

Massachusetts Institute of Technology
Department of Economics
Working Paper Series

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AND INFORMATION SUPPRESSION IN
COMPETITIVE MARKETS**

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Working Paper 05-18
April 11, 2005

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Shrouded Attributes, Consumer Myopia, and Information Suppression in Competitive Markets

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Abstract

Following Becker (1957) we ask whether competition eliminates the effects of behavioral biases. We study products with add-ons. In competitive markets with costless communication, Bayesian consumers infer that hidden prices are likely to be high prices. Hence, firms choose not to shroud information. However, information shrouding may occur in an economy with some myopic consumers. Such shrouding creates an inefficiency. Sometimes firms have an incentive to eliminate this inefficiency by educating their competitors' myopic consumers. However, if add-ons have close substitutes, a "curse of debiasing" arises, and firms will not be able to profitably debias consumers by unshrouding add-ons. In equilibrium, two kinds of exploitation coexist. Optimizing firms exploit myopic consumers through marketing schemes that shroud high-priced add-ons. In turn, sophisticated consumers exploit these marketing schemes. It is not profitable to lure either myopes or sophisticates to non-exploitative firms. We show that

*For useful suggestions we thank Daron Acemoglu, Simon Anderson, Mark Armstrong, Ian Ayres, Douglas Bernheim, Andrew Caplin, Kenneth Corts, Peter Diamond, Avinash Dixit, Glenn Ellison, Sarah Ellison, Drew Fudenberg, Edward Glaeser, Joseph Farrell, Robert Hall, Ali Hortacsu, Sergei Izmalkov, Paul Joskow, Paul Klemperer, Julie Mortimer, Barry Nalebuff, Aviv Nevo, Ariel Pakes, Nancy Rose, José Scheinkman, Andrei Shleifer, Chad Syverson, David Thesmar, Jean Tirole, and seminar participants at Berkeley, Columbia, the Federal Trade Commission, Harvard, MIT, NBER, New York University, Princeton, Stanford, the University of Virginia, Wharton, Yale, the 2003 European Econometric Society meeting, the 2004 American Economic Association meeting, and the 2004 Duke-Northwestern-Texas IO Theory conference. Nathan Barcz, Carlos Caro, Steve Joyce, Dominique Olie Lauga, Laura Serban, and Kelly Shue provided great research assistance. We acknowledge financial support from the NSF (SES-0099025). Xavier Gabaix: MIT, 50 Memorial Drive, Cambridge, MA, 02142, xgabaix@mit.edu. David Laibson: Harvard University, Department of Economics, Cambridge, MA, 02138, dlaibson@arrow.fas.harvard.edu.

informational shrouding flourishes even in highly competitive markets, even in markets with costless advertising, and even when the shrouding generates allocational inefficiencies.

JEL classification: D00, D60, D80, L00.

Keywords: behavioral economics, bounded rationality, consumer protection, information suppression, myopia, shrouded attributes.

1 Introduction

If some consumers are imperfectly rational, firms might try to exploit their biases. In some markets, competitive pressure may solve the problem. A competitor firm could explain the exploitation scheme to biased consumers and gain their patronage. In this paper, we identify environments in which firms have an incentive to debias consumers. We also identify conditions under which a “curse of debiasing” occurs, whereby no firm chooses to compete with a debiasing strategy.

We specifically study markets in which firms choose to hide information from consumers. For example, banks prominently advertise the virtues of their accounts, but the marketing materials do not highlight the costs of such an account which include ATM usage fees, bounced check fees, minimum balance fees, etc. Banks could compete on these costs, but they instead choose to shroud them. Indeed, many bank customers do not learn the details of the fee structure until long after they have opened their accounts.

Cruickshank (2000) reports results of a UK Treasury survey that investigates the origins of high fees in the UK banking sector. Half of the respondents report having no information about the fees for common financial services at their own bank.¹ The report concludes that “In the markets to supply banking services to personal customers [...] few consumers are aware of the terms and conditions of the products they hold, pointing to significant information problems.”

The printer market operates in a similar way. Printer manufacturers advertise the low price of their inkjet printers, but do not compete on the principal cost of ownership — i.e., patented ink cartridges that cost ten times more than the printer itself over the life of the product. Hall (2003) reports that only 3% of printer owners claim to know the printing cost at the time they buy their printers.

At first glance, shrouding costs seems like a natural marketing strategy. However, equilibrium theory implies that shrouded fees actually hurt the bank or printer manufacturer. Any information that is hidden in the fine print — or excluded from marketing materials altogether — is not likely to be favorable to consumers. Rational consumers will anticipate that hidden prices are likely to be high prices. Such reasoning creates an incentive for information revelation and unravelling of

¹ Respondents were asked “How accurately do you feel you know the charge for services on your account?” Response categories included: “Exactly,” “Roughly,” “Not at all,” and “Did not apply.” About half of respondents choose “Not at all.”

shrouding. Indeed, all firms choose to unshroud their prices in equilibria with rational consumers.

We show that shrouding behavior will arise if “myopic” consumers incompletely analyze the future game tree. Some economists believe that such shrouding can not survive (Shapiro 1995), arguing that competitive firms should educate other firms’ customers, offer those customers efficient pricing schemes, and consequently win their business. In contrast, we show that the existence of myopic consumers creates equilibrium shrouding that is immune to such competitive pressure.

We derive conditions under which competitive price cutting and educational advertising will *not* occur in equilibrium. We show that debiased consumers prefer to give their business to firms with *high* shrouded prices because these sophisticated consumers end up with a cross-subsidy from myopic customers (cf DellaVigna and Malmendier 2003, 2004).²

To develop intuition for our results, consider a hotel room that costs the hotel \$100 to supply. When a myopic guest checks in, the guest purchases add-ons that cost the hotel \$10 to supply (e.g., parking, meals, minibar, phone, gift shop items). Suppose that those add-ons have a 200% markup, so the hotel charges \$30 for the add-ons and makes a \$20 profit. In a competitive market, the hotel will then rent the room for \$80; in competitive equilibrium, total costs (\$100+\$10) equal total revenues (\$80+\$30).

Now consider a nearly identical “educated” customer, who anticipates all of the marked up add-ons and therefore avoids buying them (e.g., she eats before arriving at the hotel, she brings a cell phone instead of relying on the hotel phone, etc.). The educated consumer substitutes away from the add-ons while reaping the benefits of the loss-leader room charge. Our paper identifies conditions under which educated consumers will not want to leave the firm with high markups, even when competitors are offering marginal-cost pricing. It’s often better to pay \$80 for a hotel room and skip a few overpriced add-ons, than to pay \$100 for the same hotel room and get add-ons priced at marginal cost.³

In essence, we show that there are two kinds of exploitation. Sophisticated firms exploit myopic consumers. In turn, sophisticated consumers take advantage of these exploitative firms. In equilibrium, nobody has an incentive to deviate except the myopic consumers. But the myopes

²DellaVigna and Malmendier (2003, 2004) study cross-subsidies that arise from self-control problems. Naive consumers who don’t recognize their self-control problems cross-subsidize sophisticated consumers who do.

³Of course, the hotel would like to screen out such sophisticated consumers, but this may not be possible.

do not know any better and often nobody has an incentive to show them the error of their ways. Educating a myopic consumer turns him into a (less profitable) sophisticated consumer who prefers to go to firms with loss-leader base good pricing and high-priced (but avoidable) add-ons.

This mechanism applies to a wide range of markets. An educated banking customer gets the benefit of a \$50 gift for opening an account and avoids paying some of the fees that snare myopic consumers. An educated credit card holder gets convenience, float, and miles and avoids paying interest charges and late payment fees. An educated home printer buyer gets a loss-leader price and avoids paying for frequent cartridge replacements (by printing in black and white instead of color, printing in draft mode, or printing fewer large jobs at home).⁴ In such markets educated consumers prefer to stick with the firms that feature high add-on prices, since these firms have loss-leader base-good prices, and the educated consumer can partially substitute away from the overpriced add-ons.

Our analysis shows why high add-on markups will persist in markets with numerous competitors and *free* advertising. This prediction distinguishes our model from standard search models, which imply that firms have an incentive to disseminate information about their products and choose not to do so only if such dissemination is costly (e.g., Butters 1977, Salop and Stiglitz 1977, Stahl 1989).⁵ We identify conditions under which firms will choose *not* to advertise and hence *not* compete by lowering add-on prices, even when advertising is free. This explains why industries with nearly costless marginal information dissemination still shroud their add-on prices.⁶ In a search model with only rational consumers, firms will choose to disclose all of their information if they can do so costlessly. In our model, with enough myopic consumers, shrouding is the more profitable strategy.

The rest of this paper formalizes our claims. Section 2 defines a shrouded attribute and presents an equilibrium analysis of a market with discrete demand for add-ons. Section 3 discusses extensions, including the general case with continuous demand for add-ons. Section 4 concludes. All proofs are presented in appendices.

⁴A sophisticated consumer could also purchase the add-on from a third party, at some transaction cost. This is why base-good firms often hinder such third party transactions. See Salop (1993) and Hall (2003) for examples.

⁵This can be viewed as the key difference between modelling bounded rationality as search costs (e.g., Salop and Stiglitz 1977) and modelling it directly as failure to anticipate an attribute as in our model. In the search cost approach, if firms can costlessly educate the consumers, they will do so because consumers are Bayesian. If a firm goes out of its way to sustain high search costs, Salop and Stiglitz consumers will rationally infer that it has something to hide. So, if advertising costs are low, all firms reveal information to consumers.

⁶Try finding the operating cost of a personal inkjet printer on the web site of a printer manufacturer.

1.1 Literature Review

A recent literature argues that consumers' psychological biases explain a variety of puzzling market outcomes. DellaVigna and Malmendier (2003), Oster and Morton (2004), and Shui and Ausubel (2004) apply quasi-hyperbolic discounting to respectively study gym contracts, magazine subscriptions, and credit card accounts. Heidhues and Koszegi (2004) and Koszegi and Rabin (2004) apply loss aversion to study bait and switch marketing. Gabaix, Laibson and Li (2004), Jin and Leslie (2003) and Spiegel (2004) apply boundedly rational heuristics to study how market equilibria exploit noise in consumer product evaluations. Glaeser (2005) studies the supply of ideology by political entrepreneurs. Mullainathan and Shleifer (2004) study market incentives to slant news. Finally, the marketing literature (e.g., Bertrand et al. 2004, Morwitz, Greenleaf and Johnson 1998, Wertebroch 1998) shows how frame manipulations affect consumer demand. When behavioral biases affect consumer choice, one would like to know whether firms have an incentive to recruit new customers by educating and debiasing other firms' customers.

Several lines of research show that consumers pay more attention to up-front costs than to delayed costs. Hausman (1979) and Hausman and Joskow (1982) report that consumers put more weight on the store price of an appliance than on the electricity cost during the life of the product. Barber, Odean and Zheng (2005) show that mutual fund investors are more sensitive to front-end loads than to ongoing management fees. Ellison and Ellison (2004) find that price obfuscation is prevalent on the Internet. Hossain and Morgan (2004, 2005) find that consumers pay more attention to direct costs than to shipping charges, and more generally find field evidence for shrouded attributes. Other authors have argued that smarter consumers get better prices in the marketplace. For example, Woodward (2003) finds that less educated consumers pay more in the mortgage market controlling for default risk.

A long intellectual tradition argues that competition will prevent biases from affecting the market equilibrium. For instance, Becker (1957) works out conditions under which competition will drive out employment discrimination by firms.⁷ Our paper asks whether competitive pressure will prevent shrouding and high mark-ups in the market for add-ons.

Many authors have developed rational actor models that explain why add-ons have relatively

⁷Cf. Laibson and Yariv (2004).

high markups, though none of these models explain why firms gratuitously shroud those add-on markets.⁸ Ellison (2005) provides an excellent review of this literature. Here we review the main findings. Three types of explanations for high mark-ups figure prominently in the literature: high exogenous search costs, inability to commit, and price discrimination. We highlight the difference between these models and our model of consumer myopia.

Search-cost models imply that firms choose high add-on prices because it is exogenously costly for consumers to observe add-on prices before they buy the base good (Diamond 1971, Lal and Matutes 1994, Stahl 1989, Hortacsu and Syverson 2004). In such search models, an inexpensive communication technology eliminates equilibrium market power and markups.⁹ However, in our model, the existence of free advertising does not diminish market power since firms individually prefer to shroud information about the add-on market. Our model generates *voluntary* information suppression.

In the modern economy, information dissemination costs are sometimes quite low, implying that gratuitous shrouding is needed to explain why many firms make it difficult to observe the prices of their add-ons. For example, the printing cost of personal HP deskjet printers is not easily accessible on the Hewlett-Packard web site. From each printer's homepage, one must follow a large number of links to uncover the cost of printing, which is ten times greater than the cost of the printer itself. Such shrouding does not reflect exogenous information diffusion costs. The information about printing costs is further away from the printer homepage¹⁰ than any other information about the printer.

The literature on commitment shows that firms will choose high add-on prices if firms cannot commit to add-on prices at the time the base good is sold. This theory was introduced in Klemperer's (1987) work on switching costs (see the survey by Farrell and Klemperer, 2005) and extended by Borenstein *et al.* (1995). When firms cannot commit to add-on prices, firms set add-on prices above marginal cost (and rational consumers will anticipate this). Difficulties of

⁸Ayres and Nalebuff (2003) propose that high add-on prices are partially due to *suboptimal* choices on the part of firms. In their view, firms would make more profits if they had low add-on prices and consequently developed a good corporate reputation.

⁹If firms can costlessly unshroud their attributes and consumers are Bayesian, then firms will be forced to eliminate gratuitous search costs in equilibrium. A rational consumer would expect the worst of a firm that engages in gratuitous shrouding.

¹⁰We measure distance using the click metric.

commitment may be relevant in some cases, such as the Kodak antitrust case (Klein 1993). In our analysis however, we consider the polar case in which firms can commit to an add-on price (e.g., in our setting, printer manufacturers can freely and credibly preannounce the price of their printer cartridges).

Price-discrimination models imply that add-on pricing enables firms to charge high demand consumers relatively more than low demand consumers (Ellison 2005). In Ellison’s model, exogenous search costs make it costly for consumers to observe add-on prices. Add-on pricing raises profits because add-on pricing generates a technology for price discrimination. Ellison points out that add-on pricing will not raise profits when advertising is inexpensive (i.e., when search costs are exogenously small, see Stole (2005)). Ellison’s analysis motivated our own study, particularly his concluding conjecture that the persistence of shrouding might be explained if advertising is costly or if consumers are boundedly rational. We develop a model with the latter microfoundation.

Finally, we emphasize that our model explains both high add-on prices and gratuitous information shrouding. Pre-existing models can explain high add-on prices, but none of them predict voluntary shrouding.

2 Shrouded Attributes: Definitions and a Model

We analyze a market in which firms can shroud attributes of their products. These shrouded attributes are not taken into consideration by some potential customers. For example, a bank might suppress information about minimum balance fees in the bank’s marketing materials. Some consumers will neglect to consider such minimum balance fees when picking a bank. For the purposes of our model, a shrouded attribute is a product attribute that is hidden by a firm, even though the attribute could be nearly costlessly revealed.¹¹ The Hewlett-Packard decision to omit the deskjet price per page on their web site is an example of such information suppression.

Shrouded attributes may include surcharges, fees, penalties, accessories, options, or any other hidden feature of the ongoing relationship between a consumer and a firm. We divide this list into two mutually exclusive categories: (avoidable) *add-ons* and (unavoidable) *surcharges*.

¹¹More generally, communication costs need to be low enough so that unshrouding would occur in an equilibrium with rational consumers.

The analysis in this paper primarily discusses add-ons, the first type of shrouded attribute. Add-ons are complementary goods that consumers have the option to avoid. For example, hotel guests can avoid paying telephone charges if they instead use cell phones. Likewise, hotel guests can avoid paying for room service meals by finding local restaurants. Both hotel phone use and hotel room service complement a hotel stay. Such complementary (voluntary) goods are referred to as *add-ons*.

In our modeling, we distinguish between a “base good” and the shrouded attribute. In the preceding example, the base good is a hotel room and the shrouded attributes are hotel services. We assume that myopic consumers pick a base good without considering shrouded attributes.¹²

2.1 Timeline and overview of (discrete demand) shrouding game

We now discuss a model with discrete demand for the add-on. We postpone the general case — i.e., continuous demand — to section 3.2. We start by providing an overview of the timing of the discrete demand game. We discuss the details of the game after the timeline.

Period 0:

- *Firms* decide to make information about the add-on *shrouded* or *unshrouded*. This is a binary choice. Unshrouding a price is equivalent to advertising that price. To make unshrouding/advertising maximally attractive to the firm, we assume that unshrouding is free.¹³
- *Firms* pick prices for a base good (p) and an add-on (\hat{p}).

Period 1:

- *Sophisticated* consumers (fraction α of the population) always take the add-on and its price into consideration. If information about the add-on is shrouded, sophisticates form Bayesian posteriors about the unobserved add-on.
- *Myopic* consumers (fraction $1 - \alpha$ of the population) only consider the add-on if they directly observe the add-on information. When the add-on is shrouded, myopes do not observe the

¹²A consumer can compare prices of closely located four star hotels on a web travel site (e.g., Orbitz), without observing the hotels’ add-on pricing schedules. See Ayres and Nalebuff (2003).

¹³We revisit this assumption in subsection 3.3.

add-on information. When the add-on is unshrouded, fraction $\lambda \in (0, 1]$ of myopes observes the add-on information.

- Consumers choose a firm.
- Consumers can initiate costly behavior (effort cost e) that enables them to substitute away from future use of the add-on.

Period 2:

- Consumers observe the add-on price (if they haven't observed it already) and are given an opportunity to purchase the add-on. Consumers who previously engaged in costly substitution behavior have a lower incentive to purchase the add-on.

2.2 Details of the shrouding game

To motivate the model, we will discuss the example of a bank, but the model applies to any setting in which firms offer add-ons to their customers.

2.2.1 Period 0

In period 0, banks set and potentially shroud prices. Let p represent the price of a base good, which in our example is the price of opening a bank account. Let \hat{p} represent the price of an add-on. In our example, violating the minimum balance is an add-on service with price \hat{p} .¹⁴ Both p and \hat{p} are chosen by each bank in period 0. Without loss of generality, we assume that banks have zero marginal cost of opening an account or of having an account-holder violate the minimum balance threshold.

Each bank may shroud or unshroud its minimum balance fee. If the bank chooses to shroud \hat{p} , the minimum balance fee will not be seen by potential consumers. For example, \hat{p} may be hidden in fine print or published in an obscure location. One can think of this action as creating a gratuitous search cost that is large enough so that few consumers bother to see the add-on price.

¹⁴In US banks, a typical minimum balance fee is \$10 and applies in months when an account balance falls below some minimum that is strictly greater than zero. A minimum balance fee is distinct from an overdraft fee, a bounced-check fee, or an insufficient funds fee. Those fees apply to cases in which customers would like to use funds that they don't have in their accounts. Naturally, the model discussed here applies to those fees as well.

Without loss of generality, we assume that shrouding implies that no consumer observes the add-on price.

The bank may alternatively costlessly advertise \hat{p} , thereby revealing it to *all* sophisticated consumers and to λ fraction of myopic consumers, with $0 < \lambda \leq 1$. Without loss of generality we assume that λ is fixed. We allow λ to be weakly less than unity to reflect the possibility that myopes — who may not initially recognize the value of information about the add-on market — may overlook that information even when it is made available. We define *informed myopes* as the myopes that have seen (and noted) unshrouded information about the add-on. Informed myopes behave exactly like sophisticated consumers. Analogously, we define *uninformed myopes* as those myopes that have not seen information about the add-on. Hence, when information is unshrouded by one or more firms, a fraction λ of myopes is informed — and therefore become sophisticated — and a fraction $1 - \lambda$ of myopes is uninformed. Hence unshrouding by any firm increases the sophistication of the pool of potential customers shared by all firms.¹⁵

2.2.2 Period 1

Consumers pick a firm from which to buy the base good. *Sophisticates* always take the existence of the add-on into consideration, forming Bayesian posteriors about the add-on when its price is shrouded. *Myopes* only consider the add-on if it is revealed to them.

For a consumer, taking account of the add-on generates two sources of value. First, a consumer can consider add-on pricing when choosing a firm. Second, a consumer who anticipates or observes high add-on prices can exert costly effort $e > 0$ in period 1 and thereby substitute away from the add-on. For example, a consumer who faces a high minimum balance fee could transfer balances into the account or cut back withdrawals so that the fee is less likely to be invoked.

We assume that add-on fee \hat{p} is effectively bounded above by $\bar{p} > e$. For example, if a customer is forced to pay a high fee, the customer might terminate her relationship with the bank or lodge a complaint. Legal and regulatory constraints also limit the penalties/fees that banks can charge. Finally, \bar{p} could represent the cost of a last minute consumer intervention that enables the consumer to avoid purchasing the add-on.

¹⁵ Assuming that the impact of advertising is more local would not change our results.

We assume that sophisticates and *informed* myopes are aware of the add-on fee. Hence, sophisticates and informed myopes will exert substitution effort e if $e < E\hat{p}$.¹⁶

Let x_i represent the *anticipated* net surplus from opening an account at bank i less the anticipated net surplus from opening an account at the best alternative bank (ignoring idiosyncratic taste differences). Throughout the paper we use starred variables to represent the (symmetric) prices set by other firms. We analyze symmetric equilibria in this paper.

For sophisticated consumers,

$$x_i = [-p_i - \min\{E\hat{p}, e\}] - [-p^* - \min\{E\hat{p}^*, e\}],$$

where $E\hat{p}$ and $E\hat{p}^*$ are rational expectations. When the add-on information is unshrouded, expectations are equal to the true value of the add-on price. When the add-on information is shrouded, sophisticated consumers solve the Bayesian equilibrium to calculate $E\hat{p}$ and $E\hat{p}^*$.

Myopic consumers fall into two classes. When add-on prices are unshrouded, a fraction λ of myopes becomes *informed*. These informed myopes behave just like sophisticates with $E\hat{p} = \hat{p}$. A myope that was educated by firm i becomes sophisticated in his behavior vis-a-vis all firms. However, even when add-on information is unshrouded, a fraction $1 - \lambda$ of myopes remains *uninformed*. When add-on information is shrouded, all myopes are uninformed.

For uninformed myopes,

$$x_i = -p_i + p^*.$$

Uninformed myopes neglect the add-on when deciding where to open their bank account. Likewise, uninformed myopic consumers do not consider exerting substitution effort e in period 1.

Let $D(x_i)$ represent the probability that a consumer opens an account at bank i . Recall that x_i represents the *average anticipated* net surplus from opening an account at bank i less the *average anticipated* net surplus from opening an account at the best alternative bank. The demand function D is strictly increasing, bounded below by zero, and bounded above by one. Appendix A presents a microfoundation of the demand function.

¹⁶We assume local risk neutrality throughout the paper.

2.2.3 Period 2

Consumers observe the add-on price (if they haven't observed it already) and are given an opportunity to purchase the add-on. Consumers who have engaged in substitution in period 1 do not purchase the add-on. All other consumers purchase the add-on at price \hat{p} .¹⁷

2.3 Symmetric equilibrium

We now characterize the symmetric Bayesian equilibrium in this game. Let α represent the share of sophisticated consumers in the marketplace. The following proposition shows that firms will choose high markups in the add-on market. In the Shrouded Prices Equilibrium, firms will choose markups that are so high that the sophisticated consumers substitute out of the add-on market.

Proposition 1 *Let*

$$\alpha^\dagger \equiv 1 - e/\bar{p} \tag{1}$$

and

$$\mu = D(0) / D'(0). \tag{2}$$

If $\alpha < \alpha^\dagger$, there exists a symmetric equilibrium in which firms shroud the add-on price. Call this the Shrouded Prices Equilibrium. The prices of the base good and the add-on are respectively:

$$p = -(1 - \alpha)\bar{p} + \mu \tag{3}$$

$$\hat{p} = \bar{p}. \tag{4}$$

In this equilibrium only myopes purchase the add-on. The allocation is inefficient since sophisticates substitute away from the add-on.

If $\alpha > \alpha^\dagger$, there exists a symmetric equilibrium in which firms do not shroud the add-on price. Call

¹⁷Alternatively, we could assume that uninformed myopes buy the add-on in period 2 *without* observing the price: i.e., the myopes believe that the unobserved add-on price is low enough to justify the purchase.

this the *Unshrouded Prices Equilibrium*. The prices of the base good and the add-on are respectively:

$$p = -e + \mu \tag{5}$$

$$\hat{p} = e. \tag{6}$$

In this equilibrium all consumers purchase the add-on, so the equilibrium is efficient.

In each of these equilibria, the beliefs of consumers are $\hat{p} = \bar{p}$ for the add-on price at firms that shroud.

Proof: Appendix B.

Proposition 1 characterizes a Shrouded Prices Equilibrium¹⁸ in which firms choose inefficiently high markups in the add-on market and choose to *shroud* those add-on prices.¹⁹ In the Shrouded Prices Equilibrium, firms set $\hat{p}^* = \bar{p}$, though the marginal cost of producing the add-on is 0. This equilibrium is inefficient since the sophisticates pay effort cost e to substitute away from add-on consumption (see subsection 2.4 below).

Our model reproduces the well-known IO result that high markups for the add-on are offset by low or negative markups on the base good.²⁰ This is easiest to see when the market is approximately competitive (i.e., the demand curve is highly elastic, and hence μ is close to zero). In a relatively competitive market with small μ , the base good is always a loss leader with a negative markup: $p^* \approx -(1 - \alpha)\bar{p} < 0$ or $p^* \approx -e < 0$. The model implies that the add-on will be the “profit-center” and the base good will be the “loss leader.”²¹

Our model also predicts equilibrium shrouding, which is *not* predicted in the pre-existing IO literature. Indeed, previous authors have conjectured that the availability of inexpensive advertising would drive down after-market prices and eliminate shrouding. For example, Shapiro

¹⁸Proposition 1 characterizes some but not all of the symmetric equilibria. When λ is large enough another equilibrium exists. Specifically, when $\alpha < \alpha^\dagger < \alpha + \lambda(1 - \alpha)$, the Shrouded Prices and Unshrouded Prices Equilibria both exist. It is easy to see that if $\alpha + \lambda(1 - \alpha) < \alpha^\dagger$ and there is a small cost of unshrouding, then the Shrouded Prices Equilibrium is the unique symmetric equilibrium.

¹⁹For empirical applications, we reexpress Proposition 1 in the case where the marginal costs c and $\hat{c} \leq e$ are not zero. In this case, if $\alpha < \alpha^\dagger$, $p = c - (1 - \alpha)(\bar{p} - \hat{c}) + \mu$, and if $\alpha > \alpha^\dagger$, $p = c + \hat{c} - e + \mu$. The value of \hat{p} does not change.

²⁰See the literature review in the present paper and in Ellison 2005.

²¹In many seemingly competitive markets the price of the base good is typically set below its marginal cost (e.g., printer, hotel, car rental, financial services), while the price of the add-on is set well above its marginal cost (printer cartridge, hotel phone call, gas charge, minimum balance fee).

(1995) describes the inefficiency caused by high markups in the aftermarket and then observes that competition and advertising should drive them away.

Furthermore, manufacturers in a competitive equipment market have incentives to avoid even this inefficiency by providing information to consumers. A manufacturer could capture profits by raising its [base-good] prices above market levels (i.e., closer to cost), lowering its aftermarket prices below market levels (i.e., closer to cost), and informing buyers that its overall systems price is at or below market. In this fashion, the manufacturer could eliminate some or all of the deadweight loss, attract consumers by offering a lower total cost of ownership, and still capture as profits some of the eliminated deadweight loss. In other words, and unlike traditional monopoly power, the manufacturers have a direct incentive to eliminate even the small inefficiency caused by poor consumer information (Shapiro 1995, p. 495).

In the Shrouded Prices Equilibrium, Shapiro’s intuition fails to apply. In general, high markups in the aftermarket do *not* go away as a result of competition or advertising.

Why doesn’t Shapiro’s advertising argument apply? Shapiro conjectures that firms will compete by advertising low add-on prices, thereby attracting consumers by highlighting the benefits of efficiently priced add-ons.

However, Proposition 1 shows that this competitive effect is overturned by a “pooling” effect. Educated consumers would rather pool with uninformed myopes at firms with *high* add-on prices than defect to firms with marginal cost pricing of both the base good and the add-on.

Again consider the illustrative case in which the firm has no market power, so $\mu = 0$. If a sophisticated consumer gives her business to a firm with shrouded market prices, the sophisticated consumer’s surplus will be:

$$\begin{aligned}
 \text{sophisticated surplus} &= -p - e \\
 &= (1 - \alpha)\bar{p} - e \\
 &> (1 - \alpha)\bar{p} - (1 - \alpha)\bar{p} \\
 &= 0.
 \end{aligned}$$

By contrast, if the sophisticated consumer gives her business to a firm with zero markups on both the base good and the add-on, the sophisticate’s surplus will be exactly 0.²² So the sophisticated/educated consumer is strictly better off pooling at the firm with shrouded prices (and high add-on markups), than deviating to the firm with marginal cost pricing.

This preference for pooling reflects the fact that the sophisticated consumers are cross-subsidized by the uninformed myopic consumers. Educating uninformed myopes enables them to get more value out of their relationships with *high* markup firms. After education, myopes anticipate the high add-on prices, and hence substitute away from add-ons while still enjoying loss leader prices on the base good. The newly educated consumers benefit from the “free gifts” and avoid the high fees.

This generates the curse of debiasing. A firm does not want to debias uninformed myopic consumers. Informed consumers (i.e., sophisticates) are not profitable to any firm. Specifically, sophisticates prefer to patronize — and in particular, exploit — firms that offer loss-leader prices on base-goods.

In summary, the presence of uninformed myopic consumers incentivizes firms to adopt pricing schedules that have the unintended consequence of cross-subsidizing sophisticates. Making more myopes sophisticated will not help any firm. Because of this curse of debiasing, no firm has an incentive to educate myopes, even when education is costless.

2.4 Welfare

We now provide a welfare analysis of the Shrouded Price Equilibrium and highlight the inefficiency of this equilibrium.

Proposition 2 *In the Shrouded Prices Equilibrium, the social welfare loss is $\Lambda = \alpha e$. Sophisticated consumers are $\bar{p} - e$ units better off than myopic consumers. In the Unshrouded Prices Equilibrium, there is no inefficiency and all consumers are equally well-off.*

Proof. The social welfare loss is proportional (with factor e) to the fraction of agents that exerts costly effort e to avoid consuming the add-on. Recall that the firms can produce the add-on at 0

²²The particular value of a 0 surplus depends on the choice of normalization. If we shift all utilities by a factor V , the surplus will be V .

marginal cost. In the Shrouded Prices Equilibrium, all of the sophisticated agents exert effort e , so the deadweight loss is αe . Also, as sophisticates pay e to avoid buying the add-on, and myopes pay \bar{p} , sophisticates are $\bar{p} - e$ better off than myopes.

In the Unshrouded Prices Equilibrium, no consumers exert costly effort, and all purchase the add-on, which is produced at 0 marginal cost. There is no efficiency loss. ■

Since the add-on can be produced at zero *social* cost,²³ it is socially efficient for the add-on to be consumed. If a consumer substitutes away from the add-on (at effort cost e), then an equilibrium is socially inefficient. In the case with inefficiency ($\alpha < \alpha^\dagger$), the welfare losses increase as the fraction of sophisticates increases; in this case sophisticates do not consume the (high-priced) add-on.

3 Extensions

In this section we discuss several extensions of the model. First, we discuss the case in which myopes learn to become sophisticates. Second, we analyze the case of continuous demand for the add-on. Finally, we discuss a series of additional considerations that influence the persistence of shrouding.

3.1 Learning

In some markets, myopes eventually learn the high price of the add-on, thereby becoming sophisticates. We present an extension that reflects this learning process and demonstrate how learning affects equilibrium pricing.

We adopt the same timing as before, but now we assume that the decision about add-on consumption is repeated. Specifically, after choosing a firm from which to buy the base-good, sophisticates face the add-on purchase decision T_S times. For each decision, sophisticates decide whether to pay avoidance cost e or buy the add-on for price \hat{p} . Informed myopes act just like sophisticates. Uninformed myopes buy the add-on T_{MM} times. They then become sophisticates and make sophisticated choices T_{MS} times.²⁴ Our original model corresponds to $T_S = T_{MM} = 1$

²³This assumption is made without loss of generality.

²⁴In some cases it may be natural to assume $T_S = T_{MM} + T_{MS}$, but we do not make this assumption here, the Shrouded Prices Equilibrium does not depend on it.

and $T_{MS} = 0$.²⁵ We assume that firms choose their shrouding policies and prices once and for all and do not change them during the game.

The following Proposition shows that there is a Shrouded Prices Equilibrium if the fraction of sophisticates α is low.

Proposition 3 *Let*

$$\alpha^{\dagger\dagger} \equiv 1 - \frac{e \max(T_S, T_{MM} + T_{MS})}{\bar{p} T_{MM}}.$$

If $\alpha < \alpha^{\dagger\dagger}$, then there exists a symmetric equilibrium in which firms shroud the add-on pricing. Call this the Shrouded Prices Equilibrium:

$$\begin{aligned} p &= -(1 - \alpha)\bar{p}T_{MM} + \mu \\ \hat{p} &= \bar{p}. \end{aligned}$$

In this equilibrium the myopes purchase the add-on until they become sophisticates. The allocation is socially inefficient since sophisticates substitute away from the add-on. The beliefs of consumers are $\hat{p} = \bar{p}$ for the add-on price at firms that shroud.

The myopia model predicts that consumers will eventually learn to avoid add-on fees. Agarwal *et al.* (2005) empirically evaluate these dynamics, confirming the prediction that add-on fees in banks decline with customer tenure. This learning pattern is inconsistent with the predictions of a classical price discrimination model of add-on pricing.

Our analysis raises the question of long-run dynamics. If consumers learn to avoid add-on fees, does shrouding eventually vanish along with high add-on prices? Several countervailing forces may sustain shrouding in the long-run. First, new generations of myopic consumers enter the market. Second, sophistication is sometimes overturned by forgetting or distraction, particularly when the absolute costs of the add-on are small. Third, and most importantly, new shrouding techniques endogenously evolve. For example, the emphasis on fee-based revenue in the banking sector is a recent development (Rogers and Sinkey, 1999)

We believe that fees for specific add-ons have a lifecycle. When the add-on is new it tends to be shrouded and priced above marginal cost. Over time, shrouding decreases and the add-on

²⁵See Miao (2005) for another analysis.

price falls. Using our notation, the fraction α of sophisticates increases over time and shrouding eventually disappears.²⁶

3.2 Continuous add-on demand

In this section, we generalize the model to the case of continuous demand for the add-on. We show that equilibrium shrouding survives only when sophisticates have relatively inexpensive substitutes for the add-on. The structure and timing of the game in this section mirrors the details of the original game except for the extensions enumerated below.

Total consumer utility is decomposed into two parts: the value of owning the base good and the cost of purchasing — or substituting away from — the add-on. Let u_{ai} represent agent a 's value of firm i 's *base good*, overlooking the add-on.²⁷ Let $\hat{u}(\hat{e}_{ai}, \hat{q}_{ai}) - \hat{p}_i \hat{q}_{ai}$ represent the costs associated with the add-on, reflecting both the add-on quantity \hat{q}_{ai} and any costly efforts \hat{e}_{ai} to substitute away from the add-on. The leading case is $\partial^2 \hat{u}(\hat{e}_{ai}, \hat{q}_{ai}) / \partial \hat{e}_{ai} \partial \hat{q}_{ai} \leq 0$. The net value of buying the base good can be written

$$\underbrace{u_{ai} - p_i}_{\text{base good utility}} + \underbrace{\hat{u}(\hat{e}_{ai}, \hat{q}_{ai}) - \hat{p}_i \hat{q}_{ai}}_{\text{add-on utility}}.$$

In period 1, sophisticated consumer a picks a firm i and substitution effort \hat{e}_{ai} to maximize

$$U_{ai} = \max_{\hat{e}_{ai}} E \left\{ u_{ai} - p_i + \max_{\hat{q}_{ai}} [\hat{u}(\hat{e}_{ai}, \hat{q}_{ai}) - \hat{p}_i \hat{q}_{ai}] \right\}.$$

In period 2, sophisticates pick \hat{q}_{ai} to maximize $\hat{u}(\hat{e}_{ai}, \hat{q}_{ai}) - \hat{p}_i \hat{q}_{ai}$. We call $\hat{u}^S(\hat{p}_i) = \hat{u}(\hat{e}_{ai}, \hat{q}_{ai})$ the corresponding indirect utility for the rational expectations case in which $\hat{p}_i = E\hat{p}_i$.²⁸

Informed myopes behave just like sophisticates, since informed myopes observe the add-on information in period 1.

In contrast, uninformed myopes do not take account of the add-on when they pick a firm i . In

²⁶We thank Douglas Bernheim for suggesting these lifecycle dynamics.

²⁷For example u_{ai} could represent the value of the base good assuming a zero price for the add-on.

²⁸ $\hat{u}^S(\hat{p}_i) = \hat{u}(\hat{e}_{ai}, \hat{q}_{ai}) = \hat{u}(\hat{e}_{ai}(E\hat{p}_i), \hat{q}_{ai}(\hat{e}_{ai}(E\hat{p}_i), \hat{p}_i)) = \hat{u}(\hat{e}_{ai}(\hat{p}_i), \hat{q}_{ai}(\hat{e}_{ai}(\hat{p}_i), \hat{p}_i))$.

period 1, uninformed myopes pick a firm i to maximize

$$E \{u_{ai} - p_i + \text{Constant}\}.$$

Uninformed myopes passively choose a default level of substitution effort in period 1 \widehat{e}_{ai}^M which is not responsive to shrouded variation in \widehat{p}_i . In period 2, uninformed myopes pick \widehat{q}_{ai} to maximize $\widehat{u}(\widehat{e}_{ai}^M, \widehat{q}_{ai}) - \widehat{p}_i \widehat{q}_{ai}$.

We call c the the marginal cost of the base good and \widehat{c} the marginal cost of manufacturing the add-on. Let $\widehat{q}^S(\widehat{p})$ represent the equilibrium add-on demand of a sophisticate who knows she will face a price \widehat{p} . Let $\widehat{q}^M(\widehat{p})$ represent the equilibrium add-on demand of an uninformed myopic who initially overlooks add-on prices because they are shrouded. We define the average demand in the add-on market

$$\widehat{q}(\widehat{p}) \equiv \alpha \widehat{q}^S(\widehat{p}) + (1 - \alpha) \widehat{q}^M(\widehat{p}), \quad (7)$$

and we assume that there is a unique monopoly price in the add-on market, given by

$$\widehat{p}^m = \arg \max_{\widehat{p}} \left((\widehat{p} - \widehat{c}) \widehat{q}(\widehat{p}) \right). \quad (8)$$

Now we characterize symmetric equilibria.

Proposition 4 *Suppose that unshrouding makes all consumers sophisticated ($\lambda = 1$). The price vector*

$$p = c - (\widehat{p} - \widehat{c}) \widehat{q}(\widehat{p}) + \mu \quad (9)$$

$$\widehat{p} = \widehat{p}^m \quad (10)$$

supports a Shrouded Prices Equilibrium if and only if $B \geq 1$, where B is the debiasing ratio:

$$B = \frac{\text{cross-subsidy to sophisticates from myopes}}{\text{loss of social surplus (for sophisticate demand) due to add-on mark-up}} \quad (11)$$

$$= \frac{(1 - \alpha) (\widehat{p}^m - \widehat{c}) (\widehat{q}^M(\widehat{p}^m) - \widehat{q}^S(\widehat{p}^m))}{[\widehat{u}^S(\widehat{c}) - \widehat{c} \widehat{q}^S(\widehat{c})] - [\widehat{u}^S(\widehat{p}^m) - \widehat{c} \widehat{q}^S(\widehat{p}^m)]} \quad (12)$$

The beliefs of consumers are $\hat{p} = \hat{p}^m$ for the add-on price at firms that shroud.

The proof is in Appendix B.

This no-advertising result contains a boundary condition that determines when advertising will appear: $B \geq 1$.²⁹ Advertising does not arise when the cross-subsidies to sophisticates are larger than the *social* welfare distortions due to price deviations from marginal cost. An empirical test of this theory would calculate B ratios in different markets, and determine whether markets with high B values tend to be more shrouded.

To heuristically derive the result, consider another ratio that is easier to directly interpret:

$$B' = \frac{\text{loss-leader subsidy in base-good market}}{\text{loss of consumer surplus (for sophisticate demand) due to add-on mark-up}}. \quad (13)$$

A sophisticate at a shrouded firm will not defect to a marginal cost pricing firm if the loss-leader subsidy in the base-good market exceeds the *consumer* welfare gain from switching to marginal cost pricing in the add-on market (i.e., $B' \geq 1$). Since aftermarket profit generates loss-leader competition in the base-good market, the loss-leader base-good subsidy is $(\hat{p}^m - \hat{c}) [\alpha \hat{q}^S(\hat{p}^m) + (1 - \alpha) \hat{q}^M(\hat{p}^m)]$, which is the average profit per customer in the add-on market. The denominator of B' is the sophisticates' welfare loss from high mark-ups in the add-on market. At marginal cost pricing ($\hat{p} = \hat{c}$), the sophisticate would realize add-on utility of $\hat{u}^S(\hat{c}) - \hat{c} \hat{q}^S(\hat{c})$, but in the shrouded prices equilibrium the sophisticate pays add-on price \hat{p}^m and realizes a lower add-on utility of $\hat{u}^S(\hat{p}^m) - \hat{p}^m \hat{q}^S(\hat{p}^m)$. Putting these results together, we have,

$$B' = \frac{(\hat{p}^m - \hat{c}) [\alpha \hat{q}^S(\hat{p}^m) + (1 - \alpha) \hat{q}^M(\hat{p}^m)]}{[\hat{u}^S(\hat{c}) - \hat{c} \hat{q}^S(\hat{c})] - [\hat{u}^S(\hat{p}^m) - \hat{p}^m \hat{q}^S(\hat{p}^m)]}.$$

We can recover B (equation 12) by subtracting $(\hat{p}^m - \hat{c}) \hat{q}^S(\hat{p}^m)$ from both the numerator and denominator of B' . Hence $B \geq 1$ iff $B' \geq 1$.

$$B = \frac{(\hat{p}^m - \hat{c}) [\alpha \hat{q}^S(\hat{p}^m) + (1 - \alpha) \hat{q}^M(\hat{p}^m)] - (\hat{p}^m - \hat{c}) \hat{q}^S(\hat{p}^m)}{[\hat{u}^S(\hat{c}) - \hat{c} \hat{q}^S(\hat{c})] - [\hat{u}^S(\hat{p}^m) - \hat{p}^m \hat{q}^S(\hat{p}^m)] - (\hat{p}^m - \hat{c}) \hat{q}^S(\hat{p}^m)}$$

Note that the numerator of B is the (net) cross-subsidy to sophisticates resulting from high add-on

²⁹With the discrete demand model of section 2, the subsidy is $(1 - \alpha) \bar{p}$, the distortion is e , so $B = (1 - \alpha) \bar{p}/e$. Condition $B \geq 1$ is $\alpha \leq \alpha^\dagger$, reproducing the result of Proposition 1.

prices,

$$\underbrace{(\hat{p}^m - \hat{c}) [\alpha \hat{q}^S(\hat{p}^m) + (1 - \alpha) \hat{q}^M(\hat{p}^m)]}_{\text{loss-leader subsidy in base-good market}} - \underbrace{(\hat{p}^m - \hat{c}) \hat{q}^S(\hat{p}^m)}_{\text{funding from sophisticates}}.$$

Simplifying this expression yields the numerator of B :

$$(1 - \alpha) (\hat{p}^m - \hat{c}) (\hat{q}^M(\hat{p}^m) - \hat{q}^S(\hat{p}^m)).$$

This cross-subsidy will be positive iff the following three conditions hold: sophisticates do not represent all of the population ($\alpha < 1$), the monopoly price of the add-on exceeds its marginal cost ($\hat{p}^m - \hat{c} > 0$), and myopes buy more of the add-on than sophisticates ($\hat{q}^M(\hat{p}^m) - \hat{q}^S(\hat{p}^m) > 0$).

The denominator of B represents the social welfare distortion (in the sophisticate case) resulting from the high price of the add-on. At marginal cost pricing ($\hat{p} = \hat{c}$), the sophisticate would realize add-on utility of $\hat{u}^S(\hat{c}) - \hat{c}\hat{q}^S(\hat{c})$, but in the shrouded prices equilibrium the sophisticate's consumer surplus is only $\hat{u}^S(\hat{p}^m) - \hat{p}^m\hat{q}^S(\hat{p}^m)$. However, the firm realizes a surplus of $(\hat{p}^m - \hat{c})\hat{q}^S(\hat{p}^m)$. Hence, the loss of social surplus (for sophisticate demand) due to add-on mark-ups is given by,

$$\underbrace{[\hat{u}^S(\hat{c}) - \hat{c}\hat{q}^S(\hat{c})] - [\hat{u}^S(\hat{p}^m) - \hat{p}^m\hat{q}^S(\hat{p}^m)]}_{\text{loss of consumer surplus due to add-on mark-up}} - \underbrace{(\hat{p}^m - \hat{c})\hat{q}^S(\hat{p}^m)}_{\text{transfer to firm}}.$$

Simplifying this expression yields the denominator for B :

$$[\hat{u}^S(\hat{c}) - \hat{c}\hat{q}^S(\hat{c})] - [\hat{u}^S(\hat{p}^m) - \hat{c}\hat{q}^S(\hat{p}^m)].$$

To further interpret this proposition, consider the case $\mu = 0$, so firms have no market power. For this case a transparent “proof” is available. For simplicity, also assume $c = \hat{c} = 0$, so marginal costs are 0. Now consider the equilibrium payoff of a sophisticated consumer in the shrouded equilibrium:

$$-p + \hat{u}^S(\hat{p}^m) - \hat{p}^m\hat{q}^S(\hat{p}^m).$$

Compare this to the equilibrium payoff of a sophisticated consumer if the consumer has access to a firm with unshrouded marginal cost pricing: $\hat{u}^S(0)$. The shrouded equilibrium is robust if the

payoff with marginal cost pricing is less than the payoff in the shrouded equilibrium:

$$\hat{u}^S(0) \leq -p + \hat{u}^S(\hat{p}^m) - \hat{p}^m \hat{q}^S(\hat{p}^m).$$

Substituting equation (9) implies that this inequality can be reexpressed

$$\hat{u}^S(0) \leq \hat{p}^m \hat{q}(\hat{p}^m) + \hat{u}^S(\hat{p}^m) - \hat{p}^m \hat{q}^S(\hat{p}^m).$$

Recalling that $\hat{q}(\hat{p}^m) = \alpha \hat{q}^S(\hat{p}^m) + (1 - \alpha) \hat{q}^M(\hat{p}^m)$, and rearranging yields

$$\hat{u}^S(0) - \hat{u}^S(\hat{p}^m) \leq (1 - \alpha) \hat{p}^m (\hat{q}^M(\hat{p}^m) - \hat{q}^S(\hat{p}^m)), \quad (14)$$

which is equivalent to the condition in Proposition 4 when $\mu = c = \hat{c} = 0$.

Firms choose to unshroud when the *cross-subsidies* to sophisticates (the right hand side of inequality (14)) are smaller than the *distortions* arising from pricing that deviates from marginal cost (the left hand side). Firms will be able to educate and poach their rivals customers when inequality (14) is not satisfied.

3.3 Other influences on shrouding

To simplify exposition, we have ignored several additional factors that either encourage or undermine shrouding. In this subsection, we quickly discuss these factors.

First, we have so far overlooked the consumer entry decision, since we have assumed that all consumers must buy a base good. When some consumers overlook add-on costs, these myopic consumers may buy the base good when they should *avoid* the market altogether. Think of a consumer who buys a \$50 deskjet printer without realizing that the lifetime operating costs are at least ten times higher.³⁰ Firms that compete by unshrouding high add-on prices will drive some of these myopic consumers out of the base-good market. Hence, consumer entry decisions are adversely affected by unshrouding (Spence 1977, Ellison 2005).

³⁰At the moment, black and white text costs between 2 cents and 15 cents per page, depending on the inkjet printer. Color text costs a bit more than black and white text. A photographic image costs an order of magnitude more. Printing 10 pages per day at 10 cents a page costs \$1460 over four years.

Second, if consumers have heterogeneous tastes and firms have heterogeneous add-ons, firms will advertise to enable consumers to find the base-good with the right add-on. This informative advertising will accelerate unshrouding.

Third, we have so far assumed that once a consumer becomes informed about the costly add-on at *one* firm, that consumer takes account of the costly add-ons at *all* firms. However, it is instead possible that unshrouding by one firm leads consumers only to think about the unshrouded add-on at that single firm. This narrow framing effect would impede unshrouding.

Fourth, if education/advertising is costly, then unshrouding will again be impeded. Specifically, suppose there is a fixed cost C of unshrouding. Then Proposition 4 is adjusted so that a Shrouded Prices Equilibrium exists iff $B \geq 1$, where B is defined as before except the numerator of B is incremented by kC , where $k = 1$ if $\mu = 0$ and k equals the number of firms if μ is very large.³¹ Analogously Proposition 1 is adjusted so that a Shrouded Prices Equilibrium exists iff $(1-\alpha)\bar{p}+kC > e$. This implies that shrouding is more pervasive when the market is less competitive.

Fifth, we have already mentioned that learning will accelerate unshrouding. However, innovation will create new add-ons and new opportunities for shrouding.

Sixth, educational advertising might inform consumers about the general problem of shrouded add-on prices without enabling consumers to avoid the add-ons. For example, an ad might promise, “We offer marginal cost pricing and no hidden fees, unlike our competition.” If such advertising contained enough information to be credible but not enough information so myopes could substitute away from add-ons, then myopes would be attracted by such ads, thereby breaking the Shrouded Prices Equilibrium.

Finally, third party consumer education — e.g., magazines like *Consumer Reports* — will accelerate unshrouding. However, various impediments prevent such educational mechanisms from working perfectly. Non-profit educational organizations may be underfinanced. Moreover, for-profit educational organizations may have incentives to give bad advice. For example, personal finance magazines tend to recommend active portfolio management, thereby justifying ongoing demand for these magazines. Consumers may not know which advisor to trust.

³¹The proof is a simple modification of the proofs of Propositions 1 and 4, with a Taylor expansion when μ is very large.

4 Conclusion

Firms often shroud the negative attributes of their products, particularly high prices for complementary add-ons. We present a model of consumer myopia that explains this shrouding. Most importantly, we identify conditions under which shrouding survives in competitive equilibrium. We show that competition will not induce firms to reveal information that would improve market efficiency. Firms will not educate the public about the add-on market, even when unshrouding is free.

In equilibrium, sophisticated consumers buy the loss-leader base good and substitute away from add-on consumption. For example, sophisticated credit card users take advantage of the “free miles” and avoid interest rate charges and late payment fees. Sophisticates receive a cross-subsidy from myopic consumers who pay those fees. Advertising low markups and educating consumers about the add-on market will not attract customers. Sophisticated consumers would rather pool with myopic consumers (and receive cross-subsidies) than defect to firms with marginal cost pricing. A firm that unshrouds its add-on prices will *lower* its profits, implying a “curse of debiasing.”

We do not develop here the policy implications of myopia and persistent shrouding, but we can anticipate the tools required for such analysis.³² Regulatory agencies currently employ lawyers and economists. The analysis in this paper suggests that regulators should also consider employing social scientists trained in experimental and survey techniques. Survey researchers could try to measure α , the degree of consumer sophistication. This measure of marketplace literacy (a “shopper I.Q.” of sorts) might complement traditional predictors of market distortion, such as Herfindahls, elasticities, and mark-ups. Survey research could determine whether new customers underpredict payment of banking fees or the scope of credit card borrowing or spending on ink cartridges (cf Hall 2003).

When awareness α is low, one should not be confident that competitive forces will debias consumers. Compulsory unshrouding might then be desirable.³³ Regulators have already informally

³²Spence (1977) investigates a situation in which consumers misperceive the reliability of a product. He studies regulatory interventions, such as a mandatory warranty. He also investigates a solution via a signaling equilibrium. He does not consider the case where firms can directly debias consumers.

³³Jovanovic (1982) analyses a setting with Bayesian consumers. He concludes that there is too much, rather than too little, *costly* disclosure in equilibrium (firms overinvest in signalling).

engaged in such unshrouding policies (e.g., food, energy usage, or financial product labelling).³⁴ We hope that ongoing research will clarify the appropriate and inappropriate domains for such compulsory unshrouding. We also need to learn how to effectively regulate unshrouding. Regulations will probably not succeed if they simply change the font size of the fine print. Nobody yet knows how to compel transparency. And it remains to be seen whether that is desirable — or possible — in practice.

³⁴The UK Treasury is in the midst of a broad expansion of transparency regulation in the banking sector (Cruikshank 2000).

5 Appendix A: The Demand Function $D(x)$

We define $D(x)$ as the demand of a firm that offers an average perceived surplus x units greater than the average perceived surplus provided by its competitors. We develop the microfoundations for $D(x)$ using random utility theory (see Anderson *et al.* 1992 for an excellent review). We assume that good i gives agent a a decision utility equal to $U_{ai} = v_i - p_i + \varepsilon_{ai}$, where ε_{ai} is i.i.d. across firms i and agents a , with cumulative distribution function F and density $f = F'$. We interpret ε_{ia} as a tremble or an idiosyncratic consumer preference (McFadden 1981). We normalize the mass of consumers to 1. The demand for firm i is thus: $D_i = P(v_i - p_i + \varepsilon_{ai} \geq \max_{j \neq i} v_j - p_j + \varepsilon_{aj})$. We will be looking for symmetric equilibria where a firm posts quality v and prices p , while the other firms post the same quality v^* and price p^* , and all firms have the same σ . In those cases, one can set $S = v - p$ and $S^* = v^* - p^*$, introducing short-hand for the net average surpluses. Then the demand for firm 1 is $D_1 = D(S - S^*)$, where we define

$$D(x) \equiv P\left(x + \varepsilon_1 \geq \max_{j=2 \dots n} \varepsilon_j\right) = \int_{-\infty}^{\infty} f(\varepsilon) F^{n-1}(x + \varepsilon) d\varepsilon. \quad (15)$$

See Perloff and Salop (1985) or Anderson *et al.* (1992). The demand depends only on the difference $S - S^*$ between the surplus S offered by the firms, and the surplus S^* offered by its competitors. The following Proposition characterizes the symmetric equilibrium.

Proposition 5 *Suppose that $\ln f$ is concave, and that firms compete in prices, and have identical costs c and values v , so that the profit of a firm charging p is $(p - c) D(p^* - p)$. Then there is a unique symmetric equilibrium with $p - c = \mu := D(0) / D'(0)$. Also,*

$$\mu D(0) = \max_x x D(-x + \mu). \quad (16)$$

Proof. The existence of the symmetric equilibrium is guaranteed by Caplin and Nalebuff (1991), Theorem 2 and Proposition 7. If marginal costs are c and profits are $(p - c) D(p^* - p)$, the first order condition is $D(p^* - p) - (p - c) D'(p^* - p) = 0$. In the symmetric equilibrium, $p = p^*$ and so $p - c = \mu$. Finally, Eq. 16 just reflects that a price $p = p^* = \mu$ is an equilibrium if $c = 0$. ■

Two cases have compact closed forms. If the noise is Gumbel distributed, i.e. $F(\varepsilon) = \exp(-e^{-\varepsilon})$, the demand is logistic: $D(x) = 1/[1 + (n - 1)e^{-x}]$. If the noise is exponentially

distributed with density $e^{-\varepsilon}1_{\varepsilon>0}$, the demand is $D(x) = e^x [1 - 1_{x \geq 0} (1 - e^{-x})^n] / n$.

6 Appendix B: Longer Derivations

6.1 Proof of Proposition 1

We call p^* and \hat{p}^* the equilibrium prices at other firms for the base good and the add-on respectively, and we call p and \hat{p} the prices at firm i . We check that firm i does not want to deviate from the announced strategies.

Case 1: $\alpha < \alpha^\dagger$ and the Shrouded Prices Equilibrium.

- Firm i can shroud and pick p and \hat{p} . Its profit is equal to

$$\pi = (p + (1 - \alpha) \hat{p} 1_{\hat{p} \leq \bar{p}}) D(p^* - p),$$

as the beliefs are $\tilde{p} = \tilde{p}^* = \bar{p}$ and the demand for the base good of all the consumers depends only on $p^* - p$. This profit is clearly maximized when $\hat{p} = \bar{p}$ so that

$$\pi = (p + (1 - \alpha)\bar{p}) D(p^* - p).$$

The base good price p that solves the first order condition $-(p + (1 - \alpha)\bar{p}) D'(p^* - p) + D(p^* - p) = 0$ for $p = p^*$ is $p = p^* = -(1 - \alpha)\bar{p} + \mu$.

- Firm i can unshroud and pick p and \hat{p} . By unshrouding its add-on price, firm i educates some of the myopes and the fraction of sophisticates becomes $\alpha' = \alpha + \lambda(1 - \alpha)$. The myopes keep ignoring the price of the add-on when deciding to buy the add-on while the sophisticates incorporate it and will buy it iff $\hat{p} \leq e$.

– If $\hat{p} \leq e$

$$\pi = \alpha' (p + \hat{p}) D(-p - \hat{p} + p^* + e) + (1 - \alpha') (p + \hat{p}) D(p^* - p),$$

which is maximized when $\hat{p} = e$. Otherwise firm i can increase \hat{p} by a small positive increment, decrease p by the same increment, and not change the demand of sophisticated

consumers while increasing strictly the demand of naive consumers. Hence, the profit can be reexpressed:

$$\pi = (p + e) D(p^* - p).$$

As $\alpha < \alpha^\dagger$, this profit is smaller than $(p + (1 - \alpha)\bar{p}) D(p^* - p)$, the profit firm i could achieve by choosing to shroud and price at p and $\hat{p} = \bar{p}$.

– If $\hat{p} > e$,

$$\pi = (p + (1 - \alpha')\hat{p}1_{\hat{p} \leq \bar{p}}) D(p^* - p),$$

which is strictly smaller than $(p + (1 - \alpha)\bar{p}) D(p^* - p)$, the profit firm i could achieve by choosing to shroud and price at p and $\hat{p} = \bar{p}$.

– We conclude that the best response of firm i is to shroud and price at $p = p^* = -(1 - \alpha)\bar{p} + \mu$ and $\hat{p} = \hat{p}^* = \bar{p}$.

Case 2: $\alpha^\dagger < \alpha$ and the Unshrouded Prices Equilibrium.

• Firm i can unshroud and pick p and \hat{p} .

– If $\hat{p} \leq e$,

$$\pi = \alpha' (p + \hat{p}) D(-p - \hat{p} + p^* + e) + (1 - \alpha') (p + \hat{p}) D(p^* - p),$$

which is maximized when $\hat{p} = e$. Otherwise firm i can increase \hat{p} by a small positive increment, decrease p by the same increment, and not change the demand of sophisticated consumers while increasing strictly the demand of naive consumers. Hence $\pi = (p + e) D(p^* - p)$. In equilibrium, the base good price p solves the first order condition, $-(p + e) D'(p^* - p) + D(p^* - p) = 0$. This implies that $p = p^* = -e + \mu$.

– If $\hat{p} > e$, only myopes buy the add-on, and

$$\pi = (p + (1 - \alpha')\hat{p}1_{\hat{p} \leq \bar{p}}) D(p^* - p).$$

This profit is clearly maximized when $\hat{p} = \bar{p}$. The profit is $\pi = (p + (1 - \alpha')\bar{p}) D(p^* - p)$, which is strictly smaller than $(p + e) D(p^* - p)$, the profit firm i could achieve by choosing

to unshroud and price at p and $\hat{p} = e$.

- Firm i can shroud and pick p and \hat{p} and get a profit equal to

$$\pi = (p + (1 - \alpha') \hat{p} 1_{\hat{p} \leq \bar{p}}) D(p^* - p),$$

as the beliefs are $\tilde{\hat{p}} = \bar{p}$. One needs α' rather than α in the above expression, because the other firms unshroud, so they educate a fraction λ of the myopes. This profit is clearly maximized when $\hat{p} = \bar{p}$. The profit is $\pi = (p + (1 - \alpha')\bar{p}) D(p^* - p)$, which is also strictly smaller than the profit firm i could achieve by choosing to unshroud and price at p and $\hat{p} = e$.

- We conclude that the best response of firm i is to unshroud and price at $p = p^* = -e + \mu$ and $\hat{p} = \hat{p}^* = e$.

If firm i shrouds its add-on price, consumers rationally believe $\hat{p}_i = \bar{p}$, as the above proof shows that this is the optimal price if firm i shrouds. Hence using sequential rationality, the announced beliefs are consistent.

6.2 Proof of Proposition 3

We follow closely the proof of Proposition 1. The firm's optimal value \hat{p} must still be either e or \bar{p} . Recall that $\alpha' = \alpha + \lambda(1 - \alpha)$ represents the fraction of informed consumers after unshrouding. If the firm unshrouds, its profit depends on whether $\hat{p} = e$ or $\hat{p} = \bar{p}$:

$$\Pi(\hat{p} = e) = \max_p (p + [\alpha' T_S + (1 - \alpha') (T_{MM} + T_{MS})] e) D(p^* - p), \quad (17)$$

$$\Pi(\hat{p} = \bar{p}) = \max_p (p + (1 - \alpha') \bar{p} T_{MM}) D(p^* - p). \quad (18)$$

If it does not unshroud, its profit is

$$\Pi = \max_p (p + (1 - \alpha) T_{MM} \bar{p}) D(p^* - p). \quad (19)$$

To compare the profits, observe that

$$\begin{aligned} [\alpha' T_S + (1 - \alpha') (T_{MM} + T_{MS})] e &\leq \max(T_S, T_{MM} + T_{MS}) e \\ &< (1 - \alpha) \bar{p} T_{MM} \end{aligned}$$

as $\alpha < \alpha^{\dagger\dagger}$. This implies $\Pi(\hat{p} = e) < \Pi$. Unshrouding and posting a low price e for the add-on is not profitable. Also, $\Pi(\hat{p} = \bar{p}) < \Pi$ by Eq. 18, 19 and $\alpha' > \alpha$. Unshrouding and posting a high price \bar{p} for the add-on is also not profitable.

We conclude that whatever price the firm chooses to charge for the add-on, unshrouding is not profitable.

6.3 Proof of Proposition 4

In this proof, we call p^* and $\hat{p}^* = \hat{p}^m$ the equilibrium prices described in the Proposition. We check that the shrouded prices in the Proposition constitute an equilibrium.

First, it is clear that if a firm shrouds, the add-on price is the monopoly price \hat{p}^m . We check that the optimal base good price is the one announced in Eq. 9. Without loss of generality, we take $c = 0$ to simplify exposition.³⁵ The profits are

$$\Pi = \left(p + (\hat{p}^m - \hat{c}) \hat{q}(\hat{p}^m) \right) D(-p + p^*).$$

If p is an equilibrium, $\partial\Pi/\partial p = 0$ at $p = p^*$. This implies $p + (\hat{p}^m - \hat{c}) \hat{q}(\hat{p}^m) = D(0)/D'(0) = \mu$, which is Eq. 9.

We now calculate the profit of a firm that deviates, unshrouds, and sets new prices p and \hat{p} , while the other firms keep shrouding and using the prices p^* and \hat{p}^* given in Eq. 9-10. A sophisticated facing price \hat{p} in the aftermarket gets the net utility

$$\hat{v}(\hat{p}) = \max_{\hat{q}, \hat{e}} \hat{u}(\hat{e}, \hat{q}) - \hat{p}\hat{q}. \quad (20)$$

Call $\hat{q}(\hat{p})$ (or $\hat{q}^S(\hat{p})$ if there is an ambiguity) the associated choice of add-on demand, and $\hat{u}(\hat{p}) =$

³⁵To go back to the general case, replace p by $p - c$.

$\widehat{v}(\widehat{p}) + \widehat{p}\widehat{q}(\widehat{p})$ the gross utility. The utility provided by the other firms is: $u^{S*} = -p^* + \widehat{v}(\widehat{p}^*)$.

The firm's profit is

$$\Pi = (p + (\widehat{p} - \widehat{c})\widehat{q}(\widehat{p}))D(-p + \widehat{v}(\widehat{p}) - u^{S*}) = xD(-x + (\widehat{p} - \widehat{c})\widehat{q}(\widehat{p}) + \widehat{v}(\widehat{p}) - u^{S*}),$$

where $x = p + (\widehat{p} - \widehat{c})\widehat{q}(\widehat{p})$ is the total profit per customer. Maximizing $\Pi(x, \widehat{p})$ over \widehat{p} and noting that (20) and the envelope theorem imply $\frac{\partial}{\partial \widehat{p}}\widehat{v}(\widehat{p}) = -\widehat{q}(\widehat{p})$, we get

$$0 = \frac{\partial}{\partial \widehat{p}} [(\widehat{p} - \widehat{c})\widehat{q}(\widehat{p}) + \widehat{v}(\widehat{p})] = \widehat{q}(\widehat{p}) - \widehat{q}(\widehat{p}) + (\widehat{p} - \widehat{c})\widehat{q}'(\widehat{p}) = (\widehat{p} - \widehat{c})\widehat{q}'(\widehat{p}).$$

This implies $\widehat{p} - \widehat{c} = 0$. When a firm faces only sophisticated consumers, it prices of the add-on efficiently. So the highest profit the firm can get after deviating is

$$\Pi = \max_x xD(-x + x^*), \quad (21)$$

with $x^* = \widehat{v}(\widehat{c}) - u^{S*}$.

As the pre-deviation profit is μ , the firm doesn't want to deviate iff

$$\Pi \leq \mu D(0), \quad (22)$$

as $\mu D(0)$ is the pre-deviation profit. Given Eq. 16, Eq. 21, and the fact that $\max_x xD(-x + z)$ is non-decreasing in z , (22) is equivalent to $x^* \leq \mu$. To find the sign of $x^* - \mu$, we calculate

$$\begin{aligned} x^* - \mu &= \widehat{v}(\widehat{c}) - u^{S*} - \mu = \widehat{v}(\widehat{c}) - \widehat{v}(\widehat{p}^*) + p^* - \mu \\ &= \widehat{v}(\widehat{c}) - \widehat{u}^S(\widehat{p}^*) + \widehat{p}^*\widehat{q}^S(\widehat{p}^*) - (\widehat{p}^* - \widehat{c})\widehat{q}(\widehat{p}^*) \text{ by (9) and (20)} \\ &= \widehat{v}(\widehat{c}) - \widehat{u}^S(\widehat{p}^*) + \widehat{p}^*\widehat{q}^S(\widehat{p}^*) - (\widehat{p}^* - \widehat{c})[\alpha\widehat{q}^S(\widehat{p}^*) + (1 - \alpha)\widehat{q}^M(\widehat{p}^*)] \text{ by (7)} \\ &= \widehat{u}(\widehat{c}) - \widehat{c}\widehat{q}^S(\widehat{c}) - \widehat{u}^S(\widehat{p}^*) + \widehat{c}\widehat{q}^S(\widehat{p}^*) - (1 - \alpha)(\widehat{p}^* - \widehat{c})(\widehat{q}^M(\widehat{p}^*) - \widehat{q}^S(\widehat{p}^*)) \text{ by (20)}. \end{aligned}$$

As the firm doesn't want to deviate iff $x^* - \mu \leq 0$, the Proposition is proven.

7 References

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