TARGET MARKETING IN A DISTRIBUTION CHANNEL: IMPLICATIONS FOR A MANUFACTURER’S RETURNS POLICY

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A returns policy, which allows customers to return products for a refund, is commonly offered by manufacturers and retailers. In the markets of frequently purchased products, consumers who are dissatisfied with the products purchased from retailers usually return the products to the retailers rather than manufacturers. The end-user returns at the retail level, in turn, may create a pressure for returns from the retailer to the manufacturer.

This paper considers a monopolistic manufacturer who designs a product line which has different functioning probability for each product (i.e. different quality). Each product may or may not be targeted at a different market segment. The manufacturer decides as well its returns policy (for retailers) and wholesale price for each type of product. Given the product line and returns policy offered by the manufacturer, the retailer decides which products to carry, which product to target to each segment, the returns policy (for consumers) and retail price for each product. Then given the retail price and retailer’s returns policy, consumers decide whether and which product to buy.

The results show that providing returns policy on the low-end product at the retail level can be used to screen consumers if consumers’ valuations for product quality are positively correlated with their costs of returns. The screening effect, in turn, can alleviate the retailer’s incentive problems in a distribution channel. Under some circumstances, the benefits of screening effects and less retailer’s incentive problem are so high that it is worth for the manufacturer taking returns from the retailer even the returned merchandise is worthless. When it happens, the manufacturer optimally reduces the quality for the low-end product to best take advantage of the screening function of the returns policies. The intuition behind the result is, first, by using the returns policy as a screening tool, the retailer is able to extract extra consumer surplus from the high segment. That is, the cannibalization problem of the product line is alleviated as the retailer allows returns on the low-end product. Second, if the retailer accepts returns on the low-end product, this returns policy in turn reduces the difference in willingness-to-pay between the two segments, and as a result the retailer faces two more similar consumer segments. The retailer therefore has more incentives to target different products to consumers rather than sell the high-end product to the high segment only. Thus the lack of channel coordination in targeting is mitigated.

Keywords: Returns policy, Target marketing, Retailer, Manufacturer, Consumer segments

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INTRODUCTION

A returns policy, which allows consumers to return products for a refund, is commonly offered by manufacturers and retailers. As consumers are often uncertain about the product’s performance prior to purchase, returns policy are used to reduce consumer purchasing uncertainty. The Wall Street Journal reported that in 2002, the value of products that U.S. consumers return to the nation’s retailers each year exceed $100 billion (Stock et al, 2002). This observation suggests that end-user returns have become very common and deserve more attention.

Returns policies are especially an important part of the marketing mix in a distribution channel. In the frequently purchased consumer markets, consumers who are dissatisfied with the products they purchased return the products to the retailers rather than the manufacturers. The end-user returns at the retail level, in turn, may create a pressure for returns from the retailer to the manufacturer (Padmanabhan and Png, 1995). Since the manufacturers design and produce the products, they can control (at least partially) the likelihood that retailers must take returns from the consumers, which in turn affects the miscoordination problem in the distribution channel, as will be shown in the paper.

Different targeting objectives between the manufacturer and the retailer are one of the sources of channel miscoordination. A manufacturer facing an independent retailer often cannot control the ultimate targeting of the products in the line to the different consumer segments, for the retailer might only care about its own interests and have a targeting strategy inconsistent with the manufacturer’s intentions. Previous research suggests when there is no quality uncertainties, mechanisms such as targeted pull pricing strategy and product line extension can correct this lack of channel coordination (Villas-Boas, 1998; Gerstner and Hess, 1995). However, when product failure may occur and firms commit to returns policies to consumers, does returns policy play any active role in channel coordination? Does returns policy make manufacturers / retailers targeting easier or more difficult? How should the manufacturer adjust its product line design if it allows returns? These important questions, which are highly related to firms’ profitability and channel coordination, remain unanswered.

We consider a monopolistic manufacturer who designs a product line which has different functioning probability for each product (i.e. different quality). Each product may or may not be targeted at a different market segment. The manufacturer decides as well its returns policy (for retailers) and wholesale price for each type of product. Given the product line and returns policy offered by the manufacturer, the retailer decides which products to carry, which product to target to each segment, the returns policy (for consumers) and retail price for each product. Then given the retail price and retailer’s returns policy, consumers decide whether and which product to buy.

Our results show that providing returns policy on the low-end product at the retail level can be used to screen consumers if consumers’ valuations for product quality are positively correlated with their costs of returns. The screening effect, in turn, can alleviate the retailer’s incentive problems in a distribution channel. Under some circumstances, the benefits of screening effects and less retailer’s incentive problem are so high that it is worth for the manufacturer taking returns from the retailer even the returned merchandise is worthless. When it happens, the manufacturer optimally reduces the quality for the low-end product to best take advantage of the screening function of the returns policies.

The intuition for this result is as follows. First, by using the returns policy as a screening tool, the retailer is able to extract extra consumer surplus from the high segment. That is, the cannibalization problem of the product line is alleviated as the retailer allows returns on the low-end product. Second, if the retailer accepts returns on the low-end product, this returns policy in turn reduces the difference in willingness-to-pay between the two segments, and as a result the retailer faces two more similar consumer segments. The retailer therefore has more incentives to target different products to consumers.
rather than sell the high-end product to the high segment only. Thus the lack of channel coordination in targeting is mitigated.

In summary, we seek to make two main contributions to the literature. First, we present a theory of manufacturer’s product line design and returns policy based on the screening function of the returns policy. We show that allowing returns and adjusting product line design together have significant implications for manufacturer profitability. Second, we examine the interactions between a manufacturer’s returns policy and the miscoordination problem in the distribution channel. We find that in terms of channel coordination, the manufacturer’s returns policy plays neither an active nor a positive role: if allowing returns is beneficial to the whole channel, the retailer will do so voluntarily; otherwise, the retailer’s full returns policy induced by the manufacturer indeed reduces channel profits.

The rest of the paper is organized as follows. In the next section, we review the relevant literature. Section 3 outlines modeling assumptions and notations. In section 4, we analyze the benchmark case of a coordinated channel. In section 5, we examine the general model, where the case of efficient merchandise returns is distinguished from the case of inefficient merchandise returns. Section 6 concludes with a brief summary and a discussion of directions for future research extension. All proofs and derivations are presented in the Appendix.

RELATED RESEARCH

Returns policy

Previous research has analyzed returns policy in a setting where sellers sell a single product directly to their end users. Buyers often cannot verify product quality on the selling spot. To assure good product performance, manufacturers can offer product warranties (Padmanabhan and Rao, 1993; Mann and Wissink, 1990; Shieh, 1996; Welling, 1989; Grossman, 1981), while retailers may provide returns policies (Davis et al., 1998; Hess et al., 1996; Davis et al., 1995). Heiman et al. (2001) compare the effects of retailer’s money-back guarantees with demonstrations in reducing uncertainty. They support that returns policies mitigate buyers’ risk and enhance buyers’ valuations for the product. However, these studies do not provide insight about how returns policy will influence channel coordination.

Moreover, this literature is restricted to situations in which merchandise returns are efficient, i.e., salvage value of the returned merchandise is high compared with consumers’ transaction costs (e.g. Hess et al., 1996; Davis et al., 1995). However, for products that are perishable or frequently modified or updated, their salvage value after being returned can be very low (Davis et al., 1995). In this paper, we take both cases of efficient/inefficient merchandise returns into consideration, and derive the manufacturer’s optimal returns policy under different situations. We find that in order to take advantage of strategic role of returns policy, sellers may allow returns from consumers even when the returned merchandise is worthless.

There are also articles considering demand uncertainty which give rise to the role of returns policy in affecting channel coordination (Pasternack, 1985; Kandel, 1996; Padmanabhan and Png, 1997; Tsay, 2002). In this setting, the retailer orders product (and possibly set the retail price) before the resolution of that demand, and salvages any overstock at some value less than the procurement cost. It is the demand uncertainty that gives rise to the role of returns policy in affecting channel coordination. Pasternack (1985) shows that a returns policy whereby a manufacturer offers full credit for a partial return of goods may achieve channel coordination. This channel coordination can be achieved only if manufacturers maximize total channel profits instead of manufacturer profits. Kandel (1996) suggests that manufacturers prefer full returns contracts while retailers prefer no-return ones, under the assumption that either the manufacturer or the retailer controls the output of inventory. Padmanabhan and Png (1997) show that full returns offered by a manufacturer can intensify retail competition, thus alleviating double-marginalization. Tsay

1Definition of efficient (inefficient) merchandise returns are discussed in section 4.
analyzes how sensitivity to risk affects manufacturer-retailer relationship and how manufacturer returns policy change relative strategic power.

The principle insight provided by this literature is that the retailer’s aversion to overstock scenarios depresses the quantity that the manufacturer can sell. Compared to their models which focus on an environment where consumers are homogenous and product failure never occurs, we consider the heterogeneity among consumers which gives rise to the screening role of returns policy. In our setting, returns policy can be utilized to encourage the retailer to carry the full product line and mitigate the retailer’s incentive problems.

Channel coordination

Three coordination problems have been widely studied in the existing literature: “service externalities” (e.g., Lal, 1990), “input substitution” (e.g. Vernon and Graham, 1971), and “double marginalization” (e.g., Jeuland and Shugan, 1983). According to the definitions in Tirole (1988), “Service externalities” says that because the retailer and/or the manufacturer are not the full residual claimants of the channel margin, they provide less than optimal service for the channel. “Input substitution” is an effect that a monopolist retailer buying several inputs will substitute away from the inputs that are supplied through a monopolist.

“Double marginalization”, which is related to our paper, is an effect that the retail price is too high because of retail margins over manufacturer margins, resulting in the quantity sold on a single product being smaller. Previous research focuses on mechanism such as vertical integration, two-part tariffs, and quantity discounts (Jeuland and Shugan, 1983; Moorthy, 1987) for correcting this lack of channel coordination.

The results in this paper is related to Gerstner and Hess (1995), who suggest that targeted pull strategies can alleviate double marginalization and improve channel profits. In their model, the manufacturer offers discounts directly to price-conscious consumers, expecting them to ask the retailer for the product. The targeted pull discount induces the retailer to retain customers that are profitable for the entire channel. In our paper, by carrying two products and allowing returns for the low-end product at the same time, the manufacturer/retailer can extract more consumer surplus from high-willingness-to-pay consumers. This effect, in turn, encourages the retailer to have a targeting strategy consistent with the manufacturer’s intentions and be willing to carry the full product line.

Though offering a manufacturer rebate allows the manufacturer to bypass the retailer when reducing the heterogeneity in consumer valuations, as shown in Gerstner and Hess model, the manufacturer cannot influence the rebate decision by the retailer in any way. In contrast, in our paper the manufacturer can influence the retailer’s returns policy through its buyback price (together with its wholesale price, as shown in section 5), which in turn potentially makes the retailer’s threat of not serving the low segment less credible. As a consequence, the manufacturer can still improve channel coordination through its returns policy.

There is still some interesting analogy between some result in Gerstner and Hess (1991) and ours. For example, if a rebate is offered by the retailer, then the manufacturer can still obtain higher profits than those under pure push. It happens because a retailer is more willing to serve the low segment given that retailer rebates allows it to price discriminate consumers. The effect of a retail rebate on manufacturer profits is similar to that of a full returns policy at retail level on manufacturer profits. However, in Gerstner and Hess model, the retailer’s rebate policy is exogenously given, thus reducing the manufacturer’s power in capturing channel profits.

Product line design

There has been substantial research on product line design with a seller facing different consumer segments. In their setting, the seller designs the product line and prices in a way that different consumer segments choose different products (e.g., Mussa and Rosen, 1978; Oren et al., 1984; Moorthy, 1984; Villas-Boas, 1998; Chou and Jeng, 2002). Chou and Jeng (2002), for example, provide a model of the returns policy in a direct-marketing context
in which a manufacturer sells a line of products to several market segments with different preferences for quality. They find that in order to screen consumers better, the manufacturer may allow returns and stretch the product line as well. However, the context of that model does not allow for an analysis of the optimal design of the product line in a distribution model. We build on their results and furnish new understanding in the context of an uncoordinated channel.

Villas-Boas (1998) looks at the optimal product line design problem facing a manufacturer who sells products through a retailer. Assuming no quality uncertainties, he showed that a manufacturer taking into account the retailer’s rational response should increase quality differential within its product line. Our model differs from his in that we allow product failure to occur and firms to commit to returns policies. In doing so, we are able to address the interaction between the manufacturer’s optimal returns policy and quality choices (as probabilities that products work) for its product line.

THE MODEL

Consider a channel of distribution with a monopolistic manufacturer who sells two different products through a single, independent retailer to two consumer segments with different valuations for quality. The objective of this article is to identify the optimal returns policy and product line design for the manufacturer. Several key assumptions underlie the analysis, and we discuss these before presenting the model.

Assumption 1. Risk-neutral: Manufacturer, retailer, and consumers are risk neutral. This assumption allows us to focus on the problem of screening without the incorporation of risk-sharing considerations.

Assumption 2. Product quality: The two products (low-end product and high-end product) appear identical to consumers but are different in their likelihood of functioning. The product quality is \( q_j = 1 \) with probability \( \theta_j \), and \( q_j = 0 \) with probability \((1 - \theta_j)\), where \( \theta_j \) is the probability of product \( j \) works, \( j = 1, 2 \), and \( 0 \leq \theta_j \leq 1 \). We refer to the item with working probability of \( \alpha_j \) as the low-end product, and the item with working probability \( \alpha_k \) as the high-end product. We will identify these different functioning probabilities as being “different quality” throughout the paper. The manufacturer incurs a cost of \( C(\alpha_j) = c\alpha_j^2 \) for producing one unit of a product of quality \( \alpha_j \), where \( c > 0 \).

Assumption 3. Observable functioning probability (quality): The retailer and consumers observe the functioning probability of the product, but consumers can only make sure the true quality after consumption. In other words, returns policies do not signal unobservable quality.

Assumption 4. Consumer’s preference: There are two consumer segments with different valuations for product quality. We refer to the consumer segment that value quality less as the low segment \( \theta_1 \), and the consumer segment that value quality more as the high segment \( \theta_2 \), where \( \theta_j \) denotes consumers’ relative preferences for product quality, \( j = 1, 2 \), and \( \theta_1 < \theta_2 \). Consumers’ utility function is denoted as \( U_j = \theta_j q_j - p_j \), where \( \theta_j q_j \) is the gross utility. Each consumer considers buying at most one unit, and if he chooses not to purchase, he receives zero utility. The fraction of the market of the high segment and the low segment are \( \gamma \) and \((1 - \gamma)\), respectively.

Assumption 5. Consumer return costs: If a consumer would like to return the product, he must exert effort to return the product and can only go to the retailer to ask for a refund. This effort has a monetary equivalent called the return cost \( k_j \), \( j = 1, 2 \). Let \( k_1 \) and \( k_2 \) be the return costs of the low segment and the high segment, respectively, \( 0 < k_1 < k_2 \). That is, return costs are higher

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2 Assuming that functioning probability of a product is observable before purchase is a common in literature, see Matthews and Moore (1987), and Mann and Wissink (1990).

3 The linear utility function is common in literature, see Tirole (1988). As is typical, \( \partial(\theta q_j) / \partial \theta > 0 \) means that the utility is higher for a consumer with a higher relative preference for quality; \( \partial(\theta q_j) / \partial q_j > 0 \) means that the gross utility is higher with a product of higher quality. \( \partial(\theta q_j) / \partial \theta > 0 \) is the sorting condition, means that consumers with a higher relative preference for quality enjoy more an increase in the quality of a product. This characteristic of the utility function enables the derivation of explicit expressions for the prices and qualities in the seller’s menu.
Table 1  Components of the model

(Note: A tilde denotes a random variable, and superscripts and subscripts identify the channel member (R or M, for retailer or manufacturer, respectively), product, and consumer segment, and returns policy, as necessary.)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$i$</td>
<td>index for product; $i \in {1, 2}$ for “low end” and “high end”, respectively</td>
</tr>
<tr>
<td>$j$</td>
<td>index for consumer segment; $j \in {1, 2}$ for “low-valuation” and “high-valuation”, respectively</td>
</tr>
<tr>
<td>$g$</td>
<td>index for returns policy; $g \in {RB, R2, R1, N}$ for “accept returns on both products”, “accept returns on high-end product only”, “accept returns on low-end product only”, and “no return”, respectively</td>
</tr>
<tr>
<td>$\alpha_i$</td>
<td>probability of product $i$ works, with $0 \leq \alpha_i \leq 1$</td>
</tr>
<tr>
<td>$\bar{g}$</td>
<td>manufacturer’s unit production cost, with $c &gt; 0$</td>
</tr>
<tr>
<td>$\bar{s}$</td>
<td>salvage value per unit of the returned merchandise, $\begin{cases} s_H &amp; \text{(high) with probability } \alpha_i \ s_L &amp; \text{(low) with probability } (1-\alpha_i) \end{cases}$, with $s_H &gt; s_L \geq 0$</td>
</tr>
<tr>
<td>$\theta_j$</td>
<td>relative preference for product quality of consumer segment $j$, with $\theta_j &gt; 0$</td>
</tr>
<tr>
<td>$k_i$</td>
<td>return cost for consumer $j$</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>segment size of high-valuation consumers, $0 &lt; \gamma &lt; 1$</td>
</tr>
<tr>
<td>$w_i$</td>
<td>unit wholesale price charged by manufacturer for product $i$</td>
</tr>
<tr>
<td>$p_i$</td>
<td>unit retail price charged by retailer for product $i$</td>
</tr>
<tr>
<td>$w_i'$</td>
<td>unit refund price of product $i$ paid by retailer to consumer</td>
</tr>
<tr>
<td>$p_i'$</td>
<td>unit refund price of product $i$ paid by manufacturer to retailer</td>
</tr>
<tr>
<td>$\Pi_m$</td>
<td>manufacturer’s profit under returns policy $j$</td>
</tr>
</tbody>
</table>

for the high segment$^4$.

Assumption 6. Salvage value of the returned merchandise: The manufacturer receive a salvage value $\bar{s}$ from the returned merchandise, where $\bar{s} = s_H$ if the product works, $\bar{s} = s_L$ otherwise, $s_H > s_L \geq 0$. The returned merchandise is worthless to the retailer.

Basic constructs of the model are presented in Table 1. Throughout the paper, the following regularity condition is assumed to ensure that the interior solutions of quality levels are indeed optimal:

$$
\theta_j > \gamma (2 - \gamma) \theta_j + [\gamma (2 - \gamma) k_i - k_j] + 2c(1-\gamma)^2 \frac{k_i - k_j}{k_i - k_j + \theta_j - \theta_i}
$$

$^4$ This assumption follows from Gerstner and Hess (1991, 1995). Economic theory suggests that both willingness to pay and value of time are positively correlated with income. In addition, returning products to the seller often require significant processing time for consumers who have high income.

The sequence of actions is as follows. First, the manufacturer decides the product line design (the number of products in the line and the quality of each product), whether to buy back the returned merchandise from the retailer, and the wholesale prices for each of the products in the line. The retailer then considers the product line supplied by the manufacturer and the wholesale prices, and decides which products in the line it will carry, the retail price of each product, and whether he allows returns from the consumer and the associated refund prices if merchandise returns are allowed. Each consumer looks at the products carried by the retailer and the prices being asked, and chooses to buy one of the products or none. Finally, if the consumer buys and tries it, he then decides to keep it or return it for a refund when returns are allowed.
BENCHMARK

We develop a benchmark scenario in which the manufacturer sells two products to consumers directly. This benchmark helps us to understand the effect of the returns policy in a coordinated channel. We analyze two specific cases in this benchmark scenario: first, where merchandise returns are efficient (\( s_i \geq k_z \)), and second, where merchandise returns are inefficient (\( s_i \leq k_z \)). Inclusion of both cases allows us to isolate the manufacturer’s incentive to provide returns even in the absence of high salvage value. The optimal returns policy for the case \( k_z < s_i \leq k_1 \) can be inferred from the analysis of the former two cases.

If manufacturer sells two products to consumers directly, there are four returns strategies available to him:

1. **Accept returns on both products** (\( g=RB \)): Either the high-end product or the low-end product can be refunded if it fails to work.
2. **Accept returns on the high-end product only** (\( g=R2 \)): Only the high-end product can be refunded in case of product failure, while the low-end product cannot be refunded even if it fails to work.
3. **Accept returns on the low-end product only** (\( g=R1 \)): Only the low-end product can be refunded in case of product failure, while the high-end product cannot be refunded even if it is defective.
4. **No returns on either product** (\( g=N \)): Neither the high-end product nor the low-end product can be returned even if it is defective.

The complete equilibrium for each policy is obtainable by reverse induction, as detailed in the Appendix. We reach the following proposition, and the corresponding retail prices and quality levels for situations (a) and (b) in Proposition 1 are provided in Table 2.

**Proposition 1:** In a coordinated channel,

(a) If merchandise returns is efficient, i.e., \( s_i \geq k_z \), the manufacturer’s optimal returns policy is to accept returns on both products.
(b) If merchandise returns is inefficient on both items, i.e., \( s_i < k_1 < k_z \), the manufacturer’s optimal returns policy depends on the relative magnitude among \( r, k_z, k_1 \) and \( s_i \).
\[ k_z + (1-r)k_1 > k_1 \]
If \( k_z + (1-r)k_1 > k_1 \), the manufacturer should accept returns on the low-end product only. Otherwise, it should not allow returns on any product.
(c) If merchandise returns is efficient on the low-end product only, i.e., \( k_z \leq s_i < k_1 \), then only the low-end product is allowed to return.

Proposition 1 states that the returns policy for the item targeted at the high segment follows the efficiency rule, that is, allowing returns on the high-end item if and only if \( s_i \geq k_z \). This result has the same spirit as the standard result in the literature that the quality level for the product targeted at the high segment is always efficient. We state it as a corollary in the following.

**COROLLARY 1:** In a coordinated channel, the optimal returns policy for the high-end item follows the efficiency rule; that is, allowing returns if and only if \( s_i \geq k_z \).

A number of important insights are obtained in the context of direct channel. First, if the manufacturer accepts returns, both the salvage value and consumers’ return costs have impacts on manufacturer’s profits, but refund price does not. By checking the manufacturer’s optimal profit in the Table 2, we find that if the manufacturer accepts returns on the product intended for segment \( j \), the cost incurred for the manufacturer is essentially equal to \( k_j \) (together with the benefit \( s_j \)), no matter what refund price \( p'_i \) is set. A higher refund price is always accompanied by a higher retail price. A monopolistic manufacturer can extract all transaction gains resulting from its returns policy. Consequently, the magnitude of target consumers’ return cost reduces the efficiency gain the manufacturer can extract from allowing returns.

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5. From social welfare point of view, if the salvage value of the returned merchandise exceeds the consumer’s returned costs, that is, the seller is able to deal with the returned good better than the customer, then the returns are economically efficient. Otherwise, the returns are economically inefficient. Hess et al. (1996) make the similar assumption.
6. If the manufacturer sets the refund price \( p'_i \) such that a consumer will still get a refund for the purchased product even when it works, the refunded price must satisfy \( p'_i > \theta _i + k_j \), which the manufacturer cannot accept.
Table 2  Equilibrium in the coordinated channel

<table>
<thead>
<tr>
<th>Variable</th>
<th>Merchandise returns are efficient ($s_i \geq k_z$)</th>
<th>Merchandise returns are inefficient ($s_i &lt; k_i$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>manufacturer’s returns policy: $g$</td>
<td>Any product can be returned ($g=RB$)</td>
<td>Only the low-end product can be returned ($g=RI$)</td>
</tr>
<tr>
<td>$k_1 \leq p_i' \leq \theta_1 + k_1$</td>
<td>$k_1 \leq p_i' \leq \theta_1 + k_1$</td>
<td>$k_1 \leq p_i' \leq \theta_1 + k_1$</td>
</tr>
<tr>
<td>$k_2 \leq P_i' \leq \theta_2 + k_2$</td>
<td>$k_2 \leq P_i' \leq \theta_2 + k_2$</td>
<td>$k_2 \leq P_i' \leq \theta_2 + k_2$</td>
</tr>
</tbody>
</table>

quality level of the low-end product: $\alpha_1$

\[
\frac{\theta - \gamma \theta - (s - k)}{2c} = \frac{\theta - \gamma \theta + \gamma k}{2c(1 - \gamma)}
\]

quality level of the high-end product: $\alpha_2$

\[
\frac{\theta - (s - k)}{2c} = \frac{\theta}{2c}
\]

retail price of the low-end product: $p_1$

\[
\alpha_1 \theta_1 + (1 - \alpha_1)(P_i' - k_i)
\]

retail price of the high-end product: $p_2$

\[
\alpha_2 \theta_2 - \alpha_1(\theta_2 - \theta_1) + \frac{1}{2} \alpha_2 \theta
\]

manufacturer’s optimal profit: $\Pi_m$

\[
(1 - \gamma)[\alpha_1 \theta_1 + (1 - \alpha_1)(s_i - k_i)] + (1 - \gamma)[\alpha_1 \theta_1 - \gamma \alpha_1 \theta_2 - \alpha_1(\theta_2 - \theta_1)]
\]

Second, if manufacturer accepts returns on the low-end product, the manufacturer is able to raise the retail price of the high-end product by $(1 - \alpha_1)(k_2 - k_i)$ as it accepts returns on the low-end product. The result is driven by the following intuition. The high segment would incur a transaction cost $k_2$ if he returned a product. If what he buys is the high-end product, his higher transaction costs $k_2$ will be reflected in the price charged by the manufacturer, while if what he buys is the low-end product, essentially he would only be compensated by $k_1$. Therefore, the high segment would suffer an expected loss from returns $(1 - \alpha_1)(k_2 - k_i)$ if he chooses to buy the low-end product in the first place. To avoid the possible loss caused by returns, the high segment will have more incentives to buy the high-end product when he makes his purchase decision.

As a result, using the returns policy as a screening tool, the manufacturer is able to extract extra consumer surplus $(1 - \alpha_1)(k_2 - k_i)$ from the high segment. The cannibalization problem of the product line is alleviated as the manufacturer allows returns on the low-end product. In contrast, the optimal returns policy for the high-end product is totally governed by the efficiency of returns: allowing returns if and only if the salvage value of the high-end product is greater than the returning cost of its target market.

Third, the higher the return costs or the higher the proportion of the high segment, the lower the quality of the low-end product manufacturer will choose ($\alpha_1$ decreases). The manufacturer, by increasing the differences in quality between the different products, is intensifying the screening effects provided by the returns policy, and therefore the cannibalization problem faced by the manufacturer is alleviated.
Finally, the manufacturer’s optimal returns policy depends on the salvage value of the returned good, the percentage of the high segment, and the consumers’ return costs. In the case of efficient returns on both items, the manufacturer definitely allows both products to be returned, because accepting returns on the low-end product makes it possible to extract more consumer surplus from the high segment by \( \gamma(1-\alpha)(k_i-k_j) \). While in the case where merchandise returns is inefficient on both items (i.e., \( s_i < k_j \)), the manufacturer would incur expected costs \((1-\gamma)(1-\alpha)(k_i-s_i)\) if it accepts returns on the low-end product.

The advantage generated by the returns policy must be weighed against the disadvantage generated from allowing returns. We find that if the weighted average of the return cost of the high segment and the salvage value of the returned merchandise is higher than the return cost of the low segment (i.e., \( \gamma(k_j+(1-\gamma)s_i) > k_i \))\(^7\), then accepting returns on the low-end item is optimal for the manufacturer despite the merchandise returns is inefficient. We will use this condition to derive a retailer’s optimal returns policy in an uncoordinated channel in the next section.

THE UNCOORDINATED CHANNEL

In the uncoordinated channel, the retailer aims to maximize its own profits from its products carried, and therefore may adopt a targeting strategy that is inconsistent with the manufacturer’s intention. The independent retailer in our model can choose to carry two products or one product only (the high-end or the low-end product); in case it carries only one product, it chooses to target the product to the high segment or to both segments\(^8\). The manufacturer’s task is to induce the retailer to carry the full line of products and to target them to different segments by carefully choosing its wholesale prices, returns policy, and product qualities.

Corollary 1 in the previous section states that in a direct channel, the seller’s optimal returns policy for the high-end product follows the efficiency rule. In contrast, for the low-end item, due to the strategic screening effect, the seller tends to allow more returns than suggested by the efficiency rule. To further analyze the impact of returns policy on channel coordination, we shall first consider the case where \( \gamma k_j < k_i \). As will be seen, the optimal returns policy in all other cases can be inferred after this particular case has been analyzed. Besides, from now on we will assume the manufacturer has two options on each product, namely full returns or no returns\(^9\).

Retailer’s optimal returns policy

We first characterize the retailer’s optimal returns policy by using the results derived in the last section for the coordinated channel. The retailer in the uncoordinated channel faces the exactly same problem as the manufacturer does in a coordinated channel except that the salvage value of the returned product \( i \) depends on the manufacturer’s returns policy. Thus, as shown in the previous section, whether the retailer allows returns depends on \((1-\alpha)(\gamma k_j+(1-\gamma)s_i)\)\(^10\), which is the net

\(^7\) The trade-off depends on \( \gamma(1-\alpha)(k_i-k_j)+(1-\gamma)(1-\alpha)(k_i-k_j) \). Note that if \( s_i = 0 \), the above condition equals \( \gamma k_j - k_i \), which is the tightest condition for allowing inefficient returns on the low-end product to be profitable.

\(^8\) The retailer has five possible targeting strategies: (1) carrying both products targeted to different segments; (2) carrying only the low-end product sold to both segments; (3) carrying only the low-end product sold to the high segment; (4) carrying only the high-end product sold to both segments; (5) carrying only the high-end product sold to the high segment.

\(^9\) Under a full returns policy, the manufacturer will give the retailer a full refund of the wholesale price for the product, that is, \( w_f = w_i \). The alternative is no returns, in which case the retailer must bear the cost of returns when product returns is allowed, that is, \( w_f^J = 0 \). We know from section 3 that if a seller accepts returns from consumers in segment \( j \) when the product does not work, essentially it incurs a cost the same as the cost of returns for segment \( f \), i.e., \( k_j \). By the same token, in an uncoordinated channel when the manufacturer buys back the product from the retailer, the cost it incurs also equals \( k_j \), the cost of returns for the retailer. That is, the manufacturer’s buyback price is used to compensate the retailer’s cost of allowing returns, which is exactly the final consumer’s returns cost. As the higher \( w_f^J \) is always accompanied by higher wholesale price \( w_i \), the exact level of \( w_f^J \) (within its feasible range) does not influence the manufacturer’s profits and provides no more insight.

\(^10\) We know from previous section that the seller in a
benefit of the retailer for providing returns to consumers. If the manufacturer does not allow returns, the salvage value of the returned merchandise for the retailer equals zero. We summarize the retailer’s optimal returns policy in the following lemma.

**Lemma 1:** When the retailer carries only one product, he will allow returns on the product if and only if the buyback price (which equals zero if no returns is allowed) offered by the manufacturer is greater than the cost of returns for the segment which the product is targeted at; when the retailer carries both products, then he will allow returns on the low-end item if and only if $\gamma k_2 + (1-\gamma)w_1 > k_1$ and on the high-end item if and only if $w_2 > k_2$.

The retailer’s optimal returns policy for any particular product thus depends on two things: how many products it carries and the manufacturer’s returns policy. Since the returned merchandise is worthless for the retailer, merchandise returns is efficient for the retailer only if the manufacturer provides full returns for that product. In fact, if the manufacturer offers full returns on any item, the retailer will allow full returns as well under our regularity condition (we shall verify this claim later). Thus given the manufacturer’s returns policies (full returns or no returns), the retailer’s returns policy can be described in the following lemma.

**Lemma 2:** If the manufacturer offers full returns on any of its products, then the retailer will follow the same returns policy. If the manufacturer allows no returns on its high-end item, then the retailer will offer no returns as well. However, if the manufacturer allows no returns on the low-end item, the retailer will allow returns on it if and only if the retailer carries both products, and $\gamma k_2 \geq k_1$.

The immediate consequence of Lemma 2 is that the coordinated channel accepts low-end product returns if $\gamma k_2 + (1-\gamma)s_2 > k_1$. For the retailer in the distribution channel, the condition turns to be $\gamma k_2 + (1-\gamma)w_1' > k_1$, where $w_1' = w_1$ (if the manufacturer allows full returns) or $w_1' = 0$ (if the manufacturer allows no return).

Retailer would allow returns on any product for which the manufacturer offers full returns. On the other hand, even if the manufacturer allows no returns on the low-end product, the retailer allows returns on the low-end product if and only if it carries both products and $\gamma k_2 \geq k_1$. The reason is the same as discussed in the section 4: if $\gamma k_2 \geq k_1$, allowing returns on the low-end product can help the retailer screen consumers so well that it pays for the retailer to offer full returns even if the salvage value of the returned merchandise is zero. In all other cases, since accepting returns cannot generate screening effects large enough (or at all), and also the returned merchandise is worthless to the retailer, the retailer would not allow returns unless the manufacturer promises to buy the returned merchandise back.

**Manufacturer’s optimal returns policy**

We now proceed to analyze the manufacturer’s returns policies given its anticipation of how its returns policies affect the retailer’s decision. In following, we shall focus on the case $\gamma k_2 < k_1$ unless noticed to highlight the strategic role of the manufacturer’s returns policy in an uncoordinated channel and consider the case of $\gamma k_2 \geq k_1$ in Appendix. For insight we consider the case where the manufacturer offers full returns only on the low-end product and then show how the retailer’s incentive problems are alleviated through the manufacturer’s full returns policy on the low-end product. It turns out that the equilibrium condition for the illustrated case holds generally. Proposition 2 reports a manufacturer’s optimal returns policy in an uncoordinated channel. The equilibrium returns policies associated with different regions of $(k_1,k_2)$ are drawn in Figure 1. The proof of proposition 2 (a) and (b) are detailed in the appendix.

**Proposition 2:** In an uncoordinated channel, the manufacturer’s optimal returns policy is as follows:

(a) for the high-end product, the manufacturer provides full returns to the retailer if and only if $s_2 \geq k_2$;

(b) for the low-end item, the manufacturer provides full returns to the retailer if and only if $k_1 \leq (1-\gamma)^2 s_2 + \gamma(2-\gamma)k_2$.
The manufacturer’s optimal returns policies under different parameter conditions, and the corresponding quality levels, retail prices, retailer profits, and wholesale prices are reported in Table 3. The derivation of Table 3 is discussed in Appendix.

One important message sent from the above proposition is that offering full returns to the retailer on the low-end product may alleviate the latter’s incentive problems so well that it pays for the manufacturer to accept returns in an uncoordinated channel even if it involves an efficiency loss (i.e., $k_1 s_L < k_2$).

Moreover, it is true even when doing so is not optimal in a coordinated channel (i.e., when $(1-\gamma)^2 s_L + \gamma(2-\gamma) k_2 \geq k_1 \geq (1-\gamma)s_L + \gamma k_2$). In contrast, the manufacturer’s returns policy and hence the retailer’s returns policy on the high-end product does not play any strategic role in the uncoordinated channel. Note also that the results reported in proposition 2 do not depend on the quality levels chosen by the manufacturer. In other words, given any quality levels, the optimal returns policy would be as described in proposition 2.

The result that allowing returns on the low-end product serves to alleviate the retailer’s incentive problem is driven by the following intuition. As the retailer accepts returns on the low-end product, this returns policy reduces the difference in willingness-to-pay between the two segments, and as a result the retailer faces two more similar consumer segments. The retailer therefore has more incentives to target different products to consumers rather than sell the high-end product to the high segment only. For this reason, the wholesale price for the low-end product can be raised, which in turn increases the wholesale price charged to the high-end product. How can returns policy do the trick?

If no return is allowed, the difference in consumer’s willingness-to-pay for the low-end product is $\alpha_i (\theta_2 - \theta_1)$. If the low-end product can be returned, the low segment’s willingness-to-pay is increased to $\alpha_i \theta_1 + (1- \alpha_i) (p'_L - k_1)$. On the other hand, the high segment’s willingness-to-pay turns to be $\alpha_i \theta_1 + (1- \alpha_i) (p'_L - k_1)$. As a result of the returns policy, the difference in willingness-to-pay is reduced to $\alpha_i (\theta_2 - \theta_1) - (1- \alpha_i) (k_2 - k_1)$, and the consumers become more similar. The higher the transaction cost differential, the lower is the willingness-to-pay differential. Hence, the more incentives the retailer would have to target two different products to different consumers. For

![Figure 1 The equilibrium returns policy](image)

1: $(R, N)^u$: allowing returns on the low-end item and no returns on the high-end item in an uncoordinated channel
2: $(N, N)^C$: allowing no returns on both items in a coordinated channel
Table 3  Equilibrium in the uncoordinated channel

| Manufacturer’s returns policy: $g$ | Both products can be returned ($g=RB$) | Only the low-end product can be returned ($g=RI$) | Neither product can be returned ($g=N$) |
|-----------------------------------|----------------------------------------|---------------------------------|--------------------------------|-----------------|
| **Equilibrium Conditions**        | $k_i \leq \gamma (2-\gamma)k_2 + (1-\gamma)^2 s_i$;  $k_i \geq s_i,$ | $k_i \leq \gamma (2-\gamma)k_2 + (1-\gamma)^2 s_i$;  $k_i \geq s_i,$ | $k_i \geq \gamma (2-\gamma)k_2 + (1-\gamma)^2 s_i$;  $k_i \geq s_i,$ |
| **The quality level of the low-end product: $\alpha_1$** | $\theta_1 - \gamma (2-\gamma)\theta_2 + \frac{1}{(1-\gamma)^2} \frac{1}{2c} k_i - \frac{\gamma}{1-\gamma} \frac{1}{(1-\gamma)^2} k_i$ | $\theta_1 - \gamma (2-\gamma)\theta_2 + \frac{1}{(1-\gamma)^2} \frac{1}{2c} k_i - \frac{\gamma}{1-\gamma} \frac{1}{(1-\gamma)^2} k_i$ | $\theta_1 - \gamma (2-\gamma)\theta_2 + \frac{1}{(1-\gamma)^2} \frac{1}{2c} k_i$ |
| **The quality level of the high-end product: $\alpha_2$** | $\theta_1 + \frac{1}{\alpha_1}(s_i - k_i)$ | $\theta_1 + \frac{1}{\alpha_1}(s_i - k_i)$ | $\theta_1 + \frac{1}{\alpha_1}(s_i - k_i)$ |
| **The wholesale price of the low-end product: $w_1$** | $\alpha_1 \theta_1 - \frac{1}{1-\gamma} \alpha_1 (\theta_2 - \theta_1)$ | $\alpha_1 \theta_1 - \frac{1}{1-\gamma} \alpha_1 (\theta_2 - \theta_1)$ | $\alpha_1 \theta_1 - \frac{1}{1-\gamma} \alpha_1 (\theta_2 - \theta_1)$ |
| **The wholesale price of the high-end product: $w_2$** | $\alpha_1 \theta_1 + \frac{1}{\alpha_1}(s_i - k_i)$ | $\alpha_1 \theta_1 + \frac{1}{\alpha_1}(s_i - k_i)$ | $\alpha_1 \theta_1 + \frac{1}{\alpha_1}(s_i - k_i)$ |
| **The retail price of the low-end product: $p_1^*$** | $\alpha_1 \theta_1 + (1-\alpha_1)(p'_1 - k_i)$ | $\alpha_1 \theta_1 + (1-\alpha_1)(p'_1 - k_i)$ | $\alpha_1 \theta_1 + (1-\alpha_1)(p'_1 - k_i)$ |
| **The retail price of the high-end product: $p_2^*$** | $\alpha_1 \theta_1 + (1-\alpha_1)(p'_1 - k_i)$ | $\alpha_1 \theta_1 + (1-\alpha_1)(p'_1 - k_i)$ | $\alpha_1 \theta_1 + (1-\alpha_1)(p'_1 - k_i)$ |
| **The retailer’s profits: $\Pi_k^*$** | $\gamma (1-\gamma)\theta_2 (\theta_2 - \theta_1)$ | $\gamma (1-\gamma)\theta_2 (\theta_2 - \theta_1)$ | $\gamma (1-\gamma)\theta_2 (\theta_2 - \theta_1)$ |
| **The manufacturer’s profit: $\Pi_m^*$** | $(1-\gamma)(w_i + (1-\alpha_1)s_i - w_i) - \alpha_1^2$ | $(1-\gamma)(w_i + (1-\alpha_1)s_i - w_i) - \alpha_1^2$ | $(1-\gamma)(w_i - c\alpha_1^2)$ |

this reason, the wholesale price for the low-end product can be raised. Furthermore, to prevent the retailer from carrying just the low-end product and targeting it to both segments, the wholesale price for the high-end product cannot be too high compared with that for the low-end product. The increase in the wholesale price for the low-end product raises the wholesale price that can be charged to the high-end product.

Another way of seeing this problem is that this returns policy decreases the opportunity cost of retailer’s targeting.

When the retailer targets different products on consumers, and at the same time accepts returns on the low-end product, it can get an extra profit $\gamma (1-\gamma)\theta_2 (\theta_2 - \theta_1)$ from the high segment. This means that the opportunity costs of carrying just one product (no targeting) get much higher as a result of this returns policy.

As for the quality levels of products, two
comparisons can be made at this point. First, how does the presence of the independent retailer influence the manufacturer’s optimal product line design, given the same equilibrium returns policy? From Table 3, we find that consistent with previous literature (Villas-Boas, 1998), with an independent retailer, the manufacturer increases the differences in the products being supplied, and the higher the transaction cost differential, \((k_z - k_i)\), the larger is the quality differential. The manufacturer, by increasing the differences between different products, is intensifying the screening effects provided by the returns policy, and thus increasing the opportunity costs of the retailer if it did not target.

Second, how does the provision of full returns policy influence the optimal product line design and how does this impact of returns policy vary with different channel structures (i.e., the coordinated channel and the uncoordinated channel)? From Table 3, we find that the effect that allowing returns on the low-end product has on the retailer’s profits increases with the probability that the low-end product works. It happens because the higher the probability that the low-end item works, the weaker the screening effect that can be generated through consumers’ differential costs of returning products, which in turn makes it harder to induce the retailer to carry both products. We state the above results in the following lemma and prove it in Appendix.

**Lemma 3:** When the manufacturer offers full returns on the low-end item to the retailer, it will choose a lower quality level than in the absence of full returns for the low-end product; furthermore, the magnitude of this quality reduction associated with full returns is larger in the uncoordinated channel than in the coordinated channel. The differential in the magnitude of quality reduction under different channel structures increases with the transaction cost differential, \((k_z - k_i)\).

Note that the higher the return cost differential, the higher potential does the full returns policy has to alleviate the retailer’s incentive problems. As a result, the manufacturer in an uncoordinated channel tends to reduce the quality level of the low-end product by a larger amount than that in a coordinated channel when \((k_z - k_i)\) is large.

**The impact of returns policy on channel coordination**

Having characterized the manufacturer’s optimal returns policy in an uncoordinated channel, we further explore how the returns policy at the manufacturer level influences the channel profits. Proposition 2 states that the returns policy of the high-end item in an uncoordinated channel still follows the efficiency rule, i.e., adopting full returns if and only if its salvage value is larger than the transaction cost of the segment the product is targeted at. However, for the low-end item, the manufacturer may adopt full returns even if it is not optimal to do so in a coordinated channel (see Figure 1 for the inconsistency in the returns policy on the low-end product under the two channel structures). It happens because through allowing returns on the low-end item, the manufacturer can alleviate the retailer’s incentive problem, thus allowing the former to extract more rent from the latter; when this effect is large enough, the manufacturer will adopt full returns even if doing so reduces the total channel profits. We summarize it in the following proposition.

**Proposition 3:** When \((1 - \gamma)^2 s_L + \gamma(2 - \gamma)k_z \geq k_i \geq (1 - \gamma)s_L + \gamma k_z\), the manufacturer will offer full returns on the low-end item in an uncoordinated channel even if doing so reduces total channel profits.

**CONCLUDING REMARKS**

We recommend that manufacturers consider returns policy as a coordination tool in an independent channel. Previous research has shown that returns policy reduces consumers’ uncertainty, signals products’ information, and mitigates retailers’ risk (Padmanbhan and Png, 1995). In contrast, our research highlights a dimension of returns policy not studied before.

We show that full returns at the retail level on the low-end product discourages the high-valuation
consumers from buying the low-end product, thus achieving better screening and giving the retailer more incentive to carry the full product line. To intensify this effect of retailer cooperation, the manufacturer should reduce the quality of the low-end product, and as a result the quality difference in the product line increases.

Our result may seem somewhat ironic: at first glance, it would seem that if the manufacturer accepts returns on the low-end product, the quality of it should be adjusted upward, or else the returns policy will add too many costs to the manufacturer. Only by considering the subtle strategic effects is it possible to see how returns policies and the lower quality of the low-end product work together to the manufacturer’s advantage. We show that the manufacturer will accept returns on the low-end product when the percentage of the high segment or the return cost of the high segment is high enough, even though the merchandise returns may be economically inefficient.

By inducing the retailer to offer full returns, the manufacturer alleviates the retailer’s incentive problem and thus obtains more of channel profits for itself. Therefore, it may happen that the manufacturer optimally allows returns on the low-end product in an uncoordinated channel even if it reduces total channel profits. In other words, the manufacturer is more likely to accept returns in an uncoordinated channel than in a coordinated channel. When there is discrepancy in the returns policies under the two channel structures, the manufacturer’s full returns policy in an uncoordinated channel increases manufacturer profits at the retailer’s and the channel’s expense.

There are many interesting opportunities for future research in this area. In order to focus on screening and targeting issues, we assumed that all parties were risk-neutral. It would be worthwhile to explore the trade-off between targeting and insurance for the returns policies. Our model assumes that consumers do not make purchase repeatedly. Ideally, in the repeated games, returns policy may strengthen the motivation of the manufacturer to offer a returns policy. Consideration of this issue and the corresponding product line design would add further richness to the model. The present analysis concentrates on the role of returns policies on single manufacturer-retailer interaction. Combining this with a model of competitive environment would add completeness to our understanding of returns policies. Finally, Padmanbhan and Png (1995) note that manufacturers may safeguard the brand by instituting a returns policy in order to discourage retailers from selling stale good. Focusing on brand image or customer relationship management with respect to returns policies would be a worthwhile project for future research decision.

**Appendix**

**DERIVATION OF Table 2**

Denote \( \Pi_{m}^{n}, \Pi_{m}^{2}, \Pi_{m}^{1}, \Pi_{n}^{m} \) as the manufacturer’s profits under strategy “RB” (Accept returns on both products), strategy “R2” (Accept returns on the high-end product only), strategy “R1” (Accept returns on the low-end product only), and strategy “N” (No returns on either product), respectively.

(1) If the manufacturer adopts strategy “RB”, it aims to maximize its profits subject to the following constraints:

\[
\max \Pi_m = (1 - \gamma)(p_1 - \alpha x_1 + (1 - \alpha) x_1 - p_1^f) + \gamma(p_2 - \alpha x_2 + (1 - \alpha) x_2 - p_2^f)
\]

\( \text{s.t.} \)

\( p_1 \leq p_1^f \) \( \theta_1 \) \( \alpha \theta_1 + (1 - \alpha)(p_1^f - k_1) \) \( \text{(A2)} \)

\( p_2 \leq p_2^f \) \( \theta_2 \) \( \alpha \theta_2 + (1 - \alpha)(p_2^f - k_2) \) \( \text{(A3)} \)

\( \alpha \theta_1 + (1 - \alpha)(p_1^f - k_1) - p_1 \geq \alpha \theta_1 + (1 - \alpha)(p_1^f - k_1) - p_1 \) \( \text{(A4)} \)

\( \alpha \theta_2 + (1 - \alpha)(p_2^f - k_2) - p_2 \geq \alpha \theta_2 + (1 - \alpha)(p_2^f - k_2) - p_2 \) \( \text{(A5)} \)

\( 0 \leq p_1^f - k_1 \leq \theta_1 \) \( \text{(A6)} \)

\( 0 \leq p_2^f - k_2 \leq \theta_2 \) \( \text{(A7)} \)

Equation (A1) is manufacturer’s profit function. Equation (A2) and (A3) are the individual rationality constraints for both segments. Equation (A4) and (A5) are the incentive compatibility constraints to ensure that the customer in each segment prefers the product targeted to that segment. Equation (A6) and (A7) ensure that the consumers would return the product only if the product fails. From the existing literature (e.g., Moorthy 1984), we know that the binding constraints are equations (A2) and
(A5), which yield the retail prices as follows:

\[ p_1 = \alpha_1\theta_1 + (1 - \alpha_1)p'_1 - k_1 \]  
\[ p_2 = \alpha_2\theta_2 - \alpha_2(\theta_2 - \theta_1) + (1 - \alpha_2)(p'_2 - k_2) \]  
\[ \alpha_1 = \frac{\theta_1 - \gamma\theta_2 - (s_2 - k_2) + \gamma(s_1 - k_1)}{2c(1 - \gamma)}, \quad \alpha_2 = \frac{\theta_2}{2c}. \]  

4) If the manufacturer adopts strategy “N”, it aims to maximize its profits subject to the following constraints:

\[ \alpha = \frac{\theta_1 - \gamma\theta_2 - (s_2 - k_2) + \gamma(s_1 - k_1)}{2c(1 - \gamma)}, \quad \alpha = \frac{\theta_2}{2c}. \]

(2) If the manufacturer adopts strategy “R2”, it aims to maximize its profits subject to the following constraints:

\[ \text{Max } \Pi^R_{12} = (1 - \gamma)(p_1 - c\alpha_1^2) + \gamma(p_2 - c\alpha_2^2) \] 
\[ \text{s.t.} \]

\[ p_1 \leq \alpha_1\theta_1 \]
\[ p_2 \leq \alpha_2\theta_2 + (1 - \alpha_2)(p'_2 - k_2) \]
\[ \alpha_1\theta_1 - p_1 \geq \alpha_1\theta_1 + (1 - \alpha_1)(p'_1 - k_1) - p_2 \]
\[ \alpha_2\theta_2 + (1 - \alpha_2)(p'_2 - k_2) - p_2 \geq \alpha_1\theta_1 - p_1 \]
\[ 0 \leq p'_2 - k_2 \leq \theta_2 \]

Similar to the derivations of equation (A8) and (A9), we derive the retail prices and quality levels for the two products as follows:

\[ p_1 = \alpha_1\theta_1 + (1 - \alpha_1)(p'_1 - k_1) \]
\[ p_2 = \alpha_2\theta_2 - \alpha_2(\theta_2 - \theta_1) + (1 - \alpha_2)(p'_2 - k_2) \]
\[ \alpha_1 = \frac{\theta_1 - \gamma\theta_2 - (s_2 - k_2) + \gamma(s_1 - k_1)}{2c(1 - \gamma)}, \quad \alpha_2 = \frac{\theta_2}{2c}. \]  

(3) If the manufacturer adopts strategy “R1”, it aims to maximize its profits subject to the following constraints:

\[ \text{Max } \Pi^R_{1} = (1 - \gamma)(p_1 + (1 - \alpha_1)(s_1 - p'_1) - c\alpha_1^2) + \gamma(p_2 - c\alpha_2^2) \] 
\[ \text{s.t.} \]

\[ p_1 \leq \alpha_1\theta_1 + (1 - \alpha_1)(p'_1 - k_1) \]
\[ p_2 \leq \alpha_2\theta_2 \]
\[ \alpha_1\theta_1 + (1 - \alpha_1)(p'_1 - k_1) - p_1 \geq \alpha_1\theta_1 - p_2 \]
\[ \alpha_2\theta_2 + (1 - \alpha_2)(p'_2 - k_2) - p_2 \geq \alpha_1\theta_1 - p_1 \]
\[ 0 \leq p'_1 - k_1 \leq \theta_1 \]

Solving this problem, we can get the retail prices and quality levels for the two products as follows:

\[ p_1 = \alpha_1\theta_1 + (1 - \alpha_1)(p'_1 - k_1) \]
\[ p_2 = \alpha_2\theta_2 - \alpha_2(\theta_2 - \theta_1) + (1 - \alpha_2)(s_2 - p'_2) \]
\[ \alpha_1 = \frac{\theta_1 - \gamma\theta_2 - (s_2 - k_2) + \gamma(s_1 - k_1)}{2c(1 - \gamma)}, \quad \alpha_2 = \frac{\theta_2}{2c}. \]

Comparing the profits under four returns policies, we find that when \( s_2 \geq k_2 \), strategy “RB” yields the greatest profits. When \( s_2 = 0 \) and \( k_2 \leq k_1 \), strategy “R1” yields the greatest profits, while if \( s_2 = 0 \) and \( k_2 < k_1 \), strategy “N” yields the greatest profits.

PROOF OF Proposition 2(b):

Consider the case where (1) \( k_1 < k_2 \), and (2) the manufacturer allows returns only on the low-end item. The manufacturer’s problem is to choose its wholesale prices and design its product line to maximize its profits:

\[ \text{Max } \Pi^R_{1} = (1 - \gamma)(w_2 + (1 - \alpha_1)(s_1 - w_1) - c\alpha_1^2) + \gamma(w_2 - c\alpha_2^2) \]

subject to the retailer’s two incentive compatibility constraints (derived below and shown in equation (A11) and (A12), which guarantees that the retailer prefers carrying both products to carrying just the low-end product, and the retailer prefers carrying both products to carrying just the high-end product, respectively.) It can be shown that the other two constraints, i.e., carrying both products is preferred to carrying just the low-end product targeted to the high segment, and to carrying just the high-end product targeted to both segments, are implied by equation (A11) and (A12).

(1) If the retailer carries both products, it maximizes its profits 

\[ (1 - \gamma)(w_1 + (1 - \alpha_1)(w_1 - p'_1) + \gamma(p_2 - w_2)] \] 

by charging 

\[ p_1 = \alpha_1\theta_1 + (1 - \alpha_1)(p'_1 - k_1) \] 

and 

\[ p_2 = \alpha_2\theta_2 - \alpha_2(\theta_2 - \theta_1) + (1 - \alpha_2)(k_2 - k_1) \].
Retailer’s profit is maximized and turns to be
\[ (1-\gamma)(a\theta_1 + (1-\alpha_1)(w_1 - k_1) - w_1) + [a\theta_2 - \alpha_1(\theta_1 - \theta_1) + (1-\alpha_1)(k_2 - k_1) - w_1] \]

(2) If the retailer carries only the low-end product and sells it to both segments, the highest profit it can get equals \( \alpha_1\theta_1 + (1-\alpha_1)(w_1 - k_1) - w_1 \) by setting \( p_1 = \alpha_1\theta_1 + (1-\alpha_1)(p_1' - k_1) \). The condition that the retailer prefers to carry both products to carrying just the low-end product (targeted to both segments) can be written as
\[ w_1 - w_1 \leq (\alpha_2 - \alpha_1)\theta_1 + (1-\alpha_1)(k_2 - w_1). \]  

(A11)

(3) If the retailer decides to carry only the high-end product and targets it only to the high segment, it can get a profit equal to \( \gamma(\alpha_2\theta_2 - w_2) \) by setting \( p_2 = \alpha_2\theta_2 \). The condition that the retailer prefers to carry both products to carrying just the high-end product (targeted to the high segment) can then be written as
\[ w_2 - w_1 \leq (\alpha_2 - \alpha_1)\theta_2 + (1-\alpha_1)(k_2 - w_1). \]  

(A12)

It can be easily seen that the two constraints (A11) and (A12) are binding and yield the optimal wholesale prices as follows.
\[ w_1 = \alpha_1\theta_1 + (1-\alpha_1)(w_1 - k_1) - \frac{\gamma}{1-\gamma} [\alpha_1(\theta_1 - \theta_1) - (1-\alpha_1)(k_2 - k_1)] \]  

(A13)
\[ w_2 = \alpha_2\theta_2 - \frac{1}{1-\gamma} [\alpha_1(\theta_2 - \theta_1) - (1-\alpha_1)(k_2 - k_1)] \]  

(A14)

Thus, from equation (A10), (A13) and (A14), the manufacturer’s profit of accepting returns on the low-end item given \( (\alpha_1, \alpha_2) \) is
\[ \Gamma_m^n = (1-\gamma)((a\theta_1 + (1-\alpha_1)(s_1 - k_1) - s_1) + \frac{\gamma}{1-\gamma}[\alpha_1(\theta_1 - \theta_1) - (1-\alpha_1)(k_2 - k_1)] \]
\[ + [a\theta_2 - \alpha_1(\theta_1 - \theta_1) + (1-\alpha_1)(k_2 - k_1) - s_2 + \frac{1}{1-\gamma} [\alpha_1(\theta_2 - \theta_1) - (1-\alpha_1)(k_2 - k_1)] - ca_2^2)] \]  

(A15)

Instead of solving the optimal quality levels associated with this specific returns policy at this stage, we explore what the profit impact is if the manufacturer allows no returns on both products, given the same quality levels in the product line. Similar to the derivations of equation (A11) and (A12), we derive the two incentive compatibility constraints facing the manufacturer as follows:
\[ w_2 - w_1 \leq (\alpha_2 - \alpha_1)\theta_2 \]  

(A16)
\[ w_1 \leq \alpha_1\theta_1 - \frac{\gamma}{1-\gamma}(\theta_1 - \theta_1) \]  

(A17)

It can be easily shown that these two constraints are binding, which yields the optimal wholesale prices:
\[ w_1 = \alpha_1\theta_1 - \frac{\gamma}{1-\gamma}(\theta_1 - \theta_1) \]  

(A18)
\[ w_2 = \alpha_2\theta_2 - \frac{1}{1-\gamma} (\theta_2 - \theta_1) \alpha_1 \]  

(A19)

Thus the manufacturer’s profit of the no returns policy turns to be
\[ \Pi_m^n = (1-\gamma)((a\theta_1 + (1-\alpha_1)(s_1 - k_1) + \frac{\gamma}{1-\gamma}(1-\alpha_1)(k_2 - k_1)) \]
\[ + [a\theta_2 - \alpha_1(\theta_1 - \theta_1) + (1-\alpha_1)(k_2 - k_1) \]
\[ - \frac{1}{1-\gamma} (\theta_2 - \theta_1) \alpha_1 - ca_2^2)] \]  

(A20)

Comparing (A18) and (A13), we find that when no returns are allowed on the low-end product, the highest wholesale price can be charged for the high-end product is decreased by \( (1-\alpha_1)(w_1 - k_1) + \frac{\gamma}{1-\gamma}(1-\alpha_1)(k_2 - k_1) \). The wholesale price for the high-end product is decreased by \( \frac{1}{1-\gamma} (1-\alpha_1)(k_2 - k_1) \) as a result of the no returns policy on the low-end product. The manufacturer’s profits under no returns policy are therefore decreased by \( \frac{1}{1-\gamma} (1-\alpha_1)(k_2 - k_1) \) on the high-end product. Taking all effects together, allowing returns on the low-end product increases the manufacturer’s profits if
\[ k_1 \leq (1-\gamma)^2 s_1 + \gamma (2-\gamma) k_2. \]  

(A21)

**PROOF OF Proposition 2(a):**

We first focus on case \( \lambda_2 < \lambda_1 \). Suppose that the low-end product cannot be returned. It suffices to show that in the presence of full returns on the high-end product, the manufacturer’s profits will increase as long as \( s_1 \geq k_2 \).

When the manufacturer allows full returns on the high-end product, the retailer will allow returns as well and thus obtains profits \( (1-\gamma)(a\theta - w) + [a\theta_1 + (1-\alpha_1)(w - k_1) - a(\theta_1 - \theta)] \) if carrying two products. Similar to the derivations of equation (A11) and (A12), the retailer’s two incentive compatibility constraints facing the manufacturer can be
derived as follows:
\[ w_2 - w_1 \leq (\alpha_2 - \alpha_1)\theta_2 + (1 - \alpha_2)(w_2 - k_2) \]  
(A22)
\[ w_1 \leq \alpha_1\theta_1 - \frac{\gamma}{1 - \gamma} (\alpha_2 - \alpha_1)(\theta_2 - \theta_1) \]  
(A23)

The above two constraints will be binding and the manufacturer’s profits turn to be
\[ (1 - \gamma)(\alpha_2 - \alpha_1)\theta_2 + \gamma(\alpha_1\theta_1 + (1 - \alpha_2)(k_2 - k_1)) - \gamma \alpha_1(\theta_2 - \theta_1) - c\alpha_2^2, \]  
which differs from equation (A20) by
\[ \gamma(1 - \alpha_2)(s_1 - k_1) \]  
and are thus greater than the profits under the no returns case if \( s_1 \geq k_2 \). It can be easily shown that the effect that full returns policy for the high-end product has on the manufacturer’s profits does not depend on the returns policy for the other product. The manufacturer’s returns policy on the high-end product depends on the efficiency of allowing returns. As for the low-end product, we argue that equation (A21) is exactly the condition under which allowing full returns on the low-end product are optimal for the manufacturer. In other words, this condition does not depend on the returns policy adopted by the manufacturer for the high-end product.

Now consider case \( k_2 \geq k_1 \). The retailer will offer full returns on the low-end item when carrying both products, regardless of the manufacturer’s returns policy. In this case, it is in the manufacturer’s interest to offer full returns as well. It happens because full returns at the retail level is inevitable, not offering full returns only results in the loss of the salvage value and intensifying the retailer’s incentive of carrying the low-end product alone. Precisely, if the manufacturer chooses not to offer full returns on the low-end item in the case of \( k_2 \geq k_1 \), then the equation (A11) and (A12) will become the following:
\[ w_2 - w_1 \leq (\alpha_2 - \alpha_1)\theta_2 + (1 - \alpha_2)(k_2 - k_1) - \frac{1 - \gamma}{\gamma} (1 - \alpha_1)k_1 \]  
(A24)
\[ w_1 \leq \alpha_1\theta_1 - (1 - \alpha_1)k_1 - \frac{\gamma}{1 - \gamma}[\alpha_1(\theta_2 - \theta_1) - (1 - \alpha_2)(k_2 - k_1)] \]  
(A25)
Consequently, the manufacturer profits will be decreased by \( (1 - \gamma)(1 - \alpha_1)w_1 \) from the low-end segment and by \( (1 - \alpha_1)k_1 \) from the high segment.

In summary, when \( k_2 \geq k_1 \), given that the retailer will offer full returns on the low-end item when carrying both products, the manufacturer had better provide full returns as well in order to capture the salvage value of the returned product and to mitigating the retailer’s incentive of carrying the low-end product only.

**DEVIAION OF Table 3:**
Consider the case where \( k_1 - \gamma(2 - \gamma)k_2 \leq s_1 \leq k_2 \), for illustration. Since the manufacturer’s objective function (equation (A15)) is concave in \( \alpha_1 \) and \( \alpha_2 \), the first order conditions give us the corresponding optimal quality levels under our regularity conditions. Taking derivatives of equation (A15) with respect to \( \alpha_1 \) and \( \alpha_2 \), we can derive the optimal quality levels of the two products as follows:
\[ \alpha_1 = \frac{\theta_1 - \gamma(2 - \gamma)\theta_2 + k_2 - \gamma(2 - \gamma)k_2^2 - (1 - \gamma)^2 s_1}{(1 - \gamma)^2 2c} \]
\[ \alpha_2 = \frac{\theta_2}{2c} \]

**PROOF OF Lemma 3:**

From Table 2, it is easy to see that the quality reduction for the low-end product in an uncoordinated channel equals \( (1 - \gamma)^2 s_1 + \gamma(2 - \gamma)k_2 - k_1 \), while in a coordinated channel the quality reduction equals \( (1 - \gamma)^2 s_1 + \gamma(1 - \gamma)k_2 - (1 - \gamma)^2 s_1 \). The former is larger than the latter by \( \frac{2c}{(1 - \gamma)^2} \).

**REFERENCES**


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非整合通路下製造商目標行銷之研究——
製造商退貨保證的影響

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由於顧客在購買前經常不能確認產品功能是否良好，實務上廠商對顧客提供退貨保證十分常見。在非整合通路下，製造商必須透過獨立的零售商銷售產品與回收退貨。然而零售商有其自利的考量，未必會配合製造商原先產品線的設計販售產品給目標顧客，因此造成製造商目標行銷的困難。本研究以賽局分析的方式，探討非整合通路下，獨占製造商透過獨占的零售商，銷售不同品質的產品給不同品質偏好的市場區隔顧客時，製造商的退貨策略對其目標行銷及零售商動機問題的影響。研究結果發現，若高品質偏好的市場區隔較低品質偏好的市場區隔顧客有較高的退貨成本時，製造商透過零售商對低端產品提供退貨保證有以下的效果：第一，提供退貨保證有區隔顧客的效果，第二，提高零售商配合同目標行銷的誘因。因此在非整合通路下製造商提供退貨保證，能使自利的製造商與零售商雙方的目標更趨一致，對通路關係與目標行銷的達成有正面的影響。

關鍵字：退貨保證，目標行銷，零售商，製造商，市場區隔