $p \geq 0$ simplifies the analysis but is not important for our main findings.

[9] Here note that a consumer who visits an expert has to decide whether to stay or to leave without knowing whether the better-informed expert has recommended the right or the wrong quality.

[10] Here notice that we assume that a consumer does not incur another search cost if he buys $\bar{c}$ after first having tried $\underline{c}$. In an earlier version of this paper (Dulleck and Kerschbamer, 2005) we employed the alternative assumption that visiting a provider always costs s. The analysis is slightly more complicated, the qualitative results are the same, however.

[11] The only way for experts to attract customers without making losses in this situation is to act like a discounter; that is, to offer goods at marginal cost, without providing a serious diagnosis. Here note that although in our model experts and discounters are assumed to be distinct providers, nothing would change if we assumed instead that there is only one kind of seller with the characteristics we have ascribed to experts and if we call such a provider 'expert' if she sets either $p > 0$ or offers post sale services in case of insufficient quality which cost her $t > 0$, and 'discounter' otherwise. All results remain unaffected provided that at least four of these sellers populate the market. In what follows we call an expert who acts like a discounter a discounter.

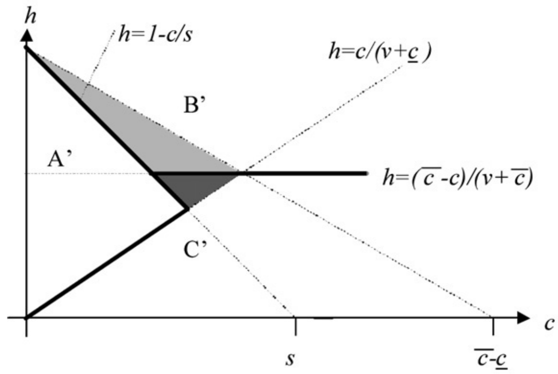

Fig. 2. Pure strategy equilibria with unobservable diagnosis effort.

strategies listed in the introduction. Given that the expert is free to set the transfer, she will use it to make sure that *strategy c* is unattractive for her. For *strategy a* to dominate *strategy c* the costs of post sale services and transfers, *t*, and the mark-ups Δ, $\underline{\Delta}$ and $\overline{\Delta}$ need to fulfill the condition $\Delta+(1-h)\underline{\Delta}+h\overline{\Delta}\geq p+\underline{\Delta}-ht$ which is equivalent to

$$t\geq\underline{\Delta}-\overline{\Delta}+\frac{c}{h}. \tag{1}$$

This condition can always be met by an appropriate choice of the warranty payment *t*. Strategy b is the more critical one. For *strategy a* to dominate *strategy b* the mark-ups Δ, $\underline{\Delta}$ and $\overline{\Delta}$ need to fulfill the condition $\Delta+(1-h)\underline{\Delta}+h\overline{\Delta}\geq p+\overline{\Delta}$ which is equivalent to

$$c/(1-h)\leq\underline{\Delta}-\overline{\Delta}. \tag{2}$$

If experts were able to commit to provide goods at prices below cost no problem would arise. Then they could post prices $p=c/(1-h)$, $\underline{p}=\underline{c}$, $\bar{p}=\overline{c}-c/(1-h)$ implying $\Delta=hc/(1-h)$, $\underline{\Delta}=0$ and $\overline{\Delta}=-c/(1-h)$. This price-structure would implement the first best solution. But given experts' commitment problem, prices need to in addition fulfill $\underline{\Delta}, \overline{\Delta}\geq 0$, which, together with the previous condition yields

$$\frac{c}{1-h}\leq\underline{\Delta}. \tag{3}$$

Consumers are aware that discounters charge marginal cost prices. Consequently, they will accept to receive the quality recommended by an expert only if the price the expert charges for the recommended quality does not exceed the sum of production cost plus search cost. This implies another restriction on the price for the low quality, namely

$$\underline{\Delta}\leq s. \tag{4}$$

Obviously, if $s<\frac{c}{1-h}$ then conditions (3) and (4) are incompatible. This leads us to our first main result.

Proposition 1. *Consider our basic model with unobservable diagnosis effort. Suppose that the parameters of the model are such that* $c\geq\min\{(1-h)(\overline{c}-\underline{c}), h(v+\underline{c})\}$. *Further suppose that experts are constrained to use pure strategies. Then the efficient solution is sustainable in equilibrium if and only if* $s\geq\frac{c}{1-h}$. *If* $s<\frac{c}{1-h}$ *then experts refrain from providing advice and the market is served by discounters.*

Proof. From the discussion above it is clear that experts cannot survive as full service providers (i.e., providing both, honest diagnosis and appropriate quality) whenever $s<\frac{c}{1-h}$. For $s\geq\frac{c}{1-h}$ prices and transfers satisfying conditions $t\geq\underline{\Delta}-\overline{\Delta}+c/h$ and $c/(1-h)\leq\underline{\Delta}-\overline{\Delta}$, as well as $p\geq 0$, $\overline{\Delta}\geq 0$ and $\Delta+(1-h)\underline{\Delta}+h\overline{\Delta}=0$ are the unique equilibrium prices of experts by the usual price-undercutting argument. These conditions together yield p=0, $\underline{p}=\underline{c}+\frac{c}{1-h}$, $\overline{p}=\overline{c}$ and $t\geq\frac{c}{(1-h)h}$. □

How does the new equilibrium look like? A comparison of Fig. 1 to Fig. 2 reveals that the original Region A is split into three distinct parts. If consumers' switching costs are high, then experts provide honest diagnosis and appropriate quality and full efficiency prevails (Region A′). Otherwise, inefficiencies arise. In the light grey area experts should but do not provide diagnosis and customers blindly buy $\overline{c}$ from a discounter. This leads to an efficiency loss of $(1-h)(\overline{c}-\underline{c})-c$. Similarly, in the dark grey area experts should but do not provide diagnosis and consumers blindly buy $\underline{c}$ from a discounter. This implies an efficiency loss of $h(v+\underline{c})-c$.

3.2. Mixed strategies: cheating experts–reliable consumers

In the above analysis we focused on pure strategy equilibria. In the region where Policy A is efficient, but in which experts are not able to use *strategy a* without making losses (the two grey areas in Fig. 2), there might exist mixed strategy equilibria in which experts randomize between *strategy a* and *strategy c* in order to keep consumers less than perfectly informed about their true needs. As a result, even if the mark-up on the low quality good is higher than the search cost, consumers might still decide to stay with the expert since only the expert offers some insurance against insufficient quality. Let us explore the exact conditions for the existence of such an equilibrium, that is, for the existence of an equilibrium in which

(i) all consumers visit an expert;
(ii) experts perform a diagnosis with probability $\alpha\in(0,1)$ and blindly recommend $\underline{c}$ otherwise; and
(iii) consumers accept to receive the recommended quality even though $s<\underline{\Delta}$.

For experts to be prepared to randomize between *strategy a* and *strategy c*, we must have

$$t=\underline{\Delta}-\overline{\Delta}+\frac{c}{h} \text{ and } \frac{c}{1-h}\leq\underline{\Delta}-\overline{\Delta}, \tag{5}$$

where the first of these conditions guarantees that the expert is indifferent between *strategy a* and *strategy c*, while the second one is needed to ensure that the expert has no incentive to choose *strategy b*. If consumers expect that all experts who post tariffs satisfying these conditions randomize in the same way, i.e. choose the same α, then in any equilibrium with the above three characteristics $\Delta=-c$, $\underline{\Delta}=c/(1-h)$, $\overline{\Delta}=0$ and $t=\frac{c}{(1-h)h}$ by the usual price cutting argument.[12]

Now consider consumers. If they anticipate that each expert performs diagnosis with probability $\alpha\in(0,1)$ and blindly recommends $\underline{c}$ with probability $(1-\alpha)$ then their updated belief of needing the high quality good, given that they have been recommended the low quality one, is

$$\hat{h}=\frac{h(1-\alpha)}{1-h+h(1-\alpha)}=\frac{h-h\alpha}{1-h\alpha}. \tag{6}$$

Thus, for a consumer who has received a $\underline{c}$ recommendation to be prepared to accept it, α must be such that

$$\frac{c}{1-h}\leq s+\hat{h}t \tag{7}$$

which is equivalent to

$$\frac{\alpha c}{1-\alpha h}\leq s. \tag{8}$$

To understand condition (7) notice that a) $\underline{\Delta}=\frac{c}{1-h}$ is the additional amount the consumer has to pay for the low quality good if he stays

[12] To see this, notice that there is no other tariff that simultaneously satisfies a) the two relations (5), b) p, $\overline{\Delta}$, $\underline{\Delta}\geq 0$, and c) $\overline{\Delta}+(1-\underline{h})\Delta+h\overline{\Delta}=0$. Also notice that mixed strategy equilibria involving higher mark-ups (and strictly positive profits for experts) can be supported by other out-of-equilibrium beliefs.

with the expert instead of switching to a discounter, b) s represents the saving of switching cost by staying with the expert, and c) $\hat{h}t$ represents the expected value of compensation he receives from the expert if the low quality does not deliver. Here notice that whenever the low quality does not deliver (probability $\hat{h}$) the consumer has to buy the high quality too. However, he has to do this independently of whether he received the low quality from the expert or the discounter.

In the least cost mixed strategy equilibrium fulfilling conditions (i)–(iii) above, Eq. (8) holds as an equality so that

$$\alpha^* = \frac{s}{c + hs}. \tag{9}$$

Comparing the inefficiencies implied by experts' randomization to the inefficiencies caused by relying on a discounter tells us whether consumers are still willing to visit an expert in the first place. In the dark grey area of Fig. 2 this is obviously the case since there we have $(1 - h)(\bar{c} - \underline{c}) - c \geq h(v + \underline{c}) - c \geq (1 - \alpha)[h(v + \underline{c}) - c]$, where both inequalities are strict in the interior of the area.[13] In the light grey area of Fig. 2 the issue is more delicate. In this region a consumer who expects that he will accept whatever the expert recommends is only willing to see an expert if

$$(1 - h)(\bar{c} - \underline{c}) - c \geq (1 - \alpha)\left[h(v + \underline{c}) - c\right]. \tag{10}$$

Obviously, on the upper end of the region – along the line $h = \frac{(\bar{c}-\underline{c}-c)}{(\bar{c}-\underline{c})}$ – this condition is always violated since the LHS of condition (10) is zero there while the RHS is strictly positive. On the other hand, on the lower end – along the line $h = \frac{(\bar{c}-\underline{c})}{(v+c)}$ – we have again $(1 - h)(\bar{c} - \underline{c}) - c = h(v + \underline{c}) - c \geq (1 - \alpha)[h(v + \underline{c}) - c]$, where the inequality is strict for $c < \frac{(v+\underline{c})(\bar{c}-\underline{c})}{(v+\bar{c})}$. So, at the lower end condition (10) is always satisfied. If we replace the α in condition (10) by α^* from Eq. (9) we see that the LHS of the inequality is decreasing in h, while the RHS is increasing in h. Given that we know already that the inequality is violated with certainty for large hs in the light grey area of Fig. 2 while it holds for small hs exceeding $\frac{(\bar{c}-\underline{c})}{(v+\bar{c})}$, we know that for each $c < \frac{(v+\underline{c})(\bar{c}-\underline{c})}{(v+\bar{c})}$ there exists a unique $\hat{h}(c) \in \left(\frac{(\bar{c}-\underline{c})}{(v+\bar{c})}, \frac{(\bar{c}-\underline{c}-c)}{(\bar{c}-\underline{c})}\right)$ such that condition (10) holds with equality. It is straightforward to solve for this $\hat{h}(c)$ and to show that $\hat{h}(c)$ is a strictly decreasing, strictly convex function that starts at $\hat{h}(0) = 1$, ends at $\hat{h}\left(\frac{(v+\underline{c})(\bar{c}-\underline{c})}{(v+\bar{c})}\right) = \frac{(\bar{c}-\underline{c})}{(v+\bar{c})}$), and is always above the line $h = 1 - \frac{c}{s}$. Thus, it has the shape as shown in Fig. 3.[14]

We summarize our findings to

Proposition 2. *Consider the basic model with unobservable diagnosis effort. Suppose that the parameters of the model are such that* $c \leq \min\{(1 - h)(\bar{c} - \underline{c}), h(v + \underline{c})\}$. *Further suppose that* $h < \hat{h}(c)$. *Then there exists an equilibrium in which all consumers visit an expert, active experts randomize between strategy a and strategy c, and consumers accept to receive the quality recommended even though* $s < \frac{c}{1-h}$.

In the equilibrium of Proposition 2 experts undertreat consumers with strictly positive probability to keep them uninformed as this deters them from free-riding on experts' advice. This result resembles one of the equilibria in Alger and Salaniè (2006). There, experts refer to an overtreatment strategy to keep customers uninformed. While Alger and Salaniè relax the assumption that the quality of the good delivered is observable and verifiable, we relax the assumption that diagnosis effort is observable. With unobservability of quality, experts

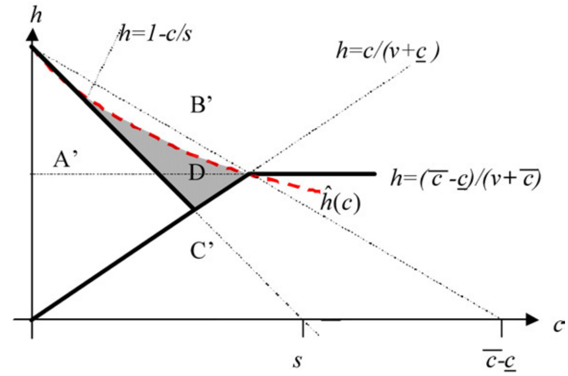

Fig. 3. Mixed strategy equilibria with unobservable diagnosis effort (Region D).

have to post the same price for both qualities to avoid fraud. This constant price, in turn, implies a cross-subsidization from low to high quality. By contrast, with unobservability of diagnosis, the cost of diagnosis has to be carried by low quality to avoid fraud, again implying a cross-subsidization. The cross-subsidization induces experts in both cases to lie to consumers to keep them uninformed thereby preventing them from seeking a better price elsewhere. In the Alger and Salanié model lying occurs in a pure strategy equilibrium and involves experts always claiming that the high quality is needed regardless of the costumer's true needs. In our model lying occurs in a mixed strategy equilibrium and involves experts sometimes claiming that the low quality is needed regardless of the customer's true needs.

4. Potential cures for the cheating experts–free-riding consumers problem

In this section we discuss three potential cures for the efficiency losses identified in the previous section. We start by discussing contingent diagnostic fees as an alternative contractual arrangement. We then discuss whether a monopolistic manufacturer applying vertical restraints solves the problem. Finally we look at cases where discounters are restricted to provide only one of the two qualities.

4.1. Alternative contractual arrangements: full efficiency

In the analysis of Section 3 we focused on simple contractual forms specifying only p, $\underline{p}$, $\bar{p}$ and t. In the real world we observe more sophisticated contracts, for example, contracts that specify a potentially high price for diagnosis and promise to waive the fee if the consumer accepts to buy the recommended quality at the same shop. We now show that such *contingent diagnostic fees* kill consumers' free-riding incentives altogether.[15] To see this consider a contract that has three components: a) a price for diagnosis $p > 0$ which is paid only under certain conditions (to be specified); b) a price for the low quality good $\underline{p}$, where $\underline{p} > \underline{c} + c$ and $\underline{p} \geq p$; c) a price for the high quality good $\bar{p}$, where $\bar{p} = \bar{c}$; and d) a sufficiently large warranty payment t the expert has to make if the quality she has recommended does not deliver. The contract specifies that if the expert recommends the low quality good, then the customer must either pay the price of diagnosis p if he rejects the recommendation, or the price $\underline{p}$ if he accepts the offer. If the expert recommends the high quality good, then the customer can choose to either receive the recommended quality at the price $\bar{p} = \bar{c}$ or he can walk away without having to pay anything.

To ensure that the expert always performs diagnosis in equilibrium $\underline{p}$ and t must be such that conditions (1) and (2) above hold for $\bar{p} - \bar{c} = \Delta = 0$. If prices and transfers satisfy those conditions then – once the diagnosis

[13] Here, the first term is the efficiency loss associated with the consumer blindly buying $\bar{c}$ in Region A of Fig. 1, the second term is the efficiency loss associated with blindly buying $\underline{c}$, and the last term is the efficiency loss associated with the consumer visiting an expert who randomizes as indicated above.

[14] The exact expression for $\hat{h}(c)$ is $\frac{s-c}{2s} + \frac{\sqrt{(v+\bar{c})\left[(v+\bar{c})(s-c)^2 + 4sc\left(\bar{c}-\underline{c}-s\right)\right]}}{2s(\bar{c}+v)}$.

[15] We are very grateful to a referee who provided us with the main result of this subsection.

is performed and only low quality is needed – it is in the expert's best interest to recommend the low quality good. Doing so leads to a profit of $\underline{p}-\underline{c}\geq\frac{c}{1-h}>0\left[\underline{p}-\underline{c}-c\geq\frac{c}{1-h}-c=\frac{hc}{1-h}>0\text{ after netting sunk cost of diagnosis}\right]$ but if she recommends high quality, she earns zero [$-c$ after netting sunk cost of diagnosis]. Also, if the expert finds out that the customer needs high quality, then she has no incentive to recommend the low quality good as doing so will lead to a loss of $t+\underline{c}-\underline{p}\geq\frac{c}{h}>0$. Therefore, it is incentive compatible for the expert to honestly diagnose and report the customer's true need. Noting that the price for diagnosis is never charged in equilibrium, for the expert to overall break even, $\underline{p}$ must be such that

$$-c+h(\bar{p}-\bar{c})+(1-h)\left(\underline{p}-\underline{c}\right)=0$$

or

$$\underline{p}=\frac{c}{1-h}+\underline{c}.$$

To solve the problems discovered in Section 3 the contingent diagnosis fee must discipline consumer's free-riding. A customer who is recommended the low quality good will not switch as long as

$$p+\underline{c}+s\geq\underline{p}=\frac{c}{1-h}+\underline{c}\Leftrightarrow p\geq\frac{c}{1-h}-s.$$

Recalling that $p\geq\underline{p}$ is also required we can establish the following result:

Proposition 3. *Consider the basic model with unobservable diagnosis effort. Suppose that the parameters of the model are such that $c\geq\min\{(1-h)(\bar{c}-\underline{c}),h(v+\underline{c})\}$. Then, whenever $s<\frac{c}{1-h}$, there exists a $p\in\left[\frac{c}{1-h}-s,\frac{c}{1-h}+\underline{c}\right]$ such that by setting a contingent fee for diagnosis equal to p, experts credibly "commit" to honestly diagnose their customers' problems, all consumers first visit an expert and no consumer switches to discounters.*

The contract derived above is close to some contingent diagnostic fee contracts observed in real life. Thus, Proposition 3 may help to explain why such contracts are a common practice in many repair services including car and computer repairs.

4.2. Vertical restraints — overprovision of diagnosis and insufficient goods

Another potential solution to the free-riding consumers–cheating experts problem identified in Section 3 are vertical restraints. The traditional vertical-restraints-literature typically takes the perspective of a profit-maximizing manufacturer wishing to market its products to consumers through a competitive retail sector.[16] Let us, in this subsection, take this perspective and ask whether a monopolistic manufacturer – or a cartelized industry – would have incentives and means to correct, or at least ameliorate, the distortions encountered in Section 3. To tackle this question we assume that the manufacturer's marginal cost of production of low quality (or high quality) is $\underline{c}$ (or $\bar{c}$, respectively) and that she sells the good at wholesale prices $\underline{w}^e$ and $\underline{w}^d$ ($\overline{w}^e$ and $\overline{w}^d$, respectively) to experts and discounters. We interpret any discriminatory pricing on the wholesale level as vertical restraints. For instance, $\underline{w}^d=\overline{w}^d=\infty$ is equivalent to exclusive dealership.

First notice, that with homogeneous consumers, the monopolistic manufacturer has never an incentive to use both, experts and discounters, as distribution channels. Thus, the following options are natural candidates for a profit-maximizing solution:

- Option 1: Sell both qualities of the good, and sell them through experts only ($\underline{w}^d=\overline{w}^d=\infty$); charge wholesale prices $\underline{w}^e$ and $\overline{w}^e$ such that all consumers visit an expert.
- Option 2: Sell only high quality ($\underline{w}^e=\underline{w}^d=\infty$), and sell it through discounters only ($\underline{w}^e=\infty$); set the wholesale price $\overline{w}^d$ such that all consumers buy $\bar{c}$ immediately.
- Option 3a: Sell both qualities of the good immediately, and sell them through discounters only ($\underline{w}^e=\overline{w}^e=\infty$); charge wholesale prices $\underline{w}^d$ and $\overline{w}^d$ such that all consumers first try $\underline{c}$, and – if this quality fails – then buy $\bar{c}$.

Option 1 is equivalent to forcing Policy A on the whole market, Option 2 is equivalent to forcing Policy B on the market, and Option 3a is equivalent to forcing Policy C on the market. As is easily verified the maximal profit per consumer the manufacturer can earn with Option 1 is $\pi_1=2v-s-c-(1-h)\underline{c}-h\bar{c}$, the maximal profit per consumer she can earn with Option 2 is $\pi_2=2v-s-\bar{c}$, and the maximal profit she can earn with Option 3a is $\pi_{3a}=(1-h)v-\underline{c}-h\bar{c}$.[17] A comparison between π_1, π_2 and π_{3a} reveals that Option 3a is strictly dominated by Option 2. The reason is, that the availability of high quality at a reasonable price in period 1 cannibalizes the market for low quality. Is there a more profitable alternative to Option 3a? In our simple static framework with a fixed population the following strategy is a natural candidate:

- Option 3b: Sell both qualities of the good through discounters only ($\underline{w}^e=\overline{w}^e=\infty$), but sell in the first period only $\underline{c}$ and in the second period only $\bar{c}$; charge wholesale prices $\underline{w}^d$ and $\overline{w}^d$ such that all consumers first try $\underline{c}$, and, if this quality fails, then buy $\bar{c}$.

Although Option 3b is feasible in our simple model, it is a policy that only makes sense in a static context with a fixed population. Up to now, this simplifying assumption did not play any role for our results. But here it definitely does. In a more elaborate model, we envision the market as operating over time without beginning or end. In any period, those consumers who have successfully bought a good – or, who have decided to abstain from the good – depart from the market and there is a flow of new consumers into the market. In such an elaborate model, Option 3b is obviously infeasible.

Is there another alternative to Option 3a? The following strategy is a candidate for a profit-maximizing strategy:

- Option 3c: Sell only $\underline{c}$, and sell it through discounters only ($\underline{w}^e=\overline{w}^e=\overline{w}^d=\infty$); set the price $\underline{w}^d$ such that all consumers buy low quality immediately.

If the consumer abstains from the good, he incurs cost $2v$, if he buys $\underline{c}$ from a discounter, he incurs cost $s+\underline{w}^d+2hv$. Thus, the maximal feasible wholesale price for $\underline{c}$ is $\underline{w}^d=2v(1-h)-s$ leading to a profit of $\pi_{3c}=2v(1-h)-s-\underline{c}$.

The use of Option 3c leads to a new kind of inefficiency, namely, that some customers do not receive sufficient quality.

Proposition 4. *Suppose a monopolistic manufacturer controls the market. If Option 3b is infeasible, then there exist (i) parameter constellations for which consumers inefficiently visit an expert instead of blindly buying $\underline{c}$ from a discounter; (ii) parameter constellations for which consumers inefficiently immediately receive high quality instead of first receiving the low and if this quality fails follow up with the high*

[16] An exception is Perry and Besanko (1991) who examine a model with two manufacturers who distribute their products through exclusive retail dealers and who compete for customers indirectly by inducing retailers to carry their product.

[17] With Option 3a, prices have to fulfill (i) a period 1 participation constraint ensuring that consumers buy $\underline{c}$ in the first period; (ii) a period 2 participation constraint ensuring that consumers buy $\bar{c}$ in the second period if the low quality fails in the first period; and (iii) a self selection constraint ensuring that customers do not buy $\bar{c}$ in period 1. It is easy to show that (i) is redundant given (ii) and (iii). Thus, since increasing $\bar{w}^d$ relaxes (iii), the manufacturer will set $\bar{w}^d=v$, the maximum value consistent with (ii). With $\bar{w}^d=v$, (iii) yields $\underline{w}^d=(1-2h)v$. Thus, the maximal feasible profit with Option 3a is $\pi_{3a}=(1-h)v-\underline{c}-h\bar{c}$.

quality; and (iii) parameter constellations for which consumers are inefficiently left dissatisfied if the low quality fails.

Proof. Easily verified by comparing π_1, π_2 and π_{3c}. □

Fig. 4 illustrates the result. In the light grey area consumers should blindly buy $\underline{c}$ from a discounter and if $\underline{c}$ fails they should then get $\bar{c}$. Now, they visit an expert. In comparison to the first best policy this leads to an efficiency loss of $c-h(v+\underline{c})$. In the dark grey area customers are overtreated by receiving always a high quality good, even though the efficient policy is to sell first the low quality good and – only if low quality fails – the high quality good. This leads to an efficiency loss of $\bar{c}-\underline{c}-h(v+\bar{c})$. In area C″ all consumers should blindly buy $\underline{c}$ from a discounter and if $\underline{c}$ fails they should then get $\bar{c}$. Now, they have no possibility to buy $\bar{c}$. This leads to an efficiency loss of $h(v-\bar{c})$.

To conclude, we observe that the pricing and vertical restraints policy of a monopolistic manufacturer solves the free-riding consumers–cheating experts problem at the cost of introducing other inefficiencies in the market.

4.3. Restricted discounters — getting better, getting worse

How robust are our results with respect to the assumption that discounters offer the same qualities as experts? The answer is that the problems identified in Section 3 only disappear if discounters cannot offer low quality goods. But, in this case some experts may specialize in providing low quality goods only (similar to Wolinsky, 1993) thereby destroying an equilibrium where experts who provide diagnosis can survive.[18] Under the more reasonable assumption that discounters can only sell low quality the problems analyzed earlier do not disappear as experts are still forced to zero mark-ups on high quality goods. On the contrary, the problems become even more severe for the following reason: On the one hand, the parameter range where Policy A is efficient is increased, since (i) Policy B is not available and (ii) consumers who buy low quality from discounters have now to bear the diagnosis cost if they actually need high quality. On the other hand, the parameter range where experts can offer Policy A without inducing free-riding remains the same. Together these considerations imply that the area where Policy A is most efficient but where an equilibrium in which experts honestly perform a diagnoses does not exist, is enlarged.

5. Conclusions

Whenever an expert can provide help to choose the appropriate quality of a good or service needed, there is scope for the expert on the one hand to cheat on providing sincere (and costly) diagnosis and on the other hand to abuse her position and to sell to consumers the quality that is most profitable for her. At the same time, there is scope for consumers to cheat on experts, by once having received her advice, buying the recommended quality of the good or service from some non-expert supplier.

We have studied this two-sided incentive problem in a model in which diagnosis effort is both costly and unobservable and in which experts face competition by discounters. Our model offers several interesting insights.

First, it provides a new explanation for why in many experts markets the *price for diagnosis is set to zero*. Our explanation is based on the unobservability of diagnosis effort and the fact that a positive diagnosis fee (or a positive mark-up on high quality goods) would induce experts to refrain from diagnosis and to always recommend high quality. By contrast, earlier explanations for diagnosis prices being set below diagnosis cost are based on the fact that such a policy

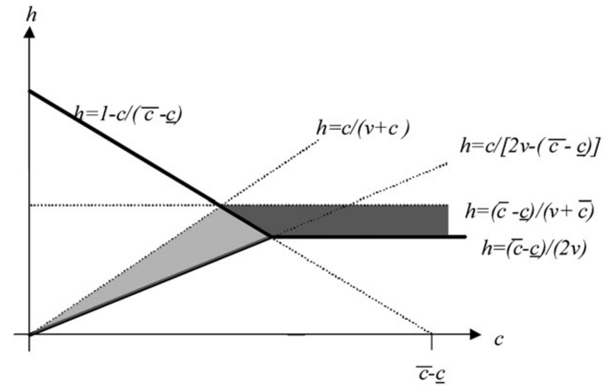

Fig. 4. Grey areas: parameter combination where the pricing and vertical restraints policy of a monopolistic manufacturer introduces other distortions.

enables experts to transfer profits to consumers that result from prices for goods being above marginal cost (see Taylor 1995, or Alger and Salaniè, 2006).

Secondly, our model predicts that *mark-ups in experts markets are higher for lower than for higher quality goods*. The reason is again that high mark-ups for high quality goods are inconsistent with experts investing time and money in finding out what a consumer really needs.

Thirdly, and closely related to the first point above, we are first (to our best knowledge) to provide an *explanation for contingent diagnostic fees*, that is, for arrangements setting a relatively high fee for diagnosis and promising to waive the fee if the consumer accepts to buy the recommended good in the same shop. As observed, to provide the right incentives for experts to invest in diagnosis and to provide the appropriate quality, the diagnostic fee has to be zero if consumers buy the recommended good from the expert, but this causes consumers to free-ride on experts' advice. The contingency avoids free-riding behavior of consumers.[19]

Forth, in the absence of contingent diagnostic fees, *consumer free-riding might cause welfare costs even in an experts' only market*. Why? Because experts may be forced to sometimes refrain from diagnosis and to blindly recommend the cheap quality. Why? Because this keeps consumers less than perfectly informed on their true needs and thereby prevents them from seeking a better price at a discount shop. This result offers – at least to our knowledge – the first explanation for equilibrium undertreatment in an otherwise competitive market.

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[18] Experts specializing on low quality provision would use a price structure satisfying $\underline{p}=\underline{c}$, $\bar{p}>\bar{c}+s$, $p=0$, $t=0$.

[19] We are very grateful to one of the referees who suggested this discussion.

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