The Impact of Return Freight Insurance on Retailer's Choice of Refund Guarantee in the Presence of Private Brand

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ABSTRACT
Based on the introduction of private brands by retailers, this paper studies the effect of return compensation on retailer's optimal pricing. The results show that: (1) consumer return cost is lower than retailer return cost: low return compensation makes retailers give up providing refund guarantee for their own brands. Generally, compensation for returned goods shall be determined according to the specific situation of returned goods cost of each member of the supply chain. When return compensation is large, the retailer should choose to provide return compensation only for its own brand. (2) Consumer return cost is higher than retailer return cost: when the return cost is smaller or larger, retailer provides refund guarantee for its own brand. When return compensation is common and consumer return costs are low, retailers offering return compensation for private brands can have a negative impact.

Key words: Private brand; Money-back guarantee; Pricing strategy

1. INTRODUCTION
In recent years, a growing number of retailers have taken a new path to growth by building their own brands, such as Wal-mart's Wyi. With the development of the Internet, online shopping has become the main way of consumption, with China's online retail sales reaching 9.19 trillion yuan in the first three quarters of 2021, up 18.5 percent year-on-year, according to China's Ministry of Commerce. The rapid development of e-commerce has pushed retailers to develop online businesses, such as Taobao Xinxuan. As consumers are unable to touch the physical objects, the possibility of products not meeting consumers' expectations exists. In response, retailers are considering introducing refund policies that allow consumers to return unsatisfied products. Product return will produce return cost, in order to reduce the negative impact of return cost to consumers, many retailers buy freight insurance for consumers that is return compensation. Freight insurance has become very common on Tmall. On the one hand, the return compensation has attracted more consumers to buy products. But on the other hand, it also makes more consumers abuse the right to return goods, resulting in the loss of retailers' profits. Therefore, after the retailer introduces its own brand, how the return compensation affects the retailer's profit and how the retailer makes the refund policy has become a problem to be studied.

As for private brands, Sun Yongbo [1] analyzed the influencing factors of online retail private brand purchase intention. Liu Zhijie [2] believe that Internet private brands should be built from the aspects of accurate positioning, improving product quality and strengthening marketing. Duan Yongrui [3] studied the influence of reference price and quality perception on private brand pricing. Cheng[4]shows that the introduction of private brands is beneficial to all members of the supply chain. Almonawer[5] considered the influence of consumer base on the quality and pricing of retailers' private brands. Zhang[6] studied whether retailers introduce high-end private brands or economical private brands to cope with manufacturer invasion. Liao[7] studied the quality positioning of retailers' private brands under different purchasing channels and the interaction with retailers' pricing.

The existing literature mainly studies the influence of refund guarantee on retailers and how retailers choose refund guarantee. Li Shumei [8] studied the influence of refund guarantee on retailers' optimal pricing, consumer surplus and social welfare. Huang Fu [9] analyzed the
effects of refund guarantee and different decision
sequences on the equilibrium results and manufacturers’
opening of dual channels. Jin Liang [10] believe that brand
differentiation competition is always beneficial to
retailers, but its impact on high-end brand manufacturers
is uncertain. Huang [11, 12] shows that the existence of
money-back guarantee is beneficial to retailers but
disadvantageous to manufacturers. Assarzadegan [13]’s
results show that retailers’ money-back guarantee for
defective products is beneficial to all parties in the supply
chain. Desmet [14] discussed the influence of refund
guarantee on private brands and manufacturers’ brand
preference. At present, there is little research on freight
insurance. Yang Lei [15] introduced freight insurance into
the newsboy model to discuss the change of income of all
parties in the supply chain under the condition of the
change of return rate. Hu Zhenhua [16] showed that the
optimal strategy was not affected by the insurance buyers
after the introduction of freight insurance.

2. Problem Description and Model Assumptions

Suppose there is a manufacturer and a retailer in the
market, and the retailer introduces its own brand to
compete with the manufacturer's brand. In the event of a
return, the retailer's own brand will be returned to the
retailer and the manufacturer's brand will be returned to
the retailer and then to the manufacturer through the
retailer. To attract consumers, retailers are offering refund
shipping costs.

In this paper, NB (National Brand) represents the
manufacturer’s Brand, SB (Store Brand) represents its
own Brand, N and G respectively represent the
situation where no or no money back guarantee is
provided. Retailers have four refund policies, which are:
(1) only private brands provide a refund guarantee
(NG); (2) Only the manufacturer brand provides a money
back guarantee (GN); (3) Both products provide a money
back guarantee (GG); (4) Neither product offers a money
back guarantee (NN). The retailer has four refund
policies $K = \{NN, GN, NG, GG\}$.

Before receiving the goods, consumers can not
determine whether the quality meets the requirements.
Use $\theta_i$ ($i = n, s$) to represent the probability that the
product meets consumer needs and $0 < \theta < 1$ assume
$\theta_s > \theta_n$. When the product meets consumer demand,
consumers can obtain utility $v_i - p_i$, which $v_i$ represents
the uniform distribution of consumers' valuation of the
product. Consumers have to pay the return cost when they
return goods. Therefore, if the retailer does not
provide refund policy, the utility function obtained by
consumers is: $U_i = \theta_i v_i - p_i$. When the retailer provides a
refund policy, the utility function obtained by the
consumer is: $U_i = \theta_i (v_i - p_i) - (1 - \theta_i) (v_i - c_i)$, in order to conform
to the actual situation, assume $c_i < v_i$. Consumers will buy
NB products only when $U_N > 0$ and $U_S > U_N$, otherwise,
they will buy SB products, where $v_i$ means there is no
difference between buying SB products and not buying
any products, $v_i$ means there is no difference between
buying NB products and buying SB products. Therefore,
the demand function of the two products can be expressed as
$q_N = 1 - v_i; q_S = v_i - v_N$.

Retailers and manufacturers incur return costs when
consumers return goods. $h_n$ and $h_s$ represents the cost
of returns to retailers and manufacturers. Based on the
existing literature, it is assumed that the production cost
of the product is 0.

3. Model

This part will solve the game equilibrium of the four
situations, and the decision order is (1) the retailer
decides the way of consumer return; (2) Manufacturers
determine the wholesale price; (3) The retailer decides
the demand for the product; (4) Consumers decide which
products to buy.

3.1 Model NN

Neither product offers a refund policy and The profit
function of retailer and manufacturer is:

$$\max_{w_i} \Pi_{NN} = q_i w_i; \quad \max_{w_i} \Pi_{NN} = (p_i - w_i)q_i + p_iq_i \quad (1)$$

3.2 Model GN

Retailers only offers a refund policy for NB products.
The profit function of retailer and manufacturer is:

$$\max_{w_i} \Pi_{GN} = \theta_i w_i q_i - h_n(1 - \theta_i)q_i; \quad \max_{w_i} \Pi_{GN} = \theta_i (p_i - w_i)q_i - (1 - \theta_i)h_i q_i + p_iq_i \quad (2)$$

3.3 Model NG

Retailers only offers a refund policy for SB products.
The profit function of retailer and manufacturer is:

$$\max_{w_i} \Pi_{NG} = q_i w_i; \quad \max_{w_i} \Pi_{NG} = (p_i - w_i)q_i + \theta_i p_i q_i - (1 - \theta_i)h_i q_i \quad (3)$$

3.4 Model GG

If the retailer provides a refund guarantee for the two
products, the profit function of the retailer and the
manufacturer is:

$$\max_{w_i} \Pi_{GG} = q_i w_i - h_n(1 - \theta_i)q_i; \quad \max_{w_i} \Pi_{GG} = \theta_i (p_i - w_i)q_i - (1 - \theta_i)h_i q_i + \theta_i p_i q_i - (1 - \theta_i)h_i q_i \quad (4)$$

The final equilibrium solution and the optimal profit
obtained are shown in Table 1 and Table 2.
### Table 1. The equilibrium

| Variable | NN | GN | NG |
|----------|----------------|----------------|--------|
| \( W^* \) | \( \theta - \theta \) | \( \frac{t - h_2(1 - \theta)}{2} + (t - r) \theta_1, \theta - \theta_1 - r \) | \( \frac{t - h_2(1 - \theta)}{2} + (t - r) \theta_1, \theta - \theta_1 - r \) | \( \frac{t - h_2(1 - \theta)}{2} + (t - r) \theta_1, \theta - \theta_1 - r \) |
| \( q^* \) | \( \frac{1}{4} \) | \( \frac{t - h_2(1 - \theta)}{2} + (t - r) \theta - \theta_1 \) | \( \frac{t - h_2(1 - \theta)}{4} + (t - r) \theta - \theta_1 \) | \( \frac{t - h_2(1 - \theta)}{4} + (t - r) \theta - \theta_1 \) |
| \( q^*_N \) | \( \frac{1}{4} \) | \( \frac{t - h_2(1 - \theta)}{4} + (t - r) \theta - \theta_1 \) | \( \frac{t - h_2(1 - \theta)}{4} + (t - r) \theta - \theta_1 \) | \( \frac{t - h_2(1 - \theta)}{4} + (t - r) \theta - \theta_1 \) |
| \( p^* \) | \( \frac{3r - \theta}{4} \) | \( \frac{t - h_2(1 - \theta)}{4} + (t - r) \theta - \theta_1 \) | \( \frac{t - h_2(1 - \theta)}{4} + (t - r) \theta - \theta_1 \) | \( \frac{t - h_2(1 - \theta)}{4} + (t - r) \theta - \theta_1 \) |
| \( p^*_G \) | \( \frac{r}{2} \) | \( \frac{t - h_2(1 - \theta)}{2} + (t - r) \theta - \theta_1 \) | \( \frac{t - h_2(1 - \theta)}{2} + (t - r) \theta - \theta_1 \) | \( \frac{t - h_2(1 - \theta)}{2} + (t - r) \theta - \theta_1 \) |

### Table 2. The optimal profit

| Variable | NN | GN | NG |
|----------|----------------|----------------|--------|
| \( \pi^*_N \) | \( \frac{1}{16} (\theta + 3 \theta) \) | \( \frac{1}{16} (\theta + 3 \theta) \) | \( \frac{1}{16} (\theta + 3 \theta) \) |
| \( \pi^*_G \) | \( \frac{1}{8} (\theta - \theta) \) | \( \frac{1}{8} (\theta - \theta) \) | \( \frac{1}{8} (\theta - \theta) \) |

### 4. ANALYSIS OF FINAL GAME RESULTS

#### 4.1 Retailer money back guarantee policy

Firstly, NG and NN is taken as the benchmark case, and the retailer profits of the two cases are compared to obtain proposition 1.

Proposition 1: (1) The return cost of consumers is higher than that of retailers: the freight compensation in \( 0 < r < r_1 \), retailers only provide a refund guarantee for SB products; in \( r_1 < r < r_2 \) the retailer does not give a money-back guarantee on any product; in \( r > r_2 \), the retailer only gives SB a money-back guarantee for its products. (2) The cost of returning goods to the consumer is lower than the cost of returning goods to the retailer: when the retailer’s cost of returning goods is lower, in \( 0 < r < r_2 \), Neither product comes with a money-back guarantee; in \( r > r_2 \) only SB products offer a money-back guarantee; When the retailer’s return costs are high, the retailer only offers a money-back guarantee for SB products.

When the return cost of consumers is higher than that of retailers, on the one hand, the market share of SB products is smaller than that of NB products. On the other hand, the offer of a money-back guarantee increases SB’s cost of selling its products. But the increase in SB’s prices was not enough to compensate for its lack of market share. When the return cost of consumers is lower than the return cost of retailers, retailers provide higher freight compensation, which will attract consumers to buy products, and retailers can charge higher prices to make up for the loss of less market share. Therefore, retailers can provide refund guarantee for SB products.

If in proposition 1 the retailer decides to NG, on the basis of proposition 1, the retailer's profits under the two scenarios NG and GG are compared and the retailer's optimal strategy is finally obtained.

Proposition 2: (1) The return cost of consumers is higher than that of retailers: in addition to \( \theta_1(t - \theta) + (t - r) \theta_1 < t < \theta_2 \), \( \theta_1(t - \theta) + (t - r) \theta_1 < t < \theta_2 \), and \( 0 < r < r_1 \) or \( \theta_1(t - \theta) + (t - r) \theta_1 < t < \theta_2 \), and \( t < r < r_2 \),
The retailer offers a money back guarantee for both products, whereas the retailer only offers a money back guarantee for SB products. (2) The cost of returning goods to consumers is lower than that to retailers:

In most cases retailers choose to only give SB a money back guarantee on their products, however in

\[ 0 < r < r_h \]

and \( r_2 < r < r_1 \), both products offer money-back guarantees to the benefit of retailers.

When manufacturers and retailers have low return costs, return compensation can entice consumers to buy products. If the cost of returning goods is high, the manufacturer will increase the wholesale price to make up for the loss of profits, the higher selling price will lead to the decrease of the purchase rate. Similarly, the purchase of freight insurance adds to the retailer's costs. In order to achieve a win-win situation for the retailer and the manufacturer, the retailer should provide a money-back guarantee for both products within appropriate freight reimbursement.

If the retailer chooses \( NN \), then the retailer's profits in case \( NN \) and case \( GN \) are compared on the basis of proposition 5, and the retailer's optimal strategy is finally obtained.

**Proposition 3:** (1) The return cost of consumers is

**Table 3. When \( t > h_m \) market equilibrium**

| \( t \) | \( h_m \) | \( r \) | The optimal strategy |
|-------|-------|-------|---------------------|
| \( 0 < h_m < \frac{2 \theta^2 (\theta + \theta^2) + 3 \theta^3 \theta^2 (\theta + \theta^2)}{(1-\theta) (4 \theta - 3 \theta^2) (1-\theta)} \) | \( 0 < r < r_h \) | \( r < r < r_5 \) | \( NG \) |
| \( \frac{1 + h_m}{1 + \theta - 2 \theta} \) \( < t < h_m \) | \( r < r < r_2 \) | \( r > r_2 \) | \( GN \) |
| \( \frac{h_m (\theta - 1) + (\theta - \theta^2)}{1 + \theta - 2 \theta} \) \( < t < h_m \) | \( r < r < r_5 \) | \( r_5 < r < r_2 \) | \( NN \) |
| \( \frac{h_m (\theta - 1)}{1 + \theta - 2 \theta} \) \( < t < h_m \) | \( r < r_2 \) | \( r > 0 \) | \( NG \) |
| \( t > h_m \) | \( h_m > 0 \) | \( r > 0 \) | \( NG \) |

**Table 4. When \( t < h_m \) market equilibrium**

| \( t \) | \( h_m \) | \( r \) | The optimal strategy |
|-------|-------|-------|---------------------|
| \( t < h_m \) | \( \frac{2 \theta^2 (\theta + \theta^2) + 3 \theta^3 \theta^2 (\theta + \theta^2)}{(1-\theta) (4 \theta - 3 \theta^2) (1-\theta)} \) | \( 0 < r < r_2 \) | \( GN \) |
| \( \frac{1 - \theta}{\theta - 1} \) | \( r < r < r_5 \) | \( r_5 < r < r_2 \) | \( NN \) |
| \( 0 < r < r_2 \) | \( r < r \) | \( r_2 < r \) | \( NG \) |
| \( 0 < r < r_2 \) | \( 0 < r < r_5 \) | \( r_5 < r < r_2 \) | \( GN \) |
Parameter settings are as follows: \( \theta = 0.5, \theta = 0.1, \theta = 0.3, \theta = 0.2 \), choose \( r = 0.3, r = 0.6, r = 0.9 \) to represent small, moderate and large cases respectively.

Figure 1 The impact of consumer return costs on retailer profits

By observing figure 1 (a), we can see that when \( t = r = 0.3 \), curve \( GN \) is at the top, and it is beneficial for retailers to provide refund guarantee only for NB products. Curves \( GG \) and \( NG \) have an obvious upward trend at \( t \rightarrow 0.8 \), and the two curves basically coincide, indicating that retailers should choose to provide refund guarantee for SB products when the return cost of consumers is high.
In figure 1 (b). With the increase of \( t \), curves \( GG \) and \( NG \) decrease slightly at first and increase greatly after \( t > 0.8 \). When \( t \) is small, curve \( GN \) is at the top; When \( t \) is large, curves \( GG \) and \( NG \) basically coincide and are located at the top, which indicates that the return compensation is generally the same as the result when the return compensation is small.

Figure 1 (c) shows that when \( t = r = 0.9 \), curve \( NG \) is at the top, which indicates that retailers should only provide refund guarantee for SB products when return compensation and consumer return cost are basically the same. When \( t \) is average, retailer's profit is the highest in \( GN \). When \( t \) is large, curve \( NG \) is at the top. This means that when the return compensation is large and the return cost to the consumer is small or large, it’s beneficial for the retailer to choose to provide a refund guarantee only for SB products.

6. CONCLUSION

Based on retailers to introduce their own brands to study the effect of the return of the compensation for retailers decision-making. NB products compete with SB products in the market, retailers in order to ensure profits for four refund way: only NB products provide, only SB products in the market, retailers in order to ensure profits retailers decision study the effect of the return of the compensation for SB products only provide refund guarantee, but in return of the compensation. (2) When consumers return cost is lower than the retailers to return costs, low enough allows retailers to give up the return of the compensation for SB products provide refund guarantee. This research only considers a single retailer in the market of the supply chain structure, however, there are multiple retailers competing in practical life, and the retailers.

APPENDIX:

The model \( NN \) equilibrium calculation

Demand function are obtained by the utility function

\[
q_{NN}^* = 1 - \frac{p_{NN}^* - p_{NN}^*}{\theta - \theta} - \frac{p_{NN}^* - p_{NN}^*}{\theta - \theta}
\]

So the inverse demand function is:

\[
p_{NN}^* = \theta - q_{NN}^* \theta - q_{NN}^* \theta
\]

\[
p_{NN}^* = \theta - q_{NN}^* \theta - q_{NN}^* \theta
\]

Hessian matrix for: \( H = \left[ \begin{array}{c} -20 & -20 & -4(\theta - \theta) \end{array} \right] \), the Hessian matrix is negative definite. Substitute the response functions into the objective function of the manufacturer, then the optimal decision of the manufacturer could be found by \( \frac{\partial ^2 T_{NN}}{\partial q_{NN}^*} = 0 \) and the second order derivative can be calculated by \( \frac{\partial ^2 T_{NN}}{\partial q_{NN}^*} = \frac{1}{\theta - \theta} < 0 \), since the second derivative is negative, it has a maximum. Take the optimal wholesale price into the response functions of the retailer could result in the equilibrium retail price of the retailer only the calculation process of the equilibrium solution in the case is shown.

Proposition 1 proves: Comparison case \( NG \) and \( NN \)

\[
\pi_{NN} - \pi_{NN} = \left( r - r + \frac{h}{3h} \right) \left( \theta - 1 \right) \left[ 2 \theta - 2 + 2h \left( \theta - 1 \right) + \frac{1}{3h} \left( r - r + \frac{h}{3h} \right) - 2 \theta - 2 \right]
\]

1. When \( t > h \), the parabola intersects the horizontal axis twice \( r_1 \) and \( r_2 \) : \( 0 < r_1 < r_2 < t \), \( f(r) = 0 \Rightarrow \pi_{NN} < \pi_{NN} \), \( r > r_1, f(r) = 0 \Rightarrow \pi_{NN} > \pi_{NN} \)

2. When \( h < h \), \( 0 < 1 < h < 1 \), \( f(r) = 0 \Rightarrow r > 0, f(r) = 0 \Rightarrow \pi_{NN} > \pi_{NN} \)

The proof of the other propositions is similar that proposition 1, so only the proposition 1 be shown.

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