# Pricing Strategy for Fashion Retailers Considering Anticipated Regret 

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#### Abstract

Under the multi-brand and fast-paced marketing, consumers' purchase decision is deeply affected by the regret of high price and shortage of stock, for this reason, many scholars propose to alleviate the impact of high price regret on strategic consumers by reducing the magnitude or possibility of price reduction, or to limit supply to reduce the impact of out of stock regret. However, retailers often cannot consider the feelings of consumers in both sales stages at the same time. In order to understand the impact of these two types of regret on retailer profits, this article constructs consumer utility functions and retailer profit functions for two scenarios: no regret psychological impact and regret psychological impact, and depicts the changes in the retailer's most profitable situation when the two regret psychological coefficients change in different directions through images, then we find that, when the reverse constant amplitude changes, the change in regret psychology with smaller coefficients has a greater impact on retailer profits; When changing in the same direction with equal amplitude, the change in regret psychology with a larger coefficient has a greater impact on retailer profits. Ultimately we provided some reference suggestions for mid-term pricing.


Keywords: High price regret, Out of stock regret, Strategic consumption behavior, Pricing strategy, Mid-term pricing

## 1 Introduction

According to statistics, over 1 billion items have been listed on the e-commerce platform of "Taobao" alone. In this situation, retailers are gradually shifting from meeting customer needs and improving their competitiveness in the past to actively guiding and stimulating demand through marketing methods, and "making quick money". For example, they have found methods such as bundled sales, planting short video content, and limited time price reductions to stimulate consumers' willingness to purchase. Gradually, these marketing methods have become an unwavering choice for retailers when launching new products or promoting.

Generally, online retailers often adopt a two-stage price reduction promotion method to sell products, which means that the sales period of the products is divided into a full price period and a discount period. Regular and transparent promotion methods are
beneficial for enhancing users' trust and loyalty to retailers, but they have also given rise to shopping comparison software such as "buy slowly" and "price comparison website", which reduce the cost of strategic consumption behavior. Strategic consumption behavior refers to consumers' expectations of a company's future pricing and inventory, resulting in a "reserve price" (also known as a "reference price"), and deciding whether to purchase by comparing the reserve price with the current actual price. As early as 1972, Ronald Coase[1] first proposed consumer waiting behavior in durable goods sales research, which can be seen as a precursor to strategic consumption behavior. These tools not only reduce the degree of information asymmetry between retailers and consumers, but also force consumers to suffer from two types of regret psychology: "high price regret" and "out of stock regret". A lot of research has shown that ignoring consumers' strategic behavior can bring significant losses to retailers, who may face the consequences of low sales during high price periods, inventory squeeze, and small profit margins. Although many scholars have studied their mitigation strategies, for example, responsive pricing strategy[2], fixed price strategy[3], price commitment strategy[4], credibly conveying inventory information and etc.

However, retailers usually cannot take into account the feelings of consumers in the two sales stages who care about different things. Therefore, this article focuses on the online retail scenario of fashion products with short life cycles and frequent promotions. By constructing a Stackelberg game model, consumer regret psychology is taken into account in the model, which is of great necessity and help for cross period pricing of fashion online retailers.

## 2 Status Que and Analysis of the Domestic and Foreign Research

On Fashion Pricing under the Influence of Strategic Consumer Behavior, Xuanming $\mathrm{Su}[5]$ research durable goods production capacity decision-making and pricing strategies under the premise of monopolistic competition, considering the influence of speculative behavior and strategic consumption behavior. Wang Ming[6] analyzes the effects of three mechanisms, including price difference return, limited rationing, and price commitment, on alleviating strategic consumer behavior in fashion products from four aspects: consumer type, reference price, inventory restrictions, and competition. Zhang $\mathrm{Lu}[7]$ considers that consumers are familiar with the pricing laws of enterprises and determine their reference prices based on historical prices and substitute prices. She establishes dynamic pricing models for strategic consumers and short-sighted consumers respectively, and concludes that the optimal pricing of enterprises depends on the patient level of consumers. Chen Genyu[8] believes that guiding strategic consumers to estimate the availability of products in the second stage can effectively alleviate the negative impact of strategic consumption on manufacturers' profits. Zhao Nenggui[9] conducted further research based on previous opinions on the impact of consumer reference prices on their purchasing decisions, proposing that their risk-taking attitude also affects their purchasing decisions, thereby affecting retailers' profits. Chen et al. [10] analyzed the impact of fashion decay factors on ordering and pricing models in the
fashion clothing industry, and discussed the impact of experiential services and promotional efforts on decision-making when fashion decay factors are different. Fang Yezi[11] believes that the proportion of strategic consumers in the consumer group will affect retailers' optimal pricing decisions, and uses "prospect theory" to discuss the impact of different consumer psychological reference points on retailers' profits. The above views the product sales process as a two-stage game, solved using reverse solving methods.

Unlike previous studies, this article believes that fast fashion products have a short lifecycle, frequent promotional activities, and neglects the impact of fashion decay on product utility. We analyzes the optimal decisions of retailers with or without regret psychology, and proposes management suggestions from the perspective of alleviating consumer regret psychology.

## 3 Model Construction and Analysis

### 3.1 Decision Procedure

Assuming that a monopoly manufacturer sells fashion products in two sales periods, the market capacity is standardized to 1 , and each consumer buys up to 1 unit of products. Both retailers and consumers are regarded as rational. The decision-making process is as follows:
1)The supplier predicts the decision behavior of consumers, and decides the listing price $P$ accordingly;
2)When considering regret psychology, consumers need to estimate the impact of regret psychology, so as to jointly decide the retention price $\gamma$, and to decide whether to buy and wait through the comparison $P$ and $\gamma$.

The above can be regarded as a two-stage game process of non-perfect information, and the Steinberg game model is constructed for solution.

### 3.2 Parameter Instructions and Assumptions

If the full price period of a product is sold at the price P , the unsold inventory will be sold at the clearing price S , and the production cost is C . Strategic consumers are affected by regret psychology. The impact of high price regret is $\alpha$,Valuation of the product isV, The utility of buying immediately and waiting for a discount is $U_{1}, U_{2}$, The reserved price is $\gamma$. The forecast value for $\gamma$ meets $\gamma_{0}=\gamma$,Suppose the retailer's forecast is accurate, $\gamma_{0}=\gamma$, The optimal pricing $P^{*}=\gamma$.Unsold out inventory will be sold at a clear price S , and meet $0 \leq S<C<P$.

Product requirements are X , its density function is $f(X)$,The distribution function is $F(X)$, and meet: (1) $f(X)>0,(2) F(0)=0$, (3) $\bar{F}(X)=1-F(X)$, (4) $\frac{\partial(f(X) / f(X))}{\partial X}>0$,
we deduce from the density function properties that, $F(Q)=\int f(Q)=1-\bar{F}(Q)$, it indicates the probability that the goods are still in stock during the clearance period.

Other parameters are shown in Table 1:
Table 1. Parameter Description

| Variable Name | Variable representation | Variable Name | Variable representation |
| :---: | :---: | :---: | :---: |
| Product requirements | X | Inventory quantity | Q |
| Demand density function | $\mathrm{f}(\mathrm{x})$ | Product Valuation | V |
| Demand distribution function | $\mathrm{F}(\mathrm{x})$ | Customer retention price | $\gamma$ |
| Full price period price | P | High price regret coefficient | $\alpha$ |
| Production costs | C | Out of stock regret coefficient | $\beta_{1}$ |
| Clearance period price | S | Full price period sales volume | $\lambda_{1}$ |
| Full price period utility | $U_{1}$ | Clearance period sales volume | $\lambda_{2}$ |
| Clearance period utility | $U_{2}$ | Negative externality coefficient | a |
| Fashion attenuation factor |  | during the full price period | P |
| Pvitive externality coefficient dur- | b |  |  |
| Availability rate of clearance |  |  |  |
| period |  |  |  |

### 3.3 Model Solving

1)Regardless of regret According to the idea of reverse solution, the retention price is obtained by comparing the utility purchased in the full price period and the discount period respectively, and the utility expression is as follows:

$$
\left\{\begin{array}{l}
U_{1}=V-P  \tag{1}\\
U_{2}=(V-S) \cdot \varepsilon
\end{array}\right.
$$

When $U_{1}>U_{2}$,consumers are more inclined to buy at the full price period;; When $U_{1}<U_{2}$, Consumers prefer to buy at a discount period; When $U_{1}=U_{2}$, Critical value price P equals to $\gamma$, It has been assumed that the retailer's reserve price forecast for consumers meets the actual situation, and that the retailers are willing to set the price of new products at this level in order to obtain maximum profits. So there is

$$
\begin{equation*}
P^{*}=V-(V-S) \cdot \varepsilon=V-(V-S) \cdot F(Q) \tag{2}
\end{equation*}
$$

due to $\varepsilon=F(Q), 1-\varepsilon=\bar{F}(Q)$, we get $P^{*}=S+(V-S) \bar{F}(Q)$,
Expected profit function:

$$
\begin{equation*}
\pi(Q, P)=\int_{0}^{Q_{0}}(P-C)+\int_{Q_{0}}^{Q}(S-C)=(P-S) \cdot Q_{0}+(S-C) \cdot Q \tag{4}
\end{equation*}
$$

among them $Q_{0}=\min \{X, Q\}$, which represents the amount sold during the full price period.

$$
\frac{Q_{0}}{Q}=\bar{F}(Q)=\frac{C-S}{P-S}, \text { so }
$$

$$
\begin{equation*}
Q^{*}=\bar{F}^{-1}\left(\frac{C-S}{P-S}\right) \tag{5}
\end{equation*}
$$

then $\frac{C-S}{P-S}=\sqrt{\frac{C-S}{V-S}}$; we get

$$
\left\{\begin{array}{l}
P^{*}=S+\sqrt{(V-S)(C-S)}  \tag{6}\\
Q^{*}=\bar{F}^{-1}\left(\frac{C-S}{P-S}\right)
\end{array}\right.
$$

Conclusion 1: $P_{a}^{*}<P_{0}^{*}, Q_{a}^{*}<Q_{0}^{*}$, That is, the optimal pricing and profit are lower than the optimal pricing and profit in the case of unstrategic consumers.

This proposition means that when there is no strategic consumption behavior, the enterprise will set the price as valuation V , and when there is a strategic consumption behavior, $P_{a}^{*}<V$, that is, the optimal pricing of the retailer is lower than that of the optimal pricing of no strategic behavior; and the existence of strategic consumption behavior makes the optimal inventory of the enterprise low. The proposition shows that for strategic consumers, the original price decision and inventory decisions are on the higher side, lower consumer price in the full price purchase utility, higher inventory increase the availability of goods in the discount period, thus improve the utility of consumers in the discount period, the superposition more incentive consumers waiting in the full price period, in the discount purchase behavior, resulting in retailers appear high inventory, capital takes up, goods eventually sell at a low price phenomenon, reduce retailers' profit margins, and bring great uncertainty to the enterprise decision.
2)Considering regret

When considering regret, the negative utility of full price purchase is $\alpha(P-S)$, The negative utility caused by the shortage of stock during the discount period is $\beta(V-P)$, the utility of purchase during the full price and discount periods are as follows:

$$
\left\{\begin{array}{l}
U_{1}=V-P-\alpha(P-S) \varepsilon \\
U_{2}=(V-S) \cdot \varepsilon-\beta(V-P)(1-\varepsilon)
\end{array}\right.
$$

The price level under the critical condition is the reserve price of consumers. Since it has been assumed that the predicted value of the reserve price for consumers is consistent with the actual situation and the retailer is willing to set the new product price at this level, we can deduce that,

$$
\begin{equation*}
P^{*}=\frac{(1+\alpha) S \varepsilon+V(1+\beta)(1-\varepsilon)}{1+\beta+(\alpha-\beta) \varepsilon}=\frac{(1+\alpha) S F(Q)+V(1+\beta)(1-F(Q))}{1+\beta+(\alpha-\beta) F(Q)} \tag{7}
\end{equation*}
$$

And we know, $Q^{*}=\bar{F}^{-1}\left(\frac{C-S}{P-S}\right)$ By combining them, we can deduce that,

$$
\left\{\begin{array}{l}
P^{*}=S+\frac{(\alpha-\beta)(C-S)+\varphi(\alpha, \beta)}{2(1+\alpha)}  \tag{8}\\
\varphi(\alpha, \beta)=\sqrt{4 V(C-S)(1+\alpha)(1+\beta)+C(C-S)(\alpha-\beta)^{2}-S(C-S)(2+\alpha+\beta)^{2}} \\
Q^{*}=\bar{F}^{-1}\left(\frac{2(1+\alpha)(C-S)}{(\alpha-\beta)(C-S)+\varphi(\alpha, \beta)}\right)
\end{array}\right.
$$

Conclusion $2: \frac{\partial P^{*}}{\partial \alpha}<0, \frac{\partial Q^{*}}{\partial \alpha}<0, \frac{\partial \pi^{*}}{\partial \alpha}<0$, that means the optimal pricing, optimal inventory and maximum expected profit are all negatively correlated with the psychological coefficient of high price regret.

This proposition shows that if consumers are more regretful by high prices, retailers should set lower prices and lower inventory to reduce the negative utility of high price regret and improve the disutility of out of stock regret, so as to encourage more strategic consumers to buy at high prices to obtain higher profits. For example, for some discount cycle short, strong seasonal goods, such as low wool content of a wool blended coat, summer cloth but lining thick cake skirt, etc., according to the customer visit results, high price is higher, faster, bigger decline, and late inventory, more customers affected by high regret heavier. At this point, retailers can moderately reduce the new price and inventory of such goods, thus alleviating the impact of strategic consumption behavior.

Conclusion 3: $\frac{\partial P^{*}}{\partial \beta}>0, \frac{\partial Q^{*}}{\partial \beta}>0, \frac{\partial \pi^{*}}{\partial \beta}>0$, That is, the optimal pricing, optimal inventory and maximum expected profit are all positively correlated with the psychological coefficient of out of stock regret.

This proposition shows that the higher the psychological coefficient of shortage of regret, the more conducive to the enterprise to set the price of new products, listed inventory, and is conducive to the enterprise to obtain higher profits. This conclusion can be understood as that consumers regret more seriously from out of stock. Retailers can set higher prices and higher inventory, improve the direct utility brought by the full price period purchase, and increase the sales volume, so as to obtain higher profits. For example, for the co-branded products, the demand is always in short supply, and more customers are not sensitive to the price. They are afraid of the shortage of stock caused by waiting, and have the incentive to buy them at an earlier price. At this time, a slightly higher price and inventory are conducive to the enterprise to obtain greater profits.

## 4 Sensibility Analysis

### 4.1 The Impact of the Maximum Expected Profit Affected by $\alpha, \beta$

When $\alpha, ~ \beta$ all change, to ensure the uniqueness of the independent variables corresponding to the value of $\alpha, \beta$, taking $\frac{1+\alpha}{1+\beta}$ as the abscissa, draw the trend of maximum expected profit pi following $\frac{1+\alpha}{1+\beta} \cdot \frac{1+\alpha}{1+\beta} \in[0.5,2]$. Take the K 1 product as an example, $\mathrm{S}=39, \mathrm{C}=65, \mathrm{~V}=100$,the diagram is shown in the following below.


- do not consider regret psychology
- consider regret psychology

Fig. 1. The change curve of the maximum expected profit of K1 with $\frac{1+\alpha}{1+\beta}$
We can see, when $\frac{1+\alpha}{1+\beta}>1$, When consumers are more affected by the regret of high price, the maximum expected profit in the case of regret is lower than the maximum expected profit in the case of considering regret; when $\frac{1+\alpha}{1+\beta}<1$, That is, when consumers are more affected by the regret of shortage, the maximum expected profit in the case of regret is higher than the maximum expected profit in the case of regret. And with the strengthening of the regret of out of stock, the profit of retailers increases, so we can consider to increase the profit by strengthening the regret of out of stock.

### 4.2 Compare the Impact of the Same Magnitude of the Change in Regret on Profits

It is observed that the profit curve of scenario 2 in Figure 1 is a concave function image. In order to investigate which regret psychology has a greater impact on the profit function when the two regret psychology coefficients change by the same magnitude on the basis of $\alpha=\beta$, we will consider two scenarios: forward and reverse changes.

When considering the reverse magnitude change, if $\alpha$ incresed, $\beta$ decresed, and the range of change is $\Delta$, when $\alpha>\beta, \frac{1+\alpha}{1+\beta}<\frac{1+\alpha+\Delta}{1+\beta}<\frac{1+\alpha}{1+\beta-\Delta}$, Corresponding to points O, C and D in Figure 1, indicating that both reduce profit. Among them, the
profit change of change of $\beta$ is larger. When $\alpha<\beta, \frac{1+\alpha}{1+\beta}<\frac{1+\alpha}{1+\beta-\Delta}<\frac{1+\alpha+\Delta}{1+\beta}$, corresponding to points $\mathrm{O}, \mathrm{C}$ and D in Figure 1, indicating that both reduce profit. Among them, the profit change of change of $\alpha$ is larger.

By contraries, if $\alpha$ decresed, $\beta$ incresed, and the range of change is $\Delta$, when $\alpha>\beta, \frac{1+\alpha}{1+\beta}>\frac{1+\alpha-\Delta}{1+\beta}>\frac{1+\alpha}{1+\beta+\Delta}$, Corresponding to points $\mathrm{O}, \mathrm{B}$ and A in Figure 1, indicating that both increase profit. Among them, the profit change of change of $\beta$ is larger. When $\alpha<\beta, \frac{1+\alpha}{1+\beta}>\frac{1+\alpha}{1+\beta+\Delta}>\frac{1+\alpha-\Delta}{1+\beta}$,corresponding to points $\mathrm{O}, \mathrm{B}$ and A in Figure 1, indicating that both increase profit. Among them, the profit change of change of $\alpha$ is larger.

When considering changes in the same direction, $\pi(1)$ indicates that regret is not considered, $\pi\left(\frac{1+\alpha}{1+\beta}\right)$ indicates that regret is considered. The new curve is $2 \pi(1)-\pi\left(1 / \frac{1+\alpha}{1+\beta}\right)$,so we got Figure 2.


Fig. 2. The effect of $\alpha$ and $\beta$ with the same variation on the maximum desired profit

We can see, when $\frac{1+\alpha}{1+\beta}<1,2 \pi(1)-\pi\left(1 / \frac{1+\alpha}{1+\beta}\right)>\pi\left(\frac{1+\alpha}{1+\beta}\right)$,that means $\alpha<\beta$.At the moment, the change of the regret factor has a greater impact on the profits of U retailers;;but when $\frac{1+\alpha}{1+\beta}>1$, means $\alpha>\beta$. At the moment, the change in the high price regret coefficient has a greater impact on the profits.

From the above conclusion, it can be concluded that when the high price regret coefficient is greater, the equal amplitude reverse change of out of stock regret psychology and the equal amplitude same direction change of high price regret psychology coeffi-
cient have a greater impact on profits. Therefore, based on the above conclusion, retailers can track the prices of products purchased by customers with the same fashion level, sales volume, price, and customer regret based on past store data, analyze which regret psychology affects consumers more deeply for each product, and analyze how retailers should choose improvement strategies for possible deviations in regret psychology estimates.

## 5 Summary and Outlook

This article points out that the relief principles of two types of regret psychology are different, often in opposite directions, and there is no strategy to stimulate potential consumers' purchasing behavior simultaneously in both sales stages. Many times, due to certain limiting factors, companies can only choose between the two. Therefore, we established a two-stage sales model and compared the impact of two effects on corporate profits. We found that (1) regardless of whether regret is considered or not, strategic consumption behavior will have a negative impact on a company's pricing decisions, affecting its profits; (2) Under the influence of regret psychology, optimal pricing, optimal inventory, and corporate profit are all negatively correlated with high price regret coefficient, and positively correlated with out of stock regret coefficient. (3) When two types of regret psychology change in reverse with the same magnitude, the regret psychology with a smaller coefficient has a greater impact on retailer profits; When changing in the same direction with the same amplitude, the regret mentality with a larger coefficient has a greater impact on the retailer's profits. This can help companies find the most favorable solution when their marketing strategies are limited or conflicting.

In addition, consumers in the actual purchase, often receive the influence of other consumer consumption behavior, for example, the early purchase consumer concerns in the price to buy too many consumers and make them to reduce the utility of the price, the pursuit of fashion, lower consumers will think, due to the law and rights always tend to protect the interests of the majority, when the more consumers, the more guaranteed after-sales service, so they in the price to buy utility will be higher. Especially for emerging fashion product brands, this phenomenon will also affect consumers' purchasing decisions. This paper will continue to consider how retailers should make interperiod pricing decisions when regret psychology and externalities exist simultaneously.

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