A Consumer Search Explanation for Hidden Fees

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Abstract

Online platforms frequently employ drip pricing, displaying a base price upfront and revealing mandatory fees later. Although consumers observe the full price before purchase, evidence shows that hidden fees increase the likelihood of purchase. Existing explanations assume that consumers are unaware of fees while browsing and exhibit behavioral biases at checkout. We depart from behavioral explanations and show that unawareness alone can be strategically exploited by firms. We develop a model in which a monopolist hides a mandatory fee while consumers browse but discloses it before purchase. In our framework, hidden fees affect purchases through consumer search. Because the fee is hidden, the product appears cheaper, inducing more consumers to initiate search and to persist longer when encountering unfavorable signals. Consequently, more consumers reach sufficiently favorable beliefs before the fee is revealed. At checkout, consumers observe the full price and decide optimally, but conditional on having acquired more positive information. Sequential disclosure raises purchase probability by altering pre-purchase search rather than via behavioral biases at checkout. We characterize optimal pricing and show that the hidden fee smooths search incentives across stages. With heterogeneous learning speeds or valuations, hidden fees can lower total prices and increase social welfare by expanding market participation, suggesting a nuanced view of policy interventions.

1 Introduction

Online platforms frequently employ drip pricing strategies, in which a base price is displayed first and mandatory fees are introduced only later in the purchasing process. Because these fees are typically disclosed before the transaction is finalized, standard rational-choice models predict that their delayed revelation should not affect purchase behavior; once the all-in price is observed at checkout, a consumer who finds it unattractive can simply abandon the transaction. Yet, empirical evidence suggests otherwise. In a field experiment on StubHub, Blake et al. (2021) randomly assigned consumers to upfront pricing (full price shown initially) or backend pricing (base price shown first, fees revealed at checkout). Although both groups faced identical total prices and the same information at the point of purchase, consumers in the backend condition were 14% more likely to complete a purchase. Numerous other studies similarly find that hidden mandatory fees affect consumer demand even when they are revealed prior to purchase (Chetty, Looney, and Kroft, 2009; Brown, Hossain, and Morgan, 2010; Feldman and Ruffle, 2015; Feldman, Goldin, and Homonoff, 2018; Bradley and Feldman, 2020).

Existing explanations for this evidence assume that consumers are unaware of hidden fees while browsing and, once those fees are revealed at checkout, exhibit behavioral biases - such as limited attention, salience, or loss aversion - that reduce their responsiveness to the higher total price (Chetty, Looney, and Kroft, 2009; Goldin and Homonoff, 2013; Kőszegi and Rabin, 2006). For example, Blake et al. (2021) argue that backend pricing can lead consumers to proceed to checkout under the belief that they have found a sufficiently cheap option; once the full price, including fees, is revealed, such consumers should exit in the absence of behavioral biases. They attribute the remaining completion to loss aversion or other such biases.

In this paper, we depart from the behavioral explanations emphasized in prior work and ask whether temporary unawareness alone, absent any additional behavioral biases, can be strategically exploited by firms. Specifically, we study a monopolist that employs mandatory fees that are hidden during consumers' initial search but are fully disclosed at checkout. In our framework, consumers observe the full price before making their purchase decision and are fully rational at that stage.

In our model, the hidden fee affects behavior not at the moment of purchase but earlier, by influencing consumers' search decisions. In many settings, consumers do not initially know how well a product matches their preferences and must exert costly effort - such as browsing alternatives, reading reviews, or evaluating attributes - to learn their valuation. Under upfront pricing, consumers make this search decision given the full price. Higher prices discourage both the initiation and continuation of learning. Under drip pricing, by contrast, consumers begin their evaluation observing only the base price and therefore perceive the product as cheaper during the search stage. This lower perceived price induces more consumers to start searching and leads them to persist longer in the face of unfavorable information. As a result, a larger fraction of consumers reach sufficiently favorable beliefs about the product before encountering the hidden fee. At checkout, consumers observe the full price and make their purchase decision optimally; however, they do so conditional on having acquired more positive information, and therefore are more likely to continue gathering information about the product rather than abandon it immediately. Sequential price disclosure thus increases purchase probability by altering consumers' search decisions prior to purchase, rather than through any bias at the purchase decision.

Building on this mechanism, we show that the ability to delay disclosure of a mandatory fee can strictly increase firm profits, even though consumers observe the full price and behave optimally at checkout. Drip pricing expands market participation by inducing transactions that would not occur under transparent pricing. We fully characterize the seller's optimal drip pricing policy and show that the optimal hidden fee balances consumers' incentives to continue to search before and after fee disclosure, smoothing search behavior across stages and increasing the likelihood of purchase. The optimal hidden fee increases with the informativeness of search signals and marginal cost, while it decreases with search costs and initial consumer valuation. By contrast, the optimal base price increases with both initial valuation and marginal cost.

When consumers are heterogeneous in their learning speeds or initial valuations, drip pricing can, under certain conditions, lead the firm to set a lower total price than under transparent pricing and can even increase social welfare. This occurs because delayed fee disclosure enables the firm to profitably serve consumers with slower learning or lower valuations, who would otherwise be excluded, thereby expanding market coverage. These findings have important policy implications. Although regulatory efforts often focus on banning hidden fees, our analysis identifies conditions under which hidden fees can increase both efficiency and welfare, suggesting a more nuanced view of policy interventions.

The rest of the paper is organized as follows. The remainder of this section positions our contribution within the literature on price disclosure and shrouded attributes. Section 2 presents a simple model of one-shot learning. Section 3 develops the more general framework in which consumers learn sequentially about multiple attributes. Section 4 characterizes optimal pricing with and without hidden fees and compares equilibrium outcomes. Section 5 considers heterogeneous learning speeds and initial valuations. Section 6 considers an extension in which some consumers are aware of the hidden fee and shows that the drip pricing strategy can remain optimal for the firm even when only an arbitrarily small fraction of consumers is initially unaware of the hidden fee. Section 7 concludes.

1.1 Related literature

Our paper relates to the literature on price disclosure and shrouded attributes. Hidden fees and surcharges are pervasive in practice. Ellison (2005) suggests that hidden fees persist because some consumers do not anticipate add-on charges when making initial purchase decisions. This insight is formalized by Gabaix and Laibson (2006), who show that shrouding can persist in equilibrium under consumer unawareness. A substantial empirical literature supports this premise, documenting that consumers often underestimate or neglect non-disclosed price components and are frequently surprised by additional charges at checkout (Jin, Luca, and Martin, 2021; Montero and Sheth, 2021; Brown, Hossain, and Morgan, 2010; Brown, Camerer, and Lovallo, 2012; Sheth, 2021; Sah and Read, 2020).[1]

Following Gabaix and Laibson (2006), a large theoretical literature studies how consumer unawareness shapes equilibrium pricing in markets with add-ons (Armstrong and Vickers, 2012; Johnen and Somogyi, 2024; Heidhues, Kőszegi, and Murooka, 2016; Kosfeld and Schüwer, 2017; Shulman and Geng, 2013; Geng, Tan, and Wei, 2018; Erat and Bhaskaran, 2012). In these models, firms exploit the fact that consumers commit to purchasing the base good before fully accounting

[1] For example, Hall (1997) finds that buyers of printers often are unaware of cartridge costs at purchase. Similarly, Feldman and Ruffle (2015) find that many participants exposed to pre-tax prices neglect the tax when making purchase decisions and are surprised when it is added at checkout.

for the add-on price - for example, a consumer booking a hotel may neglect Wi-Fi charges during the reservation process and only become aware of them upon arrival.

Gabaix and Laibson (2006) emphasize an important distinction between optional add-ons and mandatory fees. Add-ons are secondary charges that may remain unnoticed when the base product is purchased, whereas mandatory fees are tied to the base product and disclosed before the transaction is finalized - for instance, ticketing platforms reveal service fees at checkout. This distinction is crucial. The standard shrouded-attributes mechanism relies on consumers purchasing the base product without fully accounting for add-on prices and therefore does not directly apply to mandatory fees, which are disclosed before purchase and observed when the final decision is made. For mandatory fees, consumer unawareness is only temporary.

The persistence of hidden mandatory fees is therefore difficult to reconcile with the standard shrouded-attributes logic. Their prevalence has been rationalized by assuming that, in addition to unawareness of hidden fees while browsing products, consumers also exhibit behavioral biases at the point of purchase once those fees are disclosed. Our analysis unifies hidden add-ons and mandatory fees under a common informational assumption: unawareness alone can rationalize the prevalence of both phenomena. The mechanisms, however, are fundamentally different: hidden add-ons enable ex post exploitation once consumers have committed to the base product, whereas hidden mandatory fees influence consumers' search decisions prior to purchase.

2 A Simple Model of One-Attribute Learning

We begin our analysis with a simplified setting in which consumers face uncertainty about only a single product attribute. The consumer's valuation v for the product is drawn from distribution F. The consumer does not observe the realized value of v, but she has correct beliefs regarding its distribution. The consumer may choose to incur a deliberation cost $c > 0$ to learn the exact realization of her valuation. We assume that the revenue function $R(p) = p[1 - F(p)]$ is single-peaked, and we define p^* as the value that maximizes $R(p)$.

The game unfolds as follows. The firm sets a posted price p_1 and a hidden fee Δp. The consumer observes the posted price but is unaware of the hidden fee, effectively believing that

$\Delta p = 0$. She first decides whether to incur the deliberation cost c to learn her valuation. Following this decision, the consumer chooses whether to leave without purchasing or to proceed to checkout. At checkout, the hidden fee is revealed, and the consumer becomes fully informed of the final price $p_{Final} = p_1 + \Delta p$. If she has not previously learned her valuation, she may choose to do so by incurring the deliberation cost. Finally, the consumer decides whether to complete the purchase.

2.1 Optimal Consumer Search Strategy

We start by analyzing the consumer's decision in the first-stage, after observing p_1. Because the consumer is unaware of the hidden fee, she acts as if p_1 is the final price. The consumer has three options: i) learn her valuation and decide whether to proceed to checkout; ii) proceed to checkout, without learning her valuation; iii) leave without purchase. If she chooses to learn her valuation, she will proceed to checkout if and only if her valuation is larger than the price. Her expected surplus under deliberation is

$$U(learn) = \int_{p_1}^{\infty} (v - p_1)\,\mathrm{d}F(v) - c. \tag{1}$$

If she proceeds to checkout without learning her valuation, she obtains an expected surplus of

$$U(purchase) = \int_{0}^{\infty} (v - p_1)\,\mathrm{d}F(v). \tag{2}$$

She will prefer to learn her valuation over purchasing without learning if $U(learn) > U(purchase) \iff p_1 > \underline{p}$, where $\underline{p}$ satisfies the condition below.

$$c = \int_{0}^{\underline{p}} (\underline{p} - v)\,\mathrm{d}F(v) \tag{3}$$

If, instead, the consumer leaves without purchasing, she obtains zero surplus. Hence, she will prefer to learn her valuation over leaving without purchasing if $U(learn) > 0 \iff p_1 < \bar{p}$, where $\bar{p}$ satisfies the condition below.

$$c = \int_{\bar{p}}^{\infty} (v - \bar{p})\,\mathrm{d}F(v) \tag{4}$$

It follows that the consumer will choose to learn her valuation if $\underline{p} \leq p_1 \leq \bar{p}$. There is a range of prices under which deliberation is optimal provided that the deliberation cost is not too large, as characterized below.

Lemma 1. *If $c < \bar{c} \equiv \int_0^{E(v)} (E(v) - v) \, \mathrm{d}F(v)$, then $\underline{p} < \bar{p}$.*

Throughout the rest of the analysis, we assume that $c < \bar{c}$, so that there is a range of prices under which deliberation is optimal. We characterize the consumer first-stage deliberation strategy below.

Lemma 2 (First-stage deliberation)**.** *After observing p_1,*

i) The consumer proceeds to checkout if $p_1 < \underline{p}$;

ii) The consumer leaves without purchasing if $p_1 > \bar{p}$;

iii) The consumer deliberates if $p_1 \in [\underline{p}, \bar{p}]$. She then proceeds to checkout if $v \geq p_1$.

If the consumer proceeds to checkout, she observes the final price $p_{Final} = p_1 + \Delta p$. If she has already learned her valuation, she will proceed to purchase if $v \geq p_{Final}$. Otherwise, she can either leave without purchase, purchase immediately, or incur the deliberation cost to learn her valuation.

Lemma 3 (Second-stage decision)**.** *If the consumer has learned her valuation, she purchases if and only if $p_{Final} \leq v$. If she has not learned her valuation in the first stage, she will*

i) purchase if $p_{Final} < \underline{p}$;

ii) leave without purchasing if $p_{Final} > \bar{p}$;

iii) deliberate if $p_{Final} \in [\underline{p}, \bar{p}]$. She then proceeds to purchase if $v \geq p_{Final}$.

2.2 Optimal Pricing Strategy

2.2.1 Without Hidden Fees

We start with the case in which the firm is not able to use hidden fees (for example, due to government regulations or to restrictions set by the platform). In this case, $\Delta p = 0$ and we denote by p_{wo} the price that the firm sets. If $p_{wo} \leq \underline{p}$, the consumer purchases without learning her valuation - in this case, it is optimal to set $p_{wo} = \underline{p}$. If $p_{wo} > \bar{p}$, the consumer does not purchase and the firm does not make a profit. Finally, if $p_{wo} \in [\underline{p}, \bar{p}]$, the consumer deliberates and purchases with probability $1 - F(p_{wo})$ - due to the assumption of single-peaked revenue. It follows that, if it is optimal for the firm to induce deliberation, the optimal price is $p_{wo} = \min\{\bar{p}, p^*\}$.

Below, we characterize the optimal price in absence of hidden fees.

$$p^*_{wo} = \begin{cases} \underline{p} & \text{if } \underline{p} \geq \min\{\bar{p}, p^*\}[1 - F(\min\{\bar{p}, p^*\})] \\ \min\{\bar{p}, p^*\} & \text{otherwise} \end{cases} \tag{5}$$

2.2.2 With Hidden Fees

We now analyze the case in which the firm chooses both p_1 and Δp. First, notice that, if p_1 does not induce the consumer to deliberate, then the hidden fee is not playing any role. Indeed, if the consumer proceeds to checkout, she observes p_{Final} and behaves exactly as she would if she were immediately presented with p_{Final}. Hence, if the firm wants to sell to the consumer without having her learn her valuation, the most the firm can charge is $p_1 + \Delta p = \underline{p}$.

Let us now consider the case in which $p_1 \in [\underline{p}, \bar{p}]$, so that the consumer learns her valuation before proceeding to checkout. At checkout, the consumer becomes aware of the hidden fee and purchases if $v \geq p_1 + \Delta p$. The firm's profit is $(p_1 + \Delta p)[1 - F(p_1 + \Delta p)]$.

Suppose $p^* > \bar{p}$. In this case, if the consumer was informed about her valuation, it would be optimal for the firm to set price p^*. However, at that price, the consumer does not incur the deliberation cost and leaves without purchase. The firm can leverage the hidden fee by offering an attractive initial price $p_1 \leq \bar{p}$ that induces the consumer to learn her valuation, and then use the hidden fee so that the final price is p^*.

Proposition 1. *If $p^* \leq \bar{p}$, the firm's profit is the same with or without hidden fees. If $p^* > \bar{p}$ and $\underline{p} < p^*[1 - F(p^*)]$, then the firm benefits from using hidden fees, and the optimal prices are such that $p_1 \in [\underline{p}, \bar{p}]$ and $p_1 + \Delta p = p^*$.*

2.3 A Numerical Example

We illustrate the results with a simple numerical example. Let the distribution of valuations, previously denoted by F, be the Beta distribution with parameters $\alpha = 0.15$ and $\beta = 0.2$, and let the deliberation cost be $c = 0.1$. We can then use (3) and (4) to obtain $\underline{p} \approx 0.24$ and $\bar{p} \approx 0.67$. Moreover $p^* = \arg\max p[1 - F(p)] \approx 0.81$. In other words, if consumers were informed about their valuations, the optimal price would be p^* and the firm would extract profit $p^*(1 - F(p^*)) \approx 0.267$.

When the firm cannot use hidden fees, it cannot sell to the consumer at price p^*; at that price, the consumer does not incur the deliberation cost and she leaves without purchase. In order to induce deliberation, the firm can charge at most $\bar{p}$. At that price, the firm's profit is $\bar{p}(1 - F(\bar{p})) \approx 0.253$. Alternatively, the firm can set the price at $\underline{p}$, in which case the consumer purchases without deliberation, and the firm makes a profit of $\underline{p} \approx 0.24$. It follows that the optimal price in the absence of hidden fees is $\bar{p}$. Notice that the profit that the firm makes is lower than what it would make if consumers were fully informed about their valuation, in which case the firm would sell at p^*.

Let us now consider the case in which the firm can use hidden fees. In this case, the firm can induce the consumer to learn her valuation, provided that $p_1 \in [\underline{p}, \bar{p}]$. The hidden fee will be disclosed only after the consumer has learned her valuation, at which point it is optimal to set the final price at p^*, i.e., $p_1 + \Delta p = p^*$. By using hidden fees, the firm can present consumers with a low initial price that induces consumers to learn their valuations, while selling at a final price that would discourage them from incurring the deliberation cost.

The one-attribute model provides intuition for how firms may exploit hidden fees even when consumers are fully rational at the point of purchase, once all fees have been disclosed. However, this framework captures only part of the relevant mechanisms. For example, it cannot answer questions about the consumer's expected search time. In practice, consumer learning is not a one-shot process but rather occurs gradually over time and across different product dimensions. In the following section, we extend the analysis to the multi-attribute setting, which addresses these limitations and yields additional insights. Moreover, while the firm's choice of optimal price and hidden fee is not uniquely determined in the one-attribute case, the multi-attribute case yields a unique equilibrium outcome.

3 Main Model

A firm offers a product with a marginal cost of m and price p. A rational consumer decides whether to buy it. The consumer has an initial valuation v_0 about the product, which is common knowledge.[2] She can search for information before making a decision. If the consumer searches for information, she incurs a flow search cost c per period of time, and her valuation v_t evolves as a Brownian motion with a constant variance σ^2.

$$dv_t = \sigma dW_t,$$

where W_t is a standard Brownian motion. This can be interpreted as the consumer learning over time about equally important and independent attributes, and there being an infinite number of attributes (e.g., Branco, Sun, and Villas-Boas (2012)). We assume that there is no discounting because the entire process is usually quick.

3.1 Without a Hidden Fee

The firm may be banned from charging a hidden fee by regulations, or may choose not to adopt such strategies. If there is no hidden fee, the firm chooses an upfront price p_{wo}, which is observed by the consumer. At any time t, the consumer's expected payoff from purchasing the product given her valuation v_t is $v_t - p_{wo}$.

3.2 With a Hidden Fee

The firm chooses an initial price $p_1 \geq 0$ and a hidden fee $\Delta p > 0$.[3] The consumer observes p_1 initially but is unaware of the existence of a hidden fee. When the consumer's valuation v_t

[2] There can be two interpretations for the initial valuation. The first one is that consumers have homogeneous valuations. The second one is that consumers have heterogeneous valuations, but the firm knows each individual consumer's initial valuation.

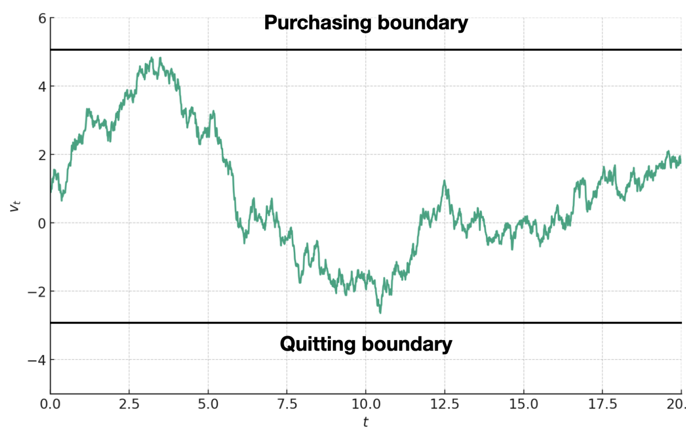
[3] The problem becomes the optimal pricing without a hidden fee if $\Delta p = 0$. In some scenarios, it may not be feasible for the firm to offer a product for free initially. In such cases, a more reasonable assumption is that $p_1 \geq r$ for a constant $r > 0$. Our analysis and mechanisms can easily extend to this case.

becomes high enough, the consumer decides to buy and proceeds to the checkout page. At that point, the hidden fee $\Delta p > 0$ is revealed, increasing the total price she faces. Given this higher price, immediate purchase is no longer optimal at her current valuation. Thus, the consumer faces an updated search problem at the checkout page.

4 Analysis

4.1 Without a Hidden Fee

According to Branco, Sun, and Villas-Boas (2012), the consumer's optimal strategy is to purchase if the valuation is sufficiently high, $v_t \geq \bar{V}_1(p_{wo}) := \sigma^2/4c + p_{wo}$ (purchasing threshold), to quit if the valuation is sufficiently low, $v_t \leq \underline{V}_1(p_{wo}) := -\sigma^2/4c + p_{wo}$ (quitting threshold), and to keep searching if the valuation is intermediate, $\underline{V}_1(p_{wo}) < v_t < \bar{V}_1(p_{wo})$. Figure 1 illustrates the consumer's optimal search strategy.



$v_0 = 1$, $p = 1$

Figure 1: Consumer's search strategy

It has been shown that, for a given valuation v and price p_{wo}, the consumer's purchasing probability is:

$$Q_1(v, p_{wo}) = \begin{cases} 1, & if\ p_{wo} \leq v - \frac{\sigma^2}{4c}, \\ \frac{v + \frac{\sigma^2}{4c} - p_{wo}}{\frac{\sigma^2}{2c}}, & if\ v - \frac{\sigma^2}{4c} < p_{wo} < v + \frac{\sigma^2}{4c}, \\ 0, & if\ p_{wo} \geq v + \frac{\sigma^2}{4c}, \end{cases} \tag{6}$$

The firm's expected profit is $(p_{wo}^* - m) \cdot Q_1(v_0, p_{wo})$, and thus the optimal price is:[4]

$$p_{wo}^* = \begin{cases} v_0 - \frac{\sigma^2}{4c},\ if\ v_0 \geq \frac{3\sigma^2}{4c} + m \\ \frac{v_0}{2} + \frac{\sigma^2}{8c} + \frac{m}{2},\ if\ \ -\frac{\sigma^2}{4c} + m < v_0 < \frac{3\sigma^2}{4c} + m \end{cases} \tag{7}$$

The ex-ante purchasing probability under the optimal price is

$$Q_1(v_0, p_{wo}^*) \begin{cases} 1,\ if\ v_0 \geq \frac{3\sigma^2}{4c} + m, \\ \frac{c}{\sigma^2}(v_0 + \sigma^2/4c - m),\ if\ \ -\frac{\sigma^2}{4c} + m < v_0 < \frac{3\sigma^2}{4c} + m, \\ 0,\ if\ v_0 \leq -\frac{\sigma^2}{4c} + m \end{cases} \tag{8}$$

When the hidden fee is not feasible, the firm cannot sell any product if $v_0 \leq -\sigma^2/4c + m$. This is because the firm must charge an upfront price of at least the marginal cost m to avoid incurring losses. When the consumer's initial valuation is too low, the consumer needs to accumulate a substantial amount of positive signals to justify a purchase, even under this minimal price. As a result, the consumer is better off not searching, in order to save the search cost.

Expected Search Time and Consumer Welfare

When $v_0 \leq -\frac{\sigma^2}{4c} + m$, the consumer will quit directly. The search time and consumer welfare are zero. When $v_0 \geq \frac{3\sigma^2}{4c} + m$, the consumer will purchase directly. The search time is zero and the consumer welfare is $v_0 - p_{wo}^* = \sigma^2/4c$.

When $-\frac{\sigma^2}{4c} + m < v_0 < \frac{3\sigma^2}{4c} + m$, the consumer will search for information before making a purchasing decision. Using Dynkin's formula, one can derive the expected search time (expectation

[4] The firm cannot make any profit if $v_0 \leq -\sigma^2/4c + m$.

of the stopping time) under the optimal price:

$$\mathbf{E}(\tau_{wo}) = \frac{\frac{\sigma^4}{16c^2} - (v_0 - p_{wo}^*)^2}{\sigma^2} = \frac{\frac{\sigma^4}{16c^2} - (\frac{v_0 - m}{2} - \frac{\sigma^2}{8c})^2}{\sigma^2}$$

Because the consumer's valuation at purchasing is always $\bar{V}_1(p_{wo}^*)$, the consumer's payoff from purchasing the product must be $\bar{V}_1(p_{wo}^*) - p_{wo}^* = \sigma^2/4c$. Hence, the expected consumer surplus under the optimal price has the following closed form:

$$\begin{aligned}
\mathbf{E}(consumer\ surplus) &= -\,c \cdot \mathbf{E}(\tau_{wo}) + \frac{\sigma^2}{4c} \cdot Q_1(v_0, p_{wo}^*) \\
&= -\,c \cdot \frac{\frac{\sigma^4}{16c^2} - (v_0 - p_{wo}^*)^2}{\sigma^2} + \frac{v_0 + \frac{\sigma^2}{4c} - p_{wo}^*}{2} \\
&= -\,c \cdot \frac{\frac{\sigma^4}{16c^2} - (\frac{v_0 - m}{2} - \frac{\sigma^2}{8c})^2}{\sigma^2} + \frac{\frac{v_0 - m}{2} + \frac{\sigma^2}{8c}}{2}
\end{aligned}$$

4.2 With a Hidden Fee

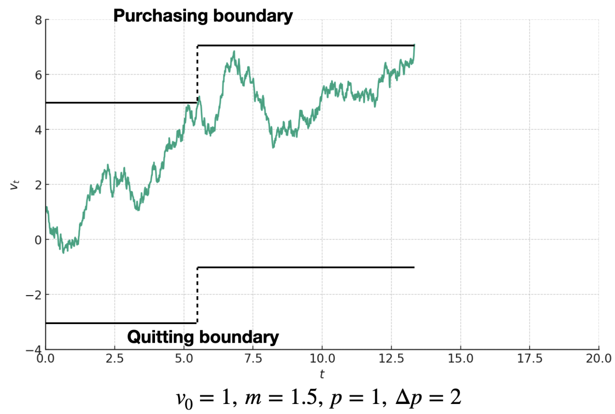
In the first stage, the consumer faces the same search problem as in the case without a hidden fee. So, the purchasing and quitting thresholds are the same as those in the previous section.

When the consumer's valuation v_t reaches the purchasing threshold $\bar{V}_1(p_1) = \sigma^2/4c + p_1$, the consumer decides to buy and proceeds to the checkout page. At that time, the hidden fee $\Delta p > 0$ is revealed. Because the fee increases the relevant purchase threshold from $\bar{V}_1(p_1)$ to $\bar{V}_1(p_1 + \Delta p)$, her current valuation is no longer sufficient to justify an immediate purchase. The consumer faces an updated search problem. She will quit if $v_t \leq \underline{V}_1(p_1 + \Delta p)$, purchase if $v_t \geq \bar{V}_1(p_1 + \Delta p)$, and keep searching if $\underline{V}_1(p_1 + \Delta p) < v_t < \bar{V}_1(p_1 + \Delta p)$. Figures 2a and 2b illustrate the consumer's optimal search strategy with a hidden fee.

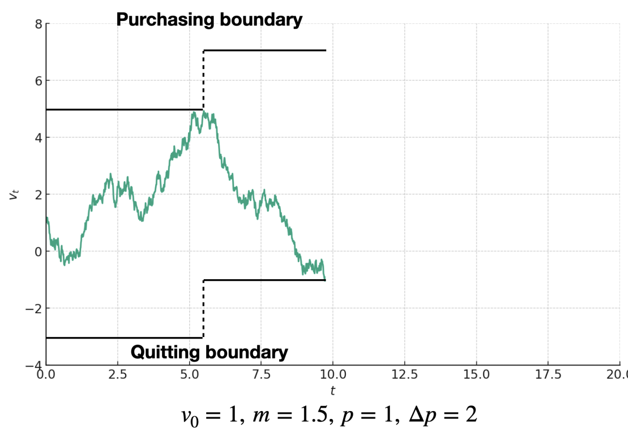
If the initial price p_1 induces immediate purchase or quit, then the problem becomes the same as the case without a hidden fee. So, we will focus on the case where the initial price p_1 induces search in the first stage, $v_0 \in (p_1 - \sigma^2/4c, p_1 + \sigma^2/4c) \Leftrightarrow p_1 \in (v_0 - \sigma^2/4c, v_0 + \sigma^2/4c)$. For a given initial price p_1, the probability that the consumer goes to the checkout page (v_t reaches $\bar{V}_1(p_1)$

before hitting $\underline{V}_1(p_1)$) is:

$$Q_1(v_0, p_1) = \frac{v_0 + \frac{\sigma^2}{4c} - p_1}{\frac{\sigma^2}{2c}} = \frac{2c}{\sigma^2}(v_0 + \frac{\sigma^2}{4c} - p_1).$$



(a) Purchase



(b) No purchase

Figure 2: Consumer's sample paths with hidden fees

Conditional on reaching the checkout page, the firm charges a hidden fee $\Delta p > 0$. If this hidden fee is too high, $\Delta p > \sigma^2/2c$, it will move the consumer's quitting threshold above $\bar{V}_1(p_1)$. Then, the consumer will quit immediately. So, in equilibrium, the hidden fee must be moderate, $\Delta p \in (0, \sigma^2/2c)$. Given the consumer's valuation $\bar{V}_1(p_1)$ and the hidden fee Δp, the purchasing probability conditional on the consumer reaching the checkout page is:

$$Q_2(\Delta p) = 1 - \frac{\Delta p}{\sigma^2/2c} = 1 - \frac{2c}{\sigma^2}\Delta p. \tag{9}$$

The firm's overall expected profit is:

$$\begin{aligned}
&\Pi_w(p_1, \Delta p) \\
=&\underbrace{(p_1 + \Delta p - m)}_{\text{profit per sale}} \cdot \underbrace{Q_1(v_0, p_1)}_{\text{probability of reaching the checkout page}} \cdot \underbrace{Q_2(\Delta p)}_{\text{conditional probability of purchasing}} \\
=&(p_1 + \Delta p - m) \cdot \frac{2c}{\sigma^2}(v_0 + \frac{\sigma^2}{4c} - p_1) \cdot (1 - \frac{2c}{\sigma^2}\Delta p).
\end{aligned}$$

In sum, the firm's constrained optimization problem is:[5]

$$\begin{aligned}
\max_{p_1, \Delta p}\ & (p_1 + \Delta p - m) \cdot \frac{2c}{\sigma^2}(v_0 + \frac{\sigma^2}{4c} - p_1) \cdot (1 - \frac{2c}{\sigma^2}\Delta p) \qquad (P_w) \\
s.t.\ & p_1 \geq 0, \\
& p_1 \in (v_0 - \sigma^2/4c, v_0 + \sigma^2/4c), \\
& \Delta p \in [0, \sigma^2/2c).
\end{aligned}$$

Proposition 2. *If* $\max\{-m/2, -3\sigma^2/4c + m\} < v_0 < 3\sigma^2/4c + m$*, then the optimal initial price is* $p_1^* = 2v_0/3 + m/3$ *and the optimal hidden fee is* $\Delta p^* = \sigma^2/4c + (m - v_0)/3$*. The optimal total price is* $p_1^* + \Delta p^* = v_0/3 + \sigma^2/4c + 2m/3$*, which is strictly higher than the optimal price without a hidden fee,* p_{wo}^**.*

If $-\sigma^2/4c < v_0 \leq -m/2$*, then the optimal initial price is* $p_1^* = 0$ *and the optimal hidden fee is* $\Delta p^* = \sigma^2/4c + m/2$*.*

The following corollary summarizes the comparative statics of the optimal price.

Corollary 1. *(Comparative statics)*

1. The hidden fee Δp *increases in the signal informativeness* σ^2 *and in the marginal cost* m*,*

[5] More generally, we can replace the constraint $p_1 \geq 0$ with $p_1 \geq \underline{p_1}$ for a positive $\underline{p_1}$. It will not qualitatively change the main results.

and decreases in the search cost c and in the initial valuation v_0.

2. *The initial price p increases in v_0 and m, and does not depend on σ^2 and c.*

3. *The total price $p + \Delta p$ increases in v_0, σ^2, and m, and decreases in c.*

Figure 3 demonstrates the optimal price with a hidden fee. When the initial valuation is low, the consumer has a low incentive to search. A high initial price will further reduce the consumer's benefit from searching, and accelerate consumer quit. So, the firm charges zero initial price. The first stage then serves as a screening device. The consumer will quit after gathering some negative information. If the consumer instead obtains enough positive signals and arrives at the checkout page, she will have an improved valuation compared to the initial one. At that point, the firm can afford to increase the price by charging a hidden fee without immediately driving the consumer out of the market.

As the initial valuation increases, the consumer has a higher incentive to purchase the product. Therefore, the firm can afford to charge a higher initial price without deterring search. When the consumer reaches the checkout page, the consumer's valuation is also higher. The opportunity cost for the firm is high if the consumer searches for too long in the second stage and eventually quits after receiving too much negative information. So, the firm charges a lower hidden fee to induce a quick purchase. When the initial valuation is high enough, the firm stops using a hidden fee, in order to induce immediate purchase once the consumer goes to the checkout page.

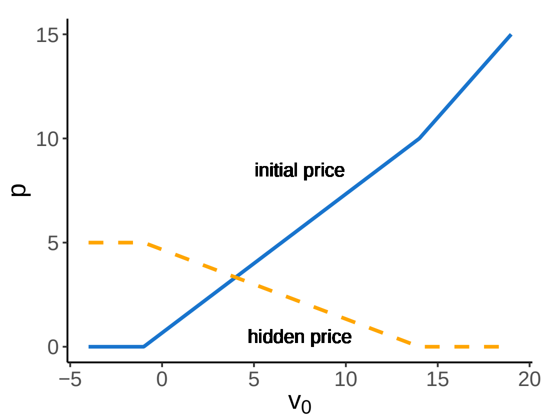


Figure 3: Optimal price with hidden fee

Expected Search Time and Consumer Welfare

1. If $v_0 \leq \max\{-m/2, -3\sigma^2/4c+m\}$, the consumer will quit immediately. The expected search time and consumer welfare are zero. If $v_0 \geq 3\sigma^2/4c+m$, the consumer will immediately buy the product. The expected search time is zero and the consumer welfare is $\sigma^2/4c$. In other cases, the consumer will search for information before making a purchasing decision.

2. If $\max\{-m/2, -3\sigma^2/4c+m\} < v_0 < 3\sigma^2/4c+m$, then, by Dynkin's formula, the expected search time in the first stage under the optimal price is:

$$\mathbf{E}(\tau_1) = \frac{\frac{\sigma^4}{16c^2} - (v_0 - p_1^*)^2}{\sigma^2} = \frac{\frac{\sigma^4}{16c^2} - (\frac{v_0-m}{3})^2}{\sigma^2}.$$

   The probability of reaching the checkout page is $Q_1(v_0, p_1^*)$. Conditional on that, the expected search time in the second stage is:

$$\mathbf{E}(\tau_2) = \frac{\frac{\sigma^4}{16c^2} - (\frac{\sigma^2}{4c} - \Delta p^*)^2}{\sigma^2} = \frac{\frac{\sigma^4}{16c^2} - (\frac{v_0-m}{3})^2}{\sigma^2} = \mathbf{E}(\tau_1).$$

   As we can see, the optimal price is such that the consumer will search for the same amount of time in each stage. The optimal hidden fee balances consumers' incentives to continue search before and after fee disclosure, perfectly smoothing consumers' search behavior across stages. The intuition is the following. For a fixed total price, the firm does not want to charge an initial price too high, such that the quitting boundary is close to a consumer's initial valuation. This is because the consumer will quit quickly if she gathers a few negative signals early on in the search process. The firm also does not want to charge an initial price that is too low, such that the purchasing boundary is close to the consumer's initial valuation. Although there is a high probability that the consumer will go to the checkout stage in such cases, she will face a high hidden fee, which pushes the quitting boundary close to her valuation at the beginning of the second stage. The consumer will then quit with a high likelihood in the second stage. The optimal price balances the consumer's likelihood of going to the checkout page and making the final purchase, and thus balances the consumer's search behavior across two stages.

The consumer's expected total search time under the optimal price is:

$$\mathbf{E}(\tau_w) = \mathbf{E}(\tau_1) + Q_1(v_0, p_1^*) \cdot \mathbf{E}(\tau_2)$$

3. If $-\sigma^2/4c < v_0 \leq -m/2$, then the expected search time in the first stage under the optimal price is:

$$\mathbf{E}(\tau_1) = \frac{\frac{\sigma^4}{16c^2} - v_0^2}{\sigma^2}$$

The probability of reaching the checkout page is $Q_1(v_0, p_1^*)$. Conditional on that, the expected search time in the second stage is:

$$\mathbf{E}(\tau_2) = \frac{\frac{\sigma^4}{16c^2} - (\frac{\sigma^2}{4c} - \Delta p^*)^2}{\sigma^2} = \frac{\frac{\sigma^4}{16c^2} - \frac{m^2}{4}}{\sigma^2} > \mathbf{E}(\tau_1).$$

Different from the previous case, the consumer will search for a longer time in the second stage under the optimal price. The reason is that the consumer's initial valuation is very low in this case. Even with a low initial price, the consumer's expected payoff from purchasing the product is low. So, she will quit the search process relatively quickly. However, if she gathers a sufficient amount of positive signals and reaches the checkout page, she will have a much higher valuation at the beginning of the second stage, and will be willing to keep searching even if she receives some negative signals at the second stage. The low initial valuation makes it impossible for the firm to perfectly smooth the consumer's search behavior.

The consumer's expected total search time under the optimal price is:

$$\mathbf{E}(\tau_w) = \mathbf{E}(\tau_1) + Q_1(v_0, p_1^*) \cdot \mathbf{E}(\tau_2).$$

Because the consumer's valuation at the time of purchase is always $\bar{V}_1(p_1^* + \Delta p^*)$, the consumer's payoff from purchasing the product must be $\bar{V}_1(p_1^* + \Delta p^*) - (p_1^* + \Delta p^*) = \sigma^2/4c$. Hence, when the consumer searches for information before making a purchasing decision, $\max\{-\sigma^2/4c, -3\sigma^2/4c + m\} < v_0 < 3\sigma^2/4c + m$, the expected consumer surplus under the optimal price has the following closed-form:

$$\mathbf{E}(consumer\ surplus) = -\,c \cdot \mathbf{E}(\tau_w) + \frac{\sigma^2}{4c} \cdot Q_1(v_0, p_1^*) \cdot Q_2(\Delta p^*).$$

4.3 Comparison Between the Cases With and Without a Hidden Fee

Figure 4 shows that the optimal total price when a hidden fee is feasible (the initial price p_1^* plus the hidden fee Δp^*) is always (weakly) higher than the optimal upfront price p_{wo}^*.

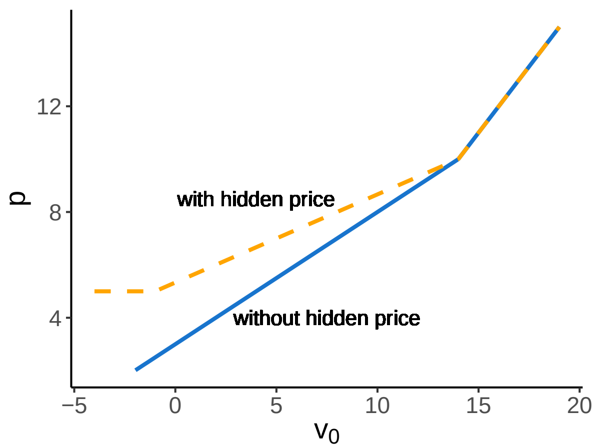


Figure 4: Optimal prices with and without hidden fee

The next result characterizes the necessary and sufficient conditions for the use of a hidden fee to strictly increase the seller's expected profit.

Proposition 3. *Hidden fees strictly increase the firm's expected profit relative to an upfront price if and only if the consumer's initial valuation is in an intermediate range,* $\max\{-\sigma^2/4c, -3\sigma^2/4c+m\} < v_0 < 3\sigma^2/4c + m$. *In this region, hidden fees also increase the consumer's expected search time.*

To understand the above result, we can divide the condition into two cases.

1. The firm can make a positive profit with a hidden fee but cannot sell any product without a hidden fee, if and only if:

$$\max\{-\sigma^2/4c, -3\sigma^2/4c + m\} < v_0 \leq -\sigma^2/4c + m.$$

We illustrate this case by an example where $v_0 = 0, \sigma^2 = 1$, and $m = 4$. Without a hidden fee, the minimal price the firm will charge is the marginal cost 4, because it will lose money by charging any $p_{wo} < m$. However, even if it charges $p_{wo} = m$, the quitting threshold $\underline{V}_1(m) = 0$. So, the consumer will neither search nor purchase in this case.

In contrast, if the firm charges an initial price that is lower than the marginal cost, say $p_1 = 2$, then the consumer's quitting threshold will be -2, lower than the initial valuation v_0. The consumer will be better off by searching rather than quitting immediately. It is possible that the consumer gathers some negative signals and then quits. However, there is a positive probability that the consumer will gain enough positive signals and reach the purchasing boundary $\bar{V}_1(p_1) = 6$. By the time she goes to the checkout page and see a hidden fee of $\Delta p = 4$, she will not quit, even though the total price she faces is higher than the marginal cost 4, because her valuation has improved over the initial valuation. It is optimal for the consumer to keep searching, and she may eventually purchase the product after hitting the new purchasing threshold of 10. Figure 5 illustrates a sample path of the consumer's valuation in this case.

In this case, the use of a hidden fee creates a market for possible trade.

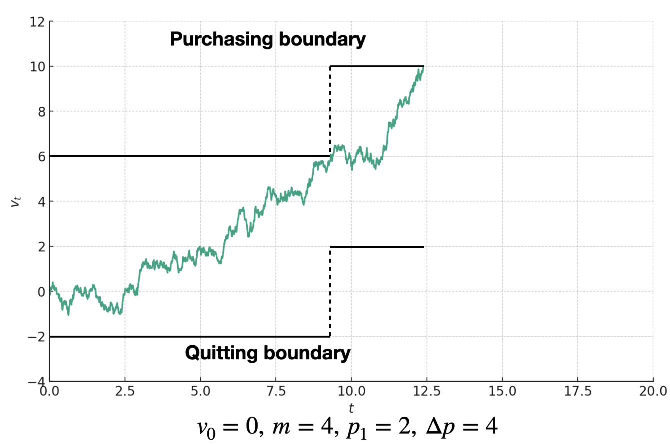


Figure 5: Consumer's sample path with hidden fee (purchase)

2. More interestingly, even if the firm can earn a positive profit without a hidden fee, it can obtain a strictly higher profit by using a hidden fee if and only if:

$$-\sigma^2/4c + m < v_0 < 3\sigma^2/4c + m.$$

We illustrate its intuition by an example where $v_0 = 2, \sigma^2 = 1$, and $m = 2$. Without a hidden fee, the firm can now induce consumer search even if it charges above the marginal price, because of the higher initial valuation. Suppose it charges $p_{wo} = 4$, which is low enough for the consumer to search. However, the consumer's initial valuation is close to the quitting boundary. So, the consumer will quit quickly if a small number of negative signals arrive at the beginning, resulting in a low purchasing likelihood. Figure 6 illustrates a sample path of the consumer's valuation in this case.

Suppose instead the firm charges a lower initial price, say $p_1 = 2$. The consumer will have a lower quitting threshold, -2. Because the initial valuation is farther away from the quitting boundary, the consumer will keep searching even if she receives some negative news at the beginning. By the time she goes to the checkout page and sees a hidden fee of $\Delta p = 4$, her valuation will still be at an acceptable distance from the new quitting boundary. Thus, the consumer will not quit quickly in the second stage, either. In other words, the use of hidden fee smooths the consumer's search decision and makes it more robust to a small amount of negative news. Figure 7 illustrates a sample path of the consumer's valuation in this case.

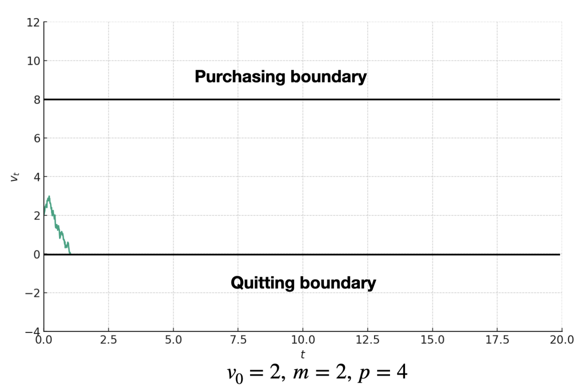


Figure 6: Consumer's sample path without hidden fee (quit)

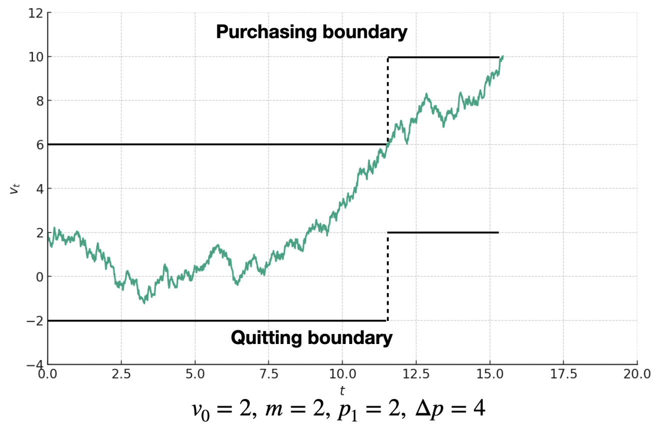


Figure 7: Consumer's sample path with hidden fee (purchase)

5 Heterogeneous Consumers

In the base model, either consumers are homogeneous or the firm knows the individual consumer's characteristics. In reality, there are scenarios where consumers are heterogeneous and the firm cannot distinguish consumers. In this section, we consider two settings, one with heterogeneous learning speeds and one with heterogeneous initial valuations.

5.1 Heterogeneous Learning Speeds

The setup is the same as the base model, except that there are two groups of consumers with $\sigma \in \{\sigma_H, \sigma_L\}$, where $\sigma_H > \sigma_L > 0$. Among consumers, $Prob(\sigma = \sigma_H) = \rho_\sigma$. The distribution of the learning speeds is common knowledge, whereas the realization of learning speeds is each consumer's private information. In such cases, a firm's pricing decision can lead to different strategic effects on different consumer segments. For instance, a higher price may generate higher profits among fast-learning (high-type) consumers, but may drive slow-learning (low-type) consumers out of the market. We find that, surprisingly, the optimal total price when the firm uses a hidden fee (initial price plus hidden fee) can be lower than the optimal upfront price under some conditions.

Proposition 4. *When the following condition holds, the optimal total price when the firm uses a hidden fee is lower than the optimal upfront price, $p_1^* + \Delta p^* < p_{wo}^*$:*

$\rho_\sigma < \widehat{\rho_\sigma}$, $\sigma_H > \sqrt{5}\sigma_L$, $\max\{-m/2, -3\sigma_L^2/4c + m\} < v_0 < -\sigma_L^2/4c + m$.[6]

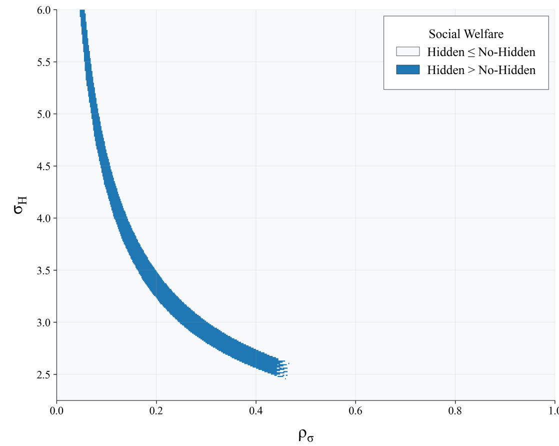
[6] The cutoff $\widehat{\rho_\sigma} \in (0,1)$ is a constant specified in the appendix.

The key mechanism behind this result is that, without hidden fees, it may be unprofitable to serve low-type consumers, leading sellers to set high prices tailored to high-type segments. Hidden pricing enables sellers to profitably serve both types by adjusting price components accordingly, thereby lowering the effective price.

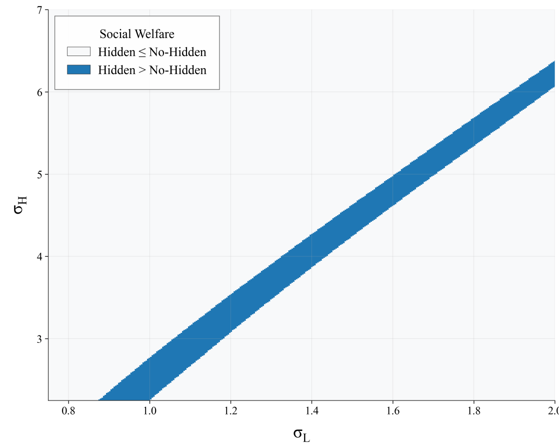
A crucial economic force behind the mechanism is the firm's incentive to expand its market coverage. For it to be profitable to extract surplus from low-type consumers at the expense of the profits from high-type consumers, there should be a sufficient proportion of low-type consumers. Therefore, the first condition of the proposition requires that the proportion of high-type consumers is small. The second condition ensures that the two types of consumers are sufficiently different so that the optimal upfront price for high-type consumers is higher than the optimal total price for both types of consumers.

Consumer search behavior exhibits different patterns when compared with the homogeneous consumer case. In the main model with homogeneous consumers, we have shown that, in expectation, consumers spend either equal time in the first and second search stages or longer in the second stage. However, when consumers have heterogeneous learning speeds, numerical simulation shows that high-type consumers' expected search time in the first stage is always greater than in the second stage, provided the parameters satisfy Proposition 4.

This is because the slow-learning consumer's search region is symmetrically nested within, and much narrower than, the fast-learning consumer's search region. Under the optimal price, the initial valuation is located inside the slow learner's search region. Consequently, the initial valuation is far from both the fast learner's purchasing and quitting boundaries, which implies a long expected search time for the fast-learning consumer in the first stage. When the fast-learning consumer arrives at the checkout page, her valuation has increased significantly, reaching the fast learner's purchasing boundary given the initial price. However, the hidden fee cannot be excessively large because the firm also sells to low-type consumers ($\Delta p < \sigma_L^2/2c$). This implies that the fast-learning consumer's purchasing boundary in the second stage will not increase much relative to her search region's width, given that σ_H is much larger than σ_L. As a result, her valuation at the beginning of the second stage is close to her updated purchasing boundary, leading to a low expected search time in this stage.



(a)



(b)

Figure 8: (Heterogeneous learning speeds) Parameter range where allowing hidden fees enhances social welfare.

It is not tractable to analytically evaluate the impact of hidden pricing on social welfare. Nevertheless, numerical simulations show that there exist parameters such that the social welfare under the optimal price when the firm uses a hidden fee is higher than the social welfare under the optimal upfront price. Figure 8 illustrates parameter ranges where allowing hidden fees enhances social welfare. The mechanism of market coverage expansion with the help of hidden fees suggests that a sufficient number of low-type consumers (i.e., the proportion of high-type consumers ρ_σ is not too high) is necessary for the firm to have an incentive to expand the market coverage when hidden fees are feasible, as illustrated by Figure 8a. A lower price also can improve social welfare. According to Proposition 4, a sufficiently large difference in consumers' learning speeds results in a lower total price when the firm employs a hidden fee rather than using an upfront price. In the meantime, the difference cannot be too large. Otherwise, the firm will always focus on the market of high-type consumers. Figure 8b demonstrates this.

5.2 Heterogeneous Initial Valuations

The setup is the same as the base model, except that there are two groups of consumers with $v_0 \in \{v_0^H, v_0^L\}$, where $v_0^H > v_0^L$. Among consumers, $Prob(v_0 = v_0^H) = \rho_v$. The distribution of initial valuations is common knowledge, whereas the realization of the initial valuation is each consumer's private information. Similarly to the previous section, a firm's pricing decision can lead to different strategic effects on different consumer segments. Again, we find that the optimal total price when the firm uses a hidden fee can be lower than the optimal upfront price under some conditions.

Proposition 5. *When the following condition holds, the optimal total price when the firm uses a hidden fee is lower than the optimal upfront price,* $p_1^* + \Delta p^* < p_{wo}^*$*:*

(1) $\rho_v < \widehat{\rho_v}$, $v_0^H - v_0^L > \sigma^2/c$, *and* $\max\{-m/2, -3\sigma^2/4c + m\} < v_0^L < -\sigma^2/4c + m < v_0^H < 3\sigma^2/4c + m$*;*

or

(2) $\rho_v < \widehat{\rho_v}'$, $v_0^H - v_0^L > \sigma^2/c$, $-\sigma^2/4c < v_0^L < -\sigma^2/4c + m < v_0^H < 3\sigma^2/4c + m$, $v_0^L < -m/2$, *and* $m < \sigma^2/2c$.[7]

Similarly to the previous section, for it to be profitable to extract surplus from low-type consumers at the expense of the profits from high-type consumers, there should be a sufficient proportion of low-type consumers, captured by the first condition in either set of conditions of the proposition.

For a hidden pricing strategy to attract low-type consumers as well, the initial price p_1^* must be lower than $v_0^L + \sigma^2/4c$ to induce low-type consumers to search in the first stage. Moreover, the hidden fee must be lower than $\sigma^2/2c$ to ensure that the consumer will not quit immediately after seeing the hidden fee at the checkout page. So, the optimal total price of selling to both types of consumers is bounded from above by $v_0^L + 3\sigma^2/4c$. Because the optimal upfront price p_{wo}^* of selling to only high-type consumers increases in the high-type consumer's initial valuation v_0^H, a sufficiently large gap between the two types' initial valuations, $v_0^H - v_0^L > \sigma^2/c$, ensures that the optimal total price when the firm uses a hidden fee is lower than the optimal upfront price.

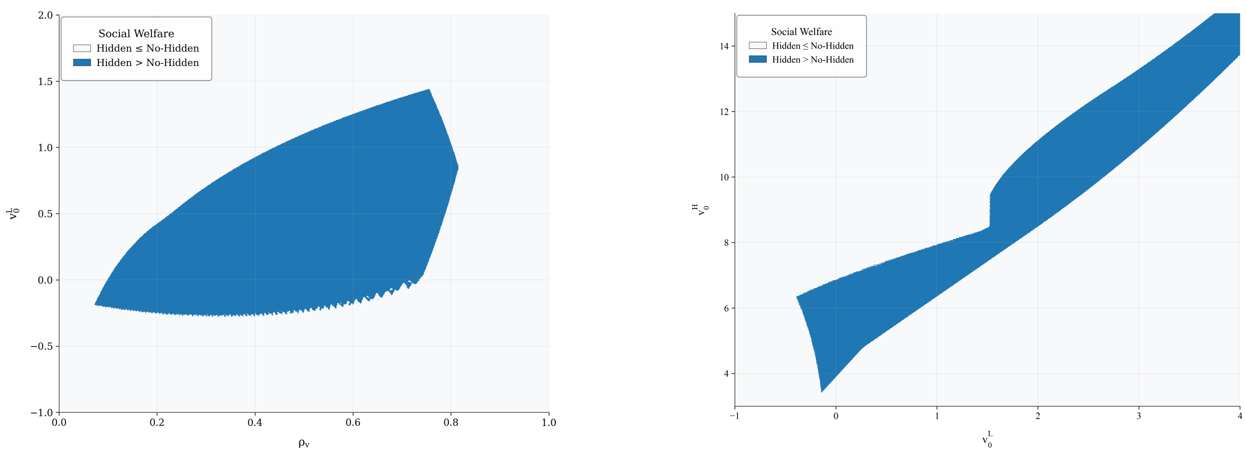
Consumer search behavior in this section qualitatively differs from the previous section on heterogeneous learning speeds. Unlike that scenario, where high-type consumers searched more in the first stage than in the second, high-type consumers in this situation do not search at all in either stage; they proceed directly to the checkout page and make the final purchase.

The reason for this divergence is that, in the heterogeneous learning speeds model, the slow-learning consumer's search region was symmetrically nested within the fast-learning consumer's

[7] The cutoffs $\widehat{\rho_v}$ and $\widehat{\rho_v}'$ are two constants specified in the appendix. Both constants $\in (0, 1)$.

search region. In contrast, when consumers have heterogeneous initial valuations, all consumers share the same search region. To sell to low-valuation consumers, the price must be sufficiently low to prevent their immediate quitting. However, at such a low price, high-valuation consumers will purchase immediately without engaging in search, provided there is a sufficiently large gap in initial valuations, as assumed in Proposition 5.

Figure 9 shows numerically parameter ranges where allowing hidden fees enhances social welfare. Similarly to the previous section, there should be a sufficient number of low-type consumers (i.e., the proportion of high-type consumers ρ_v is not too high), which is demonstrated by Figure 9a. When there is a sufficiently large gap between the initial valuations of high- and low-type consumers, the firm is more likely to reduce the total price to sell to low-type consumers, which can help with social welfare. However, such a gap cannot be too high. Otherwise, the firm will still abandon low-type consumers. Figure 9b illustrates this.



(a) (b)

Figure 9: (Heterogeneous initial valuations) Parameter range where allowing hidden fees enhances social welfare.

5.3 Discussion

Our findings carry important policy implications. Despite recent regulatory efforts to ban hidden fees, our analysis identifies scenarios under which hidden fees can be welfare-improving rather than harmful. Therefore, there is no one-size-fits-all approach for regulating the use of hidden fees. The regulator should take into account the composition of the customer base, especially the amount of heterogeneity among consumers, before imposing a policy.

6 Extension

6.1 Awareness of the Hidden Fee

Consumers are fully rational and choose optimal actions given the information available at each stage. However, in the first stage they are unaware of the hidden fee. In this extension, we consider the case in which some consumers are aware of the possibility of hidden fees, whereas other consumers are unaware of this possibility. Formally, we assume that ρ proportion of the consumers are unaware of the possibility of hidden fees, as in the main model. The remaining $1-\rho$ proportion of the consumers are aware of the possibility of hidden fees, and rationally anticipate the seller's pricing strategies in the second stage. The following results show that the main insight in the base model extends to this scenario as long as there exist consumers who are unaware of the possibility of hidden fees.

Proposition 6. *For any $\rho > 0$, there exist parameters such that the firm's expected profit under the optimal strategy with a hidden fee is strictly higher than the expected profit under the optimal upfront price.*

If all consumers are aware of the hidden fee, then it is equivalent for the firm to use a hidden fee or an upfront price. The above results show that the mere existence of any proportion of consumers unaware of the possibility of hidden fees could make the use of hidden fees a strictly dominant strategy.

7 Conclusion

Hidden fees can influence behavior only if at least some consumers do not fully anticipate the final price when they first observe the base price. In that case, some consumers may proceed to the checkout stage even though they would not have done so had they fully anticipated the final price. Upon observing the final price at checkout, however, they remain free to exit without purchasing. For hidden fees to have any impact, there must therefore be some consumers who would not purchase if the final price were presented upfront but who purchase when the same price is disclosed sequentially. Previous literature attributes the prevalence of hidden fees to behavioral biases at checkout - such as limited attention or loss aversion - that reduce consumers' responsiveness to the higher final price.

Our analysis instead shows that hidden fees can influence behavior even when consumers respond fully rationally to the final price at checkout. By presenting an initially low base price, sellers can induce consumers to begin searching in cases where they would not have searched under upfront pricing and to continue searching when early signals are unfavorable. Thus, in our framework, hidden fees operate by shaping beliefs during search. Some consumers receive unfavorable information and exit before reaching checkout, whereas those who proceed to checkout have accumulated sufficiently favorable information about product fit. Consumers who reach checkout therefore do so with more favorable beliefs about the product than they initially held, and therefore are more likely to continue gathering information about the product rather than abandon the product immediately when they see the higher total price.

This paper shows that hidden fees can increase firm profits over a wide range of parameters. Moreover, when consumers are heterogeneous, the total price under hidden pricing may be lower than the price the firm would set if constrained to an upfront price. Finally, allowing hidden fees can in some cases enhance social welfare. These findings have important policy implications. Although regulations often focus on banning hidden fees, our analysis suggests that, in the presence of heterogeneity among consumers, the use of hidden fees may be welfare-improving. Therefore, there is no one-size-fits-all approach for regulating it. In particular, the regulator should consider the composition of the customer base before implementing a policy.

Appendix

Proof of Lemma 1. We show that for $c < \bar{c}$, $\underline{p} < E(v)$ and $\bar{p} > E(v)$. Define

$$\Phi(x) := \int_0^x (x - v)\, dF(v), \qquad \Psi(x) := \int_x^1 (v - x)\, dF(v).$$

Then $\underline{p}$ is the unique solution of $\Phi(\underline{p}) = c$ and $\bar{p}$ is the unique solution of $\Psi(\bar{p}) = c$.

First, note that $\Phi(x)$ is continuous and strictly increasing; moreover, because $\Phi(0) = 0$ and $\Phi(E(v)) = \bar{c}$, it follows that $\underline{p} < E(v)$ for $c < \bar{c}$.

Second, $\Psi(x)$ is continuous and strictly decreasing. Moreover, we show below that $\Psi(E(v)) = \bar{c}$.

$$\begin{aligned}
\Psi(\mathbb{E}[v]) &= \int_{\mathbb{E}[v]}^1 \big(v - \mathbb{E}[v]\big)\, dF(v) \\
&= \int_0^1 \big(v - \mathbb{E}[v]\big)\, dF(v) - \int_0^{\mathbb{E}[v]} \big(v - \mathbb{E}[v]\big)\, dF(v) \\
&= -\int_0^{\mathbb{E}[v]} \big(v - \mathbb{E}[v]\big)\, dF(v) \\
&= \bar{c}.
\end{aligned}$$

It then follows that $\bar{p} > E(v)$ for $c < \bar{c}$. □

Proof of Lemma 2. The consumer deliberates if $U(learn) \geq U(purchase)$ and $U(learn) \geq 0$. It follows from the text that both these conditions hold for $p_1 \in [\underline{p}, \bar{p}]$. The consumer proceeds to checkout if $U(purchase) > U(learn)$ and $U(purchase) > 0$. We show in the text that the first condition holds if $p_1 < \underline{p}$. Moreover, the second condition holds if $p_1 < E(v)$. In the proof of Lemma 1 we show that $\underline{p} < E(v)$. It then follows that the consumer proceeds to checkout if $p_1 < \underline{p}$. Finally, the consumer leaves without purchase if $0 > U(purchase)$ and $0 > U(learn)$. The first condition holds for $p_1 > E(v)$ and the second holds for $p_1 > \bar{p}$. Because $\bar{p} > E(v)$, as shown in the proof of Lemma 1, it follows that both conditions hold for $p_1 > \bar{p}$. □

Proof of Lemma 3. Similar to the proof of Lemma 2. Notice that in the first-stage decision the consumer behaves as if p_1 is the final price. □

Proof of Proposition 1. First notice that the firm's profit is weakly higher when it can use hidden fees (indeed, the firm has the option to set $\Delta p = 0$, and attain the same profit as it would in absence of hidden fees). When $p^* \leq \bar{p}$, the optimal price under deliberation is achievable even without hidden fees, i.e. if a firm sells at p^* the consumer deliberates. In that case, the firm's profit is the same with or without hidden fees. If, however, $p^* > \bar{p}$ the firm cannot sell at p^* without hidden fees - at such price the consumer leaves without purchase. Under hidden fees, the firm is able to sell at p^*. Finally, in order for the firm's profit to be higher under hidden fees, it must be that by selling at p^* the firm makes a higher profit than it would make by selling at $\underline{p}$ in which case all consumers purchase without deliberation. This occurs when $\underline{p} < p^*[1 - F(p^*)]$. □

Proof of Proposition 2. There are two cases:

1. $p_1 \geq 0$ is not binding

   The first-order-conditions with regard to p_1 and Δp for the objective function in problem (P_w) are:

$$\begin{cases} 2p_1 + \Delta p = v_0 + \sigma^2/4c + m \\ p_1 + 2\Delta p = \sigma^2/2c + m \end{cases}$$

$$\Rightarrow \begin{cases} p_1 = 2v_0/3 + m/3 \\ \Delta p = \sigma^2/4c + (m - v_0)/3 \end{cases}$$

$$\Rightarrow p_1 + \Delta p = v_0/3 + \sigma^2/4c + 2m/3.$$

   One can see that $p_1 > 0 \Leftrightarrow 2v_0/3 + m/3 > 0 \Leftrightarrow v_0 > -m/2$, which is the condition for $p_1 \geq 0$ not to be binding. Also, the firm can make positive profits if and only if $p_1 + \Delta p > m \Leftrightarrow v_0 > -3\sigma^2/4c + m$. Lastly, $\Delta p > 0 \Leftrightarrow v_0 < 3\sigma^2/4c + m$. If $v_0 \geq 3\sigma^2/4c + m$, then it is optimal to sell without a hidden fee, $p^*_{wo} = v_0 - \sigma^2/4c$.

2. $p_1 \geq 0$ is binding

Omitting the constant term $2c/\sigma^2$, the Lagrangian is:

$$\mathcal{L} = (p_1 + \Delta p - m) \cdot (v_0 + \frac{\sigma^2}{4c} - p_1) \cdot (1 - \frac{2c}{\sigma^2}\Delta p) + \lambda p_1$$

Using the standard constrained optimization method, we have:

$$\begin{cases} \frac{\partial \mathcal{L}}{\partial p_1} = (v_0 + \frac{\sigma^2}{4c} - p_1 - p_1 - \Delta p + m)(1 - \frac{2c}{\sigma^2}\Delta p) + \lambda = 0 \\ \frac{\partial \mathcal{L}}{\partial \Delta p} = [1 - \frac{2c}{\sigma^2}\Delta p - \frac{2c}{\sigma^2}(p_1 + \Delta p - m)](v_0 + \frac{\sigma^2}{4c} - p_1) = 0 \\ \lambda p_1 = 0,\ \lambda \geq 0,\ p_1 \geq 0 \end{cases}$$

$$\overset{p_1 \geq 0 \text{ is binding}}{\Rightarrow} \begin{cases} p_1 = 0 \\ \Delta p = \sigma^2/4c + m/2 \\ \lambda = -(v_0 + m/2)(1 - 2c/\sigma^2 \Delta p) \geq 0 \Leftrightarrow v_0 \leq -m/2 \end{cases}$$

$$p_1 + \Delta p = \sigma^2/4c + m/2$$

One can see that the firm can make positive profits if and only if $p_1 + \Delta p > m \Leftrightarrow m < \sigma^2/2c$. Also, we must have $v_0 - p_1 > -\sigma^2/4c \Leftrightarrow v_0 > -\sigma^2/4c$ so that the consumer will not directly quit in the first stage.

□

Proof of Proposition 3. If $v_0 \leq \max\{-\sigma^2/4c, -3\sigma^2/4c + m\}$, the firm cannot sell any product at a price above the marginal cost with or without a hidden fee.

If $\max\{-\sigma^2/4c, -3\sigma^2/4c + m\} < v_0 \leq -\sigma^2/4c + m$, the firm cannot sell any product at a price above the marginal cost without a hidden fee. So, the expected profit is zero. The expected search time is zero. In contrast, with a hidden fee, the optimal total price $p_1^* + \Delta p^* > m$ and the purchasing probability is strictly positive, according to Proposition 2. So, the expected profit is strictly positive. One can see that the expected search time is also strictly positive.

If $-\sigma^2/4c + m < v_0 < 3\sigma^2/4c + m$, the seller can make a positive profit with or without a hidden fee. Note that the strategy space of the problem (P_w) includes charging an upfront price as a special case $(\Delta p = 0)$. The expected profit must be strictly higher than the expected profit from charging an optimal upfront price if $\Delta p^* > 0$ in the solution to (P_w). According to Proposition 2, if $v_0 \leq -m/2$, then $\Delta p^* = \sigma^2/4c + m/2 > 0$; if $v_0 > -m/2$, then $\Delta p^* = \sigma^2/4c + (m - v_0)/3 > 0 \Leftrightarrow v_0 < 3\sigma^2/4c + m$.

Consider the expected search time. If $v_0 > -m/2$, we have:

$$\begin{aligned}\mathbf{E}(\tau_w) - \mathbf{E}(\tau_{wo}) =& \frac{\frac{\sigma^4}{16c^2} - (\frac{v_0 - m}{3})^2}{\sigma^2} + \frac{2c}{\sigma^2}(\frac{v_0}{3} - \frac{m}{3} + \frac{\sigma^2}{4c}) \cdot \frac{\frac{\sigma^4}{16c^2} - (\frac{v_0 - m}{3})^2}{\sigma^2} - \frac{\frac{\sigma^4}{16c^2} - (\frac{v_0 - m}{2} - \frac{\sigma^2}{8c})^2}{\sigma^2} \\ =& \frac{1}{\sigma^2}(\frac{m^2}{12} + \frac{2cm^3}{27\sigma^2} + \frac{m\sigma^2}{12c} + \frac{3\sigma^4}{64c^2}) > 0.\end{aligned}$$

If $v_0 \leq -m/2$, we have:

$$\begin{aligned}\mathbf{E}(\tau_w) - \mathbf{E}(\tau_{wo}) =& \frac{\frac{\sigma^4}{16c^2} - v_0^2}{\sigma^2} + \frac{2c}{\sigma^2}(v_0 + \frac{\sigma^2}{4c}) \cdot \frac{\frac{\sigma^4}{16c^2} - \frac{m^2}{4}}{\sigma^2} - \frac{\frac{\sigma^4}{16c^2} - (\frac{v_0 - m}{2} - \frac{\sigma^2}{8c})^2}{\sigma^2} \\ =& \frac{1}{\sigma^2} \frac{8c^2m^2 + 8cm\sigma^2 + 3\sigma^4}{64c^2} > 0.\end{aligned}$$

If $v_0 \geq 3\sigma^2/4c + m$, the constraint $\Delta p \geq 0$ in the firm's problem (P_w) is binding. So, $\Delta p^* = 0$ and thus it is optimal to charge an upfront price even if it is feasible to charge a hidden fee. $\square$

Proof of Proposition 4. We first consider the case without a hidden fee. Conditions $\sigma_H > \sqrt{5}\sigma_L$ and $-3\sigma_L^2/4c + m < v_0$ imply that $v_0 > -3\sigma_L^2/4c + m > -5\sigma_L^2/4c + m > -\sigma_H^2/4c + m$. The proposition also includes the condition that $v_0 < -\sigma_L^2/4c + m$. When $-\sigma_H^2/4c + m < v_0 < -\sigma_L^2/4c + m$, a firm can only sell to high-type consumers without a hidden fee. The optimal upfront price is:

$$p_{wo}^* = \frac{v_0}{2} + \frac{\sigma_H^2}{8c} + \frac{m}{2}.$$

The corresponding profit is:

$$\rho_\sigma \cdot (\frac{v_0}{2} + \frac{\sigma_H^2}{8c} + \frac{m}{2} - m) \cdot \frac{c}{\sigma_H^2}(v_0 + \sigma_H^2/4c - m)$$

We now consider the case with a hidden fee.

1. The firm only sells to high-type consumers.

   When $v_0 > -m/2$ and $\max\{-\sigma_H^2/4c, -3\sigma_H^2/4c + m\} < v_0 < 3\sigma_H^2/4c + m$, the optimal price is $(p_1, \Delta p) = (2v_0/3 + m/3, \sigma_H^2/4c + (m - v_0)/3)$, and the total price is $p_1 + \Delta p = v_0/3 +$

$\sigma_H^2/4c+2m/3$. One can verify that $-\sigma_H^2/4c < -\sigma_L^2/4c < v_0 - p_1$ and $\sigma_L^2/2c < \Delta p < \sigma_H^2/2c$ under the conditions of this proposition. So, low-type consumers will never make a purchase, whereas high-type consumers may buy the product. The expected profit is:

$$\Pi^H = \rho_\sigma \frac{2c}{\sigma_H^2}\left(\frac{v_0}{3}+\frac{\sigma_H^2}{4c}-\frac{m}{3}\right)^2\left[1/2-\frac{2c(m-v_0)}{3\sigma_H^2}\right] \tag{10}$$

2. The firm sells to low-type consumers.

To prevent low-type consumers from quitting directly, p_1 must be strictly less than $v_0+\sigma_L^2/4c$. Instead of directly characterizing the optimal price and profit in this case, we instead examine the optimal profit from low-type consumers *only*, which is a lower bound of the optimal profit of selling to low-type consumers because the firm also earns profits from high-type consumers and the optimal price when considering profits from both types of consumers may be different.

When $v_0 > -m/2$, the optimal price of only selling to low-type consumers is $(p_1, \Delta p) = (2v_0/3 + m/3, \sigma_L^2/4c + (m - v_0)/3)$, and the total price is $p_1 + \Delta p = v_0/3 + \sigma_L^2/4c + 2m/3$. The expected profit from the low-type consumers is:

$$\Pi^L = (1-\rho_\sigma)\frac{2c}{\sigma_L^2}\left(\frac{v_0}{3}+\frac{\sigma_L^2}{4c}-\frac{m}{3}\right)^2\left[1/2-\frac{2c(m-v_0)}{3\sigma_L^2}\right] \tag{11}$$

A sufficient condition for the profit of selling to low-type consumers to be higher than the profit of only selling to high-type consumers is:

$$\begin{aligned}
\Pi^L > \Pi^H &= (1-\rho_\sigma)\frac{2c}{\sigma_L^2}\left(\frac{v_0}{3}+\frac{\sigma_L^2}{4c}-\frac{m}{3}\right)^2\left[1/2-\frac{2c(m-v_0)}{3\sigma_L^2}\right] \\
&> \rho_\sigma \frac{2c}{\sigma_H^2}\left(\frac{v_0}{3}+\frac{\sigma_H^2}{4c}-\frac{m}{3}\right)^2\left[1/2-\frac{2c(m-v_0)}{3\sigma_H^2}\right] \\
\Leftrightarrow \rho_\sigma < \widehat{\rho_\sigma} &:= \frac{\frac{2c}{\sigma_L^2}\left(\frac{v_0}{3}+\frac{\sigma_L^2}{4c}-\frac{m}{3}\right)^2\left[1/2-\frac{2c(m-v_0)}{3\sigma_L^2}\right]}{\frac{2c}{\sigma_L^2}\left(\frac{v_0}{3}+\frac{\sigma_L^2}{4c}-\frac{m}{3}\right)^2\left[1/2-\frac{2c(m-v_0)}{3\sigma_L^2}\right]+\frac{2c}{\sigma_H^2}\left(\frac{v_0}{3}+\frac{\sigma_H^2}{4c}-\frac{m}{3}\right)^2\left[1/2-\frac{2c(m-v_0)}{3\sigma_H^2}\right]} \in (0,1)
\end{aligned}$$

We now consider the price. When the above conditions hold, it is optimal to sell to low-type consumers when it is feasible to use a hidden fee. In order to sell to low-type consumers, we must have $p_1^* < v_0 + \sigma_L^2/4c$ so that low-type consumers will search in the first stage. Because

$\Delta p^* < \sigma_L^2/2c$, which ensures that the consumer may purchase after reaching the checkout page, the optimal total price with a hidden fee satisfies $p_1^* + \Delta p^* < v_0 + \sigma_L^2/4c + \sigma_L^2/2c = v_0 + 3\sigma_L^2/4c$. The optimal upfront price is:

$$\begin{aligned} p_{wo}^* &= \frac{v_0}{2} + \frac{\sigma_H^2}{8c} + \frac{m}{2} \\ &\overset{v_0 < -\sigma_L^2/4c+m}{>} \frac{v_0}{2} + \frac{\sigma_H^2}{8c} + \frac{v_0 + \sigma_L^2/4c}{2} \\ &= v_0 + \frac{\sigma_H^2}{8c} + \frac{\sigma_L^2}{8c}. \end{aligned}$$

Hence, a sufficient condition for $p_{wo}^* > p_1^* + \Delta p^*$ is:

$$\begin{aligned} & v_0 + \frac{\sigma_H^2}{8c} + \frac{\sigma_L^2}{8c} > v_0 + \frac{3\sigma_L^2}{4c} \\ \Leftrightarrow\ & \sigma_H > \sqrt{5}\sigma_L. \end{aligned} \tag{12}$$

□

Proof of Proposition 5. We first consider the case without a hidden fee. When $v_0^L < -\sigma^2/4c + m$, the firm will not sell to low-type consumers without a hidden fee, according to equation (7). The optimal upfront price is the optimal p_{wo}^* in equation (7) when $v_0 = v_0^H$:

$$p_{wo}^* = \frac{v_0^H}{2} + \frac{\sigma^2}{8c} + \frac{m}{2}.$$

The corresponding profit is:

$$\rho_v \cdot (\frac{v_0^H}{2} + \frac{\sigma^2}{8c} + \frac{m}{2} - m) \cdot \frac{c}{\sigma^2}(v_0^H + \sigma^2/4c - m)$$

We now consider the case with a hidden fee. The firm can either only selling to high-type consumers or selling to both types of consumers. If the consumer directly go to the checkout page without search, then the consumer's problem is as if the firm uses an upfront price of $p_{wo} = p_1 + \Delta p$. The use of a hidden fee does not increase the profit. This leads to the following result.

Lemma 4. *A necessary condition for the use of a hidden fee $(p_1, \Delta p)$ to increase the firm's expected* *profit over the optimal profit with an upfront price is that the initial price* p_1 *must induce consumer search in the first stage for at least one type of consumers,* $v_0 - p \in (-\sigma^2/4c, \sigma^2/4c)$ *for at least one* $v_0 \in \{v_0^H, v_0^L\}$.

1. The firm only sells to high-type consumers.

   (a) According to the proof of Proposition 2, if $v_0^H > -m/2$ and $\max\{-\sigma^2/4c, -3\sigma^2/4c + m\} < v_0^H < 3\sigma^2/4c + m$, the optimal price is $(p_1, \Delta p) = (2v_0^H/3 + m/3, \sigma^2/4c + (m - v_0^H)/3)$, and the total price is $p_1 + \Delta p = v_0^H/3 + \sigma^2/4c + 2m/3$. One can verify that:

$$\begin{aligned} v_0^L - p_1 &= v_0^L - \frac{2}{3}v_0^H - \frac{1}{3}m \\ &= \frac{1}{3}v_0^L - \frac{2}{3}(v_0^H - v_0^L) - \frac{1}{3}m \\ &< \frac{1}{3}[v_0^H - (v_0^H - v_0^L)] - \frac{2}{3}\frac{\sigma^2}{2c} - \frac{1}{3}m \\ &< \frac{1}{3}(\frac{3\sigma^2}{4c} - \frac{\sigma^2}{2c}) - \frac{2}{3}\frac{\sigma^2}{2c} - \frac{1}{3}m \\ &= -\frac{\sigma^2}{4c} \end{aligned}$$

   So, low-type consumers will directly quit in the first stage. The expected profit is:

$$\begin{aligned} \Pi_1^H &= \rho_v \cdot \underbrace{(p_1 + \Delta p - m)}_{\text{profit per sale}} \cdot \overbrace{(v_0^H + \frac{\sigma^2}{4c} - p_1)\frac{2c}{\sigma^2}}^{\text{probability of reaching the checkout page}} \cdot \underbrace{(1 - \frac{2c}{\sigma^2}\Delta p)}_{\text{conditional probability of purchasing}} \\ &= \rho_v \frac{2c}{\sigma^2}\left(\frac{v_0^H}{3} + \frac{\sigma^2}{4c} - \frac{m}{3}\right)^2 \left[1/2 - \frac{2c(m - v_0^H)}{3\sigma^2}\right] \end{aligned} \tag{13}$$

   (b) If $-\sigma^2/4c < v_0^H < -m/2$ and $m < \sigma^2/2c$, the optimal price is $(p_1, \Delta p) = (0, \sigma^2/4c + m/2)$, and the total price is $p_1 + \Delta p = \sigma^2/4c + m/2$. One can verify that $v_0^L < v_0^H - \sigma^2/2c < -\sigma^2/2c < p_1 - \sigma^2/4c$. So, low-type consumers will directly quit in the first stage. The expected profit is:

$$\Pi_2^H = \rho_v \cdot \underbrace{(p_1 + \Delta p - m)}_{\text{profit per sale}} \cdot \overbrace{(v_0^H - p_1 + \frac{\sigma^2}{4c})\frac{2c}{\sigma^2}}^{\text{probability of reaching the checkout page}} \cdot \underbrace{(1 - \frac{2c}{\sigma^2}\Delta p)}_{\text{conditional probability of purchasing}}$$

$$= \rho_v \frac{2c}{\sigma^2} \left(\frac{\sigma^2}{4c} - \frac{m}{2} \right) \left(v_0^H - \frac{m}{2} \right) \left(1/2 - \frac{mc}{\sigma^2} \right) \tag{14}$$

2. The firm sells to low-type consumers.

   To prevent low-type consumers from quitting directly, p_1 must be strictly less than $v_0^L + \sigma^2/4c$. The condition $v_0^H - v_0^L > \sigma^2/2c$ then implies that $v_0^H - \sigma^2/4c > v_0^L + \sigma^2/4c > p_1$. Hence, the high-type consumer will go to the checkout page immediately. Lemma 4 implies that for hidden pricing to increase profits, p_1 must be strictly higher than $v_0^L - \sigma^2/4c$. Therefore, we will focus on the case of $p_1 \in (v_0^L - \sigma^2/4c, v_0^L + \sigma^2/4c)$.

   Instead of directly characterizing the optimal price and profit in this case, we instead examine the optimal profit from low-type consumers *only*, which is a lower bound of the optimal profit of selling to low-type consumers because the firm also earns profits from high-type consumers and the optimal price when considering profits from both types of consumers may be different.

   (a) Similar to the previous part of the proof, if $v_0^L > -m/2$ (which implies $v_0^H > -m/2$), the optimal price of only selling to low-type consumers is $(p_1, \Delta p) = (2v_0^L/3 + m/3, \sigma^2/4c + (m - v_0^L)/3)$, and the total price is $p_1 + \Delta p = v_0^L/3 + \sigma^2/4c + 2m/3$. The expected profit from the low-type consumers is:

$$\Pi_1^L = (1 - \rho_v) \frac{2c}{\sigma^2} \left(\frac{v_0^L}{3} + \frac{\sigma^2}{4c} - \frac{m}{3} \right)^2 \left[1/2 - \frac{2c(m - v_0^L)}{3\sigma^2} \right] \tag{15}$$

   A sufficient condition for the profit of selling to low-type consumers to be higher than the profit of only selling to high-type consumers is:

$$\begin{aligned} \Pi_1^L > \Pi_1^H &= (1 - \rho_v) \frac{2c}{\sigma^2} \left(\frac{v_0^L}{3} + \frac{\sigma^2}{4c} - \frac{m}{3} \right)^2 \left[1/2 - \frac{2c(m - v_0^L)}{3\sigma^2} \right] \\ &> \rho_v \frac{2c}{\sigma^2} \left(\frac{v_0^H}{3} + \frac{\sigma^2}{4c} - \frac{m}{3} \right)^2 \left[1/2 - \frac{2c(m - v_0^H)}{3\sigma^2} \right] \\ \Leftrightarrow \rho_v < \widehat{\rho_v} &:= \frac{\left(\frac{v_0^L}{3} + \frac{\sigma^2}{4c} - \frac{m}{3} \right)^2 \left[1/2 - \frac{2c(m - v_0^L)}{3\sigma^2} \right]}{\left(\frac{v_0^L}{3} + \frac{\sigma^2}{4c} - \frac{m}{3} \right)^2 \left[1/2 - \frac{2c(m - v_0^L)}{3\sigma^2} \right] + \left(\frac{v_0^H}{3} + \frac{\sigma^2}{4c} - \frac{m}{3} \right)^2 \left[1/2 - \frac{2c(m - v_0^H)}{3\sigma^2} \right]} \in (0, 1) \end{aligned}$$

   We now consider the price. When the above conditions hold, it is optimal to sell to low-type consumers when it is feasible to use a hidden fee. In order to sell to low-type consumers, we must have $p_1^* < v_0^L + \sigma^2/4c$ so that low-type consumers will search in the first stage. Because $\Delta p^* < \sigma^2/2c$, which ensures that the consumer may purchase after reaching the checkout page, the optimal total price with a hidden fee satisfies $p_1^* + \Delta p^* < v_0^L + \sigma^2/4c + \sigma^2/2c = v_0^L + 3\sigma^2/4c$. The optimal upfront price is:

$$\begin{aligned} p_{wo}^* &= \frac{v_0^H}{2} + \frac{\sigma^2}{8c} + \frac{m}{2} \\ &\overset{v_0^H < 3\sigma^2/4c+m}{>} \frac{v_0^H}{2} + \frac{\sigma^2}{8c} + \frac{v_0^H - 3\sigma^2/4c}{2} \\ &> v_0^H - \frac{\sigma^2}{4c}. \end{aligned}$$

Hence, a sufficient condition for $p_{wo}^* > p_1^* + \Delta p^*$ is:

$$\begin{aligned} & v_0^H - \frac{\sigma^2}{4c} > v_0^L + \frac{3\sigma^2}{4c} \\ \Leftrightarrow\ & v_0^H - v_0^L > \frac{\sigma^2}{c}. \end{aligned} \tag{16}$$

(b) If $-\sigma^2/4c < v_0^L < -m/2$ and $m < \sigma^2/2c$, the optimal price of only selling to low-type consumers is $(p_1, \Delta p) = (0, \sigma^2/4c + m/2)$, and the total price is $p_1 + \Delta p = \sigma^2/4c + m/2$. The expected profit from the low-type consumer is:

$$\begin{aligned} \Pi_2^L &= (1-\rho_v) \cdot \underbrace{(p_1 + \Delta p - m)}_{\text{profit per sale}} \cdot \overbrace{(v_0^L - p_1 + \frac{\sigma^2}{4c})\frac{2c}{\sigma^2}}^{\text{probability of reaching the checkout page}} \cdot \underbrace{(1 - \frac{2c}{\sigma^2}\Delta p)}_{\text{conditional probability of purchasing}} \\ &= (1-\rho_v)\frac{2c}{\sigma^2}\left(\frac{\sigma^2}{4c} - \frac{m}{2}\right)\left(v_0^L + \frac{\sigma^2}{4c}\right)\left(1/2 - \frac{mc}{\sigma^2}\right) \end{aligned} \tag{17}$$

Conditions $v_0^L > -\sigma^2/4c$ and $v_0^H - v_0^L > \sigma^2/c$ imply that $v_0^H = v_0^L + (v_0^H - v_0^L) > 3\sigma^2/4c > -m/2$. So, the expected profit of only selling to high-type consumers is Π_1^H. A sufficient condition for the profit of selling to low-type consumers to be higher than the profit of only selling to high-type consumers is:

$$\begin{aligned}\Pi_2^L > \Pi_1^H &= (1-\rho_v)\frac{2c}{\sigma^2}\left(\frac{\sigma^2}{4c}-\frac{m}{2}\right)\left(v_0^L+\frac{\sigma^2}{4c}\right)\left(1/2-\frac{mc}{\sigma^2}\right)] \\ &> \rho_v\frac{2c}{\sigma^2}\left(\frac{v_0^H}{3}+\frac{\sigma^2}{4c}-\frac{m}{3}\right)^2\left[1/2-\frac{2c(m-v_0^H)}{3\sigma^2}\right] \\ \Leftrightarrow \rho_v < \widehat{\rho_v}' := &\frac{\left(\frac{\sigma^2}{4c}-\frac{m}{2}\right)\left(v_0^L+\frac{\sigma^2}{4c}\right)(1/2-\frac{mc}{\sigma^2})]}{\left(\frac{\sigma^2}{4c}-\frac{m}{2}\right)\left(v_0^L+\frac{\sigma^2}{4c}\right)(1/2-\frac{mc}{\sigma^2})]+\left(\frac{v_0^H}{3}+\frac{\sigma^2}{4c}-\frac{m}{3}\right)^2\left[1/2-\frac{2c(m-v_0^H)}{3\sigma^2}\right]} \in (0,1)\end{aligned}$$

We now consider the price. When the above conditions hold, it is optimal to sell to low-type consumers when it is feasible to use a hidden fee. Similar to the arguments in part 2a, a sufficient condition for $p_{wo}^* > p_1^* + \Delta p^*$ is condition (16), $v_0^H - v_0^L > \frac{\sigma^2}{c}$.

□

Proof of Proposition 6. Consider the parameter range where $\max\{-\sigma^2/4c, -3\sigma^2/4c+m\} < v_0 \leq -\sigma^2/4c+m$. Without a hidden fee, the firm cannot sell any product. With a hidden fee, the firm can make a positive profit from the consumers who are unaware of the possibility of hidden fees (ρ proportion of consumers). Therefore, the total profit is also positive.

□

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