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What drives fraud in a credence goods market?—Evidence from a field study[*]

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Abstract

This paper investigates the impact of four key economic variables on an expert firm's incentive to defraud its customers in a credence goods market: the level of competition, the expert firm's financial situation, its competence, and its reputational concerns. We use and complement the dataset of a nationwide field study conducted by the German Automobile Association that regularly checks the reliability of garages in Germany. We find that more intense competition and high competence lower firms' incentive to overcharge. A low concern for reputation and a critical financial situation increase the incentive to overcharge.

Keywords: Asymmetric information; Auto repair market; Credence goods; Expert; Fraud; Overcharging.

JEL Classification: D82; L15.

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1 Introduction

In this paper, we analyze the impact of expert and market characteristics on an expert firm's incentive to defraud its customers in a credence goods market.[1] In credence goods markets, fraud may arise due to asymmetric information between the expert and the customer: the expert knows the quality of the good the customer needs and, in most cases, performs both the diagnosis and the treatment. The customer, however, does not know which quality he needs and hence must rely on the expert's advice. We make use of a field study in the German car repair market in order to identify the drivers of fraudulent behavior in such an expert market. More precisely, we analyze experts' incentives to charge for more services than actually performed (so-called overcharging).[2]

Our empirical analysis shows that a higher degree of competition lowers the incentive to overcharge. This may be explained by pointing out that a larger number of competitors in the market reduces customers' search costs to get a second opinion and hence makes experts more cautious regarding fraudulent recommendations. Furthermore, we find that firms facing a critical financial situation are more likely to overcharge. This may be due to the fact that only firms with a solid financial background will operate in the future and therefore have higher opportunity costs of missing out on a business today. A similar argument holds for more competent garages (as measured by a cost advantage): firms with a high competence (and hence lower costs) are less likely to overcharge than those with a low competence. Finally, our results also indicate that less reputation-oriented car repair shops defraud their customers more often than those with high reputational concerns.

Fraudulent behavior and faulty repairs are major issues in the car repair market. According to a joint survey by the Consumer Federation of America, the National Association of Consumer Agency Administrators, and the North American Consumer Protection Investigators, faulty repairs in the auto repair market rank first among the top ten consumer complaints in 2010. The California Department of Consumer Affairs notes that complaints related to car repairs also grew fastest during the same period. Its Bureau of Auto Repair even shut down some shops of one chain due to overcharging and overtreatment (Consumer Federation of America et al., 2011). These results are in line with earlier studies which also found that

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[1]See Dulleck and Kerschbamer (2006) for an overview of these markets.

[2]Other forms of fraud are overtreatment, i.e., providing a higher quality than needed, and undertreatment, i.e., providing an insufficient treatment.

fraud related to auto repairs was among the most often observed types of fraudulent behavior.[3]

The market for auto repairs and the scope of fraud therein appear to be important for two reasons. Firstly, the market itself is an important economic sector in industrialized countries. For example, according to a market research report by IBISWorld, revenue in the auto mechanics industry reached $52bn in the US in 2012. Moreover, the average annual revenue growth is expected to be 1.2% over the next five years with revenue amounting to $54.7bn by 2017.[4] In Germany, the yearly turnover in the market for car repairs amounts to about €30bn (Zentralverband Deutsches Kraftfahrzeuggewerbe (Ed.), 2012).

Secondly, the insights from the functioning of this particular credence goods market may help to better understand the occurrence of fraud in other expert markets. Besides the car repair markets, many service markets exhibit credence goods properties; this is true, in particular, for many of the so-called professional services (or liberal professions). Liberal professions "are occupations requiring special training in the liberal arts or sciences" (Commission of the European Communities, 2004, p. 3). These services, whose importance for the European economy is stressed by the European Commission, include architectural, engineering, legal, and accounting services, as well as notaries among others. In Germany, the federal government issued a report on the liberal professions which highlights that they account for more than 10% of the GDP and employ about three million people (Bundesregierung, 2013). Another very important industry is the health care market which is the largest credence goods market in most industrialized economies, making up about 10% of the GDP (OECD, 2011).[5]

Given the importance of the car repair market, the issue of fraud (and overcharging in particular) therein, and the potential implications for other important credence goods markets, it is essential to gain a deeper understanding of the factors that make

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[3]See, e.g., Titus et al. (1995). See also the study by the U.S. Department of Transportation cited in Wolinsky (1993, 1995). A 2002 poll conducted by COMsciences, Inc. for Allstate Insurance Company revealed that there was a general atmosphere of distrust in auto body repair shops among consumers in California: among others, consumers were concerned about cheating and inflated prices (see *Business Wire*, August 12, 2002, Monday: "Survey shows Californians fed up with auto repair fraud; pending legislation threatens to block reform and restrict competition").

[4]See   http://www.ibisworld.com/industry/default.aspx?indid=1689   and http://www.sbdcnet.org/small-business-research-reports/auto-repair-business-2012 for details.

[5]Note that fraud is rampant in this market too: for the US, the FBI estimates that up to 10% of the expenditures are due to fraudulent behavior (Federal Bureau of Investigation, 2007).

it easier or harder for experts to exploit their informational advantage at the expense of their customers. In order to analyze experts' overcharging behavior, we make use of the results from a field study in the German car repair market that is carried out on a yearly basis by the German Automobile Association (*Allgemeiner Deutscher Automobil-Club e. V.*, ADAC), Europe's largest automobile club. The ADAC has looked into the defrauding behavior of German car repair shops over several years. We are interested in the influence of four key economic variables on expert firms' incentives to defraud their customers: competition, financial status, firm competence, and reputation. By analyzing the impact of these economic variables, our study complements other contributions that have focused on different determinants of fraudulent behavior (see below). In contrast to earlier contributions, we focus on expert rather than customer characteristics. Furthermore, by considering the degree of competition, we account for an important market characteristic. As such, we are the first to explore the influence of market characteristics on the level of overcharging in the field.

In the competition policy debate, the level of competition among car repair shops is often regarded as an important issue: for example, in the above-mentioned poll performed by COMsciences, a great majority of participants supported increased competition in auto repair (e.g., through insurance-owned shops) in order to reduce widespread fraud. The aspect of competition in credence goods markets has not yet been studied empirically. Furthermore, we investigate the effect of essential expert characteristics: the experts' financial situation as well as their competence plays a crucial role in the experts' decision on whether to overcharge the customer. Again, the 2002 COMsciences poll revealed that an "overwhelming majority (74%) [of consumers] fear they are often cheated by auto body repair shops that do poor quality work."

The automobile club's database contains information on overcharging and the firms' competence. The automobile club recorded overcharging if the number of repairs charged exceeded the number of faults fixed. We extend this database by collecting the number of garages in a ten-kilometer distance from a garage's location in order to quantify the intensity of competition. Furthermore, we determine a garage's geographical proximity to the next interstate and use it as an indicator for a lower share of repeated business contacts and hence less reputational concerns. Last, we collect data about the firm's financial situation which means that we focus on corporate garages in our analysis.

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The seminal theoretical contribution on fraud in the car repair market is Taylor (1995): he studies an expert's incentive to overcharge his customer. The author shows that under short-term contracts, experts will charge all customers for a treatment independent of whether the car is faulty or not. Consequently, all customers whose car is not faulty are overcharged. In contrast to that model, we assume that customers are not committed to a certain expert, i.e., customers can search for a second opinion after receiving the diagnosis. The reason we make use of a model that captures second opinions is based on the way a car repair market functions. We often observe that mechanics first suggest a treatment and then ask for customers' approval before performing the treatment.

There exist only few field studies focusing on the determinants of dishonest behavior in markets for credence goods. Balafoutas et al. (2013) perform a field experiment on credence goods concerning taxi rides in Athens, Greece. The authors focus on the impact of customer characteristics on the expert's incentive to cheat. Their study reveals that if passengers have only poor information about optimal routes, they are taken on longer detours. The authors also point out that a higher (perceived) customer income increases the level of fraud.[6]

A related study to ours is the recent work by Schneider (2012): similar to our paper, he is interested in garages' (dis)honest behavior toward customers. Schneider (2012) analyzes data from a field experiment where he visited garages undercover in order to check whether expert reputation may alleviate the efficiency problems arising from asymmetric information. He finds both pervasive overtreatment and undertreatment but no evidence that reputation helps reduce these problems.[7] Our study is different from the contribution by Schneider (2012) in that we explore the influence of market and expert characteristics on the level of overcharging in the field.[8]

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[6]Dulleck et al. (2011) provide the first experimental study on credence goods. Their main focus is on the role of liability and verifiability in credence goods markets and consider reputation as an extension. They show that neither competition nor reputation decreases the experts' incentive to overcharge in a market with liability. In their empirical study on restaurant hygiene, Jin and Leslie (2009) find that chain-affiliated restaurants have a better hygiene than independent restaurants. This is due to the reputational effects caused by the affiliation.

[7]He also shows that there is a positive relationship between the level of capacity available at a garage at the time of the visit and the probability of a repair recommendation. Moreover, there is a repeat-business effect for the diagnosis fee.

[8]Moreover, we provide theoretical predictions on these effects from an extension of the unifying model in Dulleck and Kerschbamer (2006). Our study is also based on a larger dataset than Schneider (2012) which allows us to draw more comprehensive conclusions on the underlying causes of fraudulent behavior. Lastly, whereas Schneider (2012) pools data from two different studies, we revert to data from a single study.

The remainder of the paper is organized as follows: in the next section, we derive our hypotheses from the theoretical literature on credence goods. We describe the dataset in *Section 3*. In *Section 4*, we present our results and compare them to the theoretical predictions. We check the robustness of our results in *Section 5*. The last section concludes and discusses implications for other credence goods markets.

2   Theoretical Predictions

In order to derive our hypotheses, we make use of the model by Dulleck and Kerschbamer (2006). We present the basic underlying incentives and intuition here; the formal derivation of the results below are relegated to *Appendix A*.

We consider a market where homogeneous customers (car owners) either have a major or a minor problem. Liable experts (mechanics)—unlike customers—are able to diagnose the treatment needed. Experts set treatment prices and incur costs for providing a treatment. Customers cannot verify the type of treatment but can tell whether their problem has been fixed. Upon treatment recommendation, customers are not committed to undergo the treatment recommended by the expert but may decide to search for a second opinion at some cost. Given the market environment, it is possible for the expert to charge for a more expensive treatment than performed (overcharging).

In this setup, there exists an equilibrium which is characterized as follows: expert firms set prices such that they make a positive profit on minor treatments whereas marginal-cost pricing occurs for the major treatment. Experts always recommend the major treatment if needed (due to liability) but also recommend the major treatment with strictly positive probability if the customer only needs the minor treatment which is then provided at the lower costs, i.e., overcharging occurs with strictly positive probability.[9] On the other hand, customers always accept a minor recommendation but visit a second expert with positive probability if they receive the major-treatment recommendation. On their second visit, they accept any recommendation with certainty. Moreover, a customer is never undertreated due to the experts' liability.

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[9]See also Pitchik and Schotter (1987, 1993), Wolinsky (1995), Fong (2005), as well as Sülzle and Wambach (2005) for outcomes with overcharging.

In such a market, two incentive-compatibility constraints play an important role: an expert firm consulted by a customer with a minor problem finds it more (less) profitable to cheat rather than treat its customers honestly if and only if the profit from honest treatment is higher (lower) than the gains from recommending the major treatment. Similarly, a customer prefers (does not prefer) to seek a second opinion if and only if the additional costs of searching for a second opinion are lower (higher) the expected savings from visiting a second expert firm.

Taking this market as a starting point, we use the two incentive-compatibility constraints to motivate our hypotheses. We first look at the relation between competition and overcharging:

Hypothesis 1. *As the degree of competition among expert firms intensifies, firms tend to overcharge less.*

We extend the model by assuming that customers' search costs depend on the number of firms that are located in a customer's neighborhood. The more garages there are in a customer's neighborhood, the lower are the search costs. This is due to the fact that customers have to spend less time and effort searching for suitable experts. Then, ceteris paribus, customers look out for a second opinion at a lower cost which means that they are more likely to reject a major-treatment recommendation. This in turn decreases firms' incentive to overcharge (see *Lemma 1* in *Appendix A*).

Next, we have a closer look at the impact of a lower financial status on overcharging:

Hypothesis 2. *An expert firm in a critical financial situation is more likely to overcharge its customers.*

Suppose a firm in the above-described market additionally has to bear fixed costs in order to run its business and firms differ in their financial assets (low and high). Now, if a firm lacks sufficient financial resources to survive the current period if it does not attract any customer, it does not pay the fixed costs in case it goes bankrupt due to limited liability.[10] As a consequence, it faces lower costs and hence higher profits whenever it recommends the major treatment compared to the firm with the sound financial background. This means that, all things equal, whenever the financially weak expert firm does not find it profitable to cheat, this is even less the case for the financially strong firm. Hence, the latter has a lower incentive to

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[10]Note that the assumption of limited liability is satisfied for most of the firms in our dataset.

defraud its customers because it gains more by recommending the minor treatment whenever it is needed (see *Lemma 2* in *Appendix A*).

Next, we look at the influence of a firm's competence on its incentive to defraud its customers:

Hypothesis 3. *A high-competence expert firm is less likely to overcharge than a low-competence firm.*

Suppose a high-competence firm in our market has lower treatment costs than a low-competence firm. This is captured by a reduction of the initial costs for each treatment which may be due to, e.g., less time-consuming fault detection. Compared to a low competence firm, a firm with high competence only benefits from its better cost situation with certainty if it recommends the minor treatment. If it recommends the major treatment, it may realize the cost advantage only with a probability strictly smaller than one. As a consequence, the high-competence firm faces relatively higher costs and lower profits whenever it recommends the major treatment. Similarly to the above argument in the context of fixed costs, this means that whenever it is not optimal for the low-competence expert firm to cheat, cheating is an even less profitable option for the high-competence firm. As a result, the former has a greater incentive to defraud its customers (see *Lemma 3* in *Appendix A*).

Last, let us have a closer look at the relation between reputation and overcharging:

Hypothesis 4. *Experts with low reputational concerns are more likely to overcharge than experts with high reputational concerns.*

Experts with high reputational concerns face many repeated interactions. Dulleck et al. (2011) show that repeated interaction decreases the incentive to overcharge as experts find it optimal to forgo short-term profits from overcharging because they benefit more from higher profits due to reputation in the future. In line with these findings, Wolinsky (1993) and Park (2005) find that the need to maintain a good reputation decreases the incentive to defraud.
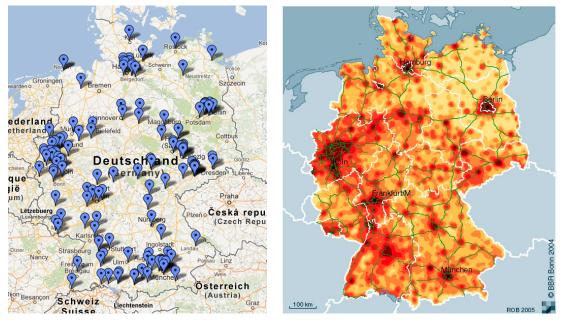
3 Data

3.1 Sample

We make use of pooled cross-section data from the ADAC's garage tests in the years 2006 and 2008–2010; in 2007, there was no test.[11] The automobile club's dataset provides information on 303 garages. We disregard 25 garages that belong to the same corporate entity because these observations are not independent with respect to their financial situation. We further restrict the sample to 134 corporate enterprises because of data availability and firm characteristics: firstly, only corporate enterprises have to publish data on their financial situation. As we shall see later, a garage's financial situation is an important predictor for the garage's incentive to overcharge. Thus, not considering the financial situation would lead to an omitted variable bias in the estimates. Secondly, we derive our theoretical predictions based on a model that assumes firms to operate under limited liability. This is the case for almost all corporate but not for non-corporate garages. Hence, restricting the dataset to the corporate enterprises appears reasonable.

The locations of the 134 corporate garages closely follow the population density within Germany. *Figures 1(a)* and *1(b)* illustrate this relationship.

The timing of the data collection is as follows:

1. Club members from all over Germany are asked whether they would like to participate in the garage test.

2. The automobile club checks whether the cars fit the test criteria. The cars have to be similar with respect to maintenance-related characteristics (concerning effort and time required): all cars had to be registered during the same time period for the first time, have a gasoline engine (of the most popular performance type), have to be due for the main inspection, and the owners need to present a detailed record of previous inspections.

3. Motor vehicle experts prepare the cars with the same five faults. The faults are the following: the license plate lamp does not work; the air pressure in the spare wheel is too low; the exhaust is loose; the coolant level is low; and the front-right light is displaced to the very bottom. If any of these faults cannot

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[11]See http://www.adac.de/infotestrat/tests/autohaus-werkstatt/ for details.

(a) Garage locations across Germany (source: Google Maps).

(b) Population density across Germany (source: Federal Institute for Research on Building, Urban Affairs and Spatial Development).

Figure 1: Location of garages and population density in Germany.

be implemented, the screen wiper blade on the passenger side is cut down to two centimeters. These potential faults are all listed in any of the car makers' inspection guidelines which means that they should be easily detected.

4. The automobile club sends these cars off to garages located in the vicinity of the car owner's residence. There is a maximum of one vehicle test per garage.

5. Each garage diagnoses either honestly or claims to have found more faults than there actually are.

6. The automobile club accepts any diagnosis by the mechanic.

7. Upon completion of the inspections, the automobile club assesses each garage's performance according to a detailed evaluation scheme that also includes issues related to service etc. The results are published in the club's monthly magazine (*ADAC motorwelt*) and can be readily accessed online. The automobile club gives detailed reports on each garage by exactly listing how many faults were found and fixed and whether only those repairs actually performed were charged.

Our binary dependent variable *overcharging* indicates whether a garage charged for a repair it did not perform. Note that our data only covers parts of the garages'

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Table 1: Overview on variables.

Variable	Proxy	Source
Overcharging	Treatments charged but not performed	ADAC experiment, 2006 & 2008–2010
Competition intensity	# of competitors within 10km is above median	*Gelbe Seiten* from 2011
Financial situation	Negative equity	*Elektronischer Bundesanzeiger*, 2006 & 2008–2010
Competence	# of faults found out of 5	ADAC experiment, 2006 & 2008–2010
Low reputation	Distance to next interstate less than 1500m	Google Maps Distance Calculator, 2010

overcharging behavior as we can only determine whether or not a garage charges more repairs than performed. We cannot account for more expensive repairs charged than performed. We consider the number of faults detected by the garage from the automobile club's dataset as an indicator for a garage's competence.

This very basic dataset does not allow us to investigate the impact of the other three key economic variables we are interested in: competition, the firm's financial situation, and its reputational concerns. In order to analyze their influence, we complement the automobile club's dataset in three steps: we (i) introduce a measure for the competitive environment each of the garages does business in, (ii) check for the garages' financial indicators, and (iii) suggest a proxy for reputational concerns (see *Appendix B* for screenshots of the data collection). *Table 1* provides an overview over the variables, the proxies, and the respective data sources.

Ad (i): in order to evaluate the strength of the competition a garage faces, we analyze the number of competitors in a garage's neighborhood. We choose the number of competitors as an indicator for competition over other measures such as the Hirschman-Herfindahl Index (Hirschman, 1964) and the price-cost margin (Boone, 2008) because of data availability. Note that the number of competitors has been used as a proxy for competition by other studies in credence goods markets before (see, e. g., Pike, 2010).

We collect the number of garages that are within a distance of ten kilometers from the garage that is characterized. We consider ten kilometers to be the average distance a potential customer is willing to travel to a competitor.[12] We obtain the data on the number of competitors of every single garage through a request to the publicly available directory of businesses sorted by branches, the German version of yellow pages (*Gelbe Seiten*). *Gelbe Seiten* provides one of the largest phone and address lists of companies in Germany.[13] The great advantage of this database compared to, e. g., *Google Places*, is that the editing process ensures that businesses listed actually exist and fall into the category of car repair shops. We perform a search for "Autowerkstätten" ("car repair shops") within a radius of ten kilometers from the garage's address and count the number of results. Last, we divide the group of garages into those being above the median number of competitors and those below. By dichotomizing competition intensity, we account for the fact that garages' overcharging behavior most likely depends upon whether there are few or many competitors but not on whether there are one or two additional competitors within close proximity. Note importantly that our results do not rely on the dichotomization of the variable as shown in the robustness section.

Ad (ii): we extend the automobile club's dataset by adding the garages' financial situation at the beginning and the end of the test year. The financial data is publicly available through the Electronic Federal Gazette for corporate enterprises in Germany (*elektronischer Bundesanzeiger*).[14] According to German corporate law, enterprises are required to publish basic financial information for possible shareholders. In case the balance information was not available by August 2011, we proxied the financial data by using the data from the year before. We divide the garages into those with positive equity and those with negative equity either at the beginning or the end of the year. A firm faces negative equity if its debts exceed its assets. These firms are in a critical financial situation because banks are no longer willing to lend additional money. Firms with a negative equity are not yet bankrupt, though. Bankruptcy is only reached if one of the debts is due and cannot be paid back to the lender. As the amount of a firm's equity is correlated with firm size, we dichotomize the equity variable. Hence, we only capture the firm's financial status without confounding the status with firm size. We choose to use equity as a proxy for a firm's financial situation over other indicators such as profit because equity is

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[12]Our results do not change if we take five or 20 kilometers as the radius a customer is willing to travel (see *Section 5* for robustness checks).

[13]See http://www.gelbeseiten.de for details.

[14]See http://www.bundesanzeiger.de for details.

not subject to yearly upturns and/or downturns. In particular, equity is invariant with respect to depreciation.

Ad (iii): we extend the database by adding the garages' distance to the next interstate. We consider this distance as a good proxy for a garage's reputational concerns. Cars that break down on the interstate are usually towed to the next garage.[15] This means that those garages that are located close to an interstate face more one-time interactions. More one-time interactions imply a lower chance of repeat business. As a consequence, they are less concerned when it comes to building up a reputation compared to the garages that are located further away from an interstate. We consider garages that are located less than 1500 meters away from an interstate to be close and all others not to be close to an interstate.[16] We dichotomize the distance to the next interstate because cars are hardly ever towed to a garage that is far away from the interstate. This holds irrespective of whether the garage is ten or 30 kilometers away from the next interstate. We complement the dataset by the garages' exact distances to the next interstate which we calculate using *Google Maps Distance Calculator*. The *Google Maps Distance Calculator* uses *Google*'s geographic database via APIs and enables the user to select two arbitrary points on the map in order to calculate the air-line distance.[17] We take the garage's address as the reference point and the closest point on the next interstate as the second point.[18]

Identification

Given the above described variables and their measurement, the main identification challenge is reverse causality. We will also shortly comment on measurement errors and possibly omitted variables. The relationship between reputational concerns and overcharging as well as the level of competition and overcharging might be reverse causal. This is because the choice of a garage's location and thus the distance to the next interstate and the level of competition might not be exogenous to explain overcharging. There are three reasons why we think that a garage's location is indeed exogenous: firstly, the average age of the garages that overcharged in the test

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[15]The vast majority of the overall number of towings in Germany are conducted by the ADAC. The ADAC always tows to the next garage as their free service for members. Having one's car towed to any other garage is subject to a service fee (see `http://www.adac.de/mitgliedschaft/leistungen/default.aspx`).

[16]Our results are robust if we consider garages less than 1000 meters or less than 2000 meters away from the next interstate as being close to the interstate (see *Section 5*).

[17]Note that our results are robust to using different distance measures as the actual way from the next interstate exit to the garages (see *Appendix 11*).

[18]See `http://www.daftlogic.com/projects-google-maps-distance-calculator.htm` for details.

amounts to 20 years (the minimum age to ten years). The garage's overcharging behavior today would have to be correlated with the choice of location twenty years ago if endogeneity concerns were to hold. Hence, a reverse causality does not seem very plausible. Secondly, garages cannot be located anywhere but have to be opened up within a zoned area. Thus, garages are not free to choose a location but are restricted in their choice of location. Thirdly, asking business insiders about where to open new garages provides a clear message: maximizing customer visits is the main goal.[19] These three reasons strengthen our argument that the location is not chosen with respect to the type of interaction (i.e., repeated or one-time) or the number of competitors.

Reverse causality between the incentive to overcharge and a garage's financial situation might also exist. As overcharging influences the firm's financial situation, we might encounter endogeneity when considering the equity at the end of the year. Note, however, that overcharging increases equity compared to an honest repair. Consequently, if there was reverse causality between overcharging and a firm's equity, we underestimate the effect of the financial situation on the probability of overcharging. Thus, reverse causality with respect to the financial situation would weaken our results.[20]

Minor identification challenges might arise due to potential measurement errors and omitted variables. A possible concern with respect to the measurement of overcharging is that garages might not have intentionally overcharged but by mistake. As we cannot distinguish between intended and unintended overcharging, we have to assume that garages are fully aware of which services they bill. As to omitted variables, we perform extensive robustness checks with respect to garages' properties and yearly variations. Due to the limited number of observations, we are not able to account for regional differences that might arise from different customer populations. It would be interesting to see, for example, whether garages are more likely to locate in areas where customers' knowledge of car repair is limited.

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[19]See, e.g., Johnson, D.L.: "6 tips to start your auto repair shop business today" (see `http://ezinearticles.com/?6-Tips-To-Start-Your-Auto-Repair-Shop-Business-Today&id=1176780`) or eHow: "How to open an auto repair shop" (see `http://www.ehow.com/how_2387498_open-auto-repair-shop.html`).

[20]One might argue that garages that frequently overcharge may face a decreased equity in the long-run. Remember, however, that customers do not observe overcharging. Hence, it is difficult for them to punish garages that overcharge even in the long-run.

Table 2: Descriptives.

Variable	Mean	Standard deviation	Min	Max	Obs.
Overcharging (= 1 if true)	0.045	0.208	0	1	134
Intense competition (= 1 if # of competitors is above median)	0.500	0.502	0	1	134
Critical financial situation (= 1 if true)	0.134	0.342	0	1	134
Competence (# of faults found out of 5)	4.239	1.125	0	5	134
Low reputation (= 1 if distance < 1500m)	0.284	0.452	0	1	134

3.2   Descriptives

After restricting the dataset, it contains 134 corporate garages of which 128 did not overcharge, i.e., we find that six (4.5%) of the garages overcharged their customers (see *Table 2*). This number is in accordance with Schneider (2012) who finds that in three out of 51 visits (or 6%) overcharging occurred.[21] Although 4.5% overcharging cases might not seem to be a lot, the issue of overcharging is an important problem as motivated in the introduction. The yearly turnover in the market for car repairs amounts to about 30 billion Euros in Germany alone (Zentralverband Deutsches Kraftfahrzeuggewerbe (Ed.), 2012). Following our data, the value of transactions where overcharging is involved would make up about 1.35 billion Euros per year which is far from negligible.

Table 2 also provides the descriptives for the four explanatory variables. 13.4% of the garages face a critical financial situation. About half of the garages by construction face of the variable an intense competition. The high competence (4.24 faults found out of 5) is due to the fact that the faults are all listed on the mechanics' checklists for inspections issued by all carmakers. 27.3% of the garages are close to the interstate and therefore have low reputational concerns.

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[21]The average amount overcharged was \$32 per incident in the study by Schneider (2012). The sum of overchargings across all visits accounted for two percent of total charges.

Table 3: Characteristics of the garages that overcharge.

Garage	Intense competition	Critical financial situation	Competence	Low reputation
Garage 1	0	0	4	0
Garage 2	0	0	1	1
Garage 3	0	1	4	1
Garage 4	0	0	2	1
Garage 5	0	1	4	0
Garage 6	1	1	3	0

In order to provide a detailed characterization of the six garages that overcharged, *Table 3* lists the values for all four variables for each of these garages.[22] Note that there is considerable variation in the three variables critical financial situation, competence, and low reputation. The variable competition intensity, however, is almost separated. We will account for this quasi-separation in our data analysis by using a special type of regression analysis.

The correlations given in *Table 4* provide a first impression concerning the relationship between the different variables. All four explanatory variables prove to be correlated with the explained variable *overcharging*. Looking at the relationship between the explanatory variables, we observe that an intense competition is slightly correlated with low reputational concerns. Furthermore, a low competence is weakly correlated with a critical financial situation. This may be due to the fact that a garage with only a low competence attracts fewer customers than those garages with a high competence. Note, though, that the correlations between the variables amount to a maximum of 23.2% and are hence far from a collinear relationship.

Table 5 and *Figure 2* illustrate that the two groups—garages that do and do not overcharge—differ considerably in their characteristics: *Figure 2(a)* shows that garages that overcharge face an intense competition less often than those garages that do not overcharge. This difference in competition intensity is weakly significant (Mann Whitney U Test, two-tailed: $p = 0.096$). 50% of the garages that overcharge are in a critical financial situation whereas significantly fewer of those garages that do

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[22]Note that the automobile club requested us not to publish names and addresses of the garages involved in the test. Therefore, garages are anonymous in *Table 3*.

Table 4: Correlations.

Variable	Over-charging	Intense competition	Critical fin. situation	Com-petence	Low reputation
Overcharging	1				
Intense competition	−0.144	1			
Critical fin. sit.	0.232	0	1		
Competence	−0.239	−0.027	−0.201	1.000	
Low reputation	0.104	0.232	−0.005	0.086	1

Table 5: Mean comparisons between garages that did and did not overcharge.
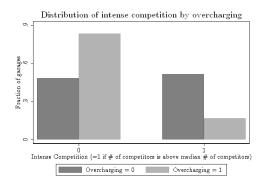
	Intense competition*	Critical financial situation***	Competence***	Low reputation
Overcharging = 1	0.167	0.500	3.000	0.500
Overcharging = 0	0.516	0.117	4.297	0.273

Mann Whitney U Test, two-tailed: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
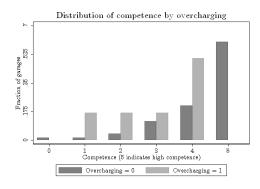
not overcharge have a critical financial background (11.7%, Mann Whitney U Test, two-tailed: $p = 0.007$; see also *Figure 2(b)*). The average competence of garages that overcharge is significantly lower than the average competence of those garages that do not overcharge (Mann Whitney U Test, two-tailed: $p = 0.003$; see also *Figure 2(c)*). *Figure 2(d)* suggests that garages that overcharge have low reputational concerns more often than garages that do not overcharge. However, this difference is not statistically significant (Mann Whitney U Test, two-tailed: $p = 0.231$).

4   Results
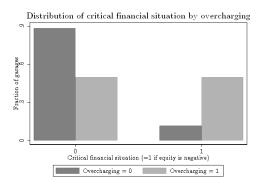
The small sample of our empirical analysis, the skewed distribution of our dependent variable, and the quasi-separation of the data with respect to competition intensity represent a challenge concerning the derivation of meaningful conclusions. When addressing these issues, we make use of a well-established method—namely the Firth logit regression (Firth, 1993)—which is typically used in other research areas
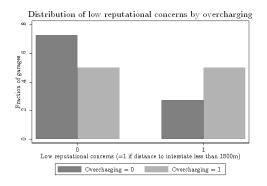
(a) Distribution of intense competition by overcharging.

(b) Distribution of critical financial situation by overcharging.

(c) Distribution of competence by overcharging.

(d) Distribution of low reputational concerns by overcharging.

Figure 2: Distribution of explanatory variables by overcharging.

where small samples, a skewed distribution of the dependent variable, and a quasi-separation are frequently observed phenomena. Most importantly, note that our results do *not* depend on the choice of the regression model used as we will show in the robustness checks (see section 5).

Let us shortly comment on the advantages of the Firth regression: the standard maximum likelihood estimation used in binary regression models assumes the sample to be large. As the sample size converges to infinity, the parameter estimates converge to the true parameter values. Hence, estimates may be biased in smaller samples. The Firth regression uses a penalized likelihood estimation removing the first-order bias that occurs due to the small sample (Heinze, 2006). The Firth approach also regularizes the data and thereby circumvents the separation problem (Zorn, 2005). Hence, the Firth regression always leads to finite parameter estimates which is not the case when using regressions based on the standard maximum like-

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lihood estimation. The approach is frequently used in medical research[23] and has proven to outperform alternative small sample models such as the exact logistic regression (Heinze, 2006). Heinze (2006) highlights that for small samples "penalized likelihood confidence intervals for parameters show excellent behavior in terms of coverage probability and provide higher power than exact confidence intervals."

Needless to say, the fact that only six out of 134 garages overcharged makes the identification of effects more difficult than if the dependent variable exhibited a higher variance. Note however, that at the given level of the type I error, the probability that we falsely reject the null hypotheses of 'no effect' amounts to 5%. Hence, if we can identify effects of the explanatory variables on overcharging, differences between garages that do and do not overcharge have to be considerably large. Then, we can in fact expect a systematic difference between both groups of garages and not just differences that arise by chance.

Given the four explanatory variables—competition intensity, financial situation, competence, and reputation—our Firth logit model is specified as follows:

$$
\begin{aligned}
firth\_logit(overcharging) = \beta_0 &+ \beta_1 intense\_competition \\
&+ \beta_2 critical\_financial\_situation \\
&+ \beta_3 competence + \beta_4 low\_reputation + \epsilon \qquad (1)
\end{aligned}
$$

We report the results of the Firth regression in *Table 6*. We also present the results of the linear probability model in order to ease interpretation. To evaluate the model fit, we calculate McFadden's R^2 for the binary response models and the ordinary R^2 for the linear model. We choose to use McFadden's R^2 as a measure for the binary model fit as it can also be applied to the Firth logit regression. McFadden's R^2 is defined as $1 - L1/L0$ where $L1$ is the log-likelihood of the fully specified model and $L0$ is the log-likelihood of the null model. Interpreting $L0$ as the total sum of squares in linear regression analysis and $L1$ as the residual sum of squares, McFadden's R^2 provides a similar measurement for the model fit compared to the ordinary R^2 (Wooldridge, 2009). McFadden (1979) suggests that models with an R^2 between 0.2 and 0.4 exhibit an excellent fit. The McFadden R^2 of our Firth regression amounts to 0.412 and is hence close to an excellent fit.

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[23]As an example, George et al. (2010) apply the Firth logit regression to the question of how a medication (phenylephrine) impacts spinal anesthesia-induced hypotension. Their work is based on a sample size of 45 test persons. Only nine test persons did not show a positive reaction to the medication.

Table 6: What drives fraud?

Overcharging	Firth logit	OLS
Intense competition	-2.049**	-0.078**
(= 1 if # of competitors > median)	(1.040)	(0.035)
Critical financial situation	1.757**	0.114**
(= 1 if true)	(0.891)	(0.051)
Competence	-0.765**	-0.041***
(# of faults found out of 5)	(0.315)	(0.015)
Low reputational concerns	2.078**	0.077**
(= 1 if distance < 1500m)	(0.999)	(0.039)
Constant	-0.510	0.220***
	(1.125)	(0.071)
McFadden R^2	0.412	–
R^2	–	0.142
Observations	134	134

Standard errors in parentheses, $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
p-values are based on two-tailed tests.

Let us next turn to the results.

Result 1. *Garages facing intense competition overcharge less often than those in a weakly competitive environment.*

In line with theory, we find that a high level of competition decreases the level of overcharging. According to the OLS estimates, a (highly) competitive environment decreases the probability of being overcharged by an expert by 7.8 percentage points. In fact, five out of the six garages that overcharge face a competition level that is lower than the median (see *Table 3*) whereas only every second garage that does not overcharge faces a competition level that is lower than the median (see *Table 5*).[24]

Result 2. *A critical financial situation leads to a larger incentive to overcharge.*

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[24]Note that clearly, the effect of competition crucially depends on whether experts' and customers' interests with respect to fraudulent behavior are aligned or not (see footnote 3). In their empirical study, Bennett et al. (2013) find that competition among experts for vehicle emissions tests increases fraud. This is due to the fact that in their case, car owners whose cars are passed at higher rates due to fiercer competition may benefit from fraud as they save money on costly repairs. This, however, gives experts a greater incentive to generate a competitive advantage through illicit actions which raises the question whether competition is necessarily the ideal market structure in such an environment.

Consistent with *Hypothesis 2*, we find that a critical financial situation increases a garage's incentive to overcharge. The OLS model estimates that a critical financial situation increases the probability of being overcharged by 11.4 percentage points. Garages in a critical financial situation overcharge more often compared to those with a solid financial background. In case overcharging is detected, the garage does not bear the costs of defrauding because it will file bankruptcy. On the other hand, if overcharging is not detected, the fraudulent behavior will help overcome the garages' financial difficulties.

Result 3. *A higher competence decreases the garages' incentive to overcharge.*

In line with *Hypothesis 3*, garages that exhibit high competence have a lower incentive to defraud their customers. The OLS regression results indicate that the probability of being overcharged decreases by 4.1 percentage points for each additional fault the garage detects.

Result 4. *Low reputational concerns increase the incentive to overcharge.*

Consistent with *Hypothesis 4*, the regression results show that low reputational concerns increase a garage's incentive to overcharge. The intuition is as follows: garages that have a low reputational concern, face many one-time interactions. Hence, they can overcharge their customers without hazarding a loss of future earnings. As recommended in Consumer Federation of America et al. (2011, p. 20), customers should "only do business with auto repair shops that you know and trust or that have good reputations based on other people's experiences. If you have any doubts about the diagnosis of your car's problem, bring it to another shop for a second opinion if possible." This statement is supported by our data. The OLS results suggest that the probability of a garage overcharging its customer is increased by 7.7 percentage points if the garage has low reputational concerns.

5   Robustness Checks

Our results turn out to be extremely robust against alternative models such as the logit model with a regular maximum likelihood estimator, the probit, and the scobit regression (see *Table 7*).[25] The latter accounts for the skewed distribution of

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[25]In order to improve the readability of this section, subsequent robustness check tables can be found in *Appendix B*.

the overcharging variable but is not significantly different from the logit regression. Significance levels of our explanatory variables remain practically unchanged when using these alternative models. The only decrease in a significance level from 5% to 10% occurs for the variable critical financial situation in the logit and probit model.

Table 7: Robustness against different models.

Overcharging	OLS	Logit	Probit	Scobit
Intense competition	-0.078**	-2.593**	-1.253**	-2.539**
(= 1 if # of competitors > median)	(0.035)	(1.262)	(0.605)	(1.162)
Critical financial situation	0.114**	1.966*	0.884*	2.014**
(= 1 if true)	(0.051)	(1.010)	(0.535)	(0.870)
Competence	-0.041***	-0.887**	-0.454**	-0.835***
(# of faults found out of 5)	(0.015)	(0.367)	(0.191)	(0.316)
Low reputational concerns	0.077**	2.423**	1.190**	2.264**
(= 1 if distance < 1500m)	(0.039)	(1.157)	(0.559)	(1.047)
Constant	0.220***	-0.540	-0.282	-15.006
	(0.071)	(1.263)	(0.717)	(1878.318)
McFadden R^2	–	0.352	0.345	0.365
R^2	0.142	–	–	–
Observations	134	134	134	134

Standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.
p-values are based on two-tailed tests.

The results are also robust against choosing different parameters as cut-off points. In the above analysis, we measured the number of competitors within ten kilometers and then divided the garages in two categories: those facing less or more competitors than the median level. As *Table 8* in *Appendix B* shows, measuring the number of competitors within five or 20 kilometers instead of ten kilometers does not change our results. Our results are also robust against including competition intensity as a continuous variable instead of using the dichotomized variable (see also *Table 8* in *Appendix B*). Looking at the variable of low reputational concerns, *Table 8* in *Appendix B* shows that when considering those garages within 1000 or 2000 meters instead of 1500 meters to the next interstate as being close to the interstate, we do not obtain results any different from the above analysis.

Table 9 in *Appendix B* presents the results of our robustness checks with respect to alternative specifications. We control for yearly effects in order to ensure that the financial crisis does not affect garages' behavior. The results remain unchanged.

Furthermore, we show that whether a garage is an authorized or independent garage does not change any of our results.

In addition, we check the robustness of our results against including those 25 garages that belong to the same chain in our analysis. Note that the financial situation between different garages of the chain does not vary. Thus, we have to exclude the garages' financial situation as a predictor for overcharging. This might lead to biased results as we have seen that the garages' financial situation plays a crucial role in explaining the experts' overcharging behavior. The other characteristics of the chain's garages are on average similar to the 134 garages. One out of the 25 garages overcharged which reflects almost exactly the mean overcharging level for the other 134 garages that do not belong to the chain. When analyzing the extended dataset, results again turn out to be fairly robust (see *Table 10* in *Appendix B*). The competition intensity and the garages' competence remain to be significant predictors of the garages' overcharging level. The coefficient of low reputational concerns is still positive as expected but not significantly different from zero anymore.

6 Conclusion

Making use of a field study, we analyze the impact of car repair shops' reputational concerns, their financial situation, the degree of market competition, and the garages' competence on their incentive to overcharge. In accordance with theory, we find that firms that care little about their reputation and those that struggle with a critical financial situation have a greater incentive to defraud their customers. On the other hand, firms with a high competence are less likely to overcharge. While Dulleck et al. (2011) do not find support for an effect of competition on the probability of overcharging in their experimental study, we show that in a more competitive environment, the expert's incentive to overcharge decreases. As such, our results provide field evidence for many of the aspects often found in recommendations by consumer-protection agencies.

On a general perspective, our results may provide insights into and testable hypotheses for the functioning of other credence goods markets. For example, applying our results to the health care market, a high physician density should reduce the physicians' incentive to overcharge. Additionally, general practitioners with repeated patient interaction should face a lower incentive to overcharge than specialists who are often only consulted once. Furthermore, our results may also provide important

implications for the comparison across different credence goods markets. Whereas the cab market is characterized by one time interactions, the market for legal advice is usually characterized by repeated interaction. In light of our analysis, we should expect more overcharging for taxi rides than for legal advice. Whether this is indeed the case is left for analysis in future studies.

Appendix A: Credence Good Market: Theoretical Predictions

Consider the following (car repair) market. There is a mass one of homogeneous customers (car owners) who all either face a major or a minor problem which occurs with an ex-ante probability of h and $1 - h$, respectively. The problem can be fixed through a major or minor treatment[26], respectively. Customers do not know which type of treatment they require. On the other hand, there are n liable expert firms (garages) (with $n \geq 2$) which are able to diagnose the treatment needed. Liability implies that experts cannot provide a minor treatment to customers facing a major problem, i.e., experts cannot undertreat their customers. Experts set treatment prices and incur costs for providing a treatment. The minor treatment induces costs c_L that are lower than for the major treatment c_H. Experts set a price p_L for the minor treatment and a price p_H for the major treatment.[27] Assuming that the customer cannot verify the type of treatment, experts have an incentive to overcharge customers with a minor problem by providing a minor treatment (at the lower costs) but charging for a major treatment. Customers get utility v if their problem is fixed and zero otherwise. They incur search costs of d (due to time and effort) per expert consulted independent of whether they accept the expert's recommendation. We assume that these costs are not too high ($d < (c_H - c_L)(1 - h)$), i.e., economies of scope are sufficiently low. This appears to be a reasonable assumption for inspections in the car repair market which follow a well-established routine. We also assume that it is always (i.e., even ex post) efficient that any customer with a problem is treated which means that $v - c_H - d > 0$ holds.[28] Note that—compatible with the car repair market—we consider the case where a customer is not committed to undergo the treatment recommended by the expert but may decide to spend additional per-visit search costs d on a second, third, etc. opinion instead. Moreover, customers are able to verify whether their problem has been fixed or not.

The timing of the stage game is as follows:

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[26] We apply the notion of minor and major treatment used in the credence goods literature. In the real-life market we analyze, the minor treatment corresponds to performing no treatment while the major treatment corresponds to performing a treatment.

[27] We assume that there is a lower bound equal to marginal costs c_H and an upper bound equal to $c_H + d$ for the price of the major treatment. The assumptions map to the car repair market because most car producers enjoin garages on a price range for inspections.

[28] We further assume that customers who are indifferent between visiting an expert and not visiting an expert opt for a visit. Customers who decide for a visit and are indifferent between two or more experts randomize (with equal probability) among them.

1. Nature determines the type of problem the customer has: with probability h, the customer has a major problem; with probability $1 - h$, he has a minor problem.

2. The customer chooses an expert firm and incurs search costs d.

3. The expert firm learns the customer's type of problem. Given that the customer has a minor problem, the expert firm decides to recommend a major treatment with probability x but provides the minor treatment (where $x \in [0, 1]$) and to recommend a minor treatment with probability $1 - x$. Given that the customer has a major problem, the expert firm recommends a major treatment with probability 1.

4. The customer decides whether to accept the expert's diagnosis.

5. If the customer accepts the diagnosis, the expert firm will charge accordingly. Otherwise the customer turns to a second expert firm and again incurs search costs d.

In this market with homogeneous customers and experts, the following result is obtained:[29]

Proposition 1. *There exists a symmetric weak perfect Bayesian equilibrium with the following characteristics:*

(i) *experts set prices $p_L = c_L + \Delta$ and $p_H = c_H > c_L + \Delta$ (where $\Delta > 0$ is a markup);*

(ii) *experts always recommend the major treatment if the customer has the major problem and they recommend the major treatment with probability $x \in (0, 1)$ if the customer has the minor problem (overcharging);*

(iii) *customers at their first visit always accept a minor recommendation and accept a major recommendation with probability $y \in (0, 1)$ and customers who visit a second (different) expert accept both recommendations with certainty; and*

(iv) *a customer who accepts a recommendation always gets sufficient treatment.*

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[29]The market and the insights presented here represent one of the cases discussed by Dulleck and Kerschbamer (2006) (see part (i) of their *Lemma 6* and the respective proof). The arguments to derive the first result closely follow their analysis.

Proof. Note that result (iv) is straightforward: due to liability, experts cannot undertreat their customers. Moreover, from the prices given in the proposition it follows that the cost differential satisfies $c_H - c_L > \Delta$, i.e., experts have no incentive to overtreat their customers.

In order to fully characterize an equilibrium with the above characteristics, consider the expert's recommendation decision given the customer's acceptance decision specified in the proposition. As mentioned in the main text, in equilibrium, an expert consulted by a customer with a minor problem must be indifferent between recommending the minor and major treatment, i.e.,

$$p_L - c_L = \frac{y + x(1-y)}{1 + x(1-y)}(p_H - c_L).^{30} \qquad (2)$$

Hence, the expert makes a strictly positive profit with the minor recommendation with certainty. The payoff from recommending the major treatment equals a lottery: if the recommendation is accepted which happens with a probability smaller than one, the experts makes a profit that is higher than for the minor recommendation; however, if the recommendation is not accepted, the payoff is equal to zero.

Next, consider customers' acceptance decisions: again as highlighted in the main text, a customer given the major recommendation must be indifferent between rejecting and accepting the diagnosis, i.e.,

$$d = \frac{x(1-h)}{h + x(1-h)}(1-x)(p_H - p_L).^{31} \qquad (3)$$

Hence, the additional costs of searching for a second opinion d must equal the expected savings from visiting a second expert firm (right-hand side). With probability $x(1-h)/(h+x(1-h))$, the customer has a minor problem given a major recommendation by the first expert. With probability $1-x$, the second expert is honest and recommends the minor treatment which means that the customer saves the cost differential $p_H - p_L$ compared to the first recommendation. Note that here, it becomes clear why a third visit does not pay off for a customer who is indifferent between accepting and rejecting a high-treatment recommendation on her first visit:

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[30] Note that in this case, the fraction $1/(1+x(1-y))$ of customers are on their first visit and accept the high recommendation with probability y. $x(1-y)/(1+x(1-y))$ customers are on their second visit and accept a high recommendation with certainty.

[31] Note that with probability $x(1-h)/(h+x(1-h))$, the customer suffers from a minor problem given a major recommendation at the first visit. With probability $1-x$, the second expert honestly recommends the minor treatment. In this case, the customer saves the cost differential $p_H - p_L$ compared to the first recommendation.

if she receives a high-treatment recommendation from a second expert, the probability that she actually only needs the minor treatment is lower compared to the first visit.

Furthermore, a customer who gets the minor recommendation always accepts. This means that experts always recommend the major treatment if the customer has the major problem as $p_L < c_H$.

Hence, for exogenously fixed prices $p_L = c_L + \Delta$ and $p_H = c_H > c_L + \Delta$ as well as for a markup Δ such that both the recommendation probability x and the acceptance probability y satisfy the compatibility constraints given by equations (2) and (3) and lie in between zero and one, the situation described in parts (i)–(iv) in the proposition is indeed part of a perfect Bayesian equilibrium.

Now consider the case where experts are free to charge p_L and choose a price $p_H \in [c_H, c_H + d]$. Denote by $\bar{x}$ ($\underline{x}$) the probability that an expert recommends the major treatment when the customer has the minor (major) problem. Furthermore, a customer who is recommended the major (minor) treatment believes that he has the major problem with probability $\bar{\mu}$ ($\underline{\mu}$). Accordingly, $\bar{y}$ ($\underline{y}$) denotes the probability that a customer accepts the recommendation of a major (minor) treatment. Last, a customer incurs expected costs of $k = d + (1-h)(1-x)(c_L+\Delta) + (h+(1-h)x)c_H > 0$ when he follows the proposed equilibrium strategy and experts make a profit of $\pi = (1-h)(1+x(1-y))\Delta > 0$ per customer when they stick to the proposed equilibrium strategy.

As far as customers' beliefs are concerned, suppose that beliefs are correct whenever expert charge those prices given in the proposition, i.e., $\bar{\mu}(p_L, p_H) = (h + x^2(1-h))/(h+x(1-h))$ and $\underline{\mu}(p_L, p_H) = x(1-h)/(h+x(1-h))$. Moreover, suppose that for out-of-equilibrium beliefs, it holds that (i) $\bar{\mu}(p_L, p_H) = 1$ and $\underline{\mu}(p_L, p_H) = 0$ if and only if $p_L \leq d + (1-x)(c_L + \Delta) + xc_H$ and $p_H \in [c_H, c_H + d)$ and (ii) $\bar{\mu}(p_L, p_H) = h$ and $\underline{\mu}(p_L, p_H) = 0$ otherwise.

Next, consider the following acceptance decisions: (i) $\underline{y}(p_L, p_H) = 1$ if and only if $p_L \leq d + (1-x)(c_L + \Delta) + xc_H$ and $\underline{y}(p_L, p_H) = 0$ otherwise and (ii) $\bar{y}(p_L, p_H) = 1$ if and only if either $p_L \leq d + (1-x)(c_L + \Delta) + xc_H$ and $p_H \leq c_H + d$ or $p_L > d + (1-x)(c_L + \Delta) + xc_H$ and $p_H \leq k$ and $\bar{y}(p_L, p_H)$ else.

Suppose further that a deviating expert always recommends the major treatment (i.e., $\underline{x}(p_L, p_H) = \bar{x}(p_L, p_H) = 1$), a customer never consults a deviating expert, and

the experts' price-posting strategy stipulates that they never deviate to set prices different from the ones given in the proposition.

To check whether the equilibrium candidate characterized above is a weak perfect Bayesian equilibrium, consider first the acceptance decisions: if a single expert deviates, the proposed price vector is still available because there is at least one remaining expert offering treatment services at these prices. Compared with expected cost k, a customer who believes that he has the minor (major) problem with certainty faces lower (higher) costs equal to $d + (1 - x)(c_L + \Delta) + xc_H$ $(d + c_H)$. Hence, customers' acceptance decisions are optimal. Given these decisions, $\underline{x}(p_L, p_H) = \bar{x}(p_L, p_H) = 1$ is optimal for a deviating expert as either $\bar{y}(p_L, p_H) = 1$ and $p_H \geq c_H$ or $\underline{y}(p_L, p_H) = \bar{y}(p_L, p_H) = 0$. In light of this recommendation policy and the observation that $p_H \geq c_H$, customers indeed rather stay away from deviating experts whose profit is zero. □

Impact of the number of firms

We consider the following adaptation of the initial market setting to analyze how a change in the number of experts influences the incentives to overcharge: suppose that an increase in the number of firms n leads to a decrease in search costs $d(n)$ as customers have to spend less time and effort searching for suitable experts.[32] In this case, we can readily state the following lemma:

Lemma 1. *All else equal, an increase in the number of expert firms active in the market reduces their incentive to overcharge.*

Proof. In this case, the initial indifference condition regarding a customer's acceptance decision given in (3) changes to

$$d(n) + \frac{x(1 - x)(1 - h)}{h + x(1 - h)} p_L + \left(1 - \frac{x(1 - x)(1 - h)}{h + x(1 - h)} \right) p_H = p_H. \tag{4}$$

Note that the left-hand side of equation (4) is lower than the one in equation (3). This means that customers find a second expert more easily and hence, the acceptance probability y of a major recommendation goes down. This in turn leads to a decrease in the probability that an expert firm dishonestly recommending the major treatment actually gets the business. More precisely, let

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[32]For example, if experts are horizontally differentiated, customers have to incur less transportation costs to reach a second expert when the number of experts in the market goes up.

$\chi := (y + x(1 - y))/(1 + x(1 - y))$. Then, $\partial\chi/\partial y = 1/(1 + x(1 - y))^2 > 0$. As a consequence, the scope for fraud is reduced as n increases because cheating becomes less profitable. □

Impact of the financial situation

In order to analyze the effect of an expert firm's financial situation on the incentives to overcharge, consider the following change to the situation described above: different from the initial setting, suppose that firms have identical fixed costs f to run their business but are heterogeneous regarding their financial assets. There are two groups of firm: firms in the first group need to attract customers as they only have limited resources left to pay their fixed costs f. Importantly, these firms only pay the fixed cost if they attract a customer. If they do not, they go bankrupt and receive a payoff of zero due to their limited liability. Firms in the second group have a much sounder financial background which means that they survive the current period even if they incur fixed costs without serving any customer. The following lemma takes a closer look at firms' incentives to defraud their customers in both groups:

Lemma 2. *All else equal, an expert firm which is in a critical financial situation is more likely to overcharge for its services.*

Proof. In this case, the initial incentive-compatibility constraint by equation (2) changes for an expert firm that is in financial distress to

$$p_L - c_L - f = \frac{y + x(1 - y)}{1 + x(1 - y)}(p_H - c_L - f). \tag{5}$$

Analogously, the incentive-compatibility constraint for the firm with the strong financial background must be equal to

$$p_L - c_L - f = \frac{y + x(1 - y)}{1 + x(1 - y)}(p_H - c_L - f) - \left(1 - \frac{y + x(1 - y)}{1 + x(1 - y)}\right)f. \tag{6}$$

Plugging constraint (5) into constraint (6) gives

$$\frac{y + x(1 - y)}{1 + x(1 - y)}(p_H - c_L - f) > \frac{y + x(1 - y)}{1 + x(1 - y)}(p_H - c_L - f) - \frac{1 - (y + x(1 - y))}{1 + x(1 - y)}f.$$

This means that whenever the incentive-compatibility constraint is satisfied for the financially weak expert firm, it is also satisfied for the financially strong firm. As a result, the latter has a lower incentive to defraud its customers as it finds it more profitable to recommend the minor treatment whenever it is needed. □

Impact of the expert's competence

Last, we analyze the effect of an expert firm's competence on the incentives to overcharge. To this end, consider the following change to the above framework. Again, there are two groups of firms. Firms in the two groups are heterogeneous with respect to their competence. The firms in the first group are of low competence and firms still incur costs c_L and c_H for the low and the major treatment, respectively. On the other hand, the firms of high competence in the second group can offer these services at lower costs of $c_L - \gamma$ and $c_H - \gamma$. Given this setup, we can state the following lemma:

Lemma 3. *All else equal, a high-competence firm is less likely to overcharge compared to its low-competence competitor.*

Proof. Note first that the incentive-compatibility constraint for the low-competence expert firm is the same as in the original setting and given by expression (2). The incentive-compatibility constraint for the high-competence firm equals

$$p_L - (c_L - \gamma) = \frac{y + x(1-y)}{1 + x(1-y)} \left(p_H - (c_L - \gamma) \right). \tag{7}$$

Plugging constraint (2) into constraint (7) gives

$$\frac{y + x(1-y)}{1 + x(1-y)}(p_H - c_L) + \gamma > \frac{y + x(1-y)}{1 + x(1-y)}(p_H - c_L + \gamma).$$

We can thus conclude that the high-competence firm has a lower incentive to defraud its customers. □

Appendix B: Tables for Robustness Checks

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Table 8: Robustness against different cut-off points.

Overcharging	Firth logit competition 5k	Firth logit competition 20k	Firth logit competition continuous	Firth logit reputation 1000m	Firth logit reputation 2000m
Intense competition (= 1 if # of competitors within 5k > median)	−1.933* (1.035)				
Intense competition (= 1 if # of competitors within 10k > median)				−1.759* (1.006)	−2.327** (1.075)
Intense competition (= 1 if # of competitors within 20k > median)		−1.844* (1.019)			
Intense competition (continuous)			−0.014* (0.008)		
Critical financial situation (= 1 if true)	1.546* (0.861)	1.580* (0.862)	1.876** (0.901)	1.811** (0.907)	1.864** (0.887)
Competence (# of faults found out of 5)	−0.800** (0.318)	−0.667** (0.301)	−0.707** (0.301)	−0.782** (0.317)	−0.754** (0.312)
Low reputational concerns (= 1 if distance < 1000m)				2.278** (1.031)	
Low reputational concerns (= 1 if distance < 1500m)	1.985** (0.991)	2.126** (0.981)	2.274** (1.026)		
Low reputational concerns (= 1 if distance < 2000m)					1.885* (1.019)
Constant	−0.339 (1.136)	−0.891 (1.086)	−0.365 (1.163)	-0.563 (1.121)	−0.529 (1.120)
McFadden R^2	0.400	0.389	0.620	0.426	0.392
Observations	134	134	134	134	134

Standard errors in parentheses, $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. p-values are based on two-tailed tests.

Table 9: Robustness against different specifications.

Overcharging	Firth logit	Firth logit controlling for authorized	Firth logit controlling for years
Intense competition ($= 1$ if # of competitors > median)	-2.049^{**} (1.040)	-2.043^{**} (1.036)	-1.956^{*} (1.160)
Critical financial situation ($= 1$ if true)	1.757^{**} (0.891)	1.720^{*} (0.887)	1.596^{*} (0.933)
Competence (# of faults found out of 5)	-0.765^{**} (0.315)	-0.747^{**} (0.312)	-0.713^{**} (0.317)
Low reputational concerns ($= 1$ if distance < 1500m)	2.078^{**} (0.999)	2.017^{**} (0.984)	2.286^{**} (1.056)
Authorized garage		1.037 (1.728)	
Year 2006			-0.260 (1.555)
Year 2008			0.179 (1.295)
Year 2009			-1.190 (1.397)
Constant	-0.510 (1.125)	-0.507 (1.119)	-0.257 (1.226)
McFadden R^2	0.412	0.375	0.426
Observations	134	134	134

Standard errors in parentheses, $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
p-values are based on two-tailed tests.

Table 10: Robustness against including the chain into the analysis.

	Firth logit
Intense competition (= 1 if # of competitors > median)	−1.760* (0.949)
Competence (# of faults found out of 5	−0.672** (0.273)
Low reputational concerns (= 1 if distance < 1500m)	1.153 (0.848)
Chain (=1 if true)	−0.678 (1.093)
Constant	−0.012 (1.014)
McFadden R^2	0.251
Observations	159

Standard errors in parentheses, *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.
p-values are based on two-tailed tests.

Table 11: Robustness against different distance measure.

Overcharging	Firth logit
Intense competition (= 1 if # of competitors > median)	−2.113** (1.063)
Critical financial situation (=1 if true)	2.558** (1.088)
Competence (# of faults found out of 5)	−0.676** (0.297)
Low reputational concerns (= 1 if driving distance to next interstate exit < 1500m)	3.457*** (1.243)
Constant	−0.971 1.250
Observations	134

Standard errors in parentheses, $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
p-values are based on two-tailed tests.

Appendix C: Screenshots of Data Collection

6.1 Overcharging

Figure 3: Data collection on the overcharging measurement. Source: `http://www.adac.de`, accessed on January 17, 2012.

6.2 Intense Competition

Figure 4: Data collection on the competition measurement. Source: `http://www.gelbeseiten.de`, accessed on January 17, 2012.

6.3 Financial Situation

Figure 5: Data collection on the financial situation. Source: `http://www.bundesanzeiger.de`, accessed on January 17, 2012.

6.4 Competence

Figure 6: Data collection on the competence measure. Source: `http://www.adac.de`, accessed on January 17, 2012.

6.5 Low Reputation
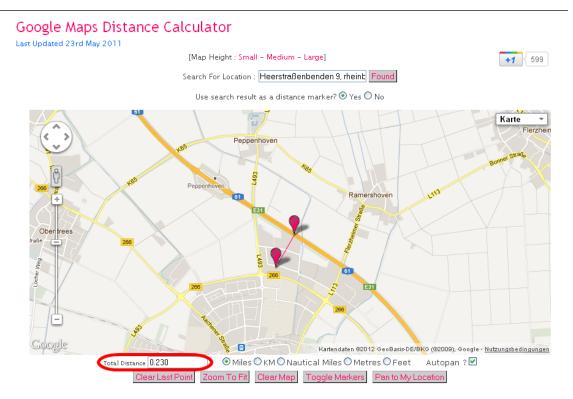
Figure 7: Data collection on the reputation measure. Source: http://www.daftlogic.com, accessed on January 17, 2012.

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