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Price Signaling with Salient-thinking Consumers*

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Abstract

This paper examines the signaling role of prices in a context of salient thinking. Consumers cannot observe product quality directly, and they focus on the product attribute – either quality or price – that stands out in the market. Our analysis shows that salience considerations mitigate the incentive to signal quality via price. Moreover, depending on the difference in quality between products, the separating price of the high-quality seller can be inflated or deflated in relation to a set-up of rational consumers. Our findings indicate that certain ways of setting prices for experience goods can be explained by combining price signaling with salient thinking.

JEL Classification: D82, D83, D90, L15

Keywords: Salient thinking, Price signaling, Separating equilibria, Experience goods

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1 Introduction

According to the conventional wisdom, if two products differ in price, the more expensive should be of higher quality, whereas if they sell at the same price they should be of equal quality. In a context in which the quality of an experience good is seller's private information, signaling quality to consumers requires the high-quality seller to alter its strategy relative to a scenario of perfect information. Typically, the price is distorted upwards in such a way as to prevent mimicking by a low-quality producer.

The presence of price distortion is very difficult to assess in practice, as it is hard to identify what price would have been paid by consumers if they were fully informed about product quality. Nevertheless, a good benchmark is the price paid by online consumers who, while not experienced, obtain information through reviews, facilitating their purchasing decisions. Accordingly, we expect high-quality sellers to launch their products at a higher price than that which incorporates the information provided by consumer reviews. In the case of a number of products, however, the launch price deviates from the expected upward distortion. For instance, Yu *et al.* (2016) reported that the launch price of the Canon VIXIA M500 mini camcorder was $500, and that an improvement in average consumer ratings led the manufacturer to raise it to $800.[1] In this example, we observe a price that is compressed relative to full information, which might lead us to think that the new product does not differ substantially in quality from comparable goods marketed at a similar price.

The present paper shows that this conjecture is not necessarily true when consumers' purchasing decisions are distorted by salient thinking. By reducing sellers' incentive to signal quality via prices, salient thinking can account for this tendency to price compression. The intuition of our argument builds on the idea that an eye-catching higher-than-average price can influence consumers' behavior in two ways. On the one hand, as Judd and Riordan (1994, p. 773) point out, "the phrase 'you get what you pay for' is a commonplace saying for the idea that a high price signals high quality". Accordingly, the consumer would believe the product is of high quality. On the other hand, the price may become more prominent than other features affecting consumer choice. This diversion of attention is what the seminal papers by Bordalo *et al.* (2012, 2013) labeled as "salient thinking": consumers' attention can be directed towards certain product attributes that become salient as they are given greater weight in the purchasing choice. Consumers with salience-driven preferences compare price and quality with their

[1] A more recent example is the Sony Xavax5650Ant SintoMonitor, which was launched on Amazon at about €440 in November 2021 but whose price was raised to €569 in January 2022 and stayed at that level until September, about 30% above the launch price once the item's quality was better disclosed to the market (source: https://www.camelcamelcamel.com).

respective averages, thereby assigning excessive weight to the attribute that is farther from the average.[2]

We investigate the optimal pricing of sellers serving a market with salient thinkers and navigating the following trade-offs: a high price can signal superior quality, but it may also make price the salient attribute, increasing the elasticity of demand; conversely, a low price may not prevent mimicking, but in this case quality is more likely to be perceived as salient, reducing demand elasticity. To formalize this argument, we posit that consumers have no information about whether a new product is of basic or high quality and differ in their valuation of high quality but value basic quality equally. They have a diffuse prior as to the type of product a seller offers. Observing the price, consumers update their beliefs and make their purchasing decisions accordingly. Salient thinking distorts product valuation. The comparison between the expected quality ratio and the corresponding price ratio determines which attribute is salient. This implies the existence of a cutoff price above which price is salient and below which quality is salient. We analyze two different settings, one with a single seller and one with two competing sellers.

In the single-seller setting, the seller could be either of two types: "low", with the basic-quality good, and "high", with the high-quality good. A separating equilibrium requires the price of the high type to lie in an interval with the endpoints determined by the incentive compatibility constraints of the two types. If the price is not high enough, the low type will always imitate the high type. If it is too high, the high type will not find separation profitable, as it would sacrifice too much demand. The salience bias affects the interval of separation, insofar as its endpoints decrease with this bias when price is salient and increase with it when quality is salient. Moreover, if the cutoff price is below (above) the higher (lower) endpoint of the interval, separation can occur with price (quality) as the salient attribute.

Applying the Intuitive Criterion (Cho and Kreps, 1987), the least costly separating equilibrium survives as a unique outcome, with price, quality, or both attributes salient. When the high type can signal its superior quality, it would prefer quality to be salient. This is not always possible, however, as mimicking is more attractive for the low type when quality is salient. Indeed, when the quality differential is sufficiently great, the incentive to mimic becomes too strong under quality salience. In these cases, separation can be achieved with both attributes salient if the quality differential is intermediate or with price salient when the differential is substantial. In the latter case, a separating outcome cannot occur

[2]Experimental evidence provided by Dertwinkel-Kalt *et al.* (2017) supports this type of consumer behavior. On the empirical side, Hastings and Shapiro (2013) estimate the model of Bordalo *et al.* (2013) using gasoline market data. They show that a parallel increase in the price of all gasoline grades makes prices less salient and induces agents to shift towards higher-octane fuel.

when the salience bias is strong enough, as the lowest separating price is not high enough to be perceived as salient. Intuitively, many of these equilibria do not survive owing to downward deviations by the high type, who would have to sacrifice too much demand in order to signal quality. In our setting, when the quality differential is substantial, signaling would require a large upward price distortion, making price the salient attribute. In these cases, salience exerts a downward pressure on the price that can offset the upward distortion required to achieve separation. When this occurs, the firm tends to compress the price, which, at the limit, can be equal to that of the basic-quality good (pooling equilibrium).

In the duopoly setting, in most cases salience undermines separation and reinforces our result of price compression. We consider a set-up in which each firm may sell either the basic or the high-quality good. Consumers are not informed ex ante about the state of the world and, after observing sellers' prices, decide whether to buy the product, and from which firm. We find that separation cannot occur under price salience because in the asymmetric states the presence of a low-quality rival makes an undercutting deviation profitable for the high-quality seller. Under quality salience, instead, undercutting is unprofitable; nonetheless, salience can bring about a profitable deviation by the low-quality seller towards price-salient configurations, thus destabilizing many candidate separating equilibria.

The price compression that we obtain in our analysis is reminiscent of the focal price outcome delivered by models of loss aversion (Heidhues and Kőszegi, 2008; Courty and Nasiry, 2018; Hahn *et al.*, 2018). These models provide an explanation for the uniform pricing puzzle observed in various industries marked by product differentiation, such as food and mass merchandise in US retail chains (DellaVigna and Gentzkow, 2019) or entertainment (Orbach, 2004; Orbach and Einav, 2007; Richardson and Stähler, 2016). These markets are characterized by fairly frequent repeated purchases and uncertainty over whether the next product will match consumer tastes. Intuitively, loss-averse consumers attach greater weight to past losses (i.e. paying a high price for a poor match) than on past pleasant surprises (paying a low price for a good match), and this leads firms to converge towards a focal price.[3]

Since the reference to past purchasing experiences naturally elicits the role of consumers' tastes, loss aversion has been applied mostly in models of horizontal product differentiation. The only paper positing loss-averse consumers and taking quality into account is Courty and Nasiry (2018), who present an application to media and entertainment markets. In their model, consumers compare current options

[3]In a Salop model, Heidhues and Kőszegi (2008) show that loss aversion may lead heterogeneous firms facing different cost distributions to pool prices. Indeed, provided that consumers are sufficiently loss averse, firms will converge on the same focal price. Given that the uncertainty is over the firms' costs, consumers do not need to infer any vertical dimension (i.e. quality) in order to make their purchasing decisions.

with past experiences of the same quality class. This is plausible in their application, where even when they observe the quality of a good, consumers, ex-ante, have an uncertain taste preference associated with its unique creative content.[4] Therefore, in this model, loss aversion applies within a class of products of the same quality, but not across quality classes. Our setting, instead, is more suitable for analyzing the first purchase of an experience good of unknown quality in a non-routine decision-making process. Here, the consumer's main problem is to infer the quality of a new product in a setting in which sellers know the quality of their products.[5]

Related literature. The seminal papers on price signaling examine monopoly settings. Milgrom and Roberts (1986) consider a monopolist using price and dissipative advertising to signal product quality. Bagwell and Riordan (1991) and Judd and Riordan (1994) demonstrate that a high-quality seller gains by setting high prices.[6] Other contributions address the issue of price signaling in duopoly. Hertzendorf and Overgaard (2001) and Fluet and Garella (2002) consider two vertically differentiated firms and show that separation generally requires upward price distortion or positive advertising (or both). Our analysis contributes to this literature by considering how the signaling problem is affected by the fact that certain specific product attributes may capture consumers' attention. We show that combining salient thinking and price signaling can explain pricing behavior that seems to run counter to the idea that price signals quality.

Our work relates to Bordalo *et al.* (2016), who propose a model of vertical differentiation in which firms compete for consumers' attention by the choice of both price and quality. These authors show that, depending on the cost of producing the high-quality product, some markets will exhibit price-salient equilibria in which consumers are more attentive to price than quality, and others will have quality-salient equilibria where the opposite occurs. We depart from them in positing incomplete information

[4]Specifically, when consumers decide, say, whether to watch a new art-house film or a blockbuster Hollywood movie, their uncertainty is more over the match value than the quality of the product itself.

[5]A different assumption is made by Yu *et al.* (2016), who posit that the firm is not informed of its product's quality and discovers it gradually through consumer reviews. Following this assumption, the initial price is not a signaling tool but a way of controlling the stream of information over time. Notice that if firms knew their quality, this model would reduce to the standard price-signaling set-up: in a separating equilibrium, consumers infer the true quality perfectly from the launch price and reviews become totally irrelevant.

[6]In a setting with a single seller and a single buyer with inelastic demand, Ellingsen (1997) and Adriani and Deidda (2009) highlight a possible detrimental effect of signaling on the market outcome, namely the impossibility of trading the high-quality product. In a multiple-seller context, Adriani and Deidda (2011) show that high-quality sellers may be driven out of the market as competition intensifies.

with heterogeneous consumers who differ in their appreciation of quality.

Salience theory affords new insights when applied to consumers' choices.[7] Herweg *et al.* (2017) show that, in the presence of salient thinking, a brand manufacturer may also produce a decoy good to boost the demand for its main product. Helfrich and Herweg (2020) point out how salience provides a rationale for the existence of vertical restraints in e-commerce, i.e. for brand manufacturers prohibiting retailers from distributing their high-quality products. Inderst and Obradovits (forthcoming) highlight how salient thinking may intensify the negative impact on welfare of firms' "shrouding" of charges. In particular, excessive competition over headline prices drives consumer choices towards basic-quality products, resulting in an inefficient reduction in quality. Inderst and Obradovits (2020) study the implications of salience on the emergence of loss-leading strategies, finding the tendency to a race-to-the-bottom in product quality. Apffelstaedt and Mechtenberg (2021) study the optimal design of product lines by retailers, demonstrating the emergence of equilibria in which they use loss leaders and decoy products. Dertwinkel-Kalt and Köster (2017) show that salience is more important than loss aversion in explaining the newsvendor problem. The present study adds to these contributions by analyzing how salience alters firms' pricing decisions when quality is private information.

Article structure. The remainder of this paper is organized as follows. Section 2 presents our model. Section 3 analyzes the single-seller setting and Section 4 the duopoly setting. Section 5 concludes.

2 The model

Consider a consumer deciding whether or not to buy a product of unknown quality and having a belief $\mu(q)$ that the product is of quality $q \in \{q_B, q_H\}$. We refer to q_B as the "basic" quality and to q_H as the "high" quality, with $q_H > q_B > 0$. In our model, q_B is the minimum quality standard available in the market. The consumer is characterized by a taste parameter θ measuring the valuation of the expected quality differential between the high-quality and the basic variants of the product. We assume that θ is uniformly distributed in the interval $[0, 1]$. A similar formulation for consumer preferences was adopted by Bagwell and Riordan (1991) and Fluet and Garella (2002), who developed price-signaling models in

[7]The focusing theory developed by Kőszegi and Szeidl (2013), and, more recently, the relative-thinking approach proposed by Bushong *et al.* (2021) are both close to salience. Landry and Webb (2021) and Somerville (2022) provide thorough discussions on the predictions of various context-dependent models. Canidio and Karle (2022) present an interesting application, showing that an inefficient breakdown of negotiations is possible owing to a focusing effect.

which all consumers have the same reservation price for the low-quality product but differ in willingness to pay for high quality.

Without salience distortion, the consumer is rational (superscript R) and the utility from buying a given product of unknown quality is $U^R = q_B + \theta\left[\mathbb{E}(q|\mu) - q_B\right] - p$, where p denotes the price and $\mathbb{E}(q|\mu)$ is the expectation of quality conditional on the consumer's belief. Salience distorts consumer valuation by attaching a lower weight, $\delta \in (0, 1]$, to the less salient attribute. The utility of a salient-thinking consumer (superscript S) is therefore given by:

$$U^S = \begin{cases} \delta q_B + \delta\theta\left[\mathbb{E}(q|\mu) - q_B\right] - p & \text{if price is salient,} \\ q_B + \theta\left[\mathbb{E}(q|\mu) - q_B\right] - \delta p & \text{if quality is salient,} \\ q_B + \theta\left[\mathbb{E}(q|\mu) - q_B\right] - p & \text{if equally salient.} \end{cases} \tag{1}$$

Before making a purchase, consumers observe price p and update their beliefs accordingly. As in Bordalo *et al.* (2016), the salience of a given attribute is determined by a function $\sigma(x, y)$, which is assumed to be symmetric and continuous and to satisfy two properties, namely ordering and homogeneity of degree zero. According to ordering, whenever the interval $[x, y]$ is contained within a larger interval $[x', y']$, then $\sigma(x', y') > \sigma(x, y)$. According to homogeneity of degree zero, for any $\epsilon > 0$, $\sigma(x, y) = \sigma(\epsilon x, \epsilon y)$, with $\sigma(0, 0) = 0$. An attribute a (price or quality) becomes salient in a given choice set whenever it "stands out" relative to the other attribute. Below, we use the salience function $\sigma(a, \bar{a}) = |a - \bar{a}|/\bar{a}$, where $\bar{a}$ denotes the average value of the attribute in the choice set.

In our benchmark model, there is one seller, producing a high-quality product with probability h and a basic-quality product with probability $1 - h$. Consistently, the prior beliefs of the consumer are $\mu(q_H) = h$ and $\mu(q_B) = 1 - h$. It follows that expected quality, based on prior beliefs, is given by $\mathbb{E}(q|h) = hq_H + (1 - h)q_B$. The consumer cannot observe quality before purchase. Based on observation of the price, beliefs about the seller's type are updated. The basic quality serves as a reference for consumers, so that the average value of quality is $\bar{q} = \left[\mathbb{E}(q|\mu) + q_B\right]/2$. The basic quality is produced by a fringe of competitive firms with marginal cost $c < q_B$. We assume that the seller is able to offer the high-quality product at the marginal cost c and that it is more efficient than the competitive fringe when offering the basic quality; formally, $c(q_H) = c > c_B = c(q_B)$. The basic quality offered by the competitive fringe can be interpreted as the standard version of a new, upgraded product introduced by the seller. Following this interpretation, consumers are uncertain about the extent of the quality upgrade delivered by the new product and, depending on the taste parameter θ, differ in willingness to pay for this upgrade.

Since the competitive fringe sets prices at marginal cost, the basic-quality product is sold at $p_B = c$. Accordingly, when the seller sets price p, the average price is $\bar{p} = (p + p_B)/2$. The two properties of the salience function imply that quality is salient if $\mathbb{E}(q|\mu)/q_B > p/p_B$ and price when the inequality runs in the other direction. After observing a price p, the consumer $j \in \{S, R\}$ forms posterior beliefs $\mu^j(q|p)$, which represent the probability that the consumer, either rational (R) or salient-thinker (S), will assign to the seller's product being of high quality. Accordingly, the consumer buys the product with probability $D^j(p, \mu^j) = Prob(U^j \geq q_B - p_B)$, which is the demand faced by the seller. The profit of a seller offering quality $q \in \{q_B, q_H\}$ to a type-j consumer is given by:

$$\pi(q, p, \mu^j) = [p - c(q)] \times D^j(p, \mu^j). \tag{2}$$

We then define the equilibrium concept as follows:

Definition 1. *Price p and posterior beliefs μ^j form a Perfect Bayesian Equilibrium (PBE) if and only if:*

(i) Given μ^j and p, the consumer maximizes utility deciding upon purchase, with associated demand $D^j(p, \mu^j)$;

(ii) $p \in \arg\max_p \pi(q, p, \mu^j)$;

(iii) Bayes' rule determines posterior beliefs μ^j whenever possible;

(iv) when $j = S$, the salience function determines which attribute is salient at equilibrium.

In a PBE, given the beliefs that consumers form after observing market prices and their consequent purchasing behavior, the price required to maximize profits is p. These posterior beliefs follow Bayes' rule whenever it applies and determine the demand. Finally, if the seller faces a salient-thinking consumer, the salience function determines which attribute stands out at equilibrium. In the next section we analyze the model by focusing on separating equilibria.[8]

[8]For the characterization of pooling equilibria see Appendix B.

3 Analysis

In this section, we analyze the model. To determine how salient thinking affects the emergence of separating outcomes, we first examine the case of the rational consumer, then that of a salient-thinking consumer.

3.1 Signaling quality to a rational consumer

In a separating equilibrium, the two seller types play different strategies, namely $p(q_H) = p_H \neq p_B = p(q_B)$. Bayes' rule gives $\mu^R(q_H|p_H) = \mu^R(q_B|p_B) = 1$, so the expected seller quality is the true one, namely q. A basic-quality seller solves the following problem:

$$\max_{p'} \begin{cases} p' - c_B & \text{if } p' \leq p_B \\ 0 & \text{otherwise.} \end{cases} \tag{3}$$

It follows that the optimal price set by a low type is p_B. Since $p_B = c < q_B$, the low type serves the entire market, earning profit of $p_B - c_B$.

For separation to be incentive-compatible, two conditions must hold. The first is that for the low type it is not profitable to mimic the strategy of the high type. That is:

$$\pi(q_B, p_B, 0) = p_B - c_B \geq \pi(q_B, p_H, 1). \tag{IC-B}$$

The low type's profit from mimicking would be equal to:

$$\pi(q_B, p_H, 1) = (p_H - c_B) D^R(p_H, 1).$$

Defining $\Delta \equiv q_H - q_B$ as the quality differential, the rational consumer's demand amounts to $D^R(p_H, 1) = 1 - \frac{p_H - p_B}{\Delta}$. It follows that condition (IC-B) holds provided that $p_H \geq c_B + \Delta$. In order to make the (IC-B) binding and the informational problem relevant, we assume that $\Delta > 2(c - c_B) \equiv 2(p_B - c_B)$, which guarantees that the high type cannot prevent mimicking by choosing the profit-maximizing price. Thus for separation, an upward price distortion is required. The second condition requires that the high type never mimics the low type. That is:

$$\pi(q_H, p_H, 1) = (p_H - c) D^R(p_H, 1) \geq \pi(q_H, p_B, 0) = 0, \tag{IC-H}$$

which is satisfied when $p_H \in [c, p_B + \Delta]$. In a separating equilibrium, price p_H should satisfy the incentive compatibility constraints of both the low type (IC-B) and the high type (IC-H). Note that these two conditions together define a region to which p_H should belong without requiring any specific assumption about out-of-equilibrium beliefs. We can therefore conclude the following:

Lemma 1. *If the consumer is rational, a separating equilibrium requires that the price p_H lie in the interval $[c_B + \Delta, p_B + \Delta]$.*

The message implicit in Lemma 1 is that in all cases in which a high-quality seller can make positive profits, it is always possible to find a price p_H that discloses high quality to a rational consumer. This price should be high enough to prevent mimicking by the low type but low enough to allow positive demand for the seller's product.

In order to restrict the set of equilibria, we focus on out-of-equilibrium beliefs that satisfy the Intuitive Criterion (Cho and Kreps, 1987). In our set-up, accordingly, we restrict attention to equilibrium prices that resist all possible deviations that are profitable for the high type but not for the low type. Since the seller's profit function exhibits the single-crossing property, it is evident that no pooling equilibria survive the Intuitive Criterion and that the least costly separating equilibrium is therefore unique.[9]

To select a unique equilibrium price, the (IC-B) can be used to show that a deviation to a price $p \geq c_B + \Delta$ is unprofitable for the low type. Further, in the price interval of Lemma 1, the high type has an incentive to deviate only downward, in that the separating equilibrium profits are strictly decreasing in p_H given that $\Delta > 2(p_B - c_B)$. Thus, we have the following:

Lemma 2. *The unique PBE surviving the Intuitive Criterion is separating and requires a price $p_H = c_B + \Delta$.*

3.2 Signaling quality to a salient-thinking consumer

As in the case of the rational consumer, a separating equilibrium requires $\mu^S(q_H|p_H) = \mu^S(q_B|p_B) = 1$. The optimal price set by a low type is again equal to p_B, and both conditions in (IC-B) and (IC-H) have to be satisfied. In order to determine the demand of a salient thinker, $D^S(p_H, 1)$, we define $\widetilde{p}_H \equiv p_B \times q_H/q_B$ as the price of the high type when price and quality are equally salient. A consumer with a taste parameter $\theta \geq \phi\left(\frac{p_H - p_B}{\Delta}\right)$ would buy the product at price p_H, with ϕ taking different values

[9]See Cho and Sobel (1990) for a thorough discussion of signaling games that satisfy the single-crossing property.

depending on which attribute is salient, namely:

$$\phi \equiv \begin{cases} 1 \text{ if } \text{ if } p_H = \tilde{p}_H & \text{(equally salient),} \\ \delta \text{ if } p_H < \tilde{p}_H & \text{(quality is salient),} \\ 1/\delta \text{ if } p_H > \tilde{p}_H & \text{(price is salient).} \end{cases}$$

Hence, condition (IC-B) holds only if $p_H \geq c_B + \Delta/\phi$, whereas (IC-H) is satisfied by any $p_H \in [c, p_B + \Delta/\phi]$.

We have not yet specified which attribute is salient in equilibrium. To restrict the set of prices that sustain a separating equilibrium, let us consider the extreme cases. When price is salient, $\phi = 1/\delta$ and the minimum price satisfying (IC-B) takes its smallest possible value, i.e. $c_B + \delta\Delta$. No price lower than $c_B + \delta\Delta$ can ever be compatible with a separating outcome. Similarly, when quality is salient, $\phi = \delta$ and any price higher than $p_B + \Delta/\delta$ fails to satisfy (IC-H) and precludes positive demand for the seller's product. The following lemma gives the necessary conditions for the existence of a separating equilibrium.

Lemma 3. *In a separating equilibrium, the price p_H should be:*

(i) equal to $\tilde{p}_H$ with $\tilde{p}_H \geq c_B + \Delta$ when both attributes are equally salient;

(ii) in the interval $[c_B + \Delta/\delta, p_B + \Delta/\delta]$ when quality is the salient attribute;

(iii) in the interval $[c_B + \delta\Delta, p_B + \delta\Delta]$ when price is the salient attribute.

Lemma 3 defines the set of admissible prices sustaining a separating outcome. Notice that a separating equilibrium at price $\tilde{p}_H$ (point *(i)*) can exist only when $\tilde{p}_H \geq c_B + \Delta$, which is needed to prevent mimicking by the low type. As is discussed more extensively in Appendix A.1, in situations where only one attribute becomes salient, two different cases can arise, depending on whether the price satisfying (IC-B) under quality salience, $c_B + \Delta/\delta$, is lower or higher than that satisfying (IC-H) under price salience, $p_B + \delta\Delta$.[10] Interestingly, when $\tilde{p}_H \in (p_B + \delta\Delta, c_B + \Delta/\delta)$, no separating outcome with one attribute becoming salient is possible. This is more likely to occur when the salience bias increases ($\delta \downarrow$), which suggests that the only way for a high type to separate is to set the cutoff price $\tilde{p}_H$ that makes the

[10]In Appendix A.1, we provide a graphical representation as well as a detailed explanation of all the possible sub-cases, depending on the positioning of $\tilde{p}_H$, which determines whether price or quality is salient at equilibrium.

two attributes equally salient. Lemma 4 presents the necessary conditions for the three possible types of separating equilibrium and also reports the parameter region in which separation cannot occur.

Lemma 4. *A separating equilibrium:*

(i) in which the two attributes are equally salient can be sustained if $q_H \leq \frac{q_B(q_B-c_B)}{q_B-p_B}$. *The seller charges* $\tilde{p}_H$*;*

(ii) in which quality is salient can be sustained if $q_H < \frac{q_B(q_B-\delta c_B)}{q_B-\delta p_B}$. *The seller charges price* $p_H \in [c_B + \Delta/\delta, \tilde{p}_H)$*;*

(iii) in which price is salient can be sustained if $\delta \in (p_B/q_B, 1)$. *If* $q_H < \frac{q_B(\delta q_B-c_B)}{\delta q_B-p_B}$*, the seller charges price* $p_H \in (\tilde{p}_H, p_B + \delta\Delta]$*, while, if* $q_H > \frac{q_B(\delta q_B-c_B)}{\delta q_B-p_B}$*, it charges* $p_H \in [c_B + \delta\Delta, p_B + \delta\Delta]$*;*

(iv) cannot emerge when $\delta < p_B/q_B$ *and* $q_H > \frac{q_B(q_B-c_B)}{q_B-p_B}$.

Proof. See Appendix A.2 for full details. ■

Lemma 4 summarizes the set of prices that can support a separating outcome. It can be conjectured that not all these prices are optimal for a high type, who would prefer to make quality salient, or at least preclude price salience. Applying the Intuitive Criterion, we restrict the set of separating prices that support this conjecture. The following proposition shows that the least costly separating equilibrium is a unique outcome.

Proposition 1. *The unique equilibrium surviving the Intuitive Criterion is separating and requires a price:*

(i) $p_H = \tilde{p}_H$ *if* $q_H \in \left(\frac{q_B(q_B-\delta c_B)}{q_B-\delta p_B}, \frac{q_B(q_B-c_B)}{q_B-p_B}\right]$ *(the attributes are equally salient);*

(ii) $p_H = c_B + \Delta/\delta$ *if* $q_H < \frac{q_B(q_B-\delta c_B)}{q_B-\delta p_B}$ *(quality is salient);*

(iii) $p_H = \max\{c_B + \delta\Delta, p_B + \delta\Delta/2\}$ *if* $\delta > \bar{\delta} \equiv \frac{p_B q_H - c_B q_B}{q_B \Delta}$ *(price is salient).*

Proof. See Appendix A.3 for full details. ■

Fig. 1 provides a graphical representation of the above equilibria in the space (δ, q_H). There are three main areas (see the legend). The horizontal line corresponding to $\delta = 1$ depicts the case of a rational consumer: separation is always the least costly outcome for the high type as shown in Lemma 2. Proposition 1 implies a similar interpretation: the high type sets the lowest price that precludes mimicking. The main difference in the salient-thinking scenario is that where possible the high type

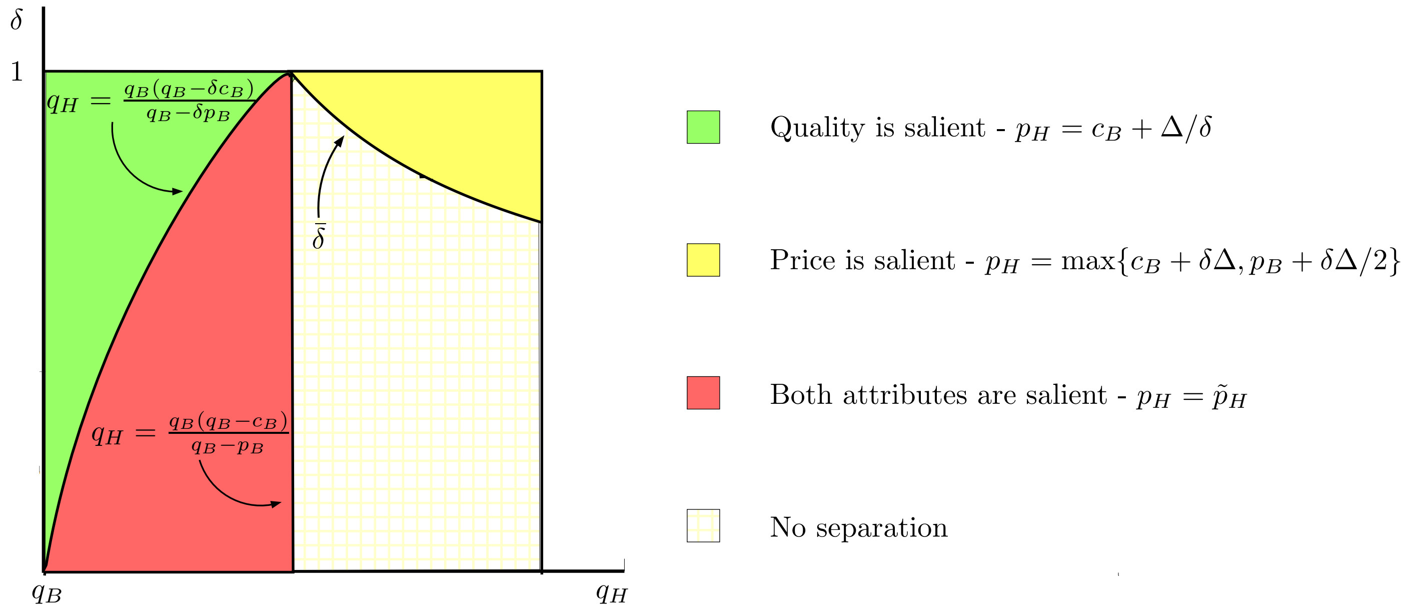

Fig. 1. Equilibria for any q_H and δ.

seeks to keep price from becoming salient. This can be done when the quality differential is not too great, given that the least costly separating price with quality salience lies below $\tilde{p}_H$ (see the green area in Fig. 1). However, this outcome is not always attainable, in that under quality salience mimicking is more attractive for the low type: when the quality differential is more pronounced, the incentive to mimic becomes too strong. In these cases, separation can be attained with both attributes salient (the red area) if the quality differential is intermediate or with price salient (the yellow area) when it is substantial. Note that in the latter case when the salience bias is sufficiently strong ($\delta < \bar{\delta}$) no separating outcome can arise, as the least costly separating price is not high enough to be perceived as salient. Many of the equilibria under price salience do not survive the Intuitive Criterion because the high type has an incentive to deviate downwards. As a result, if the salience bias is severe, the high type prefers not to separate (the light yellow square area).

Salience and the signaling role of prices. Our findings suggest that some kinds of pricing behavior for experience goods can be explained by a combination of price signaling and salient thinking.[11] In particular, there are cases in which sellers prefer to underprice their new products in spite of their high

[11]Under focusing (Kőszegi and Szeidl, 2013), the attribute that becomes salient is the one that varies the most in the choice set. In our setting, this would produce a situation in which the focusing weights do not affect the signaling problem with respect to the rational-consumer setting. Differently, relative thinking (Bushong *et al.*, 2021) posits that the attribute that becomes salient is the one that varies the least. In our setting this would imply that a price increase makes quality more likely to be salient, undermining the main trade-off that is the basis for our paper.

quality. In our model, when price becomes salient, the least costly separating equilibrium is attained with a price that is deflated by salience. This downward pressure moves in the opposite direction from the upward price distortion that separation would require. As a result, even a price that is not particularly high may signal high quality. But when the salience bias is great enough, we have the limiting case in which the high type prefers not to separate. These findings may explain the low launch price of a product of superior quality such as the Canon VIXIA M500 mini camcorder (see Introduction).[12] Intuitively, a large quality differential would require a substantial price distortion to separate, and clients become extremely price sensitive if they observe a notably high price. Therefore, pricing not far from the average may limit the demand sacrifice for a high-quality seller in solving the informational problem.

Interestingly, if quality becomes the salient attribute, salient thinking inflates the price more than would be needed for separation. This pattern is consistent with products presumed to be of higher-than-average quality introduced at excessively high prices. For instance, Yu *et al.* (2016) report the case of the Canon EOS Rebel T3 camera, launched at \$630 and discounted to just \$380 after poor consumer ratings. In this case, the launch price seems to have been too high to be ascribed purely to signaling motives. Our explanation is that the quality of this product was not actually that much higher than that of comparable products already on the market.[13] In our model, in such a context, a seller can attain separation by making quality the salient attribute.

A diagrammatic explanation of Proposition 1. The intuition underlying Proposition 1 can be better grasped by examining the isoprofit curves. To this end, we express the seller's isoprofit curve as $\{p, \bar{\mu}\}$, so that $\pi(q, p, \bar{\mu}) = [p - c(q)] \times \left[1 - \phi\left(\frac{p-p_B}{\bar{\mu}\Delta}\right)\right] \equiv \bar{\pi}$. The slope of the isoprofit curve is given by:

$$\bar{\mu}_p = -\frac{\pi_p}{\pi_\mu} = -\frac{\mu[\phi(c(q) - 2p + p_B) + \Delta\mu]}{\phi[p - c(q)](p - p_B)},$$

where all terms are partial derivatives with the subscript denoting the variable of derivation.

Holding one of the two attributes salient, the isoprofit curve of the low type ($c(q) = c_B$) crosses that of the high type ($c(q) = c$) from below, so that the single-crossing property obtains. In addition, the slopes change depending on which attribute is salient. In particular, it is easy to show that the curves are steeper when price is salient ($\phi = 1/\delta$). This occurs because the demand is more reactive than when

[12]Consumer appreciation, as documented by reviews, bore on features that are commonly identified as "high quality" in these markets, such as top-notch lenses, ergonomic design, image stabilizers, and the possibility of recording while the flip out viewing panel is closed.

[13]This camera was replaced by a new version (EOS Rebel T5), launched at \$550.

quality is salient ($\phi = \delta$). Moreover, when price is salient, the slope increases as δ decreases. Fig. 2 shows the isoprofit curves for the two types and the locus $\tilde{p} \equiv p_B \frac{\mu q_H + (1-\mu) q_B}{q_B}$. Above the line $\tilde{p}$, quality is the salient attribute given μ and p. Below it, price is salient.

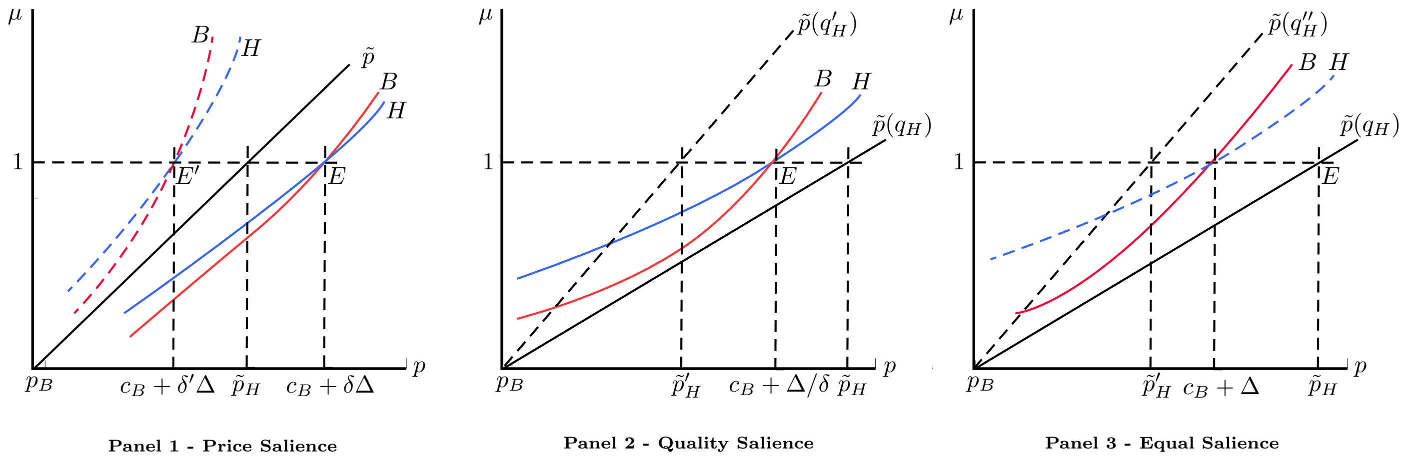

Fig. 2. Isoprofit curves in the three scenarios.

We identify three different scenarios. Panel 1 depicts how a variation in the salience bias affects the emergence of a separating outcome with price salience ($\mu = 1$). Point E designates the least costly separating equilibrium with price as the salient attribute. Given that the isoprofit curves cross below $\tilde{p}$, price is salient at the equilibrium. If the salience bias increases ($\delta' < \delta$), the curves become steeper and the intersection is at E', which is above the line $\tilde{p}$, meaning that price is not salient. Hence, when the salience bias is sufficiently strong, separation cannot occur with price salience.

Panel 2 shows that it is the level of quality which determines whether or not a separating outcome with quality salience is attainable. The isoprofit curves are now flatter than in Panel 1. Separation can occur only when the intersection E is above $\tilde{p}$. Raising quality to $q'_H > q_H$ makes the locus $\tilde{p}$ steeper, thereby making separation impossible. Finally, Panel 3 describes a situation in which making both attributes salient allows separation ($p_H = \tilde{p}_H$). In this case, the isoprofit curves of the two types with $\phi = 1$ intersect at the price $c_B + \Delta$, which is lower than $\tilde{p}_H$ so that mimicking is prevented. Again, raising quality to $q''_H > q_H$ would make this separating outcome unattainable.

4 Duopoly

The single-seller case is useful to highlight the trade-off for a high-quality seller with an uninformed consumer. However, basic-quality producers are often strategic players. Accordingly, let us consider an environment with two firms $i \in \{1, 2\}$ that compete in price. The consumer believes the sellers have an equal probability of offering the high quality, i.e. $\mu_i(q_H) = h$ and $\mu_i(q_B) = 1 - h$. The possible states of the world can thus be represented by the ordered pairs (H, H), (B, B), (H, B) and (B, H), where the type 1 seller is the first element in each pair. Nature chooses a state of the world. Firms observe this choice but the consumer does not. Given the prices observed, the consumer updates beliefs and makes purchasing decisions. To simplify the analysis, we assume that the sellers' marginal cost of production is equal, and so can be set to zero. We focus on the salient-thinking scenario, while also providing the results for the rational consumer at the end of the section.

4.1 Analysis

In a separating equilibrium, each state of nature has a specific equilibrium price pair, denoted as $(\hat{p}_B, \hat{p}_B)$ for state (B, B), (p_H, p_B) for state (H, B), (p_B, p_H) for state (B, H) and, finally, $(\hat{p}_H, \hat{p}_H)$ for state (H, H). These states are fully disclosed before purchase, so that posterior beliefs about the quality of each seller are either 0 or 1. In order to support the largest possible set of separating equilibria, we assume that beliefs are most pessimistic for a deviating firm. In other words, the observation of $\hat{p}_B$ and a generic p is interpreted as the state of nature (B, B).

Moreover, the consumer believes the seller that charges p_H is type H if and only if its rival charges a price $p \notin \{\hat{p}_B, \hat{p}_H, p_H\}$; for any other price pair, both sellers are believed to be type B. Likewise, price $\hat{p}_H$ signals the high quality if and only if the rival sets a price $p \notin \{\hat{p}_B, p_B, p_H\}$; the observation of $(\hat{p}_H, \hat{p}_H)$ engenders the belief that the state is (H, H), while for any other price pair, the consumer believes it is (B, B).

Finally, if consumers observe p_B and a generic $p \neq p_H$, they believe the state of nature is (B, B). As we will see, this specification of beliefs prevents mimicking by the basic-quality seller in the asymmetric states (H, B) and (B, H) but is completely innocuous in qualitative terms. Below, we show how these beliefs support separation and restrict the set of equilibria, considering all the possible deviations from the prescribed equilibrium strategies in each state.

State (B, B). Both sellers offer the basic quality at prices $(\hat{p}_B, \hat{p}_B) = (0, 0)$; given our specification of out-of-equilibrium beliefs, no deviation is profitable.

Asymmetric states. In the asymmetric states (H, B) and (B, H), a basic-quality seller facing competition from a high-quality rival chooses price p_B in order to maximize $\pi(q_B, p_B, 0) = p_B \frac{\phi(p_H - p_B)}{\Delta}$, where p_H is the rival's price. The parameter ϕ again takes different values depending on which attribute is salient. The best reply of a basic-quality seller is always given by $p_B(p_H) = p_H/2$, no matter which attribute is salient. Therefore, a separating equilibrium with price salience requires that $q_H/q_B < 2$, whereas with quality salience it requires that $q_H/q_B > 2$. Note that since $p_B \leq q_B$, $p_B = \min[p_H/2, q_B]$.

Let us consider a separating equilibrium in which price is salient ($\phi = 1/\delta$) and a high type sets p_H. A seller of type B would charge $p_H/2$, earning the following profit:

$$\pi(q_B, p_H/2, 0) = \frac{p_H^2}{4\delta\Delta},$$

whereas the high-quality seller would get:

$$\pi(q_H, p_H, 1) = p_H \cdot \max\left[1 - \frac{p_H}{2\delta\Delta}, 0\right]. \tag{4}$$

In any separating equilibrium, a basic-quality seller should have no incentive to deviate from price p_B to price p_H. In particular, if a seller of type B mimics firm H, the consumer will assign the same probability $\mu(q_H|\mathbf{p})$ of selling the high quality to both firms and obtain the same expected utility by purchasing from either. A consumer with appreciation for quality θ compares the expected utility of purchasing with the alternative of not purchasing at all. Therefore, if $\theta \geq \theta_\mu \equiv \frac{p_H - q_B}{\mu(q_H|\mathbf{p})\Delta}$, the consumer buys one of the two products at random. The total market demand is:

$$D_\mu(p_H) = \begin{cases} 1 & \text{if } p_H \leq q_B, \\ \max[0, 1 - \theta_\mu] & \text{if } p_H > q_B. \end{cases}$$

The profit of a seller of type B from mimicking is thus $(p_H/2)D_\mu(p_H)$. Given our specification of out-of-equilibrium beliefs, $\mu(q_H|\mathbf{p}) = 0$, since the observation of (p_H, p_H) engenders the belief that the state is (B, B). Therefore, the total market demand is either 1 – when $p_H \leq q_B$ – or 0, when $p_H > q_B$. However, in the first case, no separating equilibrium with a positive market share for the high-quality seller exists. To see this, note that consumers always purchase irrespective of their beliefs when $p_H \leq q_B$. Thus, the profits of the basic-quality seller from mimicking amount to $p_H/2$, and the no-mimicking condition for the low type becomes:

$$\frac{p_H^2}{4\delta\Delta} \geq \frac{p_H}{2},$$

which requires that $p_H \geq 2\delta\Delta$. Using Eq. (4), this in turn implies that the market share of the type H seller is 0. It then follows that the demand of the low type when mimicking the strategy of the high type is always 0, which makes price $p_H > q_B$ compatible with the incentives of the type B seller.

Separation also requires that a high-quality seller should not find it profitable to deviate from price p_H to price p_B. In the case of mimicking, the total demand is shared equally between the two firms and the consumer always purchases irrespective of beliefs because $p_B \leq q_B$. The high-quality seller's profit would be $p_H/4$. Therefore, the no-mimicking condition for the high type can be written:

$$p_H\left[1 - \frac{p_H}{2\delta\Delta}\right] \geq \frac{p_H}{4},$$

which is satisfied when $p_H \leq 3\delta\Delta/2$. Note that separation can occur when $3\delta\Delta/2 > q_B$, which requires that $q_H/q_B \in \left(\frac{2+3\delta}{3\delta}, 2\right) \wedge \delta > 2/3$.

Let us now consider a separating equilibrium in which quality is the salient attribute ($\phi = \delta$). A seller of type B would again charge the price $p_H/2$, realizing the following profit:

$$\pi(q_B, p_H/2, 0) = \frac{\delta p_H^2}{4\Delta}, \tag{5}$$

while a high-quality seller would get:

$$\pi(q_H, p_H, 1) = p_H \cdot \max\left[1 - \frac{\delta p_H}{2\Delta}, 0\right].$$

Following an approach analogous to the foregoing, separation with a positive market share for the high-quality seller requires $p_H > q_B$. Therefore, the no-mimicking condition of the basic-quality seller is always satisfied, while that of the high-quality seller becomes:

$$p_H\left[1 - \frac{\delta p_H}{2\Delta}\right] \geq \frac{p_H}{4},$$

which requires that $p_H \leq 3\Delta/(2\delta)$. Note that separation is always possible given that $3\Delta/(2\delta) > q_B$ when $q_H/q_B > 2$. These results indicate that when $q_H/q_B < \min\left\{\frac{(2+3\delta)}{3\delta}, 2\right\}$, separation cannot arise in the asymmetric states. Thus, we can state the following Lemma.

Lemma 5. *For* $q_H/q_B > \min\{\frac{(2+3\delta)}{3\delta}, 2\}$*, if there exists a separating equilibrium in the asymmetric states* (H, B) *and* (B, H)*, the low-quality seller will charge half the price of the high-quality seller.*

Let us now discuss the possible deviations by the two sellers. Full details are provided in Appendix A.4. We start by considering the deviations by the high-quality seller, which could undercut its rival by charging $p^{dev*} = p_B - \epsilon \approx p_H/2$ given $\epsilon > 0$ arbitrarily small. In this case, the consumer would believe that the state is (B, B), so a type H seller could corner the market, earning profit $p_H/2$. Thus, considering a candidate separating equilibrium with price salience, the no-deviation condition is written as:

$$p_H \left[1 - \frac{p_H}{2\delta\Delta}\right] \geq \frac{p_H}{2},$$

which is only satisfied in a parameter region that is incompatible with the fact that separation under price salience requires that $q_H/q_B < 2$. Therefore, such a deviation destabilizes any price-salient separating equilibrium. Conversely, undercutting by the high type does not destabilize separation when quality is salient.

We now verify whether a basic-quality seller has an incentive to deviate from a candidate separating equilibrium. In particular, a type B seller could deviate to a price that changes the salient attribute, from quality to price. Such a deviation, if profitable, destabilizes separation with quality salience. To determine whether this is the case, we consider a candidate separating equilibrium in which quality is the salient attribute ($q_H/q_B > 2$). A basic-quality seller could draw consumer attention to price by charging a price p^{dev} lower than $p_H/2$ such that $p_H/p^{dev} > q_H/q_B$. This deviation would not change the consumer's beliefs about the state of the world. Indeed, observing the price pair p_H and p^{dev}, the consumer will believe that the seller playing p_H is type H and the seller playing p^{dev} is type B. Formally, the basic-quality seller chooses price p^{dev} to maximize $\frac{p^{dev}(p_H - p^{dev})}{\delta\Delta}$ under the constraint $p^{dev} < p_H q_B/q_H$. The optimal price is $p^{dev*} = p_H q_B/q_H - \epsilon$ with $\epsilon > 0$ arbitrarily small and the maximum deviation profit amounts to $(p_H^2 q_B)/(q_H^2 \delta)$. In order for the basic-quality seller not to deviate, profit in (5) must be greater than the deviation profit, that is:

$$\frac{\delta p_H^2}{4\Delta} \geq \frac{p_H^2 q_B}{q_H^2 \delta},$$

which requires that $\delta \geq \check{\delta} \equiv 2\sqrt{\Delta q_B}/q_H$. This means that such a deviation destabilizes separation with quality salience when $\delta < \check{\delta}$. We summarize the foregoing results in the following Proposition.

Proposition 2. *Separating equilibria in the asymmetric states exist if and only if* $q_H/q_B > 2$ *and* $\delta \geq \check{\delta}$. *In such equilibria, quality is the salient attribute.*

The salience bias affects the region in which a separating outcome with quality salience is possible. In particular, our analysis shows that the basic-quality seller could have an incentive to deviate so as to produce a situation of price salience; the greater the salience bias (the lower δ), the more attractive this deviation is. According to Proposition 2, when $\delta < \check{\delta}$, this deviation destabilizes separation with quality salience. Notice that if the consumer were fully rational ($\delta = 1$), the condition for separation would simply become $q_H/q_B > 2$.

State (H, H). Both sellers offer the high quality at prices $(\hat{p}_H, \hat{p}_H)$ and share the market equally. As is shown in Appendix A.4, the state (H, H) can be disclosed when $q_H/q_B > \min\left\{\frac{(1+2\delta)}{2\delta}, 2\right\}$. This condition is less stringent than that required for separation in the asymmetric states. Thus, separating equilibria exist in all four states when the conditions of Proposition 2 are satisfied. In the rational-consumer setting, separation would simply require $q_H/q_B > 2$.

The intuition behind these results is similar to that of the single-seller setting. In particular, separation with price salience would come at the cost of sacrificing much demand. Compared to the single-seller case, the presence of a low-quality rival increases the demand loss and so induces an undercutting deviation by the high-quality seller in the asymmetric states. This prevents separation when $q_H/q_B < 2$. Differently, separation is possible when associated with quality salience. In the asymmetric states, however, when the salience bias is sufficiently great, the low-quality seller has a profitable deviation towards price-salient configurations, thus destabilizing many candidate separating equilibria.

5 Concluding remarks

Our paper investigates the signaling role of prices when consumers' purchasing decisions are distorted by salient thinking. We show that even prices that are not very high, when deflated by salience, may serve the purpose of signaling quality. When salient thinking is very strong, it leads high-quality producers to refrain from using the price as a signaling device and instead to pool with the basic-product price. This is due to the inability of firms to separate and at the same time divert consumer attention towards the quality attribute.

Our benchmark setting considers a seller competing against a fringe that supplies a basic-quality good. Consumers do not know which quality level is offered. Our analysis reveals that salience may make the signaling problem particularly complicated when the quality difference between the reference and the seller's product is relatively large. In this case, the quality difference together with the upward price distortion required for separation yields a price that is so high as to make this attribute salient. For this reason, the seller may refrain from setting a high price, even though this may reduce the chances of attaining separation. In a duopoly setting, separation cannot be attained with price as salient attribute, because the high-quality seller would always find a profitable deviation. Under quality salience, instead, it is deviation by the low-quality seller towards price-salient configurations that destabilizes many candidate separating equilibria.

We provide a behavioral explanation for certain price-setting decisions of sellers that operate in markets for experience goods. In particular, salient thinking may explain price compression, i.e. the existence of high-quality products priced just slightly above the average. Apart from the electronics products discussed before, other examples include high-end restaurants located in areas with plenty of cheap eateries and offering their menus at moderate prices. Conversely, there are cases in which price differences seem to be too great to ascribe strictly to signaling motives, as in the case of fast-moving generic and labeled/branded consumer goods in supermarkets. In the light of our model, in these instances the quality attribute comes to prevail over price in the eyes of a salient thinker.

Appendix A

Here we provide further details and proofs cited in the paper but unreported there for the sake of brevity.

A.1 Separating outcomes

Consider the cases in which only one attribute becomes salient. Fig. 3 shows that two cases can arise, depending on whether the price that satisfies (IC-B) under quality salience, $c_B + \Delta/\delta$, is lower (Case a) or higher (Case b) than the price that satisfies (IC-H) under price salience, $p_B + \delta\Delta$.

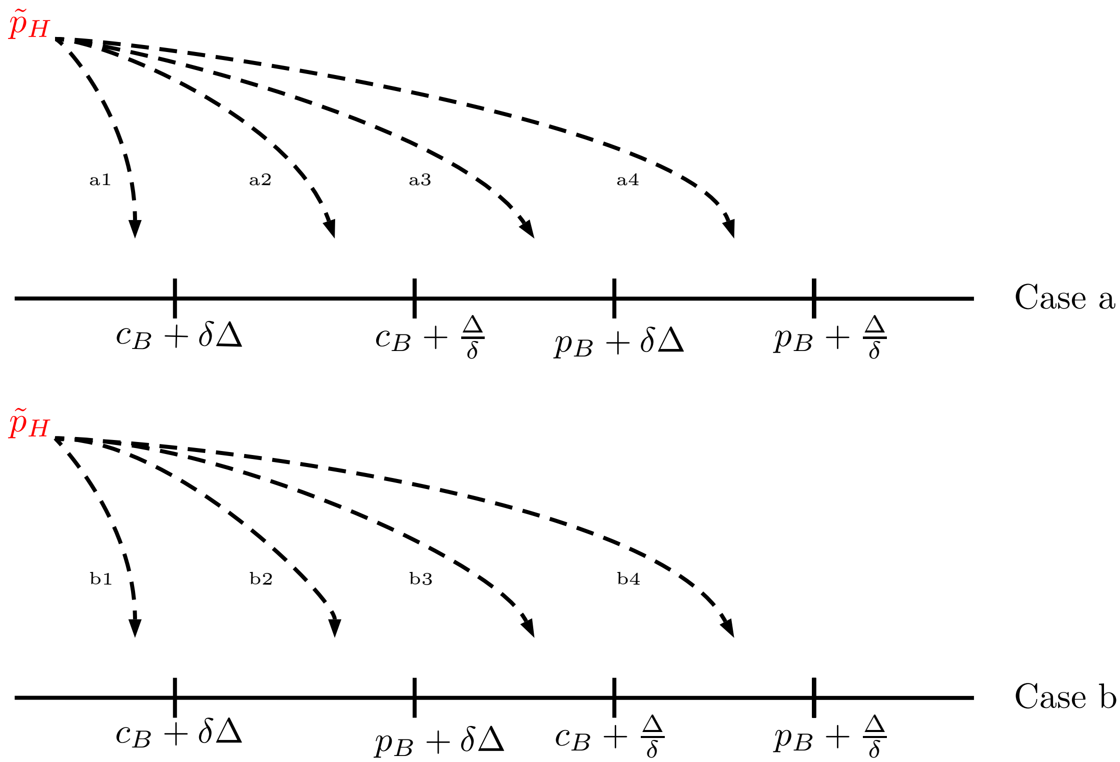

Fig. 3. Set of admissible prices sustaining a separating outcome.

For ease of exposition, we divide each case into four sub-cases, depending on the positioning of $\tilde{p}_H$, which determines whether price or quality is salient at equilibrium. Let us consider Case a (the top panel of Fig. 3). If $\tilde{p}_H < c_B + \delta\Delta$ (sub-case a1), we could obtain separation with price salience, and the price set by the high type should lie in the interval $[c_B + \delta\Delta, p_B + \delta\Delta]$. No separating equilibria with quality salience exist. If $\tilde{p}_H \in (c_B + \delta\Delta, c_B + \Delta/\delta)$ (sub-case a2), separating equilibria with price salience could be sustained by $p_H \in (\tilde{p}_H, p_B + \delta\Delta]$. Quality salience, again, would not arise. If $\tilde{p}_H \in (c_B + \Delta/\delta, p_B + \delta\Delta)$ (sub-case a3), in order to achieve a separating outcome, with quality salience the high type should set price $p_H \in [c_B + \Delta/\delta, \tilde{p}_H)$, and with price salience $p_H \in (\tilde{p}_H, p_B + \delta\Delta]$. Finally, if $\tilde{p}_H \in (p_B + \delta\Delta, p_B + \Delta/\delta)$ (sub-case a4), separation could be attained only with quality salience, and the admissible price interval would be $[c_B + \Delta/\delta, \tilde{p}_H)$. No other subcases are possible, as $\tilde{p}_H < p_B + \Delta/\delta$ given that $p_B = c < q_B$ by assumption.

The logic to apply to Case b is analogous (see the bottom panel of Fig. 3). Note, however, that a separating outcome with one of the two attributes becoming salient cannot be attained if $\tilde{p}_H \in (p_B + \delta\Delta, c_B + \Delta/\delta)$ (sub-case b3). This parametric region is very interesting; it permits thorough explanation of the role of salience in determining separation. As the salience bias influences both the lowest price that satisfies (IC-B) and the highest one that satisfies (IC-H), it helps determine the region in which separation cannot be sustained. Indeed, a separating equilibrium with price salience would require $p_H > \tilde{p}_H$. But such a price would violate the incentive-compatibility constraint of the high type. At the same time, a separating equilibrium with quality salience would need $p_H < \tilde{p}_H$, but this would not satisfy the incentive-compatibility constraint of the low type. The effect of an increase in the salience bias (decrease in δ) is to lower the highest price that satisfies (IC-H) for a separating equilibrium with price salience, $p_B + \delta\Delta$, and to raise the lowest price that satisfies (IC-B) for a separating equilibrium with quality salience, $c_B + \Delta/\delta$. Consequently, if the salience bias is sufficiently strong, separation with one of the two attributes being salient is unattainable. In this case, the only way for a high type to separate is to set the cutoff price $\tilde{p}_H$ that makes the two attributes equally salient.

A.2 Proof of Lemma 4

We now specify the conditions that guarantee the existence of separating equilibria:

(i) As $\tilde{p}_H < p_B + \Delta$, condition (IC-H) always holds. In order to sustain separation with the attributes equally salient, we need to satisfy (IC-B), which requires $\tilde{p}_H \geq c_B + \Delta$. This occurs when $q_H \leq \frac{q_B(q_B - c_B)}{q_B - p_B}$.

(ii) As above, condition (IC-H) is always satisfied, as $\tilde{p}_H < p_B + \Delta/\delta$. Therefore, to attain a separating outcome with quality salience, we need $\tilde{p}_H > c_B + \Delta/\delta$ (see sub-cases a3, a4 and b4 in Fig. 4). This occurs when $q_H < \frac{q_B(q_B - \delta c_B)}{q_B - \delta p_B}$. Therefore, in a quality-salient separating equilibrium, the seller charges $p_H \in [c_B + \Delta/\delta, \tilde{p}_H)$.

(iii) As Fig. 4 shows, a necessary condition for separation with price salience is that $\tilde{p}_H < p_B + \delta\Delta$. This requires that $\delta \in (p_B/q_B, 1)$. The seller charges a price $p_H \in [c_B + \delta\Delta, p_B + \delta\Delta]$ when $\tilde{p}_H < c_B + \delta\Delta$, which occurs when $q_H > \frac{q_B(\delta q_B - c_B)}{\delta q_B - p_B}$ (sub-cases a1 and b1). Instead, the price p_H is in interval $(\tilde{p}_H, p_B + \delta\Delta]$ when $\tilde{p}_H \in (c_B + \delta\Delta, p_B + \delta\Delta)$ (sub-cases a2, b2 and a3). This takes place when

$q_H < \frac{q_B(\delta q_B - c_B)}{\delta q_B - p_B}$ provided that $\delta > p_B/q_B$.

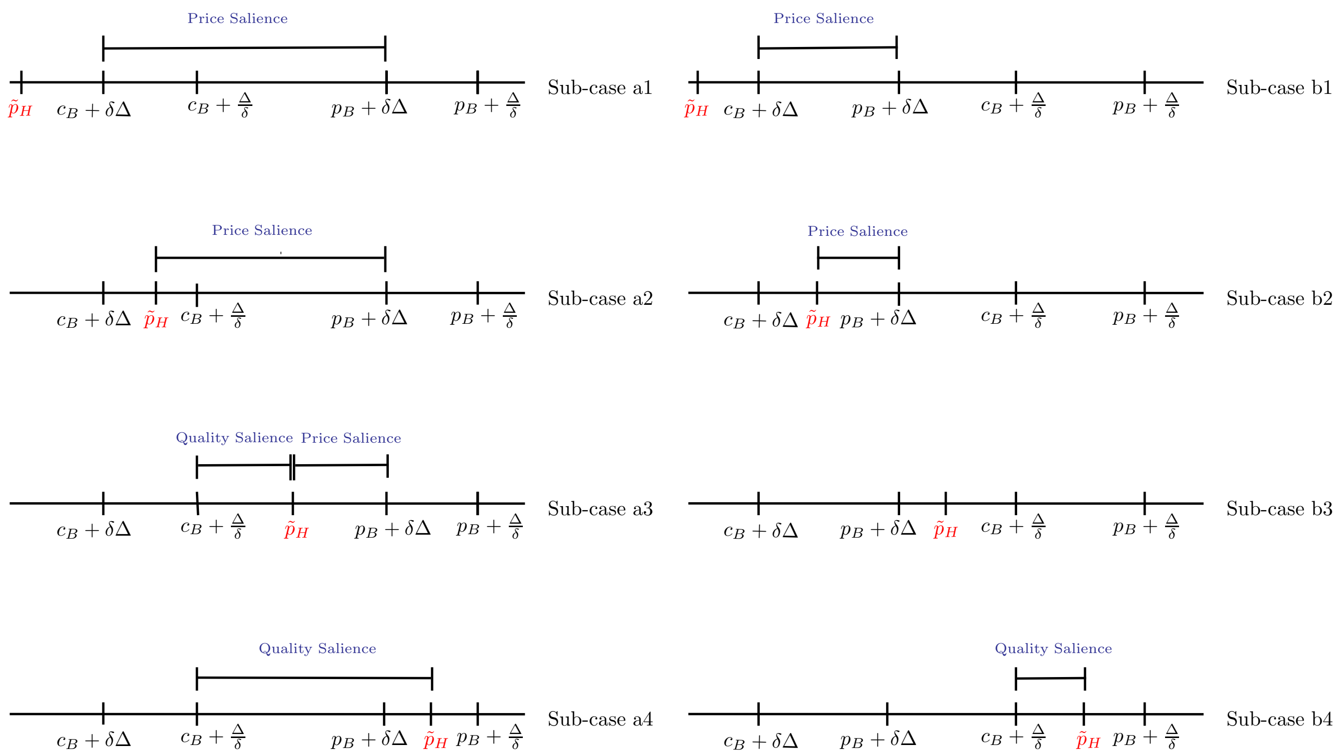

Fig. 4. Set of admissible prices sustaining a separating outcome. Case a on the left side, Case b on the right side.

We depict all the possible parametric regions in Fig. 5. Region VII is the area where separation is unattainable. Note that the area above the dashed line corresponds to the parameter regions of Case a, which occurs when $c_B + \Delta/\delta < p_B + \delta\Delta$.

A.3 Proof of Proposition 1

Let us start with point *(i)* of Lemma 4. The price $\tilde{p}_H$ survives the Intuitive Criterion only if $\tilde{p}_H < c_B + \Delta/\delta$ or $q_H > \frac{q_B(q_B - \delta c_B)}{q_B - \delta p_B}$. Indeed, when this is not the case, a deviation to $\tilde{p}_H - \epsilon$ with $\epsilon > 0$ can be profitable only for the high type, insofar as this deviation makes quality salient. When $\tilde{p}_H > c_B + \Delta/\delta$, the (IC-B) guarantees that such a deviation is unprofitable for the low type.

Consider now point *(ii)*. Given the assumption $\Delta > 2(p_B - c_B)$, the profit-maximizing price for the high type is certainly lower than $c_B + \Delta/\delta$. No equilibrium price above $c_B + \Delta/\delta$ survives the Intuitive Criterion, in that a downward deviation would be profitable only for the high type. Thus, deviating from $c_B + \Delta/\delta$ is either unprofitable (upward deviation) or profitable (downward deviation) for both types.

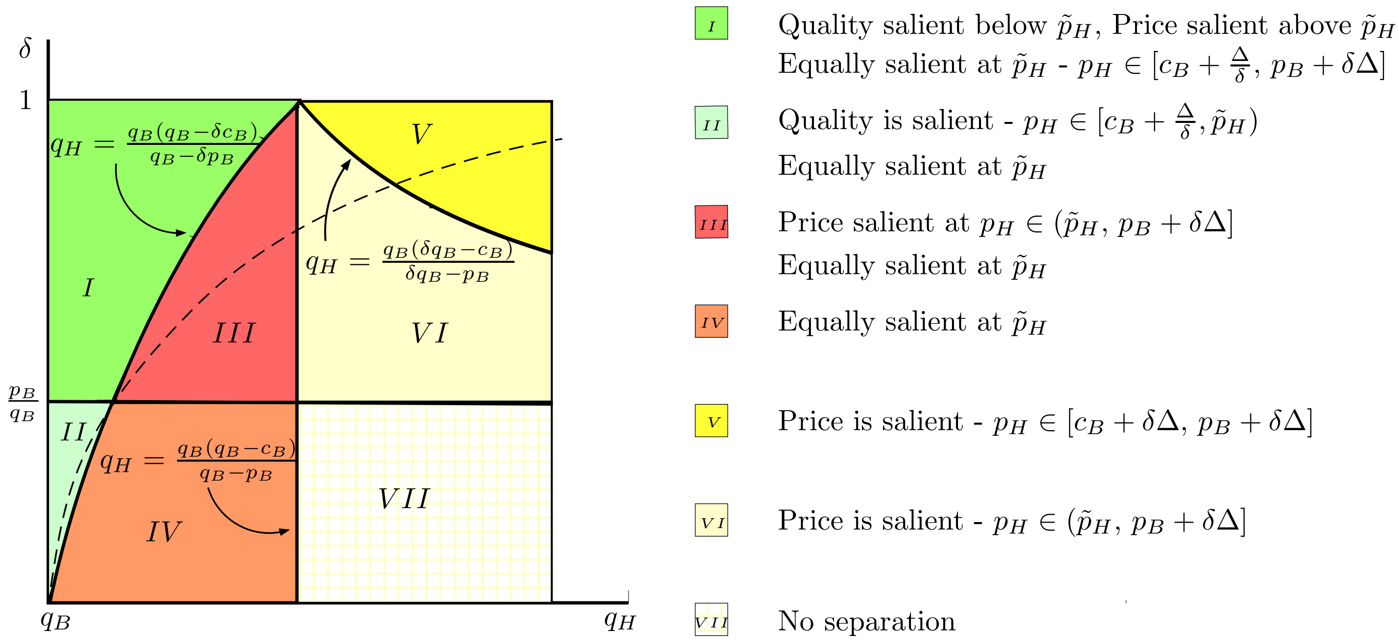

Fig. 5. Existence of separating equilibria.

Finally, consider point *(iii)*. If $\tilde{p}_H < c_B + \delta\Delta$ or $q_H > \frac{q_B(\delta q_B - c_B)}{\delta q_B - p_B}$ (or equivalently if $\delta > \bar{\delta}$), no price except $\max\{c_B + \delta\Delta, p_B + \delta\Delta/2\}$ survives the Intuitive Criterion. Indeed, if $c_B + \delta\Delta > \arg\max_{p_H}(p_H - c)\left(1 - \frac{p_H - p_B}{\delta\Delta}\right) \equiv p_B + \delta\Delta/2$, no price above $c_B + \delta\Delta$ can survive the Intuitive Criterion, as a downward deviation would be profitable only for the high type. By analogous reasoning, if $c_B + \delta\Delta < p_B + \delta\Delta/2$, an upward deviation to price $p_B + \delta\Delta/2$ is profitable only for the high type. Therefore, deviating from $\max\{c_B + \delta\Delta, p_B + \delta\Delta/2\}$ is either unprofitable or profitable for both types.

A.4 Deviation analysis

Let us examine the possible deviations by the two sellers in the asymmetric states (H, B) and (B, H) and in the state (H, H).

1. State (H, B) and (B, H): we assume, without loss of generality, that seller 1 is of type H so that the state is (H, B). Moreover, let $\hat{p}_H \neq p_H$ satisfy $\hat{p}_H > q_B$. Since $p_B \leq q_B$, it follows that $\hat{p}_H \neq p_B$. We need to verify whether a high-quality firm has an incentive to deviate from a candidate separating equilibrium. The incentive compatibility constraint of the high-quality seller ensures that there is no incentive to mimic the low type. Moreover, the type H seller does not find it profitable to deviate to either $\hat{p}_B$ or $\hat{p}_H$, as $(\hat{p}_B, p_B)$ and $(\hat{p}_H, p_B)$ induce the belief that the state is (B, B) with zero sales for the deviating firm. However, the high-quality seller could undercut the basic-quality seller, by charging $p^{dev*} = p_B - \epsilon \approx p_H/2$ given $\epsilon > 0$ arbitrarily small. This gives

the type H seller the entire market, in that the consumer would believe that the state is (B, B). The profit from deviation would be $p_H/2$. Then, considering a candidate separating equilibrium with price salience, the no-deviation condition is written as:

$$p_H \left[1 - \frac{p_H}{2\delta\Delta}\right] \geq \frac{p_H}{2},$$

which is satisfied when $p_H \leq \delta\Delta$. Since $p_H > q_B$ is needed to get separation, it follows that $\delta\Delta > q_B$ when $q_H/q_B > (1+\delta)/\delta > 2$. This inequality is incompatible with the fact that a separating equilibrium with price salience requires $q_H/q_B < 2$. Hence, such a deviation will destabilize any separating equilibrium in which price is the salient attribute. By contrast, undercutting by the high type does not destabilize separation when quality is salient. To ascertain this, consider a candidate separating equilibrium with quality salience. The no-deviation condition is written as:

$$p_H \left[1 - \frac{\delta p_H}{2\Delta}\right] \geq \frac{p_H}{2},$$

which requires that $p_H \leq \Delta/\delta$. Since $\Delta/\delta > q_B$ when $q_H/q_B > 2$, there exists a price interval, namely $p_H \in (q_B, \Delta/\delta)$, in which separation is attainable.

It remains to verify whether a basic-quality seller would have an incentive to deviate in the asymmetric states. Again, without loss of generality, assume that seller 1 is of type H. Since the incentive compatibility constraint of the basic-quality seller is always satisfied, mimicking by the low type never occurs. Furthermore, a type B seller does not find it profitable to deviate to either $\hat{p}_B$ or $\hat{p}_H$, as $(p_H, \hat{p}_B)$ and $(p_H, \hat{p}_H)$ engender the belief that the state is (B, B) with zero sales. However, the basic-quality seller can deviate to a price that changes the salient attribute from quality to price. Such a deviation, if it occurs, destabilizes separation with quality salience. To determine whether or not this is the case, consider a candidate separating equilibrium in which quality is the salient attribute ($q_H/q_B > 2$). If the basic-quality seller deviates to a situation of price salience by charging a price p^{dev} lower than $p_H/2$, consumers would still believe that the state is (H, B). Formally, the type B seller would maximize $\frac{p^{dev}(p_H - p^{dev})}{\delta\Delta}$ under the constraint $p^{dev} < p_H q_B/q_H$. The optimal price is $p^{dev*} = p_H q_B/q_H - \epsilon$ with $\epsilon > 0$ arbitrarily small, and the maximum profit from deviation would be equal to $(p_H^2 q_B)/(q_H^2 \delta)$. The basic-quality seller does not deviate when the profit in (5) is larger than the profit from deviation, namely:

$$\frac{\delta p_H^2}{4\Delta} \geq \frac{p_H^2 q_B}{q_H^2 \delta},$$

which requires that $\delta \geq \check{\delta} \equiv 2\sqrt{\Delta q_B}/q_H$. As a result, such a deviation destabilizes separation with quality salience when $\delta < \check{\delta}$.

2. State (H, H): both sellers offer the high quality at prices $(\hat{p}_H, \hat{p}_H)$. Equilibrium profits are:

$$\frac{\hat{p}_H}{2}\left(1 - \frac{\hat{p}_H - q_B}{\Delta}\right).$$

If a firm deviates to $\hat{p}_B$, p_B or p_H, both sellers are believed to produce a basic-quality good. It follows that these deviations are not profitable. If $p^{dev} \neq \{\hat{p}_B, p_B, p_H\}$, the deviating firm is believed to be B, whereas its rival playing $\hat{p}_H$ is believed to be H. The optimal price as type B is $\hat{p}_H/2$. When $q_H/q_B < 2$, price becomes the salient attribute and the no-deviation condition is written as:

$$\frac{\hat{p}_H}{2}\left(1 - \frac{\hat{p}_H - q_B}{\Delta}\right) \geq \frac{\hat{p}_H^2}{4\delta\Delta},$$

which is satisfied when $\hat{p}_H \leq \frac{2\delta q_H}{1+2\delta}$. Note that $\frac{2\delta q_H}{1+2\delta} > q_B$ is required, which occurs when $q_H/q_B > (1+2\delta)/2\delta$. Instead, when $q_H/q_B > 2$, quality becomes the salient attribute and the no-deviation condition becomes:

$$\frac{\hat{p}_H}{2}\left(1 - \frac{\hat{p}_H - q_B}{\Delta}\right) \geq \frac{\delta\hat{p}_H^2}{4\Delta},$$

which is satisfied when $\hat{p}_H < \frac{2q_H}{2+\delta}$. Since $\frac{2q_H}{2+\delta} > q_B$, we conclude that the state (H, H) can be disclosed when $q_H/q_B > \min\left\{\frac{(1+2\delta)}{2\delta}, 2\right\}$. It is readily verified that this condition is less stringent than in the asymmetric states.

Appendix B

In this appendix, we characterize pooling equilibria.

B.1 Single-seller setting

A pooling equilibrium requires that $p(q) = p$ for both types. Bayes' rule gives $\mu(q_H|p) = h$, and the expected quality is thus simply equal to $\mathbb{E}(q|h) = hq_H + (1-h)q_B$. The consumer compares the expected utility of buying from the seller to that of buying from the fringe. Using the utility specification in (1), we can write the seller's profit in a pooling equilibrium as:

$$\pi(q, p, h) = [p - c(q)] \left[1 - \phi \frac{p - p_B}{\mathbb{E}(q|h) - q_B}\right].$$

For such an equilibrium to exist, neither type must find it profitable to deviate given a system of out-of-equilibrium beliefs. In order to support the largest possible set of equilibria, we adopt the most pessimistic out-of-equilibrium beliefs, namely $\mu(q_B|p') = 1$ for all $p' \neq p$. Given these beliefs, consumers interpret any deviation from a putative equilibrium price p as coming from a basic-quality seller, so a deviating firm solves the same maximization problem as the one in (3). Hence, to get the highest profit obtainable by deviating from a pooling equilibrium, a basic-quality seller must set a price equal to p_B. Comparing $\pi(q_B, p, h)$ with the deviation profit $p_B - c_B$, we find that the low type does not deviate if the price is lower than $\hat{p} = c_B + h\Delta/\phi$. Any price lower than $\hat{p}$ also ensures that the high type does not deviate, provided $\hat{p} > p_B$.

The price interval compatible with a pooling equilibrium is therefore $(p_B, \hat{p}]$. The lower bound of this interval is p_B, which coincides with the marginal cost of the high type. The upper bound guarantees that neither type would deviate from the pooling equilibrium; its value depends on ϕ. Note that, as in the analysis of separating equilibria, there exists a cutoff price $\tilde{\tilde{p}} \equiv p_B \times \mathbb{E}(q|h)/q_B$ that is compatible with price and quality being equally salient. Therefore, any equilibrium price below this cutoff leads to quality salience; above it, to price salience.

B.2 Duopoly setting

A pooling equilibrium is a situation in which both sellers set the same price, so that consumers cannot distinguish between them and accordingly assign to each good a probability h of being of high quality.

Since the expected quality ratio equals the price ratio (equal to 1), price and quality are always equally salient for consumers.

A consumer with appreciation for quality θ compares the expected utility of buying with the alternative of not buying at all. As a result, if:

$$q_B + \theta\left[hq_H + (1-h)q_B - q_B\right] - p \geq 0 \Leftrightarrow \theta \geq \tilde{\theta} \equiv \frac{p - q_B}{h\Delta},$$

the consumer purchases one of the two products at random. The total market demand is

$$D_h(p) = \begin{cases} 1 & \text{if } p \leq q_B \\ \max[0, 1-\tilde{\theta}] & \text{if } p > q_B. \end{cases}$$

Since both sellers have the same price, they share the demand equally. Note that whenever $p \leq q_B$, all consumers buy one of the two products at price p. In a pooling equilibrium, the two firms obtain the same profit, namely $(p/2)D_h(p)$. Assuming pessimistic out-of-equilibrium beliefs as in the main text, a deviating firm is believed to be B, whereas its rival playing p is believed to be H. The optimal price as type B is $p/2$. When $q_H/q_B < 2$, price becomes the salient attribute and the no-deviation condition is written as:

$$\frac{p}{2}D_h(p) \geq \frac{p^2}{4\delta\Delta},$$

which is satisfied when $p \leq \min\left\{2\delta\Delta, \frac{2\delta[h\Delta+q_B]}{h+2\delta}\right\}$. On the other hand, when $q_H/q_B > 2$, quality becomes the salient attribute and the no-deviation condition becomes:

$$\frac{p}{2}D_h(p) \geq \frac{\delta p^2}{4\Delta},$$

which requires that $p \leq \frac{2[h\Delta+q_B]}{2+h\delta}$.

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