Dynamic Competition in Deceptive Markets

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Abstract

In many deceptive markets, firms design contracts to exploit mistakes of naive consumers. These contracts also attract less-profitable sophisticated consumers. I study such markets when firms compete repeatedly. By observing their customers' usage patterns, firms acquire private information about their level of naiveté. First, I find that private information on naiveté mitigates competition and is of great value even with homogeneous products. Second, competition between initially symmetrically-informed firms is mitigated when firms can educate naifs about mistakes. In an analogues setting without naifs, the second result does not occur; the first result occurs when firms cannot disclose fees.

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1 Introduction

Both intuition and extensive empirical evidence suggest that firms in many markets have a better understanding of consumer behavior than consumers themselves. This allows firms to exploit consumer misunderstandings. Examples are markets for credit cards (Ausubel, 1991; Agarwal et al., 2008; Stango and Zinman, 2009, 2014), retail banking (Cruickshank, 2000; Office of Fair Trading, 2008; Alan et al., 2018; Competition and Markets Authority, 2016) or mobile-phone services (Grubb and Osborne, 2014). In most of these markets, firms and consumers interact repeatedly. Yet the existing theoretical work—such as Gabaix and Laibson (2006), Grubb (2009), Armstrong and Vickers (2012), and Heidhues et al. (2016b)—considers non-repeated interactions.[1] In these models, some naive consumers are unaware of shrouded or hidden attributes. I extend this literature by introducing a dynamic model of competition with deceptive products. This allows me to investigate an increasingly relevant aspect of reality: developments in the analysis of large amounts of data help firms to predict consumer behavior with increasing precision. By evaluating their own customers' usage data, firms have an informational advantage relative to their competitors. I ask how this informational advantage affects competition when some consumers are more prone to making mistakes than others. I then compare results to an analogues setting without naive consumers.

Formally, I study a two-period model with shrouded product attributes. I firms sell a homogeneous good in each period. Firms charge a transparent price and a hidden fee, i.e. the shrouded attribute. There are naive and sophisticated consumers. Naifs pay the hidden fee but do not take it into account. Sophisticates are aware of the hidden fee and avoid it. In this way, the hidden fee represents unexpected payments due to costly mistakes.[2] The novel feature is that firms analyze their customers' usage patterns to predict their behavior, and to target offers accordingly: in period 1, firms compete with symmetric information on consumers. After observing which of their first-period customers paid the hidden fee, firms learn to distinguish between naifs and sophisticates within their customer base. In period 2, firms use this private information to discriminate between continuing customers based on their level of sophistication.

Credit cards are an example of a market close to this setting. The market is competitive by conventional measures, i.e. many firms sell a quite homogeneous product. Consumers are usually aware of maintenance

[1] Gabaix and Laibson (2006) consider an extension where consumers buy a base product once, but an add-on multiple times. But they do not allow for repeated interaction where firms adjust conditions over time.

[2] For example, naifs could underestimate their demand for an add-on service such as credit-card borrowing or late payments, whereas sophisticates do not demand the add-on, e.g. they do not borrow. I discuss further examples in Section 7.

fees, cash rewards, introductory APRs or new-client bonuses. But many consumers ignore overlimit fees, late fees, or underestimate their future borrowing when choosing a credit card. Firms condition offers on customer characteristics, including naiveté, which they can infer from usage data.

Following Gabaix and Laibson (2006), many previous articles on deceptive products study a similar setting, but with non-repeated interaction where firms cannot distinguish consumers. Firms charge large hidden fees, making naifs more profitable than sophisticates who choose the same contract. But competition with transparent prices drives away any profits. Profits from naifs end up cross-subsidizing sophisticates.

My first main result is that private information on naiveté creates profits in period 2. Firms use this information to reduce the intensity of competition. When a firm A observes past usage patterns in her customer base, she learns to distinguish between her old customers in period 2. But A's rivals remain uninformed about A's customer base. A can use her information to target continuing naifs with a smaller transparent price than sophisticates. Sophisticates do not get this transparent discount and are more prone to switch to a rival. Thus, uninformed rivals cannot attract A's profitable naifs without also attracting unprofitable sophisticates. Because of this adverse selection of sophisticates, rivals compete less vigorously. By inducing adverse selection, firms can profitably exploit the fact that private information on naiveté allows them to discriminate between their continuing customers, while rivals lack the information to do so, and naifs lack the sophistication to recognize better offers.

Firms use naiveté to induce adverse selection. With only rational consumers and observable fees, competition severely limits the value of information. I establish this in a benchmark with only sophisticated consumers. All value a base product and some also value an add-on. Firms use private information on add-on demand to target consumer-specific offers. But when consumers are aware of their add-on demand, they now recognize a cheaper add-on. This allows uninformed rivals to compete effectively: they can reduce the add-on price to attract add-on consumers *without* adverse selection of base-good consumers. Awareness prevents adverse selection and induces marginal-cost prices despite private information on add-on demand. I discuss below, however, that the first main result also occurs in the setting without naifs when firms cannot disclose add-on fees.

These results suggest that firms can use customer data to induce adverse selection of less-profitable customers. This makes the data valuable even in highly competitive markets with homogeneous products.

My first main result has further important implications. First, in contrast to the previous literature, firms prefer a mix of naive and sophisticated customers. Thus, firms themselves might want to educate some of their clients but not too many, and public consumer-education campaigns can backfire and raise profits.

Second, analyzing consumer data is increasingly relevant in markets like social media, advertisement, credit cards, or retailers' loyalty programs. Because customer information increases profits, my results predict that even firms in fiercely competitive industries are willing to invest in big-data analysis to improve predictions on their customers' naiveté or add-on demand. But because these investments do not increase product- or match values, they are profitable but inefficient.

Third, my results predict price dispersion when firms are privately informed about their customers. Firms use their customer information to lock-in profitable consumers, leading to mixed strategies in period 2 akin to Varian (1980). Price dispersion is consistent with evidence on credit cards (Schoar and Ru, 2016; Stango and Zinman, 2015). Also consistent with my results, Schoar and Ru (2016) find that firms target lower transparent fees such as annual fees to more naive consumers.

My second main result concerns competition for customers in period 1. In period 1, firms compete with symmetric information and homogeneous products, so firms should compete away future profits. But this is not true when firms can unshroud hidden fees. The ability to unshroud—rather than helping consumers—induces price-coordination in period 1 and increases total profits. As in Gabaix and Laibson (2006), unshrouding firms face a 'curse of debiasing': unshrouding turns naifs in the market into less-profitable sophisticates.[3] Thus, a firm with a customer base shrouds hidden fees to keep its profitable naifs. But a firm without customer base in period 2 has no private information on naiveté and earns zero profits. This firm unshrouds hidden fees to attract consumers, which decreases profits of rivals. Take a market with two firms A and B. If both charge the same price in period 1, both have a customer base and earn profits in period 2. But if A competes fiercely in period 1 and leaves B without customer base, B will unshroud hidden fees in period 2 to attract consumers, which reduces A's continuation profits. In equilibrium, firms prefer to coordinate transparent prices in period 1 to ensure that rivals get a sufficient customer base. Firms do not compete away future profits in period 1. The ability to induce transparency is a credible threat to fiercely-competing rivals and increases total profits. Moreover, this result only occurs in the model with naifs.

I discuss a rational reinterpretation of the basic model, connecting results to articles on expensive add-ons and loss-leader pricing (Verboven, 1999; Ellison, 2005; Lal and Matutes, 1994). Instead of naifs, there

[3]E.g. Stango and Zinman (2014) and Alan et al. (2018) show that simply mentioning certain fees raises consumer awareness.

is a form of incomplete contracts: consumers have rational expectations on add-on prices, but firms *cannot* disclose add-on prices to consumers when they choose a base good.[4] Thus, firms cannot compete with add-on fees and earn monopoly margins from add-ons. With this friction on information transmission, the first main result generalizes to this setting: private information on add-on demand creates profits in period 2. But because firms cannot disclose add-on prices, the price-coordination motive from the model with naifs is absent. Firms compete fiercely in period 1 and the second main result is not robust without naifs.

Consumer education- or protection policies are common suggestions for deceptive products. My results suggest that alternative policies that instead focus on reducing information asymmetry between firms can foster competition. For example, encourage consumers to use their data to shop for better offers.

Section 2 introduces the basic model. Section 3 presents benchmarks, and Section 4 the main results. Section 5 studies the rational reinterpretation. Section 6 explores policy implications. Section 7 discusses robustness, and how the model applies to important markets like credit cards, retail banking, mobile-phone services and others. Section 8 reviews the related literature. Section 9 concludes. Proofs are in the Appendix.

2 The Basic Model

The setup extends existing models with shrouded attributes like Gabaix and Laibson (2006), Armstrong and Vickers (2012), or Heidhues and Kőszegi (2017). The novel feature is that firms and consumers interact repeatedly. This allows firms to analyze their customers' usage data and learn their level of naiveté.

There are two periods $t \in \{1, 2\}$. In each period $I \geq 2$ firms with marginal cost $c \geq 0$ sell a homogeneous product. Each firm i sets transparent and hidden price components f_{it} and $a_{it} \in [0, \bar{a}]$, respectively. I follow the literature by assuming a cap $\bar{a}$ on hidden fees.[5] There is a unit mass of consumers with unit demand. In each period, consumers value the product at $v > c$ and their outside option at zero.

The two types of consumers differ as to whether they pay and correctly perceive hidden fees. The share $1-\alpha \in [0, 1]$ is sophisticated. They observe transparent and hidden price components, and can avoid paying the hidden one at no costs.[6] The share α is naive. Also naive consumers take only transparent prices into

[4] This assumption is reasonable when information transmission is expensive; but since credit cards are intensely advertised, these costs seem negligible. E.g. in Schoar and Ru (2016) the average household receives multiple credit card offer letters per month.

[5] Gabaix and Laibson (2006) and Armstrong and Vickers (2012) interpret $\bar{a}$ as a regulatory price cap, or consumers only noticing sufficiently large fees. It can also stand for the unanticipated willingness to pay for an additional service.

[6] For example, these consumers avoid expensive credit-card fees by not borrowing or paying back their debt in time. This can

account, but they end up paying the hidden fee.[7] Thus, all consumers have the same expected expenditures for a product—the transparent price; the hidden fee captures unexpected expenditures of naive consumers. Consumers maximize their perceived utility.[8]

In the basic model, naive consumers do not learn about their naiveté over time, except when educated by a firm. This is consistent with evidence that consumers repeatedly trigger fees they are unaware of.[9]

Firms on the other hand can unshroud hidden fees to naive consumers in each period. Unshrouding turns naifs into sophisticates. This captures that firms can reduce consumer mistakes through more transparent product design or fees, e.g. by advertising them. I discuss empirical examples of unshrouding in Section 7.2. For simplicity, the basic model assumes that unshrouding turns all naifs into sophisticates. I assume that consumers, once educated about hidden fees, remain so for the next period.

The new feature of the model is that firms analyze their customers' usage history and learn their level of naiveté over time. I call the set of consumers who purchase from a firm in period 1 its customer base. Firms observe consumption patterns in their customer base in period 1 and infer consumers' types i.e. that naifs pay the hidden fee and sophisticates do not. Firms only observe their own customers' consumption and have private information on their customer base in period 2. This captures that firms observe their customers' purchase history in more detail and have an informational advantage on their customers relative to rivals.

Firms can use information on their customers to target prices. In period 2, this enables each firm i to charge f_{i2}^{naive} and f_{i2}^{soph} to naive and sophisticated consumers in its customer base, respectively.[10] Competitors of firm i do not observe which of i's customers receives which offer. Naive consumers do not infer from equilibrium offers that they are naive.[11] To attract new customers from competitors, firm i also charges a new-customer price, or poaching price, denoted f_{i2}^{new}. Because all consumers only consider transparent

also captures precautionary behavior, like avoiding roaming charges by purchasing extra packages or by calling from land-lines. Alternatively, firms charge the hidden fee for an add-on service for which sophisticates have no demand.

[7] Additionally, one could have sophisticated consumers who are aware of the hidden fee and pay it, and naifs who falsely believe to pay the hidden fee. But Heidhues et al. (2016b) show that firms can screen these consumers into buying a separate transparent product without hidden fee, which is why I do not consider them here.

[8] In each period, sophisticates' utility and naifs' perceived utility of product i is $v - f_i$. Naifs' true utility is $v - f_i - a_i$. Consumers take their perceived continuation utility into account. When hidden fees are shrouded, both types choose a firm $i \in \operatorname{argmax}_{j\in\{1,\ldots,I\}} v - f_{j1} + V_{j2}$, where V_{j2} denotes the expected continuation utility after consuming from firm j in period 1.

[9] For evidence, see Cruickshank (2000); Stango and Zinman (2009); Office of Fair Trading (2008).

[10] This rules out that in $t = 2$ sophisticates can disguise as new customers of their old firm without paying the hidden fee in $t = 1$. In line with the applications in Section 7, firms can prevent this by asking for an ID when consumers sign a new contract.

[11] One interpretation is that naive and sophisticated consumers have non-common priors as in Eliaz and Spiegler (2006). Without this assumption, naifs could be separated as in the Benchmark in Section 3.1.

prices, a single new-customer price is not a restriction. In period 1, firms cannot distinguish and therefore discriminate between consumers and set one price f_{i1}.

When consumers are indifferent between all firms, I employ a general tie-breaking rule: each firm gets a market share $s_i > 0$ with $\sum_{i=1}^{I} s_i = 1$. When indifferent between less than I firms, I impose for ease of exposition that a firm i that attracts consumers gets a market share proportional to s_i.

Sorting Assumption: Consumers sort independently of their type among firms that make them indifferent. This simplifies the analysis by guaranteeing that—given shrouding—the distribution of types within a non-empty customer base is the same as in the overall population.

To summarize, the timing of the game is as follows:

Period 1: Competition for a Customer Base

- *Firms* simultaneously choose f_{i1} and a_{i1}, and whether to shroud or unshroud hidden fees.
- *Consumers* buy from the firm they perceive cheapest among the firms preferred to their outside option. When a firm unshrouds hidden prices, naifs become sophisticates.

Period 2: Private Information on the Firms' Customer Bases

- Firms observe which of their continuing customers paid the hidden fee in period 1, and learn their types. Firms can only identify the types in their own customer base.
- *Firms* set prices f_{i2}^{soph} and f_{i2}^{naive} for sophisticated and naive consumers in their customer base, respectively. They set a poaching price f_{i2}^{new} to attract customers from competitors. Firms choose hidden fees a_{i2}, and whether to shroud or unshroud hidden fees.
- *Consumers* buy from the firm they perceive as the cheapest. If hidden fees are shrouded, a consumer of type $\theta \in \{soph, naive\}$ who is in firm i's customer base picks the smallest price in $\{f_{i2}^{\theta}, (f_{j2}^{new})_{j \neq i}\}$ if this price is below v. When a firm unshrouds hidden fees, naifs become sophisticates.

I solve for perfect Bayesian equilibria of the game played between firms. PBE is relatively straightforward here because the Sorting Assumption pins down the beliefs of firms about their rivals' customer base: after unshrouding, all customers become identical, and type information are obsolete. After shrouding, beliefs on the composition of customer bases are identical to the distribution of types in the population. This is why I focus on sequential rationality for the rest of this article.

I call an equilibrium where firms shroud hidden fees with probability one a shrouding equilibrium.

The basic model describes just one way to model how firms benefit from learning about their clients' naiveté. Section 7 discusses a wide range of alternative modeling choices and applications of the model.

3 Benchmarks

To study the impact of consumer naiveté and private customer data, I analyze two benchmarks. First, an analogues setting where 'naive' consumers are aware of their demand for an add-on service. Second, the basic model but firms do not learn their continuing customers' types. In both benchmarks firms earn zero profits.

3.1 Private Customer-Base Information without Naive Consumers

All consumers value the base good with v. The share α—called add—also values an add-on at $\bar{a}$. The remaining consumers—called $base$—have zero value for the add-on. Two firms A and B produce the base good at cost c, and the add-on at cost zero. Without loss of generality, let firm A know all customers' types while firm B knows only their distribution. Both firms charge an add-on price a_i. Firm A can assign prices for each type, f_A^{add}, f_A^{base}, while the uninformed B can only offer one f_B. Consumers observe all prices.

Firm A cannot benefit from her information because consumers recognize any better offer. First, note that the uninformed firm B cannot earn positive profits, because the informed A could marginally undercut any profitable offer of B. But also the informed A earns zero profits. Because consumers are aware of their add-on demand, they recognize and select any cheaper offer. This allows the uninformed B to compete effectively with screening offers. In equilibrium, both firms price at marginal costs. Because sophisticated consumers recognize better offers, private information on consumer preferences does not increase profits.

Proposition 1. [Private Customer Information with Sophisticated Consumers only]
When customers are sophisticated and have heterogeneous add-on demand, a firm that is privately informed about add-on-demand types earns zero profits from each type in a competitive market with observable fees.

Remark: Of course, also in models without naive consumers, firms can have reasons to gather information on their customers that are beyond the scope of this article. As an example without naifs, Section 5 shows that private information on add-on demand increases profits when firms cannot disclose add-on fees.

3.2 No Customer Data

The next benchmark considers the basic model from Section 2 without information on customers. Firms do not learn their customers' types, so they offer only one transparent price in each period.

Proposition 2. [Deceptive Markets without Customer Data]
In each equilibrium firms earn zero profits. Shrouding equilibria exist. In each shrouding equilibrium, consumers pay $f_{i1} = f_{i2} = c - \alpha\bar{a}$ and naifs additionally pay hidden fees $a_{i1} = a_{i2} = \bar{a}$.

Without information there are no dynamic effects. Each period repeats the one-period shrouding equilibrium in Gabaix and Laibson (2006). Shrouding profits from naifs are competed away with lower transparent prices. Naifs effectively cross-subsidize sophisticates, which echos many results in the Literature.

The two benchmarks establish when consumer sophistication or the absence of information on naiveté encourage competition. I show next that private information on naiveté mitigates competition.

4 The Benefits of Customer Data in Deceptive Markets

I now discuss the model introduced in Section 2, starting with competition in period 2.

4.1 Exploiting Naiveté with Customer Data

I illustrate why in period 2 of shrouding equilibria, firms earn positive profits and play mixed strategies. To simplify the exposition, consider period 2 with two firms A and B where both firms shroud, and suppose that the informed firm A has all consumers in her customer base and the uninformed B none. Thus, A sets f_{A2}^{naive} and f_{A2}^{soph} for their own old customers, and B charges f_{B2}^{new} to poach A's customers.

Note first that firms exploit naiveté: they charge the largest hidden fee $a_{it} = \bar{a}$ when they are shrouded. Sophisticates avoid and do not pay the hidden fee. Naifs ignore the hidden fee but pay it.

I now show why A earns positive second-period profits in shrouding equilibria. Because of Bertrand competition, A will never charge a transparent price above c. Indeed, A charges $f_{A2}^{soph} = c$ to avoid losses from sophisticates. Now if $f_{A2}^{naive} \in (c - \alpha\bar{a}, c]$, firm B can undercut this price to profitably attract A's consumers. B would makes losses from sophisticates who do not pay $\bar{a}$, but the gains from naifs would be larger. However, if $f_{A2}^{naive} \leq c - \alpha\bar{a}$, charging a smaller f_{B2}^{new} is no longer profitable because the losses from sophisticates would exceed the profits from naifs. This has two implications. First, in equilibrium B charges prices $f_{B2}^{new} \geq c - \alpha\bar{a}$ to avoid losses from new customers. Second, firm A can always deviate to $f_{A2}^{naive} = c - \alpha\bar{a}$ and $f_{A2}^{soph} = c$ to earn at least $\alpha(1-\alpha)\bar{a}$ from its customer base. Though this is not an equilibrium, it establishes the minimum profits firm A can earn in each shrouding equilibrium in period 2.

The key reason for positive profits is adverse selection of sophisticates induced by an information advantage on consumer naiveté. Naive consumers pay $\bar{a}$ and are more profitable, and firm A uses its information to set $f_{A2}^{naive} < f_{A2}^{soph}$ in equilibrium. Targeting these transparent discounts to naifs makes sophisticates more responsive to B's poaching offers. As a result, the uninformed B faces adverse selection of sophisticates, reducing its willingness to compete for A's customers. This allows the informed A to enjoy positive profits.

Adverse selection hinges on the uninformed B being unable to attract A's naive customers without also attracting the less-profitable sophisticates. There are three reasons for this. First, naive consumers lack the sophistication to recognize better offers of B. If naifs were aware of the hidden fees, like consumers with add-on demand in Proposition 1, B could set $f_{B2}^{new} = c$ and $a_{B2} > 0$ sufficiently small to undercut naifs' total price from A. In this way, B could poach 'naifs' without losses on sophisticates. But because naifs do not respond to changes in hidden fees, uninformed rivals cannot use hidden fees to poach naifs only. Second, unshrouding does not help firm B due to the curse of debiasing identified by Gabaix and Laibson (2006). Unshrouding makes naifs less profitable and reduces profits from hidden fees.[12] Third, firm B lacks the information to target A's naifs with different transparent prices. As I show below in Section 6, symmetric information would allow B to target offers to naifs, thereby avoiding adverse selection.

The logic of the equilibrium construction is similar to Varian (1980), where firms compete for "shoppers" by offering low prices, but these low prices erode profits earned from captive "loyal" consumers. Here, from the perspective of the uninformed firm B, the "shoppers" are the naifs who may switch for a low-enough price, and the "loyal" types are the sophisticates who generate bigger losses from lower prices. This is why, as in Varian-type models, firms play mixed strategies for f_{B2}^{new} and f_{A2}^{naive}.

The same reasoning applies when B has a non-empty customer base and with $I \geq 2$ firms. In period 2

[12] The proof of Proposition 3 shows that this also holds when unshrouding is more profitable than in the current setting, i.e. when a share of naifs continues to pay unshrouded hidden fees. This closely resembles unshrouding results in Gabaix and Laibson (2006).

of shrouding equilibria, consumers pay new-customer prices based on this distribution:

$$G^{new}(f_{i2}^{new}) = \begin{cases} 0, & \text{if} f_{i2}^{new} \in (-\infty, c - \alpha\bar{a}] \\ 1 - \sqrt[I-1]{\frac{(1-\alpha)\bar{a}}{f_{i2}^{new}+\bar{a}-c}}, & \text{if} f_{i2}^{new} \in (c - \alpha\bar{a}, c) \\ 1, & \text{if} f_{i2}^{new} \in [c, \infty) \end{cases}, \quad \forall i. \tag{1}$$

$G^{new}(\cdot)$ has a mass point on c of weight $\sqrt[I-1]{1-\alpha}$, so firms use new-customer prices for both poaching and not poaching with strictly positive probability. When rivals do not poach, i.e. set $f_{i2}^{new} = c$, firms who charge $f_{i2}^{soph} = c$ keep sophisticates with probability 1. Firms mix naive-customer prices according to

$$G^{naive}(f_{i2}^{naive}) = \begin{cases} 0, & \text{if} f_{i2}^{naive} \in (-\infty, c - \alpha\bar{a}] \\ \frac{f_{i2}^{naive}+\alpha\bar{a}-c}{\alpha(f_{i2}^{naive}+\bar{a}-c)}, & \text{if} f_{i2}^{naive} \in (c - \alpha\bar{a}, c) \\ 1, & \text{if} f_{i2}^{naive} \in [c, \infty) \end{cases}, \quad \forall i. \tag{2}$$

The distributions (1) and (2) characterize the symmetric shrouding equilibrium. But in all shrouding equilibria, firms play identical strategies for the respective prices on $(c - \alpha\bar{a}, c)$. Intuitively, all firms $j \neq i$ mix new-customer prices to make firm i indifferent between all $f_{i2}^{naive} \in (c - \alpha\bar{a}, c)$. This must be true for all i and therefore all new-customer prices must follow the same distribution within this interval. The same logic applies to distributions of naive-customer prices.

With $I > 2$ also asymmetric equilibria exist, but all shrouding equilibria are payoff equivalent and lead to the same profits and purchase prices.[13][14] Proposition 3 summarizes the results for period 2.

Proposition 3. [Exploiting Private Information on Customer Data in Period 2]
Shrouding equilibria exist where each firm strictly prefers to shroud hidden fees in period 2 if and only if hidden prices are shrouded in period 1 and each firm has a non-empty customer base.

In all such shrouding equilibria, each firm i earns profits $\pi_{i2} = s_i\alpha(1-\alpha)\bar{a}$. Hidden prices are $a_{i2} = \bar{a}$. Sophisticated consumers pay transparent prices weakly below c based on (1)*, and naive consumers pay f_{i2}^{new}*

[13]In asymmetric equilibria, some firms shift probability from the mass points of f_{i2}^{soph} or f_{i2}^{new} on c to larger prices, but each consumer faces at least two transparent prices weakly below c with probability one. See Lemma 3 in the proof of Proposition 3 for the details.

[14]Asymmetric payoff-equivalent equilibria with $I > 2$ are common in Varian-type models (Baye et al., 1992). Johnen and Ronayne (2019) argue that only the unique symmetric one is robust.

and f_{i2}^{naive} based on (1) *and* (2) *respectively. $f_{i2}^{naive} < f_{i2}^{soph}$ for all i with probability one.*

Propositions 1 to 3 show that firms' private information on naiveté can create equilibrium profits. This sheds new light on the value of customer data in competitive environments. In Proposition 1, when all consumers are sophisticated and observe all fees, competition limits the value of firms' *private information on preferences.* Now consider Proposition 2 without information on naiveté. When a naive agent uses a misspecified model of the world, another more sophisticated agent can take advantage. Profits from naifs end up cross-subsidizing the product for sophisticates. This echoes several results in the literature cited in this article. What effect does competition have? Bertrand competition should drive away profits. But suppose that a firm has an advantage in distinguishing a set of naifs and sophisticates. When firms cannot observe one another's contract offers, uninformed rivals face an adverse selection problem that reduces their willingness to compete. This allows informed firms to earn positive profits.

Shrouding profits are bell-shaped in the share of naifs α. Firms do not always want more naifs and instead prefer a balanced customer base. Intuitively, sophisticates have a strategic value to firms. They induce adverse selection and less-intense poaching. Thus, the larger the share of sophisticates, the larger the expected margin firms earn from naifs—$(1-\alpha)\bar{a}$. This implies that public consumer-education policies can backfire and increase profits, and that firms might want to educate some of their customers but not too many.[15]

The profitability of identifying naive consumers implies that firms have strong incentives to invest in IT and big-data analysts to improve their targeting abilities. But in the present setting, improved targeting abilities do not increase product- or match values. This renders these investments profitable but inefficient.

The profitability of usage data also implies that firms, especially those active in data-intensive industries like online advertisement or credit cards, can profitably sell consumer data to a market in which they are not active, also if this market is very competitive.[16]

Proposition 3 predicts price dispersion. In the credit-card industry, this is in line with substantial variation in offers to new consumers (Schoar and Ru, 2016) and in borrowing costs (Stango and Zinman, 2015).

[15] The bell-shaped profits are reminiscent of Ireland (1993); McAfee (1994), where firms choose advertising intensity (ads), i.e. the probability that consumers see its price, before they compete. In equilibrium, one firm chooses many ads. But the other firms choose fewer ads. More ads would scale up sales, but also increase competition from the large firm and force down prices.

[16] For example, The Economist (September 13, 2014) reports that leading credit-card networks sell data about their cardholders to advertisers, and advertisement space targeted on consumers that are more likely to buy particular products such as telecommunication services.

I now discuss comparative statics of the distributions (1) and (2).[17] As the number of firms I increases, $G^{new}(\cdot)$ shifts to the right and firms set *larger* new-customer prices. More firms reduce the probability to set the lowest new-customer price that poaches naifs. To compensate, firms poach less aggressively.

When the share of naifs α increases, firms compete more fiercely, inducing lower new- and naive-customer prices.[18] Populations with more naifs have lower transparent prices. This is in line with findings of Schoar and Ru (2016): credit-card companies target offers with larger annual fees, a rather transparent fee, to consumers with higher education who are less likely to be naive.

Remark on mixed strategies: Two-stage pricing as in Myatt and Ronayne (2019) can induce stable price dispersion. Suppose firms first choose list prices for each consumer type they can identify, and afterwards non-negative discounts. Then for $I = 2$ a pure-strategy equilibrium exists with the same profits as in Proposition 3. Naive-customer prices are $c - \alpha\bar{a}$, and sophisticated- and new-customer prices are c.[19]

Remark on unshrouding: All these properties of shrouding continuation equilibria carry over to cases where unshouding is unfeasible or very costly. Without unshrouding, market continuation profits always equal $\alpha(1-\alpha)\bar{a}$. Firms earn a share of this profit equal to their customer base.

4.2 Mitigated Competition for Customer Bases

How do second-period profits impact competition for customers in period 1? Classic results on switching costs (Klemperer, 1995), or deceptive markets (Gabaix and Laibson, 2006) suggest that firms compete away future profits in period 1. I show, however, that the ability of firms to unshroud hidden fees, instead of helping consumers, softens competition even more and leads to positive total profits.

Because unshrouding induces multiple equilibria in period 2, I make the following selection assumption.

Assumption 1 (Equilibrium-Selection Assumption)**.** *Firms shroud hidden fees in period 2 if and only if all firms strictly prefer the shrouding-continuation equilibrium over unshrouding.*

This assumption rules out two types of continuation equilibria. First, firms might miscoordinate on unshrouding in period 2. When at least two firms with a customer base unshroud hidden fees, none of them

[17] The Web Appendix contains graphs of the distributions.

[18] The average margin of total naive-consumer prices is $\bar{a}\frac{1-\alpha}{\alpha}\ln(\frac{1}{1-\alpha})$, which decreases in α.

[19] Note that for an econometrician who does not observe private information of firms, as in Schoar and Ru (2016); Stango and Zinman (2015), these prices look like price dispersion.

benefits from unilaterally shrouding hidden fees. The result is a standard Bertrand equilibrium with zero profits. But because each firm strictly prefers the shrouding continuation equilibrium over the Bertrand one, it is plausible that firms coordinate on the equilibrium that is more profitable for each of them.[20]

Second, firms without customer base are indifferent between the shrouding-continuation equilibrium and unshrouding in period 2. They earn zero profits in either case. But deviating from a shrouding equilibrium by unshrouding only earns zero profits because of the simplifying assumption that unshrouding turns all naifs into sophisticates who can avoid all hidden fees. Unshrouding firms cannot profitably attract these avoiding naifs. However, shrouding-continuation equilibria where a firm earns zero profits are not robust to an arbitrarily small share of naifs who *cannot* avoid, and therefore pay, unshrouded hidden fees.[21] Firms who deviate from shrouding-continuation equilibria by unshrouding can attract these non-avoiding naifs and earn strictly positive profits from the deviation. Firms without customer base unshroud to attract consumers. This allows me—plausibly—to focus on equilibria where firms without customer base educate consumers with probability one, because other equilibria are not robust to the presence of non-avoiding naifs.

I now characterize firms' total profits when shrouding occurs. Denote the smallest s_i by $s_{min} = \min_i\{s_i\}$ and the set of all firms with the lowest price in period 1 by $M = \{i \in \{1, 2, ..., I\} | f_{i1} = \min_i\{f_{i1}\}\}$. The number of elements in M is $|M|$. Then total profits of firm i given firms shroud in period 1 (Figure 1) are

$$\pi_{i1}(f_{11}, ..., f_{I1}) = \begin{cases} \frac{s_i}{\sum_{k\in M} s_k}(f_{i1} + \alpha\bar{a} - c) + 0, & \text{if } f_{i1} = \min_j\{f_{j1}\} \leq v \ \& \ |M| < I \\ s_i(f_{i1} + \alpha\bar{a} - c) + s_i\alpha(1-\alpha)\bar{a}, & \text{if } f_{i1} = \min_j\{f_{j1}\} \leq v \ \& \ |M| = I \\ 0, & \text{if } f_{i1} > \min\{v, \min_j\{f_{j1}\}\} \end{cases} \quad (3)$$

Total profits exhibit a new kind of discontinuity that stems from the dynamic nature of the game and the possibility to unshroud hidden fees. We saw in Proposition 3 that firms strictly prefer shrouding in period 2 only if they have a positive customer base. Firms without a customer base have no private information on any consumer's naiveté. By Assumption 1, these firms deviate from the shrouding continuation equilibrium and unshroud hidden fees to attract consumers. But unshrouding turns naifs into sophisticates and reduces

[20]Heidhues et al. (2016b) argue that this is the only reasonable equilibrium. Among other things, the Bertrand-type equilibrium is not robust to positive but arbitrarily small unshrouding costs.

[21]I show this formally in the proof of Proposition 3. These non-avoiding naifs might not have liquid funds to pay back credit-card debt to avoid borrowing costs, or they might value an add-on even when it is expensive.

market profits in period 2. Thus, to ensure that all firms have a customer base, firms have a strong incentive to coordinate on the same transparent price in period 1. This *softens customer-base competition*. Future profits are not competed away ex ante. Instead, total profits can increase above the second-period level.

Firms have a strong incentive to coordinate on the same transparent price. But they might coordinate on a range of prices, inducing multiple equilibria in period 1 (see Figure 1). But shrouding equilibria with a higher transparent price dominate equilibria with a lower transparent price for all firms. This makes it plausible to apply the following equilibrium-selection assumption.

Assumption 2 (The Firms' Preferred Shrouding Equilibrium)**.** *In period 1, firms coordinate on the shrouding equilibrium that induces strictly larger total profits for each firm than any other shrouding equilibrium.*

Proposition 4. [Mitigated Customer-Base Competition in Shrouding Equilibria]
Shrouding equilibria with shrouding in both periods exist. In each equilibrium satisfying Assumptions 1 and 2, firms set hidden fees $a_{i1} = \bar{a}$ and transparent prices $f_1 = c - \alpha\bar{a} + \frac{s_{min}}{1-s_{min}}\alpha(1-\alpha)\bar{a}$. Total profits are $\Pi_i = s_i\frac{s_{min}}{1-s_{min}}\alpha(1-\alpha)\bar{a} + s_i\alpha(1-\alpha)\bar{a}$. In period 2, consumers pay prices as in Proposition 3.

The smallest firm s_{min} features prominently in Proposition 4, because it gains most market shares by deviating from the coordinated price in period 1. Also note that sophisticated consumers do not gain from pretending to be naive. To get a discount of maximally $\alpha\bar{a}$ in period 2, they would have to pay $\bar{a}$ in period 1.

These results are qualitatively robust when unshrouding affects an arbitrarily small share of naifs, when naifs cannot avoid unshrouded hidden fees, or when each firms' demand is smoothly decreasing.

Comparing Propositions 1 to 4 highlights new and important dynamic effects in markets for deceptive products. Dynamic effects become crucial when firms learn about their customers. Competition for the market in period 1 works very differently from competition within the market in period 2, and results differ in key aspects from known properties of markets for deceptive products. Total prices increase in both periods for *all* customers. Most importantly, information on customer naiveté is a valuable asset for firms.

5 Rational Reinterpretation: Expensive Add-Ons with History-Based Prices

Large hidden fees are reminiscent of models where competing firms earn monopoly margins with add-ons (Verboven, 1999; Ellison, 2005) and loss-leader pricing (Lal and Matutes, 1994). This Section investigates which results are robust under this rational reinterpretation.

Akin to the Benchmark in Section 3.1, all consumers value a base good at v. Instead of being naive, the share α of consumers—called add—values an add-on at $\bar{a}$. The remaining consumers have zero value for the add-on and are called $base$. Production cost for base good and add-on are c and zero, respectively. In period 2, each firm i can assign prices for each type, f_{i2}^{add}, f_{i2}^{base}, in its customer base, f_{i2}^{new} to poach consumers, and an add-on price a_{i2}. In period 1—without information—firms charges only f_{i1} and a_{i1}.

Unlike in Section 3.1, each period has two sub-stages. First, firms choose prices and consumers decide if and where to buy the base product. *Consumers cannot observe add-on prices*, but have rational expectations. Second, consumers observe only the add-on price of the base good they purchased and buy it or not.

Instead of naifs who misunderstand the model, this variant features a form of incomplete contracts: firms cannot disclose add-on prices to consumers when they choose a base good, preventing competition on add-on prices. For example, it might be prohibitively expensive to disclose or advertise add-on fees.

Benefits of private information on add-on demand. Revisit period 2 under the rational reinterpretation. The first main result from Proposition 3 on the value of customer information extends to this setting.

Add consumers who consider a base good cannot observe a_{i2}. But they anticipate correctly that firms will exploit their monopoly power over add-ons and charge $a_{i2} = \bar{a}$. Thus, firms extract all surplus from add-ons and add types have the same perceived utility as naifs with shrouded fees in Proposition 3. This immediately implies the Corollary.

Corollary 1. *Suppose firms cannot disclose add-on fees when consumers choose a base product. Then equilibria as in Proposition 3 also exist when naifs are replaced with add types who form correct Bayesian posteriors about add-on prices. Market profits are $\alpha(1-\alpha)\bar{a}$. Firms earn a share of this profit equal to their customer base. Prices are the same as in Proposition 3.*

Adverse selection occurs in Proposition 3 because poaching rivals cannot attract profitable naifs without attracting unprofitable sophisticates. A key reason is that naifs do not respond to cuts in shrouded hidden fees. In Corollary 1, adverse selection results from incomplete contracts. Because firms cannot disclose add-on fees, they cannot use cuts in add-on prices to poach only the profitable add types.

The reason for expensive add-ons is familiar from earlier work on add-on pricing. Already Ellison (2005) emphasizes that even though it can be jointly rational for firms not to advertise add-on fees, it is not individually rational to do so, unless information transmission of add-on fees is very costly. Gabaix and

Laibson (2006) show that the presence of naive consumers makes it individually rational not to advertise add-on prices, even when disclosing prices is cheap.[22] Thus, only the model with naive consumers can explain benefits from customer information when information transmission is cheap.

Fierce competition for customer bases. Now consider period 1. The second main result on mitigated competition for customer bases in period 1 is not robust in the rational reinterpretation. We saw in Corollary 1 that firms benefit from private information on add-on demand if firms *cannot* disclose add-on prices. Yet the positive total profits in Proposition 4 require that firms *can* unshroud hidden fees. Thus, the prediction of positive total profits is not robust in the rational reinterpretation. Standard Bertrand arguments imply that firms compete away future profits in period 1.

Corollary 2. *Suppose firms cannot disclose add-on fees when consumers choose a base product. Then firms compete away period-2 profits when competing for a customer base in period 1, and earn zero total profits.*

To conclude, the rational reinterpretation can explain large profits from private information on add-on demand—under the additional assumption that information transmission is prohibitively costly. Given modern communication technology, however, this can be a quite restrictive assumption. Taking the credit-card example, it seems unlikely that advertising post-teaser rates and late fees together with more transparent teaser rates and monthly fees would significantly increase advertisement costs. Indeed, Schoar and Ru (2016) find that credit-card offer letters regularly include late fees and back-loaded fees, but they are in small print on the last page of the offer letters. This suggests that the key issue is not disclosure costs, but that firms shroud these fees as in the model with naive consumers.[23] Complementing this argument, I discuss evidence for cheap but effective unshrouding tools in Section 7.2. Evidence also suggests that credit-card providers intensely advertise credit cards. Also in Schoar and Ru (2016), households receive multiple offer letters each month over many years, suggesting that advertisement costs are rather negligible. Finally, I cite much evidence throughout this article that naiveté is indeed an issue in the main applications I consider.

But the model with naive consumers does not only differ in the assumptions, it also makes more novel predictions. With naive consumers, unshrouding softens competition for customers when firms are still

[22] The reason is the curse of debiasing discussed in Section 4.1: unshrouding does not only reveal correctly anticipated fees to naifs, but it also makes them aware of mistakes and turns them into less-profitable sophisticates. I discuss evidence in Section 7, and robustness with more-profitable unshrouding in the extension with non-avoiding naifs.

[23] Disclosing more information to consumers can induce problems with inattention. However, (rationally) inattentive consumers might ignore certain pricing features, just like naive consumers in this model. For more on this, see Heidhues et al. (2018).

uninformed, but the rational reinterpretation predicts that firms compete away future profits in period 1.

6 Policy Implications

Private information on consumers can mitigate competition even in seemingly competitive markets with perfect substitutes. This section discusses competition-enhancing policies in this setting.[24]

Regulating fees can obviously increase consumer surplus. But my results suggest the following alternative. Regulators could try to induce symmetric information of firms on consumers. One such policy would be to encourage consumers to share their usage data with rivals when shopping for better deals.

Consumption data are usually accessible to firms *and* consumers. Because firms have to write a bill to consumers—phone bills depend on how much and which network was called, credit-card bills depend on payments made with the card and the resulting overall balance—many usage data are in principle available to consumers, who could forward them to competing firms.[25]

To evaluate such a policy in the context of the model from Section 2, suppose all consumers share their usage data with competitors to hunt for a better deal. This allows each firm to charge different prices to each customer type, whether she is in the firms' customer base or not.

Proposition 5. [Deceptive Markets with Symmetric Consumer Info in Period 2]
Firms earn zero profits in periods 1 and 2. Shrouding equilibria exist. In these equilibria, consumers pay total prices equal to marginal costs in period 2 and transparent prices $c - \alpha\bar{a}$ in period 1. Hidden prices are $a_{i1} = a_{i2} = \bar{a}$. In period 2, shrouding occurs either with probability one or zero.

With symmetric information on customers in period 2, poaching rivals no longer suffer from adverse selection of sophisticates. The market is effectively split, and firms compete for naifs and sophisticates separately. Prices for naifs decrease. As in Proposition 3, firms target transparent prices equal to marginal cost to sophisticates, but their expected payments increase because they no longer benefit from poaching offers intended to attract naifs. Overall, the policy triggers a rent shift from firms to consumers.

[24] Regulation can also improve efficiency. In Heidhues and Kőszegi (2017), transparent prices below marginal costs induce over-participation of consumers. In Heidhues et al. (2016a), large profits induce inefficient investments in exploitative technologies. Policies that move prices towards marginal costs reduce these inefficiencies.

[25] Other policies can also induce more symmetric information on consumers. First, policymakers can disclose consumers' offers to competitors. Second, and more extremely, they could force firms to share their customers' data with competitors.

In addition to the regulatory benefits, Propositions 2, 3, 5 and Corollary 1 jointly establish that indeed the *private information* on consumers causes high profits in period 2. This also implies that firms prefer not to share their customer data with rivals, because this intensifies competition.

Changing firms' information on consumers is an alternative to policies that try to help consumers make better decisions, like Nudges. Even though empirical findings strongly suggest that consumers are not aware of product or contract features in some markets, it is not always clear how exactly they misunderstand these features. This makes it difficult for regulators to design effective simplification or education policies. Such policies require deep regulatory knowledge, a feature they share with well-designed price regulations. In contrast, inducing symmetric access to customer data is much less sensitive to regulatory knowledge.

Naturally, such a policy should not be implemented lightly. One concern is that easily available customer data might induce firms to enter the market just to get the data, and to use them in another market. In addition, partial data sharing can increase profits. Suppose $\alpha \gg 0.5$, no sophisticated consumer shares data, and only few naifs do. Then with data-sharing, firms would have a more balanced customer base of consumers who do not share data. By Proposition 3, a more balanced customer base increases profits and prices.

Thaler and Sunstein (2008) discuss a similar policy called RECAP, or smart disclosure, implemented in the UK for consumer financial products as midata. These policies simplify consumer data and make them easily available to consumers to help them make better decisions. Similarly, the new EU General Data Protection Regulation (GDPR) contains data portability requirements that allow consumers to request their personal data from banks without outside authorization. My results suggests a novel mechanism through which these policies can benefit consumers. Making usage data more easily available encourages consumers to use their usage data to shop for better offers. Rivals can then more easily target offers to these consumers.

7 Extensions and Applications

7.1 Extensions

The basic model makes some simplifying assumptions to focus on the key mechanisms. However, the main results are robust to a wide range of alternative assumptions. I outline these extensions here and refer interested readers to the Web Appendix for details.

In the basic model unshrouding turns all naifs into sophisticates. Results in Propositions 2 to 5 are robust when i) unshrouding only affects an arbitrarily small share of naifs, and ii) some naifs cannot avoid unshrouded hidden fees, for example because they lack funds to pay back their credit-card debt immediately.

The basic model has homogeneous products, but results in Propositions 3 to 5 are robust in a Hotelling-type model with horizontal differentiation. Period 2 is very similar to Proposition 3. Akin to Proposition 4, firms coordinate prices in period 1 so that rivals have a large-enough customer base and shroud hidden fees.

Results are robust when firms have different shares of naifs in their customer bases. In this case, firms can trade client portfolios to make customer bases more balanced on average, inducing larger market profits.

Also with $T > 2$ periods, a shrouding equilibrium exist where in each period $t > 1$, poaching works as in Proposition 3. Results are also robust when new consumers arrive in period 2.

In the basic model, naive consumers do not learn about hidden fees by themselves. This is consistent with evidence that consumers repeatedly trigger fees they are unaware of (Cruickshank, 2000; Stango and Zinman, 2009; Office of Fair Trading, 2008). When some naifs learn about hidden fees on their own, observing naiveté in period 1 is a noisy but still informative signal for behavior in period 2 and results do not change qualitatively.

Entry in period 2 would not reduce shrouding profits to the level of fixed costs of entry. In period 2 an entrant has no customer base and therefore large incentives to unshroud hidden fees. But unshrouding reduces overall market profits, which in turn reduces incentives to enter the market.

7.2 Discussion of Key Modeling Assumptions and Applications

A key assumption is that naive consumers make unexpected payments. These unexpected payments result from consumer mistakes: consumers might misperceive product- or pricing features, or misestimate their own demand for an add-on service. This assumption is consistent with evidence from a number of industries and is made in different ways in many articles on behavioral industrial organization cited here.

The other key assumption is that firms gather and process information on consumers to design and target offers by naiveté. Some direct evidence, though not indisputable, is consistent with this assumption. Schoar and Ru (2016) show that credit-card companies target less-educated consumers with low introductory teaser rates but higher overlimit fees, penalty interest rates, and late-payment fees. Gurun et al. (2016) report evidence that mortgage lenders target less-sophisticated populations with more expensive mortgages.

This evidence is consistent with firms targeting naive consumers based on publicly observable proxies for naiveté. An additional feature of my model is that firms condition offers also on their private information about their customers, i.e. usage data on past purchases or browsing data that firms can gather in the context of their exclusive firm-customer relationship. Following Heidhues and Kőszegi (2017), I argue that simple economic reasoning imposes that firms have strong incentives to learn to distinguish their customers by their degree of naiveté. In the settings I look at, naive consumers are more profitable than sophisticated ones with the same initial beliefs and perceived preferences. This implies that i) firms have a strong incentive to use their available information to distinguish their customers' naiveté and ii) firms can use profitability of customers as a proxy for naiveté. Supplementing this argument, much of the empirical literature cited in this article documents simple correlates of the propensity of consumers to make mistakes, suggesting that also firms have access to at least partial information on naiveté. This is especially likely given recent developments in big-data analysis. These arguments suggest that firms *can* acquire information about consumer naiveté *and* firms have a strong incentive to find out which of their consumers are the profitable naive ones. Thus, targeting naive customers is or will likely soon be pervasive.

Applications of this model include credit cards, retail banking, casinos, (mobile) phone services, and bonus cards in retail markets. Consumer mistakes and targeted pricing occur in these settings, and information collection about customers is relatively simple and pervasive. For example, detailed information on consumption patterns is needed to write bills.

Credit cards are a quite homogeneous product that mainly vary in fee structures. Many consumers pay more than expected because they underestimate their tendency to borrow money or do not take overlimit or late fees into account.[26] The hidden fee captures these unanticipated payments. In contrast, maintenance fees, cash rewards, introductory APRs or new-client bonuses are rather transparent. Although each firm has access to credit-scores of new customers, firms have an informational advantage on their existing clients. They have much more detailed information about their clients' past purchasing behavior, e.g. where they buy clothes, how often they visit a pub, or which fees they had to pay in the past. It is common practice to change contract terms of existing clients on fees or APRs. Also bonuses like miles or cash benefits are common and enable issuers to target naive consumers with transparent discounts.

Additionally, some articles suggest simple, cheap, and effective unshrouding policies. Stango and Zin-

[26] See Ausubel (1991), Shui and Ausubel (2005), Stango and Zinman (2009), and Meier and Sprenger (2010) for evidence. Agarwal et al. (2008) find that many credit-card consumers seem to not know or forget about some fees.

man (2014) simply ask consumers about account overdraft in a survey, which significantly reduces their probability to pay overdraft fees. Alan et al. (2018) message overdraft fees to customers of a Turkish retail bank. This reduces demand for overdraft even when combined with a discount.

Retail-bank accounts have rather transparent maintenance fees. Evidence suggests that consumers underestimate overdraft-related expenses, indicating they resemble hidden fees.[27] Informational advantages and the ability to target discounts to existing clients are as in the credit-card example.

Casinos target gamblers with free complimentary goods like drinks, free rooms, and transportation. This targeting depends on the amount of betting. Indeed, customer data can be highly valuable for casinos.[28]

Mobile-phone services: Grubb (2009), and Grubb and Osborne (2014) show that firms can exploit consumers' overprecise beliefs about their own usage of data and minutes by offering monthly data- and minute packages combined with fees for additional usage. This results in unexpected payments corresponding to hidden fees. The vast amount of data on customers' past calls give firms an informational advantage over rivals. Firms can target transparent discounts like extra minutes or better phones to profitable consumers.

Retailing markets: Johnson (2017) studies retailer competition with unplanned purchases. Consumers visit a shop with a consumption bundle in mind but can engage in unplanned purchases once in the shop. Retailers offer discounts below marginal costs for the planned products and charge positive margins for unplanned purchases. Retailers can use data from loyalty- or bonus-card systems to predict their consumers' propensity for unplanned purchases, allowing them also to target discounts.

8 Related Literature

To the best of my knowledge, this is the first article studying the impact of private information on consumer naiveté or add-on demand on targeted pricing and competition, and the first to analyze the impact of this information on dynamic competition with shrouded attributes.

Consumer mistakes seem an intuitive explanation for large profits in seemingly competitive industries. Ausubel (1991) suggests that consumer mistakes could be a cause for large profits in the US credit-card

[27] See Alan et al. (2018), Office of Fair Trading (2008), or Cruickshank (2000). According to Competition and Markets Authority (2016), a quarter of UK account holders use unauthorized overdraft each year, earning banks £1.2 billion a year and suggesting they do not have the best account for them.

[28] Eadington (1999) surveys work on gambling markets. O'Keeffe (March 19, 2015) reports in the Wall Street Journal that the most valuable asset in the bankruptcy feud at Caesars Entertainment Corp. in 2015 was not the company's real estate in downtown Las Vegas, but their big-data customer loyalty program, valued at $1 billion by creditors.

industry, even though market fundamentals suggest a highly competitive market. Nonetheless, most articles that investigate how firms take advantage of consumer mistakes and shrouded attributes do not predict extraordinary profits in highly competitive markets. Firms use profits from naive consumers to reduce transparent prices to attract more consumers (e.g. see Gabaix and Laibson (2006), Armstrong and Vickers (2012), Murooka (2013), Heidhues et al. (2016b), Heidhues and Kőszegi (2017)). I build on these models and extend them to a dynamic setting. The main novel insight is that over time firms should learn who their profitable naive customers are, and give them retention discounts.

Some articles argue that *large profits result from price floors*. In Heidhues et al. (2016b) firms do not reduce transparent prices too much because this could attract unprofitable consumers that do not actually use the product. Miao (2010) analyzes a dynamic model where simultaneous product offerings in the primary market and aftermarket establish a price floor for the primary good. I offer an alternative explanation for large industry profits that instead builds on private information of firms about their clients.

Heidhues and Kőszegi (2017) study the role of *publicly available seller information on naiveté*, and the impact on third-degree price discrimination. Kosfeld and Schüwer (2017) extend the framework of Gabaix and Laibson (2006) to study welfare implications of consumers' effort to avoid hidden fees. Firms can target unshrouded fees to consumers based on a public signal on naiveté. In both articles firms have symmetric information on consumers, which has implications for welfare but not for equilibrium profits. In contrast, I show that *private* information of firms about their clients' naiveté increases profits.

The Literature on loss-leader pricing and expensive add-ons studies models similar to the rational reinterpretation in Section 5 (Lal and Matutes, 1994; Verboven, 1999; Ellison, 2005). To explain large profits from some products or add-ons, these models assume that firms cannot disclose their prices. But expensive add-ons alone do not increase overall profits because firms compete in base products. To my best knowledge, no previous article studies the role of firms' private information on demand for add-ons or loss-leaders.

Ellison (2005) recognizes that adverse selection of less-profitable consumers can soften competition. I build on and significantly extent this intuition. In Ellison's article firms have symmetric information about consumers and charge a single base price. Adverse selection arises because firms are horizontally differentiated and customers who pay a lot on add-on fees are less price sensitive to cuts in base prices. This reduces the benefits of cutting prices and increases equilibrium prices. In my model, however, all consumers have the same sensitivity to a given price cut. Thus, adverse selection arises from a very different mechanism which is based on firms using private information about customers to target retention discounts. Also, in Ellison's model firms derive some market power from horizontally-differentiated products. Yet in my model, adverse selection arises even with perfect substitutes. Because private information is not relevant in Ellison's model, but is key in this article, my results have very different implications for the value of customer data in competitive markets, and for policies that affect information on consumers.

Following Stigler (1952), firms *price discriminate* when they sell two goods where the price ratio differs from the ratio of marginal costs. Applying this definition, surveys on price discrimination (PD) (Stole, 2007; Esteves, 2009) emphasize that firms need some degree of market power to practice PD. Indeed, in all the articles on PD cited here consumers have brand preferences or switching costs. In my setting, however, firms price-discriminate despite Bertrand competition with homogeneous products.

Literature on targeted pricing. Bester and Petrakis (1996), Belleflamme and Vergote (2016), and Montes et al. (2018) study firms who can target prices to consumers with different brand preferences. Armstrong (2006) is most closely related. He studies a Hotelling model where one firm has private information over consumers' brand preferences. Private information reduces the informed-firm's profits, because the uninformed rival competes more intensely.[29] Dell'Ariccia et al. (1999) study banks who learn the riskiness of their old borrowers but finds that only the larger of two banks benefits from information on borrowers. In contrast to these articles, private information on naiveté or add-on demand can *increase* profits of *all* firms.

The *literature on behavior-based price discrimination* (BBPD) studies two-period models where in period 2 firms can charge different prices to its own and rivals' customers from the last period. See Fudenberg and Villas-Boas (2006), Stole (2007), or Esteves (2009) for surveys. In contrast, a crucial feature of my model is that firms target prices to different types of its own customers. Only recently, Colombo (2018) investigates firms that can distinguish between different types of its own customers, i.e. more- and less price-sensitive ones. But as in most earlier articles (Fudenberg and Tirole, 2000; Chen, 1997; Taylor, 2003), and akin to Armstrong (2006), when firms target prices in period 2, BBPD increases competition and reduces profits.[30] To my best knowledge, no previous article studies firms who can distinguish consumers by naiveté, or by their demand for add-on products.

[29] He also considers the case where a firm has private information about the choosiness parameter, i.e. transportation cost. In this case information increases profits, but in contrast to my results, the informed firm always wants to share its information.

[30] An exception is Chen and Zhang (2009), where profits can increase in period 2 with symmetric targeting. This, however, follows directly from their assumption that some consumers are locked in and rather do not consume than buy from another firm.

Literature on switching costs. Switching costs are an alternative explanation for firms benefiting from old customers. For an overview, see, Klemperer (1995). Indeed, the classic incentives to invest in market shares in period 1 and harvest in period 2 are there. However, it is adverse selection due to private information about customers, and not switching costs that lead to lock-in and high second-period prices.

The adverse selection of unprofitable consumers is reminiscent of *adverse selection and worker poaching in the labor-market literature*. Greenwald (1986) studies labor markets where current employers let their low-productivity workers go to other firms but keep their high-productivity ones. Results crucially depend on the assumption that firms cannot make offers contingent on ex-post observable information, i.e. the workers' productivity.[31][32] Although a reasonable assumption in labor markets, consumption of additional goods or services in consumer markets is frequently easy to verify.[33] Therefore, one would expect similar adverse-selection effects to be less important in retail markets. Nonetheless, I find that adverse selection is important in retail-market settings.

9 Conclusion

I investigate the role of customer data in markets where firms can employ these data to predict the likelihood of customer mistakes or add-on demand. Firms can use customer data to induce adverse selection of less-profitable customers, which increases profits. Additionally, the model with naive consumers offers a novel explanation for why firms might not compete away future profits. This article, therefore, gives a novel explanation for high profits in seemingly competitive markets like the credit-card industry.

These results are particularly important because two key characteristics become increasingly relevant in many markets. First, modern communication technology facilitates targeted offers. Second, big-data analysis becomes increasingly relevant for firms and improves predictions of their customers' behavior. In particular when big-data allows firms to predict their customers' degree of sophistication or add-on demand, my results shed new light on the role of big data in competitive markets.

[31] Without this assumption, in Riordan and Sappington (1988) first-best outcomes result quite generally, even with monopolists.

[32] In a similar article, Subramanian et al. (2013) study firms who let rivals poach their high-cost customers. Also here, poaching firms cannot condition offers on ex-post observable information. This seems often unreasonable, e.g. consumers who call a hotline are more costly, but firms can easily charge for hotline calls. Also, they do not show that customer information raises profits.

[33] A bank can easily verify whether a customer overdrew on an account, and phone companies can verify the number of calls from customers to any phone number. Contracts that specify prices for such events are standard practice.

The value of private information on customers raises an important follow-up question. If firms benefit from customer data, why do consumers not take their credit-card or phone bills to competitors to ask for better deals? As in Section 6, rivals could condition their offers on this information. Indeed, this question applies more generally and policymakers worry about low switching rates of consumers in many markets (Office of Fair Trading, 2008; Competition and Markets Authority, 2016). I suggest three reasons for insufficient shopping with data. First, consumers might be unaware of the informational content of their data. For example credit-card consumers might not know how their shopping patterns correlate with their default risk. Second, naive consumers who underestimate their expenses also underestimate how profitable they are to firms. Third, billing data are usually not in a standardized format, which complicates comparison.

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A Appendix: Proofs

Proof of Proposition 1. Consumers buy at marginal cost in any pure-strategy equilibrium. To see this, note first that firm B cannot earn positive margins from any customer type. Otherwise, firm A—being able to target each customer group—could increase profits by marginally undercutting prices for each customer group. Now suppose towards a contradiction that firm A earns a positive margin from any customer group. Then firm B could offer a separate price for the base product and the add-on, and by offering both prices close enough to marginal cost, B could profitably attract consumers of the informed firm A - a contradiction.

A standard Bertrand argument as in Lemma 1, Case 1, extends this argument to mixed strategies. □

Proof of Proposition 2. Since neither firm learns about consumers' types nor consumers about themselves, there is no updating of beliefs from any type; so the equilibrium is a SPNE. The relevant state variables are customer bases, represented by market shares in $t = 1$, and whether shrouding occurred in $t = 1$ or not.

Step 1: Period 2. The first step determines Nash equilibria of all period-2 subgames.

Lemma 1 (Nash Equilibria in Period 2 Subgames). *Firms earn zero profits in each period-2 equilibrium.*

1. *After shrouding in period 1, a shrouding equilibrium exists. If shrouding occurs with probability one, Consumers pay hidden fees of $a_{i2} = \bar{a}$, transparent prices $f_{i2} = c - \alpha\bar{a}$.*
2. *After unshrouding in period 1, all consumers types pay total prices equal marginal cost, and zero hidden fees.*

Proof of Lemma 1. Case 1: In a first step, I derive the firms' strategies given all firms shroud hidden prices. The second step derives conditions under which firms do not deviate from these strategies by unshrouding.

Given all firms shroud, two firms must set $f_{i2} = c - \alpha\bar{a}$ and $a_{i2} = \bar{a}$. Given all firms shroud, all firms with positive market share optimally set $a_{i2} = \bar{a}$ since this does not reduce demand but raises profits. I use a standard Bertrand-type argument to show that $f_{i2} = c - \alpha\bar{a}$ with probability one for at least two firms. One cannot have $f_{i2} \in (c-\alpha\bar{a}, \bar{f}_i]$ with positive probability for all firms for the supremum of transparent prices of firm i of $\bar{f}_i > c-\alpha\bar{a}$. Towards a contradiction, assume $\bar{f}_i > c-\alpha\bar{a}\ \forall i$. First note that $\bar{f}_i = \bar{f}\ \forall i$. Otherwise, a firm setting prices above the lowest supremum, say at $\bar{f}$, earns zero profits whenever these prices occur but could earn strictly positive profits by moving this probability mass to $\bar{f}-\epsilon$ for some $\epsilon > 0$ since $\bar{f} > c-\alpha\bar{a}$. Thus, if all firms have a supremum strictly above $c - \alpha\bar{a}$, they must have the same supremum. If all firms play $\bar{f}_i$ with positive probability, each firm earns non-negative profit when this occurs. But by taking the probability mass from $\bar{f}$ to $\bar{f} - \epsilon$, a firm could win the whole market when all others play $\bar{f}$ and therefore strictly increase her profit. If at least one firm does not play $\bar{f}$ with positive probability, all firms that do so earn zero profit with positive probability and could earn strictly positive profits by moving the probability mass somewhere below $\bar{f}$ instead. Therefore $f_{i2} < \bar{f}\ \forall i$ with probability one. But then profits go to zero as f_{i2} approaches $\bar{f}$ whereas expected profits are strictly positive by playing $c - \alpha\bar{a} + \epsilon$, for some $\epsilon > 0$, since all others play a larger price with positive probability when $\bar{f} > c - \alpha\bar{a}$. Thus, firms could do better by shifting probability mass from marginally below $\bar{f}$ to $c-\alpha\bar{a}+\epsilon$, for some $\epsilon > 0$. This is a contradiction. Hence, we get $\bar{f}_i = c - \alpha\bar{a}$ for at least two firms, since trivially, it is no equilibrium when only one firm sets $\bar{f}_i = c - \alpha\bar{a}$. Thus, firms earn zero profit when shrouding occurs.[34]

Unshrouding turns all naifs into sophisticates who avoid hidden fees. Thus, optimal deviation profits by unshrouding are zero and a shrouding equilibrium exists.

I show next that firms earn zero profits in each period-2 equilibrium. Unshrouding firms can earn maxi-

[34]When I say below that a standard Bertrand type argument applies, I refer to this kind of reasoning.

mally zero profits. If this was not so, transparent prices must be above marginal costs with positive probability, which is impossible in equilibrium because of Bertrand competition. I now show that if shrouding occurs with positive probability, firms must earn zero profits when shrouding. If shrouding occurs with probability one, the result has been shown above. Suppose shrouding occurs with positive probability less then one. We know that unshrouding earns firms maximally zero profits. If *at least one firm* earns strictly positive profits when shrouding occurs, such a firm must have a supremum of transparent prices when shrouding of $\bar{f} > c - \alpha\bar{a}$. But then a competitor could increase profits by shifting all probability mass from unshrouding to shrouding and earn strictly positive profits by setting a transparent price $\bar{f} - \epsilon$ for some $\epsilon > 0$ and hidden fees of $\bar{a}$ - a contradiction. If all firms earn strictly positive profits when shrouding occurs, shrouding would occur with probability one since unshrouding gives zero profits. But then we are in the case from the beginning of this proof which contradicts positive profits. Thus, if shrouding occurs with positive probability, expected profits must be zero. I conclude that firms earn zero profits in each period-2 equilibrium.

Case 2: When unshrouding occurred in t=1, firms compete in transparent prices for sophisticated consumers. By essentially the same Bertrand argument as in Case 1 when all firms shroud, firms that attract consumers charge $f_{i2} = c$ and $a_{i2} = 0$ and earn zero profits. □

Step 2: Period 1. All consumers face the same price-schedule in period 2, irrespective of the firm they purchase from. Thus, consumers maximize their total payoff by maximizing their first-period payoff. Knowing that firms earn no profits in any second-period subgames, firms simply maximize their per-period profit in period 1. The same Bertrand-type argument as in Case 1 of period 2 applies. □

Proof of Proposition 3. I prove Proposition 3 for the more general setup where a share $\eta \in [0, 1)$ of naifs cannot avoid unshrouded hidden fees. Thus, after unshrouding the share $\alpha\eta$ of consumers, non-avoiding naifs, continue t pay hidden fees. I rule out $\eta = 1$ to avoid that firms are indifferent between shrouding or not when they only consider their own customer base. The main text presents the special case $\eta = 0$.

I look for a Perfect Bayesian Equilibrium and proceed as follows. I prove two preliminary result before characterizing second-period equilibria after all histories. In preliminary 1, I argue that updating of beliefs only matters for the firms' customer base after shrouding in period 1. After such histories, firms learn only their own first period customers' types. In preliminary 2, I derive some properties of transparent prices in

Lemma 2. Lemma 3 is the main result of this proof. It characterizes the existence of shrouding continuation equilibria in period 2 as well as consumers' payments and firms' profits.

Preliminary 1: Beliefs after shrouding occurs in period 1. Assume shrouding occurred in period 1. When consumers are not educated about hidden fees, both consumer types solve the same problem: $\max_{\mathrm{i}} v - f_{i2}, s.t. v - f_{i2} \geq 0$. Hence, both consumer types will always be indifferent between the same set of firms. Therefore the Sorting Assumption implies that the distribution of customers in each customer base is the same as in the population. Hence from observing her own customer base, a firm cannot learn anything about the distribution outside of her own customer base.

Recall that after unshrouding in period 1, firms know that all consumers are sophisticated in period 2.

Preliminary 2: Properties of Transparent Prices in Period 2. In a second preliminary step, I establish some characteristics of the firms' second-period price distributions when prices are shrouded.

Lemma 2 (Properties of Transparent Prices in Period 2)**.** *In each equilibrium in which prices are shrouded in period 2 with probability one, the following properties hold.*

1. *$f_{i2}^{naive} \in [c - \alpha\bar{a}, c]$ with probability one and sophisticates pay a price below c, i.e. $min\{f_{i2}^{soph}, (f_{j2}^{new})_{j \neq i}\} \leq c \; \forall i$ with probability one. Firms earn zero profits from new customers.*
2. *All firms marginally undercut c with the new-customer price with positive probability, i.e. for all $\epsilon > 0$ and for all i, $f_{i2}^{new} \in (c - \epsilon, c]$ with positive probability.*
3. *On each subinterval on $(c - \alpha\bar{a}, c)$ at least one firm plays naive- and one firm plays new-customer prices with positive probability.*
4. *$G_i^{new}(.)$ and $G_i^{naive}(.)$ are continuous on $(c - \alpha\bar{a}, c)$.*
5. *$G_i^{new}(c - \alpha\bar{a}) = G_i^{new}(c - \alpha\bar{a}) = 0, \; \forall i$.*

Proof of Lemma 2. 1. $f_{i2}^{naive} \in [c - \alpha\bar{a}, c]$ with probability one and sophisticates pay a price below c, i.e. $min\{f_{i2}^{soph}, (f_{j2}^{new})_{j \neq i}\} \leq c \; \forall i$ with probability one. Firms earn zero profits from new customers. I have argued in the main body that in each equilibrium in which prices remain shrouded in the second period, $f_{i2}^{soph} \geq c$, $f_{i2}^{new} \geq c - \alpha\bar{a}$ and $f_{i2}^{naive} \geq c - \alpha\bar{a}$. First, I show that in equilibrium no firm i sets a price $f_{i2}^{naive} > c$ with positive probability. A firm i can guarantee itself strictly positive expected profits from its naive customers by setting $c - \alpha\bar{a}$. Thus, it must earn strictly positive expected profits for almost all prices it charges, and any price it charges with positive probability. Let $\bar{f}_{i2}^{naive}$ be the supremum of those prices and suppose $\bar{f}_{i2}^{naive} > c$ with positive probability. Then, all rivals $j \neq i$ must set prices $f_{j2}^{new} \geq \bar{f}_{i2}^{naive}$ with positive probability. If all rivals do so, each firm $j \neq i$ can deviate and move probability mass from weakly above $\bar{f}_{i2}^{naive}$ to $\bar{f}_{i2}^{naive} - \epsilon$, and for sufficiently small ϵ increase its profits. We conclude that $f_{i2}^{naive} \in [c - \alpha\bar{a}, c] \ \ \forall i$.

To show that $min\{f_{i2}^{soph}, (f_{j2}^{new})_{j \neq i}\} \leq c \ \forall i$, I first establish that firms earn zero expected profits from new-customers. Towards a contradiction, suppose a firm i earns positive expected profits from new customers and take its supremum of new-customer prices $\bar{f}_{i2}^{new}$. To be profitable at $\bar{f}_{i2}^{new}$, $\bar{f}_{i2}^{new} > c - \alpha\bar{a}$. In addition, there must be a firm $j \neq i$ such that $f_{j2}^{soph} > \bar{f}_{i2}^{new}$ or $f_{j2}^{naive} > \bar{f}_{i2}^{new}$ with positive probability. If $f_{j2}^{naive} > \bar{f}_{i2}^{new}$ with positive probability, j gets zero profits from naifs whenever playing $f_{j2}^{naive} > \bar{f}_{i2}^{new}$. By moving this probability mass to $\bar{f}_{i2}^{new} - \epsilon$ for sufficiently small $\epsilon > 0$ instead, j could make strictly positive profits, a contradiction. The same argument applies if $f_{j2}^{soph} > \bar{f}_{i2}^{new}$ with positive probability. Hence, new-customer prices earn zero expected profits in equilibrium. This directly implies that firms earn zero profits on their old sophisticates as well: otherwise, by the same reasoning as above, a firm could move the probability mass of its new-customer prices from above the supremum of sophisticates' prices of the positive-profit firm to minimally below it, and thereby increase its profits. It follows that $min\{f_{i2}^{soph}, (f_{j2}^{new})_{j \neq i}\} \leq c \ \forall i$ with probability one. I conclude that $min\{f_{i2}^{soph}, (f_{j2}^{new})_{j \neq i}\} \leq c$ for all i, and the support of f_{i2}^{naive} is [$c - \alpha\bar{a}$,c], and firms earn zero profits from new customers..

2. All firms play new-customer prices arbitrarily close to c with positive probability. 3. On each subinterval on $(c - \alpha\bar{a}, c)$*, at least one firms plays naive-, and at least one firm plays new-customer prices with positive probability.* I prove claim 3. in three steps: first, I establish claim 2, i.e. that in any arbitrarily small interval $(c - \epsilon, c]$ at least two firms play naive- and all firms play new-customer prices with positive probability. Second, I show the same for any arbitrarily small interval $[c - \alpha\bar{a}, c - \alpha\bar{a} + \epsilon)$ for at least two firms' naive- and two firms' new-customer prices. Third, I prove claim 3.

Step (i): First, I show that for all i and any $\epsilon > 0$, $f_{i2}^{new} \in (c - \epsilon, c]$ with positive probability. Suppose otherwise, i.e. for at least one firm there exists an $\epsilon > 0$ such that $f_{i2}^{new} \in (c - \epsilon, c]$ with probability zero. Of these firms, select a firm i that has the smallest supremum $\bar{f}_{i2}^{new}$. If there are many such firms select one that sets the supremum with probability less than one. Since $\bar{f}_{i2}^{new} < c$, at least one firm $j \neq i$ must set $f_{j2}^{naive} > \bar{f}_{i2}^{new}$ with positive probability for i to break even. But then, j makes zero profit for all $f_{j2}^{naive} > \bar{f}_{i2}^{new}$ with probability one, a contradiction. Thus, for any $\epsilon > 0$ all firms set $f_{i2}^{new} \in (c - \epsilon, c]$

with positive probability. It follows that for every $\epsilon > 0$ and every i, some $j \neq i$ sets $f_{i2}^{naive} \in (c-\epsilon, c]$ with positive probability: otherwise, firms could not break even when setting $f_{i2}^{new} \in (c-\epsilon, c)$ with positive probability. Since this holds for every i and $\epsilon > 0$, at least two firms set naive-customer prices in any interval $(c-\epsilon, c]$. Thus, for all prices in $(c-\alpha\bar{a}, c)$, every firm sets larger new-customer with positive probability, and at least two firms set larger naive-customer prices with positive probability.

Step (ii): First I show that for every $\epsilon > 0$, at least two firms set $f_{i2}^{naive} \in [c-\alpha\bar{a}, c-\alpha\bar{a}+\epsilon)$ with positive probability. Suppose otherwise and take a firm i and her competitors $j \neq i$. Assume towards a contradiction that there exists an $\epsilon > 0$ such that for all j, $f_{j2}^{naive} \in [c-\alpha\bar{a}, c-\alpha\bar{a}+\epsilon)$ with probability zero. Then the infimum of the naive-customer prices of i's competitors $\underline{f}$ satisfies $\underline{f} > c-\alpha\bar{a}$. For naive-customer prices above this infimum to be profitable, all new-customer prices must be larger with positive probability. But then firm i can earn strictly positive profits from new-customers by choosing $f_{i2}^{new} \in (c-\alpha\bar{a}, \underline{f})$ with probability one. But this contradicts the finding that firms earn zero expected profits from new-customers. Since this is true for all i, I conclude that for every $\epsilon > 0$, at least two firms set $f_{i2}^{naive} \in [c-\alpha\bar{a}, c-\alpha\bar{a}+\epsilon)$ with positive probability. To show that the same is true for new-customer prices, suppose towards a contradiction that there exists an $\epsilon > 0$ such that a firm i plays $f_{i2}^{naive} \in [c-\alpha\bar{a}, c-\alpha\bar{a}+\epsilon)$ with positive probability but all $j \neq i$ play greater new-customer prices with probability one. But then, i could move its probability mass from below $c-\alpha\bar{a}+\epsilon$ onto this point to strictly increase profits, a contradiction. We conclude that for any $\epsilon > 0$, at least two firms play $f_{i2}^{new} \in (c-\alpha\bar{a}, c-\alpha\bar{a}+\epsilon)$ with positive probability.

Step (iii): *On each subinterval on $(c-\alpha\bar{a}, c)$, at least one firm sets naive- and at least one other firm sets new-customer prices with positive probability.* Suppose the opposite for some interval $(\widetilde{r}, \widetilde{s})$. Then there are three cases: either no naive- and new-customer price on $(\widetilde{r}, \widetilde{s})$ occurs with positive probability, or only naive-customer prices, or only new-customer prices. Take the largest interval containing $(\widetilde{r}, \widetilde{s})$, in which either no firm sets new- or no firms sets naive-customer prices with positive probability, and denote it by (r, s); i.e., some new- or naive-customer prices are played with positive probability arbitrarily close below r and arbitrarily close above s. Note that due to step (ii), we know that $r > c-\alpha\bar{a}$.

In the first case, no naive- or new-customer price occurs on (r, s) with positive probability. But by construction, some naive- or new-customer price occurs on $(r-\epsilon, r]$ with positive probability. Note that there can be no mass point on r. If more than one firm had a mass-point on r, they could strictly increase profits by shifting probability mass from this mass point to slightly below it. If one firm had a mass point on r, it could shift this mass point upwards into (r, s) and increase margins without affecting expected market shares since (r, s) is empty. But when there is no mass point on r, then for some $\epsilon > 0$ small enough, a firm playing prices in $(r - \epsilon, r]$ with positive probability is strictly better off by shifting this probability mass to slightly below s, a contradiction.

Now consider the second case. Towards contradiction, assume only naive-customer prices are set on (r, s) with positive probability. But by shifting probability mass of naive-customer price from within (r, s) to s, firms can discretely increase margins on naifs while leaving the probability to gain these margins unaffected, a contradiction.

Third, assume towards a contradiction that only new-customer prices are played on (r, s) with positive probability. If only one firm plays new-prices on (r, s) with positive probability, this firm could strictly increase its profits by moving this probability mass to slightly below s, a contradiction. Now suppose at least two firms play new-customer prices on (r, s) with positive probability. Take a firm i playing price $f \in (r, s)$ and $f' \in (r, s)$ with positive probability where $f \neq f'$. Recall that by Step (i) both prices are the smallest new-customer price with positive probability, and by claim 1 earn zero expected margins in this case. Since no naive-customer prices occur with positive probability on (r, s), both prices induce exactly the same probability of attracting naifs when being the smallest new-customer price. But since one of these prices is strictly larger, they cannot both have zero expected margins when being the smallest new-customer price, a contradiction. I conclude that claim 3 holds.

4. The CDFs are continuous in the interior of the support, i.e. G_i^{new} and G_i^{naive} have no mass point on $(c - \alpha\bar{a}, c)$, $\forall i$. Take G_i^{new} and suppose otherwise. Pick the lowest mass-point of all firms. Say i has this mass point at f. We know from above that larger naive-customer prices occur with positive probability, so that prices at this mass point are paid with positive probability. Then there exists some $\epsilon > 0$ such that no rival $j \neq i$ charges a price f_{j2}^{naive} in $[f, f + \epsilon)$. For otherwise, a firm j that sets $f_{j2}^{naive} \in [f, f + \epsilon)$ could charge $f - \epsilon$ instead; as $\epsilon \to 0$, the price difference goes to zero but j wins with higher probability. But when no rival charges a naive-customer price in $[f, f + \epsilon)$ and only i sets a mass-point of new-customer prices at f, then i can increase profits by moving the mass point upwards, a contradiction. Alternatively, another firm but i has a mass point on new-customer prices at f as well. Recall that profits from new-customers are zero in expectation. Thus, by shifting the mass point upwards, i looses more often, gaining zero profits in this case; but due to Step (i), i still has the lowest new-customer prices with positive probability and therefore earns a strictly positive margin when attracting customers, a contradiction. This shows that G_i^{new} has no mass point on $(c - \alpha\bar{a}, c)$. A similar argument applies to G_i^{naive}: to see why, suppose otherwise that G_i^{naive} has a mass point on $(c - \alpha\bar{a}, c)$. Pick again the lowest mass point of all firms. Say firm i has this mass point at f. By the same argument as above, there exists some $\epsilon > 0$ such that no rival $j \neq i$ sets a price $f_{j2}^{new} \in [f, f + \epsilon)$ with positive probability. And since i only competes with these new-customer prices for its naive customers, i can strictly improve profits by shifting the mass point upwards, a contradiction.

5. $G_i^{new}(c - \alpha\bar{a}) = G_i^{naive}(c - \alpha\bar{a}) = 0,\ \forall i$. Suppose otherwise, i.e. $G_i^{new}(c - \alpha\bar{a}) = p > 0$ for some i. Then no rival $j \neq i$ charges $f_{j2}^{naive} \in (c - \alpha\bar{a}, c - \alpha\bar{a} + \epsilon)$ for some $\epsilon > 0$, or otherwise j could strictly increase profits by moving this probability-mass on $c - \alpha\bar{a}$ instead. But then, by the same argument as in the last paragraph, i can earn strictly positive profits by shifting the mass-point upwards, a contradiction.

Now suppose $G_i^{naive}(c - \alpha\bar{a}) = p > 0$ for some i and take firms $j \neq i$ that play new-customer prices on $(c - \alpha\bar{a}, c - \alpha\bar{a} + \epsilon)$ with positive probability. We already know that such firms exist. Then j's profits from $f_{j2}^{new} = c - \alpha\bar{a} + \epsilon$ converge to some profit-level below $p[s_i(1 - \alpha)(c - \alpha\bar{a} - c) + (1 - s_i)0] + (1 - p)0 = -ps_i\alpha\bar{a} < 0$. This is a contradiction since firms can guarantee themselves at least zero profits from new-customer prices. $\square$

The next Lemma summarizes the properties in each shrouding equilibrium in period 2 for each state.

Lemma 3 (Second Period Continuation Equilibria)**.** *There always exists the standard Bertrand equilibrium in which at least two firms unshroud and each consumer pays marginal costs. In addition to this equilibrium, there exist second-period continuation equilibria in which shrouding occurs with positive probability under the following conditions:*

1. *If shrouding occurs in t=1 and all firms have positive customer bases, shrouding occurs with positive probability if and only if*

$$s_i\alpha(1 - \alpha)\bar{a} \geq \alpha\eta \min\{(1 - \alpha)\bar{a}, v - c\},\ \forall n. \tag{4}$$

In such equilibria, shrouding occurs with probability one and profits are $s_i\alpha(1 - \alpha)\bar{a}$. For $I = 2$, the symmetric equilibrium (1)*,* (2)*, $f_{i2}^{soph} = c$ for all i is the unique shrouding equilibrium. With $I > 2$, there also exist asymmetric shrouding equilibria. In these asymmetric equilibria, f_{i2}^{new} and f_{i2}^{naive} are mixed on $(c - \alpha\bar{a})$ as in* (1) *and* (2) *for all i, respectively. For all i at least two prices* *in* $\{f_{i2}^{soph}, (f_{j2}^{new})_{j \neq i}\}$ *are weakly below c with probability one. When* (4) *is violated, unshrouding occurs with probability one and all consumers pay a price of c.*

2. *If shrouding occurs in t=1 and some firm has an empty customer base, a firm with empty customer base strictly prefers unshrouding if and only if* $\eta > 0$*. Unshrouding occurs with probability one, prices equal marginal costs and firms earn zero profits. If* $\eta = 0$*, firms without customer base are indifferent between shrouding and unshrouding.*

Proof of Lemma 3. **Proof of claim 1.** *Suppose shrouding occurred in t=1 and all firms have positive customer bases. If* (4) *holds, in all equilibria in which shrouding occurs with positive probability it occurs with probability one. If* (4) *is violated, shrouding occurs with probability zero. If shrouding occurs with probability one, firms earn expected profits of* $s_i\alpha(1-\alpha)\bar{a}$ *from naifs and zero from sophisticates and new customers.* Suppose that shrouding occurs with positive probability. I show that this implies Step (I) - (III) below. Using these facts Steps (IV) and (V) proves the above.

Step (I): *Firms earn positive profits.* When shrouding occurs, firms can get positive profits of at least $s_i\alpha(1-\alpha)\bar{a}$ by setting $f_{i2}^{soph} = f_{i2}^{new} = c$ and $f_{i2}^{naive} = c - \alpha\bar{a}$. As argued in the main text, when shrouding occurs no firm sets new-customer prices below $c - \alpha\bar{a}$ as this leads to strictly negative profits for at least one firm. Thus, firms can indeed be sure to profitably keep its naive customers when shrouding occurs by setting the above prices. Since shrouding occurs with positive probability, firms earn positive expected profits.

Step (II): *New-customer prices earn zero expected margins in equilibrium conditional on both shrouding or unshrouding occurring. Sophisticated consumers never pay positive margins in equilibrium.* Towards a contradiction, suppose a firm i profitably attracts customers with her new-customer price in expectation. Then firm i must earn positive expected margins with each new-customer price that is played with positive probability. Take the supremum of these prices $\bar{f}_{i2}^{new}$. Then prices that minimally undercut $\bar{f}_{i2}^{new}$, i.e. prices on $(\bar{f}_{i2}^{new} - \epsilon, \bar{f}_{i2}^{new}]$ for some sufficiently small $\epsilon > 0$, profitably attract either sophisticates or naifs from another firm, say $j \neq i$. We therefore have to distinguish these two cases.

Suppose i profitably attracts sophisticates conditional on shrouding in any interval of new-customer prices that marginally undercut $\bar{f}_{i2}^{new}$. Then $f_{j2}^{soph} \geq \bar{f}_{i2}^{new}$ with positive probability. Note that the inequality must be strict for some f_{j2}^{soph} when i sets $\bar{f}_{i2}^{new}$ with positive probability. Then j earns zero profits from sophisticates with probability one whenever $f_{j2}^{soph} \geq \bar{f}_{i2}^{new}$, though j could earn strictly positive profits from sophisticates when shifting this probability mass to $\bar{f}_{i2}^{new} - \epsilon$ for some small enough $\epsilon > 0$, a contradiction.

The exact same argument applies conditional on unshrouding occurring.

Now suppose i profitably attracts naifs in any interval of new-customer prices arbitrarily close below $\bar{f}_{i2}^{new}$. They are profitable when shrouding or unshrouding occurs, so I have to distinguish these two cases. If they are profitably attracted under shrouding, we must have $f_{j2}^{naive} \geq \bar{f}_{i2}^{new}$ with positive probability. Note that the inequality must be strict for some f_{j2}^{naive} when $\bar{f}_{i2}^{new}$ occurs with positive probability. Then j earns zero profits when shrouding occurs on prices $f_{j2}^{naive} \geq \bar{f}_{i2}^{new}$ that occur with positive probability. W.l.o.g. let $\bar{f}_{i2}^{new}$ be among the largest such suprema.[35] But then moving probability mass from $[\bar{f}_{i2}^{new}, \bar{f}_{i2}^{new} + \epsilon)$ to $\bar{f}_{i2}^{new} - \epsilon$ increases j's profits discretely when shrouding occurs and reduces them by maximally 2ϵ when unshrouding occurs. This is profitable for some small enough $\epsilon > 0$, a contradiction. If i profitably attracts naifs when unshrouding occurs, the same argument applies to total prices, i.e. by taking $t_{j2}^{naive} = f_{j2}^{naive} + a_{j2}$ and $t_{i2}^{new} = f_{i2}^{new} + a_{i2}$ with $\bar{t}_{i2}^{new}$ as the supremum to total new-customer prices of firm i.

I conclude that if shrouding occurs with positive probability, new-customer prices earn zero expected profits conditional on shrouding or unshrouding. To show that sophisticated consumers never pay a price $f_{i2}^{soph} > c$, suppose otherwise. Since by Lemma 2 Claim 1 sophisticates never pay a new-customer price $f_{j2}^{new} > c$, they must pay the positive margin to their old firm, i.e. with $f_{i2}^{soph} > c$. But then, a competitor can earn strictly positive profits with new-customer prices by offering $f_{j2}^{new} = f_{i2}^{soph} - \epsilon$ for some $\epsilon > 0$ small enough, a contradiction. I conclude that sophisticated consumers never pay positive margins in equilibrium.

Step (III): *The profits of firms that shroud are weakly smaller than $s_i\alpha(1-\alpha)\bar{a}$ $\forall i$ and zero when unshrouding occurs.* To show that firms' profits are weakly smaller than $s_i\alpha(1-\alpha)\bar{a}$ when shrouding occurs, suppose otherwise, i.e. there exists a firm i that earns strictly larger profits when shrouding occurs. Step (II) shows that firms earn zero profits from new- and sophisticated customers, they therefore earn the positive profits from naive customers from their customer base. Let $\bar{f}_{i2}^{naive}$ be the supremum of i's naive-customer prices that are paid with positive probability. Then all $k \neq i$ must set $f_{k2}^{new} \geq \bar{f}_{i2}^{naive}$ with positive probability. I.e. for all $\epsilon > 0$, some $j \neq i$ sets $f_{j2}^{new} \in [\bar{f}_{i2}^{naive}, \bar{f}_{i2}^{naive} + \epsilon)$ with positive probability. But by moving probability mass from this interval to $\bar{f}_{i2}^{naive} - \epsilon$, j can earn strictly positive profits: if some other firm than j sets a smaller new-customer price, j earns zero profits from new customers. But since all $k \neq i$ set $f_{k2}^{new} \geq \bar{f}_{i2}^{naive}$ with positive probability, $f_{j2}^{new} = \bar{f}_{i2}^{naive} - \epsilon$ is the smallest new customer price

[35]If i was not among the firms with the largest suprema, then another firm would have a larger supremum that earns zero profits for prices that marginally undercut it. But then this firm could do strictly better by shifting this probability mass to $\bar{f}_{i2}^{new}$. Thus $\bar{f}_{i2}^{new}$ can be taken among the largest suprema w.l.o.g..

with positive probability. In this case, j earns profits strictly above $s_i\alpha(1-\alpha)\bar{a}$ in expectation from i's naifs and looses weakly below $s_i\alpha(1-\alpha)\bar{a}$ from i's sophisticates. Note that we know from Step (I) that $f_{j2}^{new} \geq c - \alpha\bar{a}$ and therefore $f_{j2}^{naive} \geq c - \alpha\bar{a}$ for all j, which is why losses from attracting sophisticates from firm i are weakly below $s_i\alpha(1-\alpha)\bar{a}$. From all other sophisticates that j attracts with this price, it looses maximally 2ϵ. Thus, for some $\epsilon > 0$ small enough, j can discretely increase profits by shifting some probability mass from $f_{j2}^{new} \in [\bar{f}_{i2}^{naive}, \bar{f}_{i2}^{naive} + \epsilon)$ to $\bar{f}_{i2}^{naive} - \epsilon$, a contradiction.

To show that shrouding firms earn non-positive profits conditional on unshrouding, suppose otherwise for at least one firm, say i. Step (II) implies that these profits must be earned from naive customers of firm i's customer base. Thus, i must keep some non-avoiding naifs at a positive total price $f_{i2}^{naive} + a_{i2} > c$. But then, a competitor $j \neq i$ can earn strictly positive profits from new-customer prices by unshrouding and setting $f_{j2}^{new} + a_{j2} = c + \epsilon$ for some sufficiently small $\epsilon > 0$, which contradicts Step (II), i.e. that new-customer prices earn zero profits. Thus, shrouding firms earn non-positive profits conditional on unshrouding. Since firms' profits are weakly below $s_i\alpha(1-\alpha)\bar{a}$ when shrouding occurs but by Step (I) they can guarantee themselves these profits when shrouding occurs, we know that firms must earn profits of $s_i\alpha(1-\alpha)\bar{a}$ in expectation when shrouding occurs.

Step (IV): *If* (4) *holds, in all equilibria in which shrouding occurs with positive probability, it occurs with probability one. If* (4) *is violated, shrouding occurs with probability zero.* Steps (I)-(III) establish that expected profits from new customers are zero, whether shrouding or unshrouding occurs, and firms' expected profits are $s_i\alpha(1-\alpha)\bar{a}$ when shrouding occurs and non-positive when unshrouding occurs. Thus, in any candidate equilibrium in which shrouding occurs with positive probability, it occurs with probability one. Consequently, when $s_i\alpha(1-\alpha)\bar{a} \geq \eta\alpha \min\{(1-\alpha)\bar{a}, v - c\}\ \forall i$, no firm has an incentive to unshroud with probability one and set a total price of $\min\{c + (1-\alpha)\bar{a}, v\}$. But when this condition is violated for at least one firm, this firm has a strict incentive to unshroud with probability one and set the above total price.

Step (V): *Deriving G^{new} and G^{naive}.* Using Step (IV), I can use the properties in Lemma 2 and the profit levels determined above to construct equilibrium price-distributions.

Mixed strategies for new-customer prices. Recall that firms do not compete for their own old customers with the new-customer price. When a firm i sets her naive-customer price lower than all her competitors' new-customer prices, it keeps her naive customers. Otherwise, it looses them. Thus, expected profits are

$$(1-\prod_{j\neq i}(1-G_j^{new}(f_{i2}^{naive})))\cdot 0+\prod_{j\neq i}(1-G_j^{new}(f_{i2}^{naive}))\cdot s_i\alpha(f_{i2}^{naive}+\bar{a}-c)=const.\ \ ,\forall i. \tag{5}$$

We know from Lemma 2 that all new- and naive-customer prices on $(c-\alpha\bar{a},c)$ occur with positive probability and that $G_j^{new}(c-\alpha\bar{a})=0$ for all j. We also know that expected profits from naive-customer prices must be equal to $const.=s_i\alpha(1-\alpha)\bar{a}$ for all prices on the interval. Using this, I can rewrite the above

$$\prod_{j\neq i}(1-G_j^{new}(f_{i2}^{naive}))=\frac{(1-\alpha)\bar{a}}{f_{i2}^{naive}+\bar{a}-c}\ \ ,\forall i \tag{6}$$

In particular, for each $k\neq i$ and f_{i2}^{naive} this requires $\prod_{j\neq k}(1-G_j^{new}(f^{naive}))=\prod_{j\neq i}(1-G_j^{new}(f^{naive}))$, which implies $G_i^{new}(f^{naive})=G_k^{new}(f^{naive})=G^{new}(f^{naive})$. Using this symmetry in the above equation leads to the expression of (1) on $(c-\alpha\bar{a},c)$.

Note that some firms might set new- and sophisticates prices above c with positive probability. In fact, we only know from Lemma 2 that $min\{f_{i2}^{soph},(f_{j2}^{new})_{j\neq i}\}\leq c\ \forall i$ with probability one. In equilibrium, for all i two prices in $\{f_{i2}^{soph},(f_{j2}^{new})_{j\neq i}\}$ must be below c with probability one to make sure no firm can benefit by increasing transparent prices above c. Some new-customer- or sophisticates prices can be strictly larger than c with positive probability, but these prices are never paid by customers and are therefore inconsequential for consumer welfare and firms' profits. I report the strategy with the mass point on c in (1) to ease the exposition of results.

Mixed strategies for naive-customer prices. Take a firm i that sets f_{i2}^{new} to all consumers that are not in i's customer base. In order to win firm j's customers and break even, it has to offer a new-customer price f_{i2}^{new} such that (i) $f_{i2}^{new}<f_{k2}^{new}\forall k\neq j$ and (ii) $f_{i2}^{new}<f_{j2}^{naive}$. If f_{i2}^{new} is such that (i) is satisfied, but j's naive-customer price is still smaller, than i attracts only the sophisticated consumers of j, since $f_{j2}^{soph}\geq c$. Hence, the expected profit of attracting j's customers is

$$(1-G^{new}(f_{i2}^{new}))^{I-2}s_j[(1-G_j^{naive}(f_{i2}^{new}))(f_{i2}^{new}+\alpha\bar{a}-c)+G_j^{naive}(f_{i2}^{new})(1-\alpha)(f_{i2}^{new}-c)] \tag{7}$$

Summing over all $j\neq i$ leads to i's expected profits from new-customer prices:

$$\begin{aligned}(1-G^{new}(f_{i2}^{new}))^{I-2}[(f_{i2}^{new}+\alpha\bar{a}-c)\sum_{j\neq i}(1-G_j^{naive}(f_{i2}^{new}))s_j\\ +(1-\alpha)(f_{i2}^{new}-c)\sum_{j\neq i}G_j^{naive}(f_{i2}^{new})s_j]=const.\end{aligned} \tag{8}$$

Lemma 2 establishes $G^{new}(c-\alpha\bar{a})=G_j^{new}(c-\alpha\bar{a})=0$, that $const.=0$, and that all naive-customer prices on $(c-\alpha\bar{a},c)$ occur with positive probability. Thus, for $f_{i2}^{naive}\in(c-\alpha\bar{a},c)$ we can rewrite as

$$\underbrace{\sum_{j=1}^{I} G_j^{naive}(f_{i2}^{new})s_j}_{\equiv g(f)} = (1-s_i)\underbrace{\frac{(f_{i2}^{new}+\alpha\bar{a}-c)}{\alpha(f_{i2}^{new}+\bar{a}-c)}}_{\equiv\Omega(f_{i2}^{new})} + s_i G_i^{naive}(f_{i2}^{new}),\ \ \forall i \tag{9}$$

$$\Leftrightarrow g(f_{i2}^{new}) = (1-s_i)\Omega(f_{i2}^{new}) + s_i G_i^{naive}(f_{i2}^{new}),\ \ \forall i \tag{10}$$

For each i, the condition implies $G_i^{naive}(f_{i2}^{new}) = \frac{g(f)}{s_i} - \frac{1-s_i}{s_i}\Omega(f)$. Plugging this into (8) pins down $g(f)=\Omega(f)$ for all f and therefore $G_i^{naive}(f_{i2}^{new})=\Omega(f)$. Hence, in all second-period shrouding equilibria, naive customer prices are mixed symmetrically according to (2).

Proof of claim 2. I show now that after histories in which shrouding occurs and at least one firm has no customer base and another has one, firms always unshroud hidden fees if $\eta>0$. Firms earn no profit and consumers pay marginal costs.

Given shrouding occurs with positive probability, the same reasoning as in claim 1 implies that firms can earn $\widetilde{s}_i\alpha(1-\alpha)\bar{a}$ conditional on shrouding from their old naive customers while firms earn zero expected profits from new-customer prices and old sophisticates.[36] Firms without a customer base earn zero total profit since they have no customer base to exploit, and their shrouding condition reduces to $0\geq\eta\alpha\min\{(1-\alpha)\bar{a},v-c\}$. If $\eta>0$, they have a strict incentive to educate customers about hidden fees. When η is equal to zero, profits are zero after unshrouding. Firms without customer base are indifferent between shrouding and unshrouding and there are potentially multiple equilibria. $\square$

Proof of Proposition 4. I proof the more general statement summarized in the following Lemma. Proposition 4 selects the firms' preferred equilibrium from this Lemma.

Lemma 4. [Mitigated Customer-Base Competition in Shrouding Equilibria]
Shrouding equilibria with shrouding in both periods exist. In each equilibrium satisfying Assumption 1, all firms choose hidden fees $a_{i1}=\bar{a}$. In equilibria with pure strategies in period 1, all firms set the same transparent price $f_1\in\left[c-\alpha\bar{a}-\alpha(1-\alpha)\bar{a},c-\alpha\bar{a}+\frac{s_{min}}{1-s_{min}}\alpha(1-\alpha)\bar{a}\right]$. Total profits are $\Pi_i=s_i(f_1+\alpha\bar{a}-c)+s_i\alpha(1-\alpha)\bar{a}\in\left[0,s_i\frac{s_{min}}{1-s_{min}}\alpha(1-\alpha)\bar{a}+s_i\alpha(1-\alpha)\bar{a}\right]$. For all equilibria in which $\Pi_i>0$, shrouding occurs with probability one.

[36] $\widetilde{s}_i(\geq s_i)$ is the market share a firm gets when not all firms sell to consumers but i does.

The results of Proposition 3 pin down the continuation payoffs after period 1.

Lemma 3 establishes that when $\eta > 0$, firms can achieve positive continuation profits if and only if each firm has a positive customer base, i.e. when prices in the first period are identical with positive probability. Otherwise, firms without customer base strictly prefer unshrouding. This motivates selection-assumption 1.

First, I study equilibria in which firms always set the same transparent price f_1 in the first period. Given the reduced-game profits starting from $t = 1$ specified in (3), the only possible profitable deviations are either (i) shrouding and undercutting competitors or (ii) unshrouding hidden fees and attracting the remaining profitable customers. Recall that unshrouding induces zero profits and is not profitable for firms that expect positive continuation profits. (i) is unprofitable if $s_i(f_1+\alpha\bar{a}-c)+s_i\alpha(1-\alpha)\bar{a} \geq f_1+\alpha\bar{a}-c$, which is equivalent to $f_{i1} \leq c-\alpha\bar{a}+\frac{s_i}{1-s_i}\alpha(1-\alpha)\bar{a}$. Thus, all $f_1 \in \left[c-\alpha\bar{a}-\alpha(1-\alpha)\bar{a}, c-\alpha\bar{a}+\frac{s_{min}}{1-s_{min}}\alpha(1-\alpha)\bar{a}\right]$ can be pure-strategy equilibria in period 1.

Note that there can be no equilibrium where firms play mixed strategies in period 1 with a continuous distribution function. When firms mix on some interval with a continuous distribution function, the probability of charging the same prices in this interval is zero and continuation profits are zero as well. Thus, standard Bertrand arguments such as those in the proof of Proposition 2 establish the usual contradiction.

There can, however, be shrouding equilibria where firms mix over a finite number of prices, each firm playing each price with positive probability. Since continuation profits cannot be larger than when all firms coordinate on the largest candidate price $f_1 = c-\alpha\bar{a}+\frac{s_{min}}{1-s_{min}}\alpha(1-\alpha)\bar{a}$ with probability one, profits must be below $s_i\frac{s_{min}}{1-s_{min}}\alpha(1-\alpha)\bar{a}+s_i\alpha(1-\alpha)\bar{a}$ $\forall i$, motivating selection Assumption 2. $\square$

Proof of Proposition 5. Lemma 5 characterizes continuation equilibria. Afterwards, I study the first period.

Lemma 5 (Period 2 with Disclosure Policy)**.** *An Equilibrium with shrouding in period 2 exists if and only if shrouding occurs in period 1. Shrouding occurs in period 2 either with probability one or with probability zero. When shrouding occurs, both customer types pay a total price of c and naifs a hidden fee $\bar{a}$. Profits are zero in any continuation equilibrium.*

Proof of Lemma 5. First, I analyze continuation equilibria given shrouding occurs in period 1. By the exact same argument as in the proof of Proposition 3, continuation equilibrium profits are zero whenever some firm unshrouded in period 1.

Suppose prices were shrouded in period 1. Then continuation equilibrium profits must be zero conditional on shrouding and unshrouding. Suppose otherwise. Note that whether shrouding or unshrouding occurs, firms have symmetric information on customers and can charge those that were naive and sophisticated in period 1 separately in period 2. The markets for consumers who were naive or sophisticated in period 1 can therefore be treated as separate markets in period 2. For consumers that were sophisticated in period 1, the market is a standard Bertrand market and the results follow immediately. Recall that sophisticates are unaffected by shrouding. For the market for consumers that were naive in period 1, the argument is similar to the one used in the proof on Lemma 3 claim 1 Step (II). Suppose at least one firm earns strictly positive profits conditional on shrouding or unshrouding. Take the firm with the largest profits conditional on either unshrouding or shrouding. If these profits occur conditional on shrouding, take the supremum for which these profits occur and denote it by $\bar{f}$. For positive profits to occur, each competitor must set larger prices with positive probability. I.e., competitors set prices in $[\bar{f}, \bar{f} + \epsilon)$ with positive probability for each $\epsilon > 0$, or $\bar{f}$ would be shifted upwards. But then competitors can increase their profits discretely conditional on shrouding by shifting probability mass from $[\bar{f}, \bar{f} + \epsilon)$ slightly below $\bar{f}$. Since losses conditional on unshrouding are below ϵ, this deviation is strictly profitable for some ϵ small enough, a contradiction. If the largest profits occur conditional on unshrouding the same argument applied to total prices applies. Thus, expected profits are zero for all customers conditional on shrouding and unshrouding. In particular when firms shroud with probability one, a firm's demand is independent of $\bar{a}$ and hence any firm sets $a_{i2} = \bar{a}$, and standard Bertrand arguments applied to each market imply that $f_{i2}^{soph} = c$ and $f_{i2}^{naive} = c - \bar{a}$. When shrouding occurs with probability zero, all consumers pay $f_{i2}^{soph} = f_{i2}^{naive} = c$ since all are aware of hidden fees, whether they can avoid them or not.

I study unshrouding incentives next. When firms shroud with probability one, all consumers pay a total price equal to marginal costs, which is why unshrouding firms do not profitably attract any consumer. I now establish that shrouding either occurs with probability one or with probability zero. Suppose otherwise. Recall that firms earn zero profits in expectation whether shrouding or unshrouding occurs. When shrouding occurs, customers that were naive in period 1 must pay a transparent price below marginal cost and a hidden fee of $\bar{a}$. If this was not so, a firm could earn strictly positive profits by setting prices for customers that were naive in $t = 1$ of $c - \epsilon$ and $\bar{a}$ for some $\epsilon > 0$ small enough. This would marginally reduce profits on these customers when unshrouding occurs but discretely increase profits when shrouding occurs. Naifs of period 1 therefore purchase at a transparent price below c when shrouding occurs and firms earn zero expected profits from them. But when unshrouding occurs, the share of naive customers in period 2 drops discretely to zero and with it the share of naifs of period 1 that pay the hidden fee in period 2. Since these customers pay transparent fees below c and profits are zero when shrouding occurs, firms must earn strictly negative profits with these prices when unshrouding occurs. Thus, these firms are better of by unshrouding with probability one and setting transparent prices to c and hidden fees to zero, a contradiction. □

Period 1. By Lemma 5, continuation profits are zero independent of first-period behavior. Hence, the setting is the same as in period 1 of Proposition 2. □

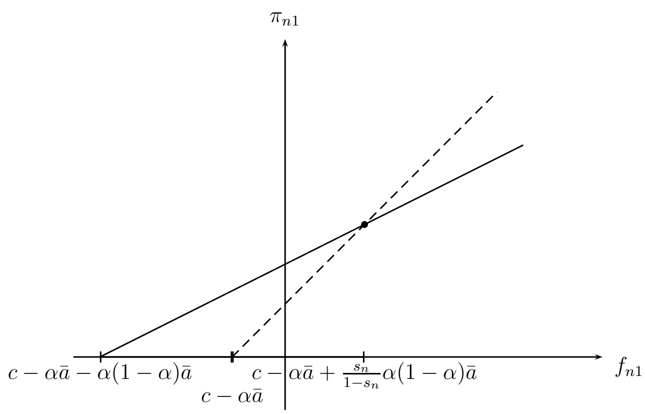

Figure 1: Suppose firms shroud in period 1. The solid line are total profits of a firm when all firms set the same price in period 1. The dashed line are total profits of a firm that undercuts all rivals in period 1.