The Market for Deceptive Products*

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Abstract

We analyze conditions facilitating profitable deception and incentives for innovation in a model of price competition in homogenous products, where each product has an "additional price" firms can shroud from naive consumers, and there is a floor on the product's up-front price. We show that the incentive to unshroud the additional prices and undercut competitors is limited by the consideration that it reveals how expensive the product is and thereby lowers demand, so that a profitable deceptive equilibrium can often be maintained by firms. If the product is socially valuable and there are sufficiently many firms in the industry, at least one is willing to unshroud, eliminating the deceptive equilibrium. But perversely, if the product is socially wasteful, unshrouding would eliminate the industry, so in this case a profitable deceptive equilibrium always exists. In a market with multiple products, a superior product both diverts sophisticated consumers and renders an inferior product socially wasteful in comparison, so firms can always make profits on the *inferior* product by selling it in deceptive ways. Because learning ways to charge consumers higher additional prices increases profits from shrouding and lowers competitors' incentive to unshroud, a firm may have a motive to make such exploitative innovations *and* pass them to its competitors. In contrast, the incentives for innovations that increase the product's value to consumers are strong only in a socially wasteful industry.

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1 Introduction

In this paper, we investigate whether and when firms sell products or contracts whose use costs are not fully understood by consumers. We build on the fundamental insight of Gabaix and Laibson (2006) that firms may find it individually rational not to unshroud the hidden fees of competitors' products, but identify more specific product features and market forces that facilitate such deception, and focus in particular on deception that leads to positive equilibrium profits in seemingly competitive industries.[1] We show that even when firms make positive profits and hence have an incentive to attract competitors' consumers, they are often unwilling to compete by coming clean about hidden fees, as this would reveal to consumers that the product is expensive and lower industry demand. As a result, a profitable deceptive equilibrium can often be maintained by firms. We identify a perverse aspect of competitive markets for deceptive products: products that generate lower social surplus than the best alternative—i.e. products that would not survive in the market if consumers understood hidden fees—facilitate deception, and firms often make profits on exactly such products. In a market with one product, if the product is socially valuable and there are sufficiently many firms in the industry, at least one is willing to unshroud, eliminating the deceptive equilibrium. But if the product is socially wasteful, unshrouding would eliminate the industry, so in this case a profitable deceptive equilibrium always exists. In a market with multiple products, a superior product both diverts sophisticated consumers and renders the inferior product socially wasteful in comparison, so firms can profitably sell the *inferior* product by deceiving consumers. We also identify a perverse incentive for socially wasteful innovation: because learning ways to charge consumers higher hidden fees increases profits from shrouding and thereby lowers

[1] Hidden fees have often enabled firms to reap substantial profits despite seemingly considerable competition, at least at the price-competition stage when entry and marketing costs have been paid and customer bases have been identified and reached. Investigating trade and portfolio data from a large German bank, for example, Hackethal, Inderst and Meyer (2010) document that "bank revenues from security transactions amount to €2,560 per customer per year" (2.4 percent of mean portfolio value), a figure likely well above the marginal cost of serving a customer. Similarly, based on a number of measures, including the 20-percent average premium in interbank purchases of outstanding credit-card balances, Ausubel (1991) argues credit-card companies make large profits. Ellison and Ellison (2009) describe a variety of obfuscation strategies online computer-parts retailers use, and document that such strategies can generate surprisingly large profits given the near homogeneity of products. Importantly, these observations do not mean that the net economic profits taking all operating costs into account are large or even positive in these markets: for example, fixed entry costs can dissipate any profits from the later stage of serving consumers.

competitors' motive to unshroud, a firm may have an incentive to make such exploitative innovations *and* pass them to its competitors. In contrast, because acquiring market share from competitors increases their motive to unshroud, the incentives for innovations that increase the product's value to consumers are strong only in a socially wasteful industry.

Section 2 introduces our model. Building on Gabaix and Laibson (2006) and other researchers, we assume that firms can charge a transparent up-front price as well as an additional price, and unless at least one firm comes clean regarding the industry's pricing structure, naive consumers ignore the additional price. In contrast to most existing work, we posit that there is a floor on the up-front price, so that profits from the additional price cannot necessarily be returned ex ante.[2] Firms simultaneously set up-front and additional prices, and decide whether to shroud their product. We investigate conditions under which a profitable shrouded-prices equilibrium—wherein all firms shroud additional prices—exists. Whenever such an equilibrium exists, it is the most plausible one: all firms prefer it over an unshrouded-prices (and hence zero-profit) equilibrium, and it is the unique equilibrium in the variant of our model in which unshrouding has a (arbitrarily small) cost.

The above model captures in a stylized way many markets, including primarily financial markets such as banking and credit-card services, actively managed mutual funds, and non-traditional mortgages. In each of these markets, there are costs—such as overdraft and other fees for bank accounts, fees, penalties, and long-term interest for credit cards, management fees for mutual funds, and penalties and future changes in monthly fees for mortgages—that many consumers may ignore when getting the product. And in each of these markets, the up-front price cannot drop (much) below \$0 without attracting "arbitrageurs" who just want to cash in on the negative price, creating a price floor.

Section 3 presents our basic results, beginning with two benchmarks. First, if the price floor is not binding, firms can compete by lowering the up-front price, so profitable deception cannot occur. Second, if consumers are sophisticated in that they can observe additional prices, a binding

[2] We informally explain a number of reasons for the price floor, and in Heidhues, Kőszegi and Murooka (2011) we formalize one possible source of it. Grubb (2011) and Ko (2011) also analyze models with features similar to our price floor.

floor on the up-front price simply shifts competition to the additional price, so again profitable shrouding cannot occur. When the price floor is binding and consumers are naive, however, we show that competition in the additional price is an imperfect substitute for competition in the up-front price. Because once consumers realize there is an additional price they may not buy the product, a firm making sufficient profits from deceiving consumers finds unshrouding unattractive. If this condition holds for all firms, an equilibrium with profitable deception exists.

The implications of the above insights depend on whether the product is socially valuable (its value to consumers is above marginal cost) or socially wasteful. If the product is socially valuable, a firm making sufficiently low profits from deception has an incentive to unshroud and lower the additional price, leading to a non-deceptive, zero-profit equilibrium. Because with many firms in the industry some will make low profits, competition policies that encourage entry therefore serve to make the industry more transparent. But for more concentrated industries, the threat that a low-profit firm unshrouds means that each firm wants to make sure competitors earn sufficient profits. This force creates a number of socially inefficient incentives for innovation we explore, and is likely to limit competition in other ways as well.

Paradoxically, if the industry is socially wasteful, unshrouding would shut down the industry, so that even with many firms no firm ever finds it profitable to unshroud. Furthermore, without the threat of unshrouding, there is no incentive for a firm to hold back competing for consumers. From the perspective of our model, therefore, whenever deceptive practices survive in an industry in which numerous firms fiercely compete for consumers, the industry is socially wasteful.

In Section 4, we extend our model by assuming that sophisticated and naive consumers coexist in the market. In our basic model, sophisticated consumers create a pressure to unshroud and cut the additional price. When there is another product in the market that is superior and transparent, however, sophisticated and naive consumers often self-separate, with sophisticated consumers choosing the transparent product and naive consumers choosing the non-transparent product, and sophisticated consumers exerting no beneficial effect on the latter market. Worse, because the superior product renders the inferior product socially wasteful in relative terms, it guarantees that profitable deception in the inferior product can be maintained. This observation has a striking

implication: all it takes for profitable deception to occur in a competitive industry is the existence of an *inferior* product with a shroudable price component and a binding floor on the up-front price, and firms' profits derive entirely from selling the inferior product.

In Section 5, we analyze firms' incentives to invest in various forms of product innovation. Our main interest is in analyzing a firm's incentive to develop costly non-appropriable exploitative innovations—innovations that increase the additional price it can charge consumers, and that other firms can copy. In an equilibrium with profitable deception, an increase in the additional price competitors charge cannot decrease the up-front price, so that a firm never minds if competitors copy such an exploitative innovation. Furthermore, because the same increase lowers competitors' incentive to unshroud by increasing profits from shrouding without affecting profits from unshrouding, a firm may even prefer competitors to acquire exploitative innovations. In contrast, a firm can never benefit from innovation that increases product value and that other firms acquire, and because such innovation *increases* the incentive to unshroud by raising the profits from expanding market share, a firm may even be willing to pay to avoid such innovations. These observations can help explain why firms in the financial market have been willing to make non-appropriable innovations, and why these often seem to have been exploitative innovations.

We also explore fully or partially appropriable value-increasing innovations. This kind of innovation steals the consumers of any competitor who lags behind and increases the market share of the innovating firm. Because in a socially valuable industry stealing others' consumers leads to unshrouding, the incentives for such innovation in socially valuable industries are weak. In contrast, because unshrouding is not a concern in a socially wasteful industry—and an increase in market share increases profits—the incentives for the same kind of innovation in socially wasteful industries are strong, and are non-trivial even for vanishingly small increases in value.

In Section 6, we consider extensions and modifications of our framework. Most importantly, we consider a specification of consumer naivete in which consumers know all prices, but underestimate their own willingness to pay for an add-on. Although we assume firms cannot eliminate consumers' misprediction of their own behavior, we show that this alternative generates insights similar to those of our basic model.

In Section 7, we discuss the behavioral-economics and classical literatures most closely related to our paper. While our framework builds on a growing theoretical literature that investigates how firms exploit naive consumers by charging hidden or unexpected fees,[3] previous work has not identified the central role of wasteful and inferior products in maintaining deception and generating profits, and has not analyzed exploitative innovation. Indeed, by existing logic such innovation is a puzzle: since much of the recent exploitative innovation is in contract terms that can be (and typically were) copied quickly by competitors, an innovating firm should gain little advantage by being the first to invent them. In addition, in existing models the competition for naive consumers returns all of the profits from hidden fees to consumers, so that these models cannot investigate market conditions that facilitate profitable deception. And although a model with switching costs also has the basic implication that consumers can be induced to pay high additional prices once they buy a product, with rational consumers such a model does not predict the systematic sale of wasteful or inferior products in competitive industries and does not feature anything corresponding to the threat of unshrouding by competitors, and hence does not generate most of the results in this paper. We conclude the paper in Section 8.

2 Basic Model

2.1 Setup

In this section, we introduce our model of a market for potentially deceptive products. In the basic model we will analyze for most of the paper, we simply posit that firms can impose a "shroudable" additional price that consumers will have to pay for actually using the product they purchased, and that—unless unshrouded by a firm—they ignore when making their purchase decision. In Section 6, we discuss an alternative formulation in which there is an add-on consumers can purchase after purchasing a base product, and consumers know the add-on price but mispredict their willingness to pay for it. These related models match different features of real-world markets to different extents,

[3] On firms' use of hidden fees, see for instance DellaVigna and Malmendier (2004), Eliaz and Spiegler (2006), Laibson and Yariv (2007), Grubb (2009), and Heidhues and Kőszegi (2010). On why firms do not come clean regarding such fees, see Gabaix and Laibson (2006).

and—subject to some important qualifications—yield qualitatively similar insights.[4]

In our basic model, then, N firms compete for naive consumers who value each firm's product at $v > 0$ and are looking to buy at most one item.[5] Firms are engaged in Bertrand-type price competition, simultaneously setting up-front prices f_n and additional prices a_n, as well as deciding whether to unshroud the additional prices. We assume that the highest possible additional price firms can impose is $\overline{a} > 0$. For much of the paper, we take $\overline{a}$ as exogenous, but in Section 5 we investigate firms' incentives to increase $\overline{a}$ through "exploitative innovation."[6] If the additional prices are shrouded, naive consumers make purchase decisions believing that the total price of product n is f_n. In Section 4, we discuss some implications of assuming that some consumers in the market observe and take into account even shrouded additional prices. Firms can also costlessly unshroud additional prices, and if at least one firm does so, all firms' additional prices become known to all consumers, and consumers make purchase decisions based on the total price $f_n + a_n$.[7] If indifferent between buying and not buying, consumers buy with probability one. If consumers are indifferent between all firms and weakly prefer buying, firm n gets an exogenously given market share $s_n \in (0, 1)$.[8] If consumers are indifferent between a subset of firms and weakly prefer buying, these firms split the market in proportion to s_n. Firm n's cost of providing the product is $c_n > 0$. We let $c_{min} = \min_n\{c_n\}$, and assume that there are at least two firms whose cost is equal to c_{min}. This assumption makes it easy to compare our results with those of classical Bertrand competition, which would then generate zero profits for firms. In addition, we assume that $v + \overline{a} > c_n$ for all

[4] In another alternative formulation, naive consumers overestimate the product's value rather than underestimate its price. In a single-product model, firms never have an incentive to unshroud this kind of misperception . When there are multiple products, however, the question arises whether the producer of a superior product would want to eliminate the misperception regarding an inferior product. We discuss this issue in Section 4.2, arguing that price misperception and value misperception have equivalent implications.

[5] In Section 6, we discuss the limited ways in which heterogeneity in v affects our conclusions, and in Section 5, we investigate whether and when firms want to invest to increase v.

[6] We think of $\overline{a}$ as being limited primarily by the nature of the industry and firms' imagination, and in some industries $\overline{a}$ can be very high. For instance, because a firm may be able to impose certain hidden fees or prices on a consumer multiple times, $\overline{a}$ could easily be greater than v.

[7] To make the economic environment most conducive to unshrouding—and to demonstrate that profitable deception can survive even in this environment—we assume that a firm can instantaneously, fully, and costlessly educate all consumers. We discuss some alternatives to this extreme assumption, as well as the possibility that consumer groups or other non-firm market participants might educate consumers, in Section 8.

[8] In many situations, it is natural to assume that firms get equal market share ($s_n = 1/N$). But in other situations, differences in s_n also seem plausible, for example when an early entrant has a natural advantage due to small switching costs on the part of existing consumers.

firms n. If $v + \overline{a} < c_n$ for some firm, consumers will not buy from it in any equilibrium, so without loss of generality we can think of it as not participating in the market.

We look for the Nash equilibrium of the game played between firms, where—deviating from much of the literature—we impose that firms face a floor on the up-front price: $f_n \geq \underline{f}$. In stating our results, we focus on identifying conditions for and properties of shrouded-prices equilibria—equilibria in which all firms shroud additional prices. Because no firm has an incentive to shroud if at least one firm unshrouds, there is always an unshrouded-prices equilibrium. When a shrouded-prices equilibrium exists, however, it is more plausible than the unshrouded-prices equilibrium for a number of reasons. Most importantly, we show in Appendix A that in this case, the shrouded-prices equilibrium is the unique equilibrium when unshrouding carries a positive cost, no matter how small the cost is.[9] In addition, the positive-profit shrouded-prices equilibrium is preferred by all firms to an unshrouded-prices equilibrium. Finally, for the lowest-priced firms the strategy they play in an unshrouded-prices equilibrium is weakly dominated by the strategy they play in the shrouded-prices equilibrium.

Although our paper identifies conditions under which a deception-based positive-profit equilibrium exists, this does not mean that firms make positive profits once their full economic environment is taken into account. Our stylized model focuses only on the stage of serving existing consumers, and ignores costs firm may have to pay to enter the industry, to identify potential consumers, and so on. Nevertheless, since many industries motivating our analysis seem quite competitive even at the price-competition stage when entry costs have been sunk and potential consumers have been identified, the existence of positive profits at this stage is an important message of our model.

[9] To see the logic of this result, notice first that if unshrouding carries a cost, in order to do so a firm must make positive gross profits from selling the product when it unshrouds. Hence, no firm will unshroud with probability one—as this would lead to Bertrand-type competition and zero profits. Now for each firm, take the supremum of the firm's total price conditional on the firm unshrouding, and consider the highest supremum. At this price, a firm cannot make positive profits if any other firm also unshrouds. Hence, conditional on all other firms shrouding, the firm must make higher profits from this price than from shrouding. But this is impossible: if the firm would have an incentive to shroud in this situation with zero unshrouding cost—which is exactly the condition for a shrouded-prices equilibrium to exist—then it strictly prefers to shroud with a positive unshrouding cost.

2.2 Motivation for Key Assumptions

Our model has two key assumptions: that naive consumers ignore the additional price when making purchase decisions, and that there is a floor on the up-front price. The former assumption appears in various forms again and again in the literature on behavioral industrial organization (DellaVigna and Malmendier 2004, Eliaz and Spiegler 2006, Grubb 2009, Heidhues and Kőszegi 2010, and others), and captures in a reduced form a variety of scenarios. In banking, credit-card, retail-investment, and mortgage services, for instance, consumers may be unaware of many fees providers impose, or may think that the fees will not apply to them. For example, a consumer might not know that overdrafts carry a hefty fee, and even if she knows she may believe that she will never overdraft. Similarly, an investor might not realize how much of a premium she will pay in management fees when investing in an actively managed mutual fund rather than an index fund.[10] In addition, in some markets a consumer may understand ex-ante that she has to pay *some* additional price after purchase, but still systematically underestimate that price. For example, a consumer presumably knows that a printer she purchases will require cartridges to operate, but she may underestimate how much these cartridges cost.[11] In this case, we can think of the price she expects to pay as being included in f_n, with the unexpected component of the price being a_n.[12]

[10] Several empirical findings are consistent with this general hypothesis. Cruickshank (2000, pages 126-7) reports that most consumers do not know specific fees associated with their bank accounts, which can contribute to Stango and Zinman's (2009) finding that consumers incur many avoidable fees. Evidence by Agarwal, Driscoll, Gabaix and Laibson (2008) indicates that many credit-card consumers seem to not know or forget about various fees issuers impose. Cruickshank (2000, page 127-8) also reports that most consumers do not understand key mortgage features, Woodward and Hall (2010) find that borrowers underestimate broker compensation, and Gerardi, Goette and Meier (2009) document that 26% of borrowers who face a prepayment penalty are completely unaware of it. Finally, evidence by Wilcox (2003) and Barber, Odean and Zheng (2005) indicates that investors underweight operating expenses when choosing mutual funds. There is also experimental evidence from other settings that individuals often ignore some components of a product's price. For instance, Chetty, Looney and Kroft (2009) show that consumers ignore sales taxes that are not posted on a supermarket's shelf, and Hossain and Morgan (2006) find that bidders on Ebay underweight shipping costs. Note that these products are considerably simpler—and the additional prices more obvious—than most of the ones we consider in this paper. The fact that consumers ignore additional prices even for these simple products suggests that the phenomenon could be quite widespread.

[11] Consistent with this perspective, Hall (1997) reports that 97% of buyers do not know the price of a cartridge when buying their printer, and as revealed in a survey by UK's Office of Fair Trading, retailers believe 75% of consumers do not have an idea about printing costs. And regulators are worried about the "bill shock" many mobile-phone consumers face when they run up charges they did not anticipate (Federal Communication Commission 2010).

[12] In all these examples, a consumer has some control over how much of the additional price she pays. So long as consumers' fundamental mistake is in underestimating additional prices, the logic of our model requires only that consumers cannot fully avoid these prices, so that firms can make profits on them. If consumers' mistake is in mispredicting their own behavior rather than prices, the model of Section 6.1 applies.

While we interpret the additional prices primarily as financial prices, our model applies equally well to non-financial costs of owning a product that can be shrouded from consumers. For example, using the product may be unhealthy or inconvenient in ways consumers do not anticipate. Alternatively, the production process might involve methods, such as sweatshops or environmentally unfriendly procedures, that decrease consumers' value, but that they might be unaware of. Companies often do seem to keep such non-financial additional "prices" shrouded from consumers.

Our assumption of a price floor is supported both by theoretical arguments and by some empirical evidence on its implications for firm behavior. In Heidhues et al. (2011), we provide one microfoundation for the price floor based on the existence of "arbitrageurs" who are willing to enter the market to make money off of a firm with overly low (for instance negative) prices, and who avoid the additional price because they are not interested in using the product itself. A simple back-of-the-envelope calculation in a specific case illustrates. Hackethal et al. (2010) document that German "bank revenues from security transactions amount to €2,560 per customer per year, based on a mean portfolio value of €105,356 Euros." If a bank handed out such sums ex ante—even if it did so net of account costs—many individuals would likely sign up for (and then not use) bank accounts just to get the handouts. This threat creates a binding floor on banks' up-front price. But there are also other possible reasons for a price floor. For instance, Miao (2010) shows that when the additional price is that of an add-on, buying the base product is a substitute for the add-on (such as for software, where updating the old version yields the new version), and firms cannot distinguish old and new consumers, the price of the add-on can serve as a floor for the price of the base product. And although this is difficult to capture formally, it might be the case that if prices dropped too low, consumers would become suspicious that "there is a catch" and not buy the product, effectively imposing a price floor.

The notion that there might be a floor on the up-front price is also consistent with implications of our model (but not natural models without a price floor) that firms may not compete on this price or adjust it to circumstances in a competitive market. For instance, many firms selling only slightly differentiated products spend tremendous resources trying to compete for consumers—indicating that they value new business—but do so using non-price methods. According to Evans

and Schmalensee (2005), for instance, credit-card companies sent out 5 billion direct-mail solicitations in 2000, an average of approximately 3.9 solicitations per month for each household in the United States (5 solicitations for each household who received offers). Similarly, mutual funds often compete for consumers by paying "independent financial advisors" to direct consumers to them. And Bar-Gill and Bubb (2012, forthcoming) find suggestive evidence that the 2009 CARD Act had the intended effect of limiting over-the-limit and late-payment fees, while—in contrast to models without a price floor predicting that these losses are compensated by increases in other fees—it had no effect on annual fees, teaser rates, and other unregulated fees, and reduced banks' profits.

3 Profitable Deception

In this section, we identify the key results of our basic model. In Section 3.1, we establish two benchmarks: if there is no price floor for the base product, or there is a price floor but consumers can figure out additional prices, firms cannot earn positive profits by shrouding. In Section 3.2, we turn to our main result: we establish conditions under which an equilibrium with profitable deception can be maintained. In Section 3.3, we discuss the effect of competition on deception, and in Section 3.4, we identify some policy implications of our findings.

3.1 Benchmarks: No Price Floor or Sophisticated Consumers

In this section, we identify situations in which profitable shrouding cannot occur, setting the stage—and establishing necessary conditions for—the results on profitable deception below. First, we state what happens when the floor on the up-front price is not binding, in which case our model generates a logic of ex-ante competition for ex-post profits similar to that in DellaVigna and Malmendier (2004), Gabaix and Laibson (2006), Laibson and Yariv (2007), and Heidhues and Kőszegi (2010):[13]

Proposition 1 (Equilibrium with Non-Binding Price Floor)**.** *Suppose* $\underline{f} \leq c_{min} - \overline{a}$*. In any*

[13] Note that the proposition is stated in terms of what product consumers get rather than what firms do. Analogously to any standard Bertrand-competion model, there is an uninteresting multiplicity of equilibria due to the fact that a firm can make zero profits by charging the up-front price f identified in the proposition, as well as by charging a higher price and attracting no consumers. Equilibrium requires only that at least two firms charge the lowest price. Which of these equilibria obtains affects neither firm profits nor consumer welfare.

shrouded-prices equilibrium consumers buy the product from a most efficient firm and pay $a = \overline{a}, f = c_{min} - \overline{a}$. *Ex-post utility of naive consumers is* $v - c_{min}$. *Firms earn zero profits in any equilibrium.*

Since in a shrouded-prices equilibrium consumers do not take into account additional prices in selecting a product, firms set the highest possible additional price. Because existing consumers are therefore valuable, firms compete aggressively for consumers ex ante, and bid down the up-front price until they eliminate net profits. At the same time, since consumers do not anticipate additional prices, they can be induced to buy a product that they value below production cost (i.e. $v - c_{min}$ might be negative). This is socially harmful even though firms make zero profits in equilibrium.

As a second benchmark, we consider the influence of a (binding or non-binding) price floor $\underline{f}$ in an environment in which all consumers are sophisticated. We define sophisticated consumers as those who can observe additional prices set by firms, and consider both f_n and a_n when making a purchase decision. In such an environment, a floor in one component of the price is not sufficient to sustain positive profits for firms:

Proposition 2 (Equilibrium with Sophisticated Consumers)**.** *Suppose all consumers are sophisticated, and consider any* $\underline{f}$. *If* $v > c_{min}$, *then in any Nash equilibrium consumers buy the product at a total price of* c_{min} *from a most efficient firm. If* $v < c_{min}$, *then in any Nash equilibrium consumers do not buy the product. Firms earn zero profits in any equilibrium.*

Intuitively, if there is a floor on the up-front price, firms simply switch to competing on the additional price, bidding down that price until profits are zero. Since there is no floor on the total price, with sophisticated consumers it is impossible to escape the Bertrand-competition logic generating zero profits. Furthermore, sophisticated consumers cannot be induced to buy a product that is inefficient to produce. Importantly, we argue in Section 6 that Proposition 2 extends to a different type of sophisticated consumer, who cannot observe shrouded additional prices but correctly predicts firms' equilibrium pricing behavior.

3.2 Naive Consumers with a Price Floor

Taken together, Propositions 1 and 2 above imply that for profitable shrouding to occur, both naive consumers must be present and the price floor must be binding. We turn to analyzing our model when this is the case, assuming for the rest of this section that all consumers are naive and $\underline{f} > c_n - \overline{a}$ for all n. To identify conditions under which a shrouded-prices equilibrium exists, first note that if additional prices remain shrouded, all firms set the maximum additional price $\overline{a}$. Then, since firms are making positive profits and hence have an incentive to attract consumers, they bid down the up-front price to $\underline{f}$. With consumers being indifferent between firms, firm n earns a profit of $s_n(\underline{f} + \overline{a} - c_n)$. In order for this to be an equilibrium, it must be the case that no firm wants to unshroud additional prices and undercut competitors. Once a firm unshrouds, consumers will be willing to pay exactly v for the product, so that an unshrouding firm can make exactly $v - c_n$ per consumer. Hence, unshrouding is unprofitable if and only if

$$s_n(\underline{f} + \overline{a} - c_n) \geq v - c_n. \tag{1}$$

These considerations lead to Proposition 3:

Proposition 3 (Equilibrium with Binding Price Floor)**.** *Suppose $\underline{f} > c_n - \overline{a}$ for all n. In any shrouded-prices equilibrium, $f_n = \underline{f}$ and $a_n = \overline{a}$ for all n. A shrouded-prices equilibrium exists if Inequality* (1) *holds for all n, and in that case all firms earn positive profits. Otherwise, in equilibrium prices are unshrouded with probability one, consumers buy from a most efficient firm at a total price of c_{min}, and all firms earn zero profits.*

If Inequality 1 holds, firms earn positive profits despite being engaged in Bertrand-type price competition. The intuition is in two parts. First, as in previous models and in our model with no price floor, firms make positive profits from the additional price, and to obtain these ex-post profits, each firm wants to compete for consumers by offering better up-front terms. But the price floor prevents firms from competing away all profits from the additional price by lowering the up-front price.

Second, because firms cannot compete for consumers by cutting their up-front price, there is pressure for competition to shift to the additional price—but because this requires unshrouding

additional prices, it is an imperfect substitute for competition in the up-front price. To understand the logic, note that if a consumer's decision to purchase the product at the total market price is suboptimal (i.e. $\underline{f} + \overline{a} > v$), a firm cannot attract consumers by unshrouding and undercutting competition just a little bit: if it does so, it not only tells consumers that its product is cheaper than competitors', it also tells consumers that the product is expensive, and consumers will not buy the product at such a high price. As a result, a firm can attract consumers by unshrouding only if it cuts the add-on price by a substantial margin, and this may not be worth it. In contrast, if purchasing the product at the total market price is optimal for consumers (i.e. $\underline{f} + \overline{a} \leq v$) a firm making positive profits always finds it optimal to unshroud. Intuitively, by announcing to consumers how expensive the additional price is and simultaneously undercutting its competitors, a firm attracts all consumers to itself, increasing profits. This logic indicates that deception in our model goes hand in hand with manipulating consumers into making purchases that reduce individual welfare.[14]

3.3 Competition and Deception

We now discuss how increasing the number of firms affects the deception of consumers in our model. We distinguish two cases, one in which the product is non-vanishingly socially valuable to produce (there is an $\epsilon > 0$ such that $v > c_n + \epsilon$ for all n), and one in which it is wasteful to produce ($v < c_n$ for all n).[15]

Non-vanishingly socially valuable product (there is an $\epsilon > 0$ such that $v > c_n + \epsilon$ for all n). Notice that the left-hand side of Inequality (1) converges to zero as s_n goes to zero, while the right-hand side is constant and bounded away from zero. This leads to interesting comparative statics with respect to N, the number of firms in the market. For relatively small N, it may be the case that Inequality (1) is satisfied for all firms and a positive-profit shrouded-prices equilibrium therefore

[14] If a shrouded-prices equilibrium is played by firms, not only are consumers acting suboptimally, productive efficiency also fails to hold: market shares are determined by how consumers happen to choose when indifferent. This contrasts sharply with natural specifications of classical Bertrand competition, in which the market share of firms other than the most efficient is zero.

[15] We do not discuss in-between cases in which the product is valuable to produce by some firms but not other firms. The implications of adding firms to the market then depend on whether the new firms are efficient or inefficient, and how the market share of the efficient firms change with entry.

exists. In this range, N has no effect on industry profits at all—as N increases, the industry profits are merely being divided among more firms. When there are sufficiently many firms in the market, however, at least one will have share s_n sufficiently low for Inequality (1) to be violated, so that the industry undergoes a regime shift: firms switch to transparent pricing and profits evaporate.[16] Intuitively, a firm making low profits from the deceptive practices has an incentive to come clean and reap the profits from consumers' realization that they should consider additional prices.

Given that firms make positive profits in a shrouded-prices equilibrium but zero profits in the unshrouded-prices equilibrium, they have a strong incentive to avoid the regime shift to an unshrouded-prices equilibrium. As a result, each firm has an incentive to make sure competitors do not find it profitable to unshroud. This has a number of competition-impairing implications we will discuss in Section 5.

Socially wasteful product ($v < c_n$ for all n). Notice that in this case, the right-hand side of Inequality (1) is negative while the left-hand side is positive. Hence, a shrouded-prices equilibrium exists regardless of the industry's concentration and other parameter values. This perverse result has a simple and compelling logic: the only reason consumers buy a socially wasteful product is that they are deceived about its total price, so that a firm cannot profitably sell the product by coming clean. As a result, no firm finds it profitable to deviate from the practice of deceiving consumers. Combined with the above insights for socially valuable products, this logic has a further seemingly important implication: if an industry experiences a lot of entry and does not come clean in its practices, from the perspective of our model it is likely to be a socially wasteful industry.[17]

Actively managed mutual funds might be a good example for this case of our model. Because most mutual-fund managers cannot persistently outperform the market (Carhart 1997), the service they provide—actively investing instead of tracking an index—is most likely not worth the high fees they charge. As a result, given the existence of index funds, actively managed mutual funds might constitute a socially wasteful industry.[18] Given these facts, the explosion of actively managed funds

[16] More precisely, if $N > (\underline{f}+\overline{a})/\epsilon$, then $s_n < \epsilon/(\underline{f}+\overline{a})$ for some n, and for this n we have $s_n(\underline{f}+\overline{a}-c_n) < \epsilon < v-c_n$, in violation of Inequality (1).

[17] Beyond the distinction between socially valuable and socially wasteful products discussed above, our model and the logic above has a related comparative-statics implication: all else equal, the more entry it takes for an industry to become transparent, the less socially valuable the industry's product is.

[18] In Section 4, we discuss in detail how our model's implications are modified when there is a superior product

is often seen as a puzzle (Gruber 1996, for example). Our model can explain why this industry has remained profitable despite a large number of firms entering the market, and why the large fees remain shrouded from consumers.

Similarly, some costly non-traditional mortgage products serve, at least for many or most borrowers taking them, no significant economic purpose, so they can be considered socially wasteful as well. For instance, the Option Adjustable-Rate Mortgage allows borrowers to pay less than the interest for a period, leading to an increase in the amount owed and sharp (even 100-percent or higher) increases in monthly payments.[19] While this mortgage may make sense for consumers who confidently expect sharp increases in income or who are willing to take the risky gamble that house prices will appreciate, it likely did not make sense for most of the vast number of consumers who took it—most of whom were prime borrowers and hence could have qualified for traditional mortgages.[20] Indeed, some features of Option ARMs, such as an introductory interest rate that applies for one or three *months*, serve only the purpose of deceiving borrowers about the product's cost. Once again, our model explains how Option ARMs have remained profitable in a seemingly very competitive market,[21] and how they continued to be sold to consumers for whom they were inappropriate.

3.4 Policy Implications

In this section, we briefly discuss some policy implications of our findings above. First, we consider the impact of a decrease in the maximum additional price $\overline{a}$ that consumers can be induced to pay—which could come from regulation that restricts the extent to which firms can overcharge consumers ex post. Although regulation that prevents such overcharging of consumers seems extremely difficult

available to consumers. Here, index funds are superior to (the majority of) managed funds because they provide similar investment performance at considerably lower cost.

[19] See "Interest-Only Mortgage Payments and Payment-Option ARMs—Are They for You?," information booklet prepared for consumers by the Board of Governors of the Federal Reserve System, available at `http://www.federalreserve.gov/pubs/mortgage_interestonly/mortgage_interestonly.pdf`.

[20] As one indication of how widespread Option ARMs had become, this product represented 19 percent of Countrywide's (the then-largest lender's) originations in 2005.

[21] The New York Times reports that Countrywide made gross profits of 4 percent on such loans, compared to profits of only 2 percent on traditional FHA loans (November 11, 2007).

in general, it may be possible in limited specific cases.[22] Because firms want to attract consumers and are limited in doing so by the price floor, they will not raise f in response to a decrease in $\overline{a}$. Hence, the decrease in $\overline{a}$ benefits consumers one-to-one. This insight provides a counterexample to a central argument brought up against the Credit CARD Act and many other consumer-protection regulations, namely that its costs to firms will be passed on to consumers. In addition, a decrease in $\overline{a}$ can lead to Inequality (1) being violated for some firm, in which case the market becomes transparent and prices drop further. Finally, if market or regulatory forces push down $\overline{a}$, the market will tend to move toward productive efficiency through the exit of the most inefficient firms which have high marginal costs—although not through the reallocation of relative market shares among surviving firms.

Relatedly, the regime shift from deceptive to transparent pricing predicted by our model for socially valuable products identifies an important interaction between competition and consumer-protection policies. Roughly speaking, classical merger analysis in the US and Europe attempts to predict how changes in market structure affect consumer surplus and welfare. Our model highlights a potential change in industry conduct as the number of firms decreases beyond a critical threshold: the focus on inventing hidden fees and unexpected charges to the detriment of customers. This threshold is reached slower if, for instance due to consumer-protection policies mentioned above, the maximum additional price $\overline{a}$ is lower.

4 Sophisticated Consumers

Our analysis has so far assumed that all consumers are naive. In this section, we discuss the implications of assuming that some consumers are sophisticated in that they observe and take into account additional prices when making purchase decisions. We begin in Section 4.1 by pointing out how this change modifies the logic of our basic model: because sophisticated consumers cannot

[22] For example, the Credit Card Accountability, Responsibility, and Disclosure (Credit CARD) Act of 2009 limits late-payment, over-the-limit, and other fees to be "reasonable and proportional to" the consumer's omission or violation, thereby preventing credit-card companies from using these fees as sources of extraordinary ex-post profits. Similarly, in July 2008 the Federal Reserve Board amended Regulation Z (implementation of the Truth in Lending Act) to severely restrict the use of prepayment penalties for high-interest-rate mortgages. Regulations that require firms to include all non-optional price components in the up-front price—akin to recent regulations of European low-cost airlines—can also serve to decrease $\overline{a}$.

be fooled by shrouded prices into mistakenly buying a product, they increase firms' incentive to unshroud and compete in the additional price. We go on to show in Section 4.2, however, that if there is a transparent alternative product that is at least as good as the exploitative product, sophisticated consumers self-select into buying the transparent product, relieving the pressure to cut the additional price of the exploitative product. Furthermore, because the presence of the superior alternative product renders the exploitative product socially wasteful to produce in relative terms, it guarantees that no firm will ever want to unshroud the exploitative product.

Throughout this section, we assume that the proportion of sophisticated consumers is $\lambda \in (0,1)$, and that the price floor is binding: $\underline{f} > c_n - \overline{a}$ for all n.

4.1 Sophisticated Consumers in Our Basic Model

If sophisticated consumers buy from any firm in equilibrium, then unshrouding must occur because a firm with the lowest total price—which must therefore be at most v—prefers to unshroud and attract all consumers. Hence, in any shrouded-prices equilibrium sophisticated consumers do not buy the product. To derive the condition for such an equilibrium to exist, note that if firm n unshrouds, it attracts consumers if and only if it cuts the total price to at most v—but if it does so, it attracts all naive and sophisticated consumers. As the analogue of Inequality (1), this is unprofitable if

$$(1-\lambda)s_n(\underline{f} + \overline{a} - c_n) \geq v - c_n. \tag{2}$$

Hence, a shrouded-prices equilibrium exists if and only if Inequality (2) holds for all n.

Condition (2) for the existence of a shrouded-prices equilibrium has two important implications. First, if the product is socially wasteful, the presence of sophisticated consumers does not affect our results, as a profitable shrouded-prices equilibrium always exists. Intuitively, whether or not the additional price is shrouded, sophisticated consumers do not buy a socially wasteful product in equilibrium, so their presence is irrelevant—firms just attempt to exploit naive consumers. But second, if the product is socially valuable, the condition for a shrouded-prices equilibrium to exist is stricter in the presence of sophisticated consumers. Intuitively, while these consumers do not buy the product when the additional price is high, they can be attracted by a price cut, creating

pressure to cut the additional price—and by implication also to unshroud.

4.2 Sophisticated Consumers with an Alternative Transparent Product

We now move beyond Section 4.1 by assuming not only that there are sophisticated consumers, but also that there is another product in the market. Our analysis is motivated by the observation that in many markets we have discussed above, products that are more transparent than and seemingly superior to the deceptive products exist. Mutual-fund investors can choose low-cost index funds that will earn them higher returns than most managed funds. Many credit-card consumers could use debit cards for the same set of basic services and avoid most fees and interest. And many mortgage borrowers would be better served by simple traditional mortgages than by the complicated exotic products that have gained significant market share recently.

Formally, suppose that in addition to the product we have assumed throughout the paper, each firm has an additional, transparent, product with value $w > 0$, where firm n's cost of producing w is c_n^w. We assume that $\min_n\{c_n^w\} = c_{min}^w > 0$, and that there are at least two firms whose cost of producing product w is c_{min}^w. Crucially, we posit that product w is socially valuable ($w - c_{min}^w > 0$), and it is not inferior to product v: $w - c_{min}^w \geq v - c_{min}$. Consumers are interested in buying at most one product. Firms simultaneously set the up-front and additional prices for product v, the single transparent price for product w, and decide whether to unshroud the additional price of product v. Then:

Proposition 4 (Separation of Naive and Sophisticated Consumers)**.** *There exists an equilibrium in which each firm shrouds the additional price of product v, naive consumers buy the shrouded product v, and sophisticated consumers buy the transparent product w, if and only if $v - \underline{f} \geq w - c_{min}^w$. In such an equilibrium, firms earn zero profits from sophisticated consumers, and positive profits from naive consumers.*

Quite in contrast to the message of Section 4.1 that sophisticated consumers increase the pressure to unshroud, Proposition says that if $v - \underline{f} \geq w - c_{min}^w$, a positive-profit equilibrium in which naive consumers are deceived always exists. In this equilibrium, firms earn all their profits from selling the *inferior* product. The intuition for why the superior product not only eliminates the

pressure to unshroud, but in fact guarantees a deceptive equilibrium with positive profits from the inferior product, is in two parts. First, because sophisticated consumers realize that the shrouded product is costly but naive consumers believe it is a better value, in equilibrium the two types of consumers separate. Second, if a firm unshrouded the additional price of product v, consumers would immediately realize that product w is a better deal, and would buy that product. As a result, a firm cannot make positive profits by unshrouding the additional price of product v. In a sense, product w serves as a barrier to unshrouding product v by rendering product v socially wasteful in comparison.

The condition $v - \underline{f} \geq w - c^w_{min}$ for a positive-profit exploitative equilibrium to exist is a sorting condition: it says that with naive consumers ignoring the additional price of product v and firms charging the $\underline{f}$ for it, consumers find product v more attractive than product w. That is, naive consumers are attracted to product v because they falsely believe it is cheaper than product w. This condition holds if product w is not much better than product v or $\underline{f}$ is not too high. For instance, although naive consumers may realize that a debit card serves essentially the same functions as a credit card, they may prefer a credit card because they falsely believe that its perks (e.g. cash-back bonuses) make it a better deal.

The basic message of Proposition 4 is that profitable deception can occur quite easily: all it takes is the availability of an *inferior* product that has a shroudable price component and a binding up-front price floor. To ensure the existence of such a product and hence maintain an equilibrium in which they exploit naive consumers, firms will often have strong incentives to invent a superior *or* inferior alternative product to the one already in the market. For instance, firms might want to create a superior product even if it means losing money on that product.

Although we have imposed exogenously that product w is transparent, even if firms make an unshrouding decision regarding both products, one would often expect the superior product to be transparent and the inferior product to be deceptive. Clearly, under the condition of Proposition 4, an equilibrium in which product v is shrouded and product w is unshrouded always exists. If in addition $w > v$—or even if $w > v$ holds for a small fraction of naive consumers—and there are sufficiently many firms in the market, the *only* profitable equilibrium is the one in which the

superior product is unshrouded and the inferior product is shrouded. Consider, for example, a candidate equilibrium in which the superior product is shrouded. Then, naive consumers for whom $w > v$ must be buying product w; otherwise, a firm could attract all these naive consumers by setting prices $\underline{f}, \overline{a}$ on product w, and for a low-profit firm this would be a profitable deviation. But if naive consumers are buying product w, a low-profit firm has an incentive to unshroud product w in order to capture this socially valuable market.[23]

The conclusions of Proposition 4 also hold if we assume that consumers misperceive the inferior product's value rather than its price. Suppose that product v has no additional price, but consumers have false beliefs about its value: they believe the value is v, but it is actually $v - \overline{a}$. Then, if product w is superior—that is, $w - c^w_{min} \geq v - \overline{a} - c_{min}$—Proposition 4 and the logic behind it survive unchanged.

Finally, our model above has an immediate implication for the marketing of superior and inferior products that contrasts with classical views of advertising. Because the inferior product is more profitable, firms have an incentive to "push" these products on consumers who may not otherwise buy them, further decreasing social welfare by expending resources selling inferior goods. This pushing can take a number of different forms. First, firms may inform consumers unaware of the inferior product of the product's existence, yet not do the same for the superior product. Second, firms may pay intermediaries to convince consumers to buy the inferior product. Third, firms may make costly (real or perceived) improvements to the inferior product to make it more attractive to consumers. In all these examples, the implication that a firm pushes the socially inferior product contrasts markedly with the predictions when all consumers are rational, even if some are uninformed: a rational consumer would realize that an inferior product that a firm finds more profitable to sell must generate lower consumer surplus, and hence never buy that product. Indeed, Anagol, Cole and Sarkar (2011) and Mullainathan, Nöth and Schoar (2011) document

[23] If $v > w$ for naive consumers (or most naive consumers), then there can also be an equilibrium in which both additional prices are shrouded, naive consumers buy product v, and sophisticated consumers buy product w. In this equilibrium, firms do not unshroud the additional price of product v, but sophisticated consumers nevertheless understand that it is the superior product. Suppose, for example, that naive mutual-fund investors do not notice management fees or consider what these fees mean for returns, and they believe that managed funds pick investments better than index funds ($v > w$). Then, naive consumers pick managed funds. But sophisticated consumers understand—even without it being explained to them—that the low management fees of index funds make these funds superior, and hence pick these funds.

that intermediaries tend to disproportionately push inferior products in the mutual-fund and life-insurance markets, respectively, and do so because they receive higher commissions from firms. Similarly, German banks advise consumers on managed mutual funds, but refuse to give advice on index funds, and even require customers to sign that they are sophisticated investors willing to buy risky products.[24]

5 Research and Development Incentives

In previous sections, we have taken the maximum additional price firms can impose, as well as consumers' valuation for the product, as exogenous. These parameters, however, depend on product features that firms can change through innovation. In this section, we analyze firms' decisions to invest in exploitative and value-increasing innovation, and identify a number of socially inefficient incentives deriving from a firm's concern that competitors might unshroud additional prices. Combined with the results above, our theory predicts some extreme combinations of inefficient behaviors: it says, for instance, that firms will market a socially wasteful product, spend lots of money trying to figure out new ways to charge consumers hidden fees, and waste yet more money trying to improve the product by tiny amounts.

To identify a firm's incentives to innovate and to understand how this incentive depends on the extent to which innovation transfers to competitors, we assume that only one firm, firm 1, can make innovation investments. We analyze firm 1's investment decisions separately for exploitative and value-increasing innovation. In each case, we modify the pricing game above by assuming that there is an initial stage in which firm 1 chooses whether or not to invest, with the decision observed by all firms. The cost of an exploitative innovation is I_a, and the innovation increases

[24] To see one formalization of the above ideas, consider a variant of our two-product model in which some naive consumers are unaware of the existence of either the inferior or the superior product, while sophisticated consumers are aware of both products. Each type of consumer acts in the way we have defined above, given the product she is aware of. Firms play the following game. First, firms simultaneously choose the prices and whether to unshroud (as above), and each consumer chooses a firm to buy from. When a consumer approaches a firm to buy a particular product, the firm can at a cost $\epsilon > 0$ point out the existence of the other product. If the firm does so, the consumer considers both products at all firms, but if she does not find what she thinks is a better deal, she buys from this firm. Then, if ϵ is sufficiently small, there is a profitable deceptive equilibrium in which firms shroud the additional price of the inferior product, price the superior product at marginal cost, inform consumers of the inferior product, but do not inform consumers of the superior product.

the maximum additional price firm n can charge by Δa_n, where $0 \leq \Delta a_n \leq \Delta a_1$. Analogously, the cost of a value-increasing innovation is I_v, and the innovation increases consumers' perceived valuation of firm n's product by Δv_n, where $0 \leq \Delta v_n \leq \Delta v_1$. While we will interpret the latter kind of innovation as increasing the product's true value to consumers, the same results hold for innovation, advertisement, and other investments that merely increase the *perceived* value—with the investment's social value of course being even lower in this case than for true value-increasing innovations.[25] Following our equilibrium-selection arguments in Section 2, we assume that whenever it exists, firms play the positive-profit shrouded-prices equilibrium in the pricing subgame. When considering the case of heterogeneous valuations, we follow the conventional assumption of classic Bertrand models that no firm charges a total price below its marginal cost. We look for the maximum investment costs I_a^*, I_v^* below which firm 1 is willing to make the investment of each type. We assume throughout that the price floor is binding for firm 1 (i.e. $\underline{f} + \overline{a} > c_1$).

Our key results in this section derive from considering how firm 1's investment affects other firms' motive to keep consumers deceived. To concisely refer to this motive, we introduce:

Condition 1 (Shrouding Condition)**.** Firm n satisfies the Shrouding Condition at $(\hat{a}_n, \hat{v}_n)$ if $s_n(\underline{f} + \hat{a}_n - c_n) \geq \hat{v}_n - c_n$.

Proposition 5 states our results for non-appropriable innovations—innovations that competitors acquire:

Proposition 5 (Non-Appropriable Innovation)**.**

I. (Exploitative.) Suppose $\Delta a_n = \Delta a > 0$ for all n. If all firms n satisfy the Shrouding Condition at $(\overline{a} + \Delta a_n, v)$, then $I_a^* \geq s_1 \Delta a$. If in addition some firm does not satisfy the Shrouding Condition at $(\overline{a}, v)$, the inequality is strict.

II. (Value-Increasing.) Suppose $\Delta v_n = \Delta v > 0$ for all n. Then, $I_v^* \leq 0$.

Part I of the proposition identifies circumstances under which a firm is willing to spend resources on a non-appropriable exploitative innovation that increases the maximum additional price by Δa.

[25] For example, a mutual-fund prospectus outlining an investment philosophy may fool consumers into believing there is systematic way to beat the market, increasing the perceived value of the fund.

So long as the Shrouding Condition holds for all firms following the innovation, an increase in profits from the additional price cannot be competed away by decreases in the up-front price, so an inventing firm benefits from its innovation by collecting Δa more from each of its share s_1 of consumers. Going further, if in addition the Shrouding Condition is violated for some firm without the innovation, the innovation has the additional benefit of shifting the equilibrium from a zero-profit non-deceptive to a positive-profit deceptive equilibrium.

Firm 1's incentive to invest in exploitative innovation is of course socially inefficient. The social cost comes in two forms. First, the resources firm 1 spends on such innovation is pure waste. Second, exploitative innovation can lead to further waste by allowing firms to sell products to consumers who value them below production cost.

In contrast, Part II of Proposition 5 says that when it comes to non-appropriable value-increasing innovation—an investment that is often socially valuable—firm 1's willingness to spend is non-positive. Because such innovation can increase neither one's market share nor one's markup, firm 1 has no incentive to invest in it. More interestingly, if the Shrouding Condition holds for all firms absent the innovation but is violated for some firm with the innovation, a firm's willingness to pay for investment is negative. Intuitively, because an increase in v does not affect profits when firms shroud but increases the profits a firm can gain from expanding market share, it increases the motive to unshroud. As a result, firm 1 may be willing to spend money to ensure that a non-appropriable value-increasing innovation does *not* occur.

To sharpen the intuitions from Proposition 5 on a firm's incentive to invest in exploitative innovation, we compare these incentives for non-appropriable and appropriable innovations:

Proposition 6 (Appropriability of Exploitative Innovation)**.** *I_a^* is weakly greater if the innovation is non-appropriable ($\Delta a_n = \Delta_a > 0$ for all n) than if it is only partially copiable ($\Delta a_1 = \Delta a \geq \Delta a_n \geq 0$ for all $n \neq 1$), and it is strictly greater if the Shrouding Condition holds at $(\overline{a} + \Delta a, v)$ for all n but fails at $(\overline{a} + \Delta a_n, v)$ for some n.*

Proposition 6 highlights that firm 1 has a *greater* incentive to engage in exploitative innovation when other firms can copy its innovation. Equivalently, firm 1 not only does not mind if other firms copy its innovation—it may positively *want* others to copy it. Intuitively, a competitor who

is not very good at imposing additional prices gains little from deception and hence may want to deviate from it, threatening firm 1's profits. To eliminate such a threat, firm 1 would like to teach this competitor how to better exploit consumers.[26]

Proposition 5's message that firms might be willing to make investments in non-appropriable innovations, and that such innovations are more likely to be exploitative than socially valuable, seems consistent with recent developments in the financial market. Credit-card companies and banks have invented a multitude of limitations on account holders—such as strict deadlines on payment, strict limits on spending with a credit card or overdrafting a bank account, and the separation of purchases and cash withdrawals—only to be able to impose hefty charges for transgressing those limits.[27] Similarly, mortgages have also started making use of strict limits on late payment as well as prepayment, with substantial late fees and prepayment penalties imposed otherwise.[28] As has been noted by a number of researchers, these features likely serve little real economic need, yet allow firms to deceive consumers (see e.g. Heidhues and Kőszegi (2010) and the references therein). Furthermore, not only are such contract innovations extremely easy to copy (and in fact quickly copied), in some instances firms seem—consistent with Proposition 6—positively willing to share them with each other.[29]

[26] We should, however, emphasize a caveat to Proposition 6: a firm's willingness to share an exploitative innovation applies only to competitors already in the marketplace, and not to potential entrants. The ability to charge higher additional prices can induce additional firms to enter, reducing the innovator's market share. Hence, the ability to charge higher additional prices would potentially have two countervailing effects: on the one hand, higher ex-post profits from a firms' customer base and, on the other hand, a lower market share. Typically, however, while one would expect entry into such markets to be attractive—due to the positive profits—one would also expect entrants to face difficulties building up market share: due to the price floor, potential entrants cannot offer introductory deals on the base fees and hence should find it hard to divert customers from more established brands absent unshrouding. Unshrouding, on the other hand, would eliminate the positive profits that make entry attractive.

[27] For example, in 2009 US banks made $20 billion in overdraft fee revenues from ATM and one-time debit-card transactions (Grubb 2011). Stango and Zinman (2009) report that in their (financially relatively sophisticated) sample, the median household pays $43 in total bank and credit card account costs per month, with the 90th percentile paying $257 per month. Among those who ever pay overdraft fees, the seventy-fifth percentile pays nearly $20 per month; and the same numbers for credit-card late and overlimit fees are $12 and $16, respectively.

[28] A prepayment penalty can be thousands of dollars. In 2006, Countrywide's revenue from late fees was $285 million (Gretchen Morgenson, *Inside the Countrywide Lending Spree*, New York Times, August 26, 2007), or 11.3% of its profits according to Fortune 500 data reported on `http://money.cnn.com/magazines/fortune/fortune500/snapshots/372.html`.

[29] For example, Argus is an information-exchange service that collects individual-level account data from credit-card issuers and, based on this data, relays information on current practices to other issuers. The information Argus collects includes fee assessment practices, strategies for balance generation, financial performance, and payment behavior. Argus emphasizes that it has detailed information on "virtually every US consumer credit card." (See `http://www.argusinformation.com/eng/our-services/syndicated-studies/credit-card-payment-study/`

To complete our analysis of innovation decisions, we consider fully or partially appropriable value-increasing innovations, beginning with socially wasteful industries. Because the result is easier to state and understand in this case, we consider only innovations that make firm's product better than that of any competitor.

Proposition 7. *Suppose* $v + \Delta v_n < c_n$ *for all* n*, and* $\Delta v_1 > \Delta v_n$ *for all* $n \neq 1$*. Then,*

$$I_v^* = \left[(1 - s_1)(\underline{f} + \overline{a} - c_1)\right] + \left[\Delta v_1 - \max_{n \neq 1} \Delta v_n\right] > 0.$$

Proposition 7 says that firm 1's willingness to pay for fully or partially appropriable value-increasing innovations in a socially wasteful industry can be quite large: it exceeds the increase in the relative value of firm 1's product, and (because I_v^* is bounded away from zero) is non-trivial even for vanishingly small product improvements—whereas in a classical setting the incentive to innovate in a socially wasteful industry would of course be zero. Firm 1's willingness to pay, I_v^*, derives from two sources. First, the innovation redirects all rival customers to firm 1, and firm 1 would benefit from this even at pre-innovation market prices. Second, because the innovation makes firm 1's product better than the best alternative, firm 1 can increase the up-front price without losing customers, further increasing its profits.

We next consider socially valuable industries. To discuss this case, we need to make an additional—completely standard—assumption to select among a continuum of equilibria in the pricing subgame: we focus on cautious equilibria in which no firm sets prices below marginal cost. As a benchmark, consider the incentives to innovate in an industry in which all consumers are sophisticated or prices are exogenously unshrouded, so that the pricing subgame is a Bertrand game. As is recognized in the literature, in a cautious equilibrium a firm earns what could be called its "competitive advantage"—its ability to deliver value over and above its competitors. For example, if firms' products are homogenous, the competitive advantage of all but the lowest-cost firms is zero, and the competitive advantage of a lowest-cost firm is the difference between the second-lowest cost

`us-credit-card-payments-study/`.) For any issuer who participates, any innovation is essentially a non-appropriable innovation. Proposition 5 explains why a participating firm makes innovations, and although there may be other reasons, Proposition 6 provides a strategic reason for why a firm that is interested in developing new exploitative practices in the credit market is willing to join ARGUS in the first place.

and its cost.[30] In our setting with heterogeneous values, the competitive advantage is

$$CA_n(v_1, \ldots, v_n) \equiv \max\{(v_n - c_n) - \max_{k \in \{1,\ldots,N\}} (v_k - c_k), 0\}.$$

Obviously, when all consumers are sophisticated, firm 1's maximum willingness to pay for a product improvement would be $CA_1(v + \Delta v_1, \ldots, v + \Delta v_n)$. The following proposition establishes that the incentives to innovate are lower in a deceptive industry that produces a socially valuable good.

Proposition 8. *Suppose $v > c_n$ for all n, and the Shrouding Condition holds for all firms n at $(v, \overline{a})$. In this industry $I_v^* < CA_1(v + \Delta v_1, \ldots v + \Delta v_n)$. Furthermore, if the shrouded-prices equilibrium profits of firm 1 are greater than $CA_1(v + \Delta v_1, \ldots v + \Delta v_n)$, $I_v^* < 0$.*

Proposition 8 says that firm 1's willingness to pay for partially appropriable value-increasing innovation in a socially valuable deceptive industry is quite small: it is lower than the competitive advantage firm 1 establishes, and it is always non-positive for vanishingly small improvements. Any innovation that improves firm 1's product above that of firm n would leave firm n with no consumers when deception occurs, violating firm n's Shrouding Condition. Hence, such an innovation must lead to unshrouding, after which firm 1 earns its competitive advantage. Firm 1's loss of profits from deception dampens its incentive to innovate, and for small improvements—which generate only a small competitive advantage—the incentive is negative.

6 Extensions and Modifications

In this section, we demonstrate some robustness of our findings by discussing a number of extensions and modifications of our framework. In Section 6.1, we analyze the implications of an alternative model of consumer naivete. In Section 6.2, we discuss how heterogeneity in consumer valuations v, strategic sophistication, and differences in firms' ability to impose additional prices affect our conclusions.

[30] In addition, a lowest-cost firm earns this competitive advantage in an equilibrium in which it charges the second-lowest cost, with lowest-cost firms getting the entire market .

6.1 Misprediction of Add-On Demand

As an alternative to our specification of consumer naivete in the rest of the paper, in this section we analyze a model in which a consumer underestimates not the total price of the product, but her own demand for an add-on to the product. When getting a credit card, for example, a consumer may be aware that she will face a high interest rate on any long-term debt she carries, but incorrectly expect to pay off her outstanding debt within a short period. Similarly, a mobile-phone consumer may know that going beyond her included minutes, or making calls or texting during a trip, can be expensive, but underestimate her use of these add-on services.[31]

We use the same model as in Section 2, with the following modifications. Instead of assuming that f_n and a_n are two components of a product's price, we posit that f_n is the price of a base product (e.g. the convenience use of a credit card) and a_n is the price of an add-on (e.g. long-term borrowing on the credit card). A consumer can only buy a firm's add-on if she purchased that firm's base product. We assume that consumers know a_n, but have false beliefs about their demand for the add-on: whereas their actual willingness to pay will be $\overline{a}$, they believe their willingness to pay will be $\hat{a}$. Consumers value the product with the add-on at v; hence, their perceived value for the product without the add-on is $v - \hat{a}$.[32] In contrast to our assumption in Section 2 that any firm can eliminate consumer misperceptions, in this version of the model we do not assume that firms can do so. This reflects our view that—while highlighting an otherwise hidden price component may be relatively easy—convincingly explaining to a consumer how she herself will behave is very difficult. Indeed, a consumer may be presented with and readily believe information about how the

[31] Consistent with the first example, Ausubel (1991) finds that consumers are much less responsive to the post-introductory interest rate in credit-card solicitations than to the teaser rate, even though the former is more important in determining the amount of interest they will pay. And consistent with the second example, Grubb (2009) documents that many mobile-phone consumers choosing contracts with high fees for high usage would have been better off choosing a plan with lower fees for high usage—while few consumers make the opposite mistake.

[32] An alternative way to set up the model is to assume that the consumer's value for the product without the add-on is v, with her perceived willingness to pay for the add-on still being $\hat{a}$. The two formulations generate the same predictions, but have slightly different interpretations. In the former case, the consumer overestimates her value for the product without the add-on. For instance, a mobile-phone consumer might not realize how painful it is to forego calling while traveling in areas where roaming charges apply. In the latter case, the consumer understands the value of the product without the add-on, but does not realize how tempted she will be buy the add-on. For example, a consumer may understand the convenience value of a credit card, but underappreciate her tendency to borrow on it.

average consumer behaves, but still believe that this does not apply to her.[33]

Proposition 9 identifies the key results in this variant of our model. As in the rest of the paper, we identify conditions for profitable equilibria in which consumers mispredict how much they will pay. But because prices are not shrouded in the current model, we refer to such an equilibrium as an "exploitative equilibrium" rather than a shrouded-prices equilibrium.

Proposition 9 (Equilibrium in Underestimation-of-Demand Model)**.** *Suppose* $\underline{f} > c_n - \overline{a}$ *for all* n*. In any exploitative equilibrium,* $f_n = \underline{f}$ *and* $a_n = \overline{a}$ *for all* n*. An exploitative equilibrium exists if and only if*

$$s_n(\underline{f} + \overline{a} - c_n) \geq \underline{f} + \hat{a} - c_n \text{ for all } n \in \{1, \ldots, N\}. \tag{3}$$

The underestimation-of-demand model shares the prediction of our basic model above that under some circumstances, a profitable exploitative equilibrium exists despite price competition in undifferentiated products. But the mechanism is somewhat different. To understand the intuition, note that consumers would not respond to a firm that undercuts competitors' add-on price of $\overline{a}$ by a little bit, as they would not believe they will get the add-on at such a high price. Instead, to attract consumers a firm must cut its add-on price so low that consumers *believe* they will want the add-on, and this may not be worth it. Condition (3) for an exploitative equilibrium to exist says that firm n makes more profits charging the highest additional price $\overline{a}$ and getting market share s_n than charging only the additional price $\hat{a}$ and getting all consumers.

Given the similarity of Conditions (1) and (3), the implications of Proposition 9 are also similar to those of the basic model. The implications, however, now depend not on whether the product is socially wasteful to produce, but on whether it is unprofitable to sell with the add-on price at which consumers *think* they value the add-on ($\underline{f} + \hat{a} < c_n$ for all n). If it is profitable to sell at this

[33] Note that for many real-life products, there may be more than one add-on, and consumers may correctly predict their demand for some add-ons but not others. We can think of any add-on for which consumers correctly predict their demand as part of the base product, with the above model applying to any add-on for which consumers mispredict their demand. Similarly, if there are multiple units of the same add-on that are priced separately, the above model applies to marginal units for which consumers mispredict their demand. For example, a credit-card consumer may know that she will borrow on her credit card each month to make purchases, but underestimate her future tendency to borrow for longer than the grace period.

"virtual" price, with a sufficient number of firms at least one is willing to lower the add-on price to the virtual price, eliminating the exploitative equilibrium. But if it is not profitable to sell at the virtual price, a profitable exploitative equilibrium exists independently of the number of firms in the industry or other parameter values.

An example consistent with the above prediction on when entry does not eliminate profitable exploitative practices may be the credit-card market. Suppose, for instance, that consumers ignore the 18% interest rate on credit-card balances because they believe they will not carry a balance for interest rates exceeding 5%. Then, to attract consumers a firm must cut its interest rate to 5%, and this may not be profitable. Indeed, the number of firms in the credit-card market has increased drastically over time, and although there are sharp disagreements on the extent, interpretation, and economic implications of this finding, firms continue to make seemingly large profits from interest charges and fees on existing consumers (Ausubel 1991, Bar-Gill 2004, Evans and Schmalensee 2005).[34,35]

6.2 Further Extensions and Modifications

For simplicity, our basic model assumes that all consumers have the same valuation v for the product, but our main insights survive when there is heterogeneity in v. As an analogue of Proposition 3, a shrouded-prices equilibrium with prices $\underline{f}, \overline{a}$ often exists because unshrouding would lead consumers with values between $\underline{f}$ and $\underline{f} + \overline{a}$ not to buy, discretely reducing industry demand. The shrouded-prices equilibrium is more likely to exist when there are more such consumers—that is,

[34] As emphasized above, this does not necessarily mean that credit-card issuers earn positive profits net of entry, marketing, product development, and other costs. Nevertheless, a model of price competition in barely-differentiated products seems to apply well to the credit market *after* entry and marketing costs have been paid and consumers have been reached by multiple firms with very high probability, but consumers have not signed on yet. Hence, from the perspective of prior research it is puzzling how credit-card issuers can sustain positive profits at this stage.

[35] It is worth noting that the above equilibrium is not robust to assuming that consumers perceive the probability of consuming the add-on to be positive, no matter how small the probability is. With products being perfect substitutes, consumers then respond to any decrease in the add-on price, so an equilibrium with an add-on price of $\overline{a}$ does not exist. Even so, if there is a positive measure of consumers who perceive the probability of purchasing the add-on at a price of $\overline{a}$ to be zero, then a positive-profit mixed-strategy exploitative equilibrium again often exists because—similarly to the "captive" consumers in Shilony (1977) and Salop (1977)—these consumers provide a profit base that puts a lower bound on firms' total profit.

when there are more consumers who are mistakenly buying the product.[36] And a shrouded-prices equilibrium exists whenever the product could not be profitably sold to consumers who understand its total price. This is the case whenever the product is socially wasteful to produce, for example because no consumer values it above marginal cost, or (in a natural extension of our model) the number of such consumers is not sufficient given some fixed costs of production. Nevertheless, if a firm can make positive profits by unshrouding, then with a sufficient number of firms at least one wants to unshroud, eliminating the shrouded-prices equilibrium.

We also consider what happens when there are sophisticated consumers in the population who are not separated by a superior transparent product, and who are heterogeneous in v. So long as a positive fraction of sophisticated consumers purchase the product despite their knowing about the high additional price, a cut in the additional price attracts all these sophisticated consumers, so that an arbitrarily small fraction of these consumers induces competition in the additional price. Whenever shrouding can be maintained, however, firms' profits are *not* driven to zero because—similarly to the "captive" consumers in Shilony (1977) and Salop (1977)—naive consumers provide a profit base that puts a lower bound on firms' total profit. Furthermore, it is clear that these profits can be sufficient to deter unshrouding.

All of our results survive unchanged if we define sophisticated consumers not as those who observe additional prices, but as those who understand firms' equilibrium pricing behavior.[37] Intuitively, such "strategically sophisticated" understand that since they cannot observe shrouded additional prices, firms have an incentive to set such prices to be the maximum $\overline{a}$. As a result, with only sophisticated consumers a positive-profit shrouded-prices equilibrium cannot be maintained (Proposition 2)—a firm could deviate and undercut competitors without decreasing industry demand. Similarly, as do sophisticated consumers in our basic model, strategically sophisticated consumers do not buy an overpriced product, leading to the same condition for when a shrouded-

[36] This point modifies the extreme implication of our basic model that a shrouded-prices equilibrium exists only if consumers should not be buying the product at the current total price. With heterogeneity, this is true for marginal consumers, but generally not for all consumers.

[37] Technically, to model such strategically sophisticated consumers, we cannot use the approach above of defining Nash equilibrium only for firms. Instead, it is necessary to think of strategically sophisticated consumers as players, and look for a natural extension of perfect Bayesian equilibrium. In this equilibrium, firms maximize profits given others' behavior, a naive consumer acts as we have defined above, and a strategically sophisticated consumer maximizes her own welfare given her (in equilibrium correct) predictions of firm behavior.

prices equilibrium exists in a market with both sophisticated and naive consumers (Inequality (2)), and for when separation of sophisticated and naive consumers occurs in such a market (Proposition 4).

The main results of our paper are also robust to allowing the maximum additional price firms can impose to be different across firms, with firm n being able to set $\overline{a}_n$.[38] This assumption substantively modifies only Proposition 1: because firms that are better at exploiting consumers can afford lower up-front prices, it is now not the firms with the lowest c_n that sell to consumers in a shrouded-prices equilibrium, but the firms with the lowest $c_n - \overline{a}_n$. Furthermore, a shrouded-prices equilibrium exists if the product is socially wasteful. In such an equilibrium, both productive efficiency and allocative efficiency fail to hold, identifying serious caveats to the "safety in markets" result that firms make zero profits from exploitation.

7 Related Theoretical Literature

In this section, we discuss the theories most closely related to our paper. Although we identify other differences below, the most important difference is that the previous literature does not address in any detail the central issues we consider in this paper, including the role of socially wasteful products and the coexistence of superior and inferior products in maintaining profitable deception, and the incentives for exploitative innovation in a market for profitable deceptive products.

The model by Gabaix and Laibson (2006) is both the most closely related to ours and a foundation for it. They consider a model in which consumers buy a base good and then have an option to purchase an add-on whose price might be shrouded by firms. Sophisticated consumers anticipate the equilibrium add-on price, and if they believe that price will be high, they take costly steps to avoid the add-on. Naive consumers do not anticipate high add-on prices and therefore do not take steps to avoid the add-on, ending up having to purchase it. Gabaix and Laibson's main prediction is that unshrouding can be unattractive because it turns profitable naive consumers (who buy the expensive add-on) into unprofitable sophisticated consumers (who do not buy the add-on).[39] Al-

[38] In fact, our proof of Proposition 3 in the appendix allows for this possibility.

[39] Relatedly, Piccione and Spiegler (2010) characterize how firms' ability to change the comparability of prices through "frames" affects profits in Bertrand-type competition. If a firm can make products fully comparable no

though the precise tradeoff determining a firm's decision of whether to unshroud is different, we start from a similar insight, and draw out a number of important implications of this insight.[40,41]

Grubb (2011) analyzes what in our language could be called the regulated unshrouding of additional prices, and develops a set of results complementary to ours. He considers services, such as mobile phones and bank overdraft protection, for which consumers may not know the marginal price of the next unit of service, and asks whether requiring firms to disclose this information at the point of sale increases welfare. If consumers correctly anticipate their probability of running into penalties, such price-posting regulation can actually hurt because it interferes with efficient screening by firms.[42] If consumers underestimate their probability of running into fees, in contrast, fees allow firms to extract more rent from consumers, and price posting prevents such exploitation.

Spiegler (2006b) analyzes a model of the market for "quacks" (producers who provide no value relative to the outside option) in which consumers overinfer from a signal received about a quack and hence are too prone to choose a quack for whom they have observed a good signal. Consumers' mistaken inference creates a form of product differentiation that allows firms to raise prices and

matter what the other firm does—which is akin to unshrouding in our model and that of Gabaix and Laibson (2006)—the usual zero-profit outcome obtains. Otherwise, profits are positive. Piccione and Spiegler highlight that increasing the comparability of products under any frame through policy intervention will often induce firms to change their frames, which can decrease comparability, increase profits, and decrease consumer welfare. Investigating different forms of government interventions, Ko (2011) and Kosfeld and Schüwer (2011) demonstrate that educating naive consumers in a Gabaix-Laibson framework can decrease welfare because formerly naive consumers may engage in inefficient substitution of the add-on.

[40] In Gabaix and Laibson's model, the incentive to unshroud derives from trying to reap the gains from trade from selling the add-on to sophisticated consumers, and the cost derives from having to compensate sophisticated consumers for the cross-subsidy they receive from naive consumers in a market with shrouded prices. In our model, the incentive to unshroud derives from trying to attract competitors' profitable consumers, and the cost derives from the fact that unshrouding makes consumers aware of high prices and thereby reduces demand for the profitable product. These different mechanisms generate some different implications. For instance, in our model (unlike in Gabaix and Laibson's) a firm might want to unshroud even though sophisticated consumers cannot avoid the add-on.

[41] We have reconsidered each of the main questions of our paper in a model based on Gabaix and Laibson's framework combining naive consumers and sophisticated consumers who can avoid the add-on, imposing that products are perfect substitutes. Our results that a firm does not want to unshroud the additional price of a socially wasteful product, and that a superior transparent product can serve to separate sophisticated and naive consumers, also hold in their model. In contrast, because in their model the unshrouding decision is driven solely by the comparison of the gains from trading the add-on and the cross-subsidy sophisticated consumers receive, the number of firms has no effect on whether deception occurs in equilibrium. In addition, because profits in their model are zero, firms never make non-appropriable investments.

[42] Intuitively, penalty fees for high usage prevent high-value consumers from taking the contracts offered to low-value consumers; yet because consumers do not know when they apply, these fees do not distort the consumption of low-value consumers.

profits. Spiegler's model applies well, for instance, to the market for managed mutual funds, in which consumers may overinfer from funds' recent performance. Nevertheless, in Spiegler's model industry profits converge to zero as the number of firms approaches infinity, so his model does not fully explain the existence of non-trivial ex-post profits in very competitive industries such as the mutual-fund industry.

In Spiegler (2006a), firms compete for consumers who choose a product based on a single random price (or value) component. In equilibrium, firms randomize their price, trying to attract consumers with a low-price component and cash in on high-price components. As the number of firms increases, prices in the high range of a firm's distribution become less effective at attracting consumers, so that firms *increase* these prices to at least make more money on consumers they do attract. As a result, profits remain bounded away from zero. Because in Spiegler's model consumers do not pay full attention to the price components, in our terminology these components correspond best to secondary prices. Hence, Spiegler's model can be thought of as a microfoundation for how firms can sustain positive profits from secondary prices even when consumers do not fully ignore those prices.[43]

At a broad level, when consumers must pay classical search costs to find out prices (or product features), one can think of the prices as being partly shrouded, and firms' attempts to increase search costs can be interpreted as a type of exploitative innovation. Indeed, Stahl (1989) shows that an increase in search costs increases firm profits, and Ellison and Wolitzky (2009) find that as a result, it can be individually rational for firms to increase search costs. While we believe that search costs are extremely important in the markets we consider, by themselves they do not seem to fully explain the behavior of firms in these markets. In a positive-profit equilibrium of a rational search-cost model along the lines of Stahl (1989) and Ellison and Wolitzky (2009), there cannot be a cheap binding price announcement that firms could make to at least some set of consumers who might otherwise end up searching and buying from other firms, and that firms are not making.[44]

[43] Our theory, and those discussed above, also build on a growing literature in behavioral industrial organization that assumes consumers are not fully attentive, mispredict some aspects of products, or do not fully understand their own behavior (DellaVigna and Malmendier 2004, Eliaz and Spiegler 2006, Laibson and Yariv 2007, Grubb 2009, Heidhues and Kőszegi 2010).

[44] To see the intuition, consider a candidate positive-profit equilibrium with no announcement, and take the lowest price any firm sets in this equilibrium. At this price, the firm setting it makes its equilibrium—and hence

Yet in many markets we consider, there seem to be very cheap such announcements firms are not making.[45] In addition, although we have no precise empirical evidence, it does not seem that firms are playing the mixed-strategy pricing equilibrium predicted by these models.

Our theory shares one basic premise with the large literature on switching costs: that consumers can be induced to pay high additional fees once they buy a product. Nevertheless, our model's main insights do not carry over to natural specifications of a rational switching-cost model. In many industries motivating our analysis, it seems that at the stage of contracting, firms can commit to all prices—including add-on or other ex-post prices—they will charge a consumer. A credit-card issuer, for instance, can easily include in its contract that it will never charge late fees. If so, in a rational switching-cost model an equilibrium in which firms charge high additional prices and make positive profits does not exist: a firm making positive profits on a consumer always has an incentive to commit to slightly lower prices than the competition. Even if firms cannot commit to ex-post prices, so long as consumers anticipate these prices most of our results do not carry over. Most importantly, although in that case an equilibrium with high additional prices and positive profits might exist, it would not be subject to the threat of unshrouding by a firm. Since many of our results—such as the effect of entry and the incentives for innovation—are driven at least in part by this threat, they have no analogue in a rational switching-cost model.

8 Conclusion

Throughout this paper, we have assumed that if a firm unshrouds, all firms' pricing schemes become known to all consumers. This assumption is unrealistically extreme. An important agenda for future research is to investigate the effect of more realistic unshrouding technologies. A simple first step is to assume that a firm can only educate a fraction of consumers, or that educating a consumer has some cost. In this case, the conditions for profitable deception to occur will of course be weaker,

positive—profits. By setting this price and making the announcement, the firm would increase market share and therefore profits, contradicting equilibrium.

[45] As discussed below, for instance, credit-card issuers could promise never to charge late fees. For a completely different example, consider the practice of internet computer-parts retailers discussed by Ellison and Ellison (2009), whereby consumers were charged exorbitant shipping fees after navigating to a retailer's homepage from a price comparison site. A firm could easily have announced its shipping charges on the price-comparison cite.

but qualitatively similar insights to those we find will still hold. Another alternative assumption is that firms can unshroud some fees but not other fees. In as much as this is the case, an interesting question is whether firms are more likely to unshroud small or large fees. Similarly, a firm may be able to unshroud its own product but not other firms' products.[46]

Understanding the implications of more realistic unshrouding technologies is important not only to understand firm behavior, but also to analyze potential education campaigns on the part of a social planner or consumer group. Literally interpreting our assumption that unshrouding products' additional prices is costless, a single consumer group or well-intentioned individual could eliminate profitable deception. If education is not so simple, however, this may no longer be the case. For example, if educating consumers is costly, it is unclear how a consumer group would finance an education campaign, and whether it could compete with firms. If consumers can solve the free-rider problem and organize a consumer group to educate consumers, presumably firms can solve their own free-rider problem and organize an interest group to obfuscate—and the latter group will have much more money behind it. With multiple institutions attempting to provide conflicting advice, naive consumers may find it difficult to sort out whom they should believe.

While our paper analyzes the mechanisms behind and welfare costs of markets for deceptive products, it does not address in detail the central policy questions of how a planner can detect whether consumers misperceive product features, and what the planner can do to make markets less deceptive. An important agenda for future research is to find ways to identify consumer mistakes from market data available to regulators and other observers for many markets, so that checking whether a particular market is deceptive does not require special data or expensive methods. In addition, it is important to develop specific interventions for lowering hidden fees that do not require a regulator to have unrealistic knowledge about what consumers understand. For example, in some industries firms (e.g. mobile-phone carriers) are able to impose large additional prices by locking consumers into a long-term contract, over the course of which they face many fees. If

[46] In some situations, this ability can be sufficient to eliminate the shrouded-prices equilibrium. Suppose that the monthly base price of a mobile-phone contract is \$50 and additional charges amount to \$50, but consumers believe they will only have to pay \$10 in additional fees. Then, a provider that can credibly offer a package with a \$59 monthly fee and no additional charges attracts all consumers, even without revealing to consumers the charges other providers impose.

the long-term contract serves no other important purpose, a regulator can prevent large additional prices by requiring contracts to be short-term—even if the regulator does not know what the hidden additional prices are.

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A A Model with Costly Unshrouding

In this section, we prove that whenever a shrouding equilibrium exists in case there are no unshrouding costs—that is if $s_n(\underline{f}+\overline{a}-c_n) \geq v-c_n$ for all firms n—, the shrouding equilibrium is the *unique* equilibrium in a model in which there are unshrouding costs $\eta > 0$—no matter how small they are. Let (f_n, a_n) and $f_n + a_n$ be firm n's contract and total price, respectively. Proposition 10 characterizes the equilibrium in this model:

Proposition 10. *Suppose there are unshrouding costs $\eta > 0$ and that a shrouding equilibrium exists in case there are no unshrouding costs. Then, there exists a unique equilibrium in which all firms shroud and offer the contract $(\underline{f}, \overline{a})$ with probability one.*

B Proofs

Proof of Proposition 1. We show that this game is equivalent to Bertrand competition. First, note that for any f_n for which firm n has positive expected market share, $a_n = \overline{a}$. Since the a_n the firm sets when it has zero market share does not affect the behavior and outcomes of consumers or any other firm, we can assume without loss of generality that $a_n = \overline{a}$ also for other prices. Now consider a model of Bertrand competition in which firm n has cost $c_n - \overline{a}$ and is choosing f_n. For any strategy profile, this game generates the same profits as our game. Hence, the result follows from the standard Bertrand proof. □

Proof of Proposition 2. With consumers who observe and take into account the additional price, we have Bertrand competition in the total price. □

Proof of Proposition 3. We establish a slightly more general version of this proposition: we allow the maximum additional prices firms can impose to differ across firms. This is useful for Proposition 6 on firms' incentives to change this additional price. Let $\overline{a}_n$ be the maximum additional price firm n can impose. We prove the statement of Proposition 3 with Inequality 1 replaced by $s_n(\underline{f} + \overline{a} - c_n) \geq v - c_n$.

We have argued in the text that in any shrouded-prices equilibrium all firms set additional price $\overline{a}_n$. We have also shown that if Inequality 1 holds for all n, then there is a shrouded-prices equilibrium in which all firms set $\underline{f}, \overline{a}$. We now provide a formal argument for why firms set $\underline{f}$ in a shrouded-prices equilibrium. The proof for this last claim, in turn, is akin to a standard Bertrand-competition argument.

Take as given that all firms shroud with probability 1, and set the additional price $\overline{a}$. Note that by setting $f_n = \underline{f}$, firm n can guarantee itself a profit of $s_n(\underline{f} + \overline{a} - c_n) > 0$. As a result, no firm will set a price $f_n > v$, because then no consumer would buy from it. Take the supremum $\overline{f}$

of the union of the supports of firms' up-front price distributions. We consider two cases. First, suppose that some firm sets $\overline{f}$ with positive probability. Then, all firms have to set $\overline{f}$ with positive probability; otherwise, a firm setting $\overline{f}$ would have zero market share with probability one. Then, we must have $\overline{f} = \underline{f}$; otherwise, a firm could deviate by moving the probability mass to a slightly lower price. Second, suppose that no firm sets $\overline{f}$ with positive probability. Suppose firm n's price distribution has supremum $\overline{f}$. Then, as $f_n \to \overline{f}$, firm n's expected market share and hence expected profit approaches zero, a contradiction.

We now show that if Inequality 1 is violated for some n, then unshrouding occurs with probability one in equilibrium. We have argued in the text that if the inequality is violated, there cannot be an equilibrium in which all firms shroud with probability one. We prove by contradiction that there is also no equilibrium in which shrouding occurs with a positive probability less than 1. Note that if shrouding occurs with positive probability, then firms must earn positive profits: if firm n's competitors all shrouded, firm n could guarantee itself positive profits by setting $\underline{f}, \overline{a}$.

Consider the supremum of the total price $\hat{t}$ set by any firm when unshrouding, and suppose firm n achieves this supremum. Notice that no firm sets $\hat{t}$ with positive probability when unshrouding: if one firm did so, it would have zero market share when unshrouding, contradicting positive profits; if two firms did so, either one would want to move this probability mass minimally lower. Then, as $t_n \to \hat{t}$, firm n's market share when others unshroud approaches zero, so that its market share when others shroud must be bounded away from zero. For that to occur, any competitor of n must set a price weakly higher than $\hat{t}$ with positive probability.

Now we establish that all firms choose the up-front price $\underline{f}$ whenever they shroud.

Take the supremum $\hat{t}'$ of firms' total-price distributions when shrouding. Suppose firm n' sets this supremum with positive probability. Then, by the above argument, it makes zero profits when unshrouding occurs, and hence must make positive profits when shrouding occurs. In addition, since it only makes profits when shrouding occurs, it sets the additional price $\overline{a}_{n'}$ with probability 1. Hence, there is an associated up-front price $\hat{f}'$ it sets with positive probability. We argue that when shrouding, firm n' does not set up-front prices strictly above $\hat{f}'$ with positive probability. Suppose by contradiction that it sets prices above $\hat{f}'$ with positive probability. Then, there must be a price

$\hat{g}' > \hat{f}'$ such that it sets prices above $\hat{g}'$ with positive probability. There cannot be a competitor whose up-front price when shrouding falls on the interval $[\hat{f}', \hat{g}']$ with positive probability. If this was the case, firm n' could decrease all prices above $\hat{g}'$ to $\hat{f}'$ and increase its additional price holding the total price constant, leaving its market share when unshrouding occurs unchanged and strictly increasing its market share when shrouding occurs. But combined with the observation that firm n' makes profits at total price $\hat{t}'$ only if shrouding occurs, this implies that it could raise $\hat{f}'$ to $\hat{g}'$ and increase profits, a contradiction. This completes the proof that when shrouding, firm n' sets up-front price of at most $\hat{f}'$.

Now we establish that at least two firms charge $\hat{f}'$ with positive probability. Suppose otherwise. Notice that in order for firm n' to make positive profits when shrouding and setting $\hat{f}'$, all other firms must shroud and set an up-front price at least as high with positive probability. If a firm sets $\hat{f}'$ with positive probability, we are done. Otherwise, all other firms set an up-front price strictly above $\hat{f}'$ with positive probability. Take the infimum $\hat{t}''$ of the total price of any firm $n'' \neq n'$ conditional on shrouding and charging an up-front price strictly greater than $\hat{f}'$. Note that any firm shrouding and charging an up-front price strictly above $\hat{f}'$ makes zero profits if shrouding occurs. For any $\epsilon > 0$, take a firm that sets a price below $\hat{t}'' + \epsilon$ with positive probability when shrouding. By unshrouding and setting $\hat{t}'' - \epsilon$, this firm reduces its profit by at most 2ϵ when at least one other firm unshrouds, but discretely increases its market share if all other firms shroud. Hence, for a sufficiently small $\epsilon > 0$ this is a profitable deviation, a contradiction.

Now we know that $\hat{f}'$ is charged by multiple firms with positive probability. Hence, $\hat{f}' = \underline{f}$, and all firms other than n'' charge $\underline{f}$ when shrouding. This implies that firm n'' also charges $\underline{f}$ when shrouding. So whenever a firm shrouds, it charges the up-front price $\underline{f}$.

To complete the proof that all firms choose $\underline{f}$ when shrouding, we consider the case when no firm sets $\hat{t}'$ with positive probability when shrouding. Then, $\hat{t}' > \hat{t}$, and hence there must exist a firm n' that sets a total price strictly greater than $\hat{t}$ with positive probability when shrouding. For any of these total prices, it sets the additional price $\overline{a}_{n'}$. Take the infimum $\hat{f}'$ of the up-front prices firm n' sets when setting total prices in this range. By the same argument as above, there is no firm n'' that shrouds and sets an up-front price $\hat{f}'' > \hat{f}'$ with positive probability, so that $\hat{f}' = \underline{f}$,

and all firms other than n'' charge $\underline{f}$ when shrouding. This implies that firm n'' also charges $\underline{f}$ when shrouding. So whenever a firm shrouds, it charges the up-front price $\underline{f}$.

Now we show that it is not an equilibrium for shrouding to occur with positive probability, and firms to charge $\underline{f}$ when shrouding. Take the infimum $\hat{t}$ of total prices firms charge when shrouding. We consider two cases. First, take $\hat{t} \leq v$. For any $\epsilon > 0$, take a firm that sets a price below $\hat{t} + \epsilon$ with positive probability when shrouding. By unshrouding and setting $\hat{t} - \epsilon$, this firm reduces its profit by at most 2ϵ when at least one other firm unshrouds, but discretely increases its market share if all other firms shroud. Hence, for a sufficiently small $\epsilon > 0$ this is a profitable deviation, a contradiction. Second, take $\hat{t} > v$. Then, take the firm n that violates Inequality 1. This firm does not sell when a rival decides to unshroud, so that its profit conditional on others shrouding is $s_n(\underline{f} + a_n - c_n)$. But then, deviating and setting a price of v is profitable by Inequality 1, since conditional on others shrouding it would earn $v - c_n$.

Finally, note that since unshrouding occurs with probability one, we have Bertrand competition in the total price. □

Proof of Proposition 4. First, we show that if an equilibrium of the type identified in the proposition exists, then $v - \underline{f} \geq w - c^w_{min}$. Since in such an equilibrium sophisticated consumers are buying the transparent product, standard Bertrand-competition logic implies that the total price of product w is c^w_{min} and firms earn zero profits on w. For product v, in turn, the same argument as in Proposition 3 shows that in a shrouded-prices equilibrium in which naive consumers buy this product firms choose the up-front price $\underline{f}$ and additional price $\overline{a}$. Then, naive consumers' ex-ante perceived utility from buying v is $v - \underline{f}$ and their ex-ante perceived utility of buying w is $w - c^w_{min}$. Hence, naive consumers are willing to choose product v only if $v - \underline{f} \geq w - c^w_{min}$.

Second, we show that if $v - \underline{f} \geq w - c^w_{min}$, then the above is actually an equilibrium. To do so, it is sufficient to show that no firm prefers to unshroud product v. If a firm unshrouds product v, to attract consumers it must provide consumer value of at least as much as they would get from product w. Hence, a firm that unshrouds must provide value of at least $w - c^w_{min} \geq v - c_{min} \geq v - c_n$, which it cannot profitably do. □

Proof of Proposition 5.

We first prove Case I. Firm 1 earns zero in the pricing subgame whenever some firm violates the Shrouding Condition. If all firms satisfy the Shrouding Condition firm 1 earns $s_1(\underline{f}+\overline{a}-c_1)$, which is independent of v. The result, hence, follows from the fact that an increase in v either does not affect whether the Shrouding Condition holds or leads to a violation of the Shrouding Condition for some firm.

We now prove Case II. In the subgame following an innovation by firm 1, the Shrouding Condition holds for all firms by assumption, and thus firm 1 earns $s_1(\underline{f}+\overline{a}+\Delta_a-c_1)$ in this case. In the subgame in which firm 1 did not innovate, firm 1 earns $s_1(\underline{f}+\overline{a}-c_1)$ if the Shrouding condition holds for all firms and zero otherwise. In the former case the innovation increases firm 1's profits by $s_1\Delta_a$, in the latter case by $s_1(\underline{f}+\overline{a}+\Delta_a-c_1)$, which is strictly greater than $s_1\Delta_a$ since $\underline{f}+\overline{a}>c_1$. □

Proof of Proposition 6.

Firm 1 earns $s_1(\underline{f}+\overline{a}+\Delta_a-c_1)$ in the subgame following its innovation if the Shrouding Condition holds for all firms and zero otherwise. An increase in Δ_{a_n} for some $n\neq 1$ increases the left-hand-side of the Shrouding Condition and hence relaxes it; thus it either does not affect firm 1's profits or—if it makes the Shrouding Condition hold for some firm $n\neq 1$ for which it does not hold otherwise—strictly increases firm 1's profits. □

Proof of Proposition 9.

We define the term "exploitative equilibrium" as an equilibrium in which consumers buy the product from a firm setting $a_n>\hat{a}$ with positive probability.

Note that if $a_n\in(\hat{a},\overline{a})$, increasing a_n to $\overline{a}$ does not change firm n's demand. Thus, without loss of generality we suppose no firm sets $a_n\in(\hat{a},\overline{a})$ with positive probability in any equilibrium. By the same argument with the proof of Proposition 3, whenever a firm sets $a_n=\overline{a}$, it charges the up-front price $\underline{f}$.

It is straightforward that the exploitative equilibrium exists if Inequality 3 holds. Suppose that Inequality 3 does not hold for firm $\tilde{n}$ and an exploitative equilibrium exists. Then, in this equilibrium some firm sets $(\underline{f},\overline{a})$ and consumers buy from the firm with positive probability. Note

that in this case each firm can earn positive profits by setting $(\underline{f}, \overline{a})$. Let t_n be the supremum of firm n's total price distribution. Let $t \equiv \max_n t_n$. First, consider the case of $t > \underline{f} + \overline{a}$. Then, $t_n = t$ for all n; otherwise some firm earn zero profits with positive probability. Also, there is no firm which has an atom on the total price t. In this case, however, a firm's expected profit of setting the total price $(t - \epsilon, t)$ goes to zero as $\epsilon \to 0$ because t is bounded from above and the probability that the firm can get a positive market share by setting that range of prices goes to zero—a contradiction. Second, consider the case of $t = \underline{f} + \overline{a}$. Then, every firm sets the total price t with positive probability because consumers buy from the firm setting $(\underline{f}, \overline{a})$ with positive probability. Firm n', however, has an incentive to deviate from $t_{n'} = \underline{f} + \overline{a}$ to $f_{n'} = \underline{f}$ and its additional price slightly lower than $\hat{a}$—a contradiction. Therefore, there is no exploitative equilibrium when Inequality 3 does not hold. □

Proof of Proposition 10.

This proof has five steps.

(i): *No firm unshrouds the additional price with probability one.* If a firm unshrouds with probability one, all consumers become sophisticated and hence buy from the firm with the lowest total price $f + a$. Hence by the exact same argument as in Proposition 2, all consumers buy at a total price $f + a = c$ and no firm makes positive profits from selling to the consumers excluding the unshrouded cost. Then, the firm that chooses to unshroud makes negative profits—a contradiction.

(ii): *All firms earn strictly positive profits.* According to (i), in any equilibrium there is a positive probability that no firm unshrouds. Thus, a firm that does not unshroud and offers a contract $(\underline{f}, \overline{a})$ earns strictly positive profits when other firms stick to their equilibrium strategy. Therefore, in equilibrium, all firms must earn strictly positive profits.

(iii): *The distributions of total prices are bounded from above.* Suppose firm n sets the total price $f_n + a_n > v + \overline{a}$ with positive probability in equilibrium. When the additional prices are shrouded, consumers never buy the product from firm n because this inequality implies $f_n > v$. Wken the additional prices are unshrouded, consumers never buy from firm n because $f_n + a_n > v$. Firm n's profits in this case is at most zero, a contradiction with (ii). Thus, each firm's total-price distribution is bounded from above in equilibrium.

(iv): *No firm unshrouds the additional price with positive probability.* Let $(\hat{f}+\hat{a})_n$ be the supremum of the equilibrium total-price distribution of firm n *conditional* on firm n unshrouding; set $(\hat{f}+\hat{a})_n = 0$ in case firm n does not unshroud. Let

$$\hat{f}+\hat{a} = \max_{n=1,\ldots,N} \left\{ (\hat{f}+\hat{a})_n \right\}, \tag{4}$$

Consider firm n that unshrouds and for whom $(\hat{f}+\hat{a})_n = (\hat{f}+\hat{a})$. Note that in any equilibrium in which some firm unshrouds with positive probability, $\hat{f}+\hat{a} > c_n$ by (ii). Also, by (iii), $\hat{f}+\hat{a}$ is bounded from above and hence well-defined.

First, suppose that firm n charges the total price $\hat{f}+\hat{a}$ with positive probability. If some other firm $n' \neq n$ also sets the total price $\hat{f}+\hat{a}$ with positive probability, then firm n has an incentive to slightly decrease its total price in this case—a contradiction. Thus, only firm n charges the total price $\hat{f}+\hat{a}$ with positive probability. Because $\hat{f}+\hat{a}$ is the supremum of the total-price distribution conditional on unshrouding, firm n can earn positive profits only if all firms other than n choose to shroud. Conditional on all other firms shrouding, n's expected profits are no larger than

$$v - c_n - \eta,$$

because the additional price is unshrouded by firm n and hence consumers never buy the product from firm n if $\hat{f}+\hat{a} > v$. When firm n shrouds and offers a contract $(\underline{f}, \overline{a})$, however, its profits conditional on all other firms shrouding are at least $s_n(\underline{f}+\overline{a}-c_n)$. Thus, the equilibrium condition $s_n(\underline{f}+\overline{a}-c_n) \geq v - c_n$ implies that deviating by shrouding and offering a contract $(\underline{f}, \overline{a})$ is profitable—a contradiction.

Second, suppose that firm n does not charge the total price $\hat{f}+\hat{a}$ with positive probability. Then, for any $\epsilon > 0$, firm n charges a total price in the interval $(\hat{f}+\hat{a}-\epsilon, \hat{f}+\hat{a})$ with positive probability. As $\epsilon \to 0$, the probability that firm n conditional on some other firm unshrouding can attract consumers goes to zero, because $\hat{f}+\hat{a}$ is the supremum of the total-price distribution conditional on unshrouding. Hence, firm n cannot earn the unshrouding cost η conditional on some other firm unshrouding—i.e. it looses money in expectation in this case relative to shrouding and offering a contract $(\underline{f}, \overline{a})$. In addition, conditional on all other firms shrouding it earns less than the deviation profits in the no-unshrouding-cost case when unshrouding and offering some

other contract, whereas it would earn at least the shrouding-equilibrium profits when shrouding and offering a contract $(\underline{f}, \overline{a})$. Since shrouding is an equilibrium in the no-unshrouding-cost case, there is a profitable deviation for firm n—a contradiction.

(v): *All firms offer the contract* $(\underline{f}, \overline{a})$ *with probability one.* By (iii), all firms choose to shroud with probability one. Hence, in equilibrium all firms charge an additional price $a = \overline{a}$ with probability one. By the exact same argument as in Proposition 2, all firms offer a base fee $f = \underline{f}$. □