

Promotional Strategy Considering Consumer Platform Preferences

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ABSTRACT

In the form of joining e-commerce platforms, an online advance model consisting of a platform Operator and a platform Resident has been established. Considering the influence of consumers' platform preferences and price discount coefficients on advance pricing and logistics service level decisions under the deposit inflation rule, the optimal pricing and logistics service level decisions of platform Operator and a platform Resident during promotion are obtained.

Keywords: *promotion, advance sale, platform preference, logistics service level*

1. INTRODUCTION

In recent years, the hybrid marketing model of e-commerce self-operated platform and third-party merchants joining platform has become the development trend of online channels [1]. For example, in addition to providing a trading platform for sellers and buyers, Alibaba also has its own T-mall self-operated platform; in addition to third-party official stores, JD also has JD self-operated stores. Platform Resident need to pay a franchise fee and a certain percentage of sales to the platform operator to sell products on e-commerce platforms, such as THERMOS JD store (platform operator) and THERMOS brand store (platform Resident). Platform operators and platform Resident are not only interested in sales, but also have competition issues.

In order to attract consumers to grab more market share, many businesses adopt two main strategies: (1) Promotion. Joint promotion in the two stages of advance and spot sale has become a basic method for merchants. (2) Improve service level. Including the improvement of logistics service level and after-sales service level.

Consumers' preferences for platform operators and platform Resident are not equal. Statistics on the JD platform show that the turnover of the THERMOS JD's self-operated store from June 2019 to June 2020 is 3.05 times that of the brand's store, and The turnover of JD International LAMY's self-operated store is 4.12 times that of LAMY's official store. This shows that consumers are more inclined to buy platform operators' products. In order to profit from the promotion, the platform Resident will choose lower prices to attract more consumers.

Commercial interests make the relationship between the platform operators and the platform Resident strained, and even occurs vicious bidding.

In view of this, compared with existing research, this article considers consumers' preference for the two platforms during the two stages of advance and spot sale, constructs two profit models for platform operators and platform Resident, and studies the product pricing and logistics service level decisions during promotion. The relevant conclusions provide references for e-commerce companies to choose reasonable and effective sales decisions.

This article mainly refers to two types of literature, one is research on advance and spot sale. Steven and Xie proved for the first time that advance can reduce competition and create greater benefits for enterprises compared to current sales [2]. Tamer studied the impact of the collection time of advance information on corporate decision-making and pricing [3]. Zhai and Li studied the optimal advance price and optimal order quantity under the uncertain market size [4]. Wu [5], Wang [6], Zhou [7] and others have studied the optimal return strategy in the advance environment. Research shows that early sales and allowable returns are the best choices. Cheng [8] studied different product pricing strategies under the advance, and compared and analyzed the optimal results with or without price discounts. Some scholars also study the optimal strategy for the two stages of advance and spot sale. Yan and Liu [9] studied the advance decision of sellers from the two dimensions of advance price and advance period based on the time value of funds. Wang [10] studied the optimal advance price

and the optimal return price of the two advance strategies of allowing and disallowing returns when considering the loss aversion of strategic consumers, and the value range of the return price. Bai et al. [11] considered consumers' time preference and studied the price strategy and inventory strategy of enterprises under the integrated mode of spot sale and advance. Zhou et al. comprehensively considered consumers' time preferences and strategic behaviors under the condition of uncertain market size, constructed a pricing and ordering model with no advance, advance only and two-stage advance strategies, and obtained corresponding the best advance price and order quantity. Most of the existing literature on advance and current sales consider the optimal advance pricing, optimal ordering and return strategies of monopolistic companies. In reality, many companies have a dual relationship of competition and cooperation. Therefore, the advance and spot sale pricing decisions of such companies are the situation considered in this article.

Another type of literature referred to is research on platform competition. Jerath [12] considers the channel structure of two competing manufacturers' products through the same retailer, and demonstrates the incentive mechanism for retailers to choose the entry model and the self-operated model. Tian aimed at direct competition between self-operated products and affiliated products, and built a model in consideration of consumers' preferences. Guo [13] studied the pricing and coordinated decision-making of a dual-channel closed-loop supply chain based on the inconsistency of consumers' demand preferences for traditional retail channels and online direct sales channels, considering the competition between channels. Zhang [14] studied the competitive behavior of online platform self-employers and franchisees, introduced the transfer of consumers' demand for returns between the two channels into the model, and analyzed the best practices of the two retailers under decentralized and centralized decision-making. Li [15] considers the coexistence of self-operated channels of e-commerce platforms and traditional retail channels, and analyzes the influence of consumer channel preferences and consumer free-riding phenomenon on the product pricing and service strategies of dual-channel supply chain members. Regarding the literature on platform competition, most of the existing literature studies the pricing decisions during spot sales, and seldom considers the pricing and logistics service level investment of the platform for advance.

Compared with the existing literature, the research innovations of this article are mainly reflected in: (1) Most of the existing literature studies the monopolistic enterprises' advance and spot sales, or the pricing decisions when two retailers make normal sales. Two competing retailers' pricing decisions during the advance period and the spot period are discussed in this article; (2) the logistics service level is introduced into the model,

taking into account the impact of logistics service factors on customer demand; (3) the consumer's preference for the platform combined with the sales model, retailers' pricing decisions are considered from the perspective of behavior.

2. PROBLEM INSTRUCTION

2.1. Problem description

This article establishes a two-stage online sales model consisting of a platform operator and a platform Resident. Assuming that the initial demand is d , the customer's demand at the platform operator and platform Resident is D_z and D_j respectively. In the advance stage, the platform operator and the platform Resident formulate deposit expansion rules, where the deposit ratio is r , and the price discount coefficient is β_z or β_j . Assuming that the proportion of the pre-sale population is η , the final transaction value of the consumers who pay the deposit is $(\beta_i + r)P_i$ that if the consumer returns or cancels the order, the deposit will not be refunded; At the spot stage, the platform operator and the platform Resident will pay the price of P_z and P_j for sales, consumers who purchase during the spot period do not enjoy price discounts, but if occurs return, a full refund will be given. Assume that the proportions of returns of platform operators and platform Residents in the advance and spot stages are respectively $a_1, a_2; b_1, b_2$.

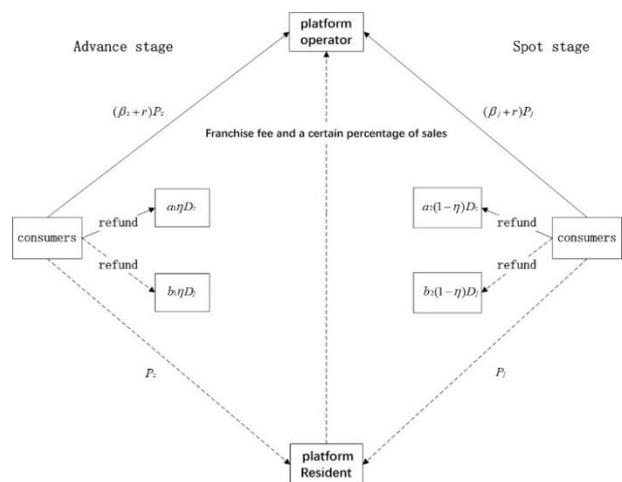


Figure 1 Consumer behavior diagram at platform operators and platform Resident. The relevant behavior of the platform operator is represented by a solid line (—), and the relevant behavior of the platform Resident is represented by a dotted line (---) →

2.2. Research hypothesis and the symbol explanation

This article has the following research hypotheses:

- 1) As a rational person, consumers seek to maximize their own interests;
- 2) There is no difference between the products sold by

the two participants and the returned products will not be sold twice, so the product cost and residual value of the platform operator and the platform Resident are the same;

3) Assuming that market demand is only affected by the

two factors of enterprise price and logistics service level, the market demand of platform operator and platform Resident are respectively D_z, D_j , so

$$\begin{aligned} D_z &= d - P_z + h\lambda_z \\ D_j &= kd - P_j + h\lambda_j \end{aligned} \quad (1)$$

where d is the initial demand, h is the influence coefficient of the logistics service level on the market demand, and λ_i is the logistics service level decided by the platform business, so there is $d, h > 0; \lambda_i \geq 0; 0 < k < 1$.

Table 1. Related parameters and variables

Related parameters	Meaning
i	$i = z$ means platform operator, $i = j$ means platform Resident
D_i	Retailer i 's demand function
k	Consumers' preference for platform Resident
η	Proportion of pre-sale population
a_t	The return ratio of the platform operator during the t period, $a < 1$ and $a_1 < a_2$
b_t	The return ratio of the platform Resident during the t period, $b < 1$ and $b_1 < b_2$
r	re-payment ratio, $r < 1$
C	Product unit production cost
F	Fixed platform fee paid by platform Resident
q	The percentage of sales collected by platform operators from Resident
S	Commodity residual value
π_i	The amount of i 's profit throughout the promotion period
β_i	Retailer i 's price discount, where $r + \beta_i < 1$
e	Logistics service cost coefficient
h	The influence coefficient of logistics service level on market demand
P_i	Retailer i 's product prices
λ_i	Retailer i 's logistics service level

2.3. Model and Result

According to the promotion rules, the sales income of consumers when they have different purchase behaviors is summarized, as shown in the following table. For consumers who pay a deposit and finally buy, they only need to pay the deposit rP_i to enjoy a proportional price

discount, so the retailer's sales are $(r + \beta_i)P_iD_{i1}$; for consumers who cancel the order or return the goods after the deposit is paid, the retailer does not refund the deposit. Since it is assumed that no secondary sale will be made after the product is returned, the residual value of the returned product is S , the retailer's sales is $(rP_i + S)TD_{i1}$; for customers who do not have prepaid deposits, the retailer's sales are P_iD_{i2} for the price P_i of the product; if the product is finally returned, then the retailer gives a full refund, so the sales are only the residual value of the returned product sTD_{i2} .

Table 2. Retailer i 's sales

	re-pay deposit	no-pay deposit
purchase finally	$\beta_i P_i D_{i1}$	$P_i D_{i2}$
refund finally	$(rP_i + S)TD_{i1}$	sTD_{i2}

Note: $D_{i1}, D_{i2}, TD_{i1}, TD_{i2}$ are the demand function and return function of the retailer in the advance period and the spot period respectively, where $D_{i1} = \eta D_i; D_{i2} = (1 - \eta)D_i$; $TD_{i1} = a_t D_{i1}; TD_{i2} = b_t D_{i2}$, $t = 1$ represents the advance period and $t = 2$ represents the spot period.

The revenues of platform operator and platform Resident during the promotion are:

$$\begin{aligned} \pi_z &= (d - P_z + h\lambda_z)[\beta_z P_z \eta + P_z(1 - \eta) + a_1 \eta(rP_z + S) + sa_2(1 - \eta) - c] + q(kd - P_j + h\lambda_j)[\beta_j P_j \eta + P_j(1 - \eta) + b_1 \eta(rP_j + S) + sb_2(1 - \eta)] + F - \frac{e}{2} \lambda_z^2 \\ \pi_j &= (1 - q)(kd - P_j + h\lambda_j)[\beta_j P_j \eta + P_j(1 - \eta) + b_1 \eta(rP_j + S) + sb_2(1 - \eta) - c] - F - \frac{e}{2} \lambda_j^2 \end{aligned} \quad (2)$$

To maximize the benefits of platform operator and platform Resident, determine their own optimal pricing and logistics service level, first calculate the respective product prices and logistics service level of platform operator and platform Resident's Hessian matrix.

The Hessian matrix of the platform operator is:

$$H_z = \begin{bmatrix} -2[\beta_z \eta + (1 - \eta) + a_1 r \eta] & h[\beta_z \eta + (1 - \eta) + a_1 r \eta] \\ [\beta_z \eta + (1 - \eta) + a_1 r \eta] & -e \end{bmatrix}$$

Obtained $|H_z| = J_z(2e - h^2 J_z)$, where

$J_z = \beta_z \eta + (1 - \eta) + a_1 r \eta$, when $e < \frac{1}{2} h^2 J_z$, platform operator has the largest product pricing and logistics service level.

Proposition 1: Let

$$\begin{aligned} \frac{\partial \pi_z}{\partial P_z} &= -[\beta_z P_z \eta + P_z(1 - \eta) + a_1 \eta(rP_z + S) + sa_2(1 - \eta) - c] + (d - P_z + h\lambda_z)[\beta_z \eta + (1 - \eta) + a_1 r \eta] = 0 \end{aligned}$$

The best pricing available for platform operator is $P_z = \frac{1}{2} \left[d + h\lambda_z + \frac{c - sA}{J_z} \right]$, where $A = a_1\eta + a_2(1-\eta)$.

$$\frac{\partial \pi_z}{\partial \lambda_z} = h[\beta_z P_z \eta + P_z(1-\eta) + a_1\eta(rP_z + s) - c$$

$+sa_2(1-\eta)] - e\lambda_z = 0$ get the optimal logistics service level of the platform operator as $\lambda_z = \frac{h}{e} (P_z J_z + sA - c)$.

In the same way, the Hessian matrix of the resident is:

$$H_j = \begin{bmatrix} -2(1-q)[\beta_j\eta + (1-\eta) + b_1r\eta] & h(1-q)[\beta_j\eta + (1-\eta) + b_1r\eta] \\ h(1-q)[\beta_j\eta + (1-\eta) + b_1r\eta] & -e \end{bmatrix}$$

compute $|H_j| = J_j(1-q)(2e - h^2J_j)$, where

$J_j = \beta_j\eta + (1-\eta) + b_1r\eta$, when $e < \frac{1}{2}h^2J_j$, the platform

Resident have the largest product pricing and logistics service level in the business.

Proposition 2: Let

$$\frac{\partial \pi_j}{\partial P_j} = -(1-q)[\beta_j P_j \eta + P_j(1-\eta) + b_1\eta(rP_j + s) - c + sb_2(1-\eta)] + (1-q)(kd - P_j + h\lambda_j)[\beta_j\eta + (1-\eta) + b_1r\eta] = 0$$

The best price available for platform Resident is

$$P_j = \frac{1}{2} \left[kd + h\lambda_j + \frac{c - sB}{J_j} \right], \text{ where } B = b_1\eta + b_2(1-\eta).$$

$$\frac{\partial \pi_j}{\partial \lambda_j} = h(1-q)[\beta_j P_j \eta + P_j(1-\eta) + b_1\eta(rP_j + s) - c$$

$+sb_2(1-\eta)] - e\lambda_j = 0$, get the optimal logistics service level of platform Residents as $\lambda_j = \frac{h(1-q)}{e} (P_j J_j + sB - c)$.

From the above propositions, it can be seen that platform preference and price discount ratio coefficients have a great impact on platform vendors' pricing and logistics service level investment decisions. With the increasing of the price discount coefficient, the pricing of platform operator and platform Resident will also increase, and the level of logistics services will also increase, that is, the price discount coefficient has a positive impact on the platform operators' pricing and logistics service level decisions. The pricing of platform operator is not affected by consumers' platform preference. The pricing of platform Resident increases with the increase of consumer's platform preference, which has a positive impact. This is also in line with the actual situation; The logistics service level decision of the platform operator and platform Resident is not affected by the consumer's platform preference.

3. CONCLUSION

Through research and analysis of the optimal decision-making problems of the platform Resident and platform operator during the promotion, the optimal pricing and logistics service level decision of the platform operator and the platform Resident in the promotion are obtained. It can be found that the pricing decisions and logistics service level investment decisions of platform operator and platform Resident are affected by price discounts and consumer platform preferences. The consumer's platform preference will affect the pricing decisions of platform Resident, and it will increase with the increasing of consumer's platform preference, which has a positive effect. The price discounts of platform providers will affect their pricing and logistics service level decisions at the same time, and have a positive impact.

According to the research results of this article, platform operators and platform Resident can make reasonable decisions based on actual conditions during promotion, and appropriately give consumers a certain percentage of price discounts during the advance period, thereby stimulating consumers to ensure the profitability of merchants; platform Resident can use market research to deeply explore the factors that consumers should consider when purchasing behaviors, reflect on and improve their own shortcomings, so as to enhance consumers' platform preference and ensure their profit. In addition, platform operator and platform Resident should provide consumers with satisfactory logistics service levels based on their own costs, so as to attract more consumers to join consumption.

Considering the reality of some oligarchic manufacturers, we can consider analyzing the different status of participants in the channel. Moreover, due to service factors such as advertising and promotion occupying an increasingly important position in online channels, Introducing the factor of consumers' 's perception level into the online channel model is also a direction for further expansion in the future.

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