CESifo WORKING PAPERS

7046
2018

May 2018

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CESifo

Impressum:

CESifo Working Papers
ISSN 2364-1428 (electronic version)
Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH
The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute
Poschingerstr. 5, 81679 Munich, Germany
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Editors: Clemens Fuest, Oliver Falck, Jasmin Gröschl
www.cesifo-group.org/wp

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CESifo *Working Paper No. 7046*
Category 13: Behavioural Economics

Competition over Cursed Consumers

Abstract

We model firms' quality disclosure and pricing in the presence of cursed consumers, who fail to be sufficiently skeptical about undisclosed quality. We show that neither competition nor the presence of sophisticated consumers necessarily protect cursed consumers from being exploited. Exploitation arises if markets are vertically differentiated, if there are few cursed consumers, and if average product quality is high. Three common policy measures aimed at consumer protection, i.e. mandatory disclosure, third party disclosure and consumer education may all increase exploitation and decrease welfare. Even where these policies improve overall welfare, they often lead to a reduction in consumer surplus.

JEL-Codes: C720, D030, D820, D830.

Keywords: naïve, cursed, disclosure, consumer protection, labeling, competition.

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May 2018
We thank Yves Breitmoser, Daisy Dai, David Ettinger, Erik Eyster, Fabian Gaessler, Jeanne Hagenbach, Doh-Shin Jeon, Laurent Linnemer, Takeshi Murooka, Regis Renault, Klaus Schmidt, Robert Somogyi, Frances Spies as well as seminar participants at the Paris School of Economics, Tilburg University, CREST, Université Paris-Dauphine, University of Munich, JKU Linz, SITE Economics and Psychology Workshop, CESifo Behavioral Economics conference, CEPR/JIE School on Applied Industrial Organization, IIOC in Philadelphia, PsyCHIC Workshop in Paris, MBEES, European Summer Meeting of the Econometric Society in Geneva, and the EIEF-Unibo-IGIER Workshop at Bocconi University for useful comments.

1 Introduction

Firms generally have better information about the quality of their products and services than consumers. A food producer knows the nutritional content of its products, a hospital collects data on the effectiveness of its care, and a financial advisor is aware of her conflicts of interest. Under the right circumstances, firms' voluntary disclosure of verifiable information has the potential to eradicate any information asymmetry between firms and consumers (Grossman and Hart, 1980; Grossman, 1981; Milgrom, 1981): since high-quality firms will disclose in order to separate themselves from low-quality firms, consumers can infer that undisclosed quality is likely to be low. However, reliance on voluntary disclosure requires a high degree of consumer sophistication.

If consumers are cursed (Eyster and Rabin, 2005), then they fail to condition their quality perception on firms' disclosure strategies and remain too optimistic about quality in the face of non-disclosure. Cursedness can thus explain the failure of information transmission observed in many markets (see Fung, Graham and Weil 2007 and Dranove and Jin 2010 for surveys) and provides an apparent rationale for protecting consumers by means of mandatory disclosure laws (e.g. the US Nutrition Labeling and Education Act), third party disclosure (e.g. the Hospital Compare webpage) or consumer education (e.g. the EU financial literacy initiative).[1]

This paper explores the exploitation of cursed consumers and the effectiveness of common policy measures designed to protect them. A growing empirical literature documents firms' strategic non-disclosure of private information and consumers' misinference when they encounter non-disclosure. Our main contribution lies in demonstrating that neither observation necessarily implies a useful role for common consumer protection policies and in deriving the conditions under which such policies backfire.

We first model the interaction between privately informed firms and cursed consumers in the simplest possible setting and then enrich the model along various dimensions, both to investigate the scope and robustness of our results and to address important additional

[1]The EU financial literacy initiative educates consumers about the information they are entitled to demand from their financial service providers. For an example, see the EU regulation on key information documents for packaged retail and insurance-based investment products at http://data.europa.eu/eli/reg/2014/1286/oj.

questions. Our main model features two firms with identical marginal costs, each selling a single product with exogenous quality that may either be high or low. Firms simultaneously choose prices and whether to disclose quality. While quality cannot be misreported (e.g. for fear of litigation), it can be concealed. Consumers consist of both sophisticated and (fully) cursed types.[2] Cursed consumers do not understand that a firm's disclosure decision depends on the quality of its product. While they rationally take disclosed quality at face value, they believe that a firm that does not disclose has average quality.[3] Consumers are homogeneous in their tastes – though not necessarily in their subjective valuations – and efficiency demands that they all purchase the higher quality good. Exploitation takes the following form: a cursed consumer buys a low-quality product at a price that is higher than her objective valuation.

Exploitation can only occur when firms are vertically differentiated, i.e. when realized product qualities are heterogeneous. When qualities are the same, a Bertrand logic applies and firms price at marginal cost irrespective of their quality level and the sophistication of consumers. In the case of heterogeneous qualities, the high-quality firm always discloses and the low-quality firm never discloses. But cursed consumers are only exploited if the high-quality firm is unwilling to attract them. This happens when cursed consumers are few and when they are optimistic about the undisclosed (low) quality, i.e. because average quality is high. If there are only a few cursed consumers, then the high-quality firm has little incentive to attract them by lowering prices on inframarginal sophisticated consumers. Similarly, if cursed consumers are optimistic about the undisclosed quality, they require too low of a price to buy high quality.

Common remedies against exploitation aim at decreasing the proportion of consumers with a mistaken perception of product quality. Consumer education teaches some cursed consumers how to interpret non-disclosure; mandatory disclosure forces firms to make it easier

[2]This bimodal distribution of strategic sophistication is consistent with experimental evidence from disclosure games (Jin, Luca and Martin, 2016; Deversi, Ispano and Schwardmann, 2017), selection contexts (Enke, 2017), and second-price auctions (Turocy and Cason, 2015).

[3]Our analysis builds on the premise that some consumers may hold overoptimistic beliefs upon observing non-disclosure. Other forms of naivete, like analogy-based reasoning (Jehiel, 2005; Jehiel and Koessler, 2008), can also deliver this assumption.

for consumers to spot quality-relevant information on product labels and in contracts;[4] and third party disclosure (e.g. by an online platform) allows those consumers who are aware of the third party (e.g. the more tech-savy) to find out the exact quality of products. If policy measures are imperfect, then a small to medium-sized group of cursed consumers remains. It is precisely then that cursed consumers are exploited and the market equilibrium is inefficient.

Perfect policy measures eradicate all quality misperceptions and lead to efficiency. However, they may still erode consumer surplus through their equilibrium effect on prices. Because cursed consumers maintain too favorable an expectation of a silent (low-quality) firm's product, they reduce the price a high-quality firm charges. In this way their presence generates a positive externality for both sophisticated and other cursed consumers.

Market structure is an important determinant of the effect of consumer protection policy. In particular, the policy implications of the two-firm model differ from those we arrive at when considering a monopoly firm. When a monopolist exploits cursed consumers, it necessarily excludes sophisticated consumers. Since this is inefficient, cursed consumers generate a negative externality on society as a whole and consumer protection policies are unambiguously welfare-enhancing.

We analyze four extensions of our main model. First, we study endogenous quality choice to better understand the effect of product market interactions and policies on firms' incentive to innovate and invest in quality. Vertical differentiation with minimal low quality arises endogenously in equilibrium. Exploitation still occurs if the fraction of cursed consumers is too small. When some consumers buy the low-quality product, the high-quality firm's incentives to invest in quality are blunted because it benefits less from its quality advantage. As a result, the inefficiency associated with common policy measures may be exacerbated.

Second, we consider markets in which firms are not only vertically but also horizontally differentiated. Now, some consumers should rationally buy a low-quality product, e.g. because they are located near the firm selling it. We find that cursed consumers still exert a

[4]Mandatory disclosure is imperfect if firms are forced to disclose information but fail to do so in a salient manner, leaving some consumers with mistaken beliefs. See Stango and Zinman (2011) for an example of non-salient disclosure and exploitation in consumer finance.

positive externality on both cursed and sophisticated consumers. Moreover, consumer protection may still backfire.

Third, we investigate the effect of an increase in the number of firms in the market. More competition increases inefficiencies when additional firms produce low-quality products, but it completely eradicates inefficiencies when a second high-quality firm enters the market. Exploitation therefore relies on the presence of a single, vertically differentiated, high-quality firm (or a colluding set of high-quality firms).

Fourth, we allow for comparative advertising. A vertically differentiated high-quality firm always has an incentive to engage in comparative advertising. However, if comparative advertising is imperfect or costly, then it is associated with the same drawbacks as consumer protection.

The next section discusses the related literature. We set up the main model in section 3 and analyze it in section 4. Section 5 features extensions to the model. In the conclusion, we discuss general policy lessons, testable implications of our model, and avenues for future research. All proofs are in the appendix.

2 Related literature

Our paper is motivated by an empirical literature on quality disclosure (see Dranove and Jin 2010 and Fung, Graham and Weil 2007) that rarely finds the complete unraveling or full disclosure predicted by seminal theoretical work.[5] While incomplete disclosure can be explained by high disclosure costs, information being unavailable, or more complicated strategic considerations[6] consumer naivete or cursedness is likely to be a key driver. First, naivete on behalf of the uninformed party drives non-disclosure in experimental disclosure games, which

[5]When there are many quality levels and disclosure is free, all firms save for the firm with the lowest quality, have a strict incentive to disclose (Grossman and Hart 1980; Grossman 1981; Milgrom 1981). The firm with the highest quality discloses to separate from the pool of lower quality firms. This in turn provides the firm with the second highest quality with an incentive to disclose, etc.

[6]See for instance Matthews and Postlewaite (1985), Anderson and Renault (2006), Board (2009), Koessler and Renault (2012) and Janssen and Roy (2015).

can rule out rational explanations for non-disclosure.[7] Second, non-disclosure occurs in field settings with negligible disclosure costs. For example, Mathios (2000) finds that the producers of salad dressings do not disclose fat content even when the product in question is not among the very fattiest of products. Third, consumers' difficulty with interpreting non-disclosure has also been documented in the field. Brown, Camerer and Lovallo (2012) find that movie goers are systematically fooled into viewing bad movies that avoid certification from reviewers by being cold-opened.

Imperfect skepticism on behalf of receivers in disclosure games has received little attention in the theoretical literature since it was first studied by Milgrom and Roberts (1986).[8] In their model, senders make no pricing decisions, all receivers are naive and no exploitation occurs in equilibrium. Going beyond this, we show that firms' pricing decisions and heterogeneity in consumers' sophistication are key to understanding exploitation and the effects of policy.

We contribute to a growing literature on the equilibrium effects of consumer protection policies.[9] Papers in this literature tend to focus on different consumer biases (e.g. inattention and present bias) and on different policies (e.g. setting defaults and sending reminders), but share our theme that well-intentioned policy can have negative effects once firms' equilibrium responses are accounted for.

Our paper also complements the shrouded attributes literature (Gabaix and Laibson, 2006, Armstrong and Vickers, 2012 and Heidhues, Kőszegi and Murooka, 2017), which is concerned with firms that can charge add-on prices that exploit naive consumers and are avoided by sophisticated consumers. Our model applies to a different set of markets, i.e. those in which purchases are made in once-off transactions,[10] and reaches different conclusions. Un-

[7]For evidence from the lab see Forsythe, Isaac and Palfrey (1989), King and Wallin (1991), Forsythe, Lundholm and Rietz (1999), Jin, Luca and Martin (2016), Hagenbach and Perez-Richet (2017) and Deversi, Ispano and Schwardmann (2017).

[8]Hagenbach and Koessler (2017) extend the analysis of Milgrom and Roberts (1986) to the case in which the sender is sometimes uninformed. Fishman and Hagerty (2003) consider a monopolist facing consumers that are fully sophisticated but do not understand the content of disclosure.

[9]For example, see Armstrong, Vickers and Zhou (2009), Armstrong and Vickers (2012), Handel (2013), De Clippel, Eliaz and Rozen (2014), Piccione and Spiegler (2012), Spiegler (2015), Johnen (2017) and Murooka and Schwarz (2018).

[10]A typical shrouded attribute model reduces to our model if firms can credibly disclose a lack of add-on costs and if consumers can only avoid paying the add-on costs by not buying the product in question.

like in our model, Gabaix and Laibson (2006) and Heidhues, Kőszegi and Murooka (2017) find that deceptive equilibria are more likely when there are fewer sophisticated consumers, that mandatory disclosure of add-on costs generally makes consumers better off and that non-deceptive firms often have no incentive to educate naive consumers.

Kosfeld and Schüwer (2017) show that if firms in a shrouded attribute model can price discriminate between different levels of sophistication, then educating naive consumers may increase exploitation. We derive a similar result in a simpler setting and based on a different mechanism since, in line with many of the markets we are interested in, we assume that firms do not have information about the sophistication of their individual customers. Our mechanism has more in common with the search literature (Anderson and Renault, 2000; Armstrong, 2015), which demonstrates that the presence of informed consumers may harm uninformed ones by increasing firms' market power.

Three contemporaneous papers investigate the impact of cursed inference on financial markets (Eyster, Rabin and Vayanos 2015 and Kondor and Köszegi 2017) and the macro economy (Eyster, Madarasz and Michaillat, 2015). Kondor and Köszegi (2017) study security design by better-informed issuers facing cursed investors. Providing cursed investors with information increases their confidence and the scope for issuers to profitably exploit their belief disagreement with investors. In our model, providing information backfires because of its effect on socially desirable firms' pricing strategies.

3 Setup

Two firms produce substitute goods and compete for a mass one of consumers with unit demand. Consumers have homogeneous preferences and derive utility $q-p$ from purchasing a good, where p denotes the good's price and q its quality. Each firm's quality is independently drawn from a commonly known binary distribution with mean μ. A firm's quality is equal to q_h with probability $\theta \in (0,1)$ and equal to q_ℓ with complementary probability, where $0 \leq$

$q_\ell < q_h$.[11]

We will refer to a generic firm as i and to its competitor as j. Qualities q_i and q_j are known to both firms and (initially) unknown to consumers. Each firm can credibly reveal the quality of its own product to consumers at no cost ($m_i = q_i$) or remain silent ($m_i = \emptyset$). A firm cannot reveal the quality of its rival, an assumption we relax in section 5.4. Marginal costs of production are normalized to zero.

A fraction $\chi \in (0,1)$ of consumers is fully cursed, as in Eyster and Rabin (2005). The remaining consumers, whose proportion is $1-\chi$, are rational. Because fully cursed consumers draw no inference about quality from a firm's failure to disclose, their perception of a silent firm's quality is equal to their prior, i.e. average quality μ.

We consider the following timing:

- **t=0**: Firms observe q_i and q_j,
- **t=1**: Each firm simultaneously decides whether or not to disclose quality and posts a price $p_i \geq 0$,
- **t=2**: Consumers observe firms' disclosure and pricing decisions and choose a product or an outside option of zero.

Our solution concept is the Perfect Bayesian Equilibrium with two natural adaptations to our setting. First, if a firm discloses, then consumers' beliefs about its quality are equal to the disclosed quality. Second, the beliefs of cursed consumers about undisclosed quality need not be correct. For simplicity and ease of exposition, we restrict our attention to equilibria in which disclosure decisions entail no randomization.[12] Moreover, we resolve any trivial multiplicity with the convention that firms and consumers who are indifferent choose respectively to sell and buy.

We use our model to study the effects of three consumer protection policies, i.e. consumer education, mandatory disclosure, and third party disclosure. Each of these policies has the

[11] Our equilibrium analysis also applies to settings in which $q_\ell < 0$ (and μ is positive), i.e. in which a low-quality product hurts consumers. Welfare should then include an additional potential source of inefficiency, i.e. that consumers purchase the harmful product rather than no product at all when high quality is not available.

[12] See Milgrom and Roberts (1986) for a discussion of the role of this assumption.

effect of turning some consumers with cursed beliefs upon non-disclosure into consumers with accurate beliefs, either by making them rational or by assuring that information is disclosed to them. We will distinguish between perfect and imperfect consumer protection policies. The former results in a completely informed consumer base, which, as will become clear, is equivalent to assuming that $\chi = 0$. The latter merely leads to a reduction in the proportion of cursed types.

4 Analysis

Before we analyze the main model with two firms and heterogeneous strategic sophistication on behalf of consumers, we establish two important benchmarks. We study, in turn, the case of a monopoly firm and the case of competition over only rational consumers.

4.1 Benchmark: Monopoly with cursed and rational consumers

Suppose that there is a single firm. The following proposition characterizes the unique equilibrium outcome.

Proposition 1 (Monopoly)**.** *If quality is high, then the monopoly discloses, charges $p^* = q_h$, and attracts all consumers. If quality is low and*

- $q_\ell \geq \chi\mu$*, then the monopolist is indifferent between disclosing and not disclosing, charges $p^* = q_\ell$ and attracts all consumers;*
- $q_\ell < \chi\mu$*, then the monopolist does not disclose, charges $p^* = \mu$, and attracts only cursed consumers.*

A monopolist with high quality discloses in order to separate from the low-quality type. Since rational consumers anticipate this disclosure strategy, a monopolist with low quality must essentially choose between two strategies. It can either charge a relatively low price of q_ℓ and attract all consumers, or it can remain silent, charge a relatively high price of μ, and sell only to cursed consumers. Naturally, the latter strategy is more attractive when the low quality level is not too high, when cursed consumers are many, and when their perceived quality upon non-disclosure is high, i.e. when $q_\ell < \chi\mu$.

If $q_\ell < \chi\mu$, then cursed consumers are exploited by the monopolist, because they pay μ for a product that yields consumption utility of less than μ. Moreover, if $q_\ell < \chi\mu$ and the low-quality good is of some value to consumers ($q_\ell > 0$), then welfare is lower than total gains from trade because rational consumers refrain from buying upon observing non-disclosure.

The presence of rational consumers is beneficial to cursed consumers because it limits exploitation. Conversely, cursed consumers exert a negative externality on other cursed consumers and no externality on rational consumers, whose utility is always zero because the monopolist either extracts all of their surplus or excludes them. The previous observations directly imply the following result.

Corollary 1 (Policy interventions under monopoly)**.** *Perfect and imperfect consumer protection policies are weakly beneficial to cursed consumers, have no effect on the utility of rational consumers, and are weakly harmful to the monopolist. Imperfect consumer protection weakly improves and perfect consumer protection ensures efficiency.*

Under monopoly, common consumer protection policies emerge as unambiguously desirable. Since a cursed consumer often behaves suboptimally and exerts a weakly negative externality on rational and other cursed consumers alike, eliminating the bias improves consumer surplus and welfare. Our main model in section 4.3 will demonstrate that this seductive intuition is not necessarily robust to a minimal departure from the monopoly setting, i.e. the inclusion of a second firm.

4.2 Benchmark: Competition with only rational consumers

We now turn to the case of two firms competing over a homogeneous group of rational consumers, i.e. the case of $\chi = 0$. In this setting, consumers' belief that a high-quality firm always discloses is self-fulfilling in that it incentivizes a high-quality firm to disclose. Then, firms' private information is perfectly revealed, irrespective of the disclosure decision of a low-quality firm. Moreover, if a firm wants to sell its product, then it can at most charge its quality advantage over the other firm.

This allocation is not necessarily a unique equilibrium because even a high-quality firm may refrain from disclosing if, somewhat arbitrarily, doing so would also boost consumers' perception of its rival's quality (see Board 2009, Janssen and Teteryatnikova 2016 and Renault 2016 for details). We rule out this source of multiplicity, by assuming that consumers' beliefs about a firm's quality depend only on this firm's behavior.[13]

Proposition 2 (Competition with only rational consumers)**.** *In equilibrium, either firm discloses if it has high quality. If qualities are the same, then consumers buy from either firm at a price equal to zero. If the two qualities differ, then consumers buy from the high-quality firm at price* $p_h^* = q_h - q_\ell$.

The equilibrium allocation mirrors the complete information outcome. As a result, policy interventions that seek to better inform consumers are pointless.

Corollary 2 (Policy interventions with only rational consumers)**.** *If all consumers are rational, then consumer protection policies have no effect.*

In our framework, cursed consumers represent the sole potential barrier to full information revelation and their presence therefore provides the sole rationale for consumer protection.

4.3 Competition with cursed and rational consumers

4.3.1 Market equilibrium

This section features our main model. For simplicity, we assume that $q_\ell = 0$, so that the low-quality product is socially useless. In section 5.1, we demonstrate that this captures an important case, since vertical differentiation with $q_\ell = 0$ will arise endogenously when firms choose their quality levels. In section 5.2, we relax the assumption in a setting that features vertical as well as horizontal differentiation. Without loss of generality, we also

[13] Note that this restriction is redundant in the presence of cursed consumers and the complete information outcome obtains as the limit of the equilibrium in Section 4.3 as the fraction of cursed consumers vanishes.

normalize $q_h = 1$ to ease notation. As a result, average quality is equal to the probability of the product having high quality, i.e. $\mu = \theta$. The following proposition characterizes the market equilibrium.

Proposition 3 (Competition with cursed and rational consumers)**.** *In equilibrium, a firm discloses if and only if its quality is high. If the two firms have the same quality, then they each charge a price of zero and make zero profits. If the two qualities differ and*

- $\chi \geq \theta$*, then the high-quality firm charges* $p_h^* = 1 - \theta$ *and attracts all consumers;*
- $\chi < \theta$*, then the high-quality firm randomizes in prices according to a distribution with full support on* $[1-\chi, 1]$*, the low-quality firm randomizes according to a distribution with full support on* $[\theta - \chi, \theta]$*, rational consumers buy from the high-quality firm, and cursed consumers buy from either firm depending on realized prices.*

When firms have identical quality levels, competition implies zero profits regardless of the composition of consumer types. As a result, no exploitation takes place. Therefore, competition is at least partially effective at protecting cursed consumers, who would always be exploited by a monopolist selling a zero-quality product (see Proposition 1).

In the case of vertical differentiation, the parameter space is partitioned into a no-exploitation region ($\chi \geq \theta$) and an exploitation region ($\chi < \theta$). In the no-exploitation region, all consumers buy high quality and obtain positive utility. In the exploitation region, cursed consumers sometimes buy low quality at a positive price.

Because rational consumers can never be fooled into buying a low-quality product, whether exploitation arises ultimately depends on the incentives of the high-quality firm to attract cursed consumers. If cursed consumers are many or if they hold sufficiently pessimistic beliefs about undisclosed quality ($\chi \geq \theta$), then they represent a profitable segment of the market and the high-quality firm chooses to attract them by charging a relatively low price. If the proportion of cursed consumers is low or their inflated assessment of a silent firm's quality is high ($\chi < \theta$), then they are less profitable and the high-quality firm will not pursue an aggressive pricing strategy to capture them. Firms then share the cursed segment of the market probabilistically, i.e. pricing is in mixed strategies, with firms' indifference obtaining from the trade-off that a higher price results in higher profits if a firm succeeds in capturing cursed consumers but also in a lower probability of doing so.

4.3.2 Lifting the curse: consumer protection policies and welfare

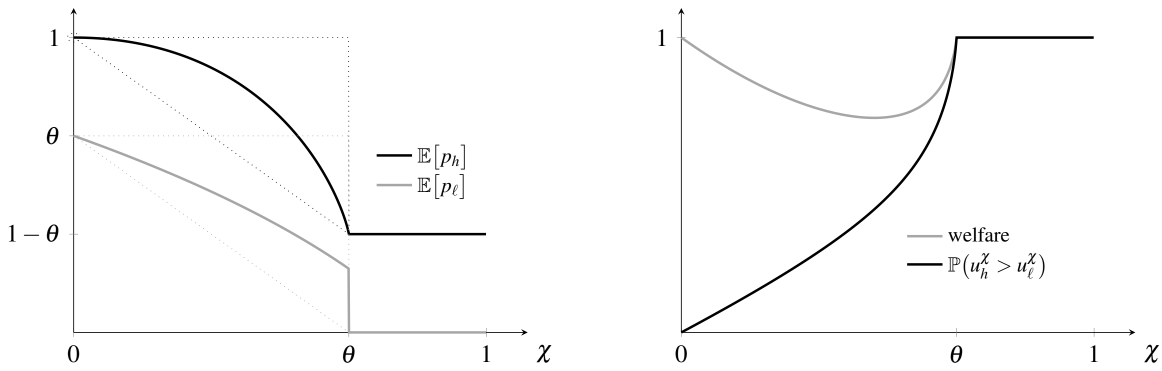
Since consumers always appropriate all gains from trade when qualities are homogeneous, our assessment of consumer protection policies focuses on the case of vertical differentiation. In that case, cursed consumers' inflated perception of a silent firm's quality strengthens competition. As a result, expected prices are decreasing in the proportion of cursed consumers (see Figure 1a). Because the high-quality firm competes more aggressively for cursed consumers the more there are, the likelihood that cursed consumers buy high quality is increasing in χ (see Figure 1b). Thus, while an individual cursed consumer may well be hurt by her naivete if it causes her to buy the inferior product, she exerts a positive externality on all other consumers. In contrast to the monopoly setting, interventions aimed at limiting consumers' naivete therefore have double-edged effects.

Proposition 4 (Imperfect consumer protection policies under competition)**.** *If no exploitation occurs in equilibrium ($\chi \geq \theta$), then imperfect consumer protection is weakly beneficial to firms and weakly decreases consumer surplus and welfare.*

If exploitation occurs in equilibrium ($\chi < \theta$), then a reduction in the proportion of cursed consumers is beneficial to firms and harmful to rational consumers as well as consumers who remain cursed. Its effect on consumers who become rational, on consumer surplus, and on welfare is generally ambiguous, but positive if χ is sufficiently small.

The comparative statics that give rise to Proposition 4 are depicted in Figures 1b, 2a and 2b. As Figure 1b illustrates, welfare is u-shaped in the proportion of cursed consumers χ and maximal for $\chi = 0$ and $\chi \geq \theta$, where all cursed consumers buy the efficient high-quality product.

An increase in χ has both a negative *composition effect* and a positive *equilibrium effect*



(a) Expected prices (with dashed supports)

(b) Welfare and the probability that cursed consumers buy the high-quality product

Figure 1 Equilibrium prices and welfare in the case of vertical differentiation

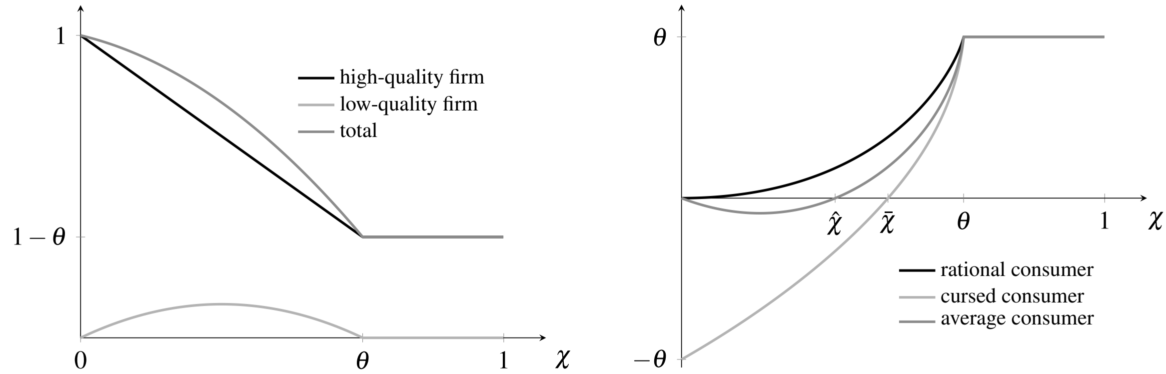
on welfare. Consider the first derivative of welfare W in χ

$$W' = \underbrace{-(1-\mathbb{P}(u_h^\chi > u_\ell^\chi))}_{\textit{composition effect}} + \underbrace{\chi\mathbb{P}'(u_h^\chi > u_\ell^\chi)}_{\textit{equilibrium effect}},$$

where $\mathbb{P}(u_h^\chi > u_\ell^\chi)$ denotes the probability that cursed consumers buy the high-quality good and $\mathbb{P}'(u_h^\chi > u_\ell^\chi)$ its first derivative in χ. The negative composition effect arises because, with probability $1-\mathbb{P}(u_h^\chi > u_\ell^\chi)$, an additional cursed consumer makes a mistake that leads to a misallocation that costs society one util. The positive equilibrium effect arises because the rate at which all χ inframarginal cursed consumers make mistakes decreases as prices adjust and the high-quality firm targets cursed consumers more aggressively.

To see why welfare is u-shaped in χ, note that for low levels of χ, the equilibrium effect is small, because there are few inframarginal cursed consumers, and the composition effect is large, because additional cursed consumers make the wrong purchasing decision with probability close to one. For high levels of χ (close to θ) the composition effect is small, because additional cursed consumers make the wrong purchasing decision with probability close to zero, and the equilibrium effect is large, because there are many inframarginal cursed consumers.

The u-shape implies that imperfect consumer protection may decrease welfare when there



(a) Expected profits **(b)** Consumer surplus

Figure 2 Equilibrium profits and consumer surplus

are many cursed consumers, but increases welfare at an intermediate proportion of cursed consumers. Moreover, consumer protection policies are most likely to be socially desirable if exploitation and the resulting buyers' remorse occur very frequently in equilibrium, i.e. at the point where welfare is at its lowest. Therefore, a high prevalence of exploitation, not cursedness, provides a sound rationale for imperfect consumer protection.

Figure 2a depicts firms' profits. In the exploitation region, aggregate profits decrease as the fraction of cursed consumers increases. While the profits of the high-quality firm always decrease in χ, the profits of the low-quality firm are hill-shaped in χ. As χ increases, the low-quality firm's pool of potential customers increases, but prices and the probability of attracting an individual cursed consumer decrease. There is a region in which both types of firm benefit from a reduction in χ through imperfect consumer protection policies. However, the low-quality firm's profits are equal to "expected" exploitation, a policy that has the support of the low-quality firm is always detrimental to consumer surplus.

Figure 2b considers the consumers' perspective. A rational consumer's utility always decreases as the fraction of cursed consumers shrinks, because the price of the high-quality product increases. The same is true for a cursed consumer, not only because the prices of both products increase, but also because the likelihood of her purchasing the inferior product increases. Below some threshold $\bar{\chi}$, a cursed consumer's net expected value from a purchase becomes negative, which is a necessary condition for policy interventions to be beneficial for consumers as a whole. In particular, if $\chi > \bar{\chi}$, then a policy initiative of large enough scale even hurts previously cursed consumers who become rational. Instead, when the fraction of cursed consumers is small enough, then even imperfect consumer protection policies are an effective measure to enhance consumer surplus, both because exploitation is severe and because competition is weak.[14]

From Figure 1 and 2, the effect of perfect consumer protection measures is also apparent.

Proposition 5 (Perfect consumer protection policies under competition)**.** *If no exploitation occurs ($\chi \geq \theta$), then perfect consumer protection preserves efficiency and redistributes welfare from both types of consumers to firms.*

If exploitation occurs ($\chi < \theta$), then perfect consumer protection restores efficiency, is beneficial to firms, harmful to rational consumers, and beneficial to cursed consumers and consumer surplus if and only if χ is sufficiently low.

A perfect consumer protection policy results in all consumers behaving as if they were rational. Since all consumers will then buy the high-quality product, efficiency is assured. However, the high-quality firm becomes a de-facto monopolist and extracts all gains from trade. In terms of consumer surplus, the negative effect on prices of an increase in the high-quality firm's market power may outweigh the benefits of a superior allocation (when $\chi < \hat{\chi}$ in Figure 2b).

5 Extensions

5.1 Endogenous quality

In this section, we consider firms' incentives to invest in product quality. The game is as before, except that firms rather than nature choose their own qualities at an initial stage. The (fixed) cost of quality for each firm i is given by a continuous, differentiable, and strictly

[14] In the limit, as χ approaches zero, not only are rational consumers held close to their reservation utility, but the marginal increase in prices due to the policy initiative is negligible. This can be seen in Figure 1a, by looking at the flat slope of $\mathbb{E}[p_h]$ when $\chi = 0$.

convex cost function $C(q_i)$ with first derivative $c(q_i)$ that satisfies $C(0) = 0$, $c(0) = 0$, $c'(\infty) > 1$ and $c^{-1}(1) - c^{-1}(\frac{1}{2}) \leq C(c^{-1}(1)) < \frac{1}{2}c^{-1}(1)$.[15]

To adapt the notion of cursedness to a setting of endogenous quality, we impose that a fully cursed consumer believes that each firm randomizes with equal probability between the two actual equilibrium investment strategies.[16] This has two implications. First, in equilibrium, cursed consumers' belief about a silent firm's quality is equal to the average quality in the market, as in our main model. Second, a firm cannot unilaterally affect this belief by deviating.

Proposition 6 (Endogenous quality)**.** *There always exists an equilibrium in which one of the two firms chooses a positive quality level and discloses while the other chooses zero quality and does not disclose.*

Equilibrium pricing and purchasing behavior is qualitatively similar to the case of vertical differentiation with exogenous qualities. Cursed consumers are exploited with positive probability if and only if χ is sufficiently small and buy high quality otherwise. Investment in quality is efficient when there is no exploitation and inefficiently low otherwise.

Because a silent firm has no incentive to invest in quality and at least one firm makes zero profits if both firms disclose, vertical differentiation with minimal low quality arises endogenously. As before, whether the high-quality firm serves the whole market or forgoes cursed consumers some of the time depends on their profitability. At the investment stage, the profitability of the cursed segment is now entirely determined by its size. When the exploitative equilibrium prevails, returns to investment fall short of the social optimum because the high-quality firm cannot entirely recoup the cost by means of higher margins on all consumers. This disincentive effect on product quality amplifies the inefficiency associated with exploitation.

[15]The upper bound for $C(c^{-1}(1))$ rules out the uninteresting case in which attracting cursed consumers would always entail a loss for a firm with positive quality. The lower bound allows ignoring preemptive strategic considerations, i.e. the possibility that a firm may want to increase its quality level solely to deter its competitor's investment. When $C(q_i) = kq_i^{\alpha}$, both inequalities hold for $\alpha > 2$.

[16]This is in the spirit of the original notion of cursedness according to which a fully cursed player believes that each type of the other players plays the same mixed action profile that corresponds to the other players average distribution of actions.

5.2 Horizontal differentiation

In our main model, it is socially optimal for every consumer to consume the high-quality product. To capture situations in which this is not the case, we now allow for consumers having a taste for the product of a given firm that is independent of the vertical quality dimension: some consumers may live closer to one firm than another or be attached to a particular brand.

Consider two firms that are located on either end of a unit interval along which rational and cursed consumers are uniformly distributed (see Figure 3). The measure of rational and cursed consumers is given by $1-\chi$ and χ respectively. A consumer's location is given by t, which represents both the distance to the firm located at the left of the interval and the transport cost associated with purchasing from that firm. Similarly, purchasing the product on the right implies transport costs of $1-t$. In addition to this horizontal differentiation, product qualities may still differ along an independent vertical dimension and firms still decide whether to disclose their own quality. As in the main model, each firm's quality is equal to $q_h > 0$ with probability $\theta \in (0,1)$ and equal to $q_\ell = 0$ with complementary probability. Each consumer has unit demand and derives a net utility of $v + q_i$ from purchasing a product of quality $q_i \in \{q_\ell, q_h\}$.[17] We assume that v is large enough to ensure that each consumer makes a purchase in equilibrium. We also assume that $q_h < 1$, so that, when firms are vertically differentiated, efficiency dictates that some consumers should purchase the low-quality product.

Firms' incentives to reveal quality are as in our main model. A firm discloses if and only if its quality is high. To assess the effect of consumer protection policies we can therefore again focus on the case of vertical differentiation.[18] In the equilibrium we construct, both the high-quality and the low-quality firm now attract some rational and cursed consumers. Nonetheless, similar trade-offs as in the main model arise.

[17] Since $v + q_\ell > 0$, we are relaxing the assumption of a socially useless product we made in the main model. Note that restricting q_ℓ to be zero eases notation, but is without loss of generality in this extension.

[18] When both firms have high quality, it is as if there existed only a homogeneous group of consumers and, due to the lack of vertical differentiation, firms share the market equally by charging identical prices that are independent of χ. This is also the case when both firms have low quality, since neither group of consumers perceive one firm to have an advantage over the other (although cursed consumers overestimate the net utility that either product delivers).

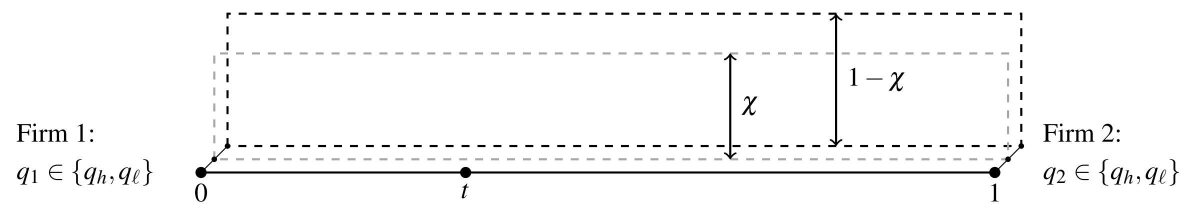


Figure 3 Cursed and rational consumers along a Hotelling line

Proposition 7 (Horizontal differentiation)**.** *There exists an equilibrium in which firms' profits are decreasing in χ, while the average welfare of rational consumers and consumers that remain cursed is increasing. Consumer surplus is increasing in χ when θ is sufficiently low and u-shaped otherwise. Welfare is decreasing in χ when θ is sufficiently low and u-shaped otherwise.*

Due to its competitive advantage, the high-quality firm covers more of the market and lowering prices implies greater losses on inframarginal consumers. As a result, the price of the high-quality product is inefficiently high and the low-quality firm draws more demand than is socially optimal.

As in the main model, an increase in the fraction of cursed consumers χ yields a composition and an equilibrium effect on overall welfare. The composition effect is negative: when a consumer turns cursed, she will make weakly more inefficient purchasing decisions. Indeed, she is more likely than a rational consumer at the same location to purchase the low-quality product, which is already overconsumed. The equilibrium effect on welfare is positive: an increase in the fraction of cursed consumers exerts competitive pressure on the high-quality firm. As a result, the high-quality firm is induced to decrease its price, whereas the low-quality firm increases its price. This in turn leads to some consumers making more efficient purchasing decisions.

Following a similar logic as in the main model, the composition effect dominates the equilibrium effect for low levels of χ, whereas the latter may eventually dominate the former for higher χ. Even in the case of horizontal differentiation it may therefore be the case that imperfect consumer protection policies decrease welfare when there are many cursed consumers (see section A.6.2 for more detailed comparative statics and intuitions).

5.3 Several competitors

The analysis of section 4.3 naturally extends to markets with $n > 2$ firms. As soon as at least two firms have high-quality, they will disclose and attract all consumers at a price of zero. Similarly, if all firms have low quality, the price will be zero and at least two firms will not disclose.

When a single firm has a high-quality product, it will disclose and at least two low-quality firms will not. In this case, the condition for an exploitative equilibrium is the same as under vertical differentiation in the case of a duopoly (i.e. $\chi < \theta$). In the region without exploitation, prices and market shares are unaffected. However, in the region with exploitation, $p_h^* = q_h$ and at least two low-quality firms do not disclose and charge $p_\ell^* = 0$. Cursed consumers now buy only the low-quality product.

Compared to the duopoly, it is less likely that any exploitation is observed when there are more firms. But in the case of a single market leader or a colluding set of firms with high quality, market outcomes will be more inefficient if there are at least two low-quality firms.

5.4 Comparative advertising

In this section we turn to firms' incentives to disclose their competitors' quality. While such comparative advertising is forbidden in some countries, it is allowed in the United States and, since 1997, in the European Union. In the US, the Federal Trade Commissions (FTC) rationale for allowing comparative advertising is the following: "Comparative advertising, when truthful and nonexploitative, is a source of important information to consumers and assists them in making rational purchase decisions (...) Comparative advertising encourages product improvement and innovation, and can lead to lower prices in the marketplace."[19]

[19] The FTC's statement of August 13, 1979, can be found at www.ftc.gov/bcp/policystmt/ad-compare.htm. Also, see Anderson and Renault (2009) for a rational model of comparative advertising and a discussion of the FTC's policy.

Our model speaks to what it means to make an irrational purchasing decision and allows us to ascertain the impact of comparative advertising on prices. In line with our categorization of policy measures, let us distinguish between perfect comparative advertising, which results in all consumers being informed about all product qualities and imperfect comparative advertising, which fails to reach some consumers, leaving them cursed.

Consider the case of the main model with vertical differentiation. As seen in Figure 2, the high-quality firm's profits are decreasing in the proportion of cursed consumers. Therefore, the high-quality firm always has an incentive to engage in comparative advertising, provided that it is cheap enough. This stands in stark contrast to shrouded attribute models (Gabaix and Laibson, 2006), in which firms have no incentive to educate their competitors' consumers.

However, our model only partially vindicates the FTC's position. While perfect comparative advertising leads to an efficient outcome, it leads to higher prices and a lower consumer surplus. Matters are worse when comparative advertising is not perfect. For example, not all consumers may be reached because advertising does not take place at the point of sale, but on television, on billboards or on the internet.[20] Then, comparative advertising may lead to an inefficient outcome. Moreover, as we have seen in section 5.1, it is in this parameter region that incentives to innovate are blunted.

6 Conclusion

The intuition that consumer protection policies that merely provide consumers with information lead to more desirable outcomes is seductive. From a partial equilibrium perspective, information unambiguously improves an individual's decision making. And since information nudges do not restrict consumers' choice sets, they qualify as the sort of soft paternalism that should not invite strong ideological opposition. This paper cautions policy makers that it is crucial to consider the equilibrium effects of information-based consumer protection.

[20] Alternatively, we may think of comparative advertising by the high-quality firm as being associated with a convex cost, whereby reaching additional consumers becomes increasingly expensive. In the presence of such costs, comparative advertising may also be imperfect because, eventually, the cost of informing a marginal consumer exceeds the high-quality firm's gain in revenue.

In vertically differentiated markets with a socially desirable high-quality good, consumer protection may decrease consumer and overall welfare. If the majority of consumers is naive, then the high-quality firm has every incentive to attract them with low prices. However, when the group of naive consumers is small and unprofitable, it will be left to buy the exploitative and inefficient product. Consequently, the most socially inefficient outcomes obtain when well-intentioned policy leaves behind a small to medium-sized group of naive consumers.

Our analysis suggests that society may sometimes be better off without mandatory disclosure, third party disclosure or consumer education. If these policies are nonetheless deemed desirable, then they should be implemented wholeheartedly and comprehensively. Since an inefficient firm's profits are highest for intermediate levels of cursedness, policy makers should be weary of industry representatives who condone mandatory disclosure, but are eager to put bounds on the salience or informativeness of the disclosed information.

As a rule of thumb, imperfect policy measures are more likely to have their intended effect if there is a high incidence of exploitation in equilibrium. Policy should therefore be predicated on a high level of observed exploitation or high profits from the sale of undesirable products. However, note that exploitation is distinct from consumer misperception or cursedness. A high incidence of misperception need not imply a useful role for consumer protection. High levels of consumer misperception in combination with low levels of consumer exploitation may reflect a socially desirable equilibrium. Therefore, it is not advisable to base consumer protection measures on observed misperception alone.

Both misperception and exploitation can be measured. Misperception can be elicited in surveys of people's subjective quality expectations of products that do not disclose quality.[21] Exploitation can be identified from a change in consumers' purchasing behavior in response to exogenously provided information, absent firms' strategic response in prices. This identification can be delivered by a field experiment that is sufficiently small to be ignored by

[21] Similar elicitations are already employed by policy makers. For example, the EU regulation on key information documents for packaged retail and insurance-based investment products (downloadable at http://data.europa.eu/eli/reg/2014/1286/oj) explicitly takes into account "existing and ongoing research into consumer behaviour, including results from testing the effectiveness of different ways of presenting information with consumers." [Paragraph 17].

firms.

Further testable implications of our model can be investigated by means of policy experiments that are large enough to solicit a strategic response from firms. For example, an unexpected mandatory disclosure law should lead to higher average prices in vertically differentiated competitive markets and to lower prices under monopoly. The policy has an ambiguous effect on exploitation and the market share of low-quality products in competitive markets and decreases exploitation under monopoly.

In our model, a firm's information is exogenous. In many markets, firms' private information is the product of search and certification. Understanding the incentives of certifiers in the presence of cursed consumers is a promising topic for future research. Furthermore, the complexity of the information firms disclose is likely to impact on how both disclosure and non-disclosure are interpreted and on how much information is transmitted to consumers. Exploring the link between informational complexity and naivete theoretically and experimentally can inform how regulators should design standardized labels and independent ratings to facilitate information transmission and efficiency.

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A Appendix

A.1 Proof of proposition 1

Existence. If the monopolist discloses its quality $q \in \{q_\ell, q_h\}$, then both rational and cursed consumers are willing to pay up to q. Therefore, the optimal price and the resulting profits are $p = q$ and $\pi = q$ respectively. If the firm does not disclose and faces only cursed consumers, its optimal price is $p = \mu$, which yields profits $\pi = \chi\mu$. It is then easy to verify that the strategies described in the proposition are an equilibrium. Upon non-disclosure, rational consumers infer that $\mathbb{E}[q|\emptyset] = q_\ell$ and, at $p = \mu$, they refuse to buy. The most profitable price that attracts all consumers given non-disclosure is $p = q_\ell$, which yields $\pi = q_\ell$. Attracting all consumers is then optimal if and only if $q \geq \chi\mu$.

Uniqueness. To establish uniqueness, note that in equilibrium type h must necessarily earn q_h. Otherwise it could profitably deviate by disclosing and charging $p = q_h$. But type h can only earn q_h if it discloses, since otherwise cursed consumers' willingness to pay is lower than q_h by construction.

Uniqueness does not hinge on the presence of cursed consumers. However, in the limit case, with $\chi = 0$, the argument for uniqueness is slightly different. Type h must fully separate in order to earn q_h. Then, in any candidate fully separating equilibrium strategy in which type h does not disclose, type l must earn less than q_h and would therefore have an incentive to mimic type h.

Welfare. When $q_\ell < \chi\mu$, expected profits of the monopolist are $\pi = \theta q_h + (1-\theta)\chi\mu$, which exceeds μ and is increasing in χ. The expected utility of a rational consumer is $U = 0$, while the expected utility of a cursed consumer is $U_\chi = (1-\theta)(q_\ell - \mu) < 0$. Welfare is given by

$$W = \Pi + \chi U_\chi = \theta q_h + (1-\theta)\chi q_\ell \leq \mu,$$

with strict inequality if $q_\ell > 0$.

A.2 Proof of proposition 2

We will repeatedly use a Bertrand competition argument, which we summarize in the following lemma.

Lemma 1 (Bertrand competition). *Fix consumers' expectations about the quality levels of firm i and j and denote these expectations by $\tilde{q}_i$ and $\tilde{q}_j$ respectively. Without loss of generality, assume that $\tilde{q}_i \geq \tilde{q}_j \geq 0$. In equilibrium,*

- *if $\tilde{q}_i = \tilde{q}_j$, then consumers buy the product at a price o zero; moreover, if $\tilde{q}_i > 0$, then $p_i^* = 0 = p_j^*$, whereas if $\tilde{q}_i = 0$, then one of the two firms' prices, say p_i^*, is equal to zero while the other can take any value;*
- *if $\tilde{q}_i > \tilde{q}_j$, then consumers buy the product from firm i at a positive price; if $\tilde{q}_j > 0$, then $p_i^* = \tilde{q}_i - \tilde{q}_j$ and $p_j^* = 0$, while if $\tilde{q}_j = 0$, then $p_i^* = \tilde{q}_i$ and p_j^* can take any value.*

Proof. Define $u_i = \tilde{q}_i - p_i$ as a consumer's perceived utility of buying from firm i and $\pi_i = p_i D_i$ as firm i's profits, where D_i denotes the firm's demand.

Suppose first that $\tilde{q}_i = \tilde{q}_j$. Then, an equilibrium in which one firm, say firm i, makes positive profits cannot exist. For any price pair[22] such that $u_i \geq u_j$ and $\pi_i > 0$, it is the case that $\pi_j < p_i$ and firm j

[22]While the proof assumes pricing in pure-strategies only, nonexistence of equilibria in which a (active) firm randomizes follows from results in Hendricks and Wilson (1992).

would profit from charging $p_j = p_i - \varepsilon$ for $\varepsilon > 0$ arbitrarily small and attracting all consumers. Thus, if a firm is active, say firm i, $p_i^* = 0$. Unless $\tilde{q}_i = \tilde{q}_j = 0$, it must also be the case that $u_i = u_j$, i.e. that $p_j^* = 0$, or otherwise firm i could make positive profits by charging $p_j^* - \varepsilon$ for $\varepsilon > 0$ arbitrarily small.

Now suppose that $\tilde{q}_i > \tilde{q}_j$. Then, firm j cannot sell in equilibrium, since for any price pair such that $u_i \leq u_j$, $u_j \geq 0$ and $D_j > 0$, firm i would profit from reducing p_i and attracting all consumers. Unless $\tilde{q}_j = 0$, it must also be that $u_i = u_j$, i.e. that $p_i^* = \tilde{q}_i - \tilde{q}_j - p_j^*$, and that $p_j^* = 0$. Otherwise firm i and j could profitably deviate by respectively increasing and decreasing their prices. □

Existence. If one replaces expected qualities with actual qualities, then Lemma 1 pins down firms' pricing and profits in the complete information outcome. Given consumers' belief that a silent firm has low quality, we can then verify that the equilibrium in Proposition 2 exists. Regardless of its disclosure decision and the quality of its rival, a low-quality firm cannot attract consumers at a price above zero. Similarly, a high-quality firm always benefits from disclosing, strictly so when its rival has low quality and weakly otherwise. Therefore, consumers' beliefs are consistent.

Uniqueness. Suppose by contradiction that there exists an equilibrium in which firms' qualities are not perfectly revealed. That is, if we denote by $\tilde{q}_i$ and $\tilde{q}_j$ consumers' expectation of firms' qualities, there is an on-the-equilibrium-path history in which for at least a firm, say firm i, $\tilde{q}_i \in (q_l, q_h)$. Clearly, firm i cannot disclose in this history. We will consider all possible messages of firm j.

- Suppose that $m_j = q_\ell$. Given the restriction that a firm's behavior does not affect consumers' belief about the quality of its competitor and that disclosure decisions entail no randomization, Lemma 1 describes the pricing and profits of firm j in this history. It also describes the maximum price and profits of firm i, namely $\tilde{q}_i - q_\ell$. In principle, these could also be lower, since a price raise by firm i could now be deterred by a decrease in $\tilde{q}_i$ off-the-equilibrium-path. Therefore, unless $\tilde{q}_i = q_h$, when $q_i = q_h$ firm i could profitable deviate by disclosing and charging $p_i = q_h - q_\ell - \varepsilon$ for $\varepsilon > 0$ arbitrarily small. Hence, either $\tilde{q}_i = q_h$ or $\tilde{q}_i = q_\ell$.

- Suppose that $m_j = q_h$. Lemma 1 implies that firm i makes zero profits, while the price and profits of firm j are now at least $p_j \geq q_h - \tilde{q}_i$. Similar to the previous case, p_i and hence p_j can in principle be higher if a price cut by firm i is deterred by a decrease in $\tilde{q}_i$ off-the-equilibrium-path. Therefore, unless $\tilde{q}_i = q_h$, when $q_i = q_h$ firm i could profitable deviate by disclosing and charging $p_i = q_h -$

$\tilde{q}_i - \varepsilon$ for $\varepsilon > 0$ arbitrarily small. Again, either $\tilde{q}_i = q_h$ or $\tilde{q}_i = q_\ell$.

- Suppose that $m_j = \emptyset$ and assume without loss of generality that $\tilde{q}_i \geq \tilde{q}_j$ (and therefore that $\tilde{q}_i > q_l$ and $\tilde{q}_j < q_h$, otherwise firms' qualities would be perfectly revealed). Firm i can now set a price and make profits of at most $\tilde{q}_i - q_l$. This bound can be attained if $\tilde{q}_j = q_l$ or, in principle, if $\tilde{q}_j > q_l$ and a price cut from firm j is deterred by the off-the-equilibrium-path belief that $\tilde{q}_j = q_l$. Therefore, unless $\tilde{q}_i = q_h$, when $q_i = q_h$ firm i could profitable deviate by disclosing and increasing p_i. It must then be the case that $\tilde{q}_i = q_h$ and that firm i is selling at $p_i \geq q_h - \tilde{q}_j$. But then, it must also be the case that $\tilde{q}_j = q_l$, since whenever $q_j = q_h$ firm j would have an incentive to disclose and charge $p_j = p_i - \varepsilon$ for $\varepsilon > 0$ arbitrarily small.

Given that firms' qualities are perfectly revealed, the only possibility for the equilibrium outcome not to be as in Lemma 1 with actual qualities replacing conjectured ones would be that at least one firm, say firm i, does not disclose and pricing differs because a deviation in p_i is discouraged by an off-the-equilibrium-path adverse inference on q_i. This is clearly not possible if $q_i = q_l$. It is also not possible when $q_i = q_h$, since firm i could simultaneously deviate in pricing and disclosure, so that all deviations by a high-quality firm in the proof of Lemma 1 remain profitable.

A.3 Proof of proposition 3

Existence. Considering all cases, we will show that firms have no profitable deviations and, along the way, we will characterize the elements of firms' equilibrium pricing left unspecified in the proposition. Throughout, $\tilde{q}_i$ and $\tilde{q}_i^\chi$ represent the belief about firm i's quality of rational and cursed consumers respectively, and u_i and u_i^χ their perceived utility from buying from firm i.

- Suppose that both firms have low quality. Upon non-disclosure by both firms $\tilde{q}_i = \tilde{q}_j = 0$, so that the willingness to pay of rational consumers is zero. Hence, the two firms compete only for cursed consumers (whose $\tilde{q}_i^\chi = \tilde{q}_j^\chi = \theta$) and, by Lemma 1, they charge zero prices and make zero profits. If firm i deviates by disclosing, it attracts no consumer regardless of the positive price it charges.
- Suppose that both firms have high quality. Since both firms disclose, Lemma 1 implies that they must charge zero prices and make zero profits. If a firm, say firm i, deviates by not disclosing, for any $p_i > 0$ it does not attract any consumers, since $\tilde{q}_i(\emptyset) = 0$ and $\tilde{q}_i^\chi(\emptyset) = \theta < 1$.

- Suppose that the qualities of the two firms differ and let the subscript h and ℓ refer to the high- and low-quality firm respectively. Given firms' disclosure strategies, we have $\tilde{q}_\ell = 0$, $\tilde{q}_\ell^\chi = \theta$ and $\tilde{q}_h = \tilde{q}_h^\chi = 1$. We will distinguish two sub-cases.
  - Suppose first that $\chi \geq \theta$. When $p_h^* = 1-\theta$ and $p_\ell^* = 0$, firm h attracts all consumers. If firm ℓ deviates by disclosing or by charging a positive price, it keeps attracting no consumer. If firm h deviates by not disclosing, it attracts no consumer for any $p_h > 0$. If firm h deviates in prices, its best deviation is $p_h = 1$, which attracts only rational consumers (because $u_\ell^\chi = \theta > u_h^\chi = 0$) and hence yields $1-\chi$. This deviation is not profitable if and only if $1-\theta \geq 1-\chi$, that is, if and only if $\chi \geq \theta$.
  - Suppose instead that $\chi < \theta$. We will construct mixed pricing strategies such that firm h randomizes according to $G_h(p_h)$ over $\left[\underline{p}_h, \bar{p}_h\right]$, firm ℓ randomizes according to $G_\ell(p_\ell)$ over $\left[\underline{p}_\ell, \bar{p}_\ell\right]$, rational consumers always buy from firm h and cursed consumers buy with positive probability from either firm (and from firm ℓ whenever indifferent). As supports, we guess $\underline{p}_h = 1-\chi$, $\bar{p}_h = 1$, $\underline{p}_\ell = \theta - \chi$ and $\bar{p}_\ell = \theta$, so that $u_h^\chi(\bar{p}_h) = u_\ell^\chi(\bar{p}_\ell) = 0$ and $u_h^\chi(\underline{p}_h) = u_\ell^\chi(\underline{p}_\ell) = \chi$. Note that $\underline{p}_\ell$ is positive if and only if $\chi < \theta$. Given these supports, rational consumers always prefer to buy from firm h. Fix $G_\ell(p_\ell)$ and assume it is atomless. The expected profits of firm h for $p_h = \bar{p}_h$ are $\pi_h(\bar{p}_h) = 1-\chi$, while for any other p_h in the candidate support

$$\pi_h(p_h) = p_h\Big(\underbrace{1 - G_\ell(p_h - (1-\theta))}_{\mathbb{P}\left(u_h^\chi > u_\ell^\chi\right)}\Big) + (1-\chi)p_h \underbrace{G_\ell(p_h - (1-\theta))}_{\mathbb{P}\left(u_h^\chi \leq u_\ell^\chi\right)}.$$

Solving $\pi_h(p_h) = \pi_h(\bar{p}_h)$ yields $G_\ell(p_h - (1-\theta)) = \frac{p_h - (1-\chi)}{\chi p_h}$ and, after the change of variable $p_h = p_\ell + 1 - \theta$, $G_\ell^*(p_\ell) = \frac{p_\ell - (\theta - \chi)}{\chi(p_\ell + 1 - \theta)}$. Note that indeed $G_\ell^*(\underline{p}_\ell) = 0$ and $G_\ell^*(\bar{p}_\ell) = 1$. Therefore, when firm ℓ randomizes according to $G_\ell^*(\cdot)$, firm h is indifferent to any p_h in the candidate support. Any p_h above $\bar{p}_h$ would yield $\pi_h = 0$, while any $p_h < \underline{p}_h$ would yield $\pi_h = p_h < 1-\chi$.

Now fix $G_h(p_h)$ and assume it is atomless except possibly at $\bar{p}_h$. The expected profits of firm ℓ from $p_\ell = \underline{p}_\ell$ are $\pi_\ell(\underline{p}_\ell) = \chi(\theta - \chi)$, while for any other p_ℓ in the candidate support

$$\pi_\ell(p_\ell) = \chi p_\ell \Big(\underbrace{1 - G_h(p_\ell + 1 - \theta}_{\mathbb{P}\left(u_\ell^\chi \geq u_h^\chi\right)}\Big).$$

Solving $\pi_\ell(p_\ell) = \pi_\ell(\underline{p}_\ell)$ yields $G_h(p_h - (1-\theta)) = \frac{p_\ell - (\theta-\chi)}{p_\ell}$ and, after the change of variable $p_\ell = p_h - (1-\theta)$, $G_h^*(p_h) = \frac{p_h-(1-\chi)}{p_h-(1-\theta)}$. Note that $G_h^*(\underline{p}_h) = 0$ and $G_h^*(\bar{p}_h) = \frac{\chi}{\theta} < 1$, which means that $G_h^*(\cdot)$ has an atom of size $\alpha_h^* \equiv \frac{\theta-\chi}{\theta}$ at $\bar{p}_h$. Therefore, if firm h randomizes according to $G_h^*(\cdot)$, then firm ℓ is indifferent to any p_ℓ in the candidate support. Any p_ℓ above $\bar{p}_\ell$ would yield $\pi_\ell = 0$, while any $p_\ell \in (0, \underline{p}_\ell)$ would yield $\chi p_\ell < \chi \underline{p}_\ell$. As for deviations in disclosure strategies, if firm ℓ deviates by disclosing it attracts no consumer for any $p_l > 0$. If firm h deviates by not disclosing, it never attracts rational consumers for any $p_h > 0$ and, as it also lowers the valuation of cursed consumers, it cannot increase its profits.

Uniqueness. Note that there cannot exist an equilibrium in which a firm discloses when its quality is $q_i = q_\ell$. Indeed, if this was the case, we would have $\tilde{q}_i = \tilde{q}_i^\chi = 0 = \pi_i = 0$ and firm j would behave as a monopolist (Proposition 1). As cursed consumers would obtain their perceived reservation utility, firm i could profitably deviate by not disclosing and attracting them with a $p_i > 0$. Thus, the valuation of rational consumers when a firm is silent must satisfy $\tilde{q}_i(\emptyset) < 1$. Then, no matter the quality of its rival, starting from any candidate equilibrium history in which firm i has high quality but remains silent, disclosure is a strictly profitable deviation for firm i since it raises the valuation of all consumers.

If disclosure decisions are as in the proposition, then the equilibrium pricing behavior characterized above is unique. In particular, in the case of vertical differentiation, when $\chi \geq \theta$, for any candidate equilibrium of the pricing game in which firm h does not attract cursed consumers with probability one, it would have an incentive to decrease p_h to ensures that it does. When $\chi < \theta$, instead, no pure strategy equilibrium can exist. Indeed, as shown above, given the unique candidate equilibrium prices for which firm h attracts cursed consumers with probability one, it would want to deviate. Similarly, there cannot exist a candidate equilibrium in which firm ℓ attracts cursed consumers with probability one, as at candidate equilibrium prices it should be that

$$u_h^\chi \equiv 1 - p_h^* = \theta - p_\ell^* \equiv u_\ell^\chi$$

and firm h would profit from slightly decreasing p_h. Uniqueness of the mixed-strategy equilibrium follows from noting that, because of standard arguments, price supports cannot have interior atoms or holes and that, unless $\bar{p}_h = 1$, firm h xould profit from charging $p_h > \bar{p}_h$.

A.4 Proof of propositions 4 and 5

The two propositions follow directly from the comparative statics of the equilibrium of Proposition 3 with respect to the fraction of cursed consumer χ and their limit as χ converges to zero from above, i.e. the allocation Proposition 2. Since the equilibrium is unaffected by changes in χ when $\chi \geq \theta$, we study comparative statics in the exploitation region. Throughout, $g_\ell^*(p_\ell)$ and $g_h^*(p_h)$ denote the derivatives of the equilibrium cumulative distributions of prices $G_\ell^*(p_\ell)$ and $G_h^*(p_h)$. Also, all derivatives below are taken with respect to χ.

Comparative Static A.4.1 (Prices)**.** Expected prices are decreasing.

We have

$$\mathbb{E}[p_h] = \int_{1-\chi}^{1} g_h^*(p_h) p_h \, \mathrm{d}p_h + \frac{\theta-\chi}{\theta} = 1-\chi-(\theta-\chi)\log\left(1-\frac{\chi}{\theta}\right)$$
$$\mathbb{E}[p_\ell] = \int_{\theta-\chi}^{\theta} g_\ell^*(p_\ell) p_\ell \, \mathrm{d}p_\ell = \frac{-\chi(1-\theta)-(1-\chi)\log(1-\chi)}{\chi}.$$

Thus, $\mathbb{E}'[p_h] = \log\left(1-\frac{\chi}{\theta}\right) < 0$ and $\mathbb{E}'[p_\ell] = \frac{\chi+\log(1-\chi)}{\chi^2} < 0$, where the second inequality follows from the fact that $y < -\log(1-y)$ for any $y \in (0,1)$.

Comparative Static A.4.2 (Profits)**.** Expected total profits and expected profits of the high-quality firm are decreasing, while the expected profits of the low quality firm are hill-shaped.

The expected profits of the high-quality and low-quality firm are respectively $\pi_h = 1-\chi$ and $\pi_\ell = \chi(\theta-\chi)$, so that firms' total expected profits are $\pi = \pi_h + \pi_\ell = (1-\chi(1-\theta+\chi))$. While $\pi_h' < 0$ and $\pi' < 0$, π_ℓ is concave, with $\pi_\ell'(\chi) < 0$ if and only if $\chi > \frac{\theta}{2}$.

Comparative Static A.4.3 (Probability of buying high-quality)**.** The probability of cursed consumers buying the high-quality good is increasing.

We have

$$\mathbb{P}(u_h^\chi > u_\ell^\chi) = \mathbb{P}(p_h < p_\ell + (1-\theta)) = \int_{1-\chi}^{1}\int_{p_h-(1-\theta)}^{\theta} g_\ell^*(p_\ell) g_h^*(p_h) \, \mathrm{d}p_\ell \mathrm{d}p_h$$
$$= \frac{(1-\chi)\left((1-\theta)\chi-(\theta-\chi)\log\left(\frac{\theta(1-\chi)}{\theta-\chi}\right)\right)}{(1-\theta)^2\chi}.$$

Thus,

$$\mathbb{P}'\left(u_h^\chi > u_\ell^\chi\right) = \frac{(\theta-\chi^2)\log\left(\frac{\theta(1-\chi)}{\theta-\chi}\right) - (1-\theta)\chi(1+\chi)}{(1-\theta)^2\chi^2}.$$

The expression has the same sign as its numerator, denoted by $N(\chi)$, which is positive because $N(0) = 0 = N'(0)$, $N''(0) = \frac{(1-\theta)^2}{\theta} > 0$ and $N''' = \frac{2(1-\theta)^3(\theta-\chi^2)}{(\theta-\chi)^3(1-\chi)^3} > 0$.

Comparative Static A.4.4 (Utility of the two types of consumers)**.** The expected utility of a rational consumer and a cursed consumer are increasing. Moreover, the latter is positive if and only if χ is greater than some cutoff $\bar{\chi} \in (0,\theta)$.

The expected utility of a rational consumer is $U = 1 - \mathbb{E}[p_h]$, which is increasing because of comparative static A.4.1. The expected utility of a cursed consumer is

$$\begin{aligned} U_\chi =& -\underbrace{\mathbb{P}\left(u_\ell^\chi \geq u_h^\chi\right)\mathbb{E}\left[p_\ell | u_\ell^\chi \geq u_h^\chi\right]}_{-\frac{\pi_\ell}{\chi}} + \mathbb{P}\left(u_h^\chi > u_\ell^\chi\right)\left(1 - \mathbb{E}\left[p_h | u_h^\chi > u_\ell^\chi\right]\right) \\ =& \chi - \theta + \frac{(1-\chi)\left((1-\theta)\theta\chi - (\theta-\chi)\log(1-\chi) + (2-\theta)\theta(\theta-\chi)\log\left(1-\frac{\chi}{\theta}\right)\right)}{(1-\theta)^2\chi}. \end{aligned}$$ [23]

Naturally, $\lim_{\chi\to 0} U_\chi = -\theta$ and $\lim_{\chi\to\theta} U_\chi = \theta$. Furthermore, differentiating U_χ with respect to χ yields

$$U'_\chi = 1 + \mathbb{P}'\left(u_h^\chi > u_\ell^\chi\right)\left(1 - \mathbb{E}\left[p_h | u_h^\chi > u_\ell^\chi\right]\right) - \mathbb{P}\left(u_h^\chi > u_\ell^\chi\right)\mathbb{E}'\left[p_h | u_h^\chi > u_\ell^\chi\right].$$

which is positive because $\mathbb{P}'\left(u_h^\chi > u_\ell^\chi\right) > 0$ by comparative static A.4.3 and $\mathbb{E}'\left[p_h | u_h^\chi > u_\ell^\chi\right] < 0$.[24]

Comparative Static A.4.5 (Consumer surplus)**.** Consumer surplus is u-shaped, equal to zero at the

[23] We used

$$\mathbb{E}\left[p_h | u_h^\chi > u_\ell^\chi\right] = \frac{1}{\mathbb{P}\left(u_h^\chi > u_\ell^\chi\right)}\int_{1-\chi}^{1}\int_{p_h-(1-\theta)}^{\theta} p_h g_h^*(p_h) g_\ell^*(p_\ell)\mathrm{d}p_\ell \mathrm{d}p_h = \frac{(1-\theta)^2\left((\theta-\chi)\log\left(\frac{\theta}{\theta-\chi}\right)-\chi\right)}{(1-\theta)\chi - (\theta-\chi)\log\left(\frac{\theta(1-\chi)}{\theta-\chi}\right)}.$$

[24] Differentiating $\mathbb{E}\left[p_h | u_h^\chi > u_\ell^\chi\right]$ yields

$$\mathbb{E}'\left[p_h | u_h^\chi > u_\ell^\chi\right] = -\frac{(1-\theta)^2\chi\overbrace{\left(\log(1-\chi) + (2-\theta)\theta\log\left(\frac{\theta}{\theta-\chi}\right) - \chi\left(1-\theta+\log\left(\frac{\theta(1-\chi)}{\theta-\chi}\right)\right)\right)}^{A(\chi)}}{(1-\chi)\left(\chi - \theta\chi - (\theta-\chi)\log\left(\frac{\theta(1-\chi)}{\theta-\chi}\right)\right)^2}.$$

The expression has the opposite sign of $A(\chi)$, which is positive because $A(0) = 0 = A'(0) = A''(0)$ and $A''' =$

left limit of the exploitation region and positive at the right limit. Therefore, it is positive if and only if χ is greater than some cutoff $\hat{\chi} \in (0,\theta)$.

Consumer surplus is defined as

$$S \equiv \chi U_\chi + (1-\chi)U.$$

Naturally, $S(0) = 0$ and $\lim_{\chi \to \theta} S = \theta$. Besides,

$$S' = \chi U'_\chi(\chi) + U_\chi(\chi) - U(\chi) + (1-\chi)U'(\chi)$$

As χ goes to zero, all terms in S' go to zero except $U_\chi < 0$, so that $S'(0) < 0$. Moreover,

$$S'' = \frac{(1-\theta)\left(\frac{1}{1-\chi} + \frac{1}{\theta-\chi} - 2\theta\right) + 2\log\left(\frac{\theta-\chi}{\theta(1-\chi)}\right)}{(1-\theta)^2},$$

which is positive since $S''(0) = \frac{2\theta+1}{\theta} > 0$ and $S''' = \frac{1-\theta}{(1-\chi)^2(\theta-\chi)^2} > 0$. Finally, note that $\hat{\chi} < \bar{\chi}$, i.e. S becomes positive earlier than U_χ, since when $U_\chi = 0$ we have that $S > 0$.

Comparative Static A.4.6 (Welfare)**.** Welfare, i.e. the expected market share of the high-quality firm, is u-shaped and maximal only at either limit of the exploitation region.

Welfare is defined as

$$W = (1-\chi) + \chi \mathbb{P}\big(u_h^\chi > u_\ell^\chi\big).$$

Naturally, $W(0) = 1$ and $\lim_{\chi \to \theta} W_\chi = 1$. Besides,

$$W' = -1 + \chi \mathbb{P}'\big(u_h^\chi > u_\ell^\chi\big) + \mathbb{P}\big(u_h^\chi > u_\ell^\chi\big)$$
$$W'' = \chi \mathbb{P}''\big(u_h^\chi > u_\ell^\chi\big) + 2\mathbb{P}'\big(u_h^\chi > u_\ell^\chi\big).$$

Since $\mathbb{P}'\big(u_h^\chi > u_\ell^\chi\big) > 0$ by comparative static A.4.3, a sufficient condition for W to be convex is that $\mathbb{P}''\big(u_h^\chi > u_\ell^\chi\big) \geq 0$. Differentiating $\mathbb{P}'\big(u_h^\chi > u_\ell^\chi\big)$ yields

$$\mathbb{P}''\big(u_h^\chi > u_\ell^\chi\big) = \frac{\frac{(1-\theta)\chi(\theta(2-\chi)-\chi)}{(\theta-\chi)(1-\chi)} - 2\theta\log\left(\frac{\theta(1-\chi)}{\theta-\chi}\right)}{(1-\theta)^2\chi^3}.$$

$\frac{(1-\theta)^2(\theta+\chi-2\chi^2)}{(\theta-\chi)^3(1-\chi)^2} > 0$. The last inequality follows from the fact that the term $\theta + \chi - 2\chi^2$ is concave in χ and positive in $\chi = 0$ and $\chi = \theta$.

The expression has the same sign as its numerator, denoted by $M(\chi)$, which is positive because $M(0) = 0 = M'(0)$ and $M''(0) = \frac{2(1-\theta)^3(\chi\theta-\chi^3)}{(1-\chi)^3(\theta-\chi)^3} > 0$.

A.5 Proof of proposition 6

The pricing and disclosure stage. Consider a candidate equilibrium in which one of two firms, indexed by ℓ, chooses $q_\ell^* = 0$ (we will check that this is indeed optimal) while the other firm, indexed by h, chooses $q_h = q > 0$. Given these quality choices and cursed consumers' exogenously given belief about undisclosed quality $\mu \in (0, q)$, behavior at the pricing and disclosure stage results is given by the two possible equilibrium configurations of Proposition 3 under vertical differentiation once we replace 1 with q and θ with μ. That is, firm h always and firm l never discloses. In a candidate equilibrium without exploitation, firm h charges $p_h = q - \mu$ and firm ℓ charges $p_\ell = 0$, while in a candidate equilibrium with exploitation, firm h randomizes its pricing over $[(1-\chi)q, q]$ and firm ℓ over $[\mu - \chi q, \mu]$. Lastly, if we denote firm h's expected profits in the two scenarios as $\pi_{NE} \equiv q - \mu - C(q)$ and $\pi_E \equiv (1-\chi)q - C(q)$ respectively, the former or the latter configuration prevails depending on whether $\pi_{NE} \geq \pi_E$, that is, depending on whether $q \geq \frac{\mu}{\chi}$.

The investment stage. Since the the prevailing equilibrium configuration is determined exclusively by a comparison of the profits of firm h in the two scenarios, the problem of firm h at the investment stage reduces to

$$\max\left\{\max_{q\geq 0} \pi_{NE}, \max_{q\geq 0} \pi_E\right\}.$$

Denote by q_{NE}^* and q_E^* the maximizers of π_{NE} and π_E respectively, and by π_{NE}^* and π_E^* the two maxima. Our assumptions on $C(\cdot)$ guarantee that q_{NE}^* and q_E^* are interior, unique, solve the first order condition, i.e. $q_{NE}^* = c^{-1}(1)$ and $q_E^* = c^{-1}(1-\chi)$, and that at least π_E^* is positive. Note also that $q_{NE}^* > q_E^*$.

Consistency with cursed beliefs. In equilibrium, it must also be the case that μ matches average quality in the market, so that in the two candidate equilibrium configurations $\mu_{NE}^* = q_{NE}^*/2$ and $\mu_E^* = q_E^*/2$, with $\mu_{NE}^* > \mu_E^*$. Notice that π_{NE}^* is continuous and decreasing in μ, independent of χ and, given our assumptions on $C(\cdot)$, $\pi_{NE}^*\big|_{\mu=q_{NE}^*} > 0$, while π_E^* is independent of μ, continuous and decreasing in χ and $\pi_E^*\big|_{\chi=0} > \pi_{NE}^*\big|_{\mu=\mu_{NE}^*} > \pi_E^*\big|_{\chi=1} = 0$ (see Figure 4a). Thus, there exists a unique $\chi_{NE} \in (0,1)$ such that $\pi_{NE}^*\big|_{\mu=\mu_{NE}^*} \geq \pi_E^*$ if and only if $\chi \geq \chi_{NE}$ (with strict inequality unless $\chi = \chi_{NE}$). Besides, since $\mu_{NE}^* > \mu_E^*$ and π_{NE}^* is continuous and decreasing in μ, $\pi_{NE}^*|_{\mu=\mu_E^*} > \pi_{NE}^*|_{\mu=\mu_{NE}^*}$ and, since μ_E^* is continuous and decreasing in χ, $\pi_{NE}^*|_{\mu=\mu_E^*}$ is continuous and increasing in χ (see Figure 4a again). Thus, there exists a unique $\chi_E < \chi_{NE}$ such that $\pi_E^* \geq \pi_{NE}^*|_{\mu=\mu_E^*}$ if and only if $\chi \leq \chi_E$ (with strict inequality unless $\chi = \chi_E$). Lastly, note that by construction, $\chi_{NE} > 1/2 > \chi_E$, since the configurations without and with exploitation require $q \geq \frac{q}{2\chi}$ and $q \leq \frac{q}{2\chi}$ respectively.

Equilibrium regions. The configuration with no exploitation prevails as the equilibrium if and only if $\chi \geq \chi_{NE}$, since only then q_{NE}^* is optimal given the consistent μ_{NE}^* and μ_{NE}^*. Likewise, the configuration with no exploitation prevails if and only if $\chi \leq \chi_E$, since only then q_E^* is optimal given the consistent μ_E^* and μ_E^*. In the region $\chi \in (\chi_E, \chi_{NE})$, the configuration with exploitation is not an equilibrium since, given the rather pessimistic belief of cursed consumers about the quality of the silent firm, firm h would have an incentive to choose q_{NE}^* and attract all consumers. Hence, in this region firm h randomizes between the two configurations in such a way that μ^* is consistent with average market quality and μ is such that firm h is indifferent between the two configurations.[25] This also implies that the profits of firm h in this region are equal to π_E^*. Figure 4b depicts the (expected) equilibrium level of q as a function of χ. Since efficiency would dictate that one firm chooses $q_l = 0$ and the other $q_h = c^{-1}(1)$, high quality in equilibrium falls short of its efficient level outside the no-exploitation region.

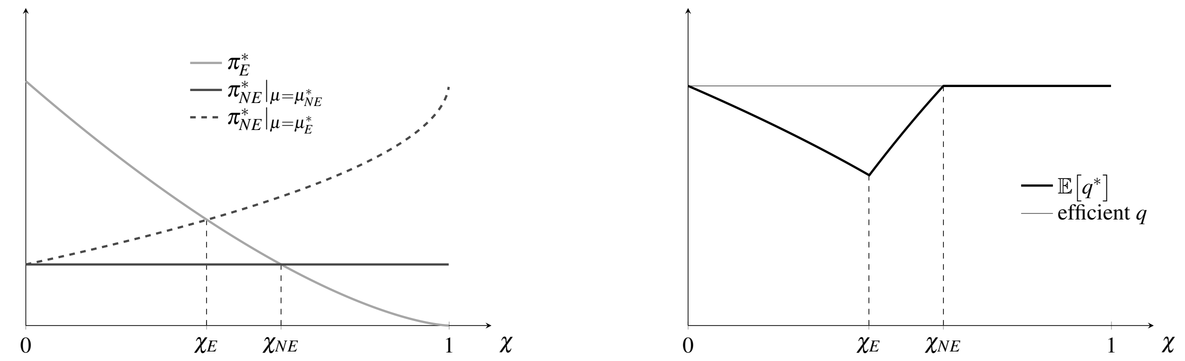
Minimal low-quality. We are left to show that firm l cannot profitably deviate from $q_l^* = 0$ by choosing a quality level $q_l > q^*$ (and disclosing).[26] Following this deviation, it is a continuation equilibrium strategy for firm h to still disclose and to charge $p_h = 0$ and for firm l to disclose and charge $p_l = q_l - q^*$, which yields profits of $\pi_{dev} = q_l - q^* - C(q_l)$. In the region without exploitation, i.e.

[25] Formally, if we denote by ε the probability with which firm h chooses q_{NE}^*, in equilibrium ε^* and μ^* jointly solve

$$q_{NE}^* - \mu - C(q_{NE}^*) = (1-\chi)q_E^* - C(q_E^*)$$
$$\varepsilon q_{NE}^* + (1-\varepsilon)q_E^* = 2\mu.$$

Existence and uniqueness of a solution in each of the two equations follows from standard continuity and monotonicity arguments, while by construction $\varepsilon^* \in (0,1)$ and $\mu^* \in (\mu_E^*, \mu_{NE}^*)$ if and only if $\chi \in (\chi_E, \chi_{NE})$.

[26] A deviation to $q_l > 0$ followed by non-disclosure can only trigger a more aggressive pricing strategy from firm h (who observes the deviation) but it cannot raise consumers' beliefs about q_l (for cursed consumers, by construction, and, for rational consumers, by the restriction that beliefs about a firm's quality do not depend on the behavior of its competitor). Likewise, any deviation to a level $q_l \leq q^*$ followed by disclosure is deterred by firm h still disclosing and charging $p_h = q - q_l$.



(a) Profits of the high-quality firm

(b) Equilibrium high-quality

Figure 4 Endogenous quality

when $\chi \geq \chi_{NE}$, $c(q_l) > 1$ for any $q_l > q_{NE}^*$ so that the deviation yields $\pi_{dev} < 0$ as opposed to $\pi_l^* = 0$. In the exploitation region, i.e. when $\chi < \chi_E$, the best deviation for firm l is $q_l = q_{NE}^*$, which yields $\pi_{dev} = q_{NE}^* - q_E^* - C(q_{NE}^*)$. Notice that $\pi_{dev}|_{\chi=0} < 0$ and, since q_E^* is decreasing in χ, π_{dev} is increasing in χ. Given our assumptions on $C(\cdot)$, $\pi_{dev}|_{\chi=1/2} < 0$, so that, since $\chi_E < 1/2$, $\pi_{dev} < 0$. Thus, the deviation yields again a loss rather than $\pi_l^* = \chi(q_E^*/2 - \chi q_E^*) > 0$. The deviation clearly yields even higher losses when $\chi \in (\chi_E, \chi_{NE})$.[27]

A.6 Proof of proposition 7

Without loss of generality, suppose that the high-quality good is located at the left end of the unit interval, so that $t_{1-\chi}$ and t_χ denote both the locations of the rational and cursed marginal consumer respectively, and the fractions of rational and cursed consumers that firm h serves. Given that the market will always be covered in equilibrium, the corresponding fractions served by firm ℓ are $1 - t_{1-\chi}$ and $1 - t_\chi$.

A.6.1 Equilibrium

We focus on a candidate equilibrium in which $t_{1-\chi} \in (0,1)$ and $t_\chi \in (0,1)$. Then, it must be that $t_{1-\chi} = \frac{1}{2}(1 - p_h + p_\ell + q_h)$ and $t_\chi = \frac{1}{2}(1 - p_h + p_\ell + (1-\theta)q_h)$. Thus, the demands faced by

[27] Given that firm h chooses q_{NE}^* with probability $\varepsilon^* \in (0,1)$ and q_E^* with complementary probability

$$\pi_{dev} = (1-\varepsilon^*)\underbrace{(q_{NE}^* - q_E^* - C(q_{NE}^*))}_{<0}\underbrace{-\varepsilon^* C(q_{NE}^*)}_{<0} < (1-\varepsilon^*)\underbrace{\chi(\mu^*/2 - \chi q_E^*)}_{>0} = \pi_l^*.$$

firms h and ℓ are respectively $D_h = (1-\chi)t_{1-\chi} + \chi t_\chi$ and $D_\ell = 1 - D_h$, and their profits are $\pi_h = p_h D_h$ and $\pi_\ell = p_\ell D_\ell$. Equilibrium prices must then necessarily satisfy first order conditions, which yield $p_h^* = \frac{1}{3}(3 + q_h - \theta\chi q_h)$ and $p_\ell^* = \frac{1}{3}(3 - q_h + \theta\chi q_h)$, so that $t_{1-\chi}^* = \frac{1}{6}(3 + q_h(2\theta\chi + 1))$, $t_\chi^* = \frac{1}{6}(3 - (\theta(3-2\chi) - 1)q_h)$, $D_h^* = \frac{1}{6}(3 + q_h(1-\theta\chi))$, $D_\ell^* = \frac{1}{6}(3 - q_h(1-\theta\chi))$, $\pi_h^* = \frac{1}{18}(3 + q_h(1-\theta\chi))^2$ and $\pi_\ell^* = \frac{1}{18}(3 - q_h(1-\theta\chi))^2$. Notice that indeed $t_{1-\chi}^* \in (0,1)$ and $t_\chi^* \in (0,1)$.

While profits in the relevant range are concave, so that second order conditions are necessarily satisfied, for this to be an equilibrium, it should also be the case that no firm profits from foregoing a segment of the market, typically the cursed segment for firm h and the rational segment for firm ℓ. Once we allow for $t_{1-\chi} = \{0,1\}$ or $t_\chi = \{0,1\}$, a firm i's 'global" demand is continuous in p_i (although not necessarily differentiable in these points), and so are its global profits $\Pi_i(p_i)$. And since Π_i is concave in the relevant deviation range, if we denote by ∂_+ the right derivative, two sufficient conditions for the two deviations not to be profitable are

$$\partial_+\Pi_h(p_h)\Big|_{p_h = 1-\theta q_h + p_\ell^* + q_h} = -\frac{1}{6}(1-\chi)\left(6 + (2 - \theta(6-\chi))q_h\right) < 0$$

and

$$\partial_+\Pi_\ell(p_\ell)\Big|_{p_\ell = p_h^* - q_h + 1} = -\frac{1}{6}\chi\left(6 - (2 + \theta(3+\chi))q_h\right) < 0.$$

The two conditions are indeed satisfied when $q_h < 1$.

A.6.2 Comparative statics

While the effects of an increase in χ described in the proposition can be derived by simple inspection of the objects of interest, we will disentangle the different economic forces behind each comparative statics, in particular for welfare. Throughout, we drop the superscript * for ease of notation and the subscript $k \in \{\chi, 1-\chi\}$ refers respectively to the cursed and the rational segment of the market. Also, each derivative is taken with respect to χ.

Comparative Static A.6.1 (Prices, Demands and Profits)**.** The price and demand of the high-quality firm are decreasing while the price and demand of the low-quality firm are increasing. Total profits are decreasing.

Note that $0 > p_h' = -p_l'$, that $0 < t_\chi' = t_{1-\chi}'$ (we can hence drop the subscript from t_k') and that

$D'_h = -D'_l = t' + t_\chi - t_{1-\chi} < 0$. We may thus write the derivative of total profits $\Pi \equiv \pi_h + \pi_\ell$ as

$$\Pi' = p'_l(D_l - D_h) + D'_l(p_l - p_h) < 0.$$

Thus, total profits decrease because variations in demands and prices of the two firms have opposite sign but the same magnitude and the high-quality firm is serving more consumers.

Comparative Static A.6.2 (Allocative efficiency of rationals and cursed)**.** For both the rational and the cursed segment average allocative efficiency is increasing.

The average allocative efficiency of the purchasing decisions of each consumer segment $k \in \{\chi, 1-\chi\}$ is

$$W_k = \int_0^{t_k^*} (v + q_h - t)\,\mathrm{d}t + \int_{t_k^*}^1 (v - 1 + t)\,\mathrm{d}t.$$

Thus, we may write

$$W'_k = 2(t^{fb} - t_k)t' > 0,$$

where $t^{fb} \equiv (1 + q_h)/2$ is the efficient location of the marginal consumer. Average welfare on each segment increases with χ as the marginal consumer gets closer to its efficient location.

Comparative Static A.6.3 (Welfare)**.** Welfare is convex, decreasing if $\theta \leq \frac{4}{7}$ and u-shaped otherwise. It is maximal when $\chi = 0$.

Welfare is $W = (1-\chi)W_{1-\chi} + \chi W_\chi$. Thus, the variation in total welfare can be decomposed as

$$W' = \underbrace{W_\chi - W_{1-\chi}}_{CE_W < 0} + \underbrace{2t'(t^{fb} - D_h)}_{EE_W > 0} = \frac{1}{36}\theta(\theta(16\chi - 9) - 4)q_h^2.$$

The composition effect (CE_W) is negative since cursed consumer take on average less efficient decisions. The equilibrium effect (EE_W) is positive since the demand of the high quality firm gets closer to its efficient level. The overall effect is positive if and only if $\chi > \frac{4+9\theta}{16\theta}$, which in particular requires $\theta > \frac{4}{7}$. It is in this case that reducing the fraction of cursed consumers by means of imperfect consumer protection may decrease welfare. Differentiating a second time and noticing that $t'' = 0$ yields

$$W'' = \underbrace{2t'(t_{1-\chi} - t_\chi)}_{CE'_W > 0} + \underbrace{2t'(-D'_h)}_{EE'_W > 0} = \frac{4}{9}\theta^2 q_h^2,$$

where $CE_W' > 0$ since $t_{1-\chi} > t_\chi$ and $EE_W' > 0$ since $D_h' < 0$. The last statement in the comparative statics simply follows from $W|_{\chi=0} - W|_{\chi=1} = \frac{1}{36}\theta(4+\theta)q_h^2 > 0$.

Thus, for low levels of χ, CE_W dominates EE_W. But because CE_W gets smaller in absolute value as χ increases and EE_W gets larger, EE_W may eventually dominate. The reason CE_W gets less negative as χ increases is that CE_W is driven by those rational consumers located where they would make different decisions if they were cursed. Because of EE_W, this group lives closer and closer to the efficient allocation t^{fb} as χ increases and therefore incurs smaller and smaller efficiency losses from turning cursed. Instead, EE_W is larger the smaller $t_{1-\chi}$ and t_χ, that is the further the two marginal consumers that react to price changes by switching to the high-quality product live from the low-quality firm. Because $t_{1-\chi} > t_\chi$, more cursedness implies larger efficiency gains from equilibrium price effects.

Comparative Static A.6.4 (Utility of rationals and cursed)**.** The average utility of rational and cursed consumers is increasing.

The average utility for each consumer segment $k \in \{\chi, 1-\chi\}$ is

$$U_k = \int_0^{t_k^*} (v + q_h - p_h^* - t)\,\mathrm{d}t + \int_{t_k^*}^1 (v - p_\ell^* - 1 + t)\,\mathrm{d}t.$$

Thus, after noticing that $p_l' = t'$ and $p_h' = -t'$, we obtain

$$U_k' = (q_h - (p_h - p_l))\,t' > 0,$$

and we can hence drop the subscript from U_k'. This equation clarifies that the assessment of the effect of a variation in χ on average surplus of each segment does not incorporate considerations on transportation costs. Intuitively, this occurs because the overall utility variation of consumers who switch their purchasing decision as a result of the change in χ is zero. Indeed, for any consumer that gains by switching to firm h, there is a consumer who suffers a proportional loss by having to shift to firm l and vice-versa (and in particular, the utility of the previous and new marginal consumer is identical since for the latter the variation in price is completely offset by the variation in transportation costs). Thus, the effect is positive since more consumers now buy the high-quality good, which yields a higher net utility than the low-quality good as consumers always appropriate some of the benefits of competition (i.e. $p_h - p_l < q_h$).

Comparative Static A.6.5 (Consumer surplus)**.** Consumer surplus is convex, increasing if $\theta \leq 4/9$ and u-shaped otherwise. It is maximal in $\chi = 1$ if $\theta < 4/5$ and in $\chi = 0$ otherwise.

Consumer surplus is $S = (1-\chi)U_{1-\chi} + (\chi)U_{\chi}$. The variation in total surplus can then again be decomposed in a negative composition effect (CE_S) and a positive equilibrium effect (EE_S)

$$S' = \underbrace{U_{\chi} - U_{1-\chi}}_{CE_S<0} + \underbrace{U'}_{EE_S>0} = \frac{1}{36}\theta(4-\theta(9-8\chi))q_h^2.$$

The total effect is positive if and only if $\chi > \frac{9\theta-4}{8\theta}$, which is always satisfied if $\theta < \frac{4}{9}$. Differentiating a second time

$$S'' = \underbrace{0}_{CE_S'} + \underbrace{(-2p_h')t'}_{EE_S'>0} = \frac{4}{9}\theta^2 q_h^2 > 0.$$

Since the composition effect is independent of χ, the convexity of U_{χ} is driven exclusively by the equilibrium effect, which increases with χ as the high-quality price premium $p_h - p_l$ decreases. The last statement in the comparative static simply follows from $S|_{\chi=0} - S|_{\chi=1} = \frac{1}{36}\theta(5\theta-4)q_h^2$.