Hindawi
Mathematical Problems in Engineering
Volume 2019, Article ID 1287968, 13 pages
https://doi.org/10.1155/2019/1287968

Research Article

Pricing Strategy for New Products with Presales

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Received 29 July 2019; Revised 6 December 2019; Accepted 11 December 2019; Published 27 December 2019

Academic Editor: Benjamin Ivorra

An increasing number of firms and retailers use presale strategies to induce customers to purchase before new products enter the market to increase their market share. Presales have gradually become a hot issue in business and academic circles. Based on a skimming pricing strategy and a penetration pricing strategy, this paper uses the different choice behaviors of two types of consumers to investigate the pricing strategy of preselling new products. The results show that if the proportion of fashion consumers is relatively low and their willingness to buy in the spot channel is below the threshold, the retailer should focus on traditional consumers by using a skimming pricing strategy; otherwise, the retailer should switch to a penetration pricing strategy. Moreover, we find that to gain more profits, the retailer should introduce a presale channel using either a penetration pricing or skimming pricing strategy. The introduction of a presale channel may not only reduce inventory risk and cost and enhance the market share and profitability of the enterprise but also help consumers avoid the risk of shortage and enhance their sense of security.

1. Introduction

The term "presale" refers to the sales strategy behavior in which sellers begin to accept orders before the products officially enter the market [1]. Presales can improve the understanding of the product market potential of retailers, reduce inventory risks and costs caused by demand uncertainty [2], and attract consumers to buy in advance and increase consumption [3]. The early presale strategy is usually used in the fashion clothing industry and has achieved effects in the rapid response to business practices in the 1990s. Presale strategies have attracted wide attention in the academic community to date. With the rapid development of e-commerce, presales are becoming increasingly common in online retailing. Almost all types of goods, including clothing, electronic products, and fresh products, can be sold in advance of their release. In fact, in recent years, due to the increasingly fierce market competition, especially the shorter life cycle of technological innovation products, increasingly high-tech industries adopt an online presale mode when launching new products. Apple, for example, offers opportunities to preorder the new generation of iPhones/iPads before they are officially launched. Xiaomi, one of Apple's main competitors in the Chinese market, has been using the presale strategy since the launch of the first generation of MIUI phones. As a result of the uncertainty of customers' future valuation, both Apple and Xiaomi benefit from presales [4].

Adopting a presale strategy when launching new products has multiple benefits for both consumers and businesses. Presales ensure that consumers, especially brand-loyal fans and technology product enthusiasts, do not have to worry about new products going out of stock when they officially go on sale; they guarantee the timely availability of new products, providing these customers with psychological security and satisfaction [1]. At the same time, when presales include some promotion strategies, such as presale discounts, gifts, and free refunds and exchanges, consumers can obtain more utility from the new product presale strategy [3].

For enterprises, presales can be a natural extension of the normal selling season and help retailers expand the wider consumer base of goods sold during the peak season [3]. Additionally, enterprises can obtain some funds and market demand response through presales and update the inventory plan and capacity decisions of new products in a timely manner according to demand information [2] to reduce inventory risk [5] and better control operations [6]. Third, presales are an effective tool that can be combined with operation strategies, such as ordering strategy [7], pricing strategy [8, 9], innovation strategy [10], and refund strategy [11, 12]. Presales can help companies understand the market and promote pricing [13], forecast market demand [14], and further enhance their market share and profitability; presales can also help consumers avoid the risk of shortage, enhance their sense of security, and promote close relationships between enterprises and consumers.

In this paper, we regard online presales and offline spot sales as two types of purchase channels, namely, the online presale channel and the offline spot sale channel. It is not difficult to imagine that because the online presale channel and the offline spot channel face the same consumer market, the introduction of the online presale channel could affect the sales of the offline spot channel (such as offline physical stores). How does the introduction of the online presale channel affect the traditional offline spot channel? How does the offline spot channel compete with the online presale channel? What factors will affect the pricing strategy of presale and spot channels? In this context, there are too many problems for us to consider here, but there are few studies on the interaction between presale and spot channels for new products. In this regard, business practices precede existing theoretical research. To bridge this gap, we use game theory to study the interaction between the online presale mode and the offline spot sale mode for new products.

We first assume that there are two types of consumers in the market with different channel preferences. Then, we derive the demand function from the choice behavior of the two types of consumers and explore two situations according to the demand function. In the first situation, only the offline spot sale channel exists. For this situation, we determine two pricing strategies for the retailer: penetration pricing strategy and skimming pricing strategy. In the second case, offline spot sale and online presale channels coexist, and the retailer can still use these two pricing strategies in this case. We determine the conditions under which the retailer should use the penetration pricing strategy and the skimming pricing strategy as follows: if the proportion of fashion consumers is relatively low and their willingness to buy through the spot channel is below the threshold, the retailer should use the skimming pricing strategy to focus on traditional consumers; if both the proportion of fashion consumers and their willingness to buy in the spot channel are relatively high, the retailer should switch to the penetration pricing strategy. Additionally, we analyzed the impact of the presale channel on the spot channel by examining the existing and nonexisting presale channel. We find that the retailer does not change the pricing strategy, regardless of whether the presale channel is introduced. In addition, the retailer should introduce a presale channel regardless of penetration pricing or skimming pricing strategy. The introduction of a presale channel can not only increase the retailer's market share and profits but also help consumers, especially fashion consumers, avoid the risk of shortages and enhance their sense of security.

The remainder of this paper is organized as follows. Section 2 provides a literature review. Section 3 describes the problem description. Section 4 studies the case of only the spot sale channel. Section 5 studies the situation in which the spot channel and the presale channel coexist. Section 6 discusses the impact of the introduction of a presale channel on the spot sale channel. Section 7 concludes with a discussion of the management insights provided in this paper and recommendations for future research.

2. Literature Review

The existing literature closely related to our work examines two main pricing strategies, namely, presale strategy and pricing strategy.

2.1. Presale Strategy. The early presale strategy is also called advance selling, and the literature focuses mainly on the relevant strategies for how member enterprises in the supply chain can improve themselves by using advanced demand information [2, 15–20]. The literature mentioned above considers mainly inventory planning and capacity decision-making problems, usually assuming that the preordered demand information is exogenous and known. However, this hypothesis is flawed because when the retailer is faced with price-sensitive consumers, the preordered demand information is an endogenous result that depends on the pricing decision of new products. For example, some early studies on enterprises' decision-making capacity [2] defined consumers as price-sensitive consumers, and their preordered demand information was derived according to their sensitivity to price. Some early studies have noticed the defect of this hypothesis, so the price, distribution plan, and other issues are considered in the study. For example, Tang et al. [21] and McCardle et al. [22] studied the preferential strategy of booking tickets in advance; that is, retailers offer price discounts to consumers who book tickets in advance. Wang and Toktay [23] considered the inventory model with advance demand information and flexible distribution and proposed a more comprehensive presale strategy and inventory decision. In these studies, the preordered demand information is implemented based on the aggregate demand function, and the behavioral factors of consumers are not taken into account. With the advances in the literature, many researchers have found that consumer behavior factors are particularly important for the impact of the presale strategy [1, 4, 24–30]. In the aforementioned papers, the researchers considered the behavioral factors of consumers in the original presale strategy based on information updates [1, 25, 28], studied the presale strategy based on information asymmetry [24], investigated the presale strategy based on samples or gifts [26, 29], examined channel management

based on presale [27], and analyzed the presale strategy of new products or technological innovations [4, 30]. Tian and Wang [4] studied the presale of new products to two types of consumers, where the valuation of high-type consumers is deterministic and the valuation of low-type consumers depends on the preordered results. Yu et al. [30] studied the presale problem of technological innovation products on the basis of considering the deviation of the presale and spot-sale valuation of strategic consumers. This paper also discusses the presale strategy of new products, especially those conforming to technological innovations, but differs from the above research in the following aspects. First, we study a new problem, the impact of the introduction of the presale period (presale channel) on the current sale period (spot channel), which has not been considered in the above papers in the market for technological innovation products. Second, the types of consumers we consider all depend on valuation, and no one type of consumer's valuation is certain. Third, we examine the pricing strategies of the spot channel based on penetration and skimming pricing strategies, as well as when the spot channel and the presale channel coexist. However, the above literature has not considered this subdivision of pricing strategies.

2.2. Pricing Strategy. The presale pricing strategy is developed mainly from three aspects: premium pricing, discount pricing, and dynamic pricing. Premium pricing means that retailers target some high-end consumers who are willing to pay a premium during the presale period. These high-end consumers are either enthusiasts of technology products or loyal fans of brands, and they are willing to pay high prices for new products in order to have them first [1]. A large number of observations have also confirmed this point, especially for high-tech innovative products; the price during the presale period is often higher than the price at the official sale. Even if consumers anticipated this difference, they would have made the same prepurchase decision.

However, although it is common for scientific and technological innovation products to adopt premium pricing in the presale period, some product categories are more suitable to adopt discount pricing in the presale period [9, 31–35]. Research on discount pricing during the presale period generally contends that presale discounts can encourage consumers to buy in advance, thus stimulating demand [21]. On the other hand, presale discounts can also be used as compensation for possible losses caused by consumers' uncertainty about products. Some researchers have also found that both presale premiums and presale discounts can obtain the optimal profit under different circumstances, but the conditions of use are different [1].

The research on dynamic pricing focuses mainly on the improvement of consumers' strategic response and business operation performance when retailers or manufacturers change their pricing, capacity decision, or inventory planning during the presale period and the current sales period [10, 31, 36–42]. Under the assumption that the consumers are strategic and the initial inventory is fixed, some scholars use the dynamic pricing method, which reduces the price once at a fixed time to examine enterprises' operation performance [31]. Some scholars study how to address strategic consumer behavior and short-sighted consumer behavior by engaging in dynamic pricing and adjusting the contingent production strategy, thereby improving presale sales objectives and profits [43]. Other studies question whether strategic consumers and short-sighted consumers should be distinguished and prove that when the production capacity of enterprises is small, enterprises can even make dynamic pricing decisions without considering strategic consumer behavior and still achieve higher operational performance [41]. These presale pricing studies have important implications for the retailer to consider consumer choice behavior when implementing the presale strategy. In the presale of new products, retailers should not take for granted that they can use high prices to anchor a certain number of consumers in the presale period or that a low price will necessarily attract some consumers, which requires us to pay full attention to the combination of consumer choice behavior and the presale strategy. On the basis of paying close attention to consumer behavior, this paper studies the presale of new products, distinguishes the presale channel and the spot sale channel according to the sales period of new products, and studies the influence of the presale channel on the spot channel by using penetration pricing and skimming pricing strategies. It is worth noting that our pricing strategies are not only closely related to consumer choice behavior but also related to the proportion of consumer types, which is different from the above papers.

3. Problem Description

Consider a retailer who promotes and sells new products, especially scientific and technological innovation products, by combining the following two sales modes: (1) online presales, where consumers can make advance reservations through an online channel before the products officially enter the market, which is defined as the presale channel, and (2) offline spot sales, where consumers can directly purchase through the traditional offline channel after the products enter the market, which is defined as the spot channel. Here, we consider the two stages of online presale and offline spot sale as two sale methods and further regard them as two types of sales channels, namely, the presale channel and spot channel. In the online presale stage, consumers may worry that new products will be out of stock when they officially go on sale, so consumers can order new products online in advance to ensure the timely availability of new products. However, consumers inevitably have to spend time waiting during the presale period and have to bear certain opportunity costs because of the value cognition uncertainty of new products in the presale stage. We indicate opportunity costs, which may be referred to as the loss due to the uncertainty of the presale demand during the presale stage, as t. In the offline selling stage, new products are officially released in physical stores, where consumers can "touch and feel" the products. We regard the two stages of online presale and offline spot sale as two types of purchase

channels, namely, the online presale channel and the offline spot sale channel.

At the same time, similar to [44], we assume that there are two types of consumers in the market, namely, traditional consumers and fashion consumers. Traditional consumers do not pursue fashion or the timely availability of new products. They consider only purchasing products in offline physical stores after the products are put on the market because they can "touch and feel" the products in offline physical stores at the spot sale stage/channel, and they can eliminate the inherent uncertainty of product recognition through professional evaluation obtained through web consumer reviews or other channels. Before giving the utility obtained by consumers' purchase of products through different channels, we first express the spot sale price and presale price of new products as p_{si}^j and p_{ai}^j, respectively, where s represents spot sale and a represents presale; $i = H$ or L indicates skimming pricing (high price) and penetration pricing (low price), respectively; $j = B$ or N denotes that the presale channel exists ($j = B$, both channels coexist) or does not exist ($j = N$, no presale channel). Thus, the utility obtained by a traditional consumer buying the product through the offline spot channel is $v - p_{si}^j$, where v is the consumer's perceived value of the product and follows a uniform distribution on [0, 1]; p_{si}^j is the spot price of the new product. For fashion consumers, they pursue fashion and the timely availability of new products, but due to the inherent uncertainty in the value recognition of new products, they will consider whether to buy the new product from online presale stage/channel or offline spot sale stage/channel. To simulate the difference between these two stages/channels of purchases, we assume that the utility of a fashion consumer when buying through the spot channel is $\alpha_1 v - p_{si}^j$, and the utility when buying through the presale channel is $\alpha_2 v - p_{ai}^j - t$. Here, parameter α indicates the purchase preference of the fashion consumer, α_1 and α_2 are the preferences of the fashion consumer in the spot sale channel and the presale channel, respectively, and these preferences satisfy $0 < \alpha_1 < 1 < \alpha_2$, while p_{ai}^j is the presale price of the new product. We assume that the proportion of fashion consumers is γ, while the proportion of traditional consumers is $1 - \gamma$, and for the convenience of analysis, the population is normalized to 1, and a consumer can buy at most one unit of product.

4. Spot Channel Only

To study the impact of the presale channel on the sales of new products for the retailer, we first analyze the sales of new products when only the spot channel exists (without the presale channel) and use these sales as a benchmark for future comparison.

In the absence of a presale channel (i.e., $j = N$), both traditional consumers and fashion consumers consider buying new products through spot channels. The traditional consumer buys from the spot channel only when the utility function satisfies $v - p_{si}^N \geq 0$, and the fashion consumer does so when $\alpha_1 v - p_{si}^N \geq 0$. The retailer has two pricing strategies, named the penetration pricing strategy and skimming pricing strategy. In the penetration pricing strategy (i.e., $i = L$), the retailer can set a low price to induce two types of consumers' buying behavior ($p_{sL}^N \leq \alpha_1$). We use d_{sL}^N to express the retailer's demand when adopting the penetration pricing strategy under the condition of the spot channel only, which can be expressed as $d_{sL}^N = (1-\gamma)(1-p_{sL}^N) + \gamma(1-(p_{sL}^N/\alpha_1))$, where $(1-\gamma)(1-p_{sL}^N)$ is the traditional consumers' demand for new products through the spot channel and $\gamma(1-(p_{sL}^N/\alpha_1))$ is the fashion consumers' demand for new products through the spot channel. Based on the skimming pricing strategy (i.e., $i = H$), fashion consumers do not buy via the spot channel (as $\alpha_1 < p_{sH}^N \leq 1$), and only traditional consumers purchase via the spot channel. Similarly, we use d_{sH}^N to express the retailer's demand when adopting the skimming pricing strategy under the condition of the spot channel only, and $d_{sH}^N = (1-\gamma)(1-p_{sH}^N)$.

The retailer determines the selling price p_{si}^N of the spot channel and pursues the maximization of profit. First, under the penetration pricing strategy, the optimal profit of the retailer can be expressed as follows:

$$\begin{aligned} \max_{p_{sL}^N \geq c+h} \quad & \pi_{sL}^N = (p_{sL}^N - c - h) d_{sL}^N \\ \text{s.t.} \quad & p_{sL}^N \leq \alpha_1, \end{aligned} \tag{1}$$

where c is the cost of the unit product, h is the average inventory holding cost of the unit product, that is, the average inventory storage cost shared by the unit product at the spot sale stage, and π_{sL}^N denotes the profit of the retailer when adopting the penetration pricing strategy under the condition of the spot channel only.

Under the skimming pricing strategy, the optimal profit of the retailer can be expressed as

$$\begin{aligned} \max_{p_{sH}^N \geq c+h} \quad & \pi_{sH}^N = (p_{sH}^N - c - h) d_{sH}^N \\ \text{s.t.} \quad & \alpha_1 < p_{sH}^N \leq 1. \end{aligned} \tag{2}$$

Similarly, π_{sH}^N denotes the profit of the retailer when adopting the skimming pricing strategy under the condition of the spot channel only.

After solving these two problems, we can obtain the following proposition.

Proposition 1. *In the case without a presale channel and only a spot channel, the retailer can use two pricing strategies. Based on the penetration pricing strategy, the retailer's optimal spot price is* $p_{sL}^{N^*} = \alpha_1(1+c+h) + (\gamma - \alpha_1\gamma)(c+h)/2(\alpha_1 + \gamma - \alpha_1\gamma)$*; based on the skimming pricing strategy, the retailer's optimal spot price is* $p_{sH}^{N^*} = (1/2)(c+h+1)$.

From Proposition 1, based on the penetration pricing strategy, the effective demand of the spot channel is $d_{sL}^{N^*} = \alpha_1 - \alpha_1 c - \alpha_1 h - c\gamma - h\gamma + \alpha_1 c\gamma + \alpha_1 hr/2\alpha_1$, and the optimal profit is $\pi_{sL}^{N^*} = (\alpha_1 c - \alpha_1 + \alpha_1 h + c\gamma + h\gamma - \alpha_1 c\gamma - \alpha_1 h\gamma)^2/4\alpha_1(\alpha_1 + \gamma - \alpha_1\gamma)$; based on the skimming pricing strategy, the effective demand of the spot channel is $d_{sH}^{N^*} = (1-\gamma)((1/2) - (c/2) - (h/2))$, and the optimal profit is $\pi_{sH}^{N^*} = (1-\gamma)(c+h-1)^2/4$.

By comparing the retailer's profits under these two pricing strategies, we can determine that one of the pricing

strategies is the optimal pricing strategy; therefore, Proposition 2 can be obtained.

Proposition 2. *The retailer's optimal pricing strategy is a penetration pricing strategy when* $\alpha_1 \geq (1/2)(c+h+1)$ *or when* $\alpha_1 < (1/2)(c+h+1)$ *and* $\gamma \geq \alpha_1((1/2\alpha_1 - c - h) - 1)/(1-\alpha_1)$. *The retailer's optimal pricing strategy is a skimming pricing strategy when* $\alpha_1 < (1/2)(c+h+1)$ *and* $\gamma \leq \alpha_1((1/2\alpha_1 - c - h) - 1)/(1-\alpha_1)$.

In Figure 1, we provide a graphical illustration of the retailer's use of the pricing strategy system. The lower left corners of Figures 1(a) and 1(b) indicate that the skimming pricing strategy is the retailer's optimal pricing strategy, while the upper right corners of Figures 1(a) and 1(b) indicate that the penetration pricing strategy is the retailer's optimal pricing strategy. This finding implies that the lower the preference of fashion consumers for spot channels α_1 is, the higher the possibility that a retailer will use a skimming pricing strategy. In addition, Figure 1(a) shows the impact of the unit cost on the retailer's pricing strategy: with the increase in the unit cost c, the scope of the skimming pricing strategy expands, while the scope of using the penetration pricing narrows, which means that the retailer has more cost disadvantages when providing spot services to consumers, leading to a higher probability that the retailer will use skimming pricing. Figure 1(b) depicts the impact of the average inventory holding cost h per unit of product on the retailer's pricing strategy: as h increases, the scope of the skimming pricing strategy expands, while the scope of the penetration pricing strategy narrows. Similarly, in this case, the retailer has an inventory holding cost disadvantage in providing spot services to consumers, which increases the possibility of using skimming pricing. The above analysis shows that as the unit cost (c or h) increases, it will not be profitable for the retailer to adopt the strategy of a low price (penetration pricing) under the condition of a spot channel only; thus, the retailer tends to adopt the strategy of a high price, i.e., the skimming pricing strategy.

5. Introducing the Presale Channel

5.1. Retailer Adopts a Skimming Pricing Strategy. In this section, we consider that a presale channel and a spot channel coexist, as with no presale channel, the retailer has two pricing strategies: the skimming pricing strategy and the penetration pricing strategy. We assume that the retailer's price in the spot channel is p_{si}^B, while that in the presale channel is p_{si}^B. Fashion consumers will consider both the presale channel and the spot channel when deciding whether to buy new products, and the retailer also needs to consider the option of selling through the penetration pricing strategy ($p_{sL}^B \leq \alpha_1$) or the skimming pricing strategy ($\alpha_1 < p_{sH}^B \leq 1$). Because traditional consumers buy only in the spot channel, there is no need to consider the presale channel.

Under a skimming pricing strategy ($\alpha_1 < p_{sH}^B \leq 1$), fashion consumers will not buy through the presale channel. However, fashion consumers will buy products in the presale channel when $\alpha_2 v - p_{aH}^B - t \geq 0$, i.e., $p_{aH}^B \leq \alpha_2 - t$, and the demand of the presale channel is $d_{aH}^B = \gamma(1 - p_{aH}^B + t/\alpha_2)$. Traditional consumers need to meet $v - p_{sH}^B \geq 0$ when buying in the spot channel, and the demand for the spot channel is $d_{sH}^B = (1-\gamma)(1-p_{sH}^B)$.

Then, the profit of the retailer's spot channel can be expressed as

$$\begin{aligned} \max_{p_{sH}^B \geq c+h} \quad & \pi_{sH}^B = (p_{sH}^B - c - h) d_{sH}^B \\ \text{s.t.} \quad & \alpha_1 < p_{sH}^B \leq 1. \end{aligned} \tag{3}$$

The profit of the retailer's presale channel can be expressed as

$$\begin{aligned} \max_{p_{aH}^B \geq c} \quad & \pi_{aH}^B = (p_{aH}^B - c) d_{aH}^B \\ \text{s.t.} \quad & p_{aH}^B \leq \alpha_2 - t. \end{aligned} \tag{4}$$

Therefore, the optimal profit of the retailer can be expressed as

$$\begin{aligned} \max_{p_{sH}^B, p_{aH}^B} \quad & \pi_H^B = \pi_{sH}^B + \pi_{aH}^B \\ \text{s.t.} \quad & \alpha_1 < p_{sH}^B \leq 1 \\ & p_{aH}^B \leq \alpha_2 - t, \end{aligned} \tag{5}$$

where π_H^B represents the sum of the retailer's spot channel profit and presale channel profit when a adopting skimming pricing strategy.

Under the skimming pricing strategy, when fashion consumers buy through the presale channel, unit cost c must be less than the retail price of the presale channel p_{aH}^B, and the presale price should satisfy $p_{aH}^B \leq \alpha_2 - t$ simultaneously. Therefore, we assume that $c < \alpha_2 - t$, which is valid throughout the text. Proposition 3 can be obtained by solving the optimal pricing of the retailer under a skimming pricing strategy.

Proposition 3. *Based on the coexistence of presale and spot channels, when the retailer adopts the skimming pricing strategy, that is, when* $\alpha_1 \leq (1/2)(c+h+1)$ *is satisfied, we can obtain the profits of the spot channel and presale channel, respectively. In the spot channel, the retailer's optimal spot selling price is* $p_{sH}^{B^*} = (1/2)(c+h+1)$; *in the presale channel, the retailer's optimal presale price is* $p_{aH}^{B^*} = 1/2(\alpha_2 + c - t)$.

From Proposition 3, the demand of the spot channel is $d_{sH}^{B^*} = 1/2(1-\gamma)(1-c-h)$, and the optimal profit of the spot channel is $\pi_{sH}^{B^*} = (1-\gamma)(c+h-1)^2/4$; the demand of the presale channel is $d_{aH}^{B^*} = \gamma(\alpha_2 - c - t)/2\alpha_2$, and the optimal profit of the presale channel is $\pi_{aH}^{B^*} = \gamma(c - \alpha_2 + t)^2/4\alpha_2$. Therefore, in the case of the coexistence of presale and spot channels, when the retailer adopts a skimming pricing strategy, the retailer's optimal profit is $\pi_H^{B^*} = \pi_{sH}^{B^*} + \pi_{aH}^{B^*} = ((1-\gamma)(c+h-1)^2/4) + \gamma(c - \alpha_2 + t)^2/4\alpha_2$.

Here, notably, $\alpha_1 < p_{sH}^{B^*}$ is a necessary condition for the feasibility of the skimming pricing strategy; thus, $\alpha_1 < (c/2) + (h/2) + (1/2) < 1$ will continue to be maintained (notice that $1 - c - h > 0$). In addition, because $c < \alpha_2 - t$, it can be concluded that $p_{aH}^{B^*} = (1/2)(\alpha_2 + c - t) < 1/2(\alpha_2 +$

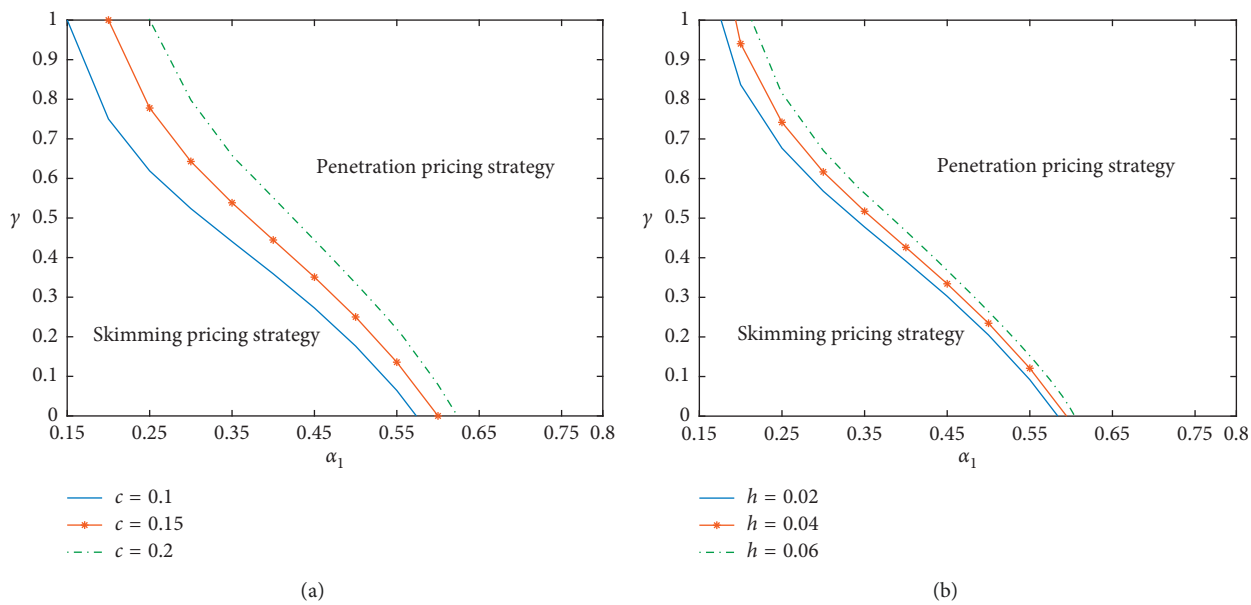

Figure 1: Pricing strategy with only the spot channel. (a) Impact of c. (b) Impact of h.

$\alpha_2 - t - t) < \alpha_2 - t$ is established (notice that $\alpha_2 - t - c > 0$). It is apparent that the total profit of the retailer $\pi_H^{B^*}$ decreases with c, h, t, and γ and increases with α_2. As cost variables, c, h, and t have a negative impact on the retailer's total profit. Since γ represents the proportion of fashion consumers, increases in γ will harm the optimal profit of the spot channel ($\pi_{sH}^{B^*}$). Although the profit of the presale channel ($\pi_{aH}^{B^*}$) will increase with γ, the increase is not enough to compensate for the decrease in the profit of the spot channel; thus, the total profit is still decreased. In addition, the purchase preference of fashion consumers in the presale channel α_2 is independent of the profit of the spot channel, but the profit of the presale channel will increase with α_2, eventually leading to an increase in the total profit $\pi_H^{B^*}$.

5.2. Retailer Adopts the Penetration Pricing Strategy. To study the effective demand of presale channels and spot-sale channels when the retailer adopts penetration pricing ($0 \le p_{sL}^B \le \alpha_1$), we need to study the purchase behavior of different consumers. The first group of consumers includes fashion consumers in the presale channel, when $\alpha_2 v - p_{aL}^B - t \ge \alpha_1 v - p_{sL}^B$ and $\alpha_2 v - p_{aL}^B - t \ge 0$, that is, fashion consumers with perception intervals in $[p_{aL}^B + t - p_{sL}^B/\alpha_2 - \alpha_1, 1]$ will buy new products in the presale channel. The second group includes fashion consumers in the spot channel, when $\alpha_2 v - p_{aL}^B - t \le \alpha_1 v - p_{sL}^B$ and $\alpha_1 v - p_{sL}^B \ge 0$, i.e., fashion consumers with a perceived value interval in $[(p_{sL}^B/\alpha_1), (p_{aL}^B + t - p_{sL}^B/\alpha_2 - \alpha_1)]$ will buy new products in the presale channel, and purchase behavior will occur.

Traditional consumers only consider buying new products through on-the-spot channels, and the utility of traditional consumers when buying new products needs to satisfy $v - p_{sL}^B \ge 0$. Therefore, based on the penetration pricing strategy of the coexistence of presale and spot-sale channels, the retailer's effective demands d_{aL}^B and d_{sL}^B of the presale channel and the spot channel, respectively, are as follows:

$$\begin{aligned} d_{aL}^B &= \gamma\left(1 - \frac{p_{aL}^B + t - p_{sL}^B}{\alpha_2 - \alpha_1}\right), \\ d_{sL}^B &= (1-\gamma)\left(1 - p_{sL}^B\right) + \gamma\left(\frac{p_{aL}^B + t - p_{sL}^B}{\alpha_2 - \alpha_1} - \frac{p_{sL}^B}{\alpha_1}\right). \end{aligned} \tag{6}$$

Based on the penetration pricing strategy in the case of the coexistence of a presale channel and a spot channel, the profit of the retailer under the presale channel can be obtained according to the effective demand d_{aL}^B.

$$\begin{aligned} \max_{p_{aL}^B \ge c} \quad & \pi_{aL}^B = \left(p_{aL}^B - c\right) d_{aL}^B \\ \text{s.t.} \quad & p_{aL}^B \le \alpha_2 - t. \end{aligned} \tag{7}$$

Similarly, according to the retailer's effective demand in the spot channel d_{sL}^B, the profit of the retailer under the spot channel can be expressed as

$$\begin{aligned} \max_{p_{sL}^B} \quad & \pi_{sL}^B = \left(p_{sL}^B - c - h\right) d_{sL}^B \\ \text{s.t.} \quad & p_{sL}^B \le \alpha_1. \end{aligned} \tag{8}$$

Then, the total profit of the retailer can be expressed as

$$\begin{aligned} \max_{p_{sL}^B, p_{aL}^B} \quad & \pi_L^B = \pi_{sL}^B + \pi_{aL}^B \\ \text{s.t.} \quad & p_{sL}^B \le \alpha_1 \\ & p_{aL}^B \le \alpha_2 - t. \end{aligned} \tag{9}$$

After solving the above problems, we can obtain Proposition 4.

Proposition 4. *Based on the coexistence of presale and spot channels, when the retailer adopts the penetration pricing strategy, that is, when $\gamma \ge \alpha_1((1/2\alpha_1 - c - h) - 1))/(1 - \alpha_1)$ is satisfied, we can obtain the retailer's optimal presale price as* $p_{aL}^{B^*} = (\alpha_1(1 + c - \gamma - t) + \alpha_1(1 - \gamma)(\alpha_2 - \alpha_1) + \gamma(\alpha_2 + c - t)$

$+\alpha_1\gamma(t-c))/2(\alpha_1+\gamma-\alpha_1\gamma)$, *and the retailer's optimal spot selling price is* $p_{sL}^{B^*}=\alpha_1(1+c+h)+(\gamma-\alpha_1\gamma)(c+h)/2(\alpha_1+\gamma-\alpha_1\gamma)$.

From Proposition 4, the effective demand of the presale channel is $d_{aL}^{B^*}=\gamma(\alpha_1-\alpha_2-h+t)/2(\alpha_1-\alpha_2)$, and the optimal profit of the presale channel is

$$\pi_{aL}^{B^*}=\frac{\gamma(\alpha_1-\alpha_2-h+t)\left[\alpha_1(c+\gamma+t-1)+\alpha_1(1-\gamma)(\alpha_1-\alpha_2)+\gamma(c-\alpha_2+t)-\alpha_1\gamma(c+t)\right]}{4(\alpha_2-\alpha_1)(\alpha_1+\gamma-\alpha_1\gamma)}. \tag{10}$$

The effective demand of the spot channel is $d_{sL}^{B^*}=(1-c-h-r)(\alpha_1^2-\alpha_1\alpha_2)-\gamma(c+h)(\alpha_1\alpha_2-\alpha_1^2-\alpha_2)-\alpha_1\gamma(c+t)/2\alpha_1(\alpha_1-\alpha_2)$, and the optimal profit of the spot channel is $\pi_{sL}^{B^*}=[\alpha_1(A-1)+\gamma(1-\alpha_1)A][\alpha_1(1-c-h-r)(\alpha_2-\alpha_1)+\gamma[\alpha_2(\alpha_1-1)A-\alpha_1^2c+\alpha_2^2h]+\alpha_1\gamma(c+t)]/4(\alpha_1-\alpha_2)(\alpha_1+\gamma-\alpha_1\gamma)$, where $A=(c+h)$. Furthermore, $\alpha_1\geq p_{sL}^{B^*}=\alpha_1(1+c+h)+(\gamma-\alpha_1\gamma)(c+h)/2(\alpha_1+\gamma-\alpha_1\gamma)$ must be true, that is, $\gamma\geq\alpha_1((1/2\alpha_1-c-h)-1)/(1-\alpha_1)$ must be established.

Therefore, when the retailer adopts a penetration pricing strategy under the coexistence of the presale and spot channels, the optimal profit of the retailer is

$$\pi_L^{B^*}=\pi_{sL}^{B^*}+\pi_{aL}^{B^*}=\frac{\left[\alpha_1(A-1)+\gamma(1-\alpha_1)A\right]B-(\gamma\alpha_1-\alpha_2-h+t)C}{4(\alpha_1-\alpha_2)(\alpha_1+\gamma-\alpha_1\gamma)}, \tag{11}$$

where,

$$\begin{aligned}B&=\left[\alpha_1(1-c-h-r)(\alpha_2-\alpha_1)+\gamma\left[\alpha_2(\alpha_1-1)A-\alpha_1^2c+\alpha_2^2h\right]+\alpha_1\gamma(c+t)\right],\\ C&=\left[\alpha_1(c+\gamma+t-1)+\alpha_1(1-\gamma)(\alpha_1-\alpha_2)+\gamma(c-\alpha_2+t)-\alpha_1\gamma(c+t)\right].\end{aligned} \tag{12}$$

At the same time, $\alpha_2-t\geq p_{aL}^{B^*}=(\alpha_1(1+c-\gamma-t)+\alpha_1(1-\gamma)(\alpha_2-\alpha_1)+\gamma(\alpha_2+c-t)+\alpha_1\gamma(t-c))/2(\alpha_1+\gamma-\alpha_1\gamma)$ must be true, that is, $\gamma\geq\alpha_1((1/2\alpha_1-c-h)-1)/(1-\alpha_1)$ must be established.

6. Impact of Introducing the Presale Channel

6.1. Impact on Pricing Strategy. By comparing the situation with only the spot channel with the situation when the presale channel and spot channel coexist, we can determine the influence of the introduction of the presale channel on retailers' pricing strategy.

Proposition 5. *The retailer's pricing strategy can be described as follows:*

(1) When $\alpha_1\geq(1/2)(c+h+1)$, the retailer will adopt a penetration pricing strategy regardless of whether the presale channel is introduced

(2) When $\alpha_1<(1/2)(c+h+1)$ and $\gamma<\alpha_1(1/2\alpha_1-c-h-1)/(1-\alpha_1)$, the retailer will adopt a skimming pricing strategy regardless of whether the presale channel is introduced

(3) When $\alpha_1<(1/2)(c+h+1)$ and $\gamma\geq\alpha_1((1/2\alpha_1-c-h)-1)/(1-\alpha_1)$, the retailer will adopt a penetration pricing strategy regardless of whether the presale channel is introduced

The discovery from Proposition 5 is very interesting. In Figure 2, we show the changes in the retailer's pricing strategy. On the left side of Figure 2, the skimming pricing strategy is the retailer's optimal pricing strategy, while in the middle and right areas, the penetration pricing strategy is the retailer's optimal pricing strategy. This finding implies that the retailer's optimal pricing decision will not change due to whether the presale channel is introduced or not, and the higher the consumer's preference α_1 for the spot channel is, the more likely the retailer is to use the penetration pricing strategy.

6.2. Impact on Market Share

(1) Based on the penetration pricing strategy, i.e., Proposition 5 (1) and (3), the market share of the

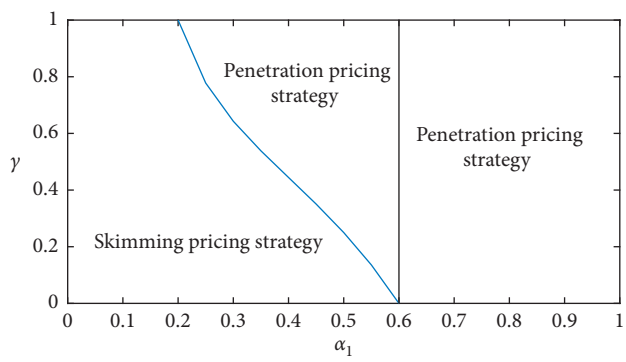

Figure 2: The retailer's pricing strategy.

retailer's spot channel is $d_L^{N^*} = d_{sL}^{N^*} = \alpha_1 - \alpha_1 c - \alpha_1 h - c\gamma - h\gamma + \alpha_1 c\gamma + \alpha_1 hr/2\alpha_1$ when there is only the spot channel before the presale channel is introduced; after introducing the presale channel, that is, when the spot-sale and presale channels coexist, the retailer's market share based on the penetration pricing strategy is

$$d_L^{B^*} = d_{aL}^{B^*} + d_{sL}^{B^*} = \frac{\gamma(\alpha_1 - \alpha_2 - h + t)}{2(\alpha_1 - \alpha_2)} + \frac{(1 - c - h - r)(\alpha_1{}^2 - \alpha_1\alpha_2) - \gamma(c + h)(\alpha_1\alpha_2 - \alpha_1{}^2 - \alpha_2) - \alpha_1\gamma(c + t)}{2\alpha_1(\alpha_1 - \alpha_2)}, \tag{13}$$

where $d_L^{B^*}$ denotes the sum of the market share of spot channel and presale channel based on the penetration pricing strategy in the coexistence situation.

Because $d_L^{B^*} - d_L^{N^*} = 0$, we find that when $\alpha_1 \geq (1/2)(c + h + 1)$ or $\alpha_1 < (1/2)(c + h + 1)$ and $\gamma \geq \alpha_1((1/2\alpha_1 - c - h) - 1)/(1 - \alpha_1)$, the retailer should use the penetration pricing strategy, and while the market share does not change after the introduction of the presale channel, the market segmentation changes. Some fashion consumers, especially enthusiastic brand-loyal fans, are eager to buy new products first and avoid the shortage of goods during the official sales period; they turn from the spot channel to the presale channel after the retailer launched the presale channel.

(2) Based on the skimming pricing strategy, i.e., Proposition 5 (2), the market share of the retailer's spot channel is $d_H^{N^*} = d_{sH}^{N^*} = (1/2)(1 - \gamma)(1 - c - h)$ before the presale channel is introduced; after introducing the presale channel, the retailer's market share based on the skimming pricing strategy is $d_H^{B^*} = d_{sH}^{B^*} + d_{aH}^{B^*} = (1/2)(1 - \gamma)(1 - c - h) + \gamma(\alpha_2 - c - t)/2\alpha_2$, where $d_H^{B^*}$ denotes the sum of the market share of the spot channel and the presale channel based on the skimming pricing strategy when both channels coexist. Obviously, $d_H^{B^*} \geq d_H^{N^*}$. In addition, we find that when $\alpha_1 < (1/2)(c + h + 1)$ and $\gamma < (\alpha_1((1/2\alpha_1 - c - h) - 1)/(1 - \alpha_1))$, the retailer should use the skimming pricing strategy, and the market share will further expand after introducing a presale channel.

In summary, we obtain the following management implications: (1) if the retailer infers from the analysis that there are fanatical brand-loyal fans in the market, it can introduce a presale channel, which may not only further increase the market share of the company but also predict the demand information of new products based on the presale information, thereby reducing inventory risk and cost; (2) consumers can obtain psychological satisfaction and security from the presale strategy of new products, and when presales are accompanied by certain promotional activities, such as price discounts, service priority, and gifts, consumers can also obtain more expected perceived utility from the presale strategy of new products to further enhance their satisfaction.

6.3. Impact on Profit

(1) Based on the penetration pricing strategy, i.e., Propositions 5 (1) and (3), the retailer's optimal profit is $\pi_L^{N^*} = \pi_{sL}^{N^*} = (\alpha_1 c - \alpha_1 + \alpha_1 h + c\gamma + h\gamma - \alpha_1 c\gamma - \alpha_1 h\gamma)^2/4\alpha_1(\alpha_1 + \gamma - \alpha_1\gamma)$ when there is only the spot channel before the presale channel is introduced; after introducing the presale channel, that is, when the spot-sale and presale channels coexist, the retailer's optimal profit is

$$\pi_L^{B^*} = \pi_{sL}^{B^*} + \pi_{aL}^{B^*} = \frac{[\alpha_1(A-1) + \gamma(1-\alpha_1)A]B - (\gamma\alpha_1 - \alpha_2 - h + t)C}{4(\alpha_1 - \alpha_2)(\alpha_1 + \gamma - \alpha_1\gamma)}, \tag{14}$$

where,

$$\begin{aligned} B &= \left[\alpha_1(1-c-h-r)(\alpha_2-\alpha_1) + \gamma\left[\alpha_2(\alpha_1-1)A - \alpha_1^2 c + \alpha_2^2 h\right] + \alpha_1\gamma(c+t)\right], \\ C &= \left[\alpha_1(c+\gamma+t-1) + \alpha_1(1-\gamma)(\alpha_1-\alpha_2) + \gamma(c-\alpha_2+t) - \alpha_1\gamma(c+t)\right]. \end{aligned} \tag{15}$$

Because $\pi_L^{B^*} - \pi_L^{N^*} = (\gamma(\alpha_1 - \alpha_2 - h + t)^2/4(\alpha_2 - \alpha_1)) \geq 0$, we find that when $\alpha_1 \geq (1/2)(c+h+1)$ or $\alpha_1 < (1/2)(c+h+1)$ and $\gamma \geq (\alpha_1((1/2\alpha_1 - c - h) - 1))/(1-\alpha_1)$, the retailer should use the penetration pricing strategy, and the introduction of a presale channel will bring more profits.

(2) Based on the skimming pricing strategy, i.e., Proposition 5 (2), the retailer's optimal profit is $\pi_H^{N^*} = \pi_{sH}^{N^*} = ((1-\gamma)(c+h-1)^2/4)$ before the presale channel is introduced; after introducing the presale channel, the retailer's optimal profit based on the skimming pricing strategy is $\pi_H^{B^*} = \pi_{sH}^{B^*} + \pi_{aH}^{B^*} = ((1-\gamma)(c+h-1)^2/4) + (\gamma(c-\alpha_2+t)^2/4\alpha_2)$. Obviously, $\pi_H^{B^*} \geq \pi_H^{N^*}$. Similarly, we find that when $\alpha_1 < (1/2)(c+h+1)$ and $\gamma < (\alpha_1((1/2\alpha_1 - c - h) - 1)/(1-\alpha_1))$, the retailer should use skimming pricing, and the introduction of a presale channel will bring more profits.

Combining the above, we can obtain Proposition 6.

Proposition 6. *Using either the penetration or skimming pricing strategy, the retailer should introduce a presale channel to further expand its market share and improve profitability.*

Proposition 6 shows that as market competition intensifies, retailers, especially those engaged in high-tech industries, should introduce the presale channel when launching new products. The benefits of promoting and preselling new products through the presale channel are undoubtedly multifaceted. We confirm that for enterprises, introducing the presale channel to promote and presell new products can further expand market share and enhance their profitability; in addition, through presales, sales funds can be obtained in advance and demand information of new products can be predicted based on presale information, thus reducing inventory risk and cost; furthermore, enterprises can combine new product presale strategies with other strategies, such as service strategies and new product innovation strategies, to further enhance enterprises' market share and profitability. For consumers, there is a psychological sense of security and satisfaction in buying a new product first through presales; when presales are accompanied by certain promotional activities, such as price discounts, service priority, and gifts, consumers can also obtain more expected perceived utility from the presale strategy of new products to further enhance satisfaction; even if the price of the new product in the presale channel/stage remains the same or even at a premium to the price in the spot channel/stage, consumers can still avoid the risk of shortage through presales to enhance the sense of security. In summary, the introduction of a new product presale channel is a strategy that retailers, especially enterprises engaged in high-tech industries, should consider when promoting and selling new products.

7. Conclusions

In recent years, with the constant and unceasing transformation of high-tech industries, the research and development of new products by enterprises has grown rapidly to meet the increasing diversification needs of consumers, and Internet presales have become one of the main channels for companies and retailers to promote new products. Some young people also purchase new products through online presale channels. Online presale business models can prevent new products from going out of stock when they are officially sold, which is a major challenge that offline spot channels often face when selling new products. However, in the online presale model, consumers inevitably need to spend time waiting before the retailer delivers new products and must bear a certain opportunity cost due to the uncertainty of consumers' value cognition of new products in the presale stage. This point is also considered in this paper.

In this study, this paper investigates consumer preferences when buying new products and, from a competitive perspective, identifies the different pricing

strategies that the retailer adopts: a skimming pricing strategy and a penetration pricing strategy. Research shows that the introduction of a presale channel does not affect the retailer's pricing strategy. Pricing strategy depends on consumers' channel consumption preference and the proportion of fashion consumers and traditional consumers. If fashion consumers have a low preference for spot channels, the retailer will adopt a skimming pricing strategy; when the proportion of fashion consumers reaches a limit, retailers will switch from a skimming pricing strategy to a penetrating pricing strategy. At this time, when consumers' preferences for the spot channel meet certain conditions, retailers will also adopt a penetration pricing strategy. When promoting new products, the retailer should not only consider the implementation of strategies but also investigate the purchasing behavior of new product buyers, focusing on the proportion of fashion consumers and their channel consumption preference or on the proportion of enthusiastic technology enthusiasts and the intensity of their desire to buy in advance. If the proportion of fashion consumers is relatively low and their willingness to buy through spot channels is below the threshold, the retailer should focus on traditional consumers by using a skimming pricing strategy; thus, if the proportion of enthusiastic technology enthusiasts is low but their desire to buy in advance is strong, then the retailer should focus on traditional consumers and adopt skimming pricing. If the proportion of fashion consumers is relatively high and their willingness to buy in the spot sale channel is relatively high, retailers should switch to the penetration pricing strategy. Equivalently, if the proportion of enthusiastic technology enthusiasts is relatively high but their desire to buy in advance is not strong, then retailers should adopt penetration pricing to balance the purchase channels of fashion consumers and technology enthusiasts.

Furthermore, our research finds that regardless of the pricing strategy adopted by the retailer, a presale channel should be introduced to obtain more profits. The introduction of a presale channel not only reduces inventory risk and cost and enhances the market share and profitability of enterprises but also helps consumers avoid the risk of shortages and enhance their sense of security. The research work in this paper is carried out in the context of a single market entity, that is, a single retailer considers whether to introduce the presale channel and its pricing strategy. However, there are multiparty competitions in the omnichannel competition environment, and it remains unknown what factors should be considered when multiparty competition exists. How should the presale channel be introduced and how will the research conclusions change? All these problems deserve our attention and discussion in future research.

Appendix

All Proofs

Proof of Proposition 1. Under the penetration pricing strategy, given that the purchase price that a consumer pays in the spot channel is p_{sL}^N, the demand can be obtained as $d_{sL}^N = (1-\gamma)(1-p_{sL}^N) + \gamma(1-p_{sL}^N/\alpha_1)$. By substituting d_{sL}^N into retailer's spot channel profit function $\pi_{sL}^N = (p_{sL}^N - c - h)d_{sL}^N$, we can obtain $\pi_{sL}^N = (p_{sL}^N - c - h)[(1-\gamma)(1-p_{sL}^N) + \gamma(1-(p_{sL}^N/\alpha_1))]$. Because π_{sL}^N is a function with p_{sL}^N as its independent variable, under the condition of the first derivative, we can obtain $p_{sL}^{N^*} = \alpha_1(1+c+h) + (\gamma-\alpha_1\gamma)(c+h)/2(\alpha_1+\gamma-\alpha_1\gamma)$, and then substituting $p_{sL}^{N^*}$ into $d_{sL}^N = (1-\gamma)(1-p_s) + \gamma(1-(p_s/\alpha_1))$, $d_{sL}^{N^*} = \alpha_1 - \alpha_1 c - \alpha_1 h - c\gamma - h\gamma + \alpha_1 c\gamma + \alpha_1 hr/2\alpha_1$ is obtained, denoted as $d_L^{N^*}$. Because of $p_{sL}^{N^*} \le \alpha_1$, $\alpha_1(1+c+h) + (\gamma-\alpha_1\gamma)(c+h)/2(\alpha_1+\gamma-\alpha_1\gamma) \le \alpha_1$ must be established. Therefore, the optimal profit is $\pi_{sL}^{N^*} = (\alpha_1 c - \alpha_1 + \alpha_1 h + c\gamma + h\gamma - \alpha_1 c\gamma - \alpha_1 h\gamma)^2/4\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)$, denoted as $\pi_L^{N^*}$.

Under a skimming pricing strategy, given that the purchase price that a consumer buys in the spot channel is p_{sH}^N, the demand can be obtained as $d_{sH}^N = (1-\gamma)(1-p_{sH}^N)$. Substituting d_{sH}^N into the retailer's spot channel profit function $\pi_{sH}^N = (p_{sH}^N - c - h)d_{sH}^N$, we can obtain $\pi_{sH}^N = (p_{sH}^N - c - h)(1-\gamma)(1-p_{sH}^N)$. Because π_{sH}^N is a function with p_{sH}^N as its independent variable, under the condition of first derivative, we can obtain $p_{sH}^{N^*} = (1/2)(c+h+1)$, and then substituting $p_{sH}^{N^*}$ into $d_{sH}^N = (1-\gamma)(1-p_{sH}^N)$, $d_{sH}^{N^*} = (1-\gamma)((1/2)-(c/2)-(h/2))$ is obtained, denoted as $d_H^{N^*}$. Because of $\alpha_1 \le p_{sH}^{N^*}$, $\alpha_1 \le (1/2)(c+h+1)$ must be established. Therefore, the optimal profit is $\pi_{sH}^{N^*} = ((1-\gamma)(c+h-1)^2/4)$, denoted as $\pi_H^{N^*}$.

Proof of Proposition 2. First, we compare the magnitude of the relationship between $(1/2)(c+h+1)$ and $\alpha_1(1+c+h) + (\gamma-\alpha_1\gamma)(c+h)/2(\alpha_1+\gamma-\alpha_1\gamma)$. Let $y = (c+h+1/2) - (\alpha_1(1+c+h) + (\gamma-\alpha_1\gamma)(c+h)/2(\alpha_1+\gamma-\alpha_1\gamma)) = (\gamma(1-\alpha_1)/2(\alpha_1+\gamma-\alpha_1\gamma))$; from $0<\alpha_1<1$ and $0<\gamma<1$, we know that $y>0$; then, $(1/2)(c+h+1) > \alpha_1(1+c+h) + (\gamma-\alpha_1\gamma)(c+h)/2(\alpha_1+\gamma-\alpha_1\gamma)$ is established. Obviously, when $\alpha_1 \ge (1/2)(c+h+1)$, $\alpha_1 \ge (\alpha_1(1+c+h) + (\gamma-\alpha_1\gamma)(c+h)/2(\alpha_1+\gamma-\alpha_1\gamma))$ is true, that is, when $\alpha_1 \ge (1/2)(c+h+1)$, the retailer's optimal pricing strategy is the penetration pricing strategy. When $\alpha_1 < (1/2)(c+h+1)$, for $\alpha_1 \ge (\alpha_1(1+c+h) + (\gamma-\alpha_1\gamma)(c+h)/2(\alpha_1+\gamma-\alpha_1\gamma))$ to be true, $\gamma \ge (\alpha_1((1/2\alpha_1 - c - h) - 1))/(1-\alpha_1))$ must be true. At this time, the retailer can adopt penetration pricing or skimming pricing. Therefore, to determine which pricing strategy is optimal at this time, we need to compare the profits of the retailer under two pricing strategies. In this case, the profit of the retailer using the penetration pricing strategy is $\pi_L^{N^*} = (\alpha_1 c - \alpha_1 + \alpha_1 h + c\gamma + h\gamma - \alpha_1 c\gamma - \alpha_1 h\gamma)^2/4\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)$, and the profit of using the

skimming pricing strategy is $\pi_H^{N^*} = (1-\gamma)(c+h-1)^2/4$. Additionally,

$$\begin{aligned}
\pi_L^{N^*} - \pi_H^{N^*} &= \frac{\left[(c+h)(\alpha_1+\gamma-\alpha_1\gamma)-\alpha_1\right]^2 - (1-\gamma)(c+h-1)^2\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)}{4\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)} \\
&= \frac{\left[(c+h-1)(\alpha_1+\gamma-\alpha_1\gamma)+(\gamma-\alpha_1\gamma)\right]^2 - (1-\gamma)(c+h-1)^2\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)}{4\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)} \\
&\geq \frac{\left[(c+h-1)(\alpha_1+\gamma-\alpha_1\gamma)\right]^2 - (1-\gamma)(c+h-1)^2\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)}{4\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)} \\
&= \frac{\left[(c+h-1)(\alpha_1+\gamma-\alpha_1\gamma)\right]^2 - (1-\gamma)(c+h-1)^2\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)}{4\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)} \\
&= \frac{(c+h-1)^2(\alpha_1+\gamma-\alpha_1\gamma)\gamma}{4\alpha_1(\alpha_1+\gamma-\alpha_1\gamma)} \geq 0.
\end{aligned} \tag{A.1}$$

Therefore, we can conclude that when $\alpha_1 < (1/2)(c+h+1)$ and $\gamma \geq \alpha_1((1/2\alpha_1 - c - h) - 1)/(1-\alpha_1)$, the retailer's optimal pricing strategy is penetration pricing; when $\alpha_1 < (1/2)(c+h+1)$ and $\gamma \leq \alpha_1((1/2\alpha_1 - c - h) - 1)/(1-\alpha_1)$, the retailer's optimal pricing strategy is skimming pricing.

Proof of Proposition 3. Based on the coexistence of presale and spot-sale channels, when the retailer adopts the skimming pricing strategy, by $\partial\pi_H^B/\partial p_{sH}^B = 0$ and $\partial\pi_H^B/\partial p_{aH}^B = 0$, we have $p_{sH}^{B^*} = (1/2)(c+h+1)$ and $p_{aH}^{B^*} = (\alpha_2/2) + (c/2) - (t/2)$. Then, substituting them into the demands and profits of the presale channel and the spot channel, we obtain $d_{sH}^{B^*} = (1/2)(1-\gamma)(1-c-h)$, $\pi_{sH}^{B^*} = (1-\gamma)(c+h-1)^2/4$, $d_{aH}^{B^*} = \gamma(\alpha_2 - c - t)/2\alpha_2$, and $\pi_{aH}^{B^*} = \gamma(c-\alpha_2+t)^2/4\alpha_2$. Therefore, the optimal profit of the retailer is $\pi_H^{B^*} = \pi_{sH}^{B^*} + \pi_{aH}^{B^*} = ((1-\gamma)(c+h-1)^2/4) + (\gamma(c-\alpha_2+t)^2/4\alpha_2)$.

Proof of Proposition 4. Based on the coexistence of presale and spot channels, when the retailer adopts the penetration pricing strategy, given the prices a consumer pays in the spot channel p_{sL}^B and the presale channel p_{sL}^B, the demand in the spot channel can be obtained as $d_{sL}^B = (1-\gamma)(1-p_{sL}^B) + \gamma((p_{aL}^B + t - p_{sL}^B/\alpha_2 - \alpha_1) - (p_{sL}^B/\alpha_1))$, and the demand in the presale channel can be obtained as $d_{aL}^B = \gamma(1 - (p_{aL}^B + t - p_{sL}^B/\alpha_2 - \alpha_1))$. By substituting d_{sL}^B and d_{aL}^B into the retailer's profits in the spot channel $\pi_{sL}^B = (p_{sL}^B - c - h)d_{sL}^B$ and presale channel $\pi_{aL}^B = (p_{aL}^B - c)d_{aL}^B$, respectively, we can further obtain $\pi_{sL}^B = (p_{sL}^B - c - h)[(1-\gamma)(1-p_{sL}^B) + \gamma((p_{aL}^B + t - p_{sL}^B/\alpha_2 - \alpha_1) - (p_{sL}^B/\alpha_1))]$ and $\pi_{aL}^B = (p_{aL}^B - c)\gamma(1 - (p_{aL}^B + t - p_{sL}^B/\alpha_2 - \alpha_1))$. Then, in the case of the coexistence of presale and spot channels, the total profit of the retailer when adopting the skimming pricing strategy is $\pi_L^B = \pi_{sL}^B + \pi_{aL}^B$. Based on $\partial\pi_L^B/\partial p_{sL}^B = 0$ and $\partial\pi_L^B/\partial p_{aL}^B = 0$, under the coexistence of presale and spot channels and when the retailer adopts the penetration pricing strategy, the optimal pricing in the spot channel is $p_{sL}^{B^*} = \alpha_1(1+c+h) + (\gamma - \alpha_1\gamma)(c+h)/2(\alpha_1+\gamma-\alpha_1\gamma)$, and the optimal pricing in the presale channel is

$$p_{aL}^{B^*} = \frac{\left(\alpha_1(1+c-\gamma-t) + \alpha_1(1-\gamma)(\alpha_2-\alpha_1) + \gamma(\alpha_2+c-t) + \alpha_1\gamma(t-c)\right)}{2(\alpha_1+\gamma-\alpha_1\gamma)}. \tag{A.2}$$

Substituting $p_{sL}^{B^*}$ and $p_{aL}^{B^*}$ into $d_{sL}^B = (1-\gamma)(1-p_{sL}^B) + \gamma((p_{aL}^B + t - p_{sL}^B/\alpha_2 - \alpha_1) - (p_{sL}^B/\alpha_1))$, $d_{sL}^{B^*} = ((1-c-h-r)(\alpha_1^2 - \alpha_1\alpha_2) - \gamma(c+h)(\alpha_1\alpha_2 - \alpha_1^2 - \alpha_2) - \alpha_1\gamma(c+t)/2\alpha_1(\alpha_1-\alpha_2))$ is obtained. Because $p_{sL}^{B^*} \leq \alpha_1$, $\gamma \geq \alpha_1(1+c+t-\alpha_2-\alpha_1)/(1-\alpha_1)(\alpha_1+\alpha_2-c-t)$ must be established. Therefore, the optimal profit of the spot channel is

$$\pi_{sL}^{B^*} = \frac{[\alpha_1(A-1)+\gamma(1-\alpha_1)A][\alpha_1(1-c-h-r)(\alpha_2-\alpha_1)+\gamma[\alpha_2(\alpha_1-1)A-\alpha_1{}^2c+\alpha_2{}^2h]+\alpha_1\gamma(c+t)]}{4(\alpha_1-\alpha_2)(\alpha_1+\gamma-\alpha_1\gamma)}, \tag{A.3}$$

where $A = (c+h)$.

Substituting $p_{sL}^{B^*}$ and $p_{aL}^{B^*}$ into $d_{aL}^{B} = \gamma(1-(p_{aL}^{B}+t-p_{aL}^{B}/\alpha_2-\alpha_1))$, $d_{aL}^{B^*} = \gamma(\alpha_1-\alpha_2-h+t)/2(\alpha_1-\alpha_2)$ is obtained. Because $\alpha_2 - t \geq p_{aL}^{B^*} = (\alpha_1(1+c-\gamma-t)+\alpha_1(1-\gamma)(\alpha_2-\alpha_1)+\gamma(\alpha_2+c-t)+\alpha_1\gamma(t-c))/2(\alpha_1+\gamma-\alpha_1\gamma)$, $\gamma \geq \alpha_1(1+c+t-\alpha_2-\alpha_1)/(1-\alpha_1)(\alpha_1+\alpha_2-c-t)$ must also be established. At this point, the optimal profit of the presale channel is

$$\pi_{aL}^{B^*} = \frac{\gamma(\alpha_1-\alpha_2-h+t)[\alpha_1(c+\gamma+t-1)+\alpha_1(1-\gamma)(\alpha_1-\alpha_2)+\gamma(c-\alpha_2+t)-\alpha_1\gamma(c+t)]}{4(\alpha_2-\alpha_1)(\alpha_1+\gamma-\alpha_1\gamma)}. \tag{A.4}$$

Therefore, based on the coexistence of the spot channel and the presale channel, the optimal profit of retailers when adopting a penetration pricing strategy is $\pi_L^{B^*} = \pi_{sL}^{B^*} + \pi_{aL}^{B^*}$.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare no conflicts of interest.

Acknowledgments

This project was funded by the Ministry of Education of the People's Republic of China (16YJA630017), National Natural Science Foundation of China (NSFC) (71771055), and Natural Science Foundation of Anhui Province (KJ2018A0353, KJ2019A0520, and KJ2019A0519).

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