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Managing Consumer Deliberations in a Decentralized Distribution Channel

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Abstract. Consumers may incur deliberation costs in learning about their valuations for new products. When the deliberation cost is not trivial, the retailer may set a low price to inhibit deliberation (*regressive pricing*) or choose a high price to induce deliberation (*transgressive pricing*). In a decentralized channel, we find that, first, the retailer is more likely to adopt the regressive pricing (versus transgressive pricing) when the wholesale price is lower. In response, the manufacturer sets a high (low) wholesale price to induce the transgressive (regressive) pricing when the deliberation cost is intermediate (high). Second, channel members can be misaligned in the incentive in investing in consumer empowerment. The ability to empower consumers and reduce their deliberation costs enhances the retailer's channel power and its share of channel profit. Finally, the manufacturer may offer a socially suboptimal product quality because a high quality can lead to excessive deliberation. These nontrivial effects of the deliberation cost underscore the importance of considering consumer deliberations in channel management. The insights are robust under a positive production cost, heterogeneous deliberation costs, continuous deliberation efforts, and a channel structure with multiple layers.

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> You might think of consumption as a fairly passive activity, but buying new products and services is actually pretty risky, at least if you value your time and money. —James Surowiecki, American journalist[1]

1. Introduction

An effective distribution strategy for a new product requires successful coordination of channel members in the provision of key channel functions. Among them, product information stands at the top of the list, especially for products that are technically complex and susceptible to rapid technological changes (Rangan et al. 1992). Because these products are new to the market, consumers have had no previous experience with the new features or technologies and are therefore uncertain about how the products can be valuable to them. Any attempt to resolve the uncertainty will require expensive efforts by the consumers. For example, when Huawei launched its Mate 10 smartphone in 2017, the company's advertisement highlighted the Kirin 970: "World's first Kirin AI [artificial intelligence] processor." With the new processor, the phone "can not only see and hear, but also think." Supported by strong chip processing capabilities, the Mate 10 could be more cognitive of user needs and provide truly personalized and readily accessible services.[2] However, because the mobile AI platform was completely new to the market, consumers would need to find out the specific benefits of the new technology and how these benefits could be relevant to them. For example, the Kirin 970 offered super fast object recognition and could enable automatic mode selection. At the same time, AI features could raise privacy concerns; "for some consumers AI features felt unnatural or 'creepy'" (Reigh 2017, Rutherford 2017). As one of Huawei's senior managers wondered, "whether its advantages would result in benefits consumers perceived relevant to them was yet to be seen" (Ofek et al. 2018). Consider another example: When drones were first introduced to the market, potential buyers had no prior experience of aerial photography or surveillance. They would have found it difficult to assess the exact values of features such as flying range and obstacle avoidance. Consumers would have needed to simulate the specific contexts of using drones and find out the relevance of benefits from these features. The cost of such thinking

efforts, defined as *deliberation cost*, has been well documented in the literature (e.g., Shugan 1980).

Recently, researchers have begun to investigate the implications of the deliberation cost on a seller's marketing decisions. Research shows that a seller may strategically induce or inhibit a consumer's deliberation efforts through decisions on price and consumer empowerment (Wathieu and Bertini 2007) or quality decisions in a product line (Guo and Zhang 2012). However, how deliberation cost may affect a manufacturer's decisions and channel relations in a decentralized channel remains an unanswered question. For a consumer product, the retailer controls the retail interface and directly influences consumer deliberation through retail price and empowerment activities such as store displays and sales assistance. But the manufacturer can use the wholesale price to sway the retail decisions and indirectly influence consumer deliberation. Furthermore, the manufacturer can affect the consumer's deliberation decision and the retailer's responses through product-related decisions such as product quality (Guo and Zhang 2012). For instance, by offering a higher quality, the manufacturer can increase the uncertainty of value and hence the expected benefits of consumer deliberation.

This paper studies the effects of deliberation cost in a decentralized channel, where a manufacturer sells a product to a retailer at a wholesale price. The retailer then chooses a retail price and resells the product to consumers. Such a distribution channel is common; for example, Huawei sold its Mate 10 smartphone through Best Buy in the North American market. To be consistent with the extant literature, our assumptions on consumer behavior and hence the results on retail pricing are very similar to those of Wathieu and Bertini (2007). The model assumes that individual product valuations become more dispersed after consumers deliberate. Given the cost of deliberation, it is optimal for consumers to deliberate if and only if the market price falls into an intermediate range (*thought-provoking prices*). If the retail price is very low, the consumers will buy without deliberation (*no-brainer purchases*). If the retail price is very high, they will neither deliberate nor purchase. Thus, the retailer can either price very low to inhibit deliberation and sell to the entire market (*regressive pricing strategy*) or price in the middle range to induce deliberation and sell only to those consumers who realize high private valuations after deliberation (*transgressive pricing strategy*).

We examine the decisions of the manufacturer who correctly anticipates the above effects of deliberation cost on the behavior of the retailer and consumers. We find that the optimal wholesale price depends on the consumer deliberation cost. In the absence of deliberation cost, the manufacturer and the retailer each choose an optimal margin to maximize their individual profits; this process of double marginalization leads to a retail price higher than the channel-optimal price. With consumer deliberation cost, the retailer no longer simply responds to the wholesale price with a retail margin. Instead, it chooses between the regressive and transgressive pricing strategies to influence consumers' deliberation decisions. Given the deliberation cost, the retailer is more likely to choose regressive pricing (versus transgressive pricing) when the wholesale price is lower. In anticipation of such retailer behavior, the manufacturer charges a low wholesale price to induce the regressive pricing when the deliberation cost is high. If the deliberation cost is intermediate, the manufacturer charges a high wholesale price to induce the transgressive pricing. Thus, the wholesale price serves the dual function of allocating the channel profit shared with the retailer and influencing the retail price to obtain the preferred level of consumer deliberation. We find the above results to be robust when we extend the model to consider positive production costs, heterogeneous deliberation costs, continuous deliberation efforts, and a channel structure with additional layers of channel intermediaries.

The deliberation cost changes the balance of power between channel members. On the one hand, deliberation cost creates a ceiling for the retail price above which the consumers will neither deliberate nor purchase (*no-brainer no purchase*). As a result, when the wholesale price is high, the retailer loses pricing flexibility and cannot obtain a proper retail margin. Relatively speaking, when the deliberation cost goes up, this price ceiling moves down, and the retailer becomes less powerful. On the other hand, the retailer gains power from managing the channel interface and directly influencing the consumers' deliberation decision. When the retailer can choose from the transgressive and regressive pricing strategies, the manufacturer has to give enough incentive through a low wholesale price to direct the retailer to the regressive pricing. Such a power gain for the retailer reaches its maximum when the deliberation cost is at a moderate level. Combining these two effects, we find that the manufacturer's profit increases with the deliberation cost, but the retailer's profit peaks at a moderate level of deliberation cost.

In practice, both the upstream and downstream companies could engage in *consumer empowerment* activities to reduce deliberation costs (Wathieu and Bertini 2007). Best Buy can provide point-of-purchase demonstrations to project consumers into usage scenarios, and train its Geek Squad to explain the benefits of AI processors in different contexts. As consumers project themselves into specific user experiences, they will find it much easier to evaluate the benefits and assess the personal relevance of new technologies. Manufacturers can also

empower consumers through online communications. In the drone market, a manufacturer can produce videos describing possible uses. For instance, DJI, the world's largest drone manufacturer, posted a video showing that its Phantom 4 drone can fly up and close to a volcano and take shots of lava. This benefit could be very relevant for some landscape photographers, but not as much for most recreational users. Our results indicate that the manufacturer and retailer have different incentives in engaging consumer empowerment. Overall, a retailer's ability to reduce deliberation cost increases the retailer's power and its share of channel profit. If the production cost is low, the manufacturer may prefer not to reduce the deliberation cost. In this case, the manufacturer would offer a low wholesale price to induce a low retail price and no-brainer consumer purchases. However, if the production cost is very high and close to the expected value without deliberation, then the manufacturer may consider reducing deliberation cost through its direct-to-consumer empowerment activities.

Finally, the consideration of deliberation cost can change the manufacturer's optimal quality decision. Although product decisions do not normally belong to the domain of channel management, they become a relevant issue because the level of product quality can affect the consumer's uncertainty in product evaluations. A manufacturer may provide a higher quality by offering a better AI processor in a phone or an extended flying range of a drone. The higher quality will raise expected consumer valuations on the one hand, and amplify consumer uncertainty and the incentive for deliberation on the other hand. We find that consumers' deliberation costs can move the equilibrium product quality below the socially optimal level. A higher product quality, by encouraging consumer deliberation, can improve the retailer's power and reduce the manufacturer's share of channel profit. Such quality distortion is less severe when the deliberation cost is higher.

Our research builds on the existing literature on deliberation cost. Shugan (1980) provides the first systematic discussion of the necessity of incorporating the deliberation cost into marketing models. However, formal studies of how the deliberation cost can affect strategic marketing decisions have appeared only recently. Wathieu and Bertini (2007) propose and examine the first model of consumer deliberation. They show that the seller may price strategically, using either transgressive pricing to induce or regressive pricing to inhibit consumer deliberations. The analysis and results at the retail level in this paper are very similar to theirs. Guo and Zhang (2012) extend the study to the context of product line design. They find that when the deliberation cost is small, the firm might maintain a minimum quality gap between its different products to induce deliberation; in contrast, when the deliberation cost is high, the firm might reduce the quality of a product to inhibit deliberation. Xiong and Chen (2013) study a similar product line design problem with deliberation cost, with an assumption that consumers must pay an upfront fee to obtain the products. Recent research in this area has also investigated the relationship between the deliberation decision and some well-discussed consumer behaviors such as the anchoring effect (Guo and Hong 2013) and compromise effect (Guo 2016). The paper is also closely related to the work of Liu and Xiao (2014), who study the competition between store brand and national brand in the presence of consumer deliberation. Besides some differences in modeling setup that are critical to our results, our paper studies equilibrium consumer empowerment and endogenous quality decisions not considered by Liu and Xiao (2014).

Advance selling is another context where firms market their products or services to consumers facing valuation uncertainty (Shugan and Xie 2000, Xie and Shugan 2001). Whereas consumer uncertainty is resolved naturally over time in advance selling, in the present paper, the valuation uncertainty is resolved immediately if and only if a consumer incurs a deliberation cost. Although these contexts are conceptually different, firms face a common decision: whether selling to the entire market before the uncertainty is resolved or selling to the high-valuation segment only after the uncertainty is resolved. One would then expect some similar results in these two contexts. For example, among many results, research has shown that the advance selling strategy is more profitable (than optimal spot selling) when the firm's unit cost is sufficiently low. Although the issue of cost is not explicitly discussed by Wathieu and Bertini (2007), intuitively one would expect that, given all others the same, a firm should be more likely to adopt the regressive pricing strategy when the unit cost is low. However, the conceptual differences in these two contexts lead to very different research focuses. The literature on deliberation cost, including the present paper, focuses on the insights related to the size of deliberation cost. Specifically, the core results of Wathieu and Bertini (2007) are the seller's retail pricing and consumer empowerment decisions for different levels of deliberation costs. Similarly, our paper studies the effect of deliberation cost on wholesale prices and how channel members may manage the deliberation behavior through consumer empowerment and quality decisions.

This paper contributes to the large body of literature on distribution channel management. The issue of double marginalization and its effect on channel efficiency in a decentralized channel has been widely discussed (e.g., Spengler 1950, Jeuland and Shugan 1983,

Tirole 1988). Standard marketing decisions often need to be distorted when examined in a decentralized channel. For instance, Villas-Boas (1998) shows that the manufacturer needs to distort the product line design in a decentralized channel. The quality of the low-end product should be significantly distorted downward. Bhargava (2012) investigates the performance of product bundling in a channel and finds that the retailer is less likely to offer a bundle of products when the manufacturer posts a sufficiently high wholesale price. Liu and Zhang (2006) examine the effectiveness of personalized pricing in a channel and show that personalized pricing can be detrimental to a retailer. Research has also investigated quality disclosure decisions by the manufacturer and the retailer (e.g., Guo 2009, Guo and Iyer 2010, Sun 2015). For instance, Guo and Iyer (2010) demonstrate that the manufacturer may refrain from acquiring perfect consumer information, even if it would cost nothing to do so. In the same spirit, we extend the literature by examining the impact of deliberation cost on channel management. Our results show that the channel members may prefer different levels of consumer deliberation efforts.

The rest of this paper is organized as follows. We start with the main model in Section 2, where the manufacturer manages the channel through the wholesale price. In this section, we discuss the effect of deliberation cost on the equilibrium wholesale and retail prices as well as the effect on the value of vertical integration. We then extend the model to discuss two alternative ways the manufacturer can directly manage deliberation behavior: reducing deliberation cost through consumer empowerment (Section 3) and managing product uncertainty through quality decision (Section 4). Then, in Section 5, we examine the robustness of our main results when we consider a positive production cost, when the market consists of consumers with heterogeneous deliberation costs, when the deliberation effort is continuous, and when a channel has an extra layer of intermediary. Finally, we conclude this paper in Section 6.

2. Consumer Deliberation and Channel Management: Main Model and Analysis

In this section, we present the main model and analysis. We consider a decentralized channel where a manufacturer manages the channel relationship with a retailer through the wholesale price. The performance of such a channel typically suffers from the double marginalization problem. We study how consumer deliberation cost may affect the equilibrium wholesale price and moderate the channel coordination problem. We will also discuss how consumer deliberation cost can change the benefit of vertical integration as a mechanism to achieve channel coordination.

2.1. Model Setup

Consider a market where a manufacturer distributes a new product to consumers through a retailer. The retailer buys the product from the manufacturer at a wholesale price w and resells the product to consumers at a retail price p. Such a linear wholesale contract has been widely observed in practice and is commonly adopted in the distribution channel literature (e.g., Desai and Srinivasan 1995, Bajari and Tadelis 2001, Iyer and Villas-Boas 2003, Cui et al. 2007). We assume that the unit production cost is zero. We will later relax this assumption and consider a positive production cost in Section 5.1 to better understand the boundary conditions.

Our model of consumer deliberation and purchase decisions closely follows the models of Wathieu and Bertini (2007) and Guo and Zhang (2012). The imitation allows us to build on the extant literature and focus on the implications of consumer deliberations for channel management. Following Wathieu and Bertini (2007), we assume that the product is new to the entire market. As a result, all consumers face uncertain valuations for the benefit of the product. A consumer i's prior valuation of the new product (denoted by v_i) follows a uniform distribution over $[0, 1]$. This prior valuation may reflect the consumer's first impression of the product. The manufacturer and the retailer have the same knowledge about this prior distribution, often obtained through their market research. But the consumers can completely resolve the uncertainty about their valuations for the new product through deliberations. In other words, consumer learning from deliberation is perfect. (We relax this assumption in Section 5.3.) The valuation can vary among consumers because of different personal preferences. In the assumed model, the realized value will be a random draw from $[0, 1]$ with equal probability, thereby reflecting the calibration of prior belief. This rational expectation assumption is common in the literature to rule out biased beliefs as the cause of market outcomes (e.g., Guo and Zhang 2012). We assume that the deliberation efforts are costly for the consumers. The deliberation cost, denoted by $c > 0$, reflects the cognitive effort invested in the evaluation process. Neither firm (the manufacturer or the retailer) has the means to assess the valuation (v_i) of individual consumers beyond its probability distribution. Thus, ex post, after consumer deliberation, the firms and consumers will experience information asymmetry regarding individual consumers' product valuations. Both the deliberation cost c and the valuation distribution are common knowledge in the market. Table 1 summarizes the notations.

The market consists of a unit mass of consumers. Each consumer chooses between buying one unit of this product and receiving an outside option. Value of

Table 1. Table of Notations

Basic model		
c		Deliberation cost
i		Index of a consumer
v_i	$\sim$	U[0, 1], consumer i's valuation
w		Wholesale price
p		Retail price
$D(p)$		Retail demand when retail price is p
π_m		Manufacturer's profit
π_r		Retailer's profit
π_c	$\triangleq$	$\pi_m + \pi_r$, channel profit
Endogenous quality		
q		Quality of product
θ_i	$\sim$	U[0, 1], consumer i's marginal willingness to pay for quality

the outside option is normalized to zero. Following Wathieu and Bertini (2007) and Guo and Zhang (2012), we assume that without deliberation, consumers have homogeneous product valuations. In this case, a representative consumer buys the product if and only if the expected value exceeds price p. All consumers will hold the average valuation for the product, which is equal to $\frac{1}{2}$. The implicit assumption that deliberation increases heterogeneity in consumer valuation follows Wathieu and Bertini (2007) and Guo and Zhang (2012), and is consistent with the evidence from consumer psychology research that these two papers discussed fairly extensively (e.g., Tesser et al. 1995). If the consumer chooses to deliberate, then he or she will make more accurate purchase decisions. More specifically, a consumer makes a purchase if and only if the realized valuation is greater than price p. When deciding whether to deliberate, a consumer is faced with the trade-off between making an informed decision and incurring the deliberation cost. To break ties, we assume that when a consumer is indifferent about buying or not, he or she always makes a purchase.

All parties are risk neutral and make their decisions to maximize their own expected payoffs. The sequence of the game is as follows. First, the manufacturer chooses the wholesale price w. After observing the wholesale price, the retailer decides on the retail price p. Finally, after observing the retail price p, consumers decide whether to deliberate and, depending on that decision, whether to buy.

2.2. Model Analysis

We now analyze the main model to investigate the effect of deliberation cost on channel management. We adopt the standard backward induction approach, starting with consumer decisions, followed by the retailer's price decision, and then the manufacturer's decision on the wholesale price. After describing the equilibrium results, we will discuss the effect of deliberation cost on channel relations. Throughout this paper, we have achieved closed-form solutions for all the main results, and our results are based on the analysis of pure strategy equilibrium only. We will also use Pareto dominance criteria to eliminate dominated pure strategy equilibrium. More specifically, if two different wholesale prices lead to the same profit for the manufacturer but different profits for the retailer, we will eliminate the dominated equilibrium and retain only the dominant equilibrium. Additional analysis and all the proofs can be found in the appendix.

Before we discuss the results, it is useful to note the results in a benchmark model where consumers know their own valuations even without deliberation. (Alternatively, one may interpret this as a model with zero deliberation cost for all consumers.) In this benchmark model, the retail demand is a linear function of the retail price: $D(p) = 1 - p$. Such a linear demand function is common in the channel literature (e.g., McGuire and Staelin 1983, Moorthy 1988). With double marginalization, the equilibrium wholesale price is $w = \frac{1}{2}$, and the equilibrium retail price is $p = \frac{3}{4}$.

2.2.1. Consumer Deliberation and Purchase Decisions.

When consumers arrive at the market, they all observe the product with a common prior valuation and retail price p. First they decide whether to deliberate. If consumer i deliberates, he or she makes a purchase if and only if the realized private valuation is $v_i \geq p$. Thus, the expected payoff from deliberation is $E(v_i - p)^+ - c = \frac{(1-p)^2}{2} - c$, where $(\cdot)^+ = \max\{\cdot, 0\}$. On the other hand, if a consumer chooses not to deliberate, he or she relies on his or her prior belief to make purchase decision. Because all the consumers share the same prior belief and hold the same expected valuation, which is equal to $\frac{1}{2}$, they will all make the same purchase decision. As a result, each consumer's expected payoff is $(Ev_i - p)^+ = (\frac{1}{2} - p)^+$. Following the same logic, all consumers should make the same decision about deliberation: either they all deliberate or none of them deliberate. By comparing the expected gains in payoff from deliberation or no deliberation, we obtain the following lemma.

Lemma 1. *When $c \leq \frac{1}{8}$,*

(i) *if $p \leq \sqrt{2c}$, consumers purchase without deliberation;*

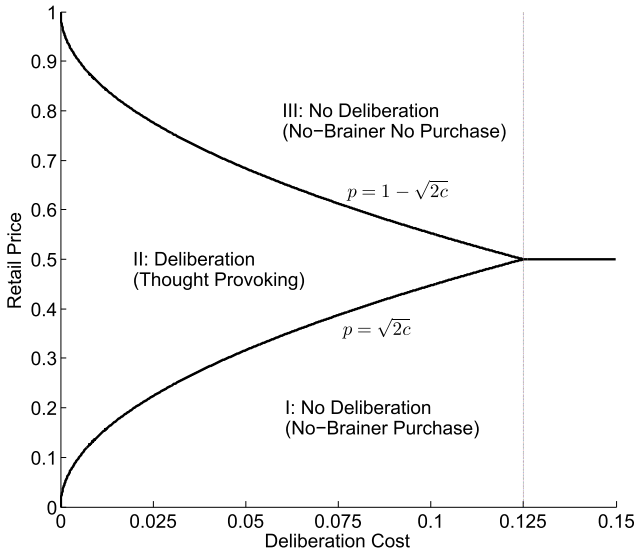
(ii) *if $\sqrt{2c} < p \leq 1 - \sqrt{2c}$, consumers deliberate; they purchase when their private valuation is no lower than p;*

(iii) *if $p > 1 - \sqrt{2c}$, consumers neither deliberate nor purchase.*

When $c > \frac{1}{8}$, consumers do not deliberate; they make purchases if and only if $p \leq \frac{1}{2}$.

Lemma 1 shows that a consumer's deliberation decision depends on retail price and deliberation cost.

Figure 1. Consumer Deliberation Behavior vs. Retail Price



(See Figure 1 for a graphic illustration.) These results are essentially the same as those of Wathieu and Bertini (2007). Briefly, consumers deliberate if the deliberation cost is low enough and the retail price falls in a middle range. The intuitive explanation for the result is that deliberation is beneficial to consumers only if the deliberation is likely to change their purchase decisions. When the price is very low (or high), consumers are very likely (or unlikely) to purchase. In both cases, the deliberation is unlikely to change the purchase decisions, and therefore the benefit of deliberation is lower than the cost of deliberation. Wathieu and Bertini (2007, p. 121) refer to this scenario as a "no-brainer" with purchase (or no purchase). Deliberation is more beneficial and likely to occur when the price falls in the middle range, which Wathieu and Bertini (2007) refer to as the "thought-provoking price range." Wathieu and Bertini (2007) provide empirical evidence to validate that midrange prices are indeed more thought provoking and induce additional deliberations, whereas low or high prices can lead to no-brainer responses of purchasing or not purchasing.

In the case of a sufficiently high deliberation cost, $c > \frac{1}{8}$, consumers will never deliberate and will simply base their purchase decisions on prior beliefs and expected valuations. In this case, any reasonable retail price cannot induce consumer deliberation. Because a manufacturer's wholesale price can influence consumer deliberation only through the retail price, in this case, the manufacturer cannot induce consumer deliberation either. Thus, this case of very high deliberation cost is unlikely to generate any interesting insights for channel management. In the rest of this paper, we will focus on the case where $c \le \frac{1}{8}$. For reference, we include a full analysis of the case of $c > \frac{1}{8}$ in the online appendix.

2.2.2. Retail Price Decision. We now analyze the retailer's price decision when $c \le \frac{1}{8}$. Given the wholesale price w, the retailer chooses retail price p to maximize its profit. According to Lemma 1, the retail price can affect consumer deliberation as a stimulus to think in addition to affecting purchase decisions as an incentive. Retail price has the usual and monotonic impact on the consumer's incentive to purchase. But the effect of price as a stimulus to think is not monotonic: a low price (below $\sqrt{2c}$) inhibits thinking, raising the price to the middle range induces thinking, but a further increase (above $1 - \sqrt{2c}$) inhibits thinking again.

When setting the retail price, the retailer considers both options of inducing and inhibiting consumer deliberation. In the appendix, we first analyze retail pricing and profits in these two distinct scenarios separately, and then derive the retailer's optimal response, which maximizes its profit. We present the results in Proposition 1 and include the details of analysis in the appendix.

Proposition 1. *The retailer's optimal response to wholesale price w is as follows*:

(i) *When* $\frac{7-3\sqrt{5}}{4} < c \le \frac{1}{8}$,

- *if* $\frac{2c}{1-\sqrt{2c}} < w \le 1 - \sqrt{2c}$, *the retail price is* $p = 1 - \sqrt{2c}$, *and total sales are* $\sqrt{2c}$;
- *if* $w \le \frac{2c}{1-\sqrt{2c}}$, *the retail price is* $p = \sqrt{2c}$, *and total sales are 1*.

(ii) *When* $\frac{1}{32} < c \le \frac{7-3\sqrt{5}}{4}$,

- *if* $1 - 2\sqrt{2c} \le w \le 1 - \sqrt{2c}$, *the retail price is* $p = 1 - \sqrt{2c}$, *and total sales are* $\sqrt{2c}$;
- *if* $2\sqrt[4]{2c} - 1 < w < 1 - 2\sqrt{2c}$, *the retail price is* $p = \frac{1+w}{2}$, *and total sales are* $\frac{1-w}{2}$;
- *if* $w \le 2\sqrt[4]{2c} - 1$, *the retail price is* $p = \sqrt{2c}$, *and total sales are 1*.

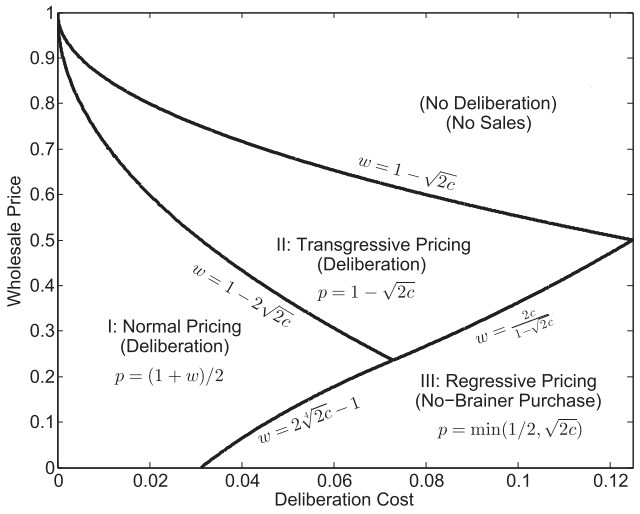
(iii) *When* $c \le \frac{1}{32}$,

- *if* $1 - 2\sqrt{2c} \le w \le 1 - \sqrt{2c}$, *the retail price is* $p = 1 - \sqrt{2c}$, *and total sales are* $\sqrt{2c}$;
- *if* $w < 1 - 2\sqrt{2c}$, *the retail price is* $p = \frac{1+w}{2}$, *and total sales are* $\frac{1-w}{2}$.

We illustrate Proposition 1 in Figure 2. The proposition focuses on the areas where wholesale price w is sufficiently low (below $1 - \sqrt{2c}$). When the wholesale price w is above $1 - \sqrt{2c}$ (as in the top region of Figure 2), the retail price will be forced to exceed $1 - \sqrt{2c}$, and then consumers will neither deliberate nor purchase according to Lemma 1. This corresponds to the no-brainer no purchase scenario where both the manufacturer and retailer receive zero sales and profit, a clearly suboptimal outcome. After excluding this scenario, the retailer limits its attention to the trade-off between the thought-provoking and no-brainer purchase scenarios.

As shown in Figure 2, if the deliberation cost is so low that $c \le \frac{1}{32}$, consumers will always deliberate. In

Figure 2. Retailer's Optimal Response to the Wholesale Price (w)



other words, all reasonable retail prices (below $1 - \sqrt{2c}$) will be thought provoking. If the deliberation cost is not too low such that $\frac{1}{32} < c \le \frac{1}{8}$, the retailer can either charge a low price (equal to $\sqrt{2c}$) so that no consumer will deliberate and all consumers will buy or charge a middle-level price to induce deliberation. The first approach leads to the no-brainer purchase scenario, giving the retailer a low retail margin but a high sales volume. The second approach leads to the thought-provoking scenario, giving the retailer a higher margin but a lower sales volume. Proposition 1 states that the retailer's choice between these two options depends on the wholesale price w. When the wholesale price is low, the retailer is more likely to prefer the no-brainer purchase scenario and price low to inhibit deliberation. Otherwise, the retailer prefers to charge a middle-level thought-provoking price.

Within the range of thought-provoking prices, Figure 2 shows two distinctive cases depending on whether the wholesale price w is higher than $1 - 2\sqrt{2c}$. When the wholesale price is low, the retailer charges a retail price $p = \frac{1+w}{2}$, the outcome of double marginalization (*normal pricing*). Otherwise, the retailer sets the retail price at $p = 1 - \sqrt{2c}$, the upper bound to maintain a thought-provoking price and ensure positive sales and profit. As the deliberation cost c increases, this upper bound price decreases.

In summary, in the presence of deliberation cost, a retailer may not follow the standard double marginalization practice for two possible reasons. First, when the wholesale price is low and deliberation cost is high, the retailer may set a lower retail price to induce no-brainer purchases. Second, when the wholesale price is high, the retailer may limit its retail margin to maintain its price thought provoking. These two types of retail responses have spirits similar to those of regressive pricing and transgressive pricing, respectively, as defined by Wathieu and Bertini (2007). For expositional convenience, in the rest of this paper, we will use these two terms to refer to the respective scenarios.

2.2.3. Optimal Wholesale Price Decision. We now move upstream to analyze the manufacturer's decision about its wholesale price. The manufacturer correctly anticipates how its wholesale price will directly affect the retailer's price decision and hence indirectly affect the consumers' deliberation and purchase decisions. Specifically, the manufacturer chooses a wholesale price for a desired retailer response, which can be regressive pricing, normal pricing, or transgressive pricing, as indicated by Proposition 1. A formal analysis of the manufacturer's problem leads to the optimal wholesale price summarized in the following proposition.

Proposition 2. (i) *When* $c \le \frac{3-2\sqrt{2}}{16}$, *the equilibrium wholesale price is* $w = \frac{1}{2}$, *the retail price is* $p = \frac{3}{4}$, *and consumers deliberate.*

(ii) *When* $\frac{3-2\sqrt{2}}{16} < c < \frac{7-3\sqrt{5}}{4}$, *the equilibrium wholesale price is* $w = 1 - \sqrt{2c}$, *the retail price is* $p = 1 - \sqrt{2c}$, *and consumers deliberate.*

(iii) *When* $\frac{7-3\sqrt{5}}{4} \le c \le \frac{1}{8}$, *the equilibrium wholesale price is* $w = \frac{2c}{1-\sqrt{2c}}$, *the retail price is* $p = \sqrt{2c}$, *and consumers do not deliberate.*

Proposition 2 shows three regions of deliberation cost c, each region corresponding to one unique type of optimal channel strategy. Under the small, intermediate, and large deliberation costs, the manufacturer chooses wholesale prices that result in the retailer responding with normal pricing, transgressive pricing, and regressive pricing, respectively.

When the deliberation cost is small, consumers deliberate and know their private valuations. The equilibrium results are identical to those of the benchmark case without deliberation cost. Given the wholesale price $\frac{1}{2}$, the equilibrium retail price is $\frac{3}{4}$ because of double marginalization. In essence, because the deliberation cost is so small ($c \le \frac{3-2\sqrt{2}}{16}$), the optimal retail price $\frac{3}{4} \le 1 - \sqrt{2c}$ is thought provoking. In this case, the wholesale margin ($\frac{1}{2}$), the retail margin ($\frac{1}{4}$), and retail demand ($\frac{1}{4}$) are all constant and independent of the size of deliberation cost. However, the expected consumer surplus, which is $\frac{(1-p)^2}{2} - c = \frac{1}{32} - c$, decreases with the deliberation cost.

When the deliberation cost is of an intermediate value, both the equilibrium wholesale and retail prices are equal to $1 - \sqrt{2c}$. This is the highest thought-provoking price. As shown in Figure 2, within this range of deliberation cost, depending on the wholesale price, the retailer may follow regressive, normal, or transgressive

pricing. For the regressive pricing to occur, the wholesale price has to be as low as $w \le 2\sqrt[4]{2c} - 1$, which increases with the deliberation cost. Thus, charging a low wholesale price to induce regressive pricing is not optimal. When the wholesale price is above $1 - 2\sqrt{2c}$, the retailer will prefer to charge the transgressive price $1 - \sqrt{2c}$ over normal pricing to ensure positive sales. Interestingly, because the transgressive price is not responsive to the wholesale price, it is optimal for the manufacturer to charge a wholesale price at the same level (or slightly below it) for maximum profit. In the equilibrium, the retailer makes nearly zero profit. This equilibrium result demonstrates a dramatic effect of the deliberation cost on channel relations: the retailer's aversion to the no-brainer no purchase scenario and the adoption of transgressive pricing minimizes its share of channel profit. Moreover, within the intermediate range of deliberation cost, as the deliberation cost increases, both the wholesale and retail prices go down, and sales go up.

When the deliberation cost is relatively high (above $\frac{7-3\sqrt{5}}{4}$), the optimal wholesale price is $w = \frac{2c}{1-\sqrt{2c}}$, and the retail price is $\sqrt{2c}$. The retailer follows the regressive pricing, which leads to the no-brainer purchase scenario. Here, both the manufacturer and the retailer enjoy positive profit margins. As the deliberation cost is relatively high, the regressive retail price $\sqrt{2c}$ is high enough to support enough wholesale margin for the manufacturer. The manufacturer has to set a wholesale price low enough and offer the retailer a reasonable profit margin to induce the regressive retail pricing. Otherwise, the retailer will choose the transgressive pricing for a higher profit margin. The resulting consumer surplus is $\frac{1}{2} - \sqrt{2c} > 0$.

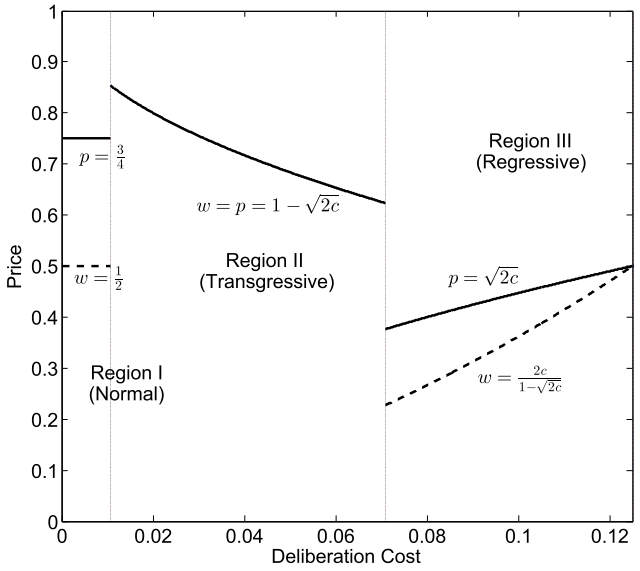
We illustrate the above results in Figure 3, where solid lines represent retail prices and dashed lines represent wholesale prices. In Region II, these two lines completely overlap, and thus the manufacturer captures the entire channel profit. Note that in Region I (low deliberation cost), just like in the case of no deliberation cost, the wholesale and retail margins are both constant and independent of the size of the deliberation cost. However, in Region II (moderate deliberation cost), the prices decrease with deliberation cost. Then, in Region III (relatively high deliberation cost), the prices increase with deliberation cost, but the retail margin decreases with deliberation cost.

2.3. Effect of Deliberation Cost on Channel Management and Value of Vertical Integration

So far we have examined equilibrium results for a decentralized channel with consumer deliberation cost. The results show that as long as the deliberation cost is not too small, the equilibrium wholesale and retail prices are altered by the deliberation cost. The retailer manages the price not only as an incentive to purchase, but also as a stimulus to think: regressive pricing for a high deliberation cost and transgressive pricing for an intermediate deliberation cost. The manufacturer then incorporates this retailer response when setting the optimal wholesale prices. These results indicate that deliberation cost leads to new and different challenges in channel management. In examining the effect of deliberation cost, we have used the classical channel model without (or with negligibly small) consumer deliberation cost as the natural benchmark. In these models, the manufacturer has the wholesale price as the only mechanism to manage channel coordination. The channel suffers from the standard double marginalization problem, leading to an above-channel-optimal retail price ($\frac{3}{4}$) and below-channel-optimal sales ($\frac{1}{4}$). With a medium to high deliberation cost, channel performance also depends on consumers' deliberation behavior. Our analysis shows that the manufacturer is no longer concerned with the conventional double marginalization problem. Instead, the manufacturer uses the wholesale price to affect the retailer's choice between a regressive and a transgressive pricing approach.

To more accurately assess the effect of deliberation cost on channel coordination, we need to compare our results to those for a vertically integrated channel with consumer deliberation cost. (Detailed analysis on vertical integration is in the online appendix.) The manufacturer owns the retail operation and sets the retail price to maximize the channel profit. In this vertically integrated model, when the channel system induces consumer deliberation, the optimization problem is $\max_p (1-p)p$, subject to the constraint $\sqrt{2c} < p \le 1 - \sqrt{2c}$ as given in Lemma 1. Alternatively, when the channel system inhibits consumer deliberation, then the optimization problem becomes $\max_p p$, subject to

Figure 3. Equilibrium Wholesale and Retail Prices



Note. Dashed lines are wholesale prices, and solid lines are retail prices.

the constraint $p \le \min(\frac{1}{2}, \sqrt{2c})$. We solve these two optimization problems and compare the resulting profits. The results are summarized in Lemma 2.

Lemma 2. *With deliberation cost c, in a vertically integrated channel, the retail price is given as follows:*

$$p = \begin{cases} \frac{1}{2} & \text{when } c \le \frac{1}{32}, \\ \sqrt{2c} & \text{when } \frac{1}{32} < c \le \frac{1}{8}. \end{cases}$$

The above lemma shows that when deliberation cost is very small ($c \le \frac{1}{32}$), all consumers deliberate, the channel-coordinating price is $\frac{1}{2}$, and sales are $\frac{1}{2}$. However, when deliberation cost c is larger than $\frac{1}{32}$, the channel prefers a regressive pricing strategy that inhibits consumer deliberation. The lower price (i.e., $p = \sqrt{2c} < \frac{1}{2}$) leads consumers to the no-brainer purchase scenario. Comparing the results in Proposition 2 and Lemma 2, we obtain the following corollary.

Corollary 1. *When the deliberation cost is high enough that $c \ge \frac{7-3\sqrt{5}}{4}$, the decentralized channel has the same performance as the vertically integrated channel, and the retail price is regressive. However, when the deliberation cost is in the middle range $\frac{3-2\sqrt{2}}{16} < c < \frac{7-3\sqrt{5}}{4}$, in the decentralized channel, the retail price ($p = 1 - \sqrt{2c}$) is transgressive and higher than the regressive price a vertically integrated retailer would charge.*

We omit the case of a small deliberation cost because it is essentially the same as the standard model without deliberation cost. In this case, the retailer's response to the wholesale price is linear, and the manufacturer may improve channel efficiency through vertical integration to eliminate the double marginalization problem. When the deliberation cost is not too trivial, the retailer no longer responds to the wholesale price linearly. Depending on the level of wholesale price, the retailer chooses a transgressive and thought-provoking approach or a regressive and no-brainer pricing approach. Within our model, a vertically integrated retailer will always follow a regressive pricing approach and serve the entire market with a low price. In contrast, a decentralized retailer will charge a regressive price when the deliberation cost is large but a transgressive price when the deliberation cost is in a middle range. Thus, a decentralized channel no longer loses channel efficiency when the deliberation cost is high. However, when the deliberation cost is in the intermediate range, vertical integration remains beneficial in improving channel efficiency, but for a reason very different from double marginalization.

To understand the above results, recall that the regressive pricing uses a low retail price to create the no-brainer purchase scenario. This is the desired outcome for the channel system. Alternatively, the retailer may follow transgressive pricing by setting a higher and thought-provoking price $1 - \sqrt{2c}$. The thought-provoking price leads to a higher margin ($1 - \sqrt{2c} > \frac{1}{2}$) but a much lower demand. The retailer prefers regressive pricing if and only if the wholesale price is sufficiently low so that the retailer can enjoy a reasonable margin while serving the entire market. This always works for the case of vertical integration because the internal transfer price is effectively zero. However, in a decentralized channel, setting a very low wholesale price can hurt the manufacturer's profit. When the deliberation cost is in the intermediate range, the manufacturer would rather choose a higher wholesale price that leads to a transgressive retail price and lower demand. Thus, the conflicting goals between the channel members can still fail the channel coordination. When deliberation cost increases, as shown in Figure 2, the transgressive price decreases, as a high price is more likely to lead to a no-brainer no purchase scenario, whereas the regressive price goes up. As a result, the regressive pricing can now accommodate a wider range of wholesale prices and becomes more attractive to the manufacturer. Therefore, with the increased downward pressure on the thought-provoking price, a decentralized channel becomes a channel arrangement as efficient as the vertically integrated channel. It is important to note that when c is larger but not too far from $\frac{7-3\sqrt{5}}{4}$, the retailer has the realistic option of choosing transgressive pricing. The manufacturer has to induce the retailer to choose regressive pricing by offering a sufficiently low wholesale price and a high retail margin. In other words, the manufacturer can use the wholesale price to achieve channel coordination when the deliberation cost is sufficiently large.

3. Channel Management with Deliberation Cost: Consumer Empowerment

Our analysis of the main model in the previous section shows how consumer deliberation cost can affect the manufacturer's channel management. In the main model, the deliberation cost is exogenously determined. In this section, we expand the strategy space of the channel members by allowing both the manufacturer and the retailer to change the deliberation cost through consumer empowerment. The concept of consumer empowerment and its impact on consumer deliberation cost have been discussed by Wathieu et al. (2002) and Wathieu and Bertini (2007). In deliberating the benefit of a new feature, a consumer needs to first simulate usage scenarios and then evaluate the personal relevance of the new feature. The channel members can help consumers develop such experience scenarios and understand the personal relevance. In practice, the retailer can use point-of-purchase promotions such as sampling and product trials, consumer education, in-store advertising, and floor sales teams like the Geek Squad at Best Buy to reduce

deliberation costs. The manufacturer may empower the consumers through advertising, a company website, and social media such as YouTube. Shugan (1980) suggests that the cost of thinking should increase with the consumer's perceptual complexity in comparing options, the difference in competing options, and the consumer's confidence in making the comparisons. The channel members empower consumers by reducing some aspects of the thinking costs.

We extend the main model by having the manufacturer and the retailer decide the respective levels of consumer empowerment. Specifically, in the game, the manufacturer makes the empowerment decision together with the wholesale price in the first stage. Afterward, the retailer chooses the retail-level empowerment and price p. To achieve a tractable equilibrium analysis of consumer empowerment, following Wathieu and Bertini (2007), instead of modeling the effort on consumer empowerment, we let each firm choose the target level of consumer deliberation cost. We let c_m and c_r denote the levels of deliberation cost selected by the manufacturer and the retailer, respectively. Effectively, the manufacturer first reduces the deliberation cost from c to c_m, and then the retailer further reduces it from c_m to c_r. We assume, as do Wathieu and Bertini (2007), that the cost of consumer empowerment efforts is zero to both firms. The literature does not provide any direction for how consumer empowerment efforts of different firms may substitute or complement each other. Our assumed technology is substitutable in the sense that one firm can single-handedly empower the consumers without the input of another firm. This assumption allows us to extend the main model in a simplistic manner to derive an equilibrium level of deliberation cost. Relaxing the assumptions, for instance, by incorporating the firm's cost of empowering consumers, is expected to change the quantitative results but unlikely to alter the qualitative implications. When the consumer empowerment cost is assumed to be zero, the analysis will clearly inform how the interests of the manufacturer and the retailer are misaligned.

Next we first describe the relation between an exogenously determined deliberation cost c and the profits of the manufacturer and the retailer, respectively. This relation will help understand the equilibrium level of consumer empowerment. We derive the results from the equilibrium outcome in Proposition 2. We summarize the results in Corollaries 2 and 3.

Corollary 2. *The effect of deliberation cost c on the manufacturer's profit is as follows:*

$$\frac{\partial \pi_m^*}{\partial c} = \begin{cases} 0 & \text{when } c < \frac{3-2\sqrt{2}}{16}, \\ \frac{1}{\sqrt{2c}} - 2 > 0 & \text{when } \frac{3-2\sqrt{2}}{16} < c < \frac{7-3\sqrt{5}}{4}, \\ \frac{2-\sqrt{2c}}{(1-\sqrt{2c})^2} > 0 & \text{when } \frac{7-3\sqrt{5}}{4} < c < \frac{1}{8}. \end{cases}$$

The corollary shows that the manufacturer's profit increases with consumer deliberation cost as long as the deliberation cost is not too small. When the deliberation cost is small, all consumers always deliberate. Any additional efforts on consumer empowerment will not change the prices or profits. Interestingly, when the consumer deliberation cost is higher, the manufacturer's profit increases with deliberation cost. In other words, consumer empowerment will decrease the manufacturer's profit. The corollary also shows that the marginal effect of deliberation cost on the manufacturer's profit differs between intermediate and high deliberation costs. This is because they correspond to different pricing strategies: the channel follows transgressive pricing when deliberation cost is in the middle range and regressive pricing when deliberation cost is higher. First, in the intermediate range of deliberation cost, where $\frac{3-2\sqrt{2}}{16} < c < \frac{7-3\sqrt{5}}{4}$, both the wholesale and retail prices are the transgressive price equal to $1-\sqrt{2c}$. Note that $1-\sqrt{2c}$ is above the channel coordinating price $\frac{1}{2}$. Thus, as c increases, the wholesale price goes down toward $\frac{1}{2}$, sales $\sqrt{2c}$ increase, and the manufacturer's profit increases. Second, when deliberation cost is high, the retail price is regressive and low enough to induce no-brainer purchases. In this case, as c increases, the wholesale price goes up and so does the manufacturer's profit. Therefore, in above two cases, the manufacturer's profit always increases with deliberation cost, but for very different reasons.

The next corollary summarizes the effect of deliberation cost on the retailer's profit.

Corollary 3. *The effect of deliberation cost c on the retailer's profit is stated as follows:*

$$\frac{\partial \pi_r^*}{\partial c} = \begin{cases} 0 & \text{when } c < \frac{3-2\sqrt{2}}{16}, \\ 0 & \text{when } \frac{3-2\sqrt{2}}{16} < c < \frac{7-3\sqrt{5}}{4}, \\ \frac{\sqrt{2}-8\sqrt{c}+4\sqrt{2}c}{(\sqrt{2}-2\sqrt{c})^2\sqrt{c}} < 0 & \text{when } \frac{7-3\sqrt{5}}{4} < c < \frac{1}{8}. \end{cases}$$

The corollary shows that the effect of consumer empowerment on the retailer's profit depends on the manufacturer's channel strategy, too. Interestingly, when deliberation cost is high ($\frac{7-3\sqrt{5}}{4} < c < \frac{1}{8}$), the retailer benefits from consumer empowerment. Recall that in this range of high deliberation cost, the retailer follows a regressive pricing strategy. But the retailer has the option of charging a high transgressive price and selling to high-valuation consumers only. The retailer can enjoy a margin because the manufacturer has to offer a sufficiently low wholesale price to induce the regressive pricing. However, as c increases, the transgressive price $1-\sqrt{2c}$ decreases, and then the retailer is forced to accommodate a smaller retail margin.

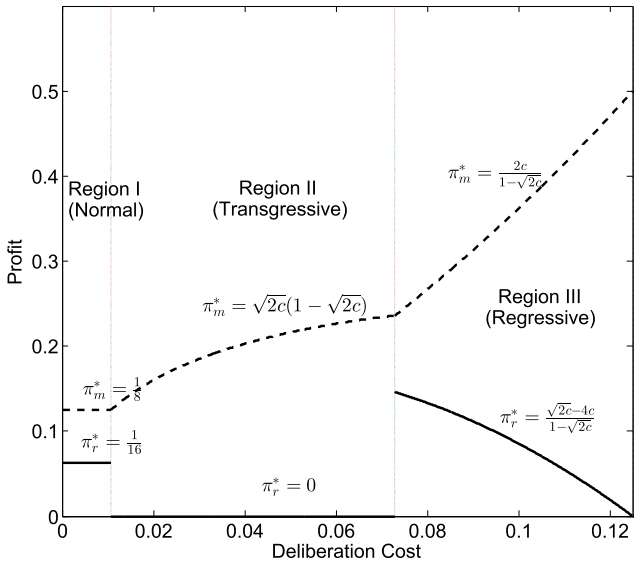
Summarizing the results of the above two corollaries, we can clearly see that the manufacturer's profit is

maximized at $c = \frac{1}{8}$ and the retailer's profit is maximized at $c = \frac{7-3\sqrt{5}}{4}$. Thus, the optimal level of the deliberation cost is different for the channel members. The results follow directly from the profit functions of the manufacturer and the retailer, as shown in Figure 4. On the one hand, the manufacturer prefers a higher cost of deliberation, with which the manufacturer can fully exploit the retailer. On the other hand, the retailer's profit is maximized at a medium deliberation cost, $c = \frac{7-3\sqrt{5}}{4}$. At this deliberation cost, the retailer has the option of either pricing high to induce deliberation or pricing low to inhibit deliberation. The manufacturer prefers to inhibit consumer deliberation; however, to have the retailer collaborate, the manufacturer has to share a significant part of the profit with the retailer.

Now we analyze the equilibrium strategies when the manufacturer and the retailer can empower the consumers. We analyze the problem using backward induction. First, in the second stage, the manufacturer has reduced deliberation cost to c_m and set the wholesale price w. The retailer chooses new deliberation cost c_r, and the retailer either induces or inhibits consumer deliberation. Specifically, the retailer chooses between the following two different strategies:

(a) *Inducing deliberation*. Given the new deliberation cost c_r, the retailer will not charge above $1 - \sqrt{2c_r}$, the highest thought-provoking price. This price upper bound becomes tighter as c_r goes up. Therefore, the retailer's profit is always nonincreasing in c_r. As a result, if the retailer prefers to induce consumer deliberation, the optimal strategy will be $c_r = 0$ and $p = \frac{1+w}{2}$. Consequently, the retailer's profit is $\pi_r = \left(\frac{1-w}{2}\right)^2$.

Figure 4. Equilibrium Profits



Note. Dashed lines are wholesale profits, and solid lines are retail profits.

(b) *Inhibiting deliberation*. If the retailer prefers to inhibit consumer deliberation, it shall not charge above $\min(\frac{1}{2}, \sqrt{2c_r})$, the highest price for no-brainer purchase. This price upper bound increases as c_r goes up. Therefore, the retailer's profit is always nondecreasing in c_r. Hence, if the retailer prefers to inhibit consumer deliberation, the optimal strategy will be $c_r = c_m$ and $p = \min(\frac{1}{2}, \sqrt{2c_m})$. Consequently, the retailer's profit is $\pi_r = \min(\frac{1}{2} - w, \sqrt{2c_m} - w)$.

By comparing the above two strategies, we have the following lemma regarding sugbame equilibrium in the second stage.

Lemma 3. *Given manufacturer empowerment decision c_m and wholesale price w, the retailer's optimal decision is as follows:*

(i) *When $c_m \geq \frac{1}{8}$ and $w > \sqrt{2} - 1$, the retailer chooses $c_r = 0$ and induces deliberation by pricing at $p = \frac{1+w}{2}$.*

(ii) *When $c_m \geq \frac{1}{8}$ and $w \leq \sqrt{2} - 1$, the retailer chooses $c_r = c_m$ and inhibits deliberation by pricing at $p = \frac{1}{2}$.*

(iii) *When $c_m < \frac{1}{8}$ and $w > 2\sqrt[4]{2c_m} - 1$, the retailer chooses $c_r = 0$ and induces deliberation by pricing at $p = \frac{1+w}{2}$.*

(iv) *When $c_m < \frac{1}{8}$ and $w \leq 2\sqrt[4]{2c_m} - 1$, the retailer chooses $c_r = c_m$ and inhibits deliberation by pricing at $p = \sqrt{2c_m}$.*

Given the retailer's optimal response, we can move backward to solve the manufacturer's optimal decision. For ease of exposition, we first summarize the equilibrium results given the manufacturer empowerment decision c_m in the following proposition.

Proposition 3. *Given manufacturer empowerment decision c_m, the equilibrium behavior is as follows:*

(i) *When $c_m < \frac{6561}{131072} \approx 0.05$, the manufacturer chooses $w = \frac{1}{2}$, and the retailer chooses $c_r = 0$ and $p = \frac{3}{4}$.*

(ii) *When $\frac{6561}{131072} \leq c_m < \frac{1}{8}$, the manufacturer chooses $w = 2\sqrt[4]{2c_m} - 1$, and the retailer chooses $c_r = c_m$ and $p = \sqrt{2c_m}$.*

(iii) *When $\frac{1}{8} \leq c_m$, the manufacturer chooses $w = \sqrt{2} - 1$, the retailer chooses $c_r = c_m$ and $p = \frac{1}{2}$.*

Moreover, channel coordination is achieved when $\frac{6561}{131072} \leq c_m$.

Proposition 3 suggests that the retailer always enjoys a positive margin ($p - w > 0$) when it can empower the consumers. The retailer, equipped with the ability to reduce the deliberation cost, now always has the option to fully empower the consumers and charge the standard double marginalization price. In response, when c_m is high, the manufacturer induces the retailer to choose regressive pricing by offering a sufficiently low wholesale price and a high retail margin. When c_m is in a middle range, the manufacturer chooses a higher wholesale price that leads to a transgressive retail price and lower demand. Clearly, the retailer gains power and earns a bigger share of channel profits. As for the manufacturer's profit, we have the following corollary.

Corollary 4. *The manufacturer's profit is* $\pi_m = \frac{1}{8}$ *when* $c_m < \frac{6561}{131072}$, $\pi_m = 2\sqrt[4]{2c_m} - 1$ *when* $\frac{6561}{131072} \le c_m \le \frac{1}{8}$, *and* $\pi_m = \sqrt{2} - 1$ *when* $\frac{1}{8} < c_m$. *The manufacturer's profit* π_m *is nondecreasing in* c_m.

It is evident that from Corollary 4 that the manufacturer's profit is nondecreasing in c_m. Therefore, the manufacturer does not have any incentive to reduce the deliberation cost from c, and the results characterized by Proposition 3 with $c_m = c$ are the full equilibrium outcome. Unlike Wathieu and Bertini (2007), in our results, the full consumer empowerment is often not optimal for the channel members. However, as we show in Section 5.1, the manufacturer's empowerment decision changes when the variable production cost is much higher.

4. Channel Management with Deliberation Cost: Optimal Quality Decision

The main model assumes an exogenous product quality to focus on channel management through prices. In this section, we let the manufacturer decide both the product quality and the wholesale price. A higher quality typically amplifies consumer uncertainty. Thus, whereas in the previous extension we let firms manage the value of deliberation cost c through consumer empowerment, in this section we allow the manufacturer to manage the size of uncertainty through quality decisions. We will examine how the deliberation cost may affect the manufacturer's quality decision and how the manufacturer may use quality and price jointly in managing a channel with consumer deliberation. How would such a quality consideration alter the channel coordination we investigated in the main model?

To examine these issues, we extend the main model to incorporate the manufacturer's quality decision. Here, we define the quality in the vertical sense (Moorthy 1984). First, we assume that the manufacturer chooses from a closed interval $[0, 1]$ of feasible product qualities. The upper bound, $\hat{q} = 1$, represents the limit to the manufacturer's production technology. The manufacturer can choose to produce the full-quality product $q = \hat{q}$ or an inferior product at any point of the interval. Second, at the point of purchase, consumers know the quality (e.g., the power of the AI chipset used for a smartphone or the maximum transmission distance for a drone) but are not certain about their marginal valuation for the quality. We assume that consumers' true valuations, measured by their marginal willingness to pay for quality, are heterogeneous. Specifically, for a quality level q, the product valuation $V_i = \theta_i q$, where θ_i, consumer i's marginal willingness to pay for quality, is uniformly distributed over the unit interval. The multiplicative formulation is standard in the literature of vertical differentiation (Moorthy 1984, Guo and Zhang 2012, Hu et al. 2015). Specifically, a "higher segment"—a segment with a larger θ_i—is willing to pay more for any increment in product quality.[3] The main model is thus a special case where the quality is fixed at $q = 1$. Third, as in the main model, a consumer does not know but can find out the true value of θ at a deliberation cost c. Finally, to focus on the strategic effect of the deliberation cost on the manufacturer's quality decision, we let the marginal production cost for quality be zero. We want to show that even in the absence of concern for production cost, the manufacturer may not choose the highest quality because of the deliberation cost. Later in this section, we will discuss the results under a commonly assumed positive and quadratic production cost function.[4]

The following proposition establishes the manufacturer's equilibrium quality decision.

Proposition 4. *When* $c \in \left[0, \frac{1}{18}\right]$, *the optimal quality is* $q^* = 1$; *when* $c \in \left(\frac{1}{18}, \frac{1}{8}\right]$, *the optimal quality is* $q^* = 8c$.

The above proposition shows that the manufacturer's equilibrium quality decision depends on the value of deliberation cost c. The manufacturer produces at full quality when c is sufficiently small; otherwise, the manufacturer chooses an inferior product quality. As c decreases from $\frac{1}{8}$ to $\frac{1}{18}$, the equilibrium quality goes down from $\hat{q}$ to $\frac{4}{9}$, which is less than half of the full quality. This result is surprising because producing a higher quality can increase a consumer's willingness to pay without incurring any additional production cost. How does the deliberation cost make the manufacturer want to forgo the costless full quality and the consumers' greater willingness to pay?

A careful examination of the results indicates that the manufacturer may prefer a lower quality to induce the retailer to follow the regressive pricing strategy. With quality q, consumers' deliberation decision no longer depends solely on the deliberation cost c as in the main model. Instead, the deliberation decision now depends on the magnitude of the quality-adjusted deliberation cost (c/q): a consumer is more likely to deliberate when quality is higher and hence the uncertainty is larger. Thus, given the deliberation cost c, with a lower quality, the retailer is more likely to pursue regressive pricing for the no-brainer purchase scenario. In contrast, with a higher quality, the retailer is more likely to pursue transgressive pricing for the thought-provoking scenario. Proposition 4 shows that when c is not too small, the equilibrium quality-adjusted deliberation cost is $\frac{c}{q^*} = \frac{1}{8}$. This is consistent with the result presented in the previous section (Corollary 2) that the manufacturer maximizes its profit at $c = \frac{1}{8}$. Thus, when the deliberation cost is not too small, the manufacturer sets a low quality to achieve the desired quality-adjusted

deliberation cost. In the equilibrium, the manufacturer achieves retailer coordination with the regressive pricing and all consumers purchase without deliberation. If the manufacturer selects a quality $q \geq q^*$, the retailer still follows the regressive pricing and sells to the entire market. The equilibrium wholesale and retail prices are

$$w(q) = \frac{2qc}{q - \sqrt{2qc}} \text{ and } p(q) = \sqrt{2qc}.$$

The retail price increases with the quality of the product because of higher consumer valuation. But the wholesale price decreases with q because as the quality improves, the quality-adjusted deliberation cost (c/q) decreases, and the retailer has a greater power. As we have discussed in detail earlier, the retailer gains power as the transgressive pricing becomes more attractive. Surprisingly, when the manufacturer increases its quality within this range, it is the retailer but not the manufacturer that gains power in channel coordination and benefits from the increased consumer valuation.

When $c \leq \frac{1}{18}$, the manufacturer produces products of full quality. In this case, the deliberation cost is very small, and consumers deliberate in the equilibrium. Setting a much lower quality q to induce the retailer to set the regressive pricing is no longer attractive to the manufacturer. Given that the retail price will be thought provoking, it is then optimal for the manufacturer to produce products of full quality to increase consumer valuations.

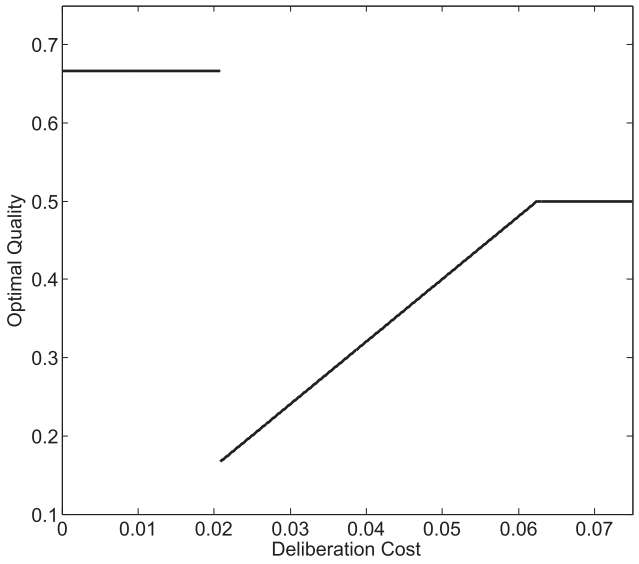
4.1. Cost of Quality

The discussions above about product quality assume away the consideration of quality costs. We now let the variable production cost for quality q be a commonly assumed quadratic function $\frac{q^2}{2}$. We analyze the manufacturer's decisions again and obtain the following result.

Proposition 5. *The optimal quality level is* (i) $\frac{2}{3}$ *when* $c \leq \frac{1}{48}$, (ii) $8c$ *when* $\frac{1}{48} < c \leq \frac{1}{16}$, *and* (iii) $\frac{1}{2}$ *when* $\frac{1}{16} < c$.

Figure 5 shows that incorporating the cost of quality does not alter the relation between the optimal product quality and consumer deliberation cost. Specifically, the manufacturer's optimal quality level remains high and constant for sufficiently large or small values of deliberation cost, but it increases with deliberation cost within the intermediate range of c. The pattern of results and underlying reasons are similar to those in Proposition 4. When c is very small, the manufacturer induces deliberation and serves only the high-valuation consumers, and thus a high quality is beneficial. There exists an intermediate range of deliberation cost where the product quality increases with c for the same reason discussed after Proposition 4.

Figure 5. Manufacturer's Optimal Quality Decision vs. Deliberation Cost



5. Robustness and Model Extensions

In this section, we relax some of the assumptions of the main model to examine the robustness of our results and deepen the insights. First, we examine whether the effects of consumer deliberations may depend on a production cost. Second, we introduce consumer heterogeneity in deliberation cost. We relax the assumption that all consumers are faced with the same deliberation cost by letting a small fraction of consumers have zero deliberation cost. Third, we consider continuous deliberation effort instead of a binary deliberation decision (either deliberate or not) assumed in the main model. Finally, we extend the simple manufacturer–retailer distribution channel structure by adding a distributor to the system. We analyze how these alternative model specifications may alter the effects of deliberation cost in channel management.

5.1. Production Cost and Effect of Consumer Deliberations

Here we assume that the manufacturer incurs a variable cost $s > 0$. The production cost does not affect consumer decisions or the retailer's best response functions, which are given by Lemma 1 and Proposition 1, respectively. However, the manufacturer may determine the wholesale price w according to the production cost. We focus on the interesting case where s is smaller than $\frac{1}{2}$, which is the expected utility for consumers. Otherwise, if $s > \frac{1}{2}$, it will never be profitable to inhibit deliberation. The equilibrium prices are established in Proposition 6.

Proposition 6. *When* $s < \frac{1}{2}$, *there exist* c_1^s *and* c_2^s *such that the equilibrium prices fall in Region I when* $c < c_1^s$, *in Region II when* $c_1^s \leq c \leq c_2^s$, *in Region III when* $c_2^s < c < \frac{1}{8}$,

Table 2. Production Cost and Prices

Region	Deliberation cost	Wholesale price	Retail price	Sales
I	$c < \frac{3-2\sqrt{2}}{16}(1-s)^2$	$\frac{1+s}{2}$	$\frac{3+s}{4}$	$\frac{1-s}{4}$
II	$\frac{3-2\sqrt{2}}{16}(1-s)^2 \le c \le c_2^s$	$1-\sqrt{2c}$	$1-\sqrt{2c}$	$\sqrt{2c}$
III	$c_2^s < c < \frac{1}{8}$	$\frac{2c}{1-\sqrt{2c}}$	$\sqrt{2c}$	1
IV	$\frac{1}{8} \le c$	$\frac{1}{2}$	$\frac{1}{2}$	1

and in Region IV when $\frac{1}{8} \le c$ *(see Table 2 for details), where* $c_1^s = \frac{3-2\sqrt{2}}{16}(1-s)^2$, *and* c_2^s *is implicitly defined by*

$$(1-\sqrt{2c_2^s}-s)\sqrt{2c_2^s} = \frac{2c_2^s}{1-\sqrt{2c_2^s}} - s.$$

Moreover, c_1^s *is decreasing in* s, *and* c_2^s *is increasing in* s.

Proposition 6 indicates that the key insights from the main model can be readily extended to the setting with a positive production cost. Although most results remain unaffected, we find that as s goes up, the manufacturer is more likely to price at $w = 1-\sqrt{2c}$, eliminating the profit margin of the retailer. This is because Region II gives the manufacturer a higher profit margin $(1-\sqrt{2c}-s)$ than its profit margins in Region I ($\frac{1+s}{2} - s = \frac{1-s}{2}$) and Region III ($\frac{2c}{1-\sqrt{2c}} - s$). When production cost increases, profit margin becomes more important than sales, and Region II becomes more profitable. Relatively speaking, the manufacturer enjoys more flexibility than the retailer in response to cost changes.

A noteworthy implication of the production cost is on the manufacturer's incentive to empower consumers. All else being equal, when the production cost is sufficiently large and hence the manufacturer's profit margin is sufficiently low, the manufacturer will prefer a lower deliberation cost. Otherwise, if consumers do not deliberate because of a high deliberation cost, the highest price the manufacturer can charge is $w = \frac{1}{2}$, and the profit marginal will be minimal when s approaches $\frac{1}{2}$. As a result, the manufacturer will prefer to reduce the deliberation cost and sell to high-valuation consumers only.

5.2. Consumer Heterogeneity in Deliberation Cost

The main model assumes that all consumers have the same positive deliberation cost c. We now extend the main model and assume that a fraction $\lambda \in (0,1)$ of the expert consumers have zero deliberation cost. These expert consumers will always deliberate and know their private valuations. The remaining $\bar{\lambda} = 1-\lambda$ of the consumers are regular consumers who, as assumed in the main model, have to incur a deliberation cost $c > 0$ to determine their true valuations. We further assume that the distribution of product valuations is uniform within the interval $[0,1]$ for both expert and regular consumers. We limit our analysis to the situations where λ is sufficiently small so that the firms will not focus on expert consumers only.

Proposition 7 summarizes the equilibrium channel strategy in this model.

Proposition 7. *There exist positive values* $0 < c_1 < c_2 < c_3 < \frac{1}{8}$ *as defined in the online appendix such that there are four different regions of deliberation costs, each region corresponding to a unique equilibrium channel outcome. The four regions and the equilibrium outcome in each region are presented in Table 3.*

The results stated in Proposition 7 show that the main insights about the effect of deliberation cost obtained from the main model can be generalized to the model with heterogeneous deliberation costs. As is consistent with the main model, when the deliberation cost is small (in Region I), the equilibrium retail strategy is normal and follows double marginalization. In this region, all consumers deliberate. When the deliberation cost is of an intermediate value (in Region II), the equilibrium retail strategy is transgressive. The retailer charges the upper bound of thought-provoking prices, and all consumers deliberate. Finally, when the deliberation cost is large (in Regions III^a and III^b), the equilibrium retail strategy is regressive. The retail price is low and leads to no-brainer purchases for consumers with positive deliberation costs.

With the introduction of consumer heterogeneity in deliberation cost, we now have a segment of expert consumers who always deliberate. This gives the retailer a new option of serving expert consumers only. As a result, Proposition 7 extends Proposition 2 in two areas. First, Table 3 shows that the manufacturer can no longer capture the entire channel profit through the transgressive pricing in Region II. In the equilibrium $w < p$ in all regions. For any wholesale price $w < 1$ that the manufacturer offers, the retailer can always make a profit by adding a margin over w and selling the product to expert consumers. The manufacturer then has to leave a profit to the retailer to satisfy the incentive compatibility condition. Second, in Region III, as in the main model, the regressive retail price is $\sqrt{2c}$, which inhibits consumer deliberation. However, with consumer heterogeneity, this region is now divided into two

Table 3. Channel Strategies at Different Deliberation Costs

Region	Wholesale price	Retail price	Strategy
I ($c \le c_1$)	$\frac{1}{2}$	$\frac{3}{4}$	Normal
II ($c_1 < c < c_2$)	$1-\frac{2}{\lambda}(\sqrt{2c}-\sqrt{2c\bar{\lambda}})$	$1-\sqrt{2c}$	Transgressive
III^a ($c_2 \le c \le c_3$)	$\frac{2c\bar{\lambda}}{1-(1+\lambda)\sqrt{2c}}$	$\sqrt{2c}$	Regressive
III^b ($c_3 < c \le \frac{1}{8}$)	$1+2\sqrt{2c}-\frac{2-2\sqrt{\bar{\lambda}(1-\sqrt{2c\bar{\lambda}})}}{\lambda}$	$\sqrt{2c}$	Regressive

subregions: III^a and III^b. With expert consumers, the retailer can consider one of the following two options:

(a) set the transgressive price at $p = 1 - \sqrt{2c}$ to induce deliberation and serve both expert and regular consumers;

(b) price high at $p = \frac{1+w}{2} > 1 - \sqrt{2c}$ and serve high-valuation expert consumers only.

The second option is new to this model owing to the presence of expert consumers. Either of these options can be more profitable depending on the values of c and λ. As the manufacturer anticipates the additional option available to the retailer, the optimal wholesale price strategy becomes more refined with consumer heterogeneity.[5]

5.3. Continuous Deliberation Effort

The main model assumes that consumer deliberation is a binary decision: a consumer either deliberates with cost c or not at all. In this section, we follow Guo (2016) and allow the consumers' deliberation effort to be continuous. Specifically, let α denote the level of deliberation effort (e.g., the time spent on reflecting over preferences). As a result of deliberation, there are two possible states regarding the consumer's ex post knowledge about his or her valuation v_i: either maintaining the prior belief or becoming fully informed of v_i. Conditional on α, the consumer can resolve the valuation uncertainty with probability $\phi(\alpha)$, and the consumer remains uninformed of v_i with probability $1 - \phi(\alpha)$, where $\phi(\alpha)$ is a continuous function of the deliberation effort.[6]

To keep the model tractable, we assume that

$$\phi(\alpha) = \begin{cases} \sqrt{2\alpha} & \text{if } \alpha \le \frac{1}{2}, \\ 1 & \text{otherwise.} \end{cases}$$

Note that $\phi(0) = 0, \phi(+\infty) = 1, \phi'(\cdot) \ge 0, \phi''(\cdot) \le 0$. Thus, the probability of resolving uncertainty is increasing in deliberation, with decreasing marginal returns to deliberation effort.[7] The marginal cost of deliberation is $c_e > 0$.

As in Guo (2016), we model a two-stage sequential decision process for the consumers. The first stage involves deciding on how much costly deliberation to invest to resolve the uncertainty over v_i. Next, in the second stage of the decision process, conditional on whether the consumer has resolved his or her valuation uncertainty in the first stage, he or she chooses the alternative with the highest (expected) utility.

5.3.1. Consumer Deliberation Decision.

We first consider the consumer's decision-making process. Given retail price p, the consumer first chooses α, the level of deliberation, and incurs the deliberation cost $c_e \cdot \alpha$. Then v_i is revealed with probability $\phi(\alpha)$. Conditional on the deliberation outcome, the consumer makes the purchase decision. The purchase decision is such that if uncertainty is resolved, the consumer makes purchase if and only if $v_i \ge p$; otherwise, the consumer purchases if and only if $E[v_i] = \frac{1}{2} \ge p$. Hence, the consumer's expected surplus, given precision ϕ, is

$$CS = \phi(\alpha)E[v_i - p]^+ + (1 - \phi(\alpha))(E[v_i] - p)^+ - c_e \cdot \alpha,$$

and the consumer chooses α that maximizes CS. Solving the consumer's first-stage decision, we obtain the following lemma.

Lemma 4. *The consumer's deliberation decision is as follows:*

(i) *If $p \le \frac{1}{2}$ and $c_e \ge \frac{p^2}{2}$, the consumer chooses deliberation level $\alpha = \frac{p^4}{8c_e^2}$, resulting in $\phi = \frac{p^2}{2c_e}$.*

(ii) *If $p \le \frac{1}{2}$ and $c_e < \frac{p^2}{2}$, the consumer chooses deliberation level $\alpha = \frac{1}{2}$, resulting in $\phi = 1$.*

(iii) *If $\frac{1}{2} < p \le 1$ and $c_e \ge \frac{(1-p)^2}{2}$, the consumer chooses deliberation level $\alpha = \frac{(1-p)^4}{8c_e^2}$, resulting in $\phi = \frac{(1-p)^2}{2c_e}$.*

(iv) *If $\frac{1}{2} < p \le 1$ and $c_e < \frac{(1-p)^2}{2}$, the consumer chooses deliberation level $\alpha = \frac{1}{2}$, resulting in $\phi = 1$.*

5.3.2. Equilibrium Channel Strategies.

Because of the high degree of the profit functions, the problem is analytically intractable. We resort to software packages to numerically optimize the corresponding profits and search for the equilibrium. The results are summarized in the following proposition.

Proposition 8. *The equilibrium channel strategies are as follow:*

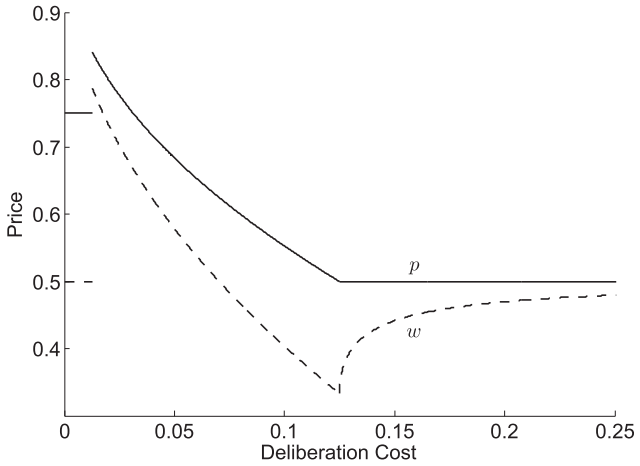
(i) *If $c_e \le \frac{3}{64}(2 - \sqrt{3})$, $w = \frac{1}{2}$ and $p = \frac{3}{4}$, resulting in $\phi = 1$.*

(ii) *If $\frac{3}{64}(2 - \sqrt{3}) < c_e \le \frac{1}{8}$, $w = 1 - \frac{4}{3}\sqrt{2c_e}$ and $p = 1 - \sqrt{2c_e}$, resulting in $\phi = 1$.*

(iii) *If $\frac{1}{8} < c_e$, $w = \hat{w}$, where $\hat{w}$ solves $27(1 - \hat{w})^4 = 16(16c_e - 1)(1 - 2\hat{w})$, and $p = \frac{1}{2}$, resulting in $\phi = \frac{1}{8c_e}$.*

Figure 6 summarizes the equilibrium pricing strategies. There are three different regions. When $c_e \le \frac{3}{64}(2 - \sqrt{3})$, deliberation cost is small and the equilibrium pricing strategies are the standard results with double marginalization ($w = \frac{1}{2}, p = \frac{3}{4}$). When $\frac{3}{64}(2 - \sqrt{3}) < c_e \le \frac{1}{8}$, the results are different. In equilibrium, the retail price is $p = \frac{1+3w}{4}$, which is below the standard double marginalization price ($p = \frac{1+w}{2}$). This is because a higher p will affect not only consumer surplus but also deliberation level α, resulting in even lower demand $D = \phi(\alpha)(1 - p)$. As a result, demand is more sensitive to the retail price, and the retailer charges a lower p. Double marginalization is less severe in this region. When $\frac{1}{8} < c_e$, deliberation is very costly, and the manufacturer would like to cover all consumers that are ex post uncertain about their valuations. However, the manufacturer still shares a (small) margin with the retailer because the retailer could otherwise raise the price to $p > \frac{1}{2}$ and sell only to consumers who are ex post informed of their valuations.

Figure 6. Equilibrium Channel Prices with Continuous Deliberation Effort



From the discussions above, we can see that our key insights from the main model hold here: double marginalization becomes less severe when c_e is large or is intermediate (i.e., slightly greater than $\frac{3}{64}(2-\sqrt{3})$).

5.3.3. Implications of Deliberation Costs on Firms' Profits. In Figure 7 we plot the manufacturer's and the retailer's equilibrium profits at different deliberation costs c_e. The shapes of the profit functions are similar to those of the main model. Like what we find in the main model, the manufacturer's profit is maximized when c_e is at the upper bound, whereas the retailer's profit is maximized at a moderate deliberation cost $c_e = \frac{1}{8}$. Again, when deliberation cost is very large, consumers do not deliberate, and their value uncertainties are unresolved, with $E(v) = \frac{1}{2}$. In this case, the manufacturer charges a wholesale price close to $\frac{1}{2}$ and obtains almost the entire channel profit. On the other hand, when $c_e = \frac{1}{8}$, the retailer has the option to either price high to serve only those consumers with resolved high valuations or price low to serve all consumers with valuation uncertainties. The manufacturer prefers the latter; however, to have the retailer collaborate, the manufacturer has to share a significant part of the profit with the retailer.

5.4. Multilevel Distribution Channel

The main model considers a decentralized channel with a manufacturer and a retailer. The manufacturer uses its wholesale price to manage the retailer's response to deliberation cost. We now extend this model to a three-level channel: the manufacturer sells its product to a distributor at the wholesale price w_1, then the distributor resells the product to the retailer at the distributor's price w_2, and finally the retailer sells the product to end consumers at the retail price p. In practice it is fairly common for manufacturers to employ such a multilayer distribution channel. In addition to making the model more realistic, we want to investigate whether the effect of consumer deliberation cost on channel management remains in such a multilevel channel. A possible complication in this model is the extra layer of marginalization, that is, the triple marginalization problem.

Our analysis of the three-level channel with consumer deliberation cost leads to the following proposition.

Proposition 9. *The equilibrium channel strategies in a three-level channel are as presented in Table 4.*

As in the main model, the equilibrium result depends on the cost of deliberation. Specifically, in Proposition 9, the entire parameter space is divided into three regions corresponding to normal pricing, transgressive pricing, and regressive pricing. First, in Region I, with a very small deliberation cost, consumers always deliberate, and we observe a case of triple marginalization. Second, in the middle range of deliberation cost, each channel member sets the price equal to the transgressive pricing, the highest thought-provoking price. In this case, the manufacturer as the channel leader takes the entire channel profit. Finally, in Region III, the retailer sets the regressive pricing and every consumer buys without deliberation. In the equilibrium, every channel member earns a positive profit. Overall the qualitative insights are identical to those in the main model. A notable distinction is that Region II covers a wider range of parameter values; in other words, the transgressive pricing is more likely to be the equilibrium outcome. Intuitively, with an extra middleman joining the channel, the manufacturer's profit is further reduced in Regions I (normal pricing) and III (regressive pricing), but its profit is not affected in Region II (transgressive pricing). Therefore, transgressive pricing becomes more attractive to the manufacturer.

6. Conclusions

This paper studies a decentralized distribution channel selling a new product. Faced with uncertain valuations

Figure 7. Equilibrium Channel Profit

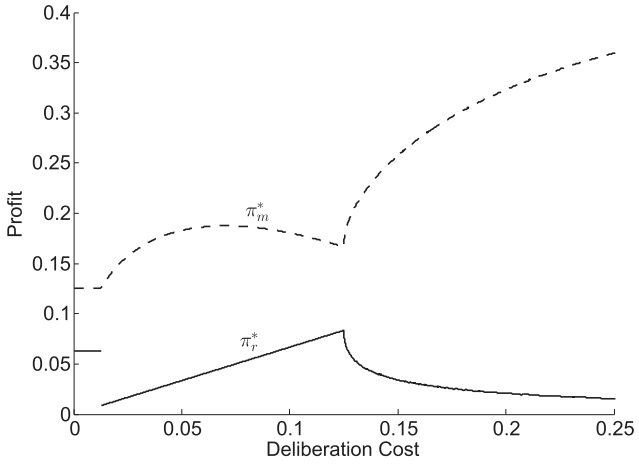


Table 4. Equilibrium Strategies for a Three-Level Channel

Region	Deliberation cost	Manufacturer price	Distributor price	Retail price
I	$c \le 0.00224$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{7}{8}$
II	$0.00224 < c < 0.104$	$1-\sqrt{2c}$	$1-\sqrt{2c}$	$1-\sqrt{2c}$
III	$0.104 \le c \le 0.125$	$\frac{\sqrt{c}(6\sqrt{c}-2\sqrt{2}c-\sqrt{2})}{(1-\sqrt{2c})^2}$	$\frac{2c}{1-\sqrt{2c}}$	$\sqrt{2c}$

for the new product, consumers have to decide whether they want to engage in costly deliberation to learn about their true valuations for the product. According to our analysis, the cost of those deliberations can have substantial effects on the channel members' marketing decisions. First, the deliberation cost can distort the equilibrium wholesale and retail prices. The retailer may use a low price (regressive pricing) to inhibit consumer deliberation or a high price (transgressive pricing) to provoke consumer deliberation. Thus, the retailer uses the price to manage consumer demand and deliberation efforts. In anticipation of this, the manufacturer sets the wholesale price to induce the desired type of retail pricing behavior. Specifically, when the deliberation cost is high, the manufacturer charges a low wholesale price for the regressive retail pricing. When the deliberation cost is intermediate, the manufacturer charges a high wholesale price for the transgressive retail pricing. The standard double marginalization problem exists only when the deliberation cost is very small. These results arise from the manufacturer's strategic use of wholesale price and thus cannot be readily inferred from the insights from the literature of information management and consumer deliberation (e.g., Lewis and Sappington 1994, Bertini and Wathieu 2010).

Second, the manufacturer and retailer can engage in consumer empowerment activities to reduce deliberation cost, but the channel members have misaligned incentives to empower consumers. The manufacturer prefers a high deliberation cost to retain its power to influence the retailer; but such power is limited by the retailer's ability to empower consumers. The retailer can directly influence consumer deliberation, which yields the retailer additional channel power for a greater retail margin. This result would imply that a retailer can be interested in developing point-of-purchase promotion activities for new products and building a knowledgeable sales team like Geek Squad for the purpose of increasing its power within the channel. In contrast, the manufacturer is more interested in consumer communications to generate consumer awareness for new features such as Huawei's AI processor. Finally, the deliberation cost may lead the manufacturer to offer a lower product quality. A higher product quality, for example, a larger flying range for a drone or a more intelligent chip for a phone, could encourage consumer deliberation, improve the retailer's power, and reduce the manufacturer's share of channel profit. Thus, although a higher quality can increase the mean valuation, the manufacturer may limit the product quality for the benefit of stronger channel power vis-à-vis the retailer. Such quality distortion, which is not socially efficient, is less severe when the deliberation cost is higher. These extended implications on marketing decisions underscore the importance of investigating consumer deliberation in the context of channel conflict.

We do not view our results as the final word on the channel relations and consumer empowerment in markets with consumer deliberations. Instead, we see our work as a modest extension of existing research on deliberation (e.g., Wathieu and Bertini 2007) and as a contribution to channel literature. Our results may be subject to the assumptions of the model and should be interpreted with care. Below, we discuss some of the important directions in which to extend the assumptions.

First, competition between the manufacturers can affect the equilibrium results. Consider a market with multiple manufacturers selling through the same retailer, for example, major cellular phone brands distributing their products through Best Buy. In this case, if the focal manufacturer offers a unique feature, our model still applies, as consumer evaluation of other brands will serve as the outside option. However, if multiple competing manufacturers offer the same new feature, then the retailer's incentive to empower consumers can change. Such a model extension will also change pricing dynamics and the impact of deliberation cost on product decisions. Second, the form of the wholesale contract will likely change the incentives of channel members to empower consumers. This paper assumes that the manufacturer uses a simple linear wholesale contract. Although such a wholesale contract is prevalent in practice, the manufacturer may offer other forms of wholesale contracts, for example, two-part tariffs commonly adopted in franchise contracts and quantity discounts. The form of wholesale contract can change the variable cost facing the retailer and the channel performance. One could also interpret such differences due to contractual forms as variations across industries. Future research may also explore some of the creative pricing formats considered thought provoking by Bertini and Wathieu (2010). Finally, although this paper employs a static model, the firms' strategy can change when considering long-term implications. In the case of zero variable cost, our analysis indicates that the

manufacturer may prefer low empowerment to achieve high market penetration. After the purchase, some consumers will realize low values and experience low satisfaction. In a dynamic model where customer satisfaction can have long-term impacts, the manufacturer should be more likely to empower consumers than the prediction of this paper. Future research may also consider a dynamic model where a manufacturer plans to offer successive generations of new products and consumer deliberation cost changes over time.

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Appendix. Proofs of Propositions

Proof of Proposition 1

The retailer's response includes two cases: induce deliberation and inhibit deliberation. We first analyze each case separately, getting the optimal solutions, and then combine the two cases together to obtain the globally optimal solution.

Case 1: Induce Deliberation. Given the wholesale price w, when the retailer sets its price to induce deliberation, its pricing problem is

$$\max_p (1-p)(p-w),$$

where $1-p$ is the demand and $p-w$ is the retail margin. The problem is subject to

$$\frac{(1-p)^2}{2} - c \geq \frac{1}{2} - p, \tag{IC$_1$}$$

$$\frac{(1-p)^2}{2} - c \geq 0. \tag{IR$_1$}$$

Here the incentive-compatible condition (IC$_1$) requires that a consumer expects a higher value from deliberating over not deliberating, and the individual rationality condition (IR$_1$) requires a nonnegative consumer surplus from deliberation. By combining conditions (IC$_1$) and (IR$_1$), we obtain a thought-provoking retail price range $\sqrt{2c} \leq p \leq 1-\sqrt{2c}$. Analysis of the above optimization problem yields the following lemma.

Lemma A.1. *Suppose the retail price induces consumer deliberation. Given wholesale price w, when $\sqrt{2c} \leq \frac{1+w}{2} \leq 1-\sqrt{2c}$, the optimal retail price is $p = \frac{1+w}{2}$, resulting in sales $S = \frac{1-w}{2}$ and a profit $\pi_r = \frac{(1-w)^2}{4}$. When $w \leq 1-\sqrt{2c} \leq \frac{1+w}{2}$, the optimal retail price is $p = 1-\sqrt{2c}$, resulting in sales $S = \sqrt{2c}$ and a profit $\pi_r = \sqrt{2c}(1-\sqrt{2c}-w)$. Otherwise, the retailer does not sell the product.*

Lemma A.1 indicates two distinctive cases of thought-provoking retail pricing approaches. Recall that a thought-provoking retail price is below $1-\sqrt{2c}$. When the wholesale price is sufficiently low that $\frac{1+w}{2} \leq 1-\sqrt{2c}$, the optimal thought-provoking retail price is the outcome of standard double marginalization, that is, $p = \frac{1+w}{2}$. However, when the wholesale price is high and the outcome of double marginalization $\frac{1+w}{2} \geq 1-\sqrt{2c}$, the optimal thought-provoking retail price is equal to $p = 1-\sqrt{2c}$, the upper bound for consumer deliberation. In this case, the retail price no longer directly responds to the wholesale price, and the retail margin decreases as the wholesale price approaches $p = 1-\sqrt{2c}$ from below. Thus, to maintain a thought-provoking price to ensure positive sales and profit, the retailer has to sacrifice its retail margin. Moreover, as the deliberation cost c increases, the upper bound for thought-provoking prices $p = 1-\sqrt{2c}$ decreases, and therefore the retail margin is more likely to be squeezed to maintain consumer deliberation.

Case 2: Inhibit Deliberation. Now we consider the case where the retailer sets the price to inhibit deliberation. The retailer's optimization problem becomes

$$\max_p p - w,$$

where the demand is 1 and $p-w$ is the retail margin. The problem is subject to the following constraints:

$$\frac{(1-p)^2}{2} - c \leq \frac{1}{2} - p, \tag{IC$_2$}$$

$$p \leq \frac{1}{2}. \tag{IR$_2$}$$

Condition (IC$_2$) ensures that a consumer expects a higher value from no deliberation than deliberation, and condition (IR$_2$) ensures that each consumer makes a purchase. Combining these two conditions, we find that p is bounded above by $\min(\sqrt{2c}, \frac{1}{2})$, which leads to the following lemma.

Lemma A.2. *Suppose that the retail price inhibits consumer deliberation. Given wholesale price w, when $w \leq \sqrt{2c}$, the optimal retail price is $p = \sqrt{2c}$, resulting in sales $S = 1$ and a profit $\pi_r = \sqrt{2c} - w$. Otherwise, the retailer does not sell the product.*

Lemmas A.1 and A.2 show the results under two retailing strategies leading to different levels of stimulus for consumer thinking. Whether to induce or inhibit consumer deliberation has significant implications for the retailer's expected profit.

Retailer's Optimal Response. With Lemmas A.1 and A.2, we can solve the retailer's optimization problem; that is, the retailer chooses between the optimal deliberation inducing strategy and the optimal deliberation inhibiting strategy. Now, consider the following cases:

(1) When $c \in (\frac{7-3\sqrt{5}}{4}, \frac{1}{8}]$, if $w \leq 1-\sqrt{2c}$, the retailer may either set its price at $p = \min\{\frac{w+1}{2}, 1-\sqrt{2c}\}$ to induce deliberation, or set its price at $p = \sqrt{2c}$ to inhibit deliberation. There are two subcases:

(i) $1-2\sqrt{2c} \leq w \leq 1-\sqrt{2c}$. In this case, $\min\{\frac{w+1}{2}, 1-\sqrt{2c}\} = 1-\sqrt{2c}$. If the retailer induces deliberation, its profit is $(1-\sqrt{2c}-w)\sqrt{2c}$; otherwise, its price is at $\sqrt{2c}$ and its profit is $\sqrt{2c}-w$. By comparing the profits, we have the following: when $w \leq \frac{2c}{1-\sqrt{2c}}$, the retailer inhibits deliberation, and it induces deliberation otherwise.

(ii) $w \leq 1-2\sqrt{2c}$. In this case, $\min\{\frac{w+1}{2}, 1-\sqrt{2c}\} = \frac{w+1}{2}$. If the retailer induces deliberation, its profit is $(\frac{w+1}{2} - w)(1-\frac{w+1}{2})$;

otherwise, its price is at $\sqrt{2c}$ and its profit is $\sqrt{2c}-w$. By comparing the profits, we have the following: the retailer inhibits consumer deliberation when $w \le 2\sqrt[4]{2c}-1$. Note that $w \le 1-2\sqrt{2c} \le 2\sqrt[4]{2c}-1$ always holds; hence, the retailer always inhibits deliberation.

(2) When $c \in (\frac{1}{32}, \frac{7-3\sqrt{5}}{4}]$, if $w \le 1-\sqrt{2c}$, the retailer may either set its price at $p = \min\{\frac{w+1}{2}, 1-\sqrt{2c}\}$ to induce deliberation or set its price at $p = \sqrt{2c}$ to inhibit deliberation. There are again two subcases:

(i) $1-2\sqrt{2c} \le w \le 1-\sqrt{2c}$. In this case, $\min\{\frac{w+1}{2}, 1-\sqrt{2c}\} = 1-\sqrt{2c}$. If the retailer induces deliberation, its profit is $(1-\sqrt{2c}-w)\sqrt{2c}$; otherwise, the retailer sets its price at $\sqrt{2c}$ and its profit is $\sqrt{2c}-w$. When $w \le \frac{2c}{1-\sqrt{2c}}$, the retailer inhibits deliberation, and it induces deliberation otherwise.

(ii) $w \le 1-2\sqrt{2c}$. In this case, $\min\{\frac{w+1}{2}, 1-\sqrt{2c}\} = \frac{w+1}{2}$. If the retailer induces deliberation, its profit is $(\frac{w+1}{2}-w)(1-\frac{w+1}{2})$; otherwise, it prices at $\sqrt{2c}$ and its profit is $\sqrt{2c}-w$. It turns out that the retailer prevents deliberation when $w \le 2\sqrt[4]{2c}-1$ and induces deliberation otherwise.

(3) When $c \le \frac{1}{32}$, suppose that $w \le 1-\sqrt{2c}$ and the retailer may either price at $p = \min\{\frac{w+1}{2}, 1-\sqrt{2c}\}$ to induce deliberation or price at $p = \sqrt{2c}$ to prevent deliberation. There are again two subcases:

(i) $1-2\sqrt{2c} \le w \le 1-\sqrt{2c}$. Then $\min\{\frac{w+1}{2}, 1-\sqrt{2c}\} = 1-\sqrt{2c}$. If the retailer induces deliberation, its profit is $(1-\sqrt{2c}-w)\sqrt{2c}$; otherwise, it prices at $\sqrt{2c}$ and its profit is $\sqrt{2c}-w$. It turns out that when $w \le \frac{2c}{1-\sqrt{2c}}$, the retailer prevents deliberation, and it induces deliberation otherwise.

(ii) $w \le 1-2\sqrt{2c}$. Then $\min\{\frac{w+1}{2}, 1-\sqrt{2c}\} = \frac{w+1}{2}$. If the retailer induces deliberation, its profit is $(\frac{w+1}{2}-w)(1-\frac{w+1}{2})$; otherwise, it prices at $\sqrt{2c}$ and its profit is $\sqrt{2c}-w$. It turns out that the retailer induces deliberation when $w \ge 2\sqrt[4]{2c}-1$. Because $c \le \frac{1}{32}$, we have $w \ge 0 \ge 2\sqrt[4]{2c}-1$; hence, deliberation is always induced.

The proof follows immediately. □

Proof of Proposition 2

Case 1: Inducing Deliberation. Consider first the case of inducing deliberation. Suppose that the manufacturer prices at $w \le 1-\sqrt{2c}$; then, following Lemma A.1, the optimal price for the retailer is $p^*(w) = \min(1-\sqrt{2c}, \frac{1+w}{2})$. Recall that if the retailer prices above $1-\sqrt{2c}$, the individual rationality constraint is violated and consumers neither deliberate nor make purchases.

When $w \le 1-2\sqrt{2c}$, the retailer prices at $p = \frac{1+w}{2} \le 1-\sqrt{2c}$, and the manufacturer's profit is $\pi_1 = (1-p)w = \frac{(1-w)w}{2}$, which is maximized when $w = \min(1-2\sqrt{2c}, \frac{1}{2})$. When $1-2\sqrt{2c} \le w \le 1-\sqrt{2c}$, the retailer prices at $p = 1-\sqrt{2c}$, and the manufacturer's profit is $\pi_2 = (1-p)w = \sqrt{2c}w$, which is maximized when $w = 1-\sqrt{2c}$. Hence, when deliberation is induced, the optimal wholesale price can only take value from the following three values: $w^* \in \{\frac{1}{2}, 1-\sqrt{2c}, 1-2\sqrt{2c}\}$. Let us consider these three values:

(i) When $w = \frac{1}{2}$, the manufacturer's profit is $\pi_1 = \frac{1}{8}$.

(ii) When $w = 1-\sqrt{2c}$, the manufacturer's profit is $\pi_2 = \sqrt{2c}(1-\sqrt{2c})$.

(iii) When $w = 1-2\sqrt{2c}$, the manufacturer's profit is $\sqrt{2c}(1-2\sqrt{2c}) < \pi_2$; hence, this can never be the optimal solution.

By comparing π_1 and π_2, we have *the manufacturer's optimal strategy when inducing deliberation*:

(i) When $c \le \frac{3-2\sqrt{2}}{16}$, the manufacturer's prices at $w = \frac{1}{2}$, and its profit is $\pi_1 = \frac{1}{8}$.

(ii) When $\frac{3-2\sqrt{2}}{16} < c < \frac{1}{8}$, the manufacturer's prices at $w = 1-\sqrt{2c}$, and its profit is $\pi_2 = \sqrt{2c}(1-\sqrt{2c})$.

Case 2: Inhibiting Deliberation. When c is above c_2, a threshold that will be defined later, the manufacturer wishes to inhibit deliberation. For this case, the retail price should be $p = \sqrt{2c}$, as derived in Lemma A.2. The retailer may and may not inhibit deliberation. If it induces deliberation, the optimal retail price is $p = \min(\frac{1+w}{2}, 1-\sqrt{2c})$.

Hence, to motive the retailer to price low enough, the following incentive compatibility constraint must be imposed:

$$\sqrt{2c}-w \ge \left(1-\min\left(\frac{1+w}{2}, 1-\sqrt{2c}\right)\right) \cdot \left(\min\left(\frac{1+w}{2}, 1-\sqrt{2c}\right)-w\right).$$

Solving this inequality, we have the manufacturer's optimal strategy when inhibiting deliberation:

(i) When $c \le \frac{7-3\sqrt{5}}{4}$, $w = \sqrt[4]{2c}-1$, and the manufacturer's profit is $\pi_3 = 2\sqrt[4]{2c}-1$;

(ii) When $\frac{7-3\sqrt{5}}{4} \le c \le \frac{1}{8}$, $w = \frac{2c}{1-\sqrt{2c}}$, and the manufacturer's profit is $\pi_4 = \frac{2c}{1-\sqrt{2c}}$.

Finally, by comparing the profit under the two cases (inducing and inhibiting deliberation), we can derive the equilibrium strategies. □

Proof of Lemma 3

Suppose that $c_m \ge \frac{1}{8}$ and the retailer either chooses $c_r = 0$, prices at $p = \frac{1+w}{2}$, and induces deliberation or chooses $c_r = c_m$, prices at $p = \frac{1}{2}$, and inhibits deliberation. The profit under the former strategy is $\frac{(1-w)^2}{4}$, and the profit under the latter strategy is $\frac{1}{2}-w$. The break-even wholesale price is thus $w = \sqrt{2}-1$, and the results follow.

Suppose that $c_m < \frac{1}{8}$ and the retailer either chooses $c_r = 0$, prices at $p = \frac{1+w}{2}$, and induces deliberation or chooses $c_r = c_m$, prices at $p = \sqrt{2c_m}$, and inhibits deliberation. The profit under the former strategy is $\frac{(1-w)^2}{4}$, and the profit under the latter strategy is $\sqrt{2c_m}-w$. The break-even wholesale price is thus $w = 2\sqrt[4]{2c_m}-1$, and the results follow. □

Proof of Proposition 3

When $c_m \le \frac{1}{32}$, the manufacturer cannot induce regressive pricing. It optimally charges the standard double marginalization price $w = \frac{1}{2}$.

When $\frac{1}{32} < c_m < \frac{1}{8}$, the manufacturer either prices at $w \le 2\sqrt[4]{2c_m}-1$ and induces regressive pricing or charges at $w > 2\sqrt[4]{2c_m}-1$ and induces transgressive pricing. The latter is more profitable when $c_m \le \frac{6561}{131072}$ and the manufacturer optimally charges at $w = \frac{1}{2}$; the former is more profitable when $c_m \ge \frac{6561}{131072}$ and the manufacturer optimally charges at $w = 2\sqrt[4]{2c_m}-1$.

When $c_m \geq \frac{1}{8}$, the manufacturer either prices at $w \leq \sqrt{2}-1$ and induces regressive pricing or charges at $w > \sqrt{2}-1$ and induces transgressive pricing. The former is more profitable, and the manufacturer optimally charges at $w = \sqrt{2}-1$. □

Proof of Proposition 4

Suppose that the quality of the product is q. Then, consumer valuation is uniformly distributed over $[0, q]$ with density $\frac{1}{q}$. The individual rationality condition for deliberation is $E[v-p]^+ - c \geq 0$, that is,

$$\left(\frac{q-p}{2}\right)\left(\frac{q-p}{q}\right) \geq c,$$

and the incentive compatibility condition for deliberation is $E[v-p]^+ - c \geq E[v]-p$, that is,

$$\left(\frac{q+p}{2}-p\right)\left(\frac{q-p}{q}\right) - c \geq \frac{q}{2}-p.$$

Solving these conditions leads to $\sqrt{2cq} \leq p \leq q-\sqrt{2cq}$. Similarly, we can find out that consumers purchase without deliberation when $p \leq \min(\sqrt{2cq}, \frac{q}{2})$. Similar to Proposition 2, we can derive the equilibrium channel strategy, as shown in Table A.1.

We can see that the equilibrium channel strategies are very similar to those in the basic model (see Proposition 2), where now the relative magnitude of deliberation cost, $\frac{c}{q}$, replaces the role of c. Now let us consider the following cases:

(1) *Case* 1. $c < \frac{3-2\sqrt{2}}{16}$, and we have the following four subcases:

(i) *Case* 1.1. $q \in [93.25c, 1]$. The relative deliberation cost falls in Region I, and the manufacturer's profit is $\pi_m = \frac{q}{8}$, which is maximized when $q = 1$, yielding a profit $\pi_m = \frac{1}{8}$.

(ii) *Case* 1.2. $q \in [13.71c, 93.25c]$. The relative deliberation cost falls in Region II, and the manufacturer's profit is

$$\pi_m = (q-\sqrt{2cq})\frac{\sqrt{2cq}}{q} = \left(1-\sqrt{\frac{2c}{q}}\right)\sqrt{2cq}$$

as $\frac{\partial \pi_m}{\partial q} = \sqrt{\frac{c}{2q}} > 0$, this is maximized when $q = 93.25c$, yielding a profit $\pi_m = 11.66c$.

(2) *Case* 1.3. $q \in [8c, 13.71c]$. The relative deliberation cost falls in Region III, and the manufacturer's profit is

$$\pi_m = \frac{2cq}{q-\sqrt{2cq}} = \frac{2c}{1-\sqrt{\frac{2c}{q}}},$$

which is maximized when $q = 8c$, yielding a profit $\pi_m = 4c$.

(3) *Case* 1.4. $q \in [0, 8c]$. The relative deliberation cost falls in Region IV, and the manufacturer's profit is $\pi_m = \frac{q}{2}$, which is maximized when $q = 8c$, yielding a profit $\pi_m = 4c$.

By comparing the four regions together, we find that the optimal quality level is $q = 1$.

(2) *Case* 2. $\frac{3-2\sqrt{2}}{16} \leq c \leq \frac{7-3\sqrt{5}}{4}$, and we have the following three subcases:

(i) *Case* 2.1. $q \in [13.71c, 1]$. The relative deliberation cost falls in Region II, and the manufacturer's profit is $\pi_m = q\left(1-\sqrt{\frac{2c}{q}}\right)\sqrt{\frac{2c}{q}}$, which is maximized when $q = 1$, yielding a profit $\pi_m = \sqrt{2c}(1-\sqrt{2c})$.

(ii) *Case* 2.2. $q \in [8c, 13.71c]$. The relative deliberation cost falls in Region III, and the manufacturer's profit is $\pi_m = \frac{2c}{1-\sqrt{\frac{2c}{q}}}$, which is maximized when $q = 8c$, yielding a profit $\pi_m = 4c$.

(iii) *Case* 2.3. $q \in [0, 8c]$. The relative deliberation cost falls in Region IV, and the manufacturer's profit is $\pi_m = \frac{q}{2}$, which is maximized when $q = 8c$, yielding a profit $\pi_m = 4c$.

By comparing the three regions together, we find that the optimal quality level is $q = 1$ when $c \leq \frac{1}{18}$, and $q = 8c$ when $c \geq \frac{1}{18}$.

(3) *Case* 3. $\frac{7-3\sqrt{5}}{4} < c < \frac{1}{8}$, and we have the following two subcases:

(i) *Case* 3.1. $q \in [8c, 1]$. The relative deliberation cost falls in Region III, and the manufacturer's profit is $\pi_m = \frac{2c}{1-\sqrt{\frac{2c}{q}}}$, which is maximized when $q = 8c$, yielding a profit $\pi_m = 4c$.

(ii) *Case* 3.2. $q \in [0, 8c]$. The relative deliberation cost falls in Region IV, and the manufacturer's profit is $\pi_m = \frac{q}{2}$, which is maximized when $q = 8c$, yielding a profit $\pi_m = 4c$.

By comparing the two regions together, we find that the optimal quality level is $q = 8c$.

(4) *Case* 4. $\frac{1}{8} \leq c$, and the relative deliberation cost is $\frac{c}{q} \geq \frac{1}{8}$ and always falls into Region IV. The manufacturer's profit is then $\pi_m = \frac{q}{2}$, leading to the optimal quality $q = 1$.

The proposition follows immediately. □

Proof of Proposition 5

As in the proof for the previous proposition, we consider four different cases. We start with the case where c is small. The results follow from standard marginalization, where the retailer prices at $\frac{q+w}{2}$ and the demand is $\frac{1}{q}\frac{q-w}{2}$. Then, the manufacturer's profit is

$$\pi_m = \left(\frac{q-w}{2q}\right)\left(w-\frac{q^2}{2}\right),$$

which is maximized when $q = \frac{2}{3}, w = \frac{4}{9}$; the corresponding profit is $\pi_m = \frac{1}{27}$.

For the second case (Region II, $w = p = q-\sqrt{2cq}$), the manufacturer induces deliberation and takes entire channel profit. Its profit is

$$\pi_m = \frac{\sqrt{2cq}}{q}\left(q-\sqrt{2cq}-\frac{q^2}{2}\right),$$

Table A.1. Channel Strategies Under Different Quality Levels

Region	Deliberation cost	Wholesale price	Retail price	Manufacturer's profit
I	$\frac{c}{q} \leq \frac{3-2\sqrt{2}}{16}$	$\frac{q}{2}$	$\frac{3q}{4}$	$\frac{q}{8}$
II	$\frac{3-2\sqrt{2}}{16} < \frac{c}{q} < \frac{7-3\sqrt{5}}{4}$	$q-\sqrt{2cq}$	$q-\sqrt{2cq}$	$(q-\sqrt{2cq})\frac{\sqrt{2cq}}{q}$
III	$\frac{7-3\sqrt{5}}{4} \leq \frac{c}{q} \leq \frac{1}{8}$	$\frac{2cq}{q-\sqrt{2cq}}$	$\sqrt{2cq}$	$\frac{2cq}{q-\sqrt{2cq}}$
IV	$\frac{1}{8} < \frac{c}{q}$	$\frac{q}{2}$	$\frac{q}{2}$	$\frac{q}{2}$

which is maximized at $q = \frac{2}{3}$; the corresponding profit is $\pi_m = \frac{4\sqrt{c}}{3\sqrt{3}} - 2c$.

For the third case (Region III, $w = \frac{2cq}{q-\sqrt{2cq}}$), the manufacturer's profit is

$$\pi_m = \frac{2cq}{q-\sqrt{2cq}} - \frac{q^2}{2} = \frac{2c}{1-\sqrt{\frac{2c}{q}}} - \frac{q^2}{2},$$

which is deceasing in q; thus, the maximum is achieved when $q = 8c$, and the corresponding profit is $\pi_m = 4c - 32c^2$.

For the last case (Region IV, $w = \frac{q}{2}$), the manufacturer's profit is

$$\pi_m = \frac{q}{2} - \frac{q^2}{2}.$$

The maximum is achieved when $q = \frac{1}{2}$, and the corresponding profit is $\pi_m = \frac{1}{8}$.

The proposition follows by comparing the profit functions under the different cases. □

Endnotes

[1] James Surowiecki (2011) Innovative consumption. *The New Yorker* 87(13), p. 42.

[2] For Huawei's Mate 10 advertisement, see the company website (https://consumer.huawei.com/en/phones/mate10/). For more information on the Kirin 970, see the company's press release https://consumer.huawei.com/en/press/news/2017/ifa2017-kirin970/.

[3] The results can be sensitive to this assumption and may change if consumers' valuations are not proportional to product quality.

[4] The quality decision in this model can be equivalently interpreted as quantity, that is, the decision on package size. All analyses and results in this section hold with this alternative interpretation.

[5] Extending the analysis of this model to decisions on consumer empowerment and optimal quality is analytically not tractable. We conduct numerical analyses and provide some results in the online appendix. Overall, in this model of heterogeneous deliberation cost, we can validate the result that the retailer may prefer a moderate level of deliberation cost while the manufacturer prefers a high deliberation cost. We can also validate the result that the manufacturer may prefer a moderate level of quality even though a higher quality does not entail any additional cost.

[6] As noted by Guo (2016, footnote 6), it is not a necessary assumption that the consumer's valuation uncertainty can be completely resolved by deliberation. In cases where residual uncertainty may persist, v_i can be redefined as the expectation of the (true) preference parameter, conditional on the information gained through deliberation.

[7] Numerical simulations suggest that a number of other specifications lead to similar results, for example, $\phi(\alpha) = \max(\sqrt[3]{\alpha}, 1)$ and $\phi(\alpha) = \frac{\alpha}{1+\alpha}$.

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