

Consumer Deliberation and Product Line Design

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This paper studies optimal product line design when consumers need to incur costly deliberation to uncover their valuations for quality. To induce deliberation, a firm must maintain quality dispersion and cut the price of the high-end product so that consumers are motivated to deliberate in the hope that high-end consumption fits their needs. To prevent deliberation, the firm may have to offer downgraded quality at a low price so that an impulsive purchase will not appear too wasteful. Whether the firm should induce deliberation depends on how much surplus it creates by aligning the supply of quality with heterogeneous demand for quality and how much surplus it captures during this process. Interestingly, equilibrium firm profit, consumer surplus, and social welfare can all increase with the cost of deliberation. We extend the model to accommodate consumers' heterogeneous prior beliefs of their valuations for quality. We also discuss how market research could benefit from taking into account the endogeneity of consumer deliberation.

Key words: consumer deliberation; product line design; price discrimination; information acquisition; agency theory; preference construction

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1. Introduction

Consider the following situation: Amy walks into a store to see a 1 GB digital camera memory card available for \$5. At this price, Amy is likely to buy without much hesitation. Suppose Amy walks into the store to find a 16 GB memory card priced at \$50 instead. Now the decision is less clear. If she truly requires this much photo storage capacity, \$50 would be a bargain (as of the time of this paper); if not, \$50 is not a wise amount to spend. Amy needs more time to think about it.

Similar situations frequently arise in categories such as technology products, financial services, personal care, and telecommunication plans. Even if there is no ambiguity about objective product features, consumers may feel uncertain about their subjective preferences (Kahn and Meyer 1991). This uncertainty can arise for a number of reasons. The product can be new to the market (it may be unclear how much incremental value a larger memory card may have), the consumer can be new to the market (a novice may not know how much space a digital image tends to occupy), or the consumer can be in a low-cognition status (Amy may not immediately recall how her memory card hits capacity while traveling).

On the other hand, consumers can learn their preferences in a variety of ways. If the memory card is new to the market, Amy can study the product

brochure and project herself into the usage scenarios associated with different capacity levels. If Amy is a novice user, she can seek out educational materials on digital photography to gauge what capacity best serves her photo-taking objectives. If Amy has not yet invested enough cognitive resources, she can do that by reviewing her past photo works, reflecting on her shooting styles, and forecasting her future demand for storage capacity. We label these preference-learning activities *deliberation*.

It is well established in behavioral decision research that people do not always know their preferences but often construct them during the decision-making process (Payne et al. 1993, Lichtenstein and Slovic 2006). As a result, preferences often depend on the specific choice context (Tversky and Simonson 1993). We posit that deliberation mediates the mapping from the choice context to preferences. This is because deliberation is costly. It consumes tangible resources, it takes time, and even the mere act of thinking comes at a cost (Shugan 1980). A consumer is then only willing to deliberate if her choice context provides her with enough motivation (Payne et al. 1988, Hauser et al. 2012). For example, the \$50 16 GB memory card would be more likely than its small-stake counterpart to prompt Amy to deliberate. In a market setting, a firm can alter consumers' choice context by changing its product offerings. Doing so can affect consumers' deliberation incentives, preferences, product choices

and thus affect firm profits. How, then, should a firm design its product line?

We consider a monopolist firm that controls how many products to offer and the quality and price of each product. Consumers have either high or low valuation for product quality, but they must deliberate to find out their exact preference; without deliberation, they stay uncertain and rationally perceive themselves as having average valuation. The firm's product line design includes two levels of decisions: product line *strategies* and product line *tactics*. On the strategic level, the firm can either target the high- and low-valuation segments with different products ("selective targeting") or serve the entire market with a single product ("mass marketing"). For the firm to benefit from selective targeting, consumers must deliberate and find out in which segment they belong. For the firm to choose mass marketing, consumers must prefer not to deliberate; if they do, the firm will then want to exploit heterogeneous consumer valuations through selective targeting. Therefore, the firm's strategic decision amounts to a choice between inducing and preventing deliberation.

Tactically, to motivate consumers to deliberate, the firm must ensure that the products appear sufficiently different to consumers post-deliberation. As a result, the firm must maintain enough quality dispersion between the products. In addition, the firm must reduce the price of the high-end product to make it appear as a clear bargain to high-valuation consumers. The possibility of choosing this bargain after deliberation attracts consumers to deliberate to find out whether they indeed have a need for high-end consumption.

On the other hand, for consumers to be willing to purchase a product without deliberation, this purchase should not represent too much of a waste, even though the actual valuation for quality turns out to be low. As a result, the firm may have to serve the entire market with excessively low quality and cut the price below the utility that unsure consumers draw from this downgraded quality. This tactic presents the product as a low-profile, low-stake option that consumers can comfortably buy out of impulse.

The profitability of these product line tactics determines a firm's choice of its product line strategy. By inducing deliberation, the firm creates extra surplus by constructing heterogeneous preferences and then matching them with different levels of quality provision. The firm can capture part of this surplus through selective targeting but must leave sufficient surplus to consumers to motivate deliberation. The higher the deliberation cost, the more expensive it is for the firm to induce deliberation. Conversely, the higher the deliberation cost, the cheaper it is for the firm to prevent deliberation and pursue mass marketing.

Therefore, the firm should choose selective targeting if deliberation is not too costly and mass marketing otherwise. Interestingly, equilibrium firm profit, consumer surplus, and social welfare can all increase with the deliberation cost; preference learning becoming less costly does not necessarily benefit the firm, the consumer, or society.

We extend the model to capture the possibility that consumers might have heterogeneous prior beliefs about their quality valuations. New insights emerge. We find that the firm can exploit this prior heterogeneity by inducing only a subset of consumers to deliberate. However, greater heterogeneity in consumers' prior beliefs is not always profit enhancing. To induce consumers with pessimistic prior beliefs to deliberate, the firm must offer a deep discount on a high-end product; to prevent these consumers from deliberating, the firm must substantially downgrade its quality. This result suggests that, again, the firm should be strategic about helping consumers uncover their preferences.

Our analysis emphasizes preference heterogeneity as an endogenous result of deliberation. In practice, failure to account for deliberation, or to properly measure the cost of deliberation, can lead to sizable marketing mistakes. If a firm chooses selective targeting but has underestimated the deliberation cost, its product line may be insufficient to stimulate deliberation. Consumers will conservatively avoid high-end consumption, and the firm will be oversegmenting the market with a high-end product that meets no demand. Alternatively, if a firm chooses mass marketing but has overestimated the cost of deliberation, its product may appear too high profile to be a no-brainer. Consumers may want to deliberate before they buy and will only buy if they indeed hold high valuation. The firm will hence be undersegmenting the market with a product that is overqualified for some consumers.

This paper contributes to three streams of literature. First, we incorporate preference uncertainty and constructed preferences into the analysis of optimal firm strategies by emphasizing the role of consumer deliberation. Shugan (1980) is among the earliest to highlight the importance of quantifying consumers' cost of thinking. However, it remains understudied as to how firms should strategically respond. One exception is Wathieu and Bertini (2007), who suggest that purposeful overpricing relative to consumers' initial willingness to pay can spur deeper thinking about the personal relevance of product benefits. In comparison, we allow the firm to determine its product line offerings—including the number, quality, and price of products—to either induce or prevent deliberation.¹

¹ In a related study, Wernerfelt (1995) shows that consumers may infer what is good for them from what is available in the market.

Second, there is a large analytical literature on product line design (e.g., Villas-Boas 1998, 2004; Desai 2001; Desai et al. 2001; Orhun 2009; Bar-Isaac et al. 2010; Liu and Cui 2010). In particular, Mussa and Rosen (1978) and Moorthy (1984) study how firms can use second-degree price discrimination to facilitate consumer self-selection between vertically differentiated products. A common assumption in the product line design literature is that consumers know their preferences (Stole 2007).² We endogenize consumers' knowledge of their preferences so that the firm uses the product line not only to tactically extract consumer surplus but also to strategically influence consumer valuation for quality.

Finally, our paper is related to the evaluation cost literature (e.g., Hauser and Wernerfelt 1990, Wernerfelt 1994, Villas-Boas 2009, Kuksov and Villas-Boas 2010). Villas-Boas (2009) shows that limiting the number of products can be profit enhancing. If the firm launches a dense assortment of products, consumers are more likely to locate a closely matching product through evaluation, which entitles the firm to charge a higher price and dampens consumers' incentive to evaluate products in the first place. Our paper echoes Villas-Boas (2009) in that firms' product line design simultaneously influences consumers' information acquisition incentives and exploits the acquired information (if any).³ However, evaluation and deliberation are different processes. Consumers discover objective product features through evaluation but uncover subjective preferences through deliberation. Therefore, in Villas-Boas (2009), evaluation is a prerequisite to purchase, so that firms will always want to encourage consumers to evaluate their products; otherwise, there will be no demand. In our

Bhardwaj et al. (2008) allow an exogenous fraction of consumers to be uncertain about their preferences and examine firms' choices between seller- and buyer-initiated discussions of product features. Iyer and Kuksov (2010) study the process by which consumers rationally infer true quality from their perceived quality that is subject to the influence of affect. Bertini et al. (2012) allow consumers to learn the importance of product quality by observing the market level of product proliferation. Dzyabura (2012) studies optimal product recommendation strategies when consumers learn their preferences through product experience.

² There are a few exceptions. Lewis and Sappington (1994) and Kuksov and Lin (2010) study firms' provisions of consumer preference information. Our paper focuses on firms' role in motivating consumers to seek preference information themselves. Nevertheless, we will discuss firms' incentive to help consumers learn their preferences by lowering the deliberation cost, providing consumers with signals of their preferences, or enhancing the informativeness of deliberation.

³ This approach is related to Simester and Zhang (2010), who examine how firms can contractually induce product managers to acquire early information about demand, which, in turn, helps managers work efficiently and reduces firms' payroll costs. See also Guo and Iyer (2010) for a study of suppliers' incentive to acquire and share demand information to affect retailers' decisions.

paper, consumers have the nontrivial option of buying without deliberation, and firms may actually find it more profitable to prevent deliberation.

2. Model and Benchmark

2.1. Model Setup

We begin with the standard setting of second-degree price discrimination (Mussa and Rosen 1978). A risk-neutral monopolist firm produces a line of products differentiated in quality q . For each unit of product, the firm incurs a manufacturing cost of $q^2/2$. The firm serves a market of risk-neutral consumers whose mass is normalized to 1. Consumers demand at most one product and enjoy an outside option normalized as 0. Consumers hold inherently heterogeneous valuations for product quality: from each unit of quality consumed, a fraction α of consumers enjoys a utility of θ_h while the remaining fraction $1 - \alpha$ derives a utility of $\theta_l < \theta_h$. Let $i \in \{h, l\}$ index a consumer's quality valuation, or *type*. The net utility that a type i consumer enjoys by purchasing a product of quality q at price p is

$$U(p, q; \theta_i) = \theta_i q - p, \quad i \in \{h, l\}. \quad (1)$$

Different from standard models of second-degree price discrimination, we posit that each consumer must incur a deliberation cost $c > 0$ to find out her true valuation for quality. In the baseline model, without deliberation, each consumer perceives herself as an "average consumer" with a prior valuation for quality equal to $\theta_m = \alpha\theta_h + (1 - \alpha)\theta_l$. We make this rational expectation assumption to rule out biased beliefs as the cause of any inefficient market outcomes. This assumption also echoes the view from the psychology literature that consumers must incur a cost to locate their preferences on an inherent master list (Simonson 2008), and it conforms with the recurring empirical finding that deliberation leads to polarized evaluations (Tesser et al. 1995, Wathieu and Bertini 2007).⁴ In §4 we allow consumers to hold heterogeneous prior beliefs of their valuation. Because of the often covert nature of deliberation, we assume that the firm cannot write a contract with consumers to specify whether they should deliberate but relies instead on product line design to influence deliberation decisions.

The game proceeds in two stages. First, the firm determines its product line strategies by choosing

⁴ This setup accommodates the interpretation that the act of deliberation per se changes preferences. For example, to reduce cognitive dissonance (Festinger 1957), consumers might polarize their preferences to justify the choice to deliberate. However, firms' optimal product line tactics and strategies remain the same as long as consumers rationally anticipate the effect of deliberation on preferences.

between selective targeting and mass marketing, and it sets its product line tactics—the price and quality of product(s)—to implement the chosen strategy. Second, a consumer chooses whether to deliberate after observing the firm’s product offerings, and she determines whether to buy and which product to buy based on the outcome of her deliberation.

We summarize the information structure as follows. The firm can only observe the consumers’ product choices (but not their deliberation decision). The consumers observe the firm’s product offerings. In addition, the consumers know their prior valuation without deliberation and their true valuation with deliberation.⁵ All the parameters, α , c , θ_h and θ_l , are common knowledge.

2.2. Benchmark: Efficient Quality Levels and Deliberation Decisions

To evaluate the firm’s equilibrium quality choices, we need a benchmark. A natural benchmark is the socially efficient quality level that equates a consumer’s marginal utility of quality consumption with the firm’s marginal cost of quality production. If consumers deliberate, there will be two consumer segments with quality valuations of θ_h and θ_l , respectively. If consumers do not deliberate, they manifest themselves as a homogeneous segment with quality valuation θ_m . For consumers of quality valuation θ_j , the efficient quality level is

$$q_j^* = \theta_j, \quad j \in \{h, l, m\}. \quad (2)$$

The efficient quality levels allow us to determine the socially efficient deliberation choice.⁶ Deliberation creates surplus by matching the supply of quality with consumers’ heterogeneous valuations for quality. If consumers deliberate, high-valuation consumers receive efficient quality θ_h and low-valuation consumers receive efficient quality θ_l , which yields social welfare of $-c + \alpha\theta_h^2/2 + (1 - \alpha)\theta_l^2/2$. If consumers do not deliberate, they receive efficient quality θ_m , which leads to social welfare of $\theta_m^2/2$. We thus obtain a threshold cost $c^* = \alpha(1 - \alpha)(\theta_h - \theta_l)^2/2$ such that deliberation is socially efficient if and only if $c < c^*$. This condition allows us to assess whether a firm’s optimal

product line design induces consumers to deliberate too much or too little. We analyze the firm’s equilibrium product line tactics and strategies in the next section.

3. Analysis and Results

This section is organized as follows. We first investigate the firm’s optimal product line tactics to either induce deliberation (§3.1) or prevent deliberation (§3.2). We then derive the firm’s optimal product line strategies (§3.3).

3.1. Product Line Tactics to Induce Deliberation

The firm will determine the price and quality of two products to maximize its profit while satisfying the following conditions. As in the case of standard second-degree discrimination, consumers in each segment should be willing to buy the product targeted for that segment (the IR_i constraints, $i \in \{h, l\}$) and should choose the product intended for them over the other product (the IC_i or self-selection constraints). In addition, all consumers must be willing to deliberate (the IC_d constraint, where d stands for deliberation). The firm’s optimization problem is summarized as follows:

$$\begin{aligned} \max_{p_h, p_l, q_h, q_l \geq 0} \quad & \Pi = \alpha(p_h - q_h^2/2) + (1 - \alpha)(p_l - q_l^2/2) \\ \text{s.t.} \quad & \theta_h q_h - p_h \geq 0, & (IR_h) \\ & \theta_l q_l - p_l \geq 0, & (IR_l) \\ & \theta_h q_h - p_h \geq \theta_h q_l - p_l, & (IC_h) \\ & \theta_l q_l - p_l \geq \theta_l q_h - p_h, & (IC_l) \\ & -c + \alpha(\theta_h q_h - p_h) + (1 - \alpha)(\theta_l q_l - p_l) \\ & \geq \max(\theta_m q_h - p_h, \theta_m q_l - p_l, 0). & (IC_d) \end{aligned} \quad (3)$$

The deliberation constraint is interpreted as follows. Upon deliberation, a consumer will choose the right product given her true valuation: with probability α , she will purchase the high-quality product, earning a surplus of $\theta_h q_h - p_h$; with probability $1 - \alpha$, she will buy the low-end product, earning a surplus of $\theta_l q_l - p_l$. Without deliberation, this consumer makes her purchase decision based on her expected quality valuation θ_m . She can choose to purchase high quality, low quality, or nothing, which gives her a surplus of $\theta_m q_h - p_h$, $\theta_m q_l - p_l$, or 0, respectively. For deliberation to be valuable to a consumer, her expected utility from making an informed purchase decision knowing her true type, net of the deliberation cost, should be no less than her “best bet” as an unsure consumer.

The appendix presents the solution to problem (3). We show that the deliberation constraint subsumes the self-selection constraints. Intuitively, for (costly) deliberation to be meaningful, consumers of different

⁵ We do not consider dynamic games whereby consumers might learn their preferences through product experience even without deliberation.

⁶ Social welfare in this setting equals consumers’ utility from consuming quality, net of the firm’s cost of producing quality, and any deliberation cost. In the first-best case, a “social planner” maximizes social welfare. The social planner does not have to dictate whether consumers deliberate; it can just determine the socially efficient number and quality of products the firm should produce, as well as product prices. These decisions, in turn, induce consumers to make the socially efficient decision of whether to deliberate.

valuations must select different products ex post. This result implies that product line tactics under standard second-degree discrimination would be insufficient to induce deliberation. Indeed, the firm’s optimal prices are such that

$$p_l = \theta_l q_l, \quad p_h - p_l = \theta_h(q_h - q_l) - \frac{c}{\alpha}. \quad (4)$$

The firm will charge low-valuation consumers a price commensurate with their consumption utility and extract all their consumer surplus. However, the firm must reduce the incremental price charged to high-valuation consumers for the incremental quality they enjoy, thus making the high-end product more affordable than under standard second-degree discrimination. This tactic increases the net purchase value for the high-end product ex post, which motivates consumers to deliberate ex ante to see whether high-end consumption matches their needs.

Moreover, the quality difference between the two products must be large enough to induce deliberation. If the high-end product is only marginally better than its low-end counterpart, its reduced price alone cannot motivate deliberation. Specifically, when deliberation is not too costly ($c \leq \hat{c}_1 = \alpha(\theta_h - \theta_l)^2$), the optimal quality provision is at the efficient level for high-valuation consumers but below the efficient level for low-valuation consumers. These results replicate the classic “efficiency at the top” and “distortion at the bottom” effects of standard second-degree price discrimination—the firm must keep the quality of the cheaper product sufficiently low to make it unattractive to high-end consumers. When the deliberation cost is sufficiently high ($c > \hat{c}_1$), the firm must further raise the quality of the high-end product and decrease the quality of the low-end product. In both cases, the quality dispersion between the high- and low-end products is wider than the gap between the efficient qualities for high- and low-valuation consumers. We label this effect “quality dispersion” and summarize the results below.

LEMMA 1 (QUALITY DISPERSION). *To induce deliberation, the firm must increase the quality dispersion between the high-end and low-end products beyond the difference in efficient quality levels for high-valuation and low-valuation consumers ($\theta_h - \theta_l$).*

The benefit of the quality dispersion tactic lies in the endogenous construction of preference heterogeneity, which the firm can exploit through price discrimination. However, this tactic can be expensive because the firm must subsidize deliberation by cutting the price of the high-end product and must also distort its quality provision. We show in the appendix that the resulting profit strictly decreases with the cost of deliberation and will eventually decline to zero if deliberation is sufficiently costly.

When the downward quality distortion for the low-end product is too severe, the firm will no longer be able to serve the low-valuation segment (i.e., $q_l \leq 0$). Indeed, if the fraction of high-valuation consumers is sufficiently large, the firm’s optimization problem reaches a boundary solution, whereby the firm offers one product to serve high-valuation consumers exclusively—upon deliberation, consumers who find out that they have low valuations will not buy.⁷ The appendix presents the full analysis of this scenario. The findings parallel those in the interior solution: product quality is weakly higher than what is efficient for high-valuation consumers; it is zero and thus below the efficient level for low-valuation consumers. Meanwhile, the firm must cut the price relative to high-valuation consumers’ consumption utility. Firm profit, as a result, strictly decreases with the cost of deliberation and reaches zero when deliberation is sufficiently costly.

3.2. Product Line Tactics to Prevent Deliberation

Without deliberation, consumers manifest a homogeneous willingness to pay for quality although they are heterogeneous in their true quality valuations. The firm maximizes its profit from mass marketing one single product, subject to the conditions that consumers are willing to buy and voluntarily forgo the deliberation opportunity:

$$\begin{aligned} \max_{p, q \geq 0} \quad & \Pi = p - q^2/2 \\ \text{s.t.} \quad & \theta_m q - p \geq 0, \quad (IR) \\ & \theta_m q - p \geq -c + \alpha \max(\theta_h q - p, 0) \\ & \quad + (1 - \alpha) \max(\theta_l q - p, 0). \quad (IC_{nd}) \end{aligned} \quad (5)$$

The right-hand side of the constraint IC_{nd} (where nd stands for no deliberation) reflects the information value for a consumer to deliberate—she can decide whether to buy after she has uncovered her true valuation for quality.

We present the full solution in the appendix and state the findings below. When deliberation is prohibitive ($c \geq \hat{c}_2 = \alpha(1 - \alpha)\theta_m(\theta_h - \theta_l)$), the IC_{nd} constraint always holds, and the firm simply selects the optimal price and quality to serve a market of unsure consumers. It will offer a quality level $q = \theta_m$ to match the quality valuation of these unsure consumers and charge a price of $p = \theta_m q = \theta_m^2$ to extract their entire consumer surplus. When deliberation is less costly ($c < \hat{c}_2$), the IC_{nd} constraint is binding. Intuitively, for deliberation to be meaningful to a consumer, it

⁷ For any product, if low-valuation consumers are willing to buy, high-valuation consumers must be willing to buy at the same price. Therefore, there is no situation in our setting where the firm serves low-valuation consumers exclusively.

must make a difference to the consumer’s product choice ex post—the consumer must be willing to buy if and only if her quality valuation is high. Therefore, to dampen the deliberation incentive, the firm must lower both quality and price to make the product more appealing to low-type consumers so that an impulsive purchase will not be an expensive mistake even if the need for quality is low. When the cost of deliberation is sufficiently low ($c \leq \hat{c}_3 = \alpha(1 - \alpha) \cdot \theta_l(\theta_h - \theta_l) < \hat{c}_2$), the optimal quality will drop to θ_l , the efficient level for low-valuation consumers. We call this tactic *quality downgrade* and summarize the results as follows.

LEMMA 2 (QUALITY DOWNGRADE). *When the consumer’s deliberation cost is not too high, to prevent deliberation the firm must offer one product with downgraded quality relative to the efficient level for unsure consumers (θ_m).*

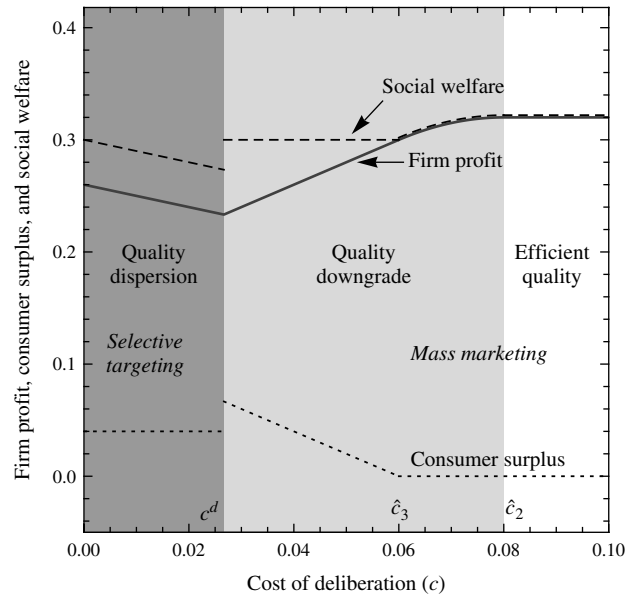
Deliberation is easier to prevent if it is more costly to the consumer. Indeed, we show that profit increases with the deliberation cost if $c < \hat{c}_2$ (that is, when the firm uses the quality downgrade tactic) and stays constant if $c \geq \hat{c}_2$. The result complements the finding from the previous section, that it is less profitable for the firm to induce deliberation when deliberation is more costly to consumers. The question is, what deliberation cost should trigger a switch in firm strategy? We examine this issue next.

3.3. Equilibrium Product Line Strategies

For any cost of deliberation c , the firm chooses between inducing and preventing deliberation by comparing the profits under these strategies. There are three observations to note. First, the firm’s profit function is continuous and strictly decreasing in c when the firm induces deliberation; it is continuous and weakly increasing in c when the firm prevents deliberation. Second, when c approaches zero, the firm is always better off pursuing selective targeting—when consumers automatically know their quality valuations, the firm should exploit this free information. Third, when c is sufficiently high, the firm should choose mass marketing. These three facts together imply that there exists a positive threshold c^d such that the firm will choose selective targeting if and only if the cost of deliberation is below this threshold. The online appendix (at <http://dx.doi.org/10.1287/mksc.1120.0736>) presents the derivation of optimal product line strategies. There exists a generous parameter condition under which $c^d < \hat{c}_2$ so that a quality downgrade emerges as an equilibrium tactic. We summarize these results below.

PROPOSITION 1. *There exists a positive threshold of deliberation cost c^d such that the firm will induce deliberation through a quality dispersion if $c \leq c^d$, prevent deliberation through a quality downgrade if $c^d < c < \hat{c}_2$, and*

Figure 1 Cost of Deliberation, Equilibrium Product Line Strategies, Tactics, and Payoffs



Notes. This figure is based on $\theta_h = 1$, $\theta_l = 0.6$, and $\alpha = 0.5$. Depending on parameter values, firm profit at $c = 0$ can be higher or lower than that at $c = \infty$.

prevent deliberation by providing the efficient level of quality for unsure consumers if $c \geq \max(c^d, \hat{c}_2)$.

These results unify two seemingly opposite views on whether firms should let consumers uncover their preferences. Some believe that firms should let consumers find out what they need and offer products that closely match those needs. Others believe in simplifying product offerings and making choices easier for consumers. Our findings suggest a way to reconcile these two viewpoints—instead of representing fundamentally divergent managerial philosophies, either can be the profit-maximizing firm strategy depending on consumers’ cost of deliberation.

Figure 1 illustrates the equilibrium product line strategies, tactics, and payoffs (firm profit, consumer surplus, social welfare) as a function of the deliberation cost. There are three interesting results. First, firm profit can increase with the cost of deliberation, as the solid line indicates. In particular, more costly deliberation makes the quality downgrade tactic more profitable. Therefore, it is not always in the firm’s best interest to help consumers reduce the cost of deliberation by, for example, distributing educational materials and providing product demonstrations, even if these activities are costless to the firm.

Second, as the dotted line shows, ex ante consumer surplus can increase with the cost of deliberation as well. To induce deliberation, the firm must subsidize consumers’ deliberation cost by taking a price cut on the high-end product. To prevent deliberation

through a quality downgrade, the firm must compensate consumers for forgoing the information value of deliberation. Consumers may fare better by receiving this compensation than by earning the subsidy for deliberation, as indicated by the increase in consumer surplus at c^d . In other words, in equilibrium, consumers can fare better by staying oblivious about their preferences.

Third, social welfare can also increase with the cost of deliberation, as the dashed line illustrates. In the socially efficient benchmark of §2.2, a higher deliberation cost plagues the alignment of quality production and quality consumption, and thus it can only damage social welfare. Here, the opposite result may arise, because the firm may distort its quality provision to endogenously influence deliberation. For example, a quality downgrade reflects a socially insufficient supply of quality, and this distortion decreases as deliberation becomes more costly. The following proposition summarizes the effect of the cost of deliberation on payoffs.

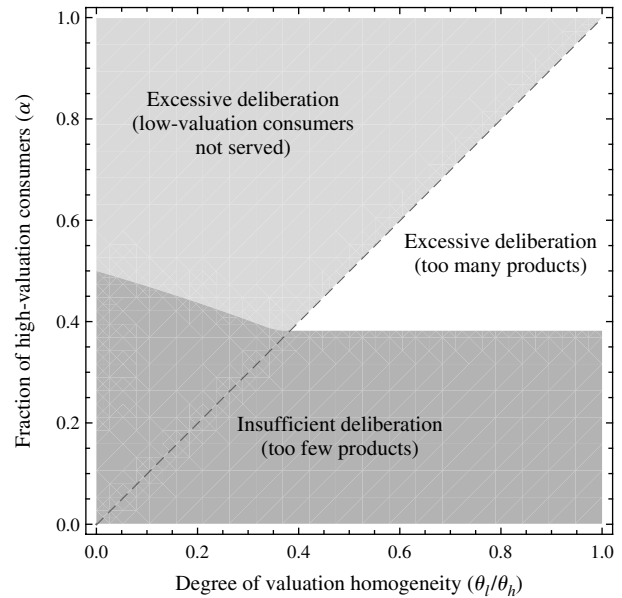
PROPOSITION 2. *Firm profit, consumer surplus, and social welfare can all increase with the cost of deliberation.*

One last question is whether the firm’s optimal product line strategies induce consumers to deliberate too much or too little compared with the socially efficient benchmark established in §2.2. We answer this question by comparing the equilibrium threshold c^d with the socially efficient threshold c^* . When $c^d > c^*$, the market is characterized by *excessive deliberation* as the firm may induce deliberation when deliberation is socially wasteful. When $c^d < c^*$, *insufficient deliberation* occurs as the firm may prevent deliberation while deliberation is socially beneficial. We map these possible distortions to different parameter ranges by comparing the cost thresholds as detailed in the online appendix.

Figure 2 shows the results. When the fraction of high-valuation consumers is sufficiently large, it is relatively more profitable to exploit these consumers’ high willingness to pay. Correspondingly, the firm may either offer two products to price discriminate or abandon the low-valuation segment altogether to prompt deliberation, even when it is efficient to provide one product that suppresses deliberation. On the contrary, as the fraction of high-valuation consumers is sufficiently low, the firm may prevent deliberation by supplying only one product, even when it is efficient to induce deliberation and provide each type of consumer with a commensurate level of quality. We state these findings below.

PROPOSITION 3. *The firm’s optimal product line strategies may induce socially excessive deliberation when the fraction of high-valuation consumers is sufficiently large and socially insufficient deliberation when this fraction is small.*

Figure 2 Possible Distortions in Deliberation



4. Heterogeneous Deliberation

Consumers may hold heterogeneous prior beliefs about their quality valuation. For example, before going through past photos to summarize their storage capacity needs, some buyers might have a better sense than others that they would prefer larger capacity because they tend to take high-resolution pictures. We are interested in whether the firm would induce *heterogeneous deliberation* in equilibrium, whereby only consumers who hold specific prior beliefs choose to deliberate.

We extend the baseline model by allowing each consumer to be endowed with a private signal of her valuation. The signal could be either “good” or “bad.” Given a consumer’s true valuation, the conditional probability of receiving either signal is $\text{Prob}(\text{good} | \theta_h) = \text{Prob}(\text{bad} | \theta_l) = \rho$, where $\rho \in (1/2, 1)$ measures the informativeness of the signals. By Bayes’ rule, a consumer who receives a good signal holds the belief that her valuation is high with probability $\alpha_g = \rho\alpha / [\rho\alpha + (1 - \rho)(1 - \alpha)]$, whereas one who receives a bad signal believes that her valuation is high with probability $\alpha_b = (1 - \rho)\alpha / [(1 - \rho)\alpha + \rho(1 - \alpha)]$. It follows that those who receive good signals perceive their quality valuation to be $\theta_g = \alpha_g\theta_h + (1 - \alpha_g)\theta_l$, whereas those who receive bad signals perceive their valuation as $\theta_b = \alpha_b\theta_h + (1 - \alpha_b)\theta_l$. It is easy to show that

$$\theta_g > \theta_m > \theta_b. \quad (6)$$

Informative signals lead to polarized beliefs, as $\partial\theta_g/\partial\rho > 0$ and $\partial\theta_b/\partial\rho < 0$.

A consumer again must incur a deliberation cost c to ascertain her valuation for quality. The firm knows the distribution of signals but does not observe the

signal each consumer covertly receives. Therefore, the firm cannot implement third-degree price discrimination based on signals. Instead, the firm faces the problem of whether, and how, to induce these partially informed consumers to deliberate. We present the full analysis in the online appendix and discuss the key findings below.

First, we revisit the optimal tactics to induce all consumers to deliberate. The firm faces the same optimization problem as problem (3) of the baseline model, except for the revised deliberation constraint:

$$\begin{aligned} & -c + \alpha_s(\theta_h q_h - p_h) + (1 - \alpha_s)(\theta_l q_l - p_l) \\ & \geq \max(\theta_s q_h - p_h, \theta_s q_l - p_l, 0), \quad (IC_{ds}) \quad (7) \end{aligned}$$

where $s \in \{g, b\}$. After deliberation, a consumer will self-select the right product based on the discovery of her true valuation. Without deliberation, she chooses to buy the high-end product, the low-end product, or nothing based on her expected valuation θ_s .

We find that Lemma 1 continues to hold—the optimal qualities satisfy $q_h \geq \theta_h$ and $q_l < \theta_l$, such that the quality dispersion between the two products is greater than the efficient level of $\theta_h - \theta_l$. In fact, relative to the case of homogeneous prior valuation, the quality dispersion needed to induce deliberation is greater; it is now harder to convince optimistic consumers to deliberate for fear of low valuation and to motivate pessimistic consumers to deliberate in the hope of high valuation.

Second, we revisit the optimal tactics that prevent all consumers from deliberating. Different from the baseline model, consumers are exogenously segmented by the signals they receive even without deliberation. The term *mass marketing* should thus be modified: the firm should exploit this signal heterogeneity and implement second-degree price discrimination by targeting good-signal receivers with “product g ” and bad-signal receivers with “product b .”

The results again echo those of the baseline model: the firm will set prices and qualities such that, upon the discovery of a low need for quality, a consumer will choose not to buy. It follows that bad-signal receivers have a greater incentive to deliberate, because through deliberation, they have a higher chance of discovering low valuation and avoiding a wasteful purchase. Overall, when the deliberation cost is not too high, to prevent deliberation the firm must offer downgraded qualities relative to the efficient levels for good- and bad-signal receivers ($q_g < \theta_g$ and $q_b < \theta_b$, respectively)—a result analogous to Lemma 2.

Besides these two cases of homogeneous deliberation whereby either all or no consumers deliberate, we need to consider the possibility of heterogeneous deliberation whereby the firm selectively induces either good- or bad-signal receivers to deliberate.

Heterogeneous deliberation leads to three types of consumers in the market, and the firm will target them with three different products that are coordinated to ensure appropriate purchase, facilitate self-selection, and induce the right deliberation choices.

We find that the firm continues to use the quality dispersion and quality downgrade tactics: to induce consumers who receive either signal to deliberate, the firm must increase the quality dispersion between the high- and low-end products relative to the efficient level of quality dispersion ($\theta_h - \theta_l$); to prevent consumers who receive signal s from deliberating, the firm must target those consumers with a “middle-tier” product whose quality is below the efficient level for them (θ_s) unless deliberation is too costly. Among the three resulting products, quality is (weakly) biased upwards for the high-end product, downwards for the middle-tier product unless deliberation is too costly, and downwards for the low-end product, relative to the efficient quality level for each product’s target consumers. We state these results below.

LEMMA 3. *To induce heterogeneous deliberation, the firm offers three products: high-end, low-end, and middle-tier. It must increase the quality dispersion between the high-end and low-end products beyond the difference in efficient quality levels for high-valuation and low-valuation consumers ($\theta_h - \theta_l$). It must downgrade the quality of the middle-tier product below the efficient level for consumers who do not deliberate (θ_s , $s \in \{g, b\}$) unless deliberation is sufficiently costly.*

The strategic decision facing the firm is whether to induce both, one, or neither segments of consumers to deliberate. In particular, we are interested in whether inducing heterogeneous deliberation could be the optimal strategy. We prove the following proposition in the online appendix.

PROPOSITION 4. *When consumers have heterogeneous prior valuation, the firm’s optimal strategy could be to induce heterogeneous deliberation, whereby only good- or bad-signal receivers deliberate. Heterogeneous deliberation can only emerge in equilibrium if deliberation is neither too cheap nor too expensive, and if consumers’ private signals of quality valuation are sufficiently informative (ρ is sufficiently large).*

This result can be understood as follows. Because consumers now start with heterogeneous prior valuation, they have heterogeneous incentives for whether to deliberate. To ensure that all consumers make homogeneous deliberation decisions, the firm may leave too much surplus to one segment of consumers. The firm might thus do better by letting one consumer segment not deliberate. However, heterogeneous deliberation can only improve profits if deliberation is neither too cheap nor too costly. If deliberation is cheap, then preventing one segment of consumers

from deliberation will be too expensive to the firm; similarly, if deliberation is prohibitive, then inducing one segment to deliberate will also be profit dissipating.

Note that even if the deliberation cost takes an “intermediate” value, heterogeneous deliberation may not emerge in equilibrium if signals are too noisy. As discussed, because the value of heterogeneous deliberation is to accommodate consumers’ heterogeneous incentives to deliberate, it is a preferable firm strategy only if consumers’ prior valuations are sufficiently heterogeneous.

In reality, markets are likely to differ in how much preexisting knowledge consumers have about their preferences. Our findings suggest that, in markets where consumers hold sufficiently divergent prior beliefs, firms may be able to exploit this heterogeneity by inducing heterogeneous deliberation. One question that follows is whether greater heterogeneity in consumers’ prior beliefs always benefits the firm. The answer is no. We prove the following proposition in the online appendix.

PROPOSITION 5. *Firm profit can decrease with the informativeness of consumers’ signals of quality valuation (ρ).*

The intuition is as follows. As signals become more informative, receiving a bad signal makes a consumer more pessimistic about her need for high quality. When a firm induces all consumers to deliberate, it must offer a greater price cut on the high-end product to motivate that pessimistic consumer to deliberate and uncover her (unlikely) high valuation. When the firm prevents all consumers from deliberating, it implements standard second-degree price discrimination for good- and bad-signal receivers. Although the quality and price of the high-end product does increase, the benefit can be overshadowed by the decline in the quality and price of the low-end product. Finally, when the firm induces heterogeneous deliberation, profit may also decrease with ρ . To induce a pessimistic consumer to deliberate, the firm must again offer a deep discount on the high-end product; to prevent a pessimistic consumer from deliberating, the firm must keep quality below an already low level.

In practice, firms may have ways to communicate with consumers besides product line offerings and may “empower” consumers by helping them uncover their preferences (Wathieu et al. 2002, Wathieu and Bertini 2007). For example, firms can provide consumers with better preference signals by offering free trials or designing advertisements that project consumers into actual usage situations (Wathieu and Bertini 2007). Our findings suggest that these information campaigns could increase firm profit; they could generate heterogeneity in consumers’ prior

valuations that the firm subsequently exploits by inducing heterogeneous deliberation (Proposition 4). However, greater heterogeneity in consumers’ prior valuations is not always profit enhancing (Proposition 5). Therefore, firms should be strategic about how much information to provide through their information campaigns.⁸

5. Implications for Firms and Market Researchers

Our theory highlights the endogenous nature of preferences. Failure to account for the effect of consumer deliberation in the preference construction process can misinform product line design. We discuss two such mistakes using the baseline model.

First, consider a firm’s false assumption that consumers automatically know their valuation for quality. The firm will implement standard second-degree discrimination to exploit consumers’ heterogeneous preferences. Under standard second-degree discrimination, high-valuation consumers are indifferent between the high- and low-end products (i.e., IC_h is binding). Therefore, after deliberation, both high-valuation and low-valuation consumers will (weakly) prefer the low-end product anyway; hence, consumers will simply skip deliberation and buy the low-end product, which defeats the purpose of second-degree price discrimination.⁹

Second, suppose the firm ignores the possibility that consumers can discover their idiosyncratic preferences through deliberation. It will offer one product with quality $q = \theta_m$ and price $p = \theta_m q = \theta_m^2$ catered to this seemingly homogeneous pool of consumers. By purchasing this product without deliberation, a

⁸ Instead of changing consumers’ prior quality valuations, firms’ information campaigns can influence the informativeness of consumers’ deliberation processes. In §OA.9 of the online appendix, we extend the baseline model by assuming that deliberation generates a diagnostic yet noisy signal of a consumer’s true quality valuation. We find that a firm’s incentive to induce deliberation increases with the informativeness of deliberation. However, more informative deliberation does not always increase profit. This result suggests that, again, it is not always in the firm’s best interest to help consumers uncover their preferences. In addition, in the online appendix we extend the baseline model to explore how a firm should design its product line in response to a variety of consumer behavioral issues. We find that the firm may actually want to induce more deliberation when consumers’ prior belief is positively biased about their need for quality (§OA.8), it should induce more deliberation when consumers suffer a higher cost of regret from making the wrong choice (§OA.10), and it should consider further quality dispersion or further quality downgrade if consumers perceive deliberation to be more costly when products are more similar in quality (§OA.11).

⁹ Similarly, we can show that if a firm exclusively serves high-end consumers while ignoring the cost of deliberation, consumers will have insufficient motivation to deliberate and will have no interest in buying.

consumer earns a surplus of zero, which means the product will be too wasteful if the consumer's true valuation is low. Unless deliberation is too costly, the consumer will indeed prefer to deliberate. The firm will then only be able to attract high-valuation consumers and will only achieve fraction α of its intended sales volume.

We can show that a firm's imprecise estimation of the deliberation cost can cause the same mistakes, which confirms the importance of measuring consumer thinking costs in the product development process (Shugan 1980). Moreover, caution should be taken when firms base product line design on consumer preference data gleaned through market research. Even if research participants have carefully reflected on and truthfully communicated their preferences, actual consumers may still need to deliberate at the point of purchase. If product offerings fail to infiltrate the barrier to deliberation, consumers may not actively evoke their segment membership when making purchase decisions. The firm thus faces the risk of oversegmentation by offering high-end products that meet no demand. On the other hand, if market research has not provided enough incentive to deliberate, subject responses may yield segmentation data that only coarsely represent reality. When the consequences of actual choices become significant, however, consumers may then meticulously reflect on their preferences. If the firm ignores this possibility, it risks undersegmenting the market by offering a product that is overqualified for some consumers.

The findings also have a number of implications for market researchers. For example, respondents of market research should ideally represent the target market in terms of deliberation costs, as well as other demographic and psychographic variables. It may be a concern if consumers with stronger cognitive skills or self-awareness of preferences respond more frequently to surveys. Meanwhile, market research should provide participants with incentives to undertake the same efforts of deliberation as in real-life purchase decisions. Indeed, by giving respondents natural tasks with real-life consequences, incentive-aligned conjoint research has been shown to generate greater involvement and better out-of-sample predictions (Ding et al. 2009, 2011). Furthermore, Hauser et al. (2012) find evidence that realistic decisions encourage consumer self-reflection, which allows consumers to articulate more accurate and enduring preferences.

Our findings can be particularly relevant for partial conjoint design. Partial conjoint analysis uses orthogonal subsets of product attributes to elicit preferences, thus reducing the number of profiles that respondents need to evaluate (Green 1974). However, including different attribute levels in conjoint analysis can change respondents' attribute valuations as

they actively impute missing attribute levels (Bradlow et al. 2004). Our analysis suggests that including different attribute levels can change respondents' attribute valuation by spurring different levels of deliberation. Suppose there are two attributes—price and quality—and two groups of subjects with the same deliberation cost, the same underlying preference distribution, and thus the same average price sensitivities. One group chooses between profiles (p_h, q_h) and (p_l, q_l) , where the attribute levels are just able to induce costly deliberation. A fraction α of respondents will select the high-end profile. The other group chooses between profiles $(p_h + \epsilon, q_h)$ and (p_l, q_l) , where ϵ is an infinitesimal positive number. The respondents will skip deliberation and all choose the low-end profile. This second group will thus appear more price sensitive, although the truth is that the second pair of profiles, by failing to induce deliberation, fails to facilitate the self-discovery of the quality-sensitive segment. Designers of partial conjoint profiles may want to consider endogenous consumer deliberation as a potential mediating variable.

6. Concluding Remarks

Firms often offer a line of products to exploit consumers' heterogeneous preferences. However, consumers may not know their preferences without effortful deliberation and will only deliberate if they have sufficient motivation. We find that when the cost of deliberation is sufficiently low, a firm should induce deliberation by maintaining sufficient quality dispersion between its two products and reducing the price for the high-end product. This tactic motivates consumers to find out whether they might be interested in high-end consumption. When the cost of deliberation is sufficiently high, the firm should prevent deliberation; it may need to downgrade quality and cut price relative to the consumption utility of unsure consumers. When consumers have heterogeneous prior beliefs of their quality valuation, the firm may want to induce only a subset of consumers to deliberate. However, greater heterogeneity in consumers' prior valuation does not always enhance profit.

This paper provides a starting point to understanding the role of consumer deliberation in shaping firms' product line decisions. One direction to extend the model is to investigate competing firms' strategies to manage consumer deliberation. Another direction is to explore what happens if consumer deliberation is a sequential process or a continuous decision. Finally, due to its normative focus, the current paper does not collect empirical evidence of companies incorporating consumer deliberation into their product line designs. Identifying such evidence would be another rewarding path for future research.

Electronic Companion

An electronic companion to this paper is available as part of the online version at <http://dx.doi.org/10.1287/mksc.1120.0736>.

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Appendix

A.1. Product Line Tactics to Induce Deliberation

A.1.1. Interior Solution (Serving All Consumers). The right-hand side of IC_d can be simplified as $\max(\theta_m q_h - p_h, \theta_m q_l - p_l)$ since $\theta_m q_l - p_l > \theta_l q_l - p_l \geq 0$ by IR_l . Therefore, IC_d reduces to requiring that deliberation is weakly better than buying either product impulsively. Rearranging terms, the condition for a consumer to prefer deliberation over buying the high-quality product impulsively is

$$p_h - p_l \geq \theta_l(q_h - q_l) + \frac{c}{1 - \alpha}. \quad (8)$$

The condition for a consumer to prefer deliberation over buying the low-quality product impulsively is

$$\theta_h(q_h - q_l) \geq p_h - p_l + \frac{c}{\alpha}. \quad (9)$$

Note that condition (8) implies constraint IC_l and that condition (9) implies constraint IC_h . Therefore, the deliberation constraint subsumes the self-selection constraints.

We further simplify the remaining constraints. IC_h and IR_l together render IR_h redundant. Meanwhile, IR_l must bind in equilibrium; otherwise, the firm can raise p_l and p_h by the same small amount, improve profits, and yet still satisfy all constraints. Condition (9) must bind as well; otherwise, the firm can do better by raising p_h infinitesimally. From these two binding constraints, we obtain the optimal prices in Equation (4). Given these optimal prices, the firm's optimization problem can be rewritten as

$$\begin{aligned} \max_{q_h, q_l \geq 0} \quad & \Pi = \theta_l q_l + \alpha \theta_h (q_h - q_l) - c - \alpha q_h^2 / 2 - (1 - \alpha) q_l^2 / 2 \\ \text{s.t.} \quad & q_h - q_l \geq \frac{c}{\alpha(1 - \alpha)(\theta_h - \theta_l)}. \end{aligned} \quad (IC'_d) \quad (10)$$

The constraint IC'_d ensures that conditions (8) and (9) hold simultaneously.

Solving the first-order conditions of problem (10), we obtain the unconstrained qualities. Substituting these unconstrained qualities into the binding constraint IC'_d identifies a cutoff value, $\hat{c}_1 = \alpha(\theta_h - \theta_l)^2$. When $c \leq \hat{c}_1$, problem (10) has unconstrained solutions. When $c > \hat{c}_1$, the problem is constrained, where $q_h = q_l + c / [\alpha(1 - \alpha)(\theta_h - \theta_l)]$. Substituting this equation into the objective function of problem (10) and solving the first-order condition with respect to q_l , we obtain the constrained qualities. In summary,

$$\begin{cases} q_h^d = \theta_h, & q_l^d = \theta_l - \frac{\alpha(\theta_h - \theta_l)}{1 - \alpha} & \text{if } c \leq \hat{c}_1; \\ q_h^d = \theta_h + \frac{c - \hat{c}_1}{\alpha(\theta_h - \theta_l)}, & q_l^d = \theta_l - \frac{c}{(1 - \alpha)(\theta_h - \theta_l)} & \text{if } c > \hat{c}_1. \end{cases} \quad (11)$$

For all values of c , we have $q_h^d - q_l^d > \theta_h - \theta_l$, which establishes Lemma 1.

We then ask how the resulting optimal profit Π^d changes with c . When $c \leq \hat{c}_1$, we apply the envelope theorem and obtain $\partial \Pi^d / \partial c = -1$. When $c > \hat{c}_1$, we substitute the constrained optimal q_h^d and q_l^d into the profit function and obtain $\partial \Pi^d / \partial c = -1 - (c - \hat{c}_1) / [\alpha(1 - \alpha)(\theta_h - \theta_l)^2] < -1$.

Finally, solving $q_l^d = 0$ from Equation (11) reveals the following cutoff value for α :

$$\hat{\alpha} = \begin{cases} \frac{\theta_l}{\theta_h} & \text{if } c \leq \hat{c}_1, \\ 1 - \frac{c}{\theta_l(\theta_h - \theta_l)} & \text{if } c > \hat{c}_1. \end{cases} \quad (12)$$

If the fraction of high-valuation consumers is sufficiently large ($\alpha \geq \hat{\alpha}$), the firm's optimization problem reaches a boundary solution, whereby the firm offers one product to serve high-valuation consumers exclusively—upon deliberation, consumers who find out that they have a low valuation will not buy. We explore this scenario in §A.1.2.

A.1.2. Boundary Solution (Serving High-Valuation Consumers Exclusively). The firm's optimization problem in the boundary scenario is

$$\begin{aligned} \max_{p, q \geq 0} \quad & \Pi = \alpha p - \alpha q^2 / 2 \\ \text{s.t.} \quad & \theta_h q - p \geq 0, & (IR_h) \\ & \theta_l q - p < 0, & (IR_l) \\ & -c + \alpha(\theta_h q - p) \geq \max(\theta_m q - p, 0). & (IC_d) \end{aligned} \quad (13)$$

Rearranging terms, the deliberation constraint becomes $\theta_l q + c / (1 - \alpha) \leq p \leq \theta_h q - c / \alpha$. For this constraint to hold, we need $\theta_l q + c / (1 - \alpha) \leq \theta_h q - c / \alpha$, or equivalently, $q \geq c / [\alpha(1 - \alpha)(\theta_h - \theta_l)]$. Note that the deliberation constraint implies both IR constraints. As a result, the optimal price is

$$p = \theta_h q - \frac{c}{\alpha}. \quad (14)$$

Given the optimal price, the firm's optimization problem becomes

$$\begin{aligned} \max_{q \geq 0} \quad & \Pi = \alpha \theta_h q - c - \alpha q^2 / 2 \\ \text{s.t.} \quad & q \geq \frac{c}{\alpha(1 - \alpha)(\theta_h - \theta_l)}. \end{aligned} \quad (IC'_d) \quad (15)$$

Solving the first-order condition of problem (15), we obtain the unconstrained quality as $q^d = \theta_h$. This quality will emerge as the optimal solution to problem (15) if it satisfies constraint IC'_d —that is, if $c \leq \hat{c}'_1 = \alpha(1 - \alpha)\theta_h(\theta_h - \theta_l)$. The optimal quality is

$$q^d = \begin{cases} \theta_h & \text{if } c \leq \hat{c}'_1, \\ \theta_h \frac{c}{\hat{c}'_1} & \text{if } c > \hat{c}'_1. \end{cases} \quad (16)$$

The optimal product quality is weakly higher than the efficient level for high-valuation consumers (θ_h). This result echoes that of the interior solution. To induce deliberation, the firm must uphold the quality of its product but offer a more accessible price.

Firm profit strictly decreases with the cost of deliberation. When $c \leq \hat{c}'_1$, by the envelope theorem, we have $\partial \Pi^d / \partial c = -1$. When $c > \hat{c}'_1$, we substitute the constrained optimal q^d into the profit function and obtain $\partial \Pi^d / \partial c = -1 - (c - \hat{c}'_1) / [\alpha(1 - \alpha)^2(\theta_h - \theta_l)^2] < -1$.

A.2. Product Line Tactics to Prevent Deliberation

We begin by simplifying the IC_{nd} constraint. Its right-hand-side term $\theta_h q - p$ is positive given the IR constraint; if an unsure consumer is willing to buy the product, a consumer who is certain about her high valuation for quality will buy as well. As a result, we only need to consider two possibilities: a consumer either buys or does not buy upon discovery of a low need for quality. The former case means that the consumer will buy regardless of her true type, which defeats the purpose of deliberation. Mathematically, constraint IC_{nd} holds with slack if $\theta_l q - p \geq 0$, in which case the firm will charge $p = \theta_l q$ to maximize profits. Therefore, the optimal price must satisfy $p \geq \theta_l q$ such that the consumer will weakly prefer not to buy upon realization of her low-quality valuation. The IC_{nd} constraint hence reduces to $\theta_m q - p \geq -c + \alpha(\theta_h q - p)$, or equivalently, $p \leq \theta_l q + c/(1 - \alpha)$. Either this simplified IC_{nd} constraint or the IR constraint must bind in equilibrium; otherwise, the firm can do better by increasing p infinitesimally. Therefore, the optimal price is

$$p = \min \left[\theta_l q + \frac{c}{(1 - \alpha)}, \theta_m q \right]. \quad (17)$$

If c is sufficiently large, $p = \theta_m q$. It follows that the firm solves the problem of $\max_q \{\theta_m q - q^2/2\}$, which yields $q^{nd} = \theta_m$. This unconstrained quality will emerge as the optimal quality as long as $\theta_l q^{nd} + c/(1 - \alpha) \geq \theta_m q^{nd}$, which is equivalent to $c \geq \hat{c}_2 = \alpha(1 - \alpha)\theta_m(\theta_h - \theta_l)$.

Similarly, if c is sufficiently small, $p = \theta_l q + c/(1 - \alpha)$. Substituting this price into the profit function, the firm solves the problem of $\max_q \{\theta_l q + c/(1 - \alpha) - q^2/2\}$, which yields $q^{nd} = \theta_l$. This unconstrained quality will emerge as the optimal quality as long as $\theta_l q^{nd} + c/(1 - \alpha) \leq \theta_m q^{nd}$, which is equivalent to $c \leq \hat{c}_3 = \alpha(1 - \alpha)\theta_l(\theta_h - \theta_l)$.

Note that $\hat{c}_3 < \hat{c}_2$. Therefore, if $\hat{c}_3 < c < \hat{c}_2$, then $\theta_l q + c/(1 - \alpha) = \theta_m q$, which yields the optimal quality $q = c/[\alpha \cdot (1 - \alpha)(\theta_h - \theta_l)]$.

In summary, the optimal product line tactics to prevent deliberation are

$$\begin{cases} q^{nd} = \theta_l, p^{nd} = \theta_l^2 + \frac{c}{1 - \alpha} & \text{if } c \leq \hat{c}_3; \\ q^{nd} = \frac{c}{\alpha(1 - \alpha)(\theta_h - \theta_l)}, \\ p^{nd} = \theta_m \frac{c}{\alpha(1 - \alpha)(\theta_h - \theta_l)} & \text{if } \hat{c}_3 < c < \hat{c}_2; \\ q^{nd} = \theta_m, p^{nd} = \theta_m^2 & \text{if } c \geq \hat{c}_2. \end{cases} \quad (18)$$

The optimal quality, price, and hence profit are all continuous and weakly increasing in c . Specifically, $\partial \Pi^{nd} / \partial c$ equals $1/(1 - \alpha)$ for $c \in [0, \hat{c}_3]$, 0 for $c \in [\hat{c}_2, \infty)$, and $(\hat{c}_2 - c)/[\alpha^2(1 - \alpha)^2(\theta_h - \theta_l)^2] > 0$ for $c \in (\hat{c}_3, \hat{c}_2)$.

References

- Bar-Isaac H, Caruana G, Cuñat V (2010) Information gathering and marketing. *J. Econom. Management Strategy* 19(2):375–401.
- Bertini M, Wathieu L, Iyengar SS (2012) The discriminating consumer: Product proliferation and willingness to pay for quality. *J. Marketing Res.* 49(1):39–49.
- Bhardwaj P, Chen Y, Godes D (2008) Buyer-initiated vs. seller-initiated information revelation. *Management Sci.* 54(6):1104–1114.
- Bradlow ET, Hu Y, Ho T-H (2004) A learning-based model of imputing missing levels in partial conjoint profiles. *J. Marketing Res.* 41(4):369–381.
- Desai PS (2001) Quality segmentation in spatial markets: When does cannibalization affect product line design? *Marketing Sci.* 20(3):265–283.
- Desai P, Kekre S, Radhakrishnan S, Srinivasan K (2001) Product differentiation and commonality in design: Balancing revenue and cost drivers. *Management Sci.* 47(1):37–51.
- Ding M, Park Y-H, Bradlow ET (2009) Barter markets for conjoint analysis. *Management Sci.* 55(6):1003–1017.
- Ding M, Hauser J, Dong S, Dzyabura D, Yang Z, Su C, Gaskin S (2011) Unstructured direct elicitation of decision rules. *J. Marketing Res.* 48(1):116–127.
- Dzyabura D (2012) Recommending products as consumers learn their preferences through product experience. Working paper, New York University, New York.
- Festinger L (1957) *A Theory of Cognitive Dissonance* (Stanford University Press, Stanford, CA).
- Green PE (1974) On the design of choice experiments involving multifactor alternatives. *J. Consumer Res.* 1(2):61–68.
- Guo L, Iyer G (2010) Information acquisition and sharing in a vertical relationship. *Marketing Sci.* 29(3):483–506.
- Hauser JR, Wernerfelt B (1990) An evaluation cost model of consideration sets. *J. Consumer Res.* 16:393–408.
- Hauser JR, Dong S, Ding M (2012) Self-reflection and articulated consumer preferences. *J. Product Innovation Management*. Forthcoming.
- Iyer G, Kuksov D (2010) Consumer feelings and equilibrium product quality. *J. Econom. Management Strategy* 19(1):137–168.
- Kahn BE, Meyer RJ (1991) Consumer multiattribute judgments under attribute-weight uncertainty. *J. Consumer Res.* 17(4):508–552.
- Kuksov D, Lin Y (2010) Information provision in a vertically differentiated competitive marketplace. *Marketing Sci.* 29(1):122–138.
- Kuksov D, Villas-Boas JM (2010) When more alternatives lead to less choice. *Marketing Sci.* 29(3):507–524.

- Lewis TR, Sappington DEM (1994) Supplying information to facilitate price discrimination. *Internat. Econom. Rev.* 35(2): 309–307.
- Lichtenstein S, Slovic P (2006) *The Construction of Preference* (Cambridge University Press, New York).
- Liu Y, Cui TH (2010) The length of product line in distribution channels. *Marketing Sci.* 29(3):474–482.
- Moorthy KS (1984) Market segmentation, self-selection, and product line design. *Marketing Sci.* 3(4):288–307.
- Mussa M, Rosen S (1978) Monopoly and product quality. *J. Econom. Theory* 18(2):301–307.
- Orhun AY (2009) Optimal product line design when consumers exhibit choice set-dependent preferences. *Marketing Sci.* 28(5):868–886.
- Payne JW, Bettman JR, Johnson EJ (1988) Adaptive strategy selection in decision making. *J. Experiment. Psych.: Learn., Memory, Cognition* 14(3):534–552.
- Payne JW, Bettman JR, Johnson EJ (1993) *The Adaptive Decision Maker* (Cambridge University Press, Cambridge, UK).
- Shugan SM (1980) The cost of thinking. *J. Consumer Res.* 7(2):99–111.
- Simester D, Zhang J (2010) Why are bad products so hard to kill? *Management Sci.* 56(7):1161–1179.
- Simonson I (2008) Will I like a “medium” pillow? Another look at constructed and inherent preferences. *J. Consumer Psych.* 18(3):155–169.
- Stole LA (2007) Price discrimination and competition. Armstrong M, Porter RH, eds. *Handbook of Industrial Organization*, Vol. 3 (Elsevier, Amsterdam), 2221–2300.
- Tesser A, Martin LL, Mendolia M (1995) The impact of thought on attitude extremity and attitude-behavior consistency. Petty RE, Krosnick JA, eds. *Attitude Strength: Antecedents and Consequences* (Lawrence Erlbaum Associates, Mahwah, NJ), 73–92.
- Tversky A, Simonson I (1993) Context-dependent preferences. *Management Sci.* 39(10):1179–1189.
- Villas-Boas JM (1998) Product line design for a distribution channel. *Management Sci.* 17(2):156–169.
- Villas-Boas JM (2004) Communication strategies and product line design. *Marketing Sci.* 23(3):304–316.
- Villas-Boas JM (2009) Product variety and endogenous pricing with evaluation costs. *Management Sci.* 55(8):1338–1346.
- Wathieu L, Bertini M (2007) Price as a stimulus to think: The case for willful overpricing. *Marketing Sci.* 26(1):118–129.
- Wathieu L, Brenner L, Carmon Z, Chattopadhyay A, Wertebroch K, Drolet A, Gourville J, et al. (2002) Consumer control and empowerment: A primer. *Marketing Lett.* 13(3):297–305.
- Wernerfelt B (1994) Selling formats for search goods. *Marketing Sci.* 13(3):298–309.
- Wernerfelt B (1995) A rational reconstruction of the compromise effect: Using market data to infer utilities. *J. Consumer Res.* 21(4):627–633.