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Whether to adopt "buy online and return to store" strategy in a competitive market?

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Abstract

This study attempts to examine whether it is beneficial to introduce the buy online and return to store (BORS) strategy in a competitive market. We consider two competing dual-channel retailers, and investigate conditions under which it is optimal for one or both of the retailers to offer the BORS strategy. We first assume that a partial refund is offered for online returns and then consider the important case of a full refund. We show that whether both retailers adopt this strategy significantly depends on the return rate and cross-selling profit. Specifically, if the return rate is sufficiently low (high), at least one retailer (both retailers) will adopt this strategy when cross-selling profit is relatively high. Nonetheless, both retailers will fall into the prisoner's dilemma under certain conditions. Interestingly, the return rate and proportion of consumers with a high hassle cost associated with BORS returns significantly influence the equilibrium channel strategy and the existence of the prisoner's dilemma. We further find that, when both retailers implement the BORS strategy, they both benefit from offering a full refund return policy when the number of online-type consumers is large enough and the unit cross-selling profit is relatively small, but should provide a partial refund otherwise. When only one retailer adopts the BORS strategy, a partial refund return policy is preferable.

Keywords: Supply chain management; Buy online and return to store; Cross-channel return strategy; Dual-channel retailer; Competition

1. Introduction

With the advent of information communication technology-enabled shopping alternatives, retailers have realized that omnichannel strategies, combined with conveniently fulfilling consumer orders or handling consumer returns, can effectively boost sales and improve operational efficiency. Under omnichannel retailing, major retailers offer various cross-channel services to meet consumer expectations, e.g., buy online and pickup in store (BOPS), ship to store, pickup in store, and buy online and return to store (BORS) (Akturk et al., 2018). In particular, consumer returns are ubiquitous in the retail industry, especially in online channels, and have been a major concern for retailers. In practice, the average return rate of online sales is much higher than that at physical stores, roughly over 30% compare to about 8.89% (Feinleib 2017). This is especially true for high fashion products such as fashion apparel, where the online rate can even reach 75% (Akcay et al., 2013). The total value of returned goods in the U.S. was $309 billion in 2019 (National Retail Federation, 2019). In this context, retailers operating in multi-channel settings need to carefully choose their channel strategies in the face of the substantial online returns. This study examines when it is advantageous for dual-channel retailers to implement the cross-channel return strategy (i.e., BORS) in a competitive market.

To examine the issue described above, it is necessary to understand that the benefits of the BORS strategy can indeed be substantial for dual-channel transactions. In addition to the widely used same-channel return strategy, under which unsatisfied consumers are required to return products via the channel from which they bought them, many retailers, such as J.C. Penney, Macy's, BestBuy, Apple, Sears and Suning, are increasingly adopting a cross-channel return option, i.e., the BORS strategy. This is because the same-channel return service cannot meet the ever-increasing personalized needs of consumers, e.g., buying a product online and returning it to a local store (Zhang et al., 2010). Under the BORS strategy, consumers can buy products online and are allowed to return unsatisfactory items to the retailers' physical stores. This strategy integrates advantages of both online and physical channels by offering a way for consumers to return products at a location and time that are convenient, and can also let consumers obtain immediate credit for returned products (Mahar and Wright, 2017). This can help enhance consumer convenience, satisfaction and loyalty, which further influences their perceptions and intentions to make purchase decisions. A report from UPS reveals that 82% of online consumers will complete their online transactions if a free "buy online and return to store" service is available (UPS, 2015). Furthermore, implementing the BORS strategy will inevitably lead to more store visits, which can help physical stores to create additional opportunities for cross-selling activities and thus increase profits (Zhang et al., 2010; Cao and Li, 2015), either through impulse purchases or through the assistance of store employees (Bell et al., 2014). UPS (2016) find that roughly 25% of consumers will make additional purchases when visiting physical stores to return unsatisfactory products. In particular, a returned product can be converted into an exchange or a sale of a more expensive item during a consumer's store visit (Akturk et al., 2018). Due to these benefits, over 50% of omnichannel retailers already provide a cross-channel return service (UPS, 2015).

Although the BORS strategy exhibits many advantages compared to the same-channel return strategy, it also leads to several challenges for dual-channel retailers. It is challenging for a dual-channel retailer to handle return products in the physical store (Nageswaran et al., 2020). To deal with returned products from the BORS channel, retailers will generally incur substantial costs including handling costs, shipping costs and even some costs caused by offering dedicated services as incentives to use the BORS channel, e.g., more parking spaces and dedicated express checkout lanes. In particular, to encourage more consumers to conduct their return transactions through the BORS channel, retailers such as Target, BestBuy and Wal-Mart even offer a full refund for consumer returns, i.e., charging no fee for any returned item. Moreover, returned products are usually transshipped to the online store if these items are not offered in the physical store (Zhang et al., 2010), which incurs some transshipment costs. These challenges make it unclear whether the BORS strategy can indeed benefit dual-channel retailers.

Notably, where competition between retailers is fierce due to selling similar products, e.g., Suning vs. Gome in China, and Grate and Barrel vs. The Home Depot in U.S, these retailers may adopt the BORS strategy to gain a competitive advantage. As consumers have various shopping and return behaviors, a retailer who introduces this strategy may capture additional market share in typical consumer segments (Nageswaran et al., 2020), as well as gaining the profit from the additional cross-selling opportunities caused by more store visits (UPS, 2016). A recent report from KPMG highlights the importance of the BORS strategy, and indicates that consumers can choose to return items to physical stores if this is easier for them, and warns that online-only retailers limit consumer choices by not offering such a strategy (KPMG, 2017). Another report from SCApath points out that adopting the BORS strategy creates many benefits, e.g., increasing consumer satisfaction, more repeat purchases and higher in-store sales (SCApath, 2021). However, in a competitive environment, whether a retailer adopts the BORS strategy may significantly depend on complex market conditions in terms of the competition on selling prices and return policies. Shulman et al (2011) find that the competition can even lead firms to charge higher restocking fees for consumer returns. In practice, some competing sellers such as Gap, H&M and Zara offer the BORS strategy, whereas retailers such as Clarks Outlet and Uniqlo do not provide such a service. This evidence motivates us to examine the conditions under which retailers should adopt the BORS strategy or not in a competitive market, and to investigate the characteristics of the associated return policies and pricing decisions which ultimately determine the retailer's profit.

The aforementioned evidence and findings raise the following research issues: (1) How do dual-channel retailers determine whether to implement the BORS strategy in a competitive market? (2) What factors influence this decision? (3) What are the optimal selling prices and return service charges when adopting the BORS strategy? (4) How does the BORS strategy affect retailers' profitability?

Despite the increasing attention given to the BORS strategy in the retail industry, the issues highlighted above have not been well documented in the literature. In this study we attempt to fill this gap. To this end, we consider two competing dual-retailers who sell two horizontally differentiated products to the same group of consumers. In addition to the same-channel return strategy, each retailer should determine whether or not to adopt the BORS strategy. Accordingly, three scenarios are considered which differ in the number of retailers offering the BORS strategy, i.e., no retailer, only one retailer or both retailers, respectively. We first assume that a partial refund is offered for online consumer returns. We develop a theoretical model in each scenario and consider that both retailers determine whether to implement the channel strategy in two cases, i.e., the case where the decision on implementing the BORS strategy is determined exogenously ex ante and the case where the decision is determined endogenously. The optimal BORS strategy and the associated prices and return service charges are examined. We then consider the important case of a full refund for online consumer returns to further explore the optimal return channel strategy.

Some important and interesting findings are achieved from our analysis. *First*, a retailer determines whether to adopt the BORS strategy in the competitive market based on the return rate and the unit cross-selling profit. Specifically, a retailer tends to adopt this strategy when the cross-selling profit is sufficiently high, but does not implement this strategy otherwise. We also find that the asymmetric implementation of the BORS strategy occurs only in the case when the return rate is sufficiently low. *Second*, when both retailers adopt the BORS strategy, they will fall into the prisoner's dilemma under certain conditions, i.e., when the cross-selling profit is not sufficiently high in the partial return refund case, but when the return rate is relatively low and the cross-selling profit is not sufficiently high in the full refund case. *Third*, it is interesting that the equilibrium channel strategy and the existence of the prisoner's dilemma are significantly affected by the product return rate. In particular, when the product return rate is medium, both retailers adopt the BORS strategy in the equilibrium channel strategy and the prisoner's dilemma is less likely to occur. Finally, when both retailers introduce the BORS strategy, both retailers are better off providing a full refund return policy if the number of online-type consumers is large enough and the unit cross-selling profit is relatively small, but better off providing a partial refund return policy otherwise. However, when only one retailer adopts the BORS strategy, both retailers are better off by providing a partial return refund.

Our contributions to the existing literature are highlighted as follows. *First*, we provide an important guidance for dual-channel retailers on when to adopt the BORS strategy in a competitive market. Specifically, it is not always beneficial for dual-channel retailers to adopt the BORS strategy, which depends on the unit cross-selling profit in the symmetric implementation of the BORS strategy, but on the return rate (or online return cost) and the unit cross-selling profit in the asymmetric implementation. This finding is different from that obtained in a monopoly market by Yan et al. (2020b), where this decision is only dependent on the unit cross-selling profit. *Second*, it is very interesting that both retailers may fall into the prisoner's dilemma under certain conditions. This finding that occurs in a competitive market when the BORS strategy is endogenously determined has never been observed in related studies. We also present a very important insight that can help retailers to avoid this dilemma: retailers can carefully choose the right products with medium return rate when introducing BORS channels in practice. *Third*, our results can also help dual-channel retailers to decide whether to offer a full refund policy or a partial refund policy for online returns when adopting the BORS strategy in a competitive market. Specifically, the decision depends on the number of online-type consumers and the unit cross-selling profit in the symmetrically competitive market, but both retailers will always benefit from offering a partial refund in the asymmetrically competitive market. These findings not only contribute to the operations management literature, but also bring valuable theoretically proven insights to practitioners engaging in omnichannel operations.

The rest of this paper is organized as follows. Section 2 reviews the most relevant literature. In Section 3, we present our model descriptions. Section 4 focuses on the case where the BORS strategy is exogenously determined ex ante and presents our theoretical models along with the analysis of the optimal decisions concerning prices, return service charges and whether or not to adopt the BORS strategy. Section 5 provides the analysis in the case where the BORS strategy is endogenously determined. Section 6 extends the analysis for full refunds. Section 7 provides concluding remarks. All proofs are provided in the Appendix.

2. Literature Review

Our work focuses on examining whether adopting the BORS strategy is beneficial for dual-channel retailers in a competitive market. There are some streams of prior research that are closely relevant to our study.

The first stream is related to return policy, which has gained considerable attention in the literature, especially in the context of online retailing. Return policy is generally specified as the return refund or return service charge policy and associated conditions. Most relevant studies aim to determine whether to offer full, partial or no refund for consumer returns under certain conditions (Hsiao and Chen, 2011; Hsiao and Chen, 2014; Chen et al., 2018). To adapt to online retailing practice, when determining the optimal return policy, some studies examine the interactions between return policy and other operational factors such as pricing strategy (Akcay et al., 2013; Chen et al., 2018), advance selling (Li et al., 2014), sales channel choices (Letizia et al, 2017; Xia et al, 2017), shipping strategy (Hua et al., 2017; Ove et al., 2017) and online reviews (Geng et al., 2017). Note that, an implicit assumption in all these studies is that consumer returns are handled in the same online or physical channel as the purchase rather than the BORS channel. In recent years, some studies have investigated decisions regarding the BORS channel. In particular, Radhi and Zhang (2018) examine a dual-channel retailer's optimal pricing and inventory management strategy in the face of consumer returns from the BORS channel. Dijkstra et al. (2019) investigate whether to transship returned items back to the online store or keep them on-hand at the offline store when online purchases are returned to offline stores. However, these two studies do not explore when to adopt the BORS strategy. Radhi and Zhang (2019) derive the optimal cross-channel return policy in a dual-channel retail system by comparing four return polices, i.e., no cross-channel returns, cross-channel return policy with shipping back to online store, cross-channel returns under a decentralized and centralized management without shipments. Yan et al. (2020b) examine the optimal pricing and return strategies related with the adoption of a cross-channel return strategy by considering the cross-selling effect in a dual-channel setting. Nageswaran et al. (2020) investigate the optimal pricing decisions and return policy of an omnichannel retailer who offers a cross-channel return strategy. Some recent studies further examine the impact of in-store returns and return policy (Mandal et al., 2021), omnichannel inventory (Li et al., 2021), and the effect of in-store return strategy on the physical store size and product breadth (Gao et al., 2021). Note that, although these studies are relevant to our work, they conduct their analysis in a monopoly market rather than in a competitive market. Jin et al. (2020) explore the omnichannel retailers' cross-channel strategy for product exchanges in a competitive market, and present the optimal channel strategies and the associated conditions. However, they only consider product exchanges across channels rather than returns for refunds. The effect of the refund strategies of retailers on the optimal decisions is an important aspect of our work.

The second stream concentrates on channel integration. Some prior work has explored this issue by introducing a direct online channel in addition to the original physical channels (e.g., Chiang et al., 2003; Tsay and Agrawal, 2004). The main issues considered include the impact of an added online channel on pricing strategies and the firm's profit (Cattani et al., 2006), the effect of sales effort (Tsay and Agrawal, 2004), and the effect of consumer returns (Ofek et al., 2011). Intuitively, introducing an online channel will definitely lead to channel competition between physical and online channels (Chen et al., 2008; Kurata et al., 2007). Such competition may arise from the players' operational strategies such as a supplier's service competition between two channels (Chen et al., 2008), price competition in a supply chain setting (Ryan et al., 2013), the competition with other retailers (e.g., Kurata et al., 2007; Chen and Chen, 2019;

Nault and Rahman, 2019), or even the competition between new and remanufactured products (Han and Chen, 2021). These studies have thoroughly documented the issues of channel integration and channel competition. However, none of these studies consider decisions regarding cross-channel operational strategies, especially the decision on whether to adopt the BORS strategy.

The last stream of related literature is omnichannel management, which has been highly valued in the retail field and has received extensive examination in recent years (Brynjolfsson et al., 2013). Two typical cross-channel strategies are deeply investigated, i.e., buy online and pickup in store (BOPS) (Gallino and Moreno, 2014; Cao et al., 2016; Gao and Su, 2017a) and physical or web showrooms (Bell et al., 2018; Gao and Su, 2017b; Sun et al., 2020). Specifically, Gallino and Moreno (2014) empirically explore the impact of adopting the BOPS channel on a retailer's demand and sales, and find that such a strategy may reduce online sales and increase offline sales and traffic. Cao et al. (2016) investigate the impact of the BOPS channel on a retailer's demand allocations, pricing, and profitability, and find that adding this channel would not always increase firms' profits for products that are only available online. Gao and Su (2017b) further examine the impact of implementing the BOPS channel, and also find that not all products are well suited for the online-to-store option. Unlike these studies that have studied the value of the BOPS in a monopoly market, Yan et al. (2020a) investigate the impacts of offering the BOPS channel on the profitability of two competing retailers, and find that introducing the BOPS channel is not always the optimal strategy in a competitive market. In addition to the BOPS channel, Bell et al. (2018) investigate the impact of opening physical showrooms on consumers' channel choices. Note that, these studies mainly address the issues of the BOPS channel and showrooming, but do not consider cross-channel returns. Mahar and Wright (2017) examine the optimal subset of a retailer's physical stores that should be set up to handle in-store pickups and online returns. Akturk et al. (2018) empirically evaluate the impact of introducing a ship-to-store channel on sales and consumer returns including cross-channel returns, and find that such channel adoption would decrease online sales but increase cross-channel returns. Neither of these studies consider the optimal decision on whether or not to introduce a cross-channel return strategy for omnichannel retailers.

Our work differs from the extant studies in the following three respects. *First*, we focus on exploring the value of the BORS channel in a competitive market, and examine the optimal decision on whether to adopt such channel for two competing dual-channel retailers, as well as the return policies and pricing decisions. *Second*, we consider two decision mechanisms for the BORS strategy, namely, where the BORS strategy is exogenously determined ex ante and where it is endogenously determined, to identify the optimal return channel strategy. *Third*, we consider both partial and full return refunds for online returns, and in the case of a partial return refund, we allow the return service charge to be a decision variable. We further compare both retailers' profits from the partial and full refund cases to identify the optimal return policy when implementing the BORS strategy. To the best of our knowledge, this is the first study to address these challenging issues analytically.

3. Model Description

We consider two dual-channel retailers who sell the competing brands of a product with some horizontal differences (the brands refer to the retailers) to a group of consumers through online and physical channels. Each retailer is assumed to sell one brand of the product, and each consumer is assumed to purchase at most one unit of the product from one retailer through either the online store or a nearby physical store. As consumer returns cannot be avoided, especially in the online channel, in addition to a same-channel return strategy, retailers may adopt a cross-channel return strategy to manage consumer returns. In particular, consumers are allowed to return products bought online to the online store or a nearby physical store when the BORS strategy is introduced. To examine the optimal return channel strategy in the competitive market, we consider three scenarios: no retailer offering the BORS strategy (NN), only one retailer offering BORS strategy (BN and NB), and both retailers offering BORS strategy (BB). We further assume that both retailers are rational and self-interested. The main notations used in this study are summarized in Table 1.

Consistent with most firms' practice, each retailer is assumed to sell its product through both channels at a uniform price p_i ($i=1,2$) with a common unit procurement cost c. Such assumption can be found in related studies (Ofek et al., 2011; Gao and Su, 2017a). In practice, many dual-channel firms adopt the uniform price scheme across both online and offline channels, such as Costco, BestBuy, Wal-Mart, SUNING and GOME. A recent survey shows that 70% of retailers have identical prices across channels (Cavallo, 2017). In our model, the selling price p_i and return service charge f_i ($i=1,2$) are decision variables, while other variables are assumed to be exogenous. Without loss of generality, the total market size is normalized to be one unit.

Table 1. Summary of notations used

Notation	Interpretation
p_i	Selling price of retailer i's product ($i = 1, 2$)
f_i	Unit return service charge of retailer i for an online return
ε	Unit cross-selling profit
c	Unit procurement cost
c_r	Unit operational cost of a physical store
v	Consumer product valuation
t	Unit misfit cost for an online store
g	Unit misfit cost for a physical store
c_o	Unit return cost incurred by retailers associated with an online return
c_{or}	Unit return cost incurred by retailers associated with a BORS purchase and return
s_t	Unit shipping and waiting cost incurred by consumers through an online purchase
s_w	Unit return cost incurred by consumers through an online return
ρ	The probability of consumer satisfaction with the product
h_j	Hassle cost incurred by consumers returning an online purchase to a physical store, where $j = H$ and L.
α $(1-\alpha)$	The proportion of online-type (store-type) consumers
β $(1-\beta)$	The proportion of consumers with a high (low) hassle cost
x $(1-x)$	Consumer's preferences for retailer 1's (retailer 2's) product

Given both retailers' selling prices, consumers can choose to buy the products through the online channel or physical store from either of the retailers. Generally, consumers will return the products when they are not satisfied after receiving and perceiving them. Notably, with improvements in product quality, most product returns are no longer due to functional quality but rather other consumer behavior-related or misfit reasons, e.g., not meeting expectation, not knowing how to use, or regrets (Li et al., 2014; Hua et al., 2017). For example, approximately 95% of returned products are non-defective and can be resold (Lawton, 2008). Specifically, in the apparel sector, most returned products are resold as new items after a quick visual inspection (Akcay et al., 2013; Ruiz-Benítez et al., 2014). In this sense, after being repacked, returned products can be resold at the same market price as regular products. Thus, returned product salvage is not considered in this study. Common practice shows that the return rate of online sales is much higher than that of the physical channel, and thus for simplicity, we only consider consumer returns in online channels. This assumption is reasonable because physical retailers usually establish some showrooms, offer some product samples, or even hire some highly qualified salespeople to help consumers to touch, feel and experience the products (Yan et al., 2020b), which can substantially help reduce the return rate due to mismatch reasons in physical stores (Ofek et al., 2011; Xia et al., 2017). As noted earlier, each retailer may adopt the BORS strategy in addition to the same-channel strategy to handle consumer returns. We assume that both retailers offer a partial refund ($p_i - f_i$) ($0 < f_i < p_i$) for an online return but a full refund for an online-to-store (BORS) return. The assumption of a full refund for cross-channel returns can be found in many related studies (e.g., Nageswaran et al., 2020) and can also be observed in practice, e.g., Target, Macy's, BestBuy, H&M and Wal-Mart. Specifically, H&M charges consumers a fixed fee $5.99 for each online purchase returned by mail, but offers "free returns to store" whereby consumers can return online purchases to physical stores (or via a BORS channel) for a full refund (H&M, 2021). Furthermore, consumers generally incur some extra costs when using an online channel including waiting and additional shipping costs for purchases and shipping fees and handling costs for returns. To capture these costs, we assume that consumers incur a waiting cost s_t when buying the product online and a return cost s_w when returning the product through the online channel.

Notably, both retailers will incur a unit in-store operational cost c_r for sales, such as the cost of changing rooms or product demonstrations, which is higher than that in the online channel. For simplicity, we assume that the unit online operational cost is zero. Such an assumption can be found in related studies, e.g., Cao et al. (2016). Generally, consumer returns incur certain return costs including collecting, repacking, restocking and other related handling costs for both retailers. In this case, we denote c_o as the unit return cost incurred by retailers from online returns, and c_{or} as the unit return cost from the BORS channel, and we assume that $c_{or} > c_o$. The rationale for this assumption is that retailers may incur more labor cost and possibly transshipment costs for returns via the BORS channel.

Consumers may buy the product online and possibly return it either online or to the physical store if the product fails to meet expectations, or visit the physical store to inspect the product before making the purchase decisions. Similar to Nageswaran et al. (2020), we classify consumers into two types: online-type and store-type. Online-type consumers prefer to purchase the products online, and after receiving and experiencing the products, they can return unsatisfactory items to the online stores or the physical stores if the BORS strategy is available. Store-type consumers like to visit the physical stores and inspect the desired items before making purchases. We assume that a consumer belongs to the online-type with a probability

α and thus belongs to the store-type with a probability $1-\alpha$. Note that α $(1-\alpha)$ can be used to capture a consumer's inherent preference for one mode of shopping over the other for a particular ominchannel firm (Nageswaran et al., 2020). Such consumer classification can be supported by practical evidence. For example, Fukami and Davis (2015) find that 53% of Macy's consumers like to make purchases at their brick-and-mortar stores. Note that v is used to characterize the base utility from the product purchase regardless of whether a product is bought from an online channel or a physical store. It is convenient for analysis to assume that v is sufficiently large to ensure full market coverage ($v > \bar{v}$, where $\bar{v}$ is provided in the Appendix). This assumption is widely used in related studies, e.g., Ofek et al. (2011), Mehra et al. (2017) and Yan et al. (2020a). These assumptions allow us to focus on the main decisions considered, while retaining analytical tractability. Note that t (g) is the unit misfit cost for an online (physical) store, which refers to the competition degree between the retailers' online (physical) stores (Kourandi et al., 2015). Without physical inspection, consumers face great uncertainty about the valuation of the product in the online retail setting (Cheng et al., 2015), and thus we assume that $t > g$. To ensure that the optimal return service charges are positive, we assume that $t > t_1$, where t_1 is provided in the Appendix.

Notably, we further consider that consumers are heterogeneous regarding the following two important aspects. First, consumers are heterogeneous in their horizontal preferences for the two retailers' products (or brands). Following Hotelling (1929) and Cao et al. (2019), we consider that consumer preference degree to retailer 1's product (or brand) is denoted by x , and is distributed uniformly on a Hotelling line [0, 1]. Thus, in this horizontal preference dimension, we assume that retailer 1's product (or brand) is located to the left at zero, while retailer 2's product (or brand) is located to the right at 1. Then, the horizontal mismatch between the retailer 1 (retailer 2) and the consumer's ideal horizontal preference is x ($1-x$). Second, consumers differ in the hassle costs associated with returned products through the BORS channel, e.g., traveling to the physical store, waiting in checkout lanes or needing to show a receipt. This hassle cost is a typical inconvenience cost suggested by Nageswaran et al. (2020). This inconvenience cost is relative in that, consumers with a higher inconvenience cost may have a relatively high opportunity cost spending their time and efforts elsewhere, and vice versa (Rosa, 2012). In this regard, consumers with a higher inconvenience cost tend to choose the same-channel (i.e., online channels) in preference to the BORS channel (i.e., physical stores) to return products. Specifically, we segment the market into two parts: consumers with a high hassle cost (h_H) who always return items via the online channel and consumers with a low hassle cost (h_L) who always choose the BORS channel when available. The proportions of consumers in these two segments are assumed to be β and $1-\beta$, respectively. To avoid the case where all online-type consumers with a high hassle cost favour the BORS channel, we assume that $h_H > f_i + s_w$. Furthermore, similar to Ofek et al. (2011) and Mehra et al. (2017), h_L is assumed to be zero for simplicity. This means that online-type consumers with low hassle cost will always prefer to return items via a retailer's BORS channel when available.

Before selling their products, both retailers first determine whether or not to adopt the BORS strategy, and then simultaneously determine their product prices and return service charges. Given both retailers' product prices and return service charges, online-type consumers first decide whether to buy the products from the online channel of retailer 1 or 2. After receiving the product, online-type consumers evaluate it to determine whether to keep it or return it either though the online channel for a partial refund or the physical store for a full refund (if the BORS channel is available). Store-type consumers decide whether to visit the physical store of retailer 1 or 2. These consumers evaluate the product in the store and will purchase the product if they are satisfied with it; otherwise they will not buy. Consumers' decision tree is shown in Fig.1.

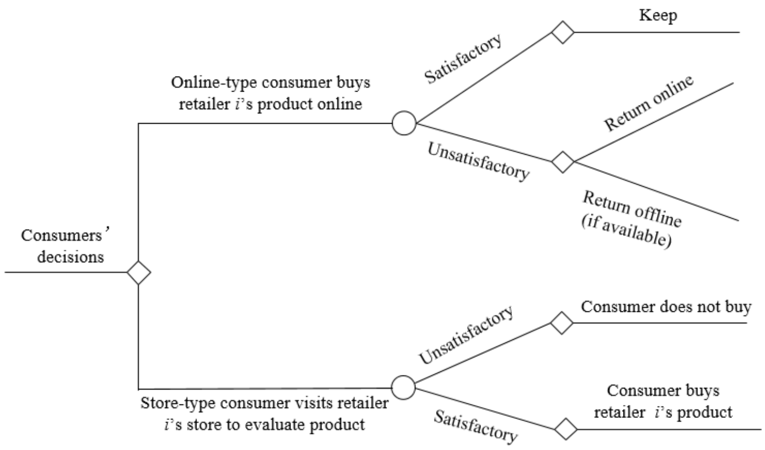

Fig.1. Consumers' decisions

4. Models, Results and Analysis

In this section, we assume that whether a retailer implements the BORS strategy is exogenously given ex ante.

4.1. Benchmark: No retailer offering the BORS strategy (NN)

In this scenario, no retailer will offer the BORS strategy, and both retailers are pure dual-channel retailers. Following Hotelling (1929) and Cao et al. (2019), for consumers with a preference degree x to retailer 1 on the Hotelling line, the expected utility functions of an online-type consumer for the products sold through the online channel of the two retailers are defined as

$$u_{1o}^{NN} = \rho(v - p_1) - (1-\rho) f_1 - tx - s_t - (1-\rho)s_w,$$
$$u_{2o}^{NN} = \rho(v - p_2) - (1-\rho) f_2 - t(1-x) - s_t - (1-\rho)s_w. \quad (1)$$

As noted earlier, we only consider consumer returns in the online channel. It is assumed that, when the product does not meet expectations, store-type consumers will realize this through inspection at the store and will not purchase. It follows that store-type consumers will have a probability of ρ to buy the product and a probability of $1-\rho$ to not buy the product. Thus, the expected utility functions of a store-type consumer for the products sold at the physical stores of the two retailers are defined as

$$u_{1r}^{NN} = \rho(v - p_1 - gx),$$
$$u_{2r}^{NN} = \rho(v - p_2 - g(1-x)). \quad (2)$$

Note that, u_{1o}^{NN} and u_{2o}^{NN} denote consumer utilities derived from online purchases from retailer 1 and retailer 2, respectively, while u_{1r}^{NN} and u_{2r}^{NN} represent those derived from purchases from physical stores of retailer 1 and retailer 2, respectively; tx (gx) and $t(1-x)$ ($g(1-x)$) refer to the misfit costs associated with online (retail store) channels of retailers 1 and 2, respectively.

Consumers may decide to buy products from the retail store or the online channel of one retailer where their utilities are relatively high. By setting $u_{1o}^{NN} = u_{2o}^{NN}$, we can derive the indifference point between purchasing retailer 1's product and retailer 2's product through their online channels, i.e., when $x_{oo}^{NN} = \frac{t - \rho(p_1 - p_2) - (1-\rho)(f_1 - f_2)}{2t}$. The product demand functions of both retailers' online channels can then be deduced as $D_{1o}^{NN} = \frac{\alpha(t - \rho(p_1 - p_2) - (1-\rho)(f_1 - f_2))}{2t}$ and $D_{2o}^{NN} = \frac{\alpha(t + \rho(p_1 - p_2) + (1-\rho)(f_1 - f_2))}{2t}$, respectively. Similarly, by setting $u_{1r}^{NN} = u_{2r}^{NN}$, we can easily get the indifference point between purchasing retailer 1's product and retailer 2's product at their physical stores, i.e., when $x_{rr}^{NN} = \frac{g - (p_1 - p_2)}{2g}$. Thus, we can obtain the product demand functions regarding both retailers' physical channels, i.e., $D_{1r}^{NN} = \frac{\rho(1-\alpha)(g - (p_1 - p_2))}{2g}$ and $D_{2r}^{NN} = \frac{\rho(1-\alpha)(g + p_1 - p_2)}{2g}$, respectively. According to the online product demands of both retailers, the quantities of online consumer returns for the retailers are then expressed as $(1-\rho)D_{io}^{NN}$ ($i = 1, 2$).

Based on these demand functions and return quantities, the objectives of the retailers are formulated as

$$\max_{p_1, f_1} \Pi_1^{NN} = D_{1r}^{NN}(p_1 - c_r - c) + (p_1 - c)\rho D_{1o}^{NN} - (c_o - f_1)(1-\rho)D_{1o}^{NN},$$

$$\max_{p_2, f_2} \Pi_2^{NN} = D_{2r}^{NN}(p_2 - c_r - c) + (p_2 - c)\rho D_{2o}^{NN} - (c_o - f_2)(1-\rho)D_{2o}^{NN}. \quad (3)$$

Note that, each retailer's profit consists of three components: the profit obtained from physical store sales, the profit obtained from the online sales and the loss caused by consumer returns through the online channel. By applying the backward induction technique, we can easily derive the equilibrium decisions and profits of both retailers in this scenario. The results are summarized in Table 2.

4.2. One Retailer Offering the BORS Strategy (BN)

In this scenario, one retailer adopts the BORS strategy, in addition to the same-channel return strategy, to cope with consumer returns. Without loss of generality, we assume that retailer 1 implements the BORS strategy while retailer 2 does not (BN). In this case, consumers will exhibit three types of purchasing behaviors, namely, buying online and returning online, buying offline, and buying from retailer 1 online and returning to retailer 1's physical store. Thus, the consumer utility functions will have three forms. Note that the proportion β of online-type consumers with a high hassle cost always choose to return to the online channel of the corresponding retailer, while the proportion $1-\beta$ of online-type consumers with a low hassle cost will return to retailer 1's physical store or retailer 2's online store if they buy from the corresponding retailer's online store. Therefore, the utility functions of online-type and store-type consumers who purchase and return products via the same channel take the same forms as those in the NN scenario, i.e., $u_{io}^{BN} = u_{io}^{NN} (i = 1,2)$ and $u_{ir}^{BN} = u_{ir}^{NN} (i = 1,2)$, respectively. The difference in consumer utility is due to online-type consumers who buy the product from retailer 1 online and choose to return the product to that retailer's physical store. These consumers obtain a utility $u_{1or}^{BN} = \rho(v - p_1) - s_t - tx$.

By setting $u_{1or}^{BN} = u_{2o}^{BN}$, $u_{1o}^{BN} = u_{2o}^{BN}$, and $u_{1r}^{BN} = u_{2r}^{BN}$, the product demand functions regarding both retailers' online channels, physical stores and BORS channels can be obtained, i.e., $D_{1o}^{BN} = \dfrac{\alpha\beta(t - \rho(p_1 - p_2) - (1-\rho)(f_1 - f_2))}{2t}$,

$D_{2o}^{BN} = \dfrac{\alpha\beta(t + \rho(p_1 - p_2) + (1-\rho)(f_1 - f_2))}{2t} + \alpha(1-\beta)\max\{\dfrac{t + \rho(p_1 - p_2) - (1-\rho)(f_2 + s_w)}{2t}, 0\}$,

$D_{1r}^{BN} = \dfrac{\rho(1-\alpha)(g - (p_1 - p_2))}{2g}$, $D_{2r}^{BN} = \dfrac{\rho(1-\alpha)(g + p_1 - p_2)}{2g}$,

$D_{1or}^{BN} = \alpha(1-\beta)\min\{\dfrac{t - \rho(p_1 - p_2) + (1-\rho)(f_2 + s_w)}{2t}, 1\}$ and $D_{2or}^{BN} = 0$. Thus, we can determine the quantities of consumer returns in this scenario. Specifically, the quantity of consumer returns associated with the same-channel for both retailers is then expressed as $(1-\rho)D_{io}^{BN}$ ($i=1,2$), and the quantity of consumer returns associated with the cross-channel for retailer 1 is $(1-\rho)D_{1or}^{BN}$. Common practice shows that consumers will make additional purchases when they visit physical stores to buy products, pick up online purchases or even return items bought online (Zhang et al., 2010; Cao and Li, 2015). Such purchasing phenomenon is referred to as cross-selling, which can lead additional profit to a retailer. To capture this effect, similar to Gao and Su (2017a) and Yan et al. (2020b), we assume that each retailer may obtain an additional cross-selling profit ε from each consumer who returns an online purchase to a physical store. Note that this cross-selling profit can be regarded as the expected profit obtained from each consumer.

The objectives of the retailers are then formulated as

$$\begin{aligned}\max_{p_1,f_1}\Pi_1^{BN} &= D_{1r}^{BN}(p_1-c_r-c)+(p_1-c)\rho(D_{1o}^{BN}+D_{1or}^{BN})+\varepsilon(1-\rho)D_{1or}^{BN} \\ &\qquad -(c_o-f_1)(1-\rho)D_{1o}^{BN}-c_{or}(1-\rho)D_{1or}^{BN}\end{aligned},$$

$$\max_{p_2,f_2}\Pi_2^{BN} = D_{2r}^{BN}(p_2-c_r-c)+(p_2-c)\rho D_{2o}^{BN}-(c_o-f_2)(1-\rho)D_{2o}^{BN}. \tag{4}$$

Note that, retailer 1's profit includes five components: the profit obtained from physical store sales, the profit obtained from online sales, the profit obtained from the cross-selling, the loss caused by consumer returns through the online channel and the loss caused by consumer returns through the cross-channel return strategy. Retailer 2's profit function takes the same form as that in the NN scenario. Similar to the NN scenario, we can easily obtain the equilibrium decisions and profits of both retailers in this asymmetric scenario (i.e., asymmetric implementation of the BORS strategy), as shown in the Table 2.

To examine the impact of adopting the BORS strategy in this asymmetric implementation scenario, we compare both retailers' optimal pricing and return service charge decisions and profits, and obtain the following two propositions.

Proposition 1. In the case where one retailer adopts the BORS strategy, there exists a threshold $\overline{s}_w$ (the value is presented in the Appendix) such that:

(1) when $s_w \geq \overline{s}_w$, we have $p_i^{BN*} > p_i^{NN*}$ and $f_i^{BN*} < f_i^{NN*}$, where $i=1, 2$.

(2) when $s_w < \overline{s}_w$, if $\varepsilon < \varepsilon_1$, we have $p_i^{BN*} > p_i^{NN*}$; if $\varepsilon < \varepsilon_2$, we have $f_1^{BN*} < f_1^{NN*}$; if $\varepsilon < \varepsilon_3$, we have $f_2^{BN*} < f_2^{NN*}$; otherwise, the opposite results hold.

Proposition 1(1) shows that, when only one retailer (irrespective of whether it is retailer 1 or 2) implements the BORS strategy, if consumers' online return cost is sufficiently large (i.e., $s_w \geq \overline{s}_w$), each retailer's optimal selling price is larger than that in the NN scenario (i.e., no retailer adopts the strategy), while the optimal return service charge is smaller. In particular, when retailer 1 introduces the BORS strategy, substantial consumer returns switch from the online channel to the BORS channel, and thus retailer 1 will incur related return costs, which are larger than that associated with the online channel. Furthermore, retailer 1 will provide more return refund by adopting the BORS strategy in order to encourage more consumers to accept the strategy. For example, many firms, such as Target, BestBuy and Wal-Mart, offer a full refund for this strategy but a partial one for online consumer returns (Nageswaran et al., 2020; Hsiao and Chen, 2011). Thus, retailer 1 tends to raise the selling price to cover these costs. For similar reasons, to trade-off the losses costs due to return refunds and return costs between the online and BORS channels, retailer 1 will reduce the return service charge for online returns accordingly, which will help balance the demand across channels. As for retailer 2, total demand will decrease after retailer 1 adopts the BORS strategy due to the relatively large online return cost ($s_w \geq \bar{s}_w$), i.e., some consumers will switch to buy retailer 1's product through the BORS channel. In this case, retailer 2 increases the selling price to counteract the loss. Due to the lower total demand, especially the online demand, to retain as many consumers as possible, retailer 2 has more incentive to reduce the return service charge as well.

When consumers' online return cost is below $\bar{s}_w$, Proposition 1(2) indicates that each retailer's optimal selling price is larger than that in the NN scenario, and the optimal return service charge is smaller than that in the NN scenario when the cross-selling profit is sufficiently low, while the opposite results hold otherwise. This is because, when $s_w < \bar{s}_w$, as compared to the case where $s_w \geq \bar{s}_w$, more consumers may buy the product from retailer 2. Nonetheless, with the introduction of the BORS strategy, there are still some consumers switching from retailer 2's product to retailer 1's store. In this case, when the cross-selling profit is sufficiently high, retailer 1 has an incentive to reduce the product price to attract more consumers to buy the product, which may lead to more cross-selling profit accordingly, and retailer 2 also has an incentive to reduce the product price to retain consumers. At the same time, due to the low online return cost, retailer 1 has an incentive to provide a lower return refund for online returns to encourage consumers to accept the BORS strategy in order to gain a higher cross-selling profit, and retailer 2 may also do so to reduce online returns.

Proposition 2. When $s_w \geq \bar{s}_w$, we derive the following findings:

(1) $\Pi_1^{BN*} > \Pi_1^{NN*}$ when $\varepsilon > \underline{\varepsilon}$ (see the Appendix for $\underline{\varepsilon}$), but $\Pi_1^{BN*} \leq \Pi_1^{NN*}$ otherwise; while $\Pi_2^{BN*} < \Pi_2^{NN*}$ always holds.

(2) $\Pi_1^{BN*} > \Pi_2^{BN*}$ ($\Pi_1^{BN*} \leq \Pi_2^{BN*}$) when $\varepsilon > \varepsilon_4$ ($\varepsilon \leq \varepsilon_4$) (see the Appendix for ε_4).

Proposition 2 shows that, when $s_w \geq \bar{s}_w$, the retailer who adopts the BORS strategy (i.e., retailer 1) does not always benefit from implementing the BORS strategy, while the other retailer is always worse off in this case. Specifically, when the cross-selling profit is sufficiently large, i.e., $\varepsilon > \underline{\varepsilon}$, retailer 1 will obtain sufficient profit from the cross-selling activities due to the implementation of the BORS strategy to fully compensate for the extra return costs and return refunds. As noted earlier, when retailer 1 adopts the BORS strategy, this leads to a reduction in retailer 2's total demand and also a reduction in its online return service charge (Proposition 1). These facts will cause a profit loss for retailer 2 accordingly. Notably, Proposition 2 also indicates that, the retailer who adopts the BORS strategy obtains more profit than its rival who offers only the same-channel return strategy when the cross-selling profit is large enough. This occurs because by introducing the BORS strategy, retailer 1 will attract some consumers from retailer 2 and benefits from more cross-selling profit accordingly. Proposition 2 indicates that, it is beneficial for a retailer to adopt the BORS strategy in a competitive market when the cross-selling profit is sufficiently large, but it will be worse off otherwise.

Note that, when $s_w < \bar{s}_w$, it is very difficult for us to compare both retailers' profits in the NB and NN scenarios analytically. To graphically illustrate the main findings in Proposition 2 when $s_w < \bar{s}_w$, we present a numerical example below. We set $\alpha = 0.5$, $\beta = 0.8$, $g = 0.1$, $t = 0.15$, $\rho = 0.8$, $c = 4$, $c_r = 0.15$, $c_o = 0.55$, $s_w = 0.1$ and $c_{or} = 0.95$, and let ε increase from zero to 0.7. The results are depicted in Fig.2.

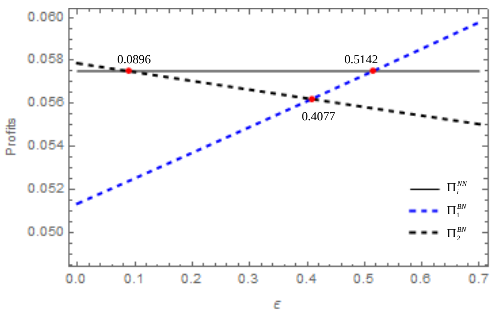

Fig.2. Both retailers' profits in the BN and NN Scenarios when $s_w < \bar{s}_w = 0.3621$

Fig.2 shows that retailer 1's profit is larger than that in the NN scenario when $\varepsilon > 0.5142$, while retailer 2's profit is less than that in the NN scenario when ε is sufficiently large, i.e., $\varepsilon > 0.0896$, but more than that in the NN scenario otherwise. This finding is different from that in Proposition 2(1). This is because, when the return cost associated with the online channel is low enough, more consumers may buy the product from retailer 2. This will benefit the retailer. We also find that retailer 1's profit is larger than retailer 2 when ε is large, i.e., $\varepsilon > 0.4077$.

4.3. Both Retailers Offering the BORS Strategy (BB)

In this scenario, both retailers adopt the BORS strategy in addition to the same-channel return strategy (BB). Again, the utility functions of online-type (store-type) consumers who purchase the products from online (offline) channel of both retailers take the same forms as those in the NN scenario, i.e., $u_{io}^{BB}=u_{io}^{NN}(i=1,2)$ and $u_{ir}^{BB}=u_{ir}^{NN}(i=1,2)$. When online-type consumers choose to return their online purchases, the proportion β of online-type consumers with a high hassle cost always return their unsatisfactory items to online stores of the retailers, while the proportion $1-\beta$ with a low hassle cost will return the items to the physical stores. The utility functions of consumers with a low hassle cost and therefore using the retailers' BORS channel are $u_{1or}^{BB}=\rho(v-p_1)-s_t-tx$ and $u_{2or}^{BB}=\rho(v-p_2)-s_t-t(1-x)$, respectively. By setting $u_{1o}^{BB}=u_{2o}^{BB}$, $u_{1or}^{BB}=u_{2or}^{BB}$ and $u_{1r}^{BB}=u_{2r}^{BB}$, the product demand functions regarding both retailers' online channels, physical stores and BORS channels can be directly obtained, i.e., $D_{1o}^{BB}=\dfrac{\alpha\beta(t-\rho(p_1-p_2)-(1-\rho)(f_1-f_2))}{2t}$, $D_{2o}^{BB}=\dfrac{\alpha\beta(t+\rho(p_1-p_2)+(1-\rho)(f_1-f_2))}{2t}$, $D_{1r}^{BB}=\dfrac{\rho(1-\alpha)(g-(p_1-p_2))}{2g}$, $D_{2r}^{BB}=\dfrac{\rho(1-\alpha)(g+p_1-p_2)}{2g}$, $D_{1or}^{BB}=\dfrac{\alpha(1-\beta)(t-\rho(p_1-p_2))}{2t}$ and $D_{2or}^{BB}=\dfrac{\alpha(1-\beta)(t+\rho(p_1-p_2))}{2t}$. The quantities of same-channel and cross-channel consumer returns of both retailers are then expressed as $(1-\rho)D_{io}^{BB}$ and $(1-\rho)D_{ior}^{BB}$ ($i=1,2$).

Hence, the objectives of both retailers are formulated as

$$\begin{aligned}\max_{p_1,f_1}\Pi_1^{BB}&=D_{1r}^{BB}(p_1-c_r-c)+(p_1-c)\rho(D_{1o}^{BB}+D_{1or}^{BB})+\varepsilon(1-\rho)D_{1or}^{BB}\\&\quad-(c_o-f_1)(1-\rho)D_{1o}^{BB}-c_{or}(1-\rho)D_{1or}^{BB},\\\max_{p_2,f_2}\Pi_2^{BB}&=D_{2r}^{BB}(p_2-c_r-c)+(p_2-c)\rho(D_{2o}^{BB}+D_{2or}^{BB})+\varepsilon(1-\rho)D_{2or}^{BB}\\&\quad-(c_o-f_2)(1-\rho)D_{2o}^{BB}-c_{or}(1-\rho)D_{2or}^{BB}.\end{aligned}\tag{5}$$

Note that, both retailers' profits include five components: the profit obtained from the physical store sales, the profit obtained from online sales, the profit from cross-selling, the loss caused by online consumer returns and the loss caused by consumer returns through the cross-channel. Similar to the two scenarios above, we can easily derive the equilibrium pricing and return service charge decisions of both retailers, which are reported in Table 2.

Table 2. Equilibrium decisions under NN, BN and BB scenarios

Scenarios	Equilibrium decisions
NN	$p_1^{NN*} = p_2^{NN*} = c + c_r + g$, $f_1^{NN*} = f_2^{NN*} = \frac{t - g\rho + c_o(1-\rho) - c_r\rho}{1-\rho}$,.
BN	When $s_w \geq \overline{s}_w$, $p_1^{BN*} = c + c_r + \frac{g(3+\alpha-4\alpha\beta)}{3-3\alpha}$, $p_2^{BN*} = c + c_r + \frac{g(3-\alpha-2\alpha\beta)}{3-3\alpha}$ $f_1^{BN*} = c_o + \frac{3t(1-\alpha) - (3c_r(1-\alpha) + g(3+\alpha-4\alpha\beta))\rho}{3(1-\alpha)(1-\rho)}$, $f_2^{BN*} = c_o + \frac{3t(1-\alpha) - (3c_r(1-\alpha) + g(3-\alpha-2\alpha\beta))\rho}{3(1-\alpha)(1-\rho)}$. When $s_w < \overline{s}_w$, $p_1^{BN*} = c + \frac{2g\alpha(2-\beta-\beta^2)(1-\rho)s_w}{3(t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho)} + \frac{3c_r t(1-\alpha)(4-\beta)}{3(t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho)}$ $\frac{g(3t(4-\beta-3\alpha\beta) + 2c_o\alpha(2-\beta-\beta^2)(1-\rho)) + 2g(\varepsilon - c_{or})\alpha(4-5\beta+\beta^2)(1-\rho)}{3(t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho)}$, $p_2^{BN*} = c + \frac{g(c_{or}-\varepsilon)\alpha(4-\beta)(1-\beta)(1-\rho)}{3(t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho)} + \frac{g\alpha(2-\beta-\beta^2)(1-\rho)s_w}{3(t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho)}$ $\frac{3c_r t(1-\alpha)(4-\beta) + 6c_r g\alpha(1-\beta)\rho + g(3t(4-\beta-\alpha(2+\beta)) + \alpha(1-\beta)(c_o(2+\beta)(1-\rho) + 6g\rho))}{3(t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho)}$ $f_1^{BN*} = \frac{3t(1-\alpha)(t-(c_r+g)\rho) + c_o(1-\rho)(3t(1-\alpha) + 2g\alpha(1-\beta)\rho)}{(1-\rho)(t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho)} -$ $\frac{2g(c_{or}-\varepsilon)\alpha(1-\beta)\rho}{t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho} - \frac{s_w(1-\beta)(t(1-\alpha) - 2g\alpha\rho)}{t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho}$ $f_2^{BN*} = \frac{(t-(c_r+g)\rho)(t(1-\alpha)(2+\beta) + 2g\alpha(1-\beta)\rho) + c_o(2+\beta)(1-\rho)(t(1-\alpha) + g\alpha(1-\beta)\rho)}{(1-\rho)(t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho)}$ $-\frac{g(c_{or}-\varepsilon)\alpha(1-\beta)\beta\rho}{t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho} - \frac{s_w(1-\beta)(2t(1-\alpha) + g\alpha(2-\beta)\rho)}{t(1-\alpha)(4-\beta) + 4g\alpha(1-\beta)\rho}$
BB	$p_1^{BB*} = p_2^{BB*} = c + \frac{g\alpha(1-\beta)(c_{or}-\varepsilon)(1-\rho) + c_r t(1-\alpha) + gt(1-\alpha\beta)}{g\alpha(1-\beta)\rho + t(1-\alpha)}$, $f_1^{BB*} = f_2^{BB*} = c_o + \frac{t^2(1-\alpha) - t(1-\alpha)(c_r+g)\rho - g\alpha(1-\beta)(c_{or}-\varepsilon)(1-\rho)\rho}{(g\alpha(1-\beta)\rho + t(1-\alpha))(1-\rho)}$.

In this symmetric scenario, both retailers adopt the BORS strategy. This option will affect both retailers' equilibrium pricing and return service charge decisions, and thus profits. We first examine the impacts of this option and then investigate whether this option benefits both retailers. The following two propositions illustrate these two issues.

Proposition 3. When $\varepsilon \le \tilde{\varepsilon}$, $p_i^{BB*} \ge p_i^{NN*}$ and $f_i^{BB*} \le f_i^{NN*}$; otherwise, $p_i^{BB*} < p_i^{NN*}$ and $f_i^{BB*} > f_i^{NN*}$, where $\tilde{\varepsilon} = \dfrac{t - g\rho + c_{or}(1-\rho) - c_r\rho}{1-\rho}$ and $i = 1, 2$.

Proposition 3 indicates that, when the cross-selling profit is sufficiently small (i.e., $\varepsilon \le \tilde{\varepsilon}$), similar to retailer 1 in the BN scenario, both retailers will increase their selling prices but decrease their return service charges. In contrast, when the cross-selling profit is relatively large, both retailers will decrease their selling prices but increase their return service charges. This is because a higher cross-selling profit will intensify the competition, encouraging both retailers to decrease their selling prices. This finding might explain why Macy's and Gap offer a discount price and a higher refund for consumer returns associated with the BORS strategy (Gap, 2019; Macy's, 2019). To trade-off the losses associated with return refunds and return costs between the online and BORS channels, both retailers will increase their return service charges for online consumer returns accordingly. This further encourages more consumers to switch to the BORS channel and thus leads to more cross-selling profits for both retailers.

Proposition 4. In the symmetric implementation scenario, when $\varepsilon > \tilde{\varepsilon}$, both retailers will be better off implementing the BORS strategy, i.e., $\Pi_i^{BB*} > \Pi_i^{NN*}$; otherwise, both retailers will be worse off, i.e., $\Pi_i^{BB*} \le \Pi_i^{NN*}$.

Proposition 4 indicates that, when the cross-selling profit is sufficiently large, i.e., $\varepsilon > \tilde{\varepsilon}$, both retailers benefit from adopting the BORS strategy. In this case, both retailers may obtain sufficient profits from the additional cross-selling activity to cover the return costs incurred and counteract the negative effects of price competition. This finding is consistent with Proposition 2(1). This can explain why many omnichannel firms in a competitive market, such as Suning and Gome in China, offer the BORS service to consumers. In contrast, when the cross-selling profit is sufficiently low, this profit may not cover the costs incurred and offset the possible loss caused by price competition.

We next explore the effects of ε and ρ on the optimal decisions and profits of both retailers and this leads us to the following interesting proposition.

Proposition 5. (1) $\dfrac{\partial p_i^{BB*}}{\partial \varepsilon} < 0$, $\dfrac{\partial f_i^{BB*}}{\partial \varepsilon} > 0$; (2) When $\varepsilon \le \varepsilon_5$, $\dfrac{\partial p_i^{BB*}}{\partial \rho} \le 0$; otherwise, $\dfrac{\partial p_i^{BB*}}{\partial \rho} > 0$; (3) When $\varepsilon > \varepsilon_6$, $\dfrac{\partial \Pi_i^{BB*}}{\partial \rho} \le 0$; otherwise, $\dfrac{\partial \Pi_i^{BB*}}{\partial \rho} > 0$; where ε_5 and ε_6 are provided in the Appendix.

Proposition 5(1) shows that, each retailer's optimal selling price (return service charge) decreases (increases) with the cross-selling profit ε in the BB scenario. Intuitively, as ε increases, both retailers can obtain more profit from the cross-selling opportunities created by consumer store visits due to the BORS returns. In this case, to gain competitive advantage in the market, both retailers have more incentive to reduce their selling prices, which may lead to more product sales. On the other hand, both retailers tend to increase their return service charge in order to induce more consumers to switch from the online channels to the BORS channels to increase the opportunities for cross-selling.

Proposition 5(2) indicates that in the BB scenario, when the unit cross-selling profit is sufficiently small (i.e., $\varepsilon \le \varepsilon_5$), as the product return rate increases (i.e., ρ decreases), both retailers' optimal selling prices increase accordingly. This is intuitive because a higher return rate means more return costs for each retailer. Thus, each retailer will have more incentive to increase the selling price in order to cover the return costs incurred. In contrast, when the unit cross-selling profit is sufficiently large, i.e., $\varepsilon > \varepsilon_5$, both retailers' optimal selling prices decrease with the product return rate. This is reasonable since a higher return rate will lead to more cross-selling profit from the BORS strategy, and thus retailers have more incentive to reduce their selling prices.

Proposition 5(3) shows that, when the cross-selling profit is sufficiently high (i.e., $\varepsilon > \varepsilon_6$), as the return rate decreases (i.e., ρ increases), the profit of any retailer who adopts the BORS strategy decreases. That is, as the return rate increases, retailers who implement the BORS strategy will benefit more from this choice. This is reasonable since a larger return rate will lead more consumers to return their purchased products at the physical store, and thus generate more cross-selling profit for the retailer. In contrast, when the cross-selling profit cannot cover the unit operational and return costs, the opposite results hold. Note that, we also examine the effects of ρ on both retailers' profit in the BN scenario, and obtain the same finding on retailer 1's profit, but find that retailer 2's profit always decreases with the return rate.

5. Endogenous Strategy Analysis

In the previous section, we assume that the BORS strategy is given and examine the optimal return channel strategy and associated conditions. In this section, we relax this assumption and assume that this strategy is endogenous. That is, both retailers will determine whether to implement the BORS strategy simultaneously. To investigate the optimal return channel strategy and related pricing and return service charge decisions in a competitive environment, we seek the subgame perfect equilibrium (SPE). There are four subgames differentiated by which retailers offer the cross-channel return strategy, i.e., (N, N), in which no retailer offers the BORS strategy; (B, N), in which retailer 1 offers the BORS strategy; (N, B), in which retailer 2 offers the BORS strategy, and (B, B), in which both retailers offer the BORS strategy. The models and results in the games (N, N), (B, N) and (B, B) are the same as those in the NN, BN and BB scenarios, respectively. The models and results in the game (N, B) are symmetric to those in BN scenario, and are presented in the Appendix.

Based on both retailers' equilibrium pricing and return service charge decisions and profits, we can derive the equilibrium return channel strategy when the decision on implementing BORS strategy is endogenous. The following proposition formally characterizes the equilibrium return channel strategy and associated conditions in this case.

Proposition 6. (1) When $\rho > \bar{\rho}$, if $\varepsilon \leq \underline{\varepsilon}$, NN is the equilibrium channel strategy; if $\underline{\varepsilon} < \varepsilon < \bar{\varepsilon}$, NB (or BN) is the equilibrium channel strategy; if $\varepsilon \geq \bar{\varepsilon}$, BB is the equilibrium strategy, where $\bar{\rho}$ and $\bar{\varepsilon}$ are presented in the Appendix.

(2) When $\rho \leq \bar{\rho}$, if $\varepsilon \leq \underline{\varepsilon}$, NN is the equilibrium channel strategy; otherwise, BB is the equilibrium strategy.

Proposition 6 shows that, whether a return channel strategy is an equilibrium depends on the return rate (i.e., $1-\rho$) and the cross-selling profit generated from the BORS channel returns. Specifically, when the return rate is sufficiently low (i.e., $\rho > \bar{\rho}$), a relatively small number of consumers will return their items and very few consumers may choose to return items at the physical stores. Thus, both retailers may expect to obtain low profit from cross-selling activities. In this case, if the unit cross-selling profit is too low, neither retailer would offer the BORS strategy. This makes sense as such low cross-selling profit cannot outweigh each retailer's return costs which will further dampen both retailers' profits. If the cross-selling profit is medium, only one retailer will adopt the BORS strategy. In this case, if one retailer does not offer the BORS strategy, the other retailer will offer the BORS strategy to obtain more profits because the positive effect of the cross-selling profit dominates the negative effects of price and return competition. This is reasonable in that adopting the BORS strategy will increase the retailer's demand while reducing its rival's demand. In this case, neither retailer can improve its profit by switching strategy. If the cross-selling profit is sufficiently large, both retailers can gain more profit from adopting the BORS strategy, which can cover the return costs incurred. In this case, both retailers will implement this strategy accordingly, and thus BB is the equilibrium strategy. In contrast, when the return rate is sufficiently high (i.e., $\rho \leq \bar{\rho}$), a relatively large number of online-type consumers will return their items, and many more consumers may be willing to return items to stores. This creates more potential cross-selling opportunities, and both retailers will have great incentive to adopt the BORS strategy if the unit cross-selling profit is sufficiently large, or will not implement the strategy otherwise. These findings can be supported by practical evidence. J. C. Penney uses the BORS strategy as the quickest and easiest way to deal with consumer returns and this strategy has been demonstrated to have strong in-store cross-selling capabilities (Nageswaran et al., 2020). A study shows that a firm can gain a 20% increase in total sales by adopting the BORS return strategy (Neslin and Shankar, 2009). As for Macy's and Gap, online sales only account for 10% and 20% of their total sales, respectively; and both firms can benefit more from cross-selling profits generated from adopting the BORS channel (Garcia, 2017). This evidence suggests that retailers can benefit from adopting the cross-channel return strategy, due to opportunities for cross-selling activities. Furthermore, these findings can be used to explain why BestBuy and Apple offer the BORS strategy for consumer electronics, and J. C. Penney and Macy's adopt such strategy for apparels and home decors. These findings indicate that retailers can always choose a preferable return channel strategy according to their market conditions and product characteristics.

By investigating the equilibrium channel strategy BB, we have obtained an interesting finding, which is formally stated in the following proposition.

Proposition 7. Given the equilibrium channel strategy BB, when $\varepsilon \geq \tilde{\varepsilon}$, both retailers are always better off adopting the BORS strategy; however, when $\max\{\underline{\varepsilon}, \overline{\varepsilon}\} \leq \varepsilon < \tilde{\varepsilon}$, both retailers fall into the prisoner's dilemma.

Proposition 7 shows that both retailers may fall into the prisoner's dilemma when $\max\{\underline{\varepsilon}, \overline{\varepsilon}\} \leq \varepsilon < \tilde{\varepsilon}$. Although in this case, the adoption of the BORS strategy is not the Pareto equilibrium strategy for both retailers, no retailer has an incentive to deviate unilaterally from the BB equilibrium strategy. Specifically, any deviation from the equilibrium by one retailer will lead to possible loss of competitive advantages which will be to the benefit of the other retailer. Thus, both retailers will still adopt the BORS strategy in equilibrium even though the cross-selling profits are not very high. Yan et al. (2020b) indicate that a retailer in the monopoly market is better off implementing the BORS strategy when the cross-selling profit is sufficiently high, but is worse off when the cross-selling profit is medium or low. This finding is similar to the results of our analysis. Fig.3 graphically illustrates the main findings in Propositions 6 and 7 when $s_w \geq \overline{s}_w$ and the other parameters are set as $\alpha = 0.5$, $\beta = 0.8$, $g = 0.1$, $t = 0.15$, $\rho = 0.8$, $c = 4$, $c_r = 0.15$, $c_o = 0.55$ and $c_{or} = 0.95$.

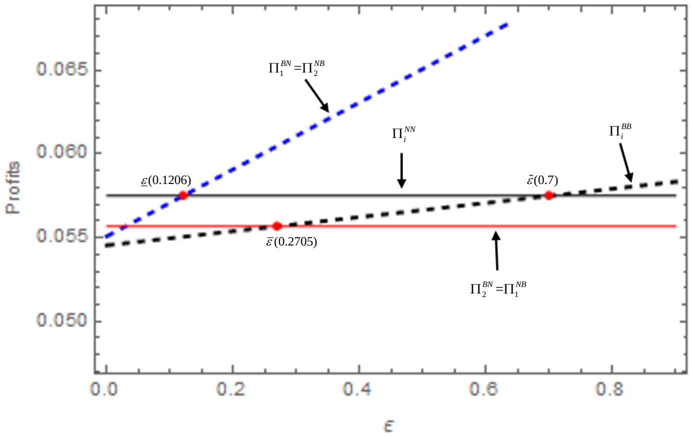

Fig.3. Optimal profits of both retailers regarding ε when $s_w \geq \bar{s}_w = 0.3621$

Fig.3 shows that, when $\varepsilon \leq \underline{\varepsilon} = 0.1206$, $\Pi_2^{NB} = \Pi_1^{BN} < \Pi_1^{NN} = \Pi_2^{NN}$ and $\Pi_1^{BB} = \Pi_2^{BB} < \Pi_2^{BN} = \Pi_1^{NB}$, and NN is the equilibrium strategy. When $0.1206 = \underline{\varepsilon} < \varepsilon \leq \bar{\varepsilon} = 0.2705$, $\Pi_2^{NB} = \Pi_1^{BN} > \Pi_1^{NN} = \Pi_2^{NN}$ and $\Pi_1^{BB} = \Pi_2^{BB} < \Pi_2^{BN} = \Pi_1^{NB}$, and BN (NB) is the equilibrium strategy. When $\varepsilon \geq \bar{\varepsilon} = 0.2705$, $\Pi_2^{NB} = \Pi_1^{BN} > \Pi_1^{NN} = \Pi_2^{BB}$ and $\Pi_1^{BB} = \Pi_2^{BB} > \Pi_2^{BN} = \Pi_1^{NB}$, and BB is the equilibrium strategy. Fig.2 also shows that, when $\varepsilon \geq \tilde{\varepsilon} = 0.7$, we have $\Pi_i^{BB} > \Pi_i^{NN}$. However, when $\bar{\varepsilon} < \varepsilon \leq \tilde{\varepsilon}$, we have $\Pi_i^{BB} < \Pi_i^{NN}$, which indicates that both retailers fall into the prisoner's dilemma. Note that, when $s_w < \bar{s}_w$, the main findings are the same as those obtained above, and we omit the details here.

Note that the two thresholds $\underline{\varepsilon}$ and $\bar{\varepsilon}$ have significant effects on the equilibrium return channel strategies as shown in Proposition 6, and $\tilde{\varepsilon}$ and $\bar{\varepsilon}$ significantly affect the existence of both retailers' prisoner's dilemma in Proposition 7. Generally, the prisoner's dilemma is not the expected outcome for both retailers, and then a question arises: how can the retailes reduce the possibility that this dilemma occurs? Note that the larger the specified threshold difference $\tilde{\varepsilon} - \max\{\underline{\varepsilon}, \bar{\varepsilon}\}$ in Proposition 7, the higher the possibility that the dilemma occurs. In this regard, we further investigate the effects of ρ on the two thresholds $\underline{\varepsilon}$ and $\bar{\varepsilon}$, and the specified threshold difference $\tilde{\varepsilon} - \max\{\underline{\varepsilon}, \bar{\varepsilon}\}$, and have the following findings.

Corollary 1. (1) $\frac{\partial \underline{\varepsilon}}{\partial \rho} < 0$ and $\frac{\partial \bar{\varepsilon}}{\partial \rho} < 0$; (2) $\frac{\partial(\tilde{\varepsilon} - \max\{\underline{\varepsilon}, \bar{\varepsilon}\})}{\partial \rho} > 0$.

Corollary 1(1) shows that, when the return rate ($1-\rho$) is sufficiently high, i.e., ρ will be sufficiently low, the condition $\varepsilon > \bar{\varepsilon}$ or even the condition $\underline{\varepsilon} < \varepsilon \leq \bar{\varepsilon}$ may be hard to satisfy. Therefore, according to Proposition 6, retailers are worse off adopting the BORS strategy and would choose to implement the same-channel return strategy instead. This suggests that products with a sufficiently high return rate may not be suitable for the BORS strategy. Notably, we further examine the effect of ρ on the threshold $\tilde{\varepsilon}$ in Proposition 4, and find that $\tilde{\varepsilon}$ is also decreasing in ρ. These results suggest that the findings under Corollary 1 are also applicable to both the asymmetric and symmetric implementation scenarios when the BORS strategy is exogenously given ex ante (Propositions 2 and 4, respectively).

Corollary 1(2) further suggests that, to avoid the prisoner's dilemma, both retailers should carefully choose the right products, i.e., those with relatively high return rates. This is intuitive as more returns leads to more consumers switching to the BORS channel and thus more cross-selling profits for both retailers. In this case, both retailers may benefit from adopting the BORS strategy. On the other hand, products with relatively low return rates give more possibility of the prisoner's dilemma outcome. This further suggests that products with very low return rates are not suitable for the BORS strategy in the symmetrically competitive market.

Interestingly, considering the findings in Corollary 1(1) and Corollary 1(2), we find that the products with a moderate return rate may be more suitable for the BORS strategy than those with a relatively high or low return rate. This finding can partly be used to explain why Amazon.com offers the BORS strategy for 3C products with a return rate between 25-35% rather than those fashion products with a return rate even reaching 70% or those low-return rate products such as books and media products with a return rate between 5-7% (Amazon, 2018). Retailers should carefully choose the right products when adopting the BORS strategy. Our findings can be used as a guideline for managers of return channels in this regard.

6. The Case of Full Refunds for Returns

In our base model, we assume that each retailer offers a partial refund for online consumer returns. In practice, many firms such as Nordstrom or Neiman Marcus simultaneously offer a full refund for consumer returns in both online and offline stores, and they introduce the BORS strategy to handle consumer returns as well. Following such a practice, in this section we consider the important case where a full refund (i.e., $f_i = 0$, $i = 1, 2$) is offered for consumer returns in both channels in order to further examine the BORS strategy. Notably, our main findings remain unchanged in this case, and in the following we present only differences in the findings due to the full refund.

Proposition 8. Given the equilibrium channel strategy BB, when $\varepsilon > \varepsilon_8$ or $\rho < \tilde{\rho}$, both retailers are always better off adopting the BORS strategy; however, when $\rho > \tilde{\rho}$ and $\varepsilon_7 < \varepsilon < \varepsilon_8$, both retailers fall into the prisoner's dilemma; where ε_7, ε_8 and $\tilde{\rho}$ are provided in the Appendix.

Proposition 8 shows that when the return rate is relatively low and the cross-selling profit is medium, both retailers will be worse off adopting the BORS strategy compared to the NN scenario, i.e., they fall into the prisoner's dilemma. This arises because adopting the BORS strategy is not the Pareto equilibrium strategy for the retailers. Specifically, a relatively low return rate means a small number of consumers will choose to return their unsatisfactory items to the physical stores, which will generate less cross-selling profits. In this case, if the cross-selling profit is not sufficiently large, both retailers' profits will be further dampened. This finding indicates that both retailers should carefully determine whether to adopt a full refund policy when implementing the BORS strategy. That is, retailers should only do so for products where the return rates are relatively high or the cross-selling profits are sufficiently large. This can be used as a guideline for managers to operate the BORS channel for products according to the market practice, and this further enriches insights on the BORS channel management in the extant literature. Fig.4 and Fig.5 graphically illustrate Proposition 8 in the cases when $\rho = 0.8$ and $\rho = 0.71$, respectively, and the other parameters are set as $\alpha = 0.5$, $\beta = 0.8$, $g = 0.07$, $t = 0.15$, $c = 3$, $c_r = 0.15$, c_{or} =0.95, $c_o = 0.55$ and $\rho = 0.8$.

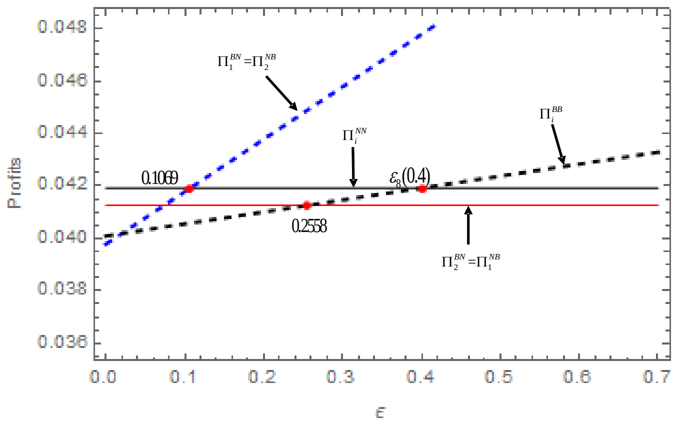

Fig.4. Both retailers' profits with $\rho = 0.8$

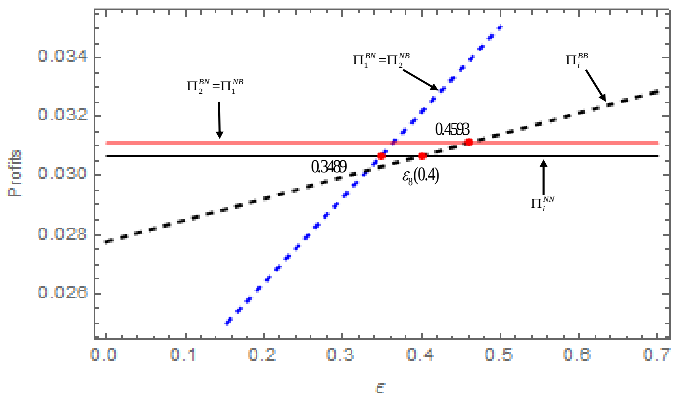

Fig.5. Both retailers' profits with $\rho = 0.71$

For simplicity, we discuss only Fig.4 here. Specifically, when $\varepsilon \leq 0.1069$, $\Pi_1^{BN} > \Pi_1^{NN}$ and $\Pi_2^{BB} > \Pi_2^{BN}$, and in this case, NN is the equilibrium strategy. When $0.1069 < \varepsilon \leq 0.2558$, $\Pi_1^{BN} > \Pi_1^{NN}$ and $\Pi_2^{BB} < \Pi_2^{BN}$, and in this case, BN or NB is the equilibrium strategy. When $\varepsilon > 0.2558$, $\Pi_1^{BN} < \Pi_1^{NN}$ and $\Pi_2^{BB} < \Pi_2^{BN}$, and in this case BB is the equilibrium strategy. Given the equilibrium channel strategy BB, when $\varepsilon \geq \varepsilon_8 = 0.4$, we have $\Pi_i^{BB} > \Pi_i^{NN}$. When $\rho = 0.8 > \tilde{\rho} = 0.7426$ and $0.2558 < \varepsilon < \varepsilon_8 = 0.4$, we have $\Pi_i^{BB} < \Pi_i^{NN}$, both retailers fall into the prisoner's dilemma.

To further examine the effects of return policies, we compare both retailers' profits in the BB scenarios in the partial and full refund cases, and achieve the following interesting findings:

Proposition 9. In the BB scenario, both retailers are better off by providing a full refund return policy when $\alpha > \alpha_1$ and $\varepsilon < \varepsilon_9$, but they both benefit more from offering a partial refund return policy otherwise; where α_1 and ε_9 are provided in the Appendix.

Proposition 9 characterizes the optimal return policy and associated conditions when both retailers implement the BORS strategy and suggests a counterintuitive finding. Specifically, when the probability α of a consumer being online-type is sufficiently large, indicating that a great quantity of consumer returns may arise for the given return rates, more consumers will choose to return their items to the physical stores. This will generally lead to greater cross-selling profits for both retailers. In this case, a partial refund return policy online may further help entice more consumers to return items to the physical stores for a full refund. Although this can generate more cross-selling profits, this may also lead to more return costs associated with the BORS channel than those at online stores. If, in this case, the unit cross-selling profit is sufficiently large, the cross-selling profits may cover the return costs incurred, and both retailers will be better off providing a partial refund return policy. Otherwise, both retailers will be worse off. In this sense, both retailers may offer a full refund return policy instead in order to entice more consumers to return items via the online channels so as to reduce the return costs. On the other hand, when α is too small, fewer online-type consumers will return to both the online and physical stores. In this case, both retailers will have less incentive to offer a full refund because thus will further dampen the cross-selling profits associated with the BORS channels. These findings can be used to partly explain why some firms with a relatively low proportion of online-type consumers (e.g., T.J. Maxx) offer partial refunds while some others with a relatively high proportion of online-type consumers (e.g., Nordstrom and Neiman Marcus) offer full refunds for some online sold products when adopting the BORS strategy (Nageswaran et al., 2020).

Since it is difficult to derive the analytical results in the BN scenario, we use a numerical example to identify the return policy. We set $\beta = 0.8$, $g = 0.1$, $t = 0.15$, $\rho = 0.8$, $c = 4$, $c_r = 0.15$, $c_o = 0.55$, $s_w = 0.1$ and $c_{or} = 0.95$, and let α increase from zero to 1. The results are depicted in Fig.6.

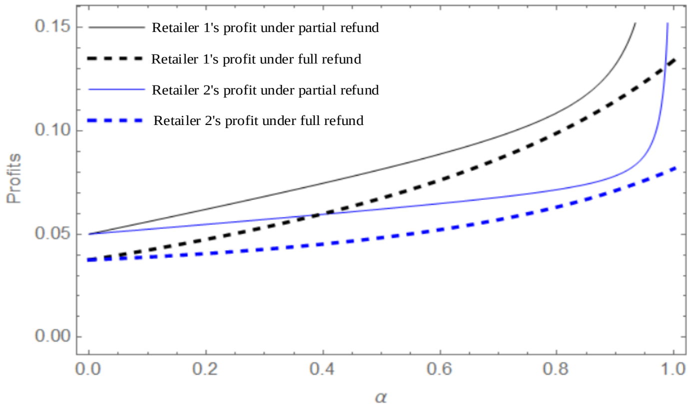

Fig.6. Both retailers' profits under partial refund and full refund

Fig.6 shows that both retailers are always better off by providing a partial refund return policy in the BN scenario. This is because, if they both provide a full return refund, the attraction of the BORS strategy will be reduced, and this will intensify the competition between their online channels.

7. Conclusions

In the face of ubiquitous consumer returns, dual-channel retailers are increasingly adopting a cross-channel return strategy "Buy Online and Return to Store" in order to achieve advantages in competitive markets. Unlike the traditional return channel, this strategy allows consumers to return products bought online to physical stores. This marketing strategy can lead to cross-selling profits for retailers but also can involve increased return costs. Therefore, retailers should carefully determine whether to introduce the cross-channel strategy, especially in a competitive market. To address this challenging issue, we consider two competing dual-channel retailers, and investigate three scenarios, with no retailer, only one retailer and both retailers offering the BORS channel, respectively, to investigate the optimal return channel strategy. We first assume that a partial refund is offered for online consumer returns, and then consider the case in which a full refund is offered for online consumer returns. We develop a theoretical model in each scenario and explore the optimal decisions regarding the implementation of the BORS channel and the associated prices and return service charges by considering two cases: one in which the BORS strategy is exogenously determined ex ante and the other in which it is endogenously determined.

Our analysis yields the following important and interesting findings and managerial insights. *First*, whether a retailer adopts the BORS strategy significantly depends on the return rate and the unit cross-selling profit. Specifically, when the return rate is sufficiently low, if the cross-selling profit is high enough, both retailers will implement the BORS strategy in a competitive market. If the cross-selling profit is medium, only one of retailers will adopt this strategy. Extremely, if the cross-selling profit is sufficiently low, none of retailers will introduce this strategy. In contrast, when the return rate is sufficiently high, whether both retailers will adopt the strategy or not is conditional on whether the unit cross-selling profit is sufficiently high or low. *Second*, under the equilibrium channel strategy BB, both retailers will fall into the prisoner's dilemma under certain conditions, i.e., when the cross-selling profit is not sufficiently high in the case where both retailers offer a partial refund return policy, or when the return rate is relatively low and the cross-selling profit is not sufficiently high in the case where both retailers off a full refund return policy. *Third*, the return rate has significant effects on the equilibrium channel strategy and the existence of the prisoner's dilemma. In particular, the products with medium return rates are suitable for the BORS strategy, and in this case, both retailers are less likely to fall into the prisoner's dilemma. Finally, when the cross-selling profit is sufficiently large, a retailer's profit increases with the product return rate when it offers the BORS strategy. These findings provide some important insights to help retailers to manage their BORS channels. Specifically, retailers should carefully choose products that are suitable for the BORS strategy, i.e., those products with a relatively high but not too high return rates, such as 3C products rather than fashion products or books and media products (Amazon, 2018).

Our results also show that, when both retailers implement the BORS strategy, it is beneficial for both retailers to offer a full refund return policy when the number of online-type consumers is large enough and the unit cross-selling profit is relatively small. Otherwise, they are better off by providing a partial refund return policy instead, and this, however, is always applicable in the case where only one retailer adopts the BORS strategy. These findings suggest important guidelines for retailers to determine their return policies according to their market conditions such as the proportion of online consumers or online sales and the store visits caused by the online-to-store returns.

This paper has identified some important insights for cross-channel return strategy management in a competitive market. Nonetheless, there are some limitations that are left as future research topics. *First*, we assume that the two products sold by the competing retailers in the market have no systematic differences. If there are significant differences between the two products such as low- and high-quality products, consumers will be further differentiated, which may generate different results. *Second*, we have not considered inventory related issues in our work. It is interesting to consider order decisions and the resale of return items under our framework in future research. *Third*, we conduct the analysis in a competitive market, and this can be directly extended to a supply chain setting, in which the two competing retailers obtain the supplied products from the same supplier. In this case, the interaction between the supplier and the two retailers will significantly affect the game, and thus will lead to different results. *Finally*, we assume that the cross-selling profit is the same for both retailers in our model. It is interesting to examine the case where the cross-selling profit is different for the two retailers in future research.

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