

Browsing versus Studying: A Pro-Market Case for Regulation*

Paul Heidhues

Düsseldorf Institute for Competition Economics

Johannes Johnen

Université catholique de Louvain and CORE

Botond Kőszegi

Central European University

December 17, 2019

Abstract

We identify a competition-policy-based argument for regulating the secondary features of complex or complexly-priced products when consumers have limited attention. Limited attention implies that consumers can only “study” a small number of complex products in full, while—by failing to check secondary features—they can superficially “browse” more. Interventions limiting ex-post consumer harm through safety regulations, caps on certain fees, or other methods free consumers from worrying about the regulated features, enabling them to do more or more meaningful browsing and thereby enhancing competition. We show that for a pro-competitive effect to obtain, the regulation must apply to the secondary features, and not to the total price or value of the product. As an auxiliary positive prediction, we establish that because low-value consumers are often more likely to study—and therefore less likely to browse—than high-value consumers, the average price consumers pay can be increasing in the share of low-value consumers. We discuss applications of our insights to health-insurance choice, the European Union’s principle on unfair contract terms, food safety in developing countries, and the shopping behavior of (and prices paid by) low-income and high-income consumers.

*We thank Mark Armstrong, Andrzej Baniak, Keith Ericson, Jonathan Gruber, Bard Harstad, Alex Imas, Daniel Krähmer, Alexander Morell, Gautam Rao, Antonio Rosato, Joshua Schwartzstein, and seminar as well as conference audiences for useful comments.

1 Introduction

In this paper, we identify a novel competition-policy-based argument for regulating the secondary features of complex or complexly-priced products when consumers have limited attention. Consumers shopping for complex products must decide how much attention to devote to each offer. A mobile-phone buyer, for instance, may spend a little bit of effort to find out an offer’s basic features (e.g., the monthly fee and amount of included data), or more effort to also understand the contract’s precise conditions, additional fees, and potential traps. A consumer with limited attention can do more of the former “browsing” than the latter “studying,” and there may also be a non-trivial tradeoff between the two activities. Because regulating secondary product features—such as the add-on prices or safety of a product, or the working conditions of a job—makes studying less essential in equilibrium, it allows consumers to do more comparison shopping and thereby enhances competition between firms.

After discussing evidence and arguments in favor of our key premises in Section 2, we develop our main insights in Section 3. We assume that firms with identical marginal costs of production sell homogeneous products to consumers looking to buy at most one item. Each firm can split the price a consumer must pay for its product into two additive components, a more salient headline price and a less salient additional price. For instance, the total price a consumer pays for a mutual fund is determined by the front load as well as the management fee, and the total price a consumer pays for an appliance is determined by the appliance’s price as well as its energy efficiency. To model a tradeoff between studying and browsing in the sharpest possible way, we posit that a consumer can observe either the headline and additional prices of one firm, or only the headline prices of two firms. Within their attentional constraints, consumers choose their search strategies optimally.

In this market, firms charge the monopoly price to all consumers who purchase: consumers must study to guard against price gouging, so they do not have sufficient capacity to meaningfully compare products, eliminating competition. Now consider a cap on the additional price that (for the sake of illustration) is above firms’ equilibrium additional prices. We interpret the cap as any regulation—such as a minimum safety standard for physical products or a restriction on certain

fees for financial products—that limits how much consumers can be hurt by hidden features after agreeing to purchase. In a classical model, such a price cap would be irrelevant both because it is not binding, and because it does not restrict a firm’s total price at all. In our model, in contrast, the cap induces perfect competition: it is now safe for consumers to redirect their attention from studying to browsing, leading firms to compete.

Natural modifications of our model yield additional important points. First, our policy result also holds when the set of prices the consumer observes is exogenously fixed—so there is no tradeoff between browsing and studying—but it includes more headline than additional prices. Such situations of “asymmetric shrouding” arise, for instance, if consumers have developed trust with their legacy energy provider, and it would be difficult or impossible for them to obtain full information about other providers. Second, regulation also works if charging an additional price is inefficient—e.g., because it takes the form of shortfalls in product safety consumers value above cost—but it does so only if it is sufficiently strict. Third, however, for our mechanism to be operational, the regulatory cap must apply to the additional price and *not* the total price, even though it is ultimately the total price that consumers (and firms) care about. A cap on the total price does not prevent firms from using the additional price to price gouge consumers, so it does not make browsing safe.

In Section 4, we turn to the (analytically more complicated) settings in which consumers can avoid the additional price of a purchased product, but only if they have studied the product. We distinguish two types of consumers according to whether their cost of avoiding the additional price is low (low-value consumers) or high (high-value consumers). In the context of mobile phones, for instance, the headline and additional prices could be the monthly fee and the fees for extra services (e.g., data above the plan limit, roaming), respectively, where extra charges can be avoided only by studying what is covered in the monthly fee. Since high-value consumers are less willing to abide by restrictions on usage, it is more costly for them to avoid the additional price.

We begin with identifying outcomes when regulation capping the additional price is in place. In equilibrium, firms charge the maximum additional price. Since high-value consumers prefer not to avoid the additional price, for the range of equilibrium headline prices they browse. More subtly, we show that in equilibrium low-value consumers always study and avoid the additional price, as

this can save them more money than browsing in the hope of finding a lower headline price. These search decisions in turn imply that the average price consumers pay is *increasing* in the share of low-value consumers. Although high-value consumers pay a higher average price than low-value consumers, their browsing spurs competition and thereby lowers prices—with the latter indirect effect dominating the former direct effect.

We then return to analyzing the effects of regulatory changes. Replicating the logic from our first model, we show that deregulation lowers competition: if there is no cap on the additional price, then each firm becomes a local monopolist. Motivated by the suggestions of Barr et al. (2008) and Thaler (“Mortgages Made Simpler,” New York Times, July 4, 2009), we also ask what happens if firms are required to offer a “plain-vanilla” product with no additional price, they can impose an additional price only if a consumer consents, and a consumer can refuse to consent without studying. Fixing prices and consumers’ search behavior, this regulation has no effect—high-value consumers pay and low-value consumers avoid the additional price. Yet because low-value consumers can now simply not consider alternatives to the plain-vanilla product, they can browse, inducing perfect competition between firms.

In Section 5, we outline a few applications of our framework. Consistent with our result that regulation facilitates comparison shopping, a 2010 reform defining minimum coverage levels in the Massachusetts health-insurance exchange led consumers to become more sensitive to the financial characteristics of plans (Ericson and Starc, 2016). Furthermore, our main insights on regulation help make sense of the European Union’s principle on unfair contract terms. Much like our cap on hidden fees, the principle effectively prohibits standard business-to-consumer contracts from using provisions that are too unclear or surprising relative to how things are normally done, and that are too disadvantageous to the consumer. And consistent with our insight that the additional price rather than the total price must be regulated, the principle applies only to the individual terms in a contract, not the entire transaction. On the other side, we illustrate the problems with an unregulated market using the example of food safety in developing countries. Although consumers express a demand for, and producers appear capable of supplying, safe food, the market works rather imperfectly: many or most consumers either buy unsafe food on a competitive market, or

safe food from expensive trusted suppliers. More stringent (and properly enforced) regulations would increase the welfare of both types of consumers by making the competitive market more attractive. Finally, our prediction regarding the differential shopping behavior of low-value and high-value consumers helps explain the finding that consumers in lower-income neighborhoods pay higher prices for various goods and services, including mortgages, insurance, and cars (e.g., Fellowes, 2006). Further evidence supports the mechanism of our model as well: observers argue that lower-income consumers face higher prices because they do less comparison shopping (e.g., Agarwal et al., 2016b), and other researchers document that lower-income consumers shop more carefully, and buy the same products at lower prices, at the stores they do frequent (e.g., Broda et al., 2009).

In Section 6, we discuss related literature. While previous pro-market arguments for regulation suggest similar interventions in many circumstances, our argument is conceptually distinct from them. In particular, our results that sufficiently tight regulations of secondary features increase competition, but less tight regulations of secondary features may not, and regulations of the total price never do, are not implied by previous models. First, the literature on choice complexity (e.g., Spiegler, 2016) emphasizes the importance of price comparability for competition, and in a reduced form our regulation can be understood as increasing comparability. But models of choice complexity specify the comparability of prices exogenously, so they do not make our predictions on which regulations work—and Piccione and Spiegler (2012) emphasize that even regulations that uniformly improve comparability can easily backfire. Second, perhaps the main message of the large literature on search is that lowering search costs increases competition, and again in a reduced form regulation in our model can be understood as lowering search costs. But the search literature does not consider the implications of asymmetric shrouding or the tradeoff between studying and browsing, so models in this literature do not imply our results. Indeed, the received wisdom from the search literature is that price caps lower competition and therefore often increase prices (Fershtman and Fishman, 1994, Armstrong et al., 2009). Third, previous research has pointed out that regulation can improve markets by lowering adverse selection, for instance when an intermediary could steal an investor’s money in the context of a securities transaction. The adverse-selection argument implies that if consumers can ascertain the quality of the seller at a lower cost than the regulator, then

regulation is not justified. Due to its indirect effect of enabling comparison shopping, in our case regulation might still be justified. A similar comparison can be made regarding regulation that aims to lower transaction costs, for instance when courts are unreliable or expensive tools for enforcing contracts. Finally, standardization through regulation can increase competition by making products less differentiated. Our mechanism works without making products closer substitutes; in our first model, for instance, products are identical in all aspects both with and without regulation. We conclude in Section 7.

2 Premises

Our main models are based on two central premises. The first, and at this stage of the literature uncontroversial, premise is that many products feature important price or contract components that consumers may not fully observe or understand when making purchase decisions. Numerous models in behavioral industrial organization starting from Ellison (2005) and Gabaix and Laibson (2006) presume such hidden prices in some form (see Heidhues and Kőszegi 2018 for a review), and researchers have documented them in a variety of markets (e.g., Choi et al., 2010, Anagol and Kim, 2012, Duarte and Hastings, 2012, Agarwal et al., 2015, 2016a, Grubb and Osborne, 2015). We deviate from this literature only in presuming that consumers can devote attention to understanding complex products better.

Our second, more novel premise is that a consumer makes a decision of how much to browse versus study, with more of one implying less of the other. Given the self-evident observation that consumers must make decisions on how carefully to evaluate a complex product, a tradeoff between browsing and studying arises if consumers exhibit search costs that are convex in the number of price searches in the given market or in overall search activity.

Indeed, some evidence indicates that consumers exhibit convex search costs. De Los Santos et al. (2012) and Honka and Chintagunta (2017) compare the empirical fit of sequential and simultaneous search models with linear search costs in markets for books and auto insurance, respectively. From a practical perspective, the assumptions of sequential search—where the consumer looks for options in sequence, and can always decide whether to stop or search for more options—describes these

markets better. Yet both papers find that models of simultaneous search—where the consumer samples a fixed number of options—better fit consumer behavior, as consumers’ decisions of whether to continue searching do not depend on the prices drawn so far. Similarly, survey evidence by the Consumer Financial Protection Bureau (2015, Figure 5) and Alexandrov and Koulayev (2018) indicates that mortgage borrowers’ propensity to search further drops off sharply after consulting two or three lenders/brokers, contradicting the prediction of sequential-search models that the hazard rate of stopping should be (almost) constant. A natural explanation is that consumers behave according to a sequential search model with convex search costs, for instance having an attentional constraint that induces them to stop no matter what they have observed.¹ Importantly, the possibility that search costs are convex does not mean that a consumer’s general cost of time is convex in the relevant range. It is plausible, for instance, that a consumer quickly gets tired or frustrated with reading and comparing complex health-insurance contracts, even while her best alternative use of time remains catching up on her Facebook news feed.

An alternative account of the above evidence is that consumers do not face convex search costs, but have made a suboptimal, heuristic initial decision of how much time or effort to devote to search, and do not reconsider this when they see specific offers. Furthermore, evidence by Woodward and Hall (2012)—which suggests that borrowers consult only one or two mortgage brokers even though they could save on the order of \$1,000 by consulting one more—indicates that in some settings consumers might have an incorrect understanding of the returns to search. So long as consumers respond sufficiently to how changes in the environment affect what can be learned from a given set of prices, the logic of our results applies with such heuristic models of search as well.

Under some special cases of convex search costs and heuristic search, the tradeoff between studying and browsing is negligible or non-existent. We model such situations by assuming that “asymmetric shrouding” is going on: the set of prices a consumer observes is fixed, but it includes

¹ This conclusion is bolstered by evidence from experiments in which the financial costs of search are induced to be linear, yet consumers do not behave according to the linear model. Specifically, while the linear model implies that reservation values are constant and therefore consumers never accept old offers, Kogut (1990) finds that a third of experimental subjects accept old offers, and Brown et al. (2011) document that reservation values decline over time. Brown et al. also run a version of their experiment in which there is a random delay between offers, and observe that the decline in reservation values is greater when delays are longer. A plausible explanation is that subjects have a convex subjective cost of time.

more headline prices than additional prices. At least two economically relevant search-cost constellations give rise to asymmetric shrouding. First, if the marginal cost of learning additional prices is initially very small but then rises sharply, the consumer cannot substitute much attention toward browsing. For instance, consumers may have learned about a dependable provider from friends or acquaintances, with little or no scope for them to obtain information about other providers. Similarly, consumers may have developed trust with a particular provider—e.g., a legacy provider in a recently deregulated industry—through personal contact or having traded previously. This possibility is in the spirit of Gennaioli et al. (2015), where an investor’s trust in different fund managers (“money doctors”), and therefore her perceived risk of investment in different funds, are asymmetric. Second, if the marginal cost of learning about headline prices is negligible, then the consumer learns all relevant headline prices in any situation, and again there is no substitution between browsing and studying. Consider, for instance, price-comparison sites, which allow a consumer to look at many offers quickly. Consistent with evidence by Ellison and Ellison (2009)—who document that sellers on a price-comparison website charge add-on prices that only become apparent once the consumer visits the seller’s own site—we take the perspective that for complex products, these tools can only be used to compare headline prices. Hence, even if consumers can observe many headline prices, their capacity to understand additional prices remains limited.

3 Main Mechanism: Unavoidable Additional Price

In this section, we analyze the effects of regulation when the additional price is unavoidable. In the market for mutual funds, for instance, an investor pays not just the front load, but also the management fee charged by a fund. In the market for electric appliances, a buyer’s surplus depends not just on the purchase price, but also on the energy efficiency of a product. And in the labor market, a worker cares not just about the wage, but also about the working conditions—such as safety—of a job. Furthermore, in all of these cases the core price—the front load, appliance price, or wage—is more easily observable to consumers because it is paid earlier and/or it is easier to figure out upon looking at the product.

Throughout the paper, our modeling strategy is to analyze a basic stylized model (Sections 3.1

and 4.1) and then consider a number of variants and extensions. In each case, we fully analyze the regulated and unregulated versions of the basic model by considering both the existence and the uniqueness of equilibria. When analyzing alternative models, however, we do not consider the technically difficult issue of when equilibrium is unique, but only look for equilibria of the forms we have found in our basic models.

3.1 Basic Model

There are $I \geq 2$ firms selling a homogeneous product with cost c . Each firm i chooses a headline price $f_i \in \mathbb{R}$ and an additional price $a_i \geq 0$. Consumers are looking to buy at most one product, and value all products at $v > c$. Each consumer sees the headline price of one randomly chosen firm automatically. A consumer assigned to firm i can then learn exactly one more thing: either the additional price a_i of firm i —which we refer to as “studying”—or the headline price f_j of a randomly chosen rival j —which we refer to as “browsing.” After making these price observations, consumers decide whether to purchase a product, and, if so, which one. If a consumer purchases product i , she pays a total price of $f_i + a_i$. To rule out fragile Diamond-paradox-type equilibria that unravel with an arbitrarily small inducement to visit multiple stores, we assume that some (potentially small positive mass of) consumers always browse. A consumer can only buy from a firm if she has seen that firm’s headline price. We look for perfect Bayesian equilibria.

Our formulation corresponds most directly to situations in which a_i is a fee or price. More generally, a_i can be any secondary feature over which the firm and consumer have conflicting interests. An unsafe product, for instance, benefits the firm in the form of cost savings and hurts the consumer in the form of potential harm. Below, we discuss the limited ways in which our results are qualified when a positive additional price not only transfers money from the consumer to the firm, but is also inefficient.

Our first proposition says that the market does not work for consumers:²

Proposition 1. *In any equilibrium in which a positive share of consumers purchase, these consumers pay a total price of v . Such equilibria exist.*

² Following common convention, in stating and discussing our propositions we ignore the possibility that firms choose suboptimal prices with probability zero.

In equilibrium, each firm acts as a monopolist, extracting all rents from all consumers who purchase. Intuitively, consumers who purchase must study, otherwise firms could raise the additional prices on them at will. Being on guard against price gouging, consumers do not have sufficient capacity to compare products, so there is no competition between firms. To make matters worse, consumers may inefficiently browse and give up on purchasing, and firms have no way of inducing them to change their minds. These points imply that although the equilibrium resembles a Diamond-paradox outcome on the surface, it is based on a different economic logic—that purchase requires using one’s limited attention to avoid being price gouged—and is therefore not fragile to some consumers visiting multiple firms.

Now suppose that the social planner imposes a cap of $\bar{a} \geq 0$ on the additional price, constraining the extent to which consumers can be hurt after agreeing to purchase. Such a cap is consistent with regulatory limits on fees for financial products, minimum safety standards for physical products or jobs, potential restrictions on labor-market contracts (for instance the elimination of complex arbitration and non-compete clauses), as well as a tort regime of strict liability (in which consumers can obtain compensation for harm through legal action). Although our result holds for any $\bar{a} \geq 0$, for illustrative purposes it is worth pointing out the special case when $\bar{a}$ exceeds firms’ no-regulation additional prices, such as when all firms charge prices f, a satisfying $f + a = v$ and $a < \bar{a}$. In a classical market in which consumers observe all prices, and even in a classical search environment in which consumers observe all characteristics of a searched product, this price cap would be ineffective for two reasons: (i) it is not binding; and, independently of whether it is binding, (ii) it does not restrict a firm’s total price at all. In our model, in contrast, the cap turns firms from local monopolists to perfect competitors:

Proposition 2. *In the unique equilibrium, all consumers buy at a total price equal to c .*

The competition-inducing effect of regulation arises from two mechanisms. First, regulation makes browsing more effective in selecting between products. In an unregulated market, any cut in the headline price can be undone by an increase in the additional price, so the cut is meaningless for a consumer not observing the additional price. In a regulated market, however, there are cuts in the headline price that cannot be fully undone by an increase in the additional price, so the

headline price is a useful signal of the total price. This mechanism is crucial in undermining the no-regulation equilibrium above.³

The first mechanism operates even without changing consumers' search behavior. The second mechanism, our main interest in this paper, instead centers on the effect of regulation on consumer search behavior. In equilibrium, consumers know that the additional price is at the maximum level, so—not needing to study—they shift to browsing. This is what enforces the perfectly competitive outcome in Proposition 2.

Note that if $\bar{a}$ exceeds firms' no-regulation additional prices, then regulation induces firms to raise their additional prices to $\bar{a}$. Many observers and policymakers have recognized the potential for such a reaction—often interpreted as a collusive focal-point effect—and used it to argue that regulatory caps can backfire and should therefore be avoided. In our model, the regulation is strongly pro-competitive despite the seemingly perverse reaction.⁴

The pro-competitive effect of a cap on the additional price contrasts sharply with what can be achieved with a cap $\bar{t} > c$ on the total price:

Proposition 3. *In any equilibrium in which a positive share of consumers purchase, these consumers pay a total price of $\min\{\bar{t}, v\}$. Such equilibria exist.*

Regulating the total price has no competition-enhancing effect. As in the unregulated market, any cut in the headline price can be offset by an increase in the additional price, so browsing consumers cannot meaningfully compare prices. It is the additional price—the secondary feature—that the social planner must regulate to encourage competition. An immediate implication is that reducing

³ Suppose all competitors of firm i charge the prices f, a satisfying $f + a = v$, but firm i deviates and instead chooses $f_i = v - \bar{a} - \epsilon$, $a_i = \bar{a}$ for some $\epsilon > 0$. Then, consumers browsing firm i realize that its total price is at most $f_i + \bar{a} = v - \epsilon$, so that they all buy from firm i . For a sufficiently small ϵ , therefore, firm i 's deviation is profitable.

⁴ The extreme result that a non-binding, even arbitrarily high, cap on the additional price increases competition is unrealistic and not robust to reasonable modifications of our model. First, in many other settings we discuss below, only tighter caps work effectively. Second, a high cap is only consistent with competition if a high additional price can be competed away by decreases in the headline price, and for many reasons this may not be the case (Heidhues and Köszegi, 2018). Consider, for example, a floor of zero on the headline price. Clearly, the competitive outcome in Proposition 2 is still an equilibrium if $\bar{a} \leq c$, but it is not feasible if $\bar{a} > c$. If $c < \bar{a} < v$ —so that consumers cannot regret purchasing if the headline price is zero—then it is safe for consumers to browse, so an equilibrium economically similar to that in Proposition 2 exists: firms charge an additional price of $\bar{a}$, and compete as hard as is feasible on the headline price, charging zero. If $\bar{a}$ is very high, however, even such an equilibrium does not exist, as consumers need to study to protect themselves against price gouging. In this case, purchase can only occur at a total price of v .

prices to marginal cost through regulation of the total price requires knowing the cost perfectly and adjusting the regulation whenever these costs change. Achieving marginal-cost pricing through regulation of the additional price, on the other hand, requires neither knowledge of the cost nor adjustment of the regulation when costs change.

3.2 Asymmetric Shrouding

To study situations of asymmetric shrouding, we modify our model by assuming that the prices a consumer observes are fixed, with each consumer learning exactly one randomly chosen additional price a_i , the corresponding headline price f_i , and at least one more randomly chosen headline price f_j .

It is easy to see that the equilibria in Propositions 1 and 2 both survive in this version of our model. In an equilibrium of the unregulated market, consumers know that any cut in the headline price is offset by an increase in the additional price, so they buy from the firm whose additional price they observe and pay a total price of v . While this equilibrium is now not unique, it becomes unique in natural variants in which consumers are reluctant to buy from a firm whose additional price they do not observe.⁵ And in an equilibrium of the regulated market, consumers know that all firms charge the maximum additional price, so they choose a firm with the cheapest headline price, resulting in perfect competition and a total price of c .

The asymmetric-shrouding version of our model shows that consumers' substitution between studying and browsing is not indispensable for the pro-competitive effect of regulation to arise. But such substitution does make the policy effect more reliable and powerful. To illustrate, suppose that in the unregulated market consumers only observe one headline price. Then, in the current version—where regulation cannot change how many offers a consumer sees—regulation has no effect, whereas in the previous version—where regulation allows consumers to switch to browsing—it results in perfect competition. More generally, if a positive fraction of consumers sees only two prices in total, then regulation cannot result in perfect competition in the current model, but does

⁵ As a microfoundation for such an assumption, suppose that there is, or consumers suspect that there is, a fringe of firms whose additional price no one observes, or whose costs and therefore total prices are very high ($\gg v$). In this situation, a consumer observing a cut in the headline price rationally worries that the firm might be a fringe firm, and therefore she does not buy from the firm.

result in perfect competition in the previous model. In addition, our main result on the behavior of low-value and high-value consumers (Proposition 4) also fails to hold under asymmetric shrouding.

An important implicit assumption of our model is that charging an additional price carries no efficiency cost. In some settings, this is clearly unrealistic; for instance, a consumer's loss in value from reduced food safety can be much higher than producers' cost savings. To capture such situations, we consider a variant of our asymmetric-shrouding model in which consumers observe all headline prices, there is a cap $\bar{a}$ on the additional price, and a consumer's utility from buying product i at prices f_i, a_i is $v - f_i - ra_i$, where $r > 1$ measures the inefficiency associated with the additional price. Because it is both technically convenient and realistic, we also assume that there is a set of fringe firms whose additional prices no consumer observes. Then, a natural equilibrium arises in which fringe firms charge $f = c - \bar{a}, a = \bar{a}$, other firms charge $f = \min\{v, c + (r - 1)\bar{a}\}, a = 0$, and each consumer buys at the latter prices from the firm she is assigned to. If consumers are heterogeneous in r , then it can also happen that consumers with a low r purchase from a fringe firm, where they can obtain an inefficient version of the product at a competitive price.

Like in our previous models, regulation of the additional price can benefit consumers. But unlike in our previous models, the strictness of the regulation also matters. If $\bar{a}$ is very high, then consumers do not buy from a firm whose additional price they do not know. Hence, competition from regulated firms with unobservable additional prices does not prevent firms from exploiting their assigned consumers. As regulation becomes stricter, firms with unobservable additional prices become more attractive to consumers, lowering the prices other firms charge. Even if consumers are heterogeneous in r , all consumers benefit from further decreases in $\bar{a}$: those buying from fringe firms obtain more efficient products, and those buying from their assigned firms obtain cheaper products.⁶

⁶ Curiously, in the range where all consumers' relevant outside option is buying from the fringe (rather than not buying), the set of consumers choosing the two markets is unaffected by $\bar{a}$. To see this, suppose that H_i is the distribution of r among firm i 's assigned consumers. Then, assigned consumers buy from firm i if $f_i \leq c + (r - 1)\bar{a}$, or $r \geq 1 + (f_i - c)/\bar{a}$. Hence, firm i 's profit is $(f_i - c)[1 - H_i(1 + (f_i - c)/\bar{a})]$, which is proportional to $[(f_i - c)/\bar{a}][1 - H_i(1 + (f_i - c)/\bar{a})]$. At the optimum, therefore, $(f_i - c)/\bar{a}$ is independent of $\bar{a}$, and hence so is the set of assigned consumers buying from firm i .

3.3 Regulation versus Certification

The question arises whether certification can guarantee the type of reassurance about the additional price that regulation provides in our model. We argue that for consumers with limited attention, it cannot. The classical role of certification is to inform consumers about aspects of the product that firms do not (or cannot credibly) reveal. Our model, however, already assumes that firms must truthfully reveal all relevant aspects of a product. Hence, the problem is not with the availability of information—the problem is with consumers’ ability to digest the information. Addressing this problem is not what certification was designed for or is effective for.

Consider first private certification companies. It is a widely recognized concern that profit-maximizing certifiers do not necessarily help consumers: the certification may not involve everything a consumer cares about, and the certifier may—in exchange for kickbacks—even aid firms in hiding information from consumers (see, e.g., Murooka, 2015, and the references therein). In such an environment, consumers can only be assured about additional prices if they study whether the certifier is trustworthy and what exactly it certifies, so the limited-attention issue at the heart of our mechanism is not alleviated.

Without regulation, government certification is subject to a similar problem: since any product is allowed, a consumer may need to study a product’s (certified) characteristics in order to understand what she is getting. Furthermore, a reliable system of certification might be more difficult to manage in practice than across-the-board regulation. Both certification and regulation require monitoring producers. Unlike regulation, however, certification also requires keeping track of different products (e.g., safe and unsafe foods) separately in the supply chain.

4 Avoidable Additional Price

In this section, we consider situations in which the additional price is avoidable, beginning with a regulated market.

4.1 Setup

Most of our assumptions are the same as in our basic model of Section 3.1. We suppose that there are $I \geq 2$ firms selling a homogeneous product with cost c to consumers looking to buy at most one item, which they value above c . Each firm i offers a contract consisting of a headline price f_i and an additional price $a_i \in [0, \bar{a}]$. Each consumer sees the headline price of one randomly chosen firm automatically. A consumer assigned to firm i can then observe either the additional price a_i of firm i (studying) or the headline price f_j of a randomly chosen rival j (browsing), and cannot learn anything else. A consumer can only buy from a firm if she has seen that firm's headline price.

We now modify this setup in two ways. First, we posit that a consumer can avoid the additional price of her purchased product, but only if she has studied the product.⁷ Second, we suppose that there are two types of consumers. Low-value consumers can costlessly avoid the additional price, so their utility from purchasing product i is $v_L - f_i$ if they have studied product i and $v_L - f_i - a_i$ if they have not studied product i . High-value consumers, in contrast, find it excessively costly to avoid the additional price, so their utility from purchasing product i is $v_H - f_i - a_i$ independently of whether they have studied product i . To capture the idea that high-value consumers always get a greater consumption utility from purchasing, we suppose that $v_H > v_L + \bar{a}$.

As an example, consider mobile phones. We can think of f_i as the monthly fee and a_i as the additional charges for roaming, extra minutes or data, or other services. Avoiding the additional price is only possible if one knows what usage is covered in the monthly fee, so it requires studying. While low-value consumers are willing to abide by restrictions on usage, high-value consumers prefer flexibility in when, where, and how they use their phones. The cap $\bar{a}$ on the additional price could come from regulation or the threat of regulation or legal action. A similar logic applies to many other products with add-ons that primarily high-income consumers tend to use.⁸

⁷ In our primary interpretation, this is the case because avoiding the additional price requires knowing when exactly it is charged. For instance, if a consumer wants to avoid additional fees postulated in her mortgage contract, then she has to find out what is in the contract. In the previous version of our paper (Heidhues et al., 2018), we provide a microfoundation for this assumption by allowing firms to choose the conditions under which the additional price is charged, and find the same results as those below. More simply, the avoidance behavior itself might take attentional resources, which we capture in reduced form as studying. For example, a consumer might use a money order instead of a—significantly more convenient—check to avoid bank overdraft charges.

⁸ To abstract from other issues, our model assumes that all consumers have the same set of search strategies available, implicitly imposing that they have the same search costs. The possibility that low-value and high-value

We look for perfect Bayesian equilibria,⁹ imposing three mild equilibrium-selection assumptions. First, some (potentially small positive mass of) high-value consumers browse. As before, this allows us to rule out fragile Diamond-paradox-type equilibria, such as the outcome when all firms set $v_L, \bar{a}$ and all consumers study. Second, firms—realizing, by sequential rationality, that studying low-value consumers always avoid a_i —choose a_i to optimally target some mix of studying high-value consumers and browsing (high- or low-value) consumers, and consumers believe firms do so for equilibrium as well as out-of-equilibrium headline prices.¹⁰ This allows us to argue that if a consumer observes an off-equilibrium cut in the headline price, then she does not artificially infer that the additional price must be low. Third, whenever a consumer type is indifferent between browsing and studying, the type studies with a fixed probability; and whenever a consumer with a fixed type and search behavior is indifferent between purchasing and not purchasing, she purchases with a fixed probability. This rules out coordination by consumers on a variable that is payoff-irrelevant for themselves.

While in the text we focus on the above baseline model, in Appendix A we argue that many natural modifications leave our main insights unchanged. One possibility that will be relevant in our applications is that studying and browsing occur in different markets, so that studying in one market crowds out browsing in another market. A consumer who studies the local supermarket’s sales and coupons to save on food, for instance, ends up with less time and attentional capacity to search for the cheapest bank account or energy provider. Further, as in the case of a consumer who carefully reads her unconventional mortgage contract and still falls for some traps, low-value

consumers face different search costs does not seem to interact with the effects we identify. In addition, it is unclear which type faces higher search costs. For instance, Kaplan and Menzio (2015) document that unemployed consumers shop more than employed consumers, but Mullainathan and Shafir (2013) suggests that low-income consumers have higher search costs because they lead busier lives.

⁹ Formally, a perfect Bayesian equilibrium is defined in our setting as follows. A firm’s strategy consists of the distribution $G_i(\cdot)$ of its headline price and the set of distributions $A_i(\cdot|f_i)$ of its additional price conditional on each $f_i \in \mathbb{R}$. A firm’s equilibrium strategy maximizes expected profits given the behavior of consumers and competitors. A consumer’s beliefs are derived from firms’ equilibrium strategies using Bayes’ Rule whenever possible, and the consumer’s strategy maximizes expected utility at each information set.

¹⁰ A closely related equilibrium-selection assumption is the notion of wary beliefs proposed by McAfee and Schwartz (1994) and adapted to a consumer-search context similar to ours by Armstrong (2015), whereby consumers who observe out-of-equilibrium offers suppose that firms chose the unobserved features of the offer optimally. As our proof makes clear, in our setting these beliefs coincide with what McAfee and Schwartz term passive beliefs: when consumers observe an out-of-equilibrium headline price, they do not revise their beliefs about the firm’s additional price.

consumers may be naive about their ability to avoid the additional price; as in the case of a high-income consumer holding a high bank-account balance and therefore never paying an overdraft fee, high-value consumers may automatically avoid the additional price; and as in the case of a person who has limited attention but does not exhaust her limit after observing two prices, consumers may be able to observe further prices at an increasing positive cost.

4.2 Baseline Equilibrium: High Prices for Low-Income Populations

Our model has a unique equilibrium outcome with the following properties:¹¹

Proposition 4. *In equilibrium, all firms charge an additional price of $\bar{a}$. Low-value consumers study and avoid paying $\bar{a}$, while high-value consumers browse and incur $\bar{a}$. Firms choose headline prices according to a unique continuous distribution with support $[f_{\min}, f_{\max}]$, and at each price earn expected profits equal to $\alpha(f_{\max} - c)/I$. Furthermore, there exists an $\alpha^* \in (0, 1)$ such that $f_{\max} = v_L$ for $\alpha \geq \alpha^*$ and $f_{\max} = \mathbb{E}[f] + \bar{a} < v_L$ for $\alpha < \alpha^*$. The average total price that consumers pay is strictly increasing in α .*

To take advantage of browsing consumers, firm i sets $a_i = \bar{a}$. Since high-value consumers prefer to buy and not to avoid the additional price, they browse for any equilibrium headline price. Less obviously, in equilibrium low-value consumers always prefer to study. For a rough intuition, note that since all firms set $a_i = \bar{a}$ for any f_i , a consumer prefers to browse if and only if the headline price she observes is sufficiently high. Now consider the firm that charges the highest equilibrium headline price, supposing that no other firm charges the same price with positive probability. If at this price low-value consumers preferred to browse, then—with all consumers browsing—the firm would lose all consumers to lower-priced competitors with probability one. In an effect reminiscent of the “competition for consumer inattention” in De Clippel et al. (2014), the firm therefore lowers its headline price to the range where low-value consumers study.¹²

¹¹ Baye et al. (1992) show that the classic search model of Varian (1980) has infinitely many equilibrium outcomes when there are more than two firms. In Varian’s setting, any non-symmetric equilibrium involves a mass point at the consumers’ reservation price for at least one firm. As we show in the proof of Lemma 4, equilibria with mass points do not exist in our setting. The difference arises because in Varian’s model informed consumers see all prices, whereas in our model browsing high-value consumers see only two headline prices.

¹² Similarly, in classic sequential search models (e.g., Stahl, 1989, Janssen et al., 2005) equilibrium prices are just low enough to discourage consumers with positive search costs from searching a second product.

The search behavior of the two consumer types in turn implies that the average price consumers pay is *decreasing* in the share of high-value consumers. On the one hand, since high-value consumers do not avoid the additional price, they pay a higher average price than low-value consumers, so they have a direct positive effect on the average price consumers pay. On the other hand, high-value consumers browse and thereby spur competition, so they have an indirect negative effect on the average price firms charge. Proposition 4 establishes that the latter effect always dominates the former effect.

The detailed logic of this result is as follows. The fact that low-value consumers study implies that if α is sufficiently high, a firm can guarantee itself the low-value consumers assigned to it by setting $f_i = v_L$. Similarly to Varian (1980), this option generates a “profit base” that ties down firms’ equilibrium profit level. Since the profit base is given by *low-value* consumers, an increase in their share raises profits.

If α is sufficiently low, the competition for consumer inattention described above further reduces firms’ prices. Again similarly to Varian, the dual objective of exploiting price-insensitive low-value consumers and attracting price-sensitive high-value consumers leads firms to select a random headline price. When there are many high-value consumers, the motive to compete for them is strong, so firms’ expected headline price is quite low. If a firm quoted a headline price of v_L , therefore, a low-value consumer would be better off browsing and choosing a competitor, forcing firms to price lower.¹³

A reassuring thought might be that the profitability of selling when the share of low-value consumers is high will attract entrants to the market, lowering prices for consumers after all. It seems natural to assume, however, that a new entrant is in a disadvantageous position when trying to attract consumers with limited attention. In Appendix B, we formulate a model that captures this disadvantage, and establish that when the share of low-value consumers is high, entry is

¹³ The main challenge in the proof of Proposition 4 is that consumers’ search strategies and firms’ pricing strategies are multidimensional and richly interdependent, making it extremely difficult to establish basic facts about equilibrium behavior. This difficulty appears most notably at two parts of the proof. First, we derive that high-value consumers browse and low-value consumers study without assuming any structure on prices, requiring a complex line of argument (see Lemmas 3 and 4). Second, low-value consumers must be indifferent between browsing and studying at f_{max} whenever $f_{max} < v$. In this case, f_{max} depends on α via the equilibrium headline-price distribution, which in turn is a function of f_{max} . As a result, pinning down f_{max} and its comparative statics is algebra-intensive.

relatively unprofitable for the same reason—lack of comparative search by consumers—that being in the market is profitable. Worse, if entry occurs, it increases the average price consumers pay. With the entrant in the market, incumbents reorient their pricing strategy toward exploiting low-value consumers, reducing overall competition. As a practical example, this logic provides one account of why liberalization led to high prices in the UK energy market: entrants attracted consumers looking to switch, leading legacy suppliers to raise prices on their remaining, disproportionately non-switching (and disproportionately lower-income) consumers (Ofgem, 2014).

4.3 The Effects of Regulation

We now return to the main message of our paper: that regulation can lead consumers to substitute their search efforts toward browsing, enhancing competition. We demonstrate this as well as a number of additional insights by analyzing how changes in regulations—in both the permissive and restrictive directions—affect the equilibrium we discussed in Section 4.2.

Deregulation Leads to Monopoly. To make our basic point, we ask what happens in the model of Section 4.1 without regulation, i.e., without a cap on the additional price.

Proposition 5. *In any equilibrium in which both consumer types buy with positive probability, firms charge $f_i = v_L$ and $a_i = v_H - v_L$, and such an equilibrium exists.*

Deregulation leads to a total collapse in competition: without a cap on the additional price, each firm acts as a monopolist, using the two prices to perfectly price discriminate between—and extract all rents from—consumers who purchase. As in Proposition 1, in equilibrium consumers must study to guard against price gouging, so they do not comparison shop, and therefore firms do not compete. Furthermore, there are also equilibria in which all high-value consumers browse and—believing that firms have priced them out of the market ($a_i \geq v_H - v_L$)—then do not buy. In such situations, regulation not only lowers prices, but also increases efficiency.

The competition-enhancing effect of regulation hinges on the regulation being sufficiently strict. Our baseline model requires that $\bar{a} \leq v_H - v_L$, i.e., it requires a cap on the additional price that is binding when one starts from the equilibrium of Proposition 5. If $\bar{a} > v_H - v_L$ and $\alpha > \alpha^*$, then the equilibrium in Proposition 4 does not survive, as high-value consumers quoted two prices

near v_L would not purchase. For $\bar{a}$ sufficiently close to $v_H - v_L$, there is an equilibrium with a similar structure, but it generates lower consumer value both because high-value consumers might not purchase and because consumers who do purchase pay a higher average price.¹⁴ And for sufficiently high $\bar{a}$, even this type of equilibrium fails to exist.¹⁵ At the same time, the equilibrium in Proposition 5 survives for any $\bar{a} > v_H - v_L$. These observations imply that only a binding cap on the additional price ($\bar{a} \leq v_H - v_L$) is robustly competition-enhancing, and higher caps may produce smaller gains even when they do have an effect. Still, the general insight that the regulation can have a large positive indirect effect holds: a binding regulation can have a much larger total impact on prices than its direct impact on the additional price.

Plain-Vanilla Regulation Leads to Perfect Competition. Completely different regulations can also engage the mechanism of empowering consumer search. As a potentially important example, we consider an intervention in our basic model with a cap $\bar{a}$ on the additional price. Suppose that the social planner requires firms to sell a “plain-vanilla” product that has only a headline price and no additional price. If a consumer purchases from a firm, the firm can offer her extra services or contract modifications that involve an additional price, but—crucially—the consumer can accept or reject any offer without paying an attention cost. This regulation is roughly consistent with Barr et al. (2008), who propose requiring lenders to offer a simple plain-vanilla mortgage contract, and to allow a consumer to refuse other offers without reading them. To stack the cards against the regulation, we assume that a high-value consumer pays the additional price in our basic model because she values the services associated with it, so that she finds the plain-vanilla contract undesirable: her utility from purchasing firm i ’s regular product is $v_H - f_i - a_i$, while her utility from purchasing the firm’s plain-vanilla product is $v_H - \kappa - f_i$, where $\kappa \geq \bar{a}$. Then, holding prices and search behavior fixed, the plain-vanilla policy does not affect any outcomes—low-value

¹⁴ In such an equilibrium, firms (beyond choosing the additional price $\bar{a}$ with probability 1) charge the headline price v_L with positive probability, and with the complementary probability charge a headline price continuously distributed on $[f_{min}, v_H - \bar{a}]$. The latter part of the distribution is similar to that in Proposition 4 and ensures that firms earn $\alpha(v_L - c)/I$ in expectation for all headline prices. If a high-value consumer samples two firms with headline price v_L , then she does not purchase. Since firms earn the same expected profit as in Proposition 4 but consumers do not always purchase, the expected total payment of a consumer conditional on purchase must be higher than in Proposition 4.

¹⁵ For sufficiently high $\bar{a}$, a firm charging a headline price of $v_H - \bar{a}$ makes losses, and hence trying to attract high-value consumers cannot be worth it.

consumers avoid the additional price, while high-value consumers do not. Nevertheless, the policy has a drastic effect:

Proposition 6. *There is an equilibrium in which low-value and high-value consumers pay total prices of $c - (1 - \alpha)\bar{a}$ and $c + \alpha\bar{a}$, respectively, and firms make zero expected profits.*

Low-value consumers stick with the plain-vanilla product, and—no longer needing to study to avoid the additional price—they can now browse, inducing perfect competition between firms. Both high-value and low-value consumers benefit from this, but because low-value consumers suffered more from the lack of competition, they benefit more.¹⁶

Efficiency Effects. Although we have noted that the lack of regulation can lead consumers to inefficiently refrain from purchase, our policy results pertain mostly to the *competitiveness* of the market. In natural variants of our model, regulation can enhance efficiency through many channels. If consumers have heterogeneous values or firms have heterogeneous costs, then an increase in competition brought about by regulation can have the classical welfare-enhancing effects of drawing more consumers into the market and forcing inefficient firms to exit. Similarly, if firms’ base products are horizontally differentiated, then the increase in browsing facilitated by regulation increases efficiency by helping consumers find better matches for their tastes. Furthermore, regulation can benefit firms in addition to increasing consumer and total welfare. For instance, consumers might use the attentional capacity freed up by regulation to enter more markets, potentially increasing firms’ profits there.

Nevertheless, the beneficial effects of regulation we identify must be balanced against classical concerns regarding regulation. For instance, the secondary features of a product may be an efficient response to heterogeneity in consumer preferences, so that regulating them is harmful. To be precise about the tradeoff, it would seem useful to integrate our framework into a model in which possible distortions are explicitly specified. Although a general analysis is beyond the scope of this paper, we give an example of a likely tradeoff in Appendix C: if a consumer needs to study to determine

¹⁶ First, within a given population, low-value consumers benefit more from the regulation. Without regulation, they obtain the product at a more expensive headline price on average. With regulation, they do so at the same headline price. Second, populations in which the share of low-value consumers is higher also benefit more from the regulation. Without regulation, the average total price consumers pay is increasing in the share of low-value consumers. With regulation, it is constant.

whether she likes the basic or the premium version of a product, then a standardization that bans the premium version enhances competition at the cost of lowering efficiency.

5 Applications

In this section, we present a few empirical applications of our framework.

5.1 Health Insurance

Evidence by Ericson and Starc (2016) on a 2010 reform of the Massachusetts health insurance exchange—a government-run marketplace for private insurance—confirms the key mechanism of our theory: that regulation of the additional price facilitates comparison shopping and thereby makes consumer purchases more sensitive to product features. In this setting, we think of the headline price as the net-of-premium expected benefit implied by the insurance product’s core financial characteristics (deductible, copay, etc.), and of the additional price as the expected disutility from holes in coverage implied by the fine print (what counts toward the deductible, which medications are covered, etc.). Before the reform, insurers had substantial leverage in how to design their plans, resulting in the potential of large additional prices. For instance, a diabetes patient’s out-of-pocket annual medical spending could differ by a factor of 4.5 (\$960 versus \$4,383) under different plans with the same actuarial value (Pollitz et al., 2009). Furthermore, anecdotal evidence as well as feedback from focus groups indicate that consumers were aware of and worried about such “gotchas” in coverage (e.g., Day and Nadash, 2012). Taking the view that most consumers find it prohibitively costly to understand the fine print but may trust some insurers based on experience or the recommendations of acquaintances, this corresponds roughly to the asymmetric-shrouding version of our model with lax regulation. Hence, the asymmetric-shrouding version of Proposition 1 — which says that consumers do not choose a firm with a lower headline price because they expect it to have a higher additional price — applies: consumers are reluctant to switch to an unknown insurer offering a seemingly better plan for fear that something major would not be covered.¹⁷ As

¹⁷ One can describe the situation more fully by going slightly outside our model. Suppose that firms choose not only the additional price, but also the conditions under which the additional price applies. For instance, insurers can

a result, consumers are not sufficiently sensitive to plan features.

The 2010 reform regulated the fine print by defining minimum coverage levels, and harmonized the basic financial characteristics of plans with the same actuarial value. Ericson and Starc (2016) document that as a result of this reform, consumers became more sensitive to the financial characteristics of plans, and chose more generous plans. Complementary evidence by Abaluck and Gruber (2011) suggests that in making insurance choices, consumers tend to place too little weight on plan generosity, so the change in behavior likely benefited consumers. From the perspective of our model, the reform allowed consumers to do more comparison shopping on financial characteristics, resulting in better choices.

While this setting can be used to study the consumer response to regulation, it is not appropriate for testing our predictions on firm responses. Since the financial characteristics of plans were harmonized, there was no scope for competition in this dimension to increase. And Ericson and Starc find that consumers were quite sensitive to premia even before the reform and did not become more sensitive afterwards, indicating that the premium was salient throughout. Regulation did increase consumers' willingness to switch between brands, which suggests greater competition in other aspects of insurance coverage—especially the physician network—but we have not seen direct evidence of such an effect.

5.2 Unfair Contracts Principle

Our framework provides a novel rationale for existing regulation of standard-form contracts, a common arrangement for selling consumer services. A standard-form contract consists of a price to be paid together with non-negotiable fine-print contract terms detailing other terms and obligations of the trade. The German Civil Code's as well as the European Union's principle on unfair terms in standard-form contracts effectively prohibits provisions that are too unclear or surprising relative to how things are normally done, and that are too disadvantageous to the consumer.¹⁸ The main

include in the fine print an obscure list of medications or conditions that are not covered. While each consumer has an insurer that she trusts covers her conditions appropriately, it is impossible for her to ascertain whether this is the case for an unknown insurer.

¹⁸ See Sec. 305c and 307 of the German Civil Code (with Sec. 308-9 spelling out Sec. 307 in more detail) and Articles 3, 5, and 6 of directive 93/13/EEC of the Council of the European Communities. The documents are available at https://www.gesetze-im-internet.de/englisch_bgb/englisch_bgb.html#p0925 and

existing justification for this principle is that it reduces the transaction cost of obtaining information about a product. To the extent that consumers cannot or do not read the contract, the principle can also reduce information asymmetries. Consistent with the latter perspective, conventional wisdom in the law-and-economics community is that most consumers do not read standard-form contracts.¹⁹

While existing arguments for regulation can justify the unfair contracts principle, our model strengthens the case for it. Thinking of the price and core features of the product as the headline price and disadvantageous details contained in the fine print as the additional price, the principle corresponds exactly to a cap on the additional price. Hence, our model predicts that the principle facilitates competition, in part by allowing consumers to comparison shop rather than study contracts. Indeed, some evidence indicates that consumers’ tendency not to read standard-form contracts is strategic—they would read more if they perceived a greater benefit of doing so—so that the principle has freed up consumer attention.²⁰

Furthermore, our model provides a justification for a part of the unfair contracts principle that existing arguments do not immediately address. The principle explicitly states that it applies only to individual provisions in a contract, and *not* to the transaction as a whole.²¹ From a classical perspective, it may be puzzling why the social planner insists on regulating the fairness of individual terms rather than the fairness of the transaction as a whole; after all, it is the entire transaction that both parties care about. Yet Proposition 3 implies that only individual terms should be regulated: unlike regulation of the additional price, regulation of the total price fails to change consumers’

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31993L0013:en:HTML>, respectively.

¹⁹ See the discussions in Becher and Unger-Aviram (2010), Eisenberg (1995), and Luth (2010). For the case of retail software licenses, for instance, Bakos et al. (2014) empirically investigate whether shoppers access the license agreement, which is just one click away. Less than 0,2% of consumers access the agreement, and almost all who do spend far too little time to read it in full (many consumers read it for less than a second).

²⁰ Based on student answers to hypothetical scenarios, Becher and Unger-Aviram (2010) conclude that a vast majority of subjects would read through their child’s nursery contract, but not rental-car, bank-account, or laundry contracts. Similarly, survey evidence on first-year law students in Hillman (2005) indicates that they are more likely to read internet standard-form contracts if the value of the contract is high. And in the same vein, consumers are more likely to study firms they perceive as less trustworthy: Bakos et al. (2014) find that consumers are more likely to read the license agreement of companies that are smaller or offer suspicious products such as freeware, and Hillman (2005) finds that over a third of his subjects read contract terms when buying from an unknown vendor.

²¹ “Assessment of the unfair nature of the terms shall relate neither to the definition of the main subject matter of the contract nor to the adequacy of the price and remuneration, on the one hand, as against the services or goods supplied in exchange, on the other” (Article 4.2 of directive 93/13/EEC of the Council of the European Communities).

behavior and therefore does not increase competition.

5.3 Food Safety in Developing Countries

Our model also helps understand problems in an insufficiently regulated market. At a general level, it seems widely recognized that the decision environment is more difficult in developing countries than in developed countries (Kremer et al., 2019), and Duflo (2012) argues that these difficulties often arise due to a lack of regulation, as consumers in developing countries have to pay attention to things residents in developed countries take for granted. A poor mother, for instance, has to worry about whether to boil her infant’s drinking water or where to get safe immunizations, and as a result she may not have energy left to think about the older sibling’s education.

As a specific example, we discuss the market for food and the associated issue of food safety. While developed countries have seen some well-publicized scares, in developing countries food safety is a constant issue.²² Consumers recognize the issue and are concerned, with the vast majority listing food safety as a major to most important problem of daily life.²³ Furthermore, many studies indicate that consumers are willing to pay a premium for safe food that is between 5 and 100% (Grace, 2015). At the same time, producers are capable of maintaining high standards for food safety; notably, many developing countries export food that passes stringent import requirements in developed nations (Unnevehr, 2015). There is some evidence that one way in which exporters maintain higher standards is by vertically integrating with producers, and not buying from other, especially smaller producers (Schuster and Maertens, 2013). Based on personal conversations, domestic consumers who really care about food safety can engage in a similar practice of buying food from select trusted suppliers, although we have not found direct evidence of this behavior.²⁴

²² Developing countries probably bear most of the burden of foodborne disease, including from viruses, bacteria, parasites, fungal toxins, agricultural chemicals, and marine toxins (e.g., World Health Organization, 2015, Grace, 2015). These result from unsafe agricultural practices, including improper use of agro-chemicals, fertilizers, and pesticides, a water supply that might be contaminated by sewage or industrial chemicals, and the use of harmful preservatives and additives during processing (e.g., Lam et al., 2013).

²³ For instance, Lam et al. (2013) report that Chinese consumers consider food safety as more worrisome than public safety, traffic safety, health safety, and environmental safety. Only about 7% of consumers are seldom or never concerned about food safety (Liu and Ma, 2016).

²⁴ For example, according to anecdotal evidence from Nigeria, safety-conscious consumers often refrain from buying food at outdoor markets and instead go to the large South African retailer Shoprite. And some consumers in India buy exclusively from trusted merchants, and have gruesome stories of what happened when they made exceptions.

There is therefore an apparent mismatch: consumers have a demand for food safety, producers seem capable of supplying this demand, yet a lot of food on the market is unsafe. This situation is described by the insufficiently regulated case of our framework. Consider our model with an unavoidable additional price from Section 3.2, where the headline price is the retail price of food and the additional price is the utility loss from unsafe food. Producing unsafe food saves suppliers money, but consistent with the notion that the cost savings is lower than the harm to consumers, consumers value the additional price more highly than producers ($r > 1$). In equilibrium, consumers less concerned with safety buy a product with a high additional price (i.e., unsafe food) in a competitive market, while consumers more concerned with safety buy a product with no additional price (i.e., safe food) from a trusted producer. While the former consumers are getting cheap food, they are not happy, as they would prefer to buy safer food at higher prices. But they are not buying the safe food available from reliable producers because in that market, they would have to pay a double premium: one for the higher cost of production and one for being served by a trusted supplier with monopoly power.²⁵

As we have shown, tightening regulation benefits all consumers: those buying on the competitive market are able to purchase safer food at reasonable prices, and those buying from trusted suppliers can now purchase equally safe food at a lower price. Once again, previous arguments for regulation centered around reducing transaction costs and information asymmetries also justify food safety regulation, but our argument strengthens the case for it in at least two ways. First, our model says that by strengthening competition, regulation benefits even the latter consumers above, who are buying food that they have checked out themselves and that is safer than required by regulation. Second, as we discuss in more detail in Section 6 below, our framework implies that regulation might be justified even if it is costlier to enforce than what it saves citizens in studying costs.

²⁵ Beyond illustrating the problems of an unregulated market, this example also highlights the shortcomings of certification we have discussed in Section 3.3. Zhang et al. (2015) describe the emergence of third-party certification in China, but also its unreliability in the eyes of consumers and its decline. Illegal enterprises forge certificates, and several certification agencies sell certificates to producers without regard to farming practices. One might hope that public certification agencies can do better. But Zhang et al. (2015) also report that local governments conceal food safety problems to protect tax-paying local companies.

5.4 Shopping Behavior of Different Consumers

Our theory can be used to tie together in a single framework various observations regarding the behavior of low- and high-income consumers and the prices they pay. On the one hand, in some settings low-income consumers shop more effectively than high-income consumers. Aguiar and Hurst (2007) find that lower-income consumers go on more grocery-shopping trips, and pay lower prices for the same items, than do higher-income consumers. This reflects at least in part that low-income consumers take better advantage of a seller's sales or discounts: Broda et al. (2009) and Handbury and Weinstein (2015) document that lower-income consumers spend less on the same items even *in the same chain* and after controlling for zip-code-level per-capita income or including city dummies.

On the other hand, in some markets low-income consumers shop less intensively than high-income consumers. A survey by Fannie Mae (2015) indicates that those with incomes over \$75,000 are 17 percent more likely to obtain multiple quotes for a mortgage than those with incomes below \$50,000, while education is not associated with a higher likelihood of such shopping. Looking at the same issue more carefully, Agarwal et al. (2016b) compare applicants with identical ex-ante risk profiles whose first mortgage was rejected, and who ended up borrowing either from an affiliate of the originally approached lender or from an unaffiliated lender. Borrowers in high-income neighborhoods were more likely to purchase a mortgage from a different lender and to receive a better deal, indicating that high-income consumers do more comparison shopping.²⁶

Without additional assumptions on differences in search costs across domains, the above can be seen as puzzling: the evidence from grocery shopping indicates that lower-income consumers have lower search costs, while the evidence from mortgage markets suggests the opposite. Our framework naturally reconciles the two findings. To see this, consider our two-market model, in which groceries is one market and mortgages is the other market. For groceries, we think of

²⁶ These findings are part of a broader conclusion that low-income borrowers received very unfavorable mortgage terms before the financial crisis (e.g., Engel and McCoy, 2002). Indeed, the pre-crisis subprime mortgage market is a good example of an insufficiently regulated market in the spirit of Propositions 1 and 5. Bar-Gill (2009) argues that the complexity of the fees lenders could impose rendered it exceedingly difficult to compare products, so borrowers may have even rationally decided not to comparison shop. Despite the seemingly competitive nature of the market by conventional measures of concentration, therefore, lenders acted as local monopolies.

the prices that a consumer can obtain using sales and discounts as the headline price, and the savings she foregoes if she does not use sales and discounts as the additional price. Studying then corresponds to keeping track of discounts and visiting the store more often to obtain goods on sale, which crowds out comparison shopping for mortgages. Furthermore, lower-income consumers are more willing to substitute between brands to obtain lower prices. A version of Proposition 4 then says that—in line with the stylized facts—lower-income consumers study in the groceries market and higher-income consumers browse in the mortgage market.²⁷

Furthermore, the prediction of Proposition 4 that prices are higher when the share of low-value consumers is higher helps explain evidence that consumers in lower-income neighborhoods pay higher prices for some goods and services, including mortgages, insurance, cars, mobile phones, and energy (Fellowes, 2006, Hogan, 2016). While other factors surely contribute to this phenomenon, it is not clear that they can provide a full explanation. The most natural explanation is that the cost of doing business is higher in lower-income neighborhoods, for instance because these neighborhoods are less safe or consumers living there have higher default rates. But the costs of doing business are presumably often lower in lower-income neighborhoods (e.g., due to lower wages or property prices). For instance, the above study by Agarwal et al. (2016b) shows that the higher prices for lower-income borrowers were not justified by borrowers’ previous qualifications or subsequent default rates.

While consistent with our positive predictions, this setting also points to a limit of our main point regarding regulation. Here, studying is aimed at obtaining deals on groceries, so capping the additional price would amount to limiting sales or discounts for groceries. But it is likely that such discounts serve a useful price-discrimination rule, so regulating them is inefficient.

6 Related Literature

From a formal point of view, our model can be thought of as combining the literatures on consumer search, hidden prices, and rational inattention. We modify three assumptions that the vast majority of the search literature makes: (i) once a consumer decides to search a product, she comes to

²⁷ We outline this two-market model in more detail in Appendix A.

understand the product perfectly; (ii) the cost of searching products is linear; and (iii) the way in which consumers can search is exogenously fixed. Following the framework of Ellison (2005) and Gabaix and Laibson (2006), as well as the growing theoretical literature on consumer naivete in markets (e.g., Eliaz and Spiegler, 2006, Gabaix and Laibson, 2006, Spiegler, 2006b, Grubb, 2009, Heidhues and Köszegi, 2010, Grubb, 2015a, Heidhues and Köszegi, 2018), we modify (i) by distinguishing between more visible headline prices and more hidden additional prices, and allowing a consumer to look only at the headline price of a product. We relax (ii) by positing limited search capacity. And consistent with the literature on rational inattention, we relax (iii) by assuming that consumers optimally choose what they pay attention to.²⁸ A few previous papers have modified these assumptions, but always one at a time. Replacing (i), Gamp (2015) considers consumers who can purchase a product without knowing its price. Replacing (ii), Carlin and Ederer (2012) and Ellison and Wolitzky (2012) assume convex search costs. And replacing (iii), Haan et al. (2015) and Armstrong (2016) have started to investigate directed search.

Our paper also belongs to the literature on the interaction between boundedly rational consumers and profit-maximizing firms. Most papers in that literature specify consumer search exogenously (e.g., Spiegler, 2006a, Armstrong and Chen, 2009, Bachi and Spiegler, 2018, Grubb, 2015b), but there are exceptions. Most related to our paper, De Clippel et al. (2014) study a model of competition with strategically inattentive consumers who observe the price of the market leader in each of multiple markets, and can also inspect competitors' prices in a given number of markets of their choice. By lowering its price, a market leader increases the chance that the consumer ignores competitors and buys from it, so that leaders effectively compete for consumer inattention. An increase in consumers' capacity to inspect markets can induce leaders to focus on exploiting the most inattentive consumers, lowering competition and increasing prices.²⁹

²⁸ That people make such strategic attentional decisions is documented by Gabaix et al. (2006) and Bartoš et al. (2016), and implications are explored by Sims (2003, 2010), Mackowiak and Wiederholt (2009), Matějka and McKay (2015), and many others. In much of the literature, the uncertainty that consumers seek to understand is exogenously given, whereas in ours it results from optimizing decisions by firms.

²⁹ Ravid (2017) modifies a standard bargaining model by assuming that the buyer is rationally inattentive to the product's quality and the seller's offers. He finds that this increases the buyer's surplus. Roesler (2015) studies a monopolist selling to a consumer who chooses how to learn about product value taking into account the impact on the subsequent pricing decision of the firm. She establishes that the consumer prefers a coarse perception of her own valuation. Gamp and Krämer (2017) consider a search model in which firms choose quality, and naive consumers

The existing literature identifies several channels through which regulation can improve markets; our argument, however, applies even when existing ones do not. Most importantly, regulation can mitigate adverse selection when consumers cannot ascertain some dimensions of quality or more generally lack trust in sellers (see, e.g., Christensen et al. 2016 in the context of securities and Shavell 1980 in the context of product safety), and it can also substitute for costly private solutions to market failures (Shleifer, 2011, Schwartzstein and Shleifer, 2013).³⁰ In either case, if private parties are able to mitigate market failures through less costly and more effective measures, then regulation is not justified. Because in our model regulation has a beneficial indirect effect through consumer search, it may be justified even in such situations. In the unregulated equilibrium of our model in Section 3.2 with $r > 1$, for instance, consumers are studying to make sure they are not hurt by the additional price, and the additional price is zero. Yet capping the additional price at an above-equilibrium level $\bar{a} > 0$ —i.e., a regulatory solution that is worse than the private one—has a major positive effect on consumer welfare. This is often true even if the regulation is more costly than what it saves consumers in studying costs (zero).

In the literature on choice complexity (e.g., Carlin, 2009, Piccione and Spiegler, 2012, Chioveanu and Zhou, 2013, Spiegler, 2016), consumers who cannot understand or compare prices choose randomly and thereby lower competition, so that regulations increasing the comparability of prices—e.g., by making them scalars (Grubb, 2015c)—are pro-competitive. In our model, regulation of secondary features encourages comparative search and hence less random choice by consumers, so in a reduced form it can be understood as increasing comparability. But models of choice complexity specify the comparability of prices exogenously, so they do not make predictions about what

erroneously believe that all firms offer high quality. They show that as search frictions disappear, low-quality products come to dominate the market and naive consumers' purchases.

³⁰ Shleifer (2011) singles out especially contract regulations, emphasizing that from a classical perspective contracts are a substitute for regulation (e.g., for dealing with externalities), and hence should not themselves be the objects of regulation. To explain why contracts are nevertheless regulated, Shleifer argues that litigation is “expensive, unpredictable, or biased,” rendering regulation the more efficient alternative. Schwartzstein and Shleifer (2013) construct a model in which firms decide whether to take safety precautions, and courts make errors in determining whether precautions were ex-ante necessary. This makes litigation following accidents unpredictable, creating a risk that discourages firms from entry. Schwartzstein and Shleifer show that imposing a regulatory standard, and partially or fully exempting firms that comply with the standard from litigation, can induce more entry while still encouraging safety precautions. If the social return from entry is higher than the private return, therefore, regulation increases efficiency.

kind of regulations work—and Piccione and Spiegler (2012) emphasize that even regulations that uniformly improve comparability can easily backfire. In particular, our results that sufficiently tight regulations of the additional price increase competition, but less tight regulations of the additional price may not, and regulations of the total price never do, do not follow from models in the comparability literature.

Similarly, perhaps the main message of the large literature on search is that lowering search costs increases competition. Again, in a reduced form regulation in our model can be understood as lowering search costs. But the search literature does not consider the implications of asymmetric shrouding or the tradeoff between studying and browsing, so models in this literature do not imply the above results. In fact, the received wisdom from the search literature is that price caps *lower* consumers’ propensity to comparison shop, decreasing competition and potentially increasing prices.³¹

Regulation can also enhance competition by standardizing products and thereby making them closer substitutes (Ronnen, 1991, for example). In this literature, there is no parallel to the insight that additional and not total prices should be regulated, and regulation does not work through influencing consumers’ search behavior. Indeed, in our setting regulation can induce competition without changing substitutability; for instance, in our first model products are identical in all respects both with and without regulation.

Finally, the case for regulation we make has some parallels with the idea of “managed competition” researchers have proposed in the context of health-insurance markets in the US (e.g., Enthoven, 1993). Managed competition is defined as a group-insurance purchasing strategy that “structures and adjusts the market to overcome attempts by insurers to avoid price competition.” Though we are unaware of a formal treatment of this idea and a precise mechanism is not spelled out, one piece of the proposed strategy is the standardization of plans to make consumers more price sensitive, in part by ensuring that consumers are not worried about hidden gaps in coverage.

³¹ In Fershtman and Fishman (1994) and Armstrong et al. (2009), consumers observe the price of only one firm, but can incur a cost to become informed about the prices of other firms. A price cap shrinks price dispersion and thereby reduces consumers’ incentive to become informed, decreasing competition. As a result, the price cap can raise the average price consumers pay.

7 Conclusion

A caveat to our predictions is that if consumers do not trust the government, then government regulation does not eliminate the need to study. For instance, a consumer in a developing country might have to research whether regulations that are on the books are actually being enforced. Hence, our policy results rely on relatively well-functioning public institutions.

Furthermore, one must recognize that learning about and understanding policies requires attention just like learning about and understanding products does. Hence, to really liberate consumers to do more browsing, the regulations motivated by our framework should be simpler to communicate and understand than the market practices they govern, and they are likely to be most effective if distilled into clear, broad principles. Once again, the European Union’s principle on unfair contract terms is a potential practical example: it has extremely broad scope (it applies to any business-to-consumer contract), yet its basic idea is easy to understand. But it would be fruitful to develop and analyze a framework incorporating individuals’ limitations in understanding policies as well.

While we have focused on prices in this paper, it would seem worthwhile to analyze the effects of our competition-enhancing regulations on other market outcomes. As a notable example, one wonders how such a regulation affects firms’ incentive to innovate. In as much as the regulation induces firms to improve products along valuable core dimensions—e.g., thinking about the functionality and style of baby furniture rather than cutting costs by skimping on safety—the indirect effect on innovations could be substantially beneficial. But in as much as the regulation induces firms to think about how to get around it—e.g., by inventing new fees for a mortgage—the indirect effect on innovations can also be detrimental.

References

- Abaluck, Jason and Jonathan Gruber**, “Choice Inconsistencies among the Elderly: Evidence from Plan Choice in the Medicare Part D Program,” *American Economic Review*, 2011, 101 (4), 1180–1210.
- Agarwal, Sumit, Changcheng Song, and Vincent Yao**, “Banking Competition and Shrouded Attributes: Evidence from the US Mortgage Market,” 2016. Working Paper.

- , **Gene Amromin, Itzhak Ben-David, and Douglas D. Evanoff**, “Loan Product Steering in Mortgage Markets,” Working Paper 22696, National Bureau of Economic Research 2016.
- , **Souphala Chomsisengphet, Neale Mahoney, and Johannes Stroebe**, “Regulating Consumer Financial Products: Evidence from Credit Cards,” *Quarterly Journal of Economics*, 2015, *130* (1), 111–164. Previously NBER Working Paper #19484.
- Aguiar, Mark and Erik Hurst**, “Life-Cycle Prices and Production,” *American Economic Review*, 2007, *97* (5), 1533–1559.
- Alexandrov, Alexei and Sergei Koulayev**, “No Shopping in the US Mortgage Market: Direct and Strategic Effects of Providing Information,” May 2018. Working Paper.
- Anagol, Santosh and Hoikwang Kim**, “The Impact of Shrouded Fees: Evidence from a Natural Experiment in the Indian Mutual Funds Market,” *American Economic Review*, 2012, *102* (1), 576–593.
- Armstrong, Mark**, “Search and Ripoff Externalities,” *Review of Industrial Organization*, 2015, *47* (3), 273–302.
- , “Ordered Consumer Search,” 2016. Working Paper.
- **and Yongmin Chen**, “Inattentive Consumers and Product Quality,” *Journal of the European Economic Association*, 2009, *7* (2-3), 411–422.
- , **John Vickers, and Jidong Zhou**, “Consumer Protection and the Incentive to Become Informed,” *Journal of the European Economic Association*, 2009, *7* (2-3), 399–410.
- Bachi, Benjamin and Ran Spiegler**, “Buridanic Competition,” *Games and Economic Behavior*, January 2018, *107* (1), 298–315.
- Bakos, Yannis, Florencia Marotta-Wurgler, and David R. Trossen**, “Does Anyone Read the Fine Print? Consumer Attention to Standard-Form Contracts,” *Journal of Legal Studies*, January 2014, *43* (1), 1–35.
- Bar-Gill, Oren**, “The Law, Economics and Psychology of Subprime Mortgage Contracts,” *Cornell Law Review*, 2009, *94* (5).
- Barr, Michael S., Sendhil Mullainathan, and Eldar Shafir**, “Behaviorally Informed Financial Services Regulation,” Technical Report, New America Foundation 2008.
- Bartoš, Vojtěch, Michal Bauer, Julie Chytilová, and Filip Matějka**, “Attention Discrimination: Theory and Field Experiments with Monitoring Information Acquisition,” *American Economic Review*, 2016, *106* (6), 1437–75.
- Baye, Michael R., Dan Kovenock, and Casper G. de Vries**, “It Takes Two to Tango: Equilibria in a Model of Sales,” *Games and Economic Behavior*, 1992, *4* (4), 493–510.

- Becher, Shmuel and Esther Unger-Aviram**, “The Law of Standard Form Contracts: Misguided Intuitions and Suggestions for Reconstruction,” *DePaul Business & Commercial Law Journal*, 2010, 199.
- Blume, Andreas and Paul Heidhues**, “Private Monitoring in Auctions,” *Journal of Economic Theory*, 2006, 131 (1), 179 – 211.
- Broda, Christian, Ephraim Leibtag, and David E. Weinstein**, “The Role of Prices in Measuring the Poor’s Living Standards,” *Journal of Economic Perspectives*, 2009, 23 (2), 77–97.
- Brown, Meta, Christopher J. Flinn, and Andrew Schotter**, “Real-Time Search in the Laboratory and the Market,” *American Economic Review*, 2011, 101 (2), 948–974.
- Carlin, Bruce I.**, “Strategic Price Complexity in Retail Financial Markets,” *Journal of Financial Economics*, 2009, 91 (3), 278–287.
- and **Florian Ederer**, “Search Fatigue,” 2012. Working Paper.
- Chioveanu, Ioana and Jidong Zhou**, “Price Competition with Consumer Confusion,” *Management Science*, 2013, 59 (11), 2450–2469.
- Choi, James J., David Laibson, and Brigitte C. Madrian**, “Why Does the Law of One Price Fail? An Experiment on Index Mutual Funds,” *Review of Financial Studies*, 2010, 23 (4), 1405–1432.
- Christensen, Hans B., Luzi Hail, and Christian Leuz**, “Capital-Market Effects of Securities Regulation: Prior Conditions, Implementation, and Enforcement,” *Review of Financial Studies*, 2016, 29 (11), 2885–2924.
- Consumer Financial Protection Bureau**, “Consumers’ Mortgage Shopping Experience,” Technical Report, Consumer Financial Protection Bureau 2015. https://files.consumerfinance.gov/f/201501_cfpb_consumers-mortgage-shopping-experience.pdf.
- Day, Rosemarie and Pamela Nadash**, “New State Insurance Exchanges Should Follow The Example Of Massachusetts By Simplifying Choices Among Health Plans,” *Health Affairs*, 2012, 31 (5), 982–989.
- De Clippel, Geoffroy, Kfir Eliaz, and Kareen Rozen**, “Competing for Consumer Inattention,” *Journal of Political Economy*, 2014, 122 (6), 1203–1234.
- DellaVigna, Stefano and Ulrike Malmendier**, “Contract Design and Self-Control: Theory and Evidence,” *Quarterly Journal of Economics*, 2004, 119 (2), 353–402.
- Duarte, Fabian and Justine S. Hastings**, “Fettered Consumers and Sophisticated Firms: Evidence from Mexico’s Privatized Social Security Market,” 2012. NBER Working Paper #18582.
- Dufo, Esther**, “Human Values and the Design of the Fight Against Poverty,” 2012. Tanner Lectures.

- Eisenberg, Melvin Aron**, “The Limits of Cognition and the Limits of Contract,” *Standard Law Review*, 1995, 47 (2), 211–259.
- Eliasz, Kfir and Ran Spiegler**, “Contracting with Diversely Naive Agents,” *Review of Economic Studies*, 2006, 73 (3), 689–714.
- Ellison, Glenn**, “A Model of Add-On Pricing,” *Quarterly Journal of Economics*, 2005, 120 (2), 585–637.
- **and Alexander Wolitzky**, “A Search Cost Model of Obfuscation,” *RAND Journal of Economics*, 2012, 43 (3), 417–441.
- **and Sara Fisher Ellison**, “Search, Obfuscation, and Price Elasticities on the Internet,” *Econometrica*, 2009, 77 (2), 427–452.
- Engel, Kathleen C. and Patricia A. McCoy**, “A Tale of Three Markets: The Law and Economics of Predatory Lending,” *Texas Law Review*, 2002, 80 (6), 1255–1381.
- Enthoven, Alain C.**, “The History and Principles of Managed Competition,” *Health Affairs*, 1993, 12 (Supplement 1), 24–48.
- Ericson, Keith M. Marzilli and Amanda Starc**, “How Product Standardization Affects Choice: Evidence from the Massachusetts Health Insurance Exchange,” *Journal of Health Economics*, 2016, 50, 71–85.
- Fannie Mae**, “Fannie Mae Husing Survey,” Technical Report, Fannie Mae 2015. <http://www.fanniemae.com/portal/research-insights/perspectives/041315-cai-shahdad.html>.
- Farrell, Joseph and Paul Klemperer**, “Coordination and Lock-In: Competition with Switching Costs and Network Effects,” in Mark Armstrong and Rob Porter, eds., *Handbook of Industrial Organization*, Vol. 3, North-Holland, 2007.
- Fellowes, Matt**, “From Poverty, Opportunity: Putting the Market to Work for Lower Income Families,” Technical Report, The Brookings Institution, Metropolitan Policy Program 2006.
- Fershtman, Chaim and Arthur Fishman**, “The ‘Perverse’ Effects of Wage and Price Controls in Search Markets,” *European Economic Review*, 1994, 38 (5), 1099–1112.
- Gabaix, Xavier and David Laibson**, “Shrouded Attributes, Consumer Myopia, and Information Suppression in Competitive Markets,” *Quarterly Journal of Economics*, 2006, 121 (2), 505–540.
- , — , **Guillermo Moloche, and Stephen Weinberg**, “Costly Information Acquisition: Experimental Analysis of a Boundedly Rational Model,” *American Economic Review*, 2006, 96 (4), 1043–1068.
- Gamp, Tobias**, “Search, Differentiated Products, and Obfuscation,” 2015. Working Paper.

- **and Daniel Krähmer**, “Deceptive Products and Comptition in Search Markets,” 2017. Working Paper.
- Gennaioli, Nicola, Andrei Shleifer, and Robert W. Vishny**, “Money Doctors,” *Journal of Finance*, 2015, 70 (1), 91–114.
- Grace, Delia**, “Food Safety in Developing Countries: An Overview,” Technical Report, Evidence on Demand 2015.
- Grubb, Michael D.**, “Selling to Overconfident Consumers,” *American Economic Review*, 2009, 99 (5), 1770–1805.
- , “Behavioral Consumers in Industrial Organization: An Overview,” *Review of Industrial Organization*, 2015, 47 (3), 247–258.
- , “Consumer Inattention and Bill-Shock Regulation,” *Review of Economic Studies*, 2015, 82 (1), 219–257.
- , “Failing to Choose the Best Price: Theory, Evidence, and Policy,” *Review of Industrial Organization*, 2015, 47 (3), 303–340.
- **and Matthew Osborne**, “Cellular Service Demand: Biased Beliefs, Learning, and Bill Shock,” *American Economic Review*, 2015, 105 (1), 234–271.
- Haan, Marco, José L. Moraga-González, and Vaiva Petrikaite**, “Price and Match-Value Advertising with Directed Consumer Search,” 2015. Working Paper.
- Handbury, Jessie and David E. Weinstein**, “Goods Prices and Availability in Cities,” *Review of Economic Studies*, 2015, 82 (1), 258–296.
- Heidhues, Paul and Botond Köszegi**, “Exploiting Naivete about Self-Control in the Credit Market,” *American Economic Review*, 2010, 100 (5), 2279–2303.
- **and** – , “Behavioral Industrial Organization,” in B. Douglas Bernheim, Stefano DellaVigna, and David I. Laibson, eds., *Handbook of Behavioral Economics - Foundations and Applications 1*, Elsevier, 2018.
- , – , **and Takeshi Murooka**, “Inferior Products and Profitable Deception,” *Review of Economic Studies*, 2017, 84 (1), 323–356.
- , **Johannes Johnen, and Botond Köszegi**, “Browsing versus Studying Offers: A Pro-Market Case for Regulation,” 2018. Working Paper.
- Hillman, Robert A.**, “On-line Consumer Standard-Form Contracting Practices: A Survey and Discussion of Legal Implications,” 2005. Cornell Law Faculty Publications. Paper 29.
- Hogan, Patrick**, “Paying more to be poor,” Technical Report, Citizens Advice Scotland 2016.

- Honka, Elisabeth and Pradeep Chintagunta**, “Simultaneous or Sequential? Search Strategies in the U.S. Auto Insurance Industry,” *Marketing Science*, 2017, 36 (1), 21–42.
- Janssen, Maarten C. W. and José Luis Moraga-González**, “Strategic Pricing, Consumer Search and the Number of Firms,” *Review of Economic Studies*, 2004, 71 (4), 1089–1118.
- , —, and **Matthijs R. Wildenbeest**, “Truly costly sequential search and oligopolistic pricing,” *International Journal of Industrial Organization*, 2005, 23 (5-6), 451–466.
- Johnen, Johannes**, “Dynamic Competition in Deceptive Markets,” *RAND Journal of Economics*, forthcoming.
- Kaplan, Greg and Guido Menzio**, “The Morphology Of Price Dispersion,” *International Economic Review*, 2015, 56 (4), 1165–1206.
- Kogut, Carl A.**, “Consumer Search Behavior and Sunk Costs,” *Journal of Economic Behavior & Organization*, 1990, 14 (3), 381–392.
- Kremer, Michael, Gautam Rao, and Frank Schilbach**, “Behavioral Development Economics,” in B. Douglas Bernheim, Stefano DellaVigna, and David I. Laibson, eds., *Handbook of Behavioral Economics*, Vol. 2, Elsevier, 2019, chapter 5, pp. 345–458.
- Lal, Rajiv and Carmen Matutes**, “Retail Pricing and Advertising Strategies,” *The Journal of Business*, 1994, 67 (3), 345–70.
- Lam, Hon-Ming, Justin Remais, Ming-Chiu Fung, Liqing Xu, and Samuel Sai-Ming Sun**, “Food Supply and Food Safety Issues in China,” *Lancet*, 2013, 381 (2044-2053).
- Liu, Peng and Liang Ma**, “Food Scandals, Media Exposure, and Citizens’ Safety Concerns: A Multilevel Analysis Across Chinese Cities,” *Food Policy*, 2016, 63 (C), 102–111.
- Luth, Hanneke A.**, “Behavioural Economics in Consumer Policy: The Economic Analysis of Standard Terms in Consumer Contracts Revisited,” 2010. PhD Thesis, Erasmus University Rotterdam.
- Mackowiak, Bartosz and Mirko Wiederholt**, “Optimal Sticky Prices under Rational Inattention,” *American Economic Review*, 2009, 99 (3), 769–803.
- Matějka, Filip and Alisdair McKay**, “Rational Inattention to Discrete Choices: A New Foundation for the Multinomial Logit Model,” *American Economic Review*, 2015, 105 (1), 272–298.
- McAfee, R. Preston and Marius Schwartz**, “Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity, and Uniformity,” *American Economic Review*, 1994, 84 (1), 210–30.
- Mullainathan, Sendhil and Eldar Shafir**, *Scarcity: Why Having Too Little Means So Much*, Time Books, Henry Holt & Company LLC, New York, NY, 2013.

- Murooka, Takeshi**, “Deception under Competitive Intermediation,” 2015. Working Paper.
- Ofgem**, “State of the Market Assessment,” 2014. Available at https://www.ofgem.gov.uk/sites/default/files/docs/2014/03/assessment_document_published_1.pdf.
- Piccione, Michele and Ran Spiegler**, “Price Competition under Limited Comparability,” *Quarterly Journal of Economics*, 2012, 127 (1), 197–135.
- Pollitz, Karen, Eliza Bangit, Jennifer Libster, Stephanie Lewis, and Nicole Johnston**, “Coverage When It Counts: How much protection does health insurance offer and how can consumers know?,” Technical Report, Center for American Progress Action Fund 2009.
- Ravid, Doron**, “Bargaining with Rational Inattention,” 2017. Working Paper.
- Roesler, Anne-Katrin**, “Is Ignorance Bliss? Rational Inattention and Optimal Pricing,” 2015. Working paper.
- Ronnen, Uri**, “Minimum Quality Standards, Fixed Costs, and Competition,” *Rand Journal of Economics*, Winter 1991, 22 (4), 490–504.
- Santos, Babur De Los, Ali Hortacsu, and Matthijs R. Wildenbeest**, “Testing Models of Consumer Search Using Data on Web Browsing and Purchasing Behavior,” *American Economic Review*, 2012, 102 (6), 2955–2980.
- Schuster, Monica and Miet Maertens**, “Do Private Standards Create Exclusive Supply Chains? New Evidence from the Peruvian Asparagus Export Sector,” *Food Policy*, 2013, 43, 291–305.
- Schwartzstein, Joshua and Andrei Shleifer**, “An Activity-Generating Theory of Regulation,” *Journal of Law and Economics*, 2013, 56 (1), 1–38.
- Shavell, Steven**, “Strict Liability versus Negligence,” *Journal of Legal Studies*, 1980, 9 (1), 1–25.
- Shleifer, Andrei**, “Efficient Regulation,” in Daniel P. Kessler, ed., *Regulation vs. Litigation: Perspectives from Economics and Law*, University of Chicago Press, 2011, chapter 2.
- Sims, Christopher A.**, “Implications of Rational Inattention,” *Journal of Monetary Economics*, 2003, 50 (3), 665–690.
- , “Rational Inattention and Monetary Economics,” in Benjamin A. Friedman and Michael Woodford, eds., *Handbook of Monetary Economics*, Vol. 3A, Elsevier, 2010, chapter 4.
- Spiegler, Ran**, “Competition over Agents with Boundedly Rational Expectations,” *Theoretical Economics*, 2006, 1 (2), 207–231.
- , “The Market for Quacks,” *Review of Economic Studies*, 2006, 73 (4), 1113–1131.
- , “Choice Complexity and Market Competition,” *Annual Review of Economics*, 2016, 8, 1–25.

- Stahl, Dale O.**, “Oligopolistic Pricing with Sequential Consumer Search,” *American Economic Review*, 1989, 79 (4), 700–712.
- Unnevehr, Laurian**, “Food Safety in Developing Countries: Moving Beyond Exports,” *Global Food Security*, 2015, 4, 24–29.
- Varian, Hal R.**, “A Model of Sales,” *American Economic Review*, 1980, 70 (4), 651–659.
- Woodward, Susan E. and Robert E. Hall**, “Diagnosing Consumer Confusion and Sub-Optimal Shopping Effort: Theory and Mortgage-Market Evidence,” *American Economic Review*, 2012, 100 (2), 511–515.
- World Health Organization**, “WHO’s First Ever Global Estimates of Foodborne Diseases Find Children Under 5 Account for Almost One Third of Deaths,” 2015. News Release.
- Zhang, Man, Hui Qiao, Xu Wang, Ming zhe Pu, Zhi jun Yu, and Feng tian Zheng**, “The Third-Party Regulation on Food Safety in China: A Review,” *Journal of Integrative Agriculture*, 2015, 14 (11), 2176–2188.

Appendix

A Robustness

In this section, we argue that our qualitative results carry over to many extensions of our baseline model in Section 4.1. We first identify the extensions and variants we consider here that we have not elaborated on in the text. Then, we discuss how the modifications affect our results, doing so in the order of the main Propositions in Section 4.

Shape of Attention Costs. Our model captures limited attention in an extreme form: by assuming that the consumer can observe two prices for free, and observing any other price is infinitely costly. As a less extreme way of capturing convex attention costs, we solve a model in which observing any price after the first two has positive and increasing—but finite—cost.³²

Two Markets. Our basic model assumes that the tradeoff between studying and browsing is limited to one market, but in reality attentional spillovers can cross to other markets. A formal two-market example is the following. One market is monopolistic, in which both low-value and high-value consumers value their ideal products at v , low-value consumers are willing to avoid any additional price, and high-value consumers are never willing to do so. For simplicity, suppose the monopolist’s cost of producing is zero. To ensure that it is optimal for the monopolist to sell to both types at a headline price of $v - \bar{a}$, we suppose that $\alpha \leq v/(v + \bar{a})$.³³ In the other market, there are I firms, low-value and high-value consumers derive values $v_L > c$ and $v_H \geq v_L$ from the product, respectively, and each firm can only charge a headline price. Consumers see a headline price in each market, and can either study in the monopolistic market or browse another firm in the oligopolistic market. Avoiding the additional price in the monopolistic market requires studying.

Avoiding the Additional Price. We have also assumed that high-value consumers—whom we interpret as higher-income consumers—find it more costly than low-value consumers to avoid the additional price. But we consider a version of the opposite case as well, analyzing situations in which high-value consumers avoid all or part of the additional price without any effort. For instance, because a high-income consumer has little trouble repaying her credit-card balance every month, she may rarely pay interest or late fees; and because she always carries high bank-account balances, she may never pay overdraft fees.

Beyond being economically relevant, this extension helps clarify the mechanism behind our result on high prices in low-income neighborhoods (Section 4.2). The logic of the result hinges on the assumption that low-value consumers want to avoid additional prices, *and* that they need to study to do so. The assumption on the difference in valuations between high-value and low-value consumers—which we made only to ensure that both types purchase—and the assumption that

³² We also briefly discuss issues that arise when observing one or both of the first two prices is costly. These parallel issues in existing search models.

³³ Technically, this condition replaces the condition $\bar{a} \leq v_H - v_L$ in our basic model in Section 4 and ensures that both consumer types always buy, and can be easily extended to cases in which $v_L \neq v_H$. With sufficiently strict regulation of $\bar{a}$ the condition holds, as the condition is equivalent to $\bar{a} \leq v(1-\alpha)/\alpha$. Furthermore, if there is a third consumer group that is unwilling to study and active in the monopolistic market only, this sufficient condition can be relaxed further to allow for all $\alpha \in (0, 1)$.

high-value consumers do not want to avoid the additional price, are unimportant. Indeed, if high-value consumers avoid all of the additional price for free and $v_H = v_L > c$, then our results apply unchanged.³⁴

Consumer Understanding. While we have assumed that consumers are rational, we also analyze the implications of a plausible form of consumer naivete: the possibility that consumers who study and attempt to avoid the additional price nevertheless incur unexpected charges. For example, a borrower who carefully looks at her unconventional mortgage contract and believes that she understands everything may still fall for some traps.

Proposition 4. First, the extreme form of convex attention costs we have assumed in Section 4—that observing two prices is free, but observing anything else is impossible—is not crucial for our results. We now relax this assumption and assume consumers can at a cost learn further prices. Denote the cost of searching price number n by s_n . Search costs are weakly increasing such that $s_{n+1} \geq s_n$ for all n . Consider first the case in which—as in Section 4—searching the first two prices is for free ($s_1 = s_2 = 0$). Searching the third price requires effort $s_3 > 0$.

The following proposition summarizes how results from Proposition 4 are robust to this specification.

Proposition 7. *There exists an equilibrium with the following properties. All firms charge an additional price of $\bar{a}$. Low-value consumers study and avoid paying the additional price, while high-value consumers browse and incur the additional price. For any $s_3 > 0$ all consumers search two price components. Firms choose headline prices according to a distribution with support $[f_{\min}, f_{\max}]$, and at each price earn expected profits equal to $\alpha(f_{\max} - c)/I$. Furthermore, there exists an $\alpha^* \in (0, 1)$ such that $f_{\max} = v_L$ for $\alpha \geq \alpha^*$. If $s_3 \geq \bar{a}$, $f_{\max} = \mathbb{E}[f] + \bar{a} < v_L$ for $\alpha < \alpha^*$. If $s_3 < \bar{a}$, $f_{\max} = \mathbb{E}[f] + s_3 < v_L$ for $\alpha < \alpha^*$. In both cases, the expected price that consumers pay is increasing in α .*

The main logic from Proposition 4 applies in this context. Firms compete for inattention of low-value consumers. Firms set $f_{\max}$ just low enough to prevent low-value consumers from searching a third price. This $f_{\max}$ will be sufficiently low to also discourage high-value consumers from browsing more than two products.

Intuitively, consumers searching a third price introduces a new inattention constraint that is irrelevant in the model of Section 4. Studying low-value consumers might be tempted to browse and study a second offer at a cost s_3 . If $s_3 \geq \bar{a}$, browsing and studying a second offer is very costly, making this deviation inferior to only browsing a second offer. In this case the search cost s_3 are irrelevant for equilibrium attention and the equilibrium of Proposition 4 is unaffected. For $\alpha < \alpha^*$, $f_{\max}$ is determined by $f_{\max} = \mathbb{E}[f] + \bar{a}$ and the price cap $\bar{a}$ drives competition for inattention.

If $s_3 < \bar{a}$ the novel inattention constraint is binding. Browsing and studying a second offer is the most beneficial deviation for low-value consumers. For $\alpha < \alpha^*$, $f_{\max}$ is determined by $f_{\max} = \mathbb{E}[f] + s_3$. Now the search cost s_3 drives competition for inattention and no longer the price

³⁴ While our stylized models apply to many economic situations, we note that there are also settings in which high-income consumers are likely to study more than low-income consumers, leading to higher margins in higher-income neighborhoods. As a case in point, if studying helps a consumer determine which of multiple horizontally differentiated products she likes, and a high-income consumer—such as a rich wine connoisseur—has more particular tastes, then she studies more. Such instances, however, seem economically less important than those above.

cap $\bar{a}$. But as in the previous case, firms reduce f_{max} to prevent low-value consumers from studying a second offer. Even though the inattention constraint is a different one, firms again compete for consumer inattention and the comparative statics w.r.t. α are qualitatively unaffected.

Which inattention constraint is binding has important implications for price regulation. Consider again $\alpha < \alpha^*$. If $s_3 < \bar{a}$ and $f_{max} = \mathbb{E}[f] + s_3$, the search cost s_3 induce competition for inattention. Thus, a small reduction of $\bar{a}$ that preserves $s_3 < \bar{a}$ only reduces the additional price that high-value consumers pay, which reduces competitive pressure. Just as a decrease in $\bar{a}_H$ in Proposition 8, this leads to an *increase* in the average price consumers pay. In contrast, a large enough reduction of $\bar{a}$ induces $s_3 > \bar{a}$ where $f_{max} = \mathbb{E}[f] + \bar{a}$. Now the price cap $\bar{a}$ drives competition for inattention, and a reduction in $\bar{a}$ *reduces* the average price consumers pay.

What would happen to the results of Proposition 4 if $s_2 > 0$? As long as $s_2 \leq \bar{a}$, low-value consumers still study their initial offer. But high-value consumers would no longer browse when they observe initial prices close to f_{min} . As a response, firms increase f_{min} ; firms play pure strategies in equilibrium and high-value consumers neither browse nor study. The problem is that high-value consumers benefit from browsing only because of some price variation in headline prices. Realistic extensions—commonly assumed in the search literature—that induce variation in benefits for high-value consumers, however, induces them to pay (low enough) $s_2 > 0$ as well. For example, if by browsing high-value consumers learn their match value they have an incentive to incur search cost. Alternatively, if as in Stahl (1989) or Janssen et al. (2005) there are some consumers with zero search cost or intrinsic benefits from browsing (so-called shoppers), then headline prices must vary in equilibrium. This price variation, in turn, induces high-value consumers to pay (low enough) s_2 and browse as well. These extensions also make the results in Proposition 4 robust to $s_1 > 0$.

To simplify the discussion, for the remainder of this Appendix, we again suppose that consumers can only observe two prices.

Second, we note that it is easy to check that an equilibrium with essentially the same properties exists if browsing and studying occur in different markets. Namely: (i) the monopolist charges headline price $v - \bar{a}$ and additional price $\bar{a}$; (ii) the oligopolists randomize their prices on an interval $[f_{min}, f_{max}]$; (iii) low-value consumers study in the monopolistic market and high-value consumers browse in the oligopolistic market; (iv) there is an α^* such that if $\alpha \geq \alpha^*$, then f_{max} equals consumers' value, and if $\alpha < \alpha^*$, then f_{max} is determined by the condition that low-value consumers quoted a price of f_{max} are indifferent between studying in the monopolistic market and browsing in the oligopolistic market.

Third, suppose that high-value but not low-value consumers avoid all or part of the additional price without studying. We capture this by positing that the maximum additional price a firm can charge is $\bar{a}_H \geq 0$ for high-value consumers and $\bar{a}_L > 0$ for low-value consumers.³⁵ We show that the equilibrium characterized in Proposition 4 survives qualitatively unchanged, and in fact features interesting comparative statics:

Proposition 8. *In the extension with type-dependent additional price caps, there exist an equilibrium with the same properties as in the main model. In this equilibrium, the average total price consumers pay is decreasing in $\bar{a}_H$, and increasing in $\bar{a}_L$.*

³⁵ We continue to assume that high-value consumers' cost of satisfying almost any condition is greater than $\bar{a}_H$, and to ensure that the market is covered that $v_L + \bar{a}_H \leq v_H$.

It has long been recognized in models of loss leaders (e.g., Lal and Matutes, 1994), switching costs (e.g., Farrell and Klemperer, 2007), and naive consumers (e.g., DellaVigna and Malmendier, 2004) that the profits firms make on consumers ex post are competed away in an effort to attract consumers ex ante. In our model, the profits firms make on high-value consumers ex post are *more than* competed away ex ante, so that the average price consumers pay is *decreasing* in these ex-post profits. Intuitively, the ex-ante competition for profitable high-value consumers increases the threat of low-value consumers browsing, inducing firms to lower prices further. In contrast, the average total price is increasing in the additional price low-value consumers would pay—even though low-value consumers do not pay it. A higher additional price lowers low-value consumers’ incentive to browse, which in turn lowers firms’ incentive to keep prices depressed.³⁶

Unlike in our baseline model, in markets where high-value consumers face a lower additional price than low-value consumers, it is no longer generally true that high-value consumers pay higher average prices. This happens not because low-value consumers pay the high additional price, but because they are spending their effort trying to avoid the additional price. Since high-value consumers browse and then pay a relatively small additional price, they may obtain the product at a lower price. Of course, in this case the prediction that the average price consumers pay increases in α is only strengthened.

Our results also survive if low-value consumers are naive: they believe that by studying, they can avoid the additional price, whereas in reality they will incur a given proportion of it. This leaves the equilibrium prices completely unchanged:

Corollary 1. *The properties of equilibrium prices identified in Proposition 4 are unaffected by the proportion of the additional price naive consumers incur after studying.*

While the ex-post profits firms make on high-value consumers are more than competed away, the ex-post profits they make from unexpected payments by naive low-value consumers are not competed away at all. Since naive low-value consumers do not anticipate paying the additional price, the fact that they pay does not affect their perceived-optimal search behavior. And since low-value consumers study, they cannot be attracted by a cut in the headline price. This means that the additional price they unexpectedly pay does not induce any competition in the headline price. Once again, in this case low-value consumers may end up paying higher average prices than high-value consumers.

It is important to note that Corollary 1 relies on naive consumers realizing that there is an additional price to worry about, and believing that they can avoid it. Suppose, in contrast, that—as in Gabaix and Laibson (2006), Heidhues et al. (2017), and Johnen (forthcoming), for instance—naive consumers are completely oblivious to the additional price, equating the headline price with the total price of the product. Then, they browse just like high-value consumers, generating perfect competition between firms. In a sense, therefore, partial naivete can lead to higher prices and more exploitation of naive consumers than complete naivete.

³⁶ Since studying low-value consumers avoid the additional price, Proposition 8 also holds when $\bar{a}_L$ captures wrong beliefs due to naiveté about additional prices. This implies that the tradeoff between browsing and studying is also robust to low-value consumers underestimating additional fees, as long as they believe that additional fees are non-zero.

Proposition 5. As in this equilibrium there is no benefit to further search, the equilibrium survives unchanged if consumers can observe further prices at a positive cost. The implications of naivete by low-value consumers depend on how much unexpected charges firms can impose on these consumers, and how this is related to a_i . If a firm can generate large profits from low-value consumers by increasing a_i , then the equilibrium must involve doing so and thereby pricing high-value consumers out of the market. Otherwise, the equilibrium survives. If consumers face different additional prices, the equilibrium survives so long as firms can charge all consumers a sufficiently high additional price ($\bar{a}_L > 0, \bar{a}_H > v_H - v_L$).³⁷

Proposition 6. Again, there is no benefit to further search, so the equilibrium survives if consumers can observe further prices at a cost. Since there is no benefit to studying, competitive (zero-profit) equilibria in which all consumers browse also exist when low-value consumers are naive or high-value consumers avoid (part of) the additional price for free. The same logic applies when studying and browsing occur in different markets. Finally, when studying is aimed directly at avoiding—rather than learning how to avoid—the additional price, then the plain-vanilla regulation works so long as it makes avoiding the additional price costless.

B Entry

We analyze a model of how entry interacts with the attention issues at the heart of our paper. We modify the model in Section 4.1 by assuming that there are three firms, two incumbents (firms 1 and 2) and an entrant (firm 3), and each consumer initially observes the headline price of a randomly chosen incumbent firm. Consumers can either study the additional price and conditions of their own firm, or look at the headline price of one randomly chosen other firm. Both of these randomizations are with equal probability. All our other assumptions are unchanged.

As we have shown in Proposition 4, without the entrant the incumbents' profits are increasing in the share of low-value consumers, α . One might naturally conjecture that the entrant's expected profit—and hence its willingness to enter—is therefore also increasing in α . Instead:

Proposition 9. *In equilibrium, all firms charge an additional price of $\bar{a}$. Low-value consumers study and avoid paying the additional price, while high-value consumers browse and incur the additional price. Firms 1 and 2 choose their headline prices according to the same unique continuous distribution with support $[f_{\min}, f_{\max}]$, while firm 3 chooses its headline price according to a unique continuous distribution with support $[f_{\min}, \bar{f}_3]$, where $f_{\min} < \bar{f}_3 < f_{\max}$. Firms 1 and 2 earn expected profits of $\frac{\alpha}{2}(f_{\max} - c)$, and firm 3 earns an expected profit of $\frac{(1-\alpha)\alpha}{(3-\alpha)}(f_{\max} + \bar{a} - c)$. Furthermore, there exists an $\alpha^* \in (0, 1)$ such that $f_{\max} = v_L$ for $\alpha \geq \alpha^*$ and $f_{\max} < v_L$ for $\alpha < \alpha^*$. The expected price that consumers pay is increasing in α .*

Proposition 9 says that entry preserves the structure of equilibrium consumer behavior we have found in the basic version of our model: high-value consumers browse, but low-value consumers find it more advantageous to study. As a result, the entrant's profit is increasing in α for low

³⁷ If high-value consumers automatically avoid any additional price even in a deregulated market, then they can safely browse, so a cap on low-value consumers' additional price leaves the equilibrium unchanged.

α , but decreasing in α for high α . When α is small, most consumers browse, and the resulting Bertrand-type competition leaves the entrant with low profits. When α is high, most consumers study and hence cannot be attracted away from the incumbents, again leaving the entrant with low profits. For intermediate values of α , however, incumbents keep prices high to take advantage of studying low-value consumers, so the entrant can ensure non-trivial profits by competing for browsing high-value consumers.

Once a neighborhood has a sufficiently large share of low-value consumers, therefore, economic incentives create a “desert” in which new firms have little incentive to enter, even though incumbents are making large profits. Exactly the same force that allows incumbents to make large profits—lack of comparative search by consumers—makes it difficult for an entrant to carve out significant market share.

Worse, Proposition 9 implies not only that for high α entry is unlikely to occur, but also that the average price consumers pay *increases* if entry does occur. Intuitively, because the entrant makes it more difficult to attract browsing consumers, incumbents focus their business model more on studying consumers, raising average prices. And because high-value consumers at least benefit from the presence of the entrant, the increase in prices is borne entirely by low-value consumers.^{38,39}

C Competitiveness versus Efficiency

We identify a simple setting in which a tradeoff between competitiveness and efficiency arises. There are I identical firms that each sell a basic product and a premium product. The premium product could be a higher-quality version of the basic product, or the basic product embellished with an add-on. Firm i charges f_i and $f_i + a_i$ for the basic and premium products, respectively. A consumer values the basic product at v , but her valuation for the premium product is uncertain: it is either v or $v + \bar{a}$, each with positive probability. Producing the basic product costs zero, and producing the premium product costs c . We assume $\bar{a} > c$, so that the premium product is efficient for consumers who value it. Each consumer is initially assigned to one firm, with each firm getting a share $1/I$ of consumers. A consumer assigned to firm i sees both f_i and a_i . If she then studies, she finds out whether she prefers firm i ’s basic or premium product. If she browses, she learns another firm’s prices (drawn with equal probability from the rivals), but not which product she prefers. Then:

³⁸ To understand these results in more detail, notice that for high α —where $f_{max} = v_L$ —the incumbents’ profits are unaffected by entry. When setting $f_{max} = v_L$, an incumbent earns profits from its low-value consumers only, and entry does not affect these profits because low-value consumers do not browse the entrant’s offer. Given that the incumbents earn the same profits and the entrant earns higher profits than without entry, consumers must pay more on average. Furthermore, note that to keep an incumbent indifferent between different prices, the probability that the firm loses a high-value consumer must at any price be the same with and without entry. This implies that at any price, a high-value consumer has the same probability of finding a lower price—that is, the distribution of prices she pays is the same.

³⁹ The point that entry might increase prices in a Varian-type pricing model has previously been made by Janssen and Moraga-González (2004). In the equilibrium of their model that resembles Varian-type pricing, entry increases the average price that firms charge, not the average price that consumers pay (the latter remains unchanged). In other equilibria, the number of firms might affect average consumer prices via the search intensity of consumers. In our model, search intensity is constant.

Proposition 10. *Marginal-cost pricing is not an equilibrium. There exists an equilibrium in which $f_i = v$ and $a_i = \bar{a}$ for all $i \in I$, and all consumers study.*

The competitive outcome is not an equilibrium. For firms to compete, consumers have to browse—but this is not stable because facing marginal-cost pricing, consumers have a strict incentive to learn their match values. Instead, there is an equilibrium in which consumers learn their match values and therefore do not browse, so that firms can charge monopoly prices. While not competitive, this outcome is efficient: all consumers buy the product that is best for them.

Now consider a standardization policy that allows firms to offer only the basic product. Then, there is no point in studying, leading consumers to browse and generating Bertrand competition. The policy therefore reduces choices for consumers and reduces efficiency, but also lowers prices.

D Proofs

Proof of Proposition 1. We first show that in equilibrium almost all consumers who buy study. Suppose otherwise, i.e., suppose the probability that a consumer browses and then buys is positive. Then there is a firm i and a headline price f_i such that firm i attracts a positive mass of browsing consumers conditional on charging f_i . Firm i can profitably deviate by charging the same f_i while increasing the corresponding a_i arbitrarily. This enables firm i to earn unbounded profits, contradicting equilibrium. We conclude that almost no browsing consumer buys with positive probability.

We now know that consumers purchase with positive probability only if they study with positive probability. Any consumer who studies accepts any offer for which $f_i + a_i < v$. Hence, if a positive mass of consumers studies with positive probability in equilibrium, then firms must charge $f_i + a_i = v$. Finally, an equilibrium in which all firms charge $f_i + a_i = v$, all consumers who study purchase if $f_i + a_i \leq v$, and the remaining browsing consumers do not purchase, clearly exists. $\square$

Proof of Proposition 2. Our proof has five steps. In Step (i), we show that consumers buy with probability one. We prove in Step (ii) that total prices are below v with probability one. Step (iii) establishes that all consumers browse at all headline prices for which the total expected price is not below that of all rivals with probability one. Step (iv) uses this fact and standard Bertrand-type reasoning, to establish that all firms must set the same total expected price. Step (v) shows that there is a profitable deviation whenever this total expected price does not equal marginal cost.

Step (i): all consumers buy with probability one. Sequential rationality implies that upon observing a headline price $f_i < v - \bar{a}$, a consumer must buy with probability one. Suppose some consumers do not buy with positive probability in equilibrium. Then there must exist a firm i that with positive probability charges a headline price $f_i \geq v - \bar{a}$, and a positive mass of consumers that are initially assigned to firm i and do not buy with positive probability conditional upon observing such a headline price. We argue that conditional on such an f_i , firm i cannot charge a total price strictly below v and sell to a positive mass of consumers. If it did so, firm i could increase a_i by a small amount and still charge a total price below v ; after this change consumers who study still buy and as such a deviation is unobservable to browsing consumers, it also does not change their buying

behavior. Hence, firm i must charge a total price $f_i + a_i \geq v$ with probability one if it sells to some consumers. Furthermore, firm i cannot be selling with probability zero. For it could then deviate and set a pair of prices $f_i \in (c - \bar{a}, v - \bar{a})$ and $a_i = \bar{a}$, for which all consumers strictly prefer buying. And because in the candidate equilibrium some consumers buy with probability less than one after observing f_i , this attracts additional consumers with positive probability, a contradiction. Next, we establish that for such an f_i , $f_i + a_i = v$ with probability one. For otherwise, since it charges total prices below v with probability zero, browsing consumers strictly prefer not buying from firm i and studying consumers do not buy from firm i whenever it charges a total price greater than v , contradicting the fact that firm i must sell with positive probability for all price pairs. Almost all studying consumers must buy with probability one, for otherwise the firm could lower a_i by an arbitrarily small amount, thereby inducing all studying consumers to buy without changing the purchase behavior of browsing consumers, and this is a profitable deviation. If browsing consumers do not buy with positive probability, then the firm can deviate and set prices $f_i = v - \bar{a} - \eta$ and $a_i = \bar{a}$, which increases the demand from the browsing consumers for any positive $\eta > 0$, and hence it is profitable if all consumers browse conditional on seeing f_i . Furthermore, if some consumers study, then since they earn zero surplus from firm i , they must in equilibrium also earn zero surplus from browsing. Hence, the deviation, which gives consumers a small positive surplus, attracts all consumers with probability one and thus is profitable. We conclude that all consumers purchase with probability one in equilibrium.

Step (ii): all firms set total prices $f_i + a_i < v$ with probability one. Suppose otherwise, that is some firm i sets a total price of $f_i + a_i \geq v$ with positive probability in equilibrium. Then all its rivals must earn positive profits in equilibrium, for they would earn positive profits when setting a pair of prices $f_j \in (c - \bar{a}, v - \bar{a})$ and $a_j = \bar{a}$. Let π be the lowest expected equilibrium profits from any rival of i . Then each rival must charge a total price weakly greater than $c + \pi$ with positive probability, and hence firm i can ensure positive profits by charging a pair of prices $f_i = c + \pi/2 - \bar{a}$ and $a_i = \bar{a}$. Hence, firm i must earn positive expected profits when charging an optimal pair of prices f'_i, a'_i for which $f'_i + a'_i \geq v$. Hence, conditional on observing f'_i , consumer either study and buy or browse. In either case, it is suboptimal to charge an additional price of $a_i < v - f'_i$, for otherwise firm i could raise a_i slightly without reducing demand. In other words, $\mathbb{E}(f'_i + a_i | f'_i) \geq v$ and if $\mathbb{E}(f'_i + a_i | f'_i) > v$ browsing consumers do not buy and studying consumer do not buy when $f'_i + a_i > v$, so that firm i for such prices (f'_i, a_i) has zero sales, and hence zero profits—contradicting the fact that for optimal prices i earns positive equilibrium profits. Thus, $\mathbb{E}(f'_i + a_i | f'_i) = v$ and hence for firm i to earn positive profits some rival j must set headline prices for which $\mathbb{E}(f_j + a_j | f_j) \geq v$ with positive probability. But then, since by assumption some consumers browse, firm i can profitably attract the browsing consumers of firm j by deviating and setting prices $(\hat{f}_i, \hat{a}_i)$ such that $\hat{a}_i = \bar{a}$ and $\hat{f}_i = v - \bar{a} - \eta$ for a sufficiently small $\eta > 0$, a contradiction. We conclude that all firms set total prices $f_i + a_i < v$ with probability one.

For the equilibrium price distribution, let $\underline{\mathbb{E}}_i = \inf\{\mathbb{E}(f_i + a_i | f_i)\}$, and let $\underline{\mathbb{E}} = \min_i \{\underline{\mathbb{E}}_i\}$. Similarly, let $\bar{\mathbb{E}}_i = \sup\{\mathbb{E}(f_i + a_i | f_i)\}$, and let $\bar{\mathbb{E}} = \max_i \{\bar{\mathbb{E}}_i\}$.

Step (iii): consumers browse at all f_i for which $\mathbb{E}(f_i + a_i | f_i) > \min_{j \neq i} \underline{\mathbb{E}}_j$. Since total prices are strictly below valuations, consumers always strictly prefer buying over not buying. Consequently, consumers strictly benefit from browsing if with positive probability some rival sets a price f_j for

which $\mathbb{E}(f_j + a_j | f_j) < \mathbb{E}(f_i + a_i | f_i)$.

Step (iv): $\bar{\mathbb{E}} = \underline{\mathbb{E}}$. Suppose otherwise, i.e. $\bar{\mathbb{E}} > \underline{\mathbb{E}}$. Because $\underline{\mathbb{E}} \geq c$, whenever some rival sets prices above $\underline{\mathbb{E}}$, a firm can earn positive profits. By the same argument as in Step (ii) above, this implies that all firms earn positive profits in equilibrium. If only one firm sets $\bar{\mathbb{E}}$ with positive probability, this firm earns zero profits when doing so—a contradiction. If two or more firms set $\bar{\mathbb{E}}$ with positive probability, then one of these firms can deviate and move this probability mass to a price offer $f_i = \bar{\mathbb{E}} - \bar{a} - \eta$ and $a_i = \bar{a}$, which is profitable for sufficiently small $\eta > 0$. If no firm has a mass point at $\bar{\mathbb{E}}$ then consider some firm i that attains the supremum. Take a sequence of f_i for which $\mathbb{E}(f_i + a_i | f_i) \rightarrow \bar{\mathbb{E}}$, then the expected profit associated with this sequence converges to zero, contradicting that the firm must earn a given positive equilibrium profit. We conclude that $\bar{\mathbb{E}} = \underline{\mathbb{E}}$.

Step (v): $\bar{\mathbb{E}} = \underline{\mathbb{E}} = c$. Suppose otherwise, then $\bar{\mathbb{E}} = \underline{\mathbb{E}} > c$. In this case, since by assumption a small fraction of consumers always browse, a firm i can deviate to a price offer $f_i = \bar{\mathbb{E}} - \bar{a} - \eta$ and $a_i = \bar{a}$, which is profitable for sufficiently small $\eta > 0$. $\square$

Proof of Proposition 3. We proceed in two steps. First, we show that in any equilibrium where consumers buy with positive probability, they pay a total price equal $\min\{v, \bar{t}\}$. Second, we show that these equilibria exist.

Step (i): in any equilibrium where consumers buy with positive probability, they pay a total price $\min\{v, \bar{t}\}$. We show first that in any equilibrium where consumers buy, a firm i that sells to consumers with strictly positive probability charges f_i, a_i , such that $f_i + a_i \geq \min\{v, \bar{t}\}$. Towards a contradiction, suppose there exists a firm i that sells to consumers with strictly positive probability and charges f_i, a_i such that $f_i + a_i < \min\{v, \bar{t}\}$ with positive probability. Then, for any such pair f_i, a_i , firm i can strictly increase profits by charging a larger additional price $a'_i \in (a_i, \min\{v, \bar{t}\} - f_i)$. Studying consumers continue to buy at this price, and browsing consumers do not observe the increased additional price and hence make identical purchase decisions as well. We conclude that in any equilibrium where consumers buy with positive probability, they buy at a price of at least $\min\{v, \bar{t}\}$.

Next, we show that in any equilibrium, consumers do not buy at prices f_i, a_i for which $f_i + a_i > \min\{v, \bar{t}\}$. If $\min\{v, \bar{t}\} = \bar{t}$, firms cannot charge a total price strictly larger than $\bar{t}$. If $\min\{v, \bar{t}\} = v$, consumers are strictly better off when they do not buy from a firm i that charges $f_i + a_i > v$. Studying consumers observe $f_i + a_i > v$ and do not buy, and if a firm i for a given f_i with positive probability sets total prices $f_i + a_i > v$, browsing consumers are strictly better off either not purchasing or studying and only buying if the firm's price is weakly below v . We conclude that in any equilibrium where consumers buy, they pay a total price $\min\{v, \bar{t}\}$.

Step (ii): equilibria exist where consumers buy. Suppose all firms charge $f_i + a_i = \min\{\bar{t}, v\}$, a given positive mass of consumers always browses and all other consumers study and buy if and only if the total price is $\leq v$. For $\bar{t} \leq v$, browsing consumers buy from the firm they were initially assigned to. For $\bar{t} > v$, they do not buy. In case $\bar{t} \leq v$, for any (equilibrium or out-of-equilibrium) headline price f_i , consumers believe that $a_i = \bar{t} - f_i$. In case $\bar{t} > v$, consumers believe that $f_i + a_i = v$ for all (equilibrium and out-of-equilibrium) $f_i \leq v$ and for $f_i > v$ that $f_i + a_i = \bar{t}$. Note that the consumers' on-path beliefs are consistent with firms' equilibrium strategies. Given the consumers beliefs, they are indifferent between studying and browsing, and when $\bar{t} \geq v$ browsing consumers are indifferent between purchasing or not purchasing. Hence, the consumer behavior is optimal.

For $\bar{t} \leq v$ firms charge the maximum total price and cannot attract more consumers, so their pricing is optimal. Similarly, in case $\bar{t} > v$, for all equilibrium and out-of-equilibrium headline prices firms sell only to studying consumers and do so whenever $f_i + a_i \leq v$, thus it is optimal for them to set prices $f_i + a_i = \min\{\bar{t}, v\}$. $\square$

Auxiliary results for the proof of Proposition 4.

Lemma 1. *In any equilibrium in which low-value browsing consumers purchase with positive probability at a headline price $f_i \leq v_L$, $A_i(a_i|f_i)$ puts positive weight only on the maximal additional price. Furthermore, for any out-of-equilibrium headline price $f_i \leq v_L$, consumers' belief about $A_i(a_i|f_i)$ puts positive weight only on the additional price $\bar{a}$.*

Proof. We first argue that if in equilibrium browsing low-value consumers purchase from firm i with positive probability at a headline price $f'_i < v_L$, then $A_i(a_i|f'_i)$ puts probability one on $\bar{a}$. Suppose otherwise, that is the firm sets some other additional prices with positive probability. Then firm i could deviate and move all probability mass from $A_i(a_i|f'_i)$ to $\bar{a}$. In this case, it remains strictly optimal for studying low-value consumers to purchase from firm i , and this deviation cannot affect the behavior of browsing low- or high-value consumers. In addition, since low-value consumers buy and $v_H - v_L > \bar{a}$, high-value studying consumers will continue to buy after the increase of the additional price. Hence, $A_i(a_i|f'_i)$ puts probability mass one on $\bar{a}$.

Next to consider the case in which low-value browsing consumers purchase in equilibrium at a headline price $f_i = v_L$. For their purchase behavior to be optimal, it must be that $A_i(a_i|f_i)$ puts probability one on $a_i = 0$. But note that in this case firm i can deviate and set $a_i = \bar{a}$; this does not affect the purchase probability of (high or low-value) browsing consumers, it remains strictly optimal for studying high-value consumers to purchase, and it follows from our third equilibrium-selection assumption that the purchase probability of low-value studying consumers is also unaffected. Hence, as demand is constant and some browsing consumers purchase, this deviation strictly increases profits, a contradiction.

We have thus shown that conditional on low-value browsing consumers buying with positive probability at a headline price $f_i \leq v_L$, it is optimal for firm i to charge $\bar{a}$. Our second equilibrium-selection assumption imposes that if consumers observe an off-equilibrium $f_i \leq v_L$, consumers believe $A_i(a_i|f_i)$ is chosen to optimally target either studying high-value consumers or (high or low-value) browsing consumers supposing that they purchase. For all of these consumer groups, it is optimal to set $\bar{a}$ if $f_i \leq v_L$. Hence, consumers believe the additional price is $\bar{a}$ with probability one. $\square$

Lemma 2. *If consumers who browse offers see two headline prices, the second price can be of each competitor with positive probability, and at least two firms are assigned a strictly positive share of initial customers, then all firms earn strictly positive profits.*

Proof. We proceed in three steps. First, we establish a lower bound on headline prices. Second, using this bound we show by contradiction that firms with a positive share of initial consumers earn strictly positive profits. Third, we prove that this implies strictly positive profits for all firms.

Step (i): Lower bound on headline prices. Note that all firms almost surely set prices $f_i \geq c - \bar{a}$. Otherwise, at least one firm would earn strictly negative profits for prices below $c - \bar{a}$.

Step (ii): Firms with a positive share of initial consumers earn strictly positive profits. To prove that firms with a positive share of initial consumers earn strictly positive profits, suppose otherwise. Then there exists a firm i that earns zero profits whose headline price is visible to its share of initial high- and low-value consumers.

Zero profits of firm i imply that all low-value consumers browse headline prices for $f_i = c + \eta$ for all $\eta > 0$ and then buy from the rival they see, since otherwise firm i could earn positive profits by setting these prices. But this requires that all other firms charge $f_{-i} + a_{-i} = c$ with probability one, since otherwise there exists a sufficiently small η such that the low-value consumers of firm i strictly prefer studying and avoiding $\bar{a}$ when firm i sets $f_i = c + \eta$. $f_{-i} + a_{-i} = c$ implies that in any candidate equilibrium in which firm i earns zero profits, all other firms earn zero profits as well. Because we have two firms that are initially assigned consumers, by iterating the above argument, firm i also must set a total price $f_i + a_i = c$. Furthermore, any firm that sells to browsing high-value consumers conditional on charging f_i, a_i must set an additional price of $a_i = \bar{a}$ when doing so; otherwise, firm i could deviate and increase a_i to $\bar{a}$, which does not affect the probability of selling to browsing consumers (who cannot condition their purchase behavior on a_i) and does not alter the probability of selling to studying consumers (since for $f_i < v_L$ low-value studying consumers must purchase and avoid any positive a_i and studying high-value consumers are willing to pay $f_i + \bar{a} \leq c + \bar{a}$). Similarly, any firm selling to studying high-value consumers must set $a_i = \bar{a}$ because they are still willing to buy at that additional price. And since browsing high-value consumers with positive probability see only the up-front price of a pair of firms i, j that are initially assigned consumers, one of these firms must sell to high-value consumers and thus set $\bar{a}$ with probability one, and hence charge $f_i = c - \bar{a}, a_i = \bar{a}$ with positive probability. Firm i can only break even if its initially assigned low-value consumers browse rather than study and avoid paying the additional price. But the low-value consumers assigned to firm i are only willing to do so if browsing leads them to pay in expectation total prices weakly less than $c - \bar{a} < c$, a contradiction. We conclude that all firms with a positive share of initial consumers earn strictly positive profits.

Step (iii): All firms earn strictly positive profits. We already know that all firms with a positive share of initial consumers earn strictly positive profits. Hence, with probability one they must set a total price $t > c$. Let firm i be a firm that is assigned some initial consumers, and let t_{min} be the infimum of the support of firm i 's total price distribution $f_i + a_i$. Then any rival j that has no consumers initially assigned to it can ensure strictly positive demand by charging $f_j = t_{min} - \bar{a} - \eta, a_j = \bar{a}$, because in that case browsing high-value consumers initially assigned to firm i will strictly prefer to buy from firm j when seeing its offer, and by equilibrium-selection assumption one some high-value consumers browse. For sufficiently small η , the total price of firm j is greater than c , and because firm j only serves browsing consumers, all of firm j 's consumers pay this total price. We conclude that all firms earn strictly positive profits. $\square$

Lemma 3. *Suppose there are at least two firms that are initially assigned a strictly positive fraction of consumers. If consumers who browse draw the second headline price from all other firms with*

strictly positive probability, then in equilibrium high-value consumers browse with probability one.

Proof of Lemma 3. We proceed in five steps. We show first that at any profit-maximizing headline price offer, at least browsing high-value consumers must be willing to purchase. Second, we establish that $a_i = \min\{v_H - f_i, \bar{a}\}$ for any optimal f_i at which high-value consumers buy with positive probability. Third, we prove that $f_{max} \leq v_L$. Fourth, we prove that there is no mass point at f_{min} in any firms' headline price distribution, and that at least two firms must attain f_{min} . Finally, we conclude that all high-value consumers browse with probability one.

Step (i): At any profit-maximizing headline price offer, at least browsing high-value consumers must be willing to purchase. By Lemma 2 firms earn positive profits, and hence with probability one must set profit-maximizing prices f_i, a_i at which some consumers buy. In case $f_i \leq v_L$, a high-value consumer prefers the offer f_i, a_i to her outside option since $f_i + a_i \leq v_L + \bar{a} < v_H$. For $f_i > v_L$, low-value consumers never buy. In case a firm sets $f_i > v_L$ and $f_i + a_i > v_H$ studying high-value consumers also do not buy, and hence browsing high-value consumers must (i.e. $f_i + \mathbb{E}(a_i|f_i) \leq v_H$, where the expectation is taken with respect to the equilibrium price distribution). In case a firm sets $f_i > v_L$ and $f_i + a_i \leq v_H$ with probability one, browsing high-value consumers are willing to purchase. Thus, at any profit-maximizing headline price offer, at least browsing high-value consumers must be willing to purchase.

Step (ii): $a_i = \min\{v_H - f_i, \bar{a}\}$ for any optimal f_i at which high-value consumers buy with positive probability. Consider an f_i in the support of firm i 's headline price distribution, and let $A_i(a_i|f_i)$ be the corresponding conditional equilibrium price distribution over a_i . A firm i 's strategy is a collection $(G_i, \{A_i\}_{f_i})$, where G_i is a cumulative distribution function over headline prices, and $\{A_i\}_{f_i}$ a set of conditional additional price distributions. In equilibrium, with probability one each firm chooses a profit-maximizing pair $f_i, A_i(\cdot|f_i)$, and we from now on restrict attention to such profit-maximizing combinations. Consider any headline price for which high-value consumers buy from firm i with positive probability conditional on firm i choosing f_i . We establish that the corresponding $A_i(\cdot|f_i)$ puts mass one on $a_i = \min\{v_H - f_i, \bar{a}\}$.

To see this, we first rule out that $a_i < \min\{v_H - f_i, \bar{a}\}$ with positive probability. In this case, firm i can move probability mass from an interval $(0, a'_i)$ to a'_i , with $a'_i < \min\{v_H - f_i, \bar{a}\}$. This does not affect the demand from any consumer who browses headline prices; it also does not lower demand from high-value consumers who study because they still strictly prefer purchasing the product; and it also does not lower demand from low-value consumers who study because they can costlessly avoid paying the additional price (so it remains strictly optimal to purchase if $f_i < v_L$ and by equilibrium-selection assumption three, these consumers purchase with a given probability when indifferent, i.e. when $f_i = v_L$). Hence, this change increases expected profits, contradicting that $f_i, A_i(\cdot|f_i)$ was profit-maximizing.

We next rule out $A_i(\cdot|f_i)$ puts positive probability weight on additional prices $a_i \in (v_H - f_i, \bar{a}]$. Suppose otherwise. Then, since $a_i \geq v_H - f_i$ with probability one, the expected value of a_i conditional on f_i is greater than $v_H - f_i$. Hence, high-value consumers will not purchase without studying, and upon studying purchase only if $a_i \notin (v_H - f_i, \bar{a}]$. Furthermore, low-value consumers cannot be buying because $f_i > v_H - \bar{a} \geq v_L$. Thus, high-value consumers must be studying with positive prob-

ability and purchasing because otherwise firms would not sell in equilibrium, which we ruled out above. We conclude that $A_i(\cdot|f_i)$ puts probability one on the additional price $a_i = \min\{v_H - f_i, \bar{a}\}$ for any optimal f_i at which high-value consumers buy with positive probability.

Before continuing, we introduce some notation. Let $\underline{f}_i$ be the infimum of firm i 's headline price distribution and let $f_{\min} = \min_i \{\underline{f}_i\}$. Similarly, let $\bar{f}_i$ be the supremum of firm i 's headline price distribution and let $f_{\max} = \max_i \{\bar{f}_i\}$.

Step (iii): $f_{\max} \leq v_L$. Suppose otherwise, i.e. $f_{\max} > v_L$. Low-value consumers do not buy at any headline price $f_j > v_L$. We will now argue that a firm charging at or sufficiently close to $f_{\max}$ cannot earn its equilibrium profits. Suppose at least two firms have a mass point at $f_{\max}$. Then any such firm must sell to high-value consumers and set an additional price of $a_{\text{high}} = \min\{v_H - f_{\max}, \bar{a}\}$. But then, by equilibrium-selection one, a firm could discretely increase its demand from browsing high-value consumers by setting $f_j = f_{\max} + a_{\text{high}} - \bar{a} - \eta$ and $a_j = \bar{a}$, which is profitable for sufficiently small $\eta > 0$ —a contradiction.

If only one firm has a mass point at $f_{\max}$ and charges a total price strictly less than v_H , high-value consumers get a better deal for certain when browsing, and hence must do so. But this implies that the firm has no demand, and hence does not earn its positive equilibrium profits. Hence, it must charge a total price of v_H with positive probability, and some rival must also charge a total price of v_H with positive probability. But then by essentially the same argument as above where two or more firms have a mass point at $f_{\max}$, there is a profitable deviation.

Now suppose no firm has a mass point at $f_{\max}$. Consider a firm j that has $f_{\max}$ as a supremum over its headline price distribution, and consider a sequence of prices f_j at which high-value consumers buy and that converges to $f_{\max}$. There are two subcases to consider. If $f_{\max} + \bar{a} \leq v_H$, then as $f_j \rightarrow f_{\max}$, firm j charges a higher total price than all other firms with a probability that approaches one, and hence all high-valuation consumers must browse, which in turn implies that the expected demand of firm j converges to 0. Thus, j cannot earn its equilibrium profits in this subcase. If, on the other hand, $f_{\max} + \bar{a} > v_H$ then for an interval of prices sufficiently close to $f_{\max}$, firm j charges a total price of v_H . If some other firm also charges a total price of v_H with positive probability, deviating to a price offer $f_j = v_H - \bar{a} - \eta$ and $a_j = \bar{a}$ is profitable for sufficiently small $\eta > 0$. In case no other firm charges a total price of v_H with positive probability, high-value consumers strictly prefer to browse for the headline prices that induce a total price of v_H , and hence j does not earn its equilibrium profits. We conclude that $f_{\max} \leq v_L$.

Step (iv): there is no mass point at $f_{\min}$ in any firms' headline price distribution, and at least two firms must attain $f_{\min}$. Note that high-valuation consumers must buy at $f_{\min} \leq f_{\max} \leq v_L$, so that a firm that has a mass point at $f_{\min}$ sets an additional price $a_i = \bar{a}$ whenever it charges $f_{\min}$. Suppose at least two firms have a mass point at $f_{\min}$. Then one of these firms i can increase profits by shifting probability mass from the mass point to the pair $f_i = f_{\min} - \eta$ and $a_i = \bar{a}$ for some $\eta > 0$. This discretely increases demand from browsing high-value consumers; furthermore, since upon observing the headline price consumers know that deviant offer is better, it cannot lower demand from any other consumer group. To see that this deviation is profitable for a sufficiently low

η , it remains to establish that the deviant firm cannot loose through inducing low-value consumers that are initially assigned to it, to study and save on the additional price. Observe, however, that if $f_{min} < v_L$ low-value consumers must study conditional on observing f_{min} , as this guarantees the lowest possible expenditure. Hence, for $f_{min} < v_L$, the loss from low-value consumers is bounded by η . In case $f_{min} = v_L$ a browsing low-value consumer does not buy, and the firm can choose η such that $f_{min} - \eta > c$ in which case inducing low-value consumers to study and buy further increase profits. Hence, there can be at most one firm with a mass point at f_{min} .

To rule this out, suppose i has a mass point at f_{min} . Recall that at f_{min} low-value consumers that are initially assigned to firm i must study. We first argue that $\min_{j \neq i} \{f_j\} = f_{min}$, for otherwise firm i could deviate to $f_i \in (f_{min}, \min\{\min_{j \neq i} \{f_j\}, v_L\})$ and $a_i = \bar{a}$. At such a headline price low-value consumers initially assigned to firm i still prefer to study and buy from firm i , and any high-value browsing consumer still prefers firm i 's offer to any alternative offer that they accept in equilibrium, as well as their outside option. Hence, all browsing high-value consumers still buy from firm i with probability one. To evaluate the response of low-value consumers to this price increase, we now consider three subcases: (a) $f_{min} + \bar{a} < v_L$; (b) $f_{min} + \bar{a} > v_L$; and (c) $f_{min} + \bar{a} = v_L$. In subcase (a) for $f_i \in (f_{min}, v_L - \bar{a})$, browsing low-value consumers still buy after the headline price increase, and hence the firm loses no demand when raising its price, a contradiction. In subcase (b) browsing low-value consumers do not buy, and hence the price increase does not affect demand, again implying that it is profitable. In subcase (c), a browsing low-value consumer cannot receive a positive surplus. Hence, the surplus of a low-value consumer who does not study is zero, and thus low-value consumers strictly prefer to study for all headline prices $f_i \in (f_{min}, v_L)$. So raising the price to just below $\min\{\min_{j \neq i} \{f_j\}, v_L\}$ is profitable. We conclude that $\min_{j \neq i} \{f_j\} = f_{min}$.

Now consider a rival j for whom $f_j = f_{min}$. Hence, in equilibrium firm j charges headline prices in an interval $(f_{min}, f_{min} + \eta)$ for any $\eta > 0$. Since at most one firm has a mass point at f_{min} , $f_{max} > f_{min}$, and thus $v_L > f_{min}$. Consider sufficiently small $\eta > 0$ that satisfy $\eta < \min\{v_L - f_{min}, \bar{a}\}$. We first establish that if η is sufficiently small, low-value consumers initially assigned to firm j study with probability one for all profit-maximizing equilibrium headline prices in $(f_{min}, f_{min} + \eta)$. Suppose not. Then a positive fraction of these consumers browse. If either the browsing low-value or browsing high-value consumers buy with positive probability from firm j , then the additional price must satisfy $a_j = \min\{v_H - f_{min}, \bar{a}\} = \bar{a}$. Consider such price pairs $f_j, \bar{a}$ of firm j for which low-value consumers browse. Furthermore, as $\eta \rightarrow 0$, the probability of a firm $l \neq i, j$ setting a headline price $f_l > f_{min} + \eta$ goes to 1, and the probability of firm l setting a headline price in the interval $(f_{min}, f_{min} + \eta)$ goes to 0. (Trivially, when $I = 2$, the probability that a third firm charges a price in $(f_{min}, f_{min} + \eta)$ is zero for any $\eta > 0$.) Note that a low-value consumer who sees a headline price in the interval $(f_{min}, f_{min} + \eta)$ is strictly better off studying whenever it is matched with a headline price at or above $f_{min} + \eta$; with positive probability, however, a browsing low-value consumer initially assigned to firm j is matched with firm i when it charges f_{min} and in that case loses a payoff of at least $\bar{a} - \eta$ relative to studying; finally, the probability of being matched with a headline price in $(f_{min}, f_{min} + \eta)$ goes to zero, so that for sufficiently small η low-value consumers initially assigned to firm j strictly prefer studying. We conclude that low-value consumers initially assigned to firm j study with probability one for all profit-maximizing equilibrium headline price in $(f_{min}, f_{min} + \eta)$. But this implies a profitable deviation for firm j . If firm j deviates and charges

$f_j = f_{min} - \eta, a_j = \bar{a}$ it keeps all consumers initially assigned to it and loses at most 2η from any consumer it sells to, and attracts all browsing consumers that are matched with it. Since firm i charges f_{min} with positive probability, this strictly increases demand, and hence is profitable for sufficiently small η . We conclude that there is no mass point in the headline price distribution at f_{min} .

We prove now that at least two firms must attain the infimum f_{min} . Suppose otherwise that $\underline{f}_i = f_{min}$ for only one firm i . Then there exists an $\eta < v_L - f_{min}$ such that only firm i sets prices in $(f_{min}, f_{min} + \eta)$ with probability one. Browsing high-value consumers buy from firm i for headline prices in $(f_{min}, f_{min} + \eta)$ with positive probability, so that $a_i = \bar{a}$ for these prices. Furthermore, for these prices it is strictly optimal for low-value consumers to study and purchase. But then firm i could increase profits from all consumers buying at prices in $(f_{min}, f_{min} + \eta)$ by shifting all probability mass from this interval to just below $f_{min} + \eta$, a contradiction. We conclude that $\underline{f}_i = f_{min}$ for at least two firms i .

Step (v): All high-value consumers browse with probability one. It follows from Step (iii) that there is no benefit of studying for high-value consumers since they buy and do not avoid the additional price, and furthermore by Step (ii) high-value consumers pay $\bar{a}$. At any headline price above f_{min} , hence, they strictly benefit from browsing by Step (iv), and since there is no mass point at f_{min} , high-value consumers browse with probability one. $\square$

Lemma 4. *Suppose there are $N \geq 2$ firms each of which is assigned an initial share of $1/N$ of consumers. Let $I = N$ or $I = N+1$ (i.e. there is at most one additional firm that has no consumers assigned to it). If consumers who browse draw the second headline price from all other firms with equal probability, then in any equilibrium that satisfies our equilibrium-selection assumptions, firms that have initially assigned consumers earn the same profits and play symmetric headline-price strategies, and low-value consumers study with probability one. Furthermore, the symmetric headline-price equilibrium distribution of the firms that have initially assigned consumers has no mass points.*

Proof of Lemma 4. We use the same notation as in the proof of Lemma 3; that is, let $\underline{f}_i$ be the infimum of firm i 's headline price distribution and let $f_{min} = \min_i \{\underline{f}_i\}$. Similarly, let $\bar{f}_i$ be the supremum of firm i 's headline price distribution and let $f_{max} = \max_i \{\bar{f}_i\}$.

We proceed in five steps. First, we prove that $f_{max} \leq v_L$. Second, we establish that for all equilibrium headline prices, we can have $a_i < \bar{a}$ only for the headline price f_{max} and only if exactly one firm has a mass point at f_{max} and sells only to studying low-value consumers. Otherwise, all equilibrium headline prices charge $\bar{a}$. For any off-equilibrium headline price $f_i \leq v_H$, consumers believe that $a_i = \min\{v_H - f_i, \bar{a}\}$ with probability one. Third, we show that for any headline price at which low-value consumers weakly prefer to browse, the firm would earn higher profits if low-value consumers switched to studying instead. Fourth, we establish that firms that are initially assigned consumers that attain f_{min} or f_{max} earn the same profits, and use the same price distributions. Fifth, we prove that all firms with initially assigned consumers attain f_{min} .

Step (i): $f_{max} \leq v_L$. This follows directly from Lemma 3 step (iii).

Step (ii): for any $f_i \leq v_L$, consumers believe $a_i = \bar{a}$ with probability one and for almost any f_i, a_i firm i charges in equilibrium, $a_i = \bar{a}$.

We focus on equilibria in which, by our second equilibrium-selection assumption, consumers believe that a_i optimally targets either studying high-value consumers or (purchasing) browsing consumers. In either case, for all f_i , thus, $a_i \in \{v_H - f_i, \bar{a}\}$ with probability one. Since $v_L < v_H - \bar{a}$, thus, consumers believe that $a_i = \bar{a}$ for all $f_i \leq v_L$. Furthermore, with probability one the firm chooses a headline price $f_i \leq v_L$ in equilibrium, so our second-equilibrium assumption implies that firms set $a_i = \bar{a}$.

Step (iii): For any headline price at which low-value consumers weakly prefer to browse, the firm would earn higher profits if low-value consumers switched to studying instead. We next establish that for any headline price at which low-value consumers weakly prefer to browse, the firm would earn higher profits if low-value consumers switched to studying instead. To see this, we denote by $1 - H_{-j}(f_j) = \frac{1}{I-1} \sum_{i \neq j} \mathbb{P}(f_i > f_j)$ the probability that the average competitor charges a strictly larger headline price than firm j and by $1 - H_{-j}^-(f_j) = \frac{1}{I-1} \sum_{i \neq j} \mathbb{P}(f_i \geq f_j)$ the corresponding probability for a weakly larger one. Note that $H_{-j}(f_j) = H_{-j}^-(f_j)$ if no competitor has a mass point at f_j .

We now set up a condition under which low-value consumers weakly prefer to browse for all $f_j \leq f_{max}$. By the previous step, for all $f_j \leq f_{max}$, consumers believe $a_j = \bar{a}$ with probability one. Thus, low-value consumers weakly prefer to browse at such a headline price f_j if and only if

$$\underbrace{f_j}_{\text{price when studying}} \geq \underbrace{(1 - H_{-j}(f_j))(f_j + \bar{a})}_{\text{browse larger price}} + \underbrace{[H_{-j}(f_j) - H_{-j}^-(f_j)](f_j + \bar{a})}_{\text{browse identical price}} + \underbrace{H_{-j}^-(f_j)[\mathbb{E}(f_{-j}|f_{-j} < f_j) + \bar{a}]}_{\text{browse smaller price}}.$$

This last expression is equivalent to

$$\bar{a} \leq H_{-j}^-(f_j)[f_j - \mathbb{E}(f_{-j}|f_{-j} < f_j)].$$

We now characterize under which condition firm j 's profit when a low-valuation consumer studies, i.e. $f_j - c$, is greater than the profit it earns from the low-value consumer browsing. As outlined in Step (ii), firms charge $a_j = \bar{a}$ for all $f_j \leq f_{max}$, and the condition becomes

$$f_j - c > (1 - H_{-j}(f_j))(f_j + \bar{a} - c) + \beta_j [H_{-j}(f_j) - H_{-j}^-(f_j)] (f_j + \bar{a} - c) + H_{-j}^-(f_j) \times 0,$$

where $\beta_j \in [0, 1]$ can be any tie-breaking rule. The left-hand-side captures that studying low-value consumers never pay any strictly positive additional price. Hence, since $f_j + \bar{a} > c$, a sufficient condition for the firm preferring the consumer to study is

$$f_j - c > (1 - H_{-j}^-(f_j))(f_j + \bar{a} - c),$$

which is equivalent to

$$\bar{a} < H_{-j}^-(f_j)[f_j - (c - \bar{a})].$$

Since firms must earn positive profits, headline prices are strictly greater than $c - \bar{a}$, and hence $\mathbb{E}(f_{-j}|f_{-j} < f_j) > c - \bar{a}$, which implies that the firm strictly prefers consumers to study whenever they weakly prefer to browse.

Step (iv): Firms that are initially assigned consumers that attain f_{min} or f_{max} earn the same profits, and use the same price distributions. We first rule out that two (or more) firms have a mass point at f_{max} . In that case, high-value (browsing) consumers must buy from one of these firms with positive probability, and this firm must set $a_i = \bar{a}$. Then another firm j setting f_{max} would be strictly better off setting $f_j = f_{max} - \eta$ and $a_j = \bar{a}$ for a sufficiently small $\eta > 0$. In this case, it attracts the browsing high-value consumers when firm i charges f_{max} and they see firm i and j 's headline prices. Furthermore, by Step (ii) consumers believe the additional price equals $\bar{a}$ with probability one for any headline price $f \leq f_{max}$. Thus, if low-value consumers strictly preferred to browse at $f_i = f_{max}$, then they still strictly prefer to browse after a small price cut. If they strictly preferred to study, they must still strictly prefer to study. And if the low-value consumers were indifferent between studying and browsing, then they strictly prefer to study following the headline price decrease because they think $a_i = \bar{a}$; and such a switch is beneficial to firm j by Step (iii). We conclude that at most one firm has a mass point at f_{max} .

Let h be a firm that has the mass point at f_{max} , or attains the supremum of the headline price distribution f_{max} if no firm has a mass point at f_{max} . Since high-value consumers browse, this firm must sell to low-value studying consumers at (or arbitrarily close to) f_{max} . This implies that firm h is one of the N firms, which have consumers initially assigned to it, and that the low-value consumers weakly prefer to study when firm h sets f_{max} .

Let π_h be the equilibrium profits of firm h . It follows from Step (iv) in the proof of Lemma 3 that no firm has a mass point at f_{min} , and at least two firms obtain f_{min} . Let l be a firm that attains f_{min} and belongs to the group N of firms that have consumers initially assigned to it. Let π_l be its equilibrium profits. We next establish that $\pi_h = \pi_l$. This holds trivially if $l = h$. Hence, suppose that $l \neq h$.

We show that low-value consumers that see firm l 's headline price study for all headline prices strictly below f_{max} , including out-of-equilibrium ones. Suppose otherwise. Then since low-value consumers believe that $a_l = \bar{a}$ for these headline price, and studying is optimal at f_{min} , there exists some headline price $f_{min} < \hat{f}_l < f_{max}$ at which consumers are indifferent between studying and browsing. First, we establish that if $\hat{f}_l > \underline{f}_h > f_{min}$, then $\pi_l > \pi_h$. The reason is that if firm l charges $\underline{f}_h$ (or minimally undercuts it), then it earns as much as firm h does when doing so from browsing consumers that are initially assigned to a firm $i \neq h, l$, and it earns as much from low-value consumers initially assigned to itself as firm h does from its initially assigned low-value consumers because low-value consumers study at this price. But l earns more from high-value consumers that browse and are matched with firm h than firm h does from browsing high-value consumers matched with firm l , because firm h charges higher prices with probability one. This, however, is a contradiction because by charging f_{min} firm h could earn at least firm l 's equilibrium profits—both firms make the same profits from low-value studying consumers, both earn the same

from browsing consumers of firms $i \neq h, l$, both earn the same from high-value browsing consumers assigned to the other firm, and since none of firm h 's initially-assigned low-value consumers browse, l earns weakly less from browsing low-value consumers. This rules out that $\hat{f}_l > \underline{f}_h > f_{min}$.

We next rule out that $\underline{f}_h \geq \hat{f}_l$. Since low-value consumers of firm l are indifferent between studying to save $\bar{a}$ and browsing for the chance of getting a lower headline price from a firm $i \neq l, h$ (since h always charges weakly higher headline prices) at $\hat{f}_l$, low-value consumers of firm h strictly prefer to browse because firm l with positive probability charges lower headline prices. But this contradicts the fact that low-value consumers of firm h weakly prefer to study at f_{max} , which saves them $\bar{a}$ but forgoes the chance of bigger price savings from a firm $i \neq h, l$ as well as a potential cheaper headline price from firm l . Hence, we conclude that $\hat{f}_l \geq f_{max}$.

In addition, by Step (iii), it must be that all low-value consumers study at f_{max} , for otherwise the firm setting f_{max} would have an incentive to minimally undercut it. Therefore, low-value consumers of firms l and h always study. Since in addition no firm has a mass point at f_{min} , this implies that if the high-value firm set f_{min} , it earns π_l , so we conclude that $\pi_h \geq \pi_l$. Furthermore, because $\hat{f}_l \geq f_{max}$, firm l can arbitrarily closely approximate π_h by setting headline prices (arbitrarily close to) f_{max} and inducing all low-value consumer to study. We thus conclude that $\pi_l = \pi_h$.

We next rule out that firm l or h has a mass point strictly below f_{max} . Suppose otherwise, that is firm $i \in \{h, l\}$ has a mass point at $f \in (f_{min}, f_{max})$. We consider two cases. Either (a) for any $\epsilon > 0$ and corresponding interval $[f, f + \epsilon)$, there exists some rival $j \neq i$ that sets prices in $[f, f + \epsilon)$ with positive probability. Or (b) there exists a non-empty interval $[f, f + \epsilon)$ in which no rival sets prices with positive probability.

Consider case (a) first. Since $f < f_{max}$, we can choose ϵ so that all consumers believe firm j sets an additional price of $\bar{a}$ for all headline prices in the interval $[f, f + \epsilon)$. For sufficiently small ϵ firm j is better off minimally undercutting firm i 's mass point at f rather than selecting the price in the interval. Such undercutting cannot reduce the demand from browsing consumers initially assigned to any firm $k \neq i, j$; it strictly increases the demand by a discrete amount from high-value consumers initially assigned to firm i since these browse by Lemma 3; it also increases demand from high-value consumers initially assigned to firm j if they are matched with firm i . We are left to consider low-value consumers assigned to firm j . In case they strictly prefer to browse at a headline price of f , they still strictly prefer to browse in case firm j undercuts by a sufficiently small amount, and in this case undercutting weakly increases demand. In case they strictly prefer to study at f , they still strictly prefer to study if firm j undercuts by a sufficiently small amount, and in that case demand from these consumers is unaltered. Finally, if these consumers are indifferent between studying and browsing at f , by Step (iii) firm j earns strictly higher profits if they study, which minimally undercutting f ensures. We conclude that minimally undercutting discretely increases demand and hence profits in case (a).

Consider case (b) next. Then firm i can increase its price without losing any demand, a contradiction.

It remains to rule out a mass point at f_{max} . Suppose firm h has a mass point at f_{max} . Then it earns profits solely from studying low-value consumers. But if firm l mimics it and minimally undercut f_{max} , it earns profits from studying low-value consumers and attracts some browsing high-value consumers from firm h , earning strictly greater profits—a contradiction. We conclude

that neither l, h has a mass point.

For any price $f_i \leq f_{max}$ that firm $i \in \{h, l\}$ sets in equilibrium, it must earn weakly greater profits than its rival, for otherwise the rival would have a strict incentive to set this price as in equilibrium $\pi_l = \pi_h$. Furthermore, because by setting (or to break indifference minimally undercutting) f_i , firm j can attract the same amount of browsing consumers from firms $k \neq h, l$ and because among the consumers assigned to either firm l or h all low-value consumers study and all high-value consumers browse, firm i earns weakly higher profits in case firm j is weakly less likely to undercut it; thus, we have that $G_i(f_i) \geq G_j(f_i)$ for all f_i that firm i charges in equilibrium. Furthermore, if $G_i(f) > G_j(f)$, then firm j cannot set price f in equilibrium. This implies that if $G_i(f) > G_j(f)$ then $G_i(f') > G_j(f')$ for all $f' \in (f, f_{max}]$, contradicting the fact that $G_i(f_{max}) = G_j(f_{max}) = 1$. Hence, $G_i(f) = G_j(f)$ for any price firm i , and by a symmetric argument firm j , sets in equilibrium. But then it follows that $G_i(f) = G_j(f)$.

Step (v): All N symmetric firms that are initially assigned consumers must attain f_{min} . Suppose towards a contradiction that there is a firm i among this group of firms that does not attain f_{min} , i.e. $\underline{f}_i > f_{min}$. We now show this implies $\pi_l > \pi_i$. Consider the profits from firm l setting $f_l = \underline{f}_i - \eta$ and $a_l = \bar{a}$. Firm l attracts weakly more browsing consumers of firms $j \neq \{i, l\}$ than firm i does, and earns no more than η less per browsing consumer it attracts. Since at any headline price at which low-value consumers prefer to browse firms earn larger profits when they study and since low-value consumers of firm l study with probability one, firm l 's profit from a low-value consumer initially assigned to it is at most η less. Similarly, firm l earns at most η less from attracting a browsing high-value consumer of firm i than what firm i earns when attracting a browsing high-value consumer from firm l . But crucially, with probability one firm l attracts all browsing consumers from firm i when matched with it because it undercuts firm i 's lowest headline price. In contrast, because in equilibrium firm l sets prices $f_l < \underline{f}_i$ with strictly positive probability, firm i attracts the browsing high-value consumers of firm l with a probability strictly bounded away from one. Thus for sufficiently small η , $\pi_l > \pi_i$. But firm i could deviate an set f_{min} in which case it would earn π_l , contradicting that $\underline{f}_i > f_{min}$. We conclude that all firms i that are initially assigned consumers attain f_{min} , and hence by the above argument for these firms $G_i(f) = G_h(f)$ and therefore all firms i that are initially assigned consumers use a symmetric price distribution. And because we established above that the headline price distribution of firm h does not have a mass point, the symmetric price distribution does not have a mass point. Finally, because low-value consumers study at f_{max} , they must study with probability one. $\square$

Proof of Proposition 4. We proceed in five steps. First we determine equilibrium profits and price distributions conditional on f_{max} . Second, we establish that $f_{max} \leq \min\{\mathbb{E}(f) + \bar{a}, v_L\}$. Third, we show that there exists an $\alpha^* \in (0, 1)$ such that $f_{max} = v_L$ if and only if $\alpha \geq \alpha^*$. Fourth, we prove that f_{max} increases in α . Fifth, we show that profits weakly increase in $\bar{a}$

Step (i): Equilibrium profits and price distributions. By Lemma 2 firms earn positive profits, and hence with probability one must set profit-maximizing prices f_i, a_i at which some consumers buy. In case $f_i \leq v_L$, a high-value consumer prefers the offer f_i, a_i to her outside option since $f_i + a_i \leq v_L + \bar{a} < v_H$. Thus, at any profit-maximizing headline price offer, at least browsing

high-value consumers must be willing to purchase, that is $f_i + \mathbb{E}(a_i|f_i) \leq v_H$, where the expectation is taken with respect to the equilibrium price distribution.

We now show that firms earn $\frac{\alpha}{I}(f_{max} - c)$. Since by Lemma 3 high-value consumers browse and by Lemma 4 the symmetric equilibrium price distribution has no mass point, as $f_i \rightarrow f_{max}$ the probability that high-value consumers find a cheaper headline price converges to one. Thus, low-value consumers, who study by Lemma 4, must buy with probability one for sufficiently high f_i as otherwise profits would go to zero as $f_i \rightarrow f_{max}$; indeed, thus studying low-value consumers must buy for all $f_i \in (f_{min}, f_{max})$. Since there is no mass point at f_{max} , this implies that in equilibrium firms must earn $\frac{\alpha}{I}(f_{max} - c)$.

We next use standard arguments to show that the support of the equilibrium headline-price distribution is connected. Suppose the support is not connected. Take the largest interval $(\check{f}, \hat{f}) \subset (f_{min}, f_{max})$ for which the probability that a firm charges a price in that interval is zero. Consider a firm i that deviates and for a sufficiently small $\eta > 0$, moves the probability mass from an interval $(\check{f} - \eta, \check{f}]$ to $\hat{f}$. This loss from browsing high-value consumers is bounded by $[H_{-i}(\check{f}) - H_{-i}(\check{f} - \eta)]\check{f}$, while the gain per studying low-value consumer is at least $\hat{f} - \check{f}$. Thus, as $\eta \rightarrow 0$, the loss per high-value browsing consumer vanishes while the gain from studying low-value consumers is bounded from below by a constant, and thus there exists a profitable deviation. We conclude that the support of the headline price distribution is connected.

Indifference between all prices in the equilibrium price distribution requires that the cumulative equilibrium price distribution $G(f)$ satisfies

$$\begin{aligned} \frac{\alpha}{I}(f_{max} - c) &= \frac{\alpha}{I}(f - c) + \frac{(1 - \alpha)}{I}(1 - G(f))(f + \bar{a} - c) + (1 - \frac{1}{I})\frac{(1 - \alpha)}{I - 1}(1 - G(f))(f + \bar{a} - c) \\ &= \frac{\alpha}{I}(f - c) + \frac{2(1 - \alpha)}{I}(1 - G(f))(f + \bar{a} - c). \end{aligned} \quad (1)$$

Hence, one has

$$f_{min} = \frac{\alpha(f_{max} + \bar{a} - c)}{2 - \alpha} + c - \bar{a},$$

and

$$G(f) = 1 - \frac{\alpha(f_{max} - f)}{2(1 - \alpha)(f + \bar{a} - c)} \quad \text{for } f \in [f_{min}, f_{max}]. \quad (2)$$

Step (ii): $f_{max} \leq \min\{\mathbb{E}(f) + \bar{a}, v_L\}$. For low-value consumers to be willing to purchase at f_{max} after studying, it must be that $f_{max} \leq v_L$ and that $f_{max} \leq \mathbb{E}(f_{-i}) + \bar{a}$, where the expectation is taken with regard to the equilibrium headline price distribution $G(f)$. Thus, $f_{max} \leq \min\{\mathbb{E}(f) + \bar{a}, v_L\}$.

Step (iii): There exists an $\alpha^* \in (0, 1)$ such that $f_{max} = v_L$ if and only if $\alpha \geq \alpha^*$. If $\mathbb{E}(f) + \bar{a} \geq v_L$, we must have $f_{max} = v_L$ because otherwise the firm can charge a higher headline price at which low-value consumers would still be willing to study and then buy, and hence charging such a headline price would increase profits.

If $\mathbb{E}(f) + \bar{a} < v_L$, low-value consumers would prefer to browse when seeing headline prices above $\mathbb{E}(f) + \bar{a}$ rather than to study, contradicting the above. In that case, it must be that $f_{max} = \mathbb{E}(f) + \bar{a}$

because for any $f_{max} < \mathbb{E}(f) + \bar{a}$ low-value consumers would still be studying and then buying when facing a slightly higher headline price, and hence there would be a profitable deviation.

Hence in equilibrium $f_{max} = v_L$ if $\mathbb{E}(f|f_{max} = v_L) + \bar{a} > v_L$. Integration by parts yields

$$\begin{aligned}\mathbb{E}(f) &= \int_0^\infty f \cdot g(f) df \\ &= [fG(f)]_0^{f_{max}} - \int_0^{f_{max}} G(f) df \\ &= \int_0^{f_{max}} 1 - G(f) df \\ &= f_{min} + \int_{f_{min}}^{f_{max}} 1 - G(f) df.\end{aligned}\tag{3}$$

Substituting (2) into (3) gives

$$\mathbb{E}(f) = f_{min} + \int_{f_{min}}^{f_{max}} \frac{\alpha(f_{max} - f)}{2(1 - \alpha)(f + \bar{a} - c)} df,\tag{4}$$

which is increasing in f_{max} because

$$\begin{aligned}\frac{\partial \mathbb{E}(f)}{\partial f_{max}} &= \frac{\partial f_{min}}{\partial f_{max}} - \frac{\partial f_{min}}{\partial f_{max}} \frac{\alpha(f_{max} - f_{min})}{2(1 - \alpha)(f_{min} + \bar{a} - c)} + \int_{f_{min}}^{f_{max}} \frac{\alpha}{2(1 - \alpha)(f + \bar{a} - c)} df \\ &= \frac{\partial f_{min}}{\partial f_{max}} G(f_{min}) + \int_{f_{min}}^{f_{max}} \frac{\alpha}{2(1 - \alpha)(f + \bar{a} - c)} df > 0.\end{aligned}$$

Hence $\mathbb{E}(f|f_{max} = v_L) + \bar{a} > v_L$ is equivalent to

$$f_{min} + \int_{f_{min}}^{v_L} \frac{\alpha(v_L - f)}{2(1 - \alpha)(f + \bar{a} - c)} df > v_L - \bar{a}.\tag{5}$$

Observe that the left-hand side of the above equation is increasing in α , since

$$\frac{\partial LHS}{\partial \alpha} = \frac{\partial f_{min}}{\partial \alpha} G(f_{min}) + \int_{f_{min}}^{v_L} \frac{\partial}{\partial \alpha} \left[\frac{\alpha(v_L - f)}{2(1 - \alpha)(f + \bar{a} - c)} \right] df > 0.$$

Using that for $\alpha \rightarrow 1$, $f_{min} \rightarrow f_{max}$ it is easy to verify that indeed $\mathbb{E}(f|f_{max} = v_L) + \bar{a} > v_L$ for α sufficiently close to one and hence $f_{max} = v_L$. To verify that $\mathbb{E}(f|f_{max} = v_L) + \bar{a} < v_L$ when $\alpha \rightarrow 0$, we substitute f_{min} into Inequality (5), which gives

$$\frac{\alpha}{2 - \alpha}(v_L + \bar{a} - c) + c - \bar{a} + \frac{\alpha}{2(1 - \alpha)} \int_{\frac{\alpha(v_L + \bar{a} - c)}{2 - \alpha} + c - \bar{a}}^{v_L} \frac{v_L - f}{f + \bar{a} - c} df < v_L - \bar{a}.\tag{6}$$

Since

$$\begin{aligned}\int_{\frac{\alpha(v_L + \bar{a} - c)}{2 - \alpha} + c - \bar{a}}^{v_L} \frac{v_L - f}{f + \bar{a} - c} df &< \int_{\frac{\alpha(v_L + \bar{a} - c)}{2 - \alpha} + c - \bar{a}}^{v_L} \frac{v_L}{f + \bar{a} - c} df \\ &< [v_L \ln(f + \bar{a} - c)]_{\frac{\alpha(v_L + \bar{a} - c)}{2 - \alpha} + c - \bar{a}}^{v_L} = v_L \ln\left(\frac{2 - \alpha}{\alpha}\right)\end{aligned}$$

one has

$$\begin{aligned}
\lim_{\alpha \rightarrow 0} \frac{\alpha}{2(1-\alpha)} \int_{\frac{\alpha(v_L + \bar{a} - c)}{2-\alpha} + c - \bar{a}}^{v_L} \frac{v_L - f}{f + \bar{a} - c} df &\leq \lim_{\alpha \rightarrow 0} \frac{\alpha}{2(1-\alpha)} v_L \ln\left(\frac{2-\alpha}{\alpha}\right) \\
&= \lim_{\alpha \rightarrow 0} v_L \frac{\ln\left(\frac{2-\alpha}{\alpha}\right)}{\frac{2(1-\alpha)}{\alpha}} \\
&= \lim_{\alpha \rightarrow 0} v_L \frac{\alpha}{2-\alpha} = 0,
\end{aligned}$$

where the last step follows from L'Hospital's rule. Hence the left hand side of Inequality 6 goes to some value less than v_L as $\alpha \rightarrow 0$, implying that $\mathbb{E}(f|f_{max} = v_L) + \bar{a} < v_L$. Thus, there exists a critical $\alpha^* \in (0, 1)$ such that $f_{max} < v_L$ if and only if $\alpha < \alpha^*$.

Step (iv): f_{max} increases in α . Since all consumers purchase the product for any α , and hence the cost of production are the same independently of α it suffices to show that the firms' expected profits $\frac{\alpha}{1}(f_{max} - c)$ are increasing in α . This holds obviously for any $\alpha > \alpha^*$. It remains to show that for any $\alpha \leq \alpha^*$, f_{max} increases in α .

For these values of α , f_{max} is implicitly defined by $f_{max} - \mathbb{E}(f) = \bar{a}$. Using Equation 4 for the expected price $\mathbb{E}(f)$ and applying the implicit-function theorem, we get

$$\frac{\partial f_{max}}{\partial \alpha} = \left[1 - \int_{f_{min}}^{f_{max}} \frac{\alpha}{2(1-\alpha)(f + \bar{a} - c)} df \right]^{-1} \cdot \left[\int_{f_{min}}^{f_{max}} \frac{(f_{max} - f)}{(1-\alpha)^2(f + \bar{a} - c)} df \right].$$

The second factor is always positive and the first one is positive if the integral it contains is less than one.

$$\begin{aligned}
\int_{f_{min}}^{f_{max}} \frac{\alpha}{2(1-\alpha)(f + \bar{a} - c)} df &= \frac{\alpha}{2(1-\alpha)} \int_{f_{min}}^{f_{max}} (f + \bar{a} - c)^{-1} df \\
&= \frac{\alpha}{2(1-\alpha)} \ln \left(\frac{f_{max} + \bar{a} - c}{f_{min} + \bar{a} - c} \right) \\
&= \frac{\alpha}{2(1-\alpha)} \ln \left(\frac{2-\alpha}{\alpha} \right) < 1,
\end{aligned}$$

which is equivalent to

$$\ln \left(\frac{2-\alpha}{\alpha} \right) < \frac{2(1-\alpha)}{\alpha}.$$

The left- and right-hand side of the above inequality are decreasing in α and are identical for $\alpha = 1$. But since the derivative of the left-hand side with respect to α , $\frac{-2}{\alpha(2-\alpha)}$, is larger than the derivative of the right-hand side with respect to α , $\frac{-2}{\alpha^2}$, the above inequality holds for all $\alpha \in (0, 1)$. This proves that f_{max} increases in α everywhere, and hence that expected profits $\frac{\alpha}{1}(f_{max} - c)$ are increasing in α . We conclude that the expected consumer payment is increasing in α . $\square$

Proof of Proposition 5. First, we show that (almost) all consumers who buy at some (equilibrium or out-of-equilibrium) headline price f_i must study with probability one. Towards a contradiction, suppose firm i attracts some browsing consumers with a given positive probability conditional on setting f_i (and all firms $j \neq i$ follow their equilibrium pricing strategy). Firm i can therefore earn arbitrarily large profits by charging f_i and increasing a_i to the desired (expected) profit level, a contradiction. We conclude that (almost) all consumers who buy study with probability one at any given (equilibrium or out-of equilibrium) headline price f_i .

We next show that for any equilibrium headline price $f_i < v_H$ at which some high-value consumers study, $a_i \geq v_H - f_i$. If $a_i < v_H - f_i$ firm i could increase the additional price slightly in which case all high-value consumers still have a strict incentive to buy, and thereby increase its profits—a contradiction. We now show that for any equilibrium headline price $f_i < v_H$ and $f_i \neq v_L$ at which some high value consumers study, $a_i = v_H - f_i$. If $a_i > v_H - f_i$ all studying high-value consumers do not purchase. In case $a_i > v_H - f_i$, the firm could raise its profits by charging an additional price $a_i = v_H - f_i - \epsilon_1$ for some small enough $\epsilon_1 > 0$; in this case studying low-value consumers behavior is unaltered and all studying high-value consumers purchase and pay $v_H - \epsilon_1 > c$, increasing the firms profit—a contradiction. We conclude that $f_i + a_i = v_H$ in equilibrium whenever $f_i < v_H$ and $f_i \neq v_L$.

Furthermore, our second equilibrium selection assumption implies that for any equilibrium $f_i \leq v_L$ at which no high-value consumers study or any out-of-equilibrium headline price f_i , the expected additional price $\mathbb{E}[a_i|f_i] \geq v_H - f_i$. This follows from the fact that studying low-value consumers do not pay the additional price, and hence consumers must believe a_i to be chosen to target another group: either studying high-value consumers (in which case $a_i = v_H - f_i$) or browsing consumers that purchase in which case a_i would have to be chosen arbitrarily high.

Given that for all (equilibrium and out-of equilibrium) $f_i < v_L$, consumers believe that $\mathbb{E}[a_i|f_i] \geq v_H - f_i$ and that they incur it with probability one when purchasing without studying, the expected payoff of browsing is non-positive. This implies that (a) for all $f_i < v_L$, low-value consumers must study and buy with probability one. Furthermore, (b) high-value consumers are indifferent between studying and browsing (and not purchasing) for any $f_i < v_L$.

Furthermore, since by the first and third equilibrium selection assumption a given positive fraction $\epsilon \in (0, 1]$ of high-value consumers browse when indifferent, then—since for any equilibrium headline price f_i high-value consumers are indifferent between studying and browsing—a fraction $1 - \epsilon$ of high-value consumers study for any $f_i < v_L$. We will now argue that in any equilibrium firms must set $f_i = v_L$. Suppose not. If $f_i < v_L$ firm i could deviate and set a price $f'_i = f_i + (v_L - f_i)/2$ for which studying low-value consumers still have a strict incentive to buy. Because the payoff from browsing is zero, the fraction $1 - \epsilon$ of high-value consumers study at f'_i . Firm i could then set an additional price $a_i = v_H - f'_i - \epsilon_2$, which for sufficiently small $\epsilon_2 > 0$ induces all studying high-value consumers to buy. Because this deviation raises the profits earned from low-value consumers by some given strictly positive amount, it is a profitable deviation for sufficiently small ϵ_2 . We conclude that in any equilibrium, $f_i \geq v_L$.

We next show that in any equilibrium $f_i \leq v_L$. Consider a firm that charges $f_i = v_L - \epsilon_3$ and $a_i = v_H - v_L$ for some $\epsilon_3 > 0$. This firm earns $v_L - \epsilon_3$ from low-value consumers and $v_H - \epsilon_3$ from the fraction $1 - \epsilon$ of high-value consumers that study; i.e. it earns $\alpha v_L + (1 - \alpha)(1 - \epsilon)v_H - \epsilon_3$.

For small enough ϵ_3 , this is strictly greater than the maximal profits a firm can earn from high-value consumers, which is $(1 - \alpha)(1 - \epsilon)v_H$. And because low-value consumers do not purchase for $f_i > v_L$, this implies that $f_i \leq v_L$. Together with the previous paragraph, we can thus conclude that $f_i = v_L$.

We now show that the firm sets $a_i = v_H - v_L$ as long as some high-value consumers buy (and hence the fraction of high-value consumers ϵ that browse when indifferent is less than one). We already ruled out that $a_i < v_H - v_L$ when some high-value consumers study. In case, $a_i > v_H - v_L$ and some high-value consumers study when indifferent, the firm can deviate by setting $a_i = v_H - v_L$ and $f_i = v_L - \epsilon_4$ for some $\epsilon_4 > 0$. In this case all low-value consumers study and buy from firm i , and the fraction $1 - \epsilon$ of high-value consumers that study now also buy from firm i , which for sufficiently small ϵ_4 increases profits. Hence, in any equilibrium consumers who purchase pay their valuation.

We are left to show that there exists an equilibrium in which $f_i = v_L$ and $a_i = v_H - v_L$ and a fraction ϵ of high-value consumers browse. We specify equilibrium strategies as follows: Low-value consumers study for all f_i , and purchase if and only if $f_i \leq v_L$. A given share ϵ of high-value consumers browse for all f_i , and refrain from purchasing when doing so. The remaining high-value consumers study for all f_i , and purchase if and only if $f_i + a_i \leq v_H$. Firms set prices $f_i = v_L$ and $a_i = v_H - v_L$. For any $f_i \leq v_H$, consumers believe that $a_i = v_H - f_i$ and hence optimally targets studying high-value consumers; for $f_i > v_H$ consumers believe that $a_i = 0$.

It is straightforward to verify that the firms strategies are a best response, and that the consumers search and purchase decisions are sequentially rational and consistent. Since high-value consumers browse with probability ϵ , the equilibrium satisfies the first equilibrium selection assumption. Obviously, a_i optimally targets studying high-value consumers for all $f_i \leq v_H$ and because for $f_i > v_H$ independent of the consumer's beliefs about a_i all consumers never purchase, a_i also optimally targets studying high-value consumers in this case. Hence the equilibrium is consistent with our second equilibrium-selection assumption. When indifferent, each consumer type browses with a given probability, and then conditional on this choice purchases with a given probability. Therefore the equilibrium also satisfies the third equilibrium-selection assumption. $\square$

Proof of Proposition 6. We construct an equilibrium as follows. Firms always charge $f_i = c - (1 - \alpha)\bar{a}$, $a_i = \bar{a}$. For any headline price(s), consumers believe that $a_i = \bar{a}$. It suffices to specify consumer strategies for headline prices in which at most one firm deviated. For these histories, both consumer types always browse and low-value consumers who do not value the additional service purchase the plain-vanilla product while high-value consumers purchase the product with additional service, which is optimal as $\kappa \geq \bar{a}$. Both consumer types choose the cheaper headline price, and if they are equal, the consumer buys from the firm she was initially assigned to. $\square$

Proof of Proposition 7. In the proof of Proposition 4, we derived the headline-price distribution for any value f_{max} when high-value consumers browse and low-value consumers study. Take this distribution (2) as a candidate equilibrium headline price distribution with $f_{max} = \min\{v_L, \mathbb{E}[f] + \bar{a}, \mathbb{E}[f] + s_3\}$. Recall that (2) has no mass point at f_{max} . Furthermore, suppose that firms for any (equilibrium) headline price always set an additional price of $\bar{a}$.

We now consider the beliefs of consumers. Suppose that (consistent with our second equilibrium-selection assumption) consumers believe additional prices for on or off-equilibrium headline price offers are $\bar{a}$, and that all so far unobserved headline prices are distributed according to the candidate equilibrium headline price distribution. Obviously, these beliefs are consistent with the firms' strategies specified above.

We now specify consumer strategies starting with high-value consumers; we follow the common convention to only specify consumer strategies for those histories in which at most one firm deviated as other histories do not matter for the incentives on the path of play (for a formal discussion of irrelevant histories for which strategies need not be specified see Blume and Heidhues, 2006). Independent of the initial headline price they see, high-value consumers always browse for a second headline price. When having observed at least one headline price weakly below f_{max} within the first two price observations (which they must if only one firm deviated and they browsed initially), high-value consumers refrain from paying the search cost to see another price. Suppose the consumer (out-of-equilibrium) studied initially firm i , then she is going to pay s_3 and browse another headline price if $\max\{v_H - (f_i + a_i), 0\} < v_H - \mathbb{E}[f_j] + \bar{a} + s_3$. When having seen three prices, the high value consumer must have seen one headline price below f_{max} even if one firm deviated, so in this case the consumer stops browsing. When stopping to browse, high-value consumers purchase from the firm with the lowest expected price (which must be below $f_{max} + \bar{a}$ if only one firm deviated) and choose to pay the additional price.

We now verify that the high-value consumers' strategy is optimal. After having browsed at least a second-headline price, purchasing strictly dominates not purchasing in the histories we consider since $f_{max} + \bar{a} < v_H$, and when purchasing high-value consumers always prefer to pay the additional price and purchase from the firm with cheapest expected total price. After having observed one headline price, high-value consumers strictly prefer browsing a second headline price when the lowest (on- or off-equilibrium-) headline price f_i they observed so far is greater than f_{min} to studying. For on or off-equilibrium headline prices $f_i \leq f_{min}$, they weakly prefer browsing a second headline price to studying. And once the consumer has seen at least two headline prices, one must be below f_{max} in which case the consumer always strictly prefers to purchase from the firm with the lowest expected cost to studying a so far unobserved additional price because she believes all unobserved additional prices are $\bar{a}$ with probability one. Hence, following any search history, studying is suboptimal. Following any history in which at most one firm deviated and the consumer browsed $n \geq 2$ headline prices and observed $k \geq n$ prices overall, it is optimal for her to not pay additional search costs and purchase immediately; to prove this, note that there are only finitely many prices. Consider the last costly search $k' \geq 3$ the consumer engages in and note that if at most one firm deviated the lowest expected cost of purchasing from a firm whose headline price the consumer has already seen satisfies $f_j + \mathbb{E}[a_j|f_j] \leq f_{max} + \bar{a}$, where $\mathbb{E}[a_j|f_j] = \bar{a}$ if the consumer did not study firm j and a_j otherwise. In expectation, hence, she is better off not engaging in search k' because $f_{max} + \bar{a} \leq \mathbb{E}[f] + \bar{a} + s_{k'}$. We conclude that it is always optimal to stop browsing after having seen two headline prices, and thus the specified high-value consumers' search strategy is optimal. Furthermore, as long as at most one firm deviates, high-value consumers always refrain from studying, and browse exactly one more headline price.

We now turn to low-value consumers. Consider first histories in which the lowest headline price

the consumer has seen $f_i \leq f_{max}$. Let f_l be the lowest headline price that the consumer has studied and set $f_l = \infty$ if the consumer studied no headline price. In case $f_i = f_l$, the low-value consumer purchases product i . Consider from now on the case in which $f_i < f_l$. The consumer studies product i if and only if $s_{k+1} < \bar{a}$ and $f_i + s_{k+1} \leq \min\{v_L, f_l\}$; the consumer purchases product i (without studying) if $\bar{a} \geq s_{k+1}$ and $f_i + \bar{a} \leq \min\{v_L, f_l\}$; purchases product l if and only if $f_l \leq v_L$ and $f_i + \min\{s_{k+1}, \bar{a}\} > f_l$; the consumer stops searching and does not purchase otherwise, i.e. if and only if $f_i + \min\{s_{k+1}, \bar{a}\} > v_L$ and $f_l > v_L$. Now consider histories in which the lowest headline price $f_i > f_{max}$. Because we only specify strategies for histories in which at most one firm deviated, it must be that f_i is the initial headline price the consumer has seen. In case the consumer did not study firm i 's additional price, she browses another headline price; in case she studied firm i 's additional price, she browses a second headline price if and only if

$$\max\{0, v_L - f_i\} < v_L - \mathbb{E}[f] - s_3 - \min\{s_4, \bar{a}\},$$

purchases immediately if and only if

$$v_L - f_i \geq \max\{0, v_L - \mathbb{E}[f] - s_3 - \min\{s_4, \bar{a}\}\},$$

and stops searching without purchasing otherwise.

We begin by establishing that for any history in which a low-value consumer has seen a headline price $f_i \leq f_{max}$ browsing is suboptimal. We do so by showing that studying the additional price of the lowest headline price she has seen (if she has not already done so) and then purchasing gives a greater expected surplus than browsing and then behaving optimal; obviously, if she already studied this headline price, the surplus of just buying is even greater, so our argument covers this case as well. We argue by backward induction, establishing first that it is suboptimal to browse the last remaining product after the consumer has seen all other headline prices. Let f_i be the lowest headline price the low-value consumer has seen, and suppose the consumer has seen k (headline and additional) prices so far. Consider the case in which $f_i = f_{max}$, which gives the consumer the highest incentive to browse the final product. Browsing the final product is suboptimal if

$$v_L - f_{max} - s_{k+1} \geq v_L - \mathbb{E}[f] - s_{k+1} - \min\{\bar{a}, s_{k+2}\},$$

where we use the fact that the consumer will see a lower headline price for certain, and then study the product if and only if the additional price is greater than the search cost. Since the search cost are weakly increasing and $f_{max} \leq \min\{\mathbb{E}[f] + \bar{a}, \mathbb{E}[f] + s_3\}$ the above inequality is always satisfied and the consumer never browses the final product after having browsed all $I - 1$ others. By backward induction, hence, she will never browse after having seen $I - 2$ others, and so on. We conclude that refraining from browsing is optimal whenever the consumer has seen a headline price below f_{max} .

Given that browsing is suboptimal, it is optimal to stop searching and refraining from purchasing if $f_i + \min\{s_{k+1}, \bar{a}\} > v_L$ and $f_l > v_L$ because the consumer does not want to buy product i with or without studying, and she does not want to buy product l either. It is optimal to buy product l if $f_l \leq v_L$ and $f_i + \min\{s_{k+1}, \bar{a}\} > f_l$, where the latter condition ensures that the consumer prefers buying l to buying i with or without studying. Similarly, she prefers purchasing product i without studying to studying if $\bar{a} \geq s_{k+1}$ and prefers purchasing i without studying to purchasing

product l or the outside option if $f_i + \bar{a} \leq \min\{v_L, f_l\}$; finally, studying is optimal if $s_{k+1} < \bar{a}$ and $f_i + s_{k+1} \leq \min\{v_L, f_l\}$.

In case the initial headline price $f_i > f_{max}$, the consumer believes that if she browses she sees an offer below f_{max} ; using the one-deviation principle, thus, we just need to consider strategies in which she browses at most one additional offer. Now if the initial offer $f_i > f_{max} = \min\{v_L, \mathbb{E}[f] + \bar{a}, \mathbb{E}[f] + s_3\}$, we argue that it is optimal for the consumer to browse. In case $f_{max} \geq v_L$, the low-value consumer gets zero surplus when studying product i so browsing is optimal; in case $v_L > f_i > \mathbb{E}[f] + \bar{a}$ the consumer strictly prefers browsing a second headline price and purchasing that product without studying to studying firm i 's offer; and finally if $v_L > f_i > \mathbb{E}[f] + s_3$, the consumer strictly prefers to browse another offer and then study the new offer. Therefore, studying is never strictly optimal, and hence browsing part of a best response. If the consumer nevertheless studied the initial offer, she strictly benefits from paying s_3 and browsing in case

$$v_L - \mathbb{E}[f] - s_3 - \min\{s_4, \bar{a}\} > \max\{0, v_L - f_i\},$$

where we use the fact that after observing the new headline price paying s_4 and studying it is strictly optimal if and only if $s_4 < \bar{a}$; purchasing immediately is optimal if

$$v_L - f_i \geq \max\{0, v_L - \mathbb{E}[f] - s_3 - \min\{s_4, \bar{a}\}\},$$

and stopping to search without purchasing is optimal otherwise.

Given the specified consumers' search strategies, any firm earns zero profits when setting a headline price above f_{max} and so it is never optimal to do so. Because high-value consumers browse and low value-consumers study exactly once for headline prices below f_{max} , they behave exactly as postulated in the proof of Proposition 4, it is optimal for firms to set headline prices according to (2) with $f_{max} = \min\{v_L, \mathbb{E}[f] + \bar{a}, \mathbb{E}[f] + s_3\}$. We conclude that the candidate equilibrium is indeed an equilibrium.

Note that in case $s_3 > \bar{a}$, f_{max} is unaffected and hence the comparative statics follow immediately from the proof of Proposition 4. Otherwise, we have $f_{max} = \min\{v_L, \mathbb{E}[f] + s_3\}$. Since s_3 is constant, we can simply replace $\mathbb{E}[f] + \bar{a}$ by $\mathbb{E}[f] + s_3$ in Steps (iii) and (iv) of the proof of Proposition 4 without altering it otherwise. We conclude that if $s_3 < \bar{a}$, there exists an $\alpha^* \in (0, 1)$ such that $f_{max} = v_L$ for $\alpha \geq \alpha^*$, and $f_{max} = \mathbb{E}[f] + s_3 < v_L$ for $\alpha < \alpha^*$, and that the expected price consumers pay is increasing in α . $\square$

Proof of Proposition 8. We look for an equilibrium of the same type as in Proposition 4 in which low-value consumers study, high-value consumers browse, and firms charge the maximal additional prices $\bar{a}_L$ and $\bar{a}_H$, and randomize over headline prices according to a common distribution $G(f)$ with support $[f_{min}, f_{max}]$, where $f_{max} \leq \mathbb{E}(f) + \bar{a}_L$ and $f_{max} \leq v_L$. Furthermore, we suppose that consumers believe that firms charge the maximal additional prices $\bar{a}_L$ and $\bar{a}_H$ for equilibrium and out-of-equilibrium headline prices.

Because $f_{max} \leq \mathbb{E}(f) + \bar{a}_L$ and $f_{max} \leq v_L$, it is optimal for low-value consumer to study and then buy for all equilibrium headline prices and to browse for headline prices strictly above f_{max} . Since for high-value consumers prefer to incur the additional price $\bar{a}_H$, and since equilibrium headline prices f_i satisfy $f_i \leq v_L \leq v_L + \bar{a}_H \leq v_H$ for all firms, high-value consumers strictly prefer browsing

over studying. Thus, in equilibrium high-value consumers browse offers and low-value consumers study offers to avoid paying $\bar{a}_L$.

Given the consumers search behavior, firms cannot increase profits by reducing $\bar{a}_H$ or $\bar{a}_L$. A lower additional price for high-value consumers strictly decreases profits from these consumers without affecting demand since high-value browsing consumers do not observe the additional price. Since low-value consumers study and avoid $\bar{a}_L$, changing $\bar{a}_L$ does not affect profits, and hence the firms' additional prices are chosen optimally.

We now show that if $\bar{a}_H$ gets smaller, average profits increase. The construction of the equilibrium headline price distribution parallels that in the proof of Proposition 4, and we therefore only sketch it here. With the different notation, the minimum headline price and the distribution of headline prices become

$$f_{min} = \frac{\alpha(f_{max} + \bar{a}_H - c)}{2 - \alpha} + c - \bar{a}_H,$$

and

$$G(f) = 1 - \frac{\alpha(f_{max} - f)}{2(1 - \alpha)(f + \bar{a}_H - c)} \quad \text{for } f \in [f_{min}, f_{max}], \quad (7)$$

respectively. Since only high-value consumers browse, it is only their headline price that appears in f_{min} and $G(\cdot)$.

We first consider the case where $f_{max} < v_L$. In this case, f_{max} is pinned down by $f_{max} = \mathbb{E}(f) + \bar{a}_L$. When drawing the largest headline price, low-value consumers are indifferent between studying and browsing, which would induce them to pay an average total price of $\mathbb{E}(f) + \bar{a}_L$.

Since industry profits are $\alpha(f_{max} - c)$, we can show that average profits decrease in $\bar{a}_H$ by showing that f_{max} decreases in $\bar{a}_H$. Using again that $\mathbb{E}(f) = f_{min} + \int_{f_{min}}^{f_{max}} 1 - G(f)df$, and applying the implicit-function theorem on $f_{max} - \mathbb{E}(f) - \bar{a}_L = 0$, we get

$$\frac{\partial f_{max}}{\partial \bar{a}_H} = - \left[1 - \int_{f_{min}}^{f_{max}} \frac{\alpha}{2(1 - \alpha)(f + \bar{a}_H - c)} df \right]^{-1} \cdot \left[\int_{f_{min}}^{f_{max}} \frac{\alpha(f_{max} - f)}{2(1 - \alpha)(f + \bar{a}_H - c)^2} df \right].$$

We know from the proof of Proposition 4 that the first term in squared brackets is always positive. To see that the second term is positive we simplify it

$$\begin{aligned} \int_{f_{min}}^{f_{max}} \frac{\alpha(f_{max} - f)}{2(1 - \alpha)(f + \bar{a}_H - c)^2} df &= \frac{\alpha}{2(1 - \alpha)} \cdot \left[- \left[\frac{f_{max} - f}{(f + \bar{a}_H - c)} \right]_{f_{min}}^{f_{max}} - \int_{f_{min}}^{f_{max}} (f + \bar{a}_H - c)^{-1} df \right] \\ &= 1 - \frac{\alpha}{2(1 - \alpha)} \ln \left(\frac{f_{max} + \bar{a}_H - c}{f_{min} + \bar{a}_H - c} \right) \\ &= 1 - \frac{\alpha}{2(1 - \alpha)} \ln \left(\frac{2 - \alpha}{\alpha} \right) > 0. \end{aligned}$$

In the first line, we use integration by parts. We simplify in the second line and in the third use the equilibrium level of f_{min} . We know from *Step (iv)* of Proposition 4 that the last expression is positive.

We therefore know that f_{max} decreases in $\bar{a}_H$. And since $f_{max} = v_L$ whenever $f_{max} < \mathbb{E}(f) + \bar{a}_L$, we conclude that average profits and prices decrease in $\bar{a}_H$.

To see that f_{max} increases in $\bar{a}_L$, recall that whenever $f_{max} < v_L$, f_{max} is determined by $f_{max} - \mathbb{E}(f) = \bar{a}_L$. Since by previous arguments we know that

$$\frac{\partial[f_{max} - \mathbb{E}(f)]}{\partial f_{max}} = 1 - \int_{f_{min}}^{f_{max}} \frac{\alpha}{2(1-\alpha)(f + \bar{a}_H - c)} df > 0,$$

and since $[f_{max} - \mathbb{E}(f)]$ does not depend on $\bar{a}_L$, we know that a larger $\bar{a}_L$ increases f_{max} . We conclude that f_{max} , and hence profits, increases in $\bar{a}_L$. $\square$

Proof of Proposition 9. It follows from Lemmas 3 and 4 that firms 1 and 2 play symmetric strategies in equilibrium, and that high-value consumers browse while low-value consumers study with probability one. Furthermore, the symmetric equilibrium headline price distribution of firms 1 and 2 has no mass point. Let f_{max} and f_{min} be the supremum and infimum of the incumbent firms' headline price distribution.

We proceed in four steps. First, we pin down equilibrium profits and price distributions. Second, we continue by showing that $f_{max} \leq \min\{(1/2)\mathbb{E}(f) + (1/2)\mathbb{E}_3(f_3) + \bar{a}, v_L\}$. Third, we establish that if $f_{max} < v_L$, then f_{max} is strictly increasing in α . Fourth, we show that there exists a unique $\alpha^* \in (0, 1)$ such that $f_{max} = v_L$ if and only if $\alpha \geq \alpha^*$.

Step (i): Equilibrium profits and price distributions. We show first that firm 3 has no mass point on its support. Suppose otherwise that firm 3 has a mass point at some price $\tilde{f}_3$. Then firms 1 and 2 must set headline prices in an interval $(\tilde{f}_3, \tilde{f}_3 + \eta)$ for *some* $\eta > 0$, since otherwise firm 3 would earn zero profits at the mass point, contradicting Lemma 2. Additionally the incumbents must set headline prices in an interval $(\tilde{f}_3, \tilde{f}_3 + \eta)$ for *any* $\eta > 0$, since otherwise firm 3 could increase profits by shifting probability mass from $\tilde{f}_3$ to a marginally larger headline price. But then an incumbent can increase demand by shifting probability mass from $(\tilde{f}_3, \tilde{f}_3 + \eta)$ to $\tilde{f}_3 - \eta/2$ for any $\eta > 0$. This does not affect demand from studying low-value consumers, but discretely increases demand from browsing high-value consumers who would otherwise switch to firm 3 more often. Since for a sufficiently small η , the loss in margins is negligible, this deviation strictly increases profits, contradicting that firm 3 has a mass point on its support. We conclude that firm 3 has no mass point on its support.

We continue by showing that $G_1(\cdot)$ and $G_2(\cdot)$ have a connected support. Suppose otherwise that there exists an interval $(\check{f}, \hat{f}) \subset (f_{min}, f_{max})$ such that $G_1(f) = G_2(f) = \text{const.} \in (0, 1)$ for all $f \in (\check{f}, \hat{f})$, and take $(\check{f}, \hat{f})$ to be the largest such interval such that incumbent firms set prices in any interval $(\check{f} - \eta, \check{f})$ and $(\hat{f}, \hat{f} + \eta)$ for any $\eta > 0$. Then the headline price of firm 3 either has no probability mass in $(\check{f}, \hat{f})$, or has probability mass only on $\hat{f}$. But then an incumbent firm can strictly increase profits from consumers who buy by shifting probability mass from $(\check{f} - \eta, \check{f})$ to $\hat{f} - \eta/2$ for any $\eta > 0$. Since by Lemma 4, the headline price distributions of firms 1 and 2 have no mass point, the loss in demand goes to zero as η gets arbitrarily small. Thus, for a sufficiently small $\eta > 0$, this deviation strictly increases profits, contradicting that firms 1 and 2 do not have connected support. We conclude that firms 1 and 2 have connected support.

Denoting $G_i(\cdot)$ the headline price distribution of firm i , we use the fact that no firm has a mass point in the headline price distribution and that $a_i = \bar{a}$ by Lemma 1 to write the profits of firm 1 as

$$\frac{1}{2}\alpha(f_1 - c) + \frac{1}{2}(1 - \alpha) \left[\frac{1}{2}(1 - G_2(f_1)) + \frac{1}{2}(1 - G_3(f_1)) \right] (f_1 + \bar{a} - c) + \frac{1}{2} \frac{1 - \alpha}{2} (1 - G_2(f_1))(f_1 + \bar{a} - c).$$

The first term are profits from low-value consumers. The second term are profits from high-value consumers who initially observe headline prices of firm 1. The term in squared brackets captures that with equal probability, these consumers compare prices with firm 2 or firm 3. The third term captures profits from poaching high-value consumers that initially observe f_2 . Exchanging indices 1 and 2 leads to the profits of firm 2. Rearranging terms simplifies the expression to

$$\frac{1}{2}\alpha(f_1 - c) + \frac{1}{2}(1 - \alpha) \left[(1 - G_2(f_1)) + \frac{1}{2}(1 - G_3(f_1)) \right] (f_1 + \bar{a} - c). \quad (8)$$

Low-value consumers are a profit base for firms 1 and 2 and these firms earn at least $\alpha(f_{max} - c)/2$ by charging f_{max} . They must earn at least these profits for almost all prices in the support, implying that total prices $f_i + \bar{a}$ are almost surely strictly larger than c . Hence $f_{min} + \bar{a} > c$. Therefore the entrant charges the tuple $(f_{min}, \bar{a})$ and thereby profitably attracts all browsing high-value consumers that see its headline price with probability one. Furthermore, the highest price in the support of firm 3's headline price distribution, denoted $\bar{f}_3$, satisfies $\bar{f}_3 < f_{max}$ for firm 3 to earn positive profits since there is no mass point at f_{max} .

Therefore, firms 1 and 2 earn profits $(1/2)\alpha(f_{max} - c)$ when setting the largest price f_{max} . Hence, for almost all headline prices firms 1 and 2 must earn these profits. Since there is no mass point at f_{min} , firms earn $\alpha/2(f_{min} - c) + 3/4(1 - \alpha)(f_{min} + \bar{a} - c)$ when charging f_{min} . Thus, for firms 1 and 2 to earn $(1/2)\alpha(f_{max} - c)$ for almost all prices in the support, it must be that $f_{min} + \bar{a} - c = \frac{2\alpha}{3-\alpha}(f_{max} + \bar{a} - c)$.

Firm 3 has no profit base and only earns profits from poaching, that is

$$\frac{1}{2}(1 - \alpha) \left[\frac{1}{2}(1 - G_1(f_3)) + \frac{1}{2}(1 - G_2(f_3)) \right] (f_3 + \bar{a} - c).$$

Since by Lemma 4 firms 1 and 2 play symmetric strategies in equilibrium, we can simplify this expression to

$$\frac{1}{2}(1 - \alpha)(1 - G_2(f_3))(f_3 + \bar{a} - c). \quad (9)$$

We show next that firm 3 attains f_{min} . Clearly, firm 3 does not charge prices below f_{min} because at f_{min} it attracts all browsing high-value consumers. Suppose for the sake of contradiction that firm 3 does not attain f_{min} . Then there exists an interval $(f_{min}, f_{min} + \eta)$ for $\eta > 0$ such that $G_3(f) = 0$ for any $f \in (f_{min}, f_{min} + \eta)$. Take this to be the largest such interval, implying that $G_3(f_{min} + \eta + \eta_2) > 0$ for any $\eta_2 > 0$. Using this, (8), i.e. profits of firms 1 and 2, on the interval $(f_{min}, f_{min} + \eta)$, simplifies to

$$\frac{1}{2}\alpha(f_1 - c) + \frac{1}{2}(1 - \alpha) \left[\frac{3}{2} - G_2(f_1) \right] (f_1 + \bar{a} - c).$$

Using that firms 1 and 2 earn $\alpha/2(f_{max} - c)$ and rearranging terms, we get

$$\frac{1}{2}(1 - \alpha)[1 - G_2(f_1)](f_1 + \bar{a} - c) = \frac{\alpha}{2}(f_{max} - f_1) - \frac{(1 - \alpha)}{4}(f_1 + \bar{a} - c).$$

Comparing the left-hand-side to (9), we see that this is equal to the profits of firm 3 when setting a headline price $f \in (f_{min}, f_{min} + \eta)$. Furthermore, we see on the right-hand side that this expression is strictly decreasing in f (i.e. f_1). This implies that if the right-hand side is strictly positive at $f_1 = f_{min}$, firm 3, could increase profits from shifting probability mass from $(f_{min} + \eta, f_{min} + \eta + \eta_2)$ to f_{min} for a sufficiently small $\eta_2 > 0$. Since the right-hand side is indeed strictly positive at $f_1 = f_{min}$ for all $\alpha \in (0, 1)$, this contradicts that firm 3 does not attain f_{min} . We conclude that firm 3 attains f_{min} .

This pins down the equilibrium profits of firm 3. If firm 3 sets the lowest price f_{min} , it earns $\frac{(1-\alpha)\alpha}{(3-\alpha)}(f_{max} + \bar{a} - c)$. Hence firm 3 must earn these profits for almost all headline prices in its equilibrium headline price distribution. Using in addition that firms 1 and 2 have a symmetric headline price distribution by Lemma 4, (9) implies that for almost all f in the support of firm 3's headline price distribution, we have $G(f) = G_1(f) = G_2(f) = 1 - \frac{2\alpha}{3-\alpha} \frac{f_{max} + \bar{a} - c}{f + \bar{a} - c}$.

In the next step, we use $G_2(f)$ and (8) as well as the equilibrium profits of firm 3 to get $G_3(f) = 1 + \frac{4\alpha}{3-\alpha} \frac{f_{max} + \bar{a} - c}{f + \bar{a} - c} - \frac{2\alpha}{1-\alpha} \frac{f_{max} - f}{f + \bar{a} - c}$ for all $f \in (f_{min}, \bar{f}_3)$. It follows from the CDF that $\bar{f}_3 = f_{max} - \frac{2(1-\alpha)}{3-\alpha}(f_{max} + \bar{a} - c) < f_{max}$.

Since $1 - G_3(f) = 0$ for all prices $f \in [\bar{f}_3, f_{max}]$, we need to revisit the profits of firm 1 to see that $G(f) = 1 - \frac{\alpha}{(1-\alpha)} \frac{f_{max} - f}{f + \bar{a} - c}$ for $f \in [\bar{f}_3, f_{max}]$.

Overall, we get

$$G(f) = \begin{cases} 1 - \frac{2\alpha}{3-\alpha} \frac{f_{max} + \bar{a} - c}{f + \bar{a} - c} & \text{if } f \in [f_{min}, \bar{f}_3] \\ 1 - \frac{\alpha}{(1-\alpha)} \frac{f_{max} - f}{f + \bar{a} - c} & \text{if } f \in [\bar{f}_3, f_{max}] \end{cases}$$

for firms 1 and 2, and for firm 3

$$G_3(f) = 1 + \frac{4\alpha}{3-\alpha} \frac{f_{max} + \bar{a} - c}{f + \bar{a} - c} - \frac{2\alpha}{1-\alpha} \frac{f_{max} - f}{f + \bar{a} - c} \quad \text{if } f \in [f_{min}, \bar{f}_3],$$

where $f_{min} = c - \bar{a} + \frac{2\alpha}{3-\alpha}(f_{max} + \bar{a} - c)$ and $\bar{f}_3 = f_{max} - \frac{2(1-\alpha)}{3-\alpha}(f_{max} + \bar{a} - c)$.

Using these CDFs at hand, the expected prices set by the firms are as follows. For firms 1 and 2

$$\mathbb{E}(f) = f_{min} + \int_{f_{min}}^{\bar{f}_3} \frac{2\alpha}{3-\alpha} \frac{f_{max} + \bar{a} - c}{f + \bar{a} - c} df + \int_{\bar{f}_3}^{f_{max}} \frac{\alpha}{1-\alpha} \frac{f_{max} - f}{f + \bar{a} - c} df,$$

and for firm 3

$$\mathbb{E}_3(f) = f_{min} + \int_{f_{min}}^{\bar{f}_3} \frac{2\alpha}{1-\alpha} \frac{f_{max} - f}{f + \bar{a} - c} - \frac{4\alpha}{3-\alpha} \frac{f_{max} + \bar{a} - c}{f + \bar{a} - c} df.$$

Taking into account that f_{min} and $\bar{f}_3$ are functions of f_{max} , and computing the first derivatives, we see that both expected values increase in f_{max} .

Step (ii): $f_{max} \leq \min\{(1/2)\mathbb{E}(f) + (1/2)\mathbb{E}_3(f_3) + \bar{a}, v_L\}$. Similar to Proposition 4, since low-value consumers must prefer to buy at f_{max} , we have $f_{max} \leq v_L$. Since by Lemma 4, low-value consumers prefer studying to browsing and paying $\bar{a}$, one has $f_{max} \leq (1/2)\mathbb{E}(f) + (1/2)\mathbb{E}_3(f_3) + \bar{a}$. Overall, we thus have $f_{max} \leq \min\{(1/2)\mathbb{E}(f) + (1/2)\mathbb{E}_3(f_3) + \bar{a}, v_L\}$.

Step (iii): If $f_{max} < v_L$, then f_{max} is strictly increasing in α . For these α , we know that f_{max} is determined by $f_{max} - (1/2)\mathbb{E}(f) - (1/2)\mathbb{E}_3(f_3) - \bar{a} = 0$. Applying the implicit-function theorem on this expression, we see that

$$\begin{aligned} \frac{\partial f_{max}}{\partial \alpha} = & \left[1 - \frac{1}{2} \int_{f_{min}}^{\bar{f}_3} \frac{2\alpha}{(3-\alpha)(f+\bar{a}-c)} df \right. \\ & - \frac{1}{2} \int_{\bar{f}_3}^{f_{max}} \frac{\alpha}{(1-\alpha)(f+\bar{a}-c)} df - \frac{1}{2} \int_{f_{min}}^{\bar{f}_3} \frac{2\alpha(1+\alpha)}{(1-\alpha)(3-\alpha)(f+\bar{a}-c)} df \left. \right]^{-1} \\ & \cdot \left[\frac{1}{2} \int_{f_{min}}^{f_{max}} \frac{\partial(1-G(f;\alpha))}{\partial \alpha} df + \frac{1}{2} \int_{f_{min}}^{\bar{f}_3} \frac{\partial(1-G_3(f;\alpha))}{\partial \alpha} df \right] \end{aligned} \quad (10)$$

The second term is positive since all CDFs decrease in α at any price in the support. Using the same algebra as in the proof of Proposition 4, the first term simplifies to

$$1 - \frac{2\alpha}{(1-\alpha)(3-\alpha)} \ln \left(\frac{1+\alpha}{2\alpha} \right) - \frac{\alpha}{2(1-\alpha)} \ln \left(\frac{3-\alpha}{1+\alpha} \right).$$

Standard algebra shows that this expression decreases in α and approaches zero as α approaches 1. Thus, we conclude that if $f_{max} < v_L$, f_{max} strictly increases in α .

Step (iv): There exists a unique $\alpha^* \in (0, 1)$ such that $f_{max} = v_L$ if and only if $\alpha \geq \alpha^*$. That there exists a unique $\alpha^* \in [0, 1]$ such that $f_{max} = v_L$ if and only if $\alpha \geq \alpha^*$ follows from step (iii).

We already established that $\mathbb{E}(f)$ and $\mathbb{E}_3(f)$ increase with f_{max} . In the limit when $\alpha \rightarrow 1$, we can see immediately that $f_{min} \rightarrow f_{max}$ and $\bar{f}_3 \rightarrow f_{max}$. It follows that in the limit, $\mathbb{E}(f) = \mathbb{E}_3(f_3) = f_{max}$, implying that low-value consumers strictly prefer studying to browsing for large enough α . Then firms set the largest possible price $f_{max} = v_L$ for large enough α , for otherwise a firm could move probability mass to v_L and strictly increase profits. Thus $\alpha^* < 1$.

We show next that as $\alpha \rightarrow 0$, $v_L > (1/2)\mathbb{E}(f) + (1/2)\mathbb{E}_3(f_3) + \bar{a}$ which implies that $f_{max} = (1/2)\mathbb{E}(f) + (1/2)\mathbb{E}_3(f_3) + \bar{a} < v_L$. When $\alpha \rightarrow 0$, $f_{min} \rightarrow c - \bar{a}$ and $f_{3,min} \rightarrow c - \bar{a}$. Looking at $\mathbb{E}(f)$, we see that the integrands go to zero as $\alpha \rightarrow 0$, and since f_{max} is bounded by v_L , this implies that as $\alpha \rightarrow 0$, $\mathbb{E}(f) \rightarrow f_{min} = c - \bar{a}$. Similarly, the integrand of $\mathbb{E}_3(f)$ goes to zero as $\alpha \rightarrow 0$ and $\mathbb{E}_3(f) \rightarrow f_{min} = c - \bar{a}$ as $\alpha \rightarrow 0$. Overall, we get that as $\alpha \rightarrow 0$, $(1/2)\mathbb{E}(f) + (1/2)\mathbb{E}_3(f_3) + \bar{a} \rightarrow c < v_L$.

Since by step (iii), f_{max} is strictly increasing if $f_{max} < v_L$, and since $f_{max} = v_L$ is constant for large enough α , we conclude that there exists a unique $\alpha^* \in (0, 1)$ such that $f_{max} = v_L$ if and only if $\alpha \geq \alpha^*$. $\square$

Proof of Proposition 10. We begin by establishing that $f_i = v$ and $f_i + a_i = v + \bar{a}$ for all i , and all consumers studying match values is an equilibrium outcome.

Consumers who study and have the high valuation $v + \bar{a}$ for the premium product buy the premium product if and only if $a_i \leq \bar{a}$ and $f_i + a_i \leq v + \bar{a}$. Consumers who study and have the low valuation for the premium product v do not buy the premium whenever $a_i > 0$ and do not purchase the base product when $f_i > v$. Hence, as long as all consumers study, it is a best response for firm i to charge $f_i = v$ and $f_i + a_i = v + \bar{a}$.

Denote the probability that the consumer prefers the premium version by α . Given that all firms charge $f_i = v$ and $f_i + a_i = v + \bar{a}$, we now show that it is a best response for consumers to study. Browsing and buying the premium product leads to $v + \alpha\bar{a} - (v + \bar{a}) \leq 0$, while browsing and buying the basic product induces $v - v \leq 0$. Thus, no consumer benefits from deviating in her search strategy when firms charge $f_i = v$ and $f_i + a_i = v + \bar{a}$.

Finally, if firm i deviates and charges different prices it does not attract any consumers from its rivals. And since it extracts the entire ex post social surplus from the consumers that are initially assigned to it, rationality of its consumers together with the fact that they observe both prices implies that there is no profitable deviation for firm i .

We now show that marginal cost pricing, i.e. $f_i = 0$ and $a_i = c$ for all i is not an equilibrium. Observe that the payoff of a consumer who browses and buys the premium product from a firm that engages in marginal-cost pricing is $v + \alpha\bar{a} - c$, and the payoff of a consumer who browses and buys the basic product is v . This is strictly less than the payoff of a consumer who studies and buys from a firm that engages in marginal-cost pricing, which gives $\alpha(v + \bar{a} - c) + (1 - \alpha)v$. But this implies that for sufficiently small $f_i > 0$, it is still strictly optimal for the consumer to study and buy when the firm charges $f_i, a_i = c$. Hence, there is a profitable deviation for firm i . $\square$