A study of return strategy under Omni-Channel retail based on Stackelberg game

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Abstract. In practice more and more retailers began to allow consumers to order online and pick up in store (BOPS), this paper focuses on the BOPS omni-channel model under the return strategy selection problem of the research, considering the product matching rate, online return processing costs, cross-channel return probability and other factors. Constructing Stackelberg game models by using the consumer utility function which is used for analyzing the consumers' choices for different channels and constructing the demand function of each channel and the profit function of retailers and manufacturers. Backward induction is used for calculating the price and profit equilibrium and manufacturers' optimal pricing and channel demand are examined both before and after cross-channel return services are implemented. In addition, the manufacturer's perspective on return strategy selection gets examined. The results show that: compared to the dual-channel model, the overall demand of the supply chain increases substantially after the implementation of the BOPS strategy regardless of whether cross-channel returns are allowed or not; aggregate demand in the supply chain increases as product matching increases and is at its highest when cross-channel returns are permitted; the implementation of a cross-channel returns strategy by manufacturers is optimal when the cross-channel returns processing cost are minimal and the benefits derived from implementing a BOPS strategy are considerable.

Keywords: Stackelberg game, BOPS, cross-channel return, omni-channel model.

1. Introduction

The advent of e-commerce and modern logistics systems has led to a significant surge in online shopping. According to the official website of the National Bureau of Statistics [1], the total retail sales of consumer goods amounted to 4,714.95 billion yuan in 2023, representing an increase of 7.2% over the previous year. The national online retail sales figure for 2023 was 154,264 billion yuan, an increase of 11.0% over the previous year. Among them, online retail sales of physical goods amounted to 130,174 billion yuan, an increase of 8.4%, accounting for 27.7% of total retail sales of consumer goods. In 2022, online retail sales of physical goods accounted for 27.2% of total retail sales of consumer goods. This figure represents a 0.5 percentage point increase compared to the previous year and the emphasis on structural changes to online and offline channels merits further consideration. Consequently, the accelerated growth of channel convergence has the potential to offer consumers a wider range of choices. However, it also presents novel challenges for dual-channel retailers in returns management.

This study focuses on two aspects: omni-channel and return management. In terms of channel management, Zhou[2] constructed different master-slave relationship models to study the impact of consumer channel preference on channel selection. The findings of this study offer a valuable reference point for future research on channel structure design and selection strategies for various decision-making subjects in the dual-channel supply chain environment,which has possessed significant reference value and guiding principles. Zijian Zhang and Xiaoqiao Liu [3] constructed different pricing strategy models under the implementation of BOPS omni-channel model, comparing and analyzing the pricing strategies in centralized and decentralized models. Zhao,Cheng and Qiu et al.[4] explored the implementation of BOPS and the option for cross-channel return services. They utilized Stackelberg game to develop dual-channel and omni-channel models. After deriving the equilibrium solutions for pricing in each channel, they compared various factors to analyze how product pricing and channel demand change. Gallino and Moreno[5] has explored whether retailer's online and offline channel demand would be affected by the fact BOPS strategy and the results showed that the offline market may encroach on a part of the original online market after the implementation of BOPS, but the cross-benefits would lead to an improvement in the overall profitability of the supply chain. Chenchen G et al.[6] investigated whether the implementation of BOPS is affected by differences in market competition and timing of decisions with the objective of maximizing consumer profits.

In the area of returns management, Piye Yuan, Shuyu Wang, and Mengzhu Guan [7] constructed an omni-channel retailing model to study the impact of BOPS and cross-returns on the overall supply chain demand, profit and the conditions for the implementation of the return strategy by examining the factors such as the return processing cost and the probability of cross-returns. Ren H et al. [8] considered quality control and cross-channel returns and study their impact on supply chain decision-making and profitability, and study their impact on supply chain decision making and profitability. Under different return policies,Zhao, Zhang, and Min [9] studied the implementation conditions of online retailers' return policies. It is found that product match rate, cross-earnings, and cross-channel return processing costs all affect return strategy choice. Moutaz K[10],Huirong F[11] et al. has created a comparison of different methods of return refunds(e.g. cash returns,store credit card or gift card returns,etc.) in the presence of opportunistic consumer behavior (closet) to analyze retailers' pricing, quantity, and product return policies.

2. Problem description and notation

In this paper, I consider the supply chain structure of a manufacturer with an online direct sales channel and an offline retailer and assume that the manufacturer and the retailer sell defect-free products of the same quality and price, and consider whether to allow cross-channel return strategies in the case of implementing BOPS strategies on top of the dual-channel model (hereinafter referred to as the omni-channel model), and denote the three strategies by 1,2,3, respectively. When purchasing through offline channels, consumers will only purchase after their needs have been satisfied , so it is assumed that there are no returns offline. In the case where cross-channel returns are not permitted, consumers will choose to purchase through online channels, and if the product does not meet their expectations, they will return it, but they can only return it to the online channel and will have to pay for the return shipping costs themselves. When consumers choose to buy through the BOPS channel, some retailers provide special service, such us dedicated pickup counters and reserved parking spaces, which reduces the cost of shopping hassles to a certain extent. Consumers buy online and pick up offline, and when they are not satisfied with the product, they need to return it to the online channel and bear the return shipping cost.Consumers buy online and pick up offline, and when they are not satisfied with the product, they will have to return it to the online channel and bear the return shipping cost. In cases where cross-channel returns are allowed, consumers can choose to return the product online or to an offline physical store according to their own preference; when consumers choose to purchase through the BOPS channel, they can purchase online and pick up offline, and they may take the product home to try it out for reasons of time or their own preference; they can choose to return the product offline when the product does not meet their expectations. When the product does not meet expectations, consumers can choose to return the product directly offline or online. The above three channels are denoted by s, o, b, respectively.

In this paper, it is assumed that the total market demand is 1, and that each consumer buys at most one unit of the product and does not buy from more than one channel at the same time. The manufacturer wholesales the product to retailers at price w, and the product is sold in each channel at price p. The unit cost of the product is c ($c<p$). Assume that the consumer's valuation of the product is v, which obeys a uniform distribution on [0,1].The consumer needs to pay a hassle cost (e.g., transportation cost, queuing cost, etc.) for going to the offline brick-and-mortar store, which is denoted as h_s; the consumer incurs the hassle cost of searching online h_0, as well as the hassle cost of waiting for the product h_1, when he/she purchases online. When purchasing in BOPS channel, consumers first browse online and then go to offline to pick up the goods, which also generates the trouble cost of searching, but at the same time generates a certain amount of traveling cost, but does not need to queue up to pay for the trouble cost, so α ($0<\alpha<1$) is the inconvenience coefficient, and the larger α is, the higher the trouble cost of going to offline to pick up the goods and the lower the convenience degree of picking up the goods. As online products can not be directly experienced, after receiving the goods, the product has a probability of λ can match the consumer demand, λ for the product matching rate, $0\leq\lambda\leq1$; if consumers are not satisfied with the product will produce a return, so there will be online return costs (eg, logistics costs, etc.), recorded as t_o, in the case of cross-channel returns are allowed, the consumer chooses to go to the offline return will produce the cost of the offline return t_s, due to online return, you need to send back the product by yourself and bear the return shipping cost., so there is a relationship $t_s<t_o$. The returned product will generate a residual value **r**, assuming that the returned product is not subject to secondary sales, so $s<c$.The manufacturer needs to handle the products returned online (e.g., checking into the warehouse, etc.), denoted as $\mathbf{c_o}$; the offline retailer needs to process the products returned offline, which is recorded as $\mathbf{c_b}$; when the consumer chooses to return the products across the channels, which requires the brick-and-mortar stores to pay more service costs as well as inventory costs; thus, $c_b>c_o$. Any offline pickup and return of a product purchased by a consumer in the BOPS channel is likely to result in cross-earnings for the retailer e. Retailer to pay a certain unit cost for the service provided by the retailer, denoted as μ. In this paper, cross-channel return refers to the fact that online channel purchases can go to offline for return, offline channel purchases can be returned online, and consumers can choose the return channel based on their own preferences. Therefore, this study introduces cross-channel return probability in online and BOPS channels, β denotes the cross-channel return probability in online channel, which is the probability that consumers choose to go to offline physical stores to return goods when purchasing in online channel, and $\boldsymbol{\gamma}$ denotes the probability that consumers choose to return goods directly offline when purchasing in BOPS channel, where β and γ obey a uniform distribution on [0,1].

3. Model Construction

In this paper, I construct Stackelberg game models under dual-channel, BOPS same-channel return strategy and BOPS cross-channel return strategy respectively, and study the manufacturer's return strategy choices by comparing and analyzing the profit and demand under the two strategies. Where the superscript * denotes the equilibrium solution.

3.1 Benchmark Model

In the benchmark model, there is no cooperation between the manufacturer and the retailer and a same-channel return strategy is implemented. The game sequence is:(1)the manufacturer announces the product matching pricing strategy;(2)the manufacturer prices the product and wholesales it to the retailer at wholesale price **w**, and the offline retailer matches the price of the online product;(3)the consumer makes the purchasing decision and chooses the method of return (in case of a return). Borrowing the consumer utility function to establish Stackelberg game model, at this time the online and offline consumer utility function is: $U_s^1 = \lambda(v-p) - h_s$, $U_o^1 = \lambda v - p - h_0 - h_1 - (1-\lambda)t_o$. When $U_s^1 > 0$ and $U_s^1 > U_o^1$, consumers choose offline channels to buy; when $U_o^1 > 0$ and $U_o^1 > U_s^1$, consumers choose online channels to buy, which can be obtained from the distribution of demand for each channel, as shown in Fig.1.

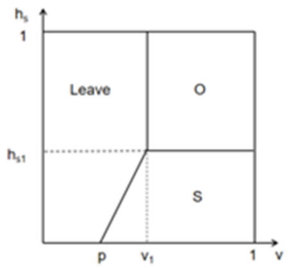

Fig. 1. Demand distribution by channel

Of these, $h_{s_1} = (1-\lambda)p + h_0 + h_1 + (1-\lambda)t_o$, $v_1 = p + \frac{h_{s_1}}{\lambda}$ .From Fig.1. the following constraints need to be satisfied in order to ensure that there is demand for each channel: $0 < (1-\lambda)p + h_0 + h_1 + (1-\lambda)t_o < 1$ and $0 < p < p + \frac{h_{s_1}}{\lambda} < 1$, respectively:

$$D_s^1 = \left(1 - p - \frac{h_{s_1}}{2\lambda}\right) * h_{s_1} \tag{1}$$

$$D_o^1 = \left(1 - p - \frac{h_{s_1}}{\lambda}\right) * (1 - h_{s_1}) \tag{2}$$

Total demand is:

$$D^1 = D_s^1 + D_o^1 \tag{3}$$

The total profit of the model is:

$$\pi^1 = (p-c) * D_o^1 + (1-\lambda)(r - p - c_o) * D_o^1 + (w - c) * D_s^1 + \lambda * p * D_s^1 - w * D_s^1 \tag{4}$$

Substituting the demand functional equation for each channel into the profit function, the second order derivative of the retailer's profit $\boldsymbol{\pi^1}$ with respect to **p** is less than zero, so there exists an optimal solution to the function, and the optimal price p^{1^*} is obtained by using backward induction:

$$p^{1^*} = \frac{\lambda + c - h_{s_1} + (1-h_{s_1})(1-\lambda)(c_o - r) + \frac{{h_{s_1}}^2}{2}}{2\lambda} \tag{5}$$

Substituting optimal pricing into each equation yields the optimal solution for each channel's demand, the retailer's total demand, and the retailer's profit.

3.2 Same-Channel Return Strategy Model In Omni-Channel Mode

In the omni-channel model, where the manufacturer and retailer cooperate with each other to implement the BOPS strategy but only allow same-channel returns, the sequence of the game is as follows: (1) the manufacturer announces a product-matching pricing strategy;(2)the manufacturer prices the product and wholesales it to the retailer at a wholesale price of **w**, and the offline retailer matches the price of the product on-line;(3)the two parties reach a cooperation, the offline retailer receives the unit subsidy **μ** given to the retailer by the manufacturer of the BOPS channel;(4) the consumer makes a purchase decision with a choice of return method (if a return occurs). Borrowing the consumer utility function to establish Stackelberg game model, the consumer utility function of each channel is: $U_s^2 = \lambda(v-p) - h_s$, $U_o^2 = \lambda v - p - h_0 - h_1 - (1-\lambda)t_o$, $U_b^2 = \lambda(v-p) - \alpha h_s - h_0 - (1-\lambda)t_o$ .When $U_s^2 > 0$ and $U_s^2 > U_o^2, U_b^2$, consumers choose offline channels to buy; when $U_o^2 > 0$ and $U_o^2 > U_s^2, U_b^2$, choose online channels to buy; when $U_b^2 > 0$ and $U_b^2 > U_s^2, U_o^2$, choose BOPS channels to buy, which can be obtained from the distribution of demand for each channel, as shown in Fig. 2.

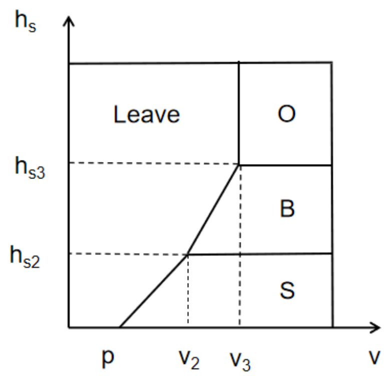

Fig. 2. Distribution of demand by channels in the same-channel return scenario

Of these, $h_{s_2} = \frac{h_0 + (1-\lambda)t_o}{1-\alpha}$, $h_{s_3} = \frac{(1-\lambda)p + h_1}{\alpha}$, $v_2 = p + \frac{h_{s_2}}{\lambda}$, $v_3 = \frac{(1-\alpha)h_{s_2} + \alpha h_{s_3}}{\lambda} + p$. From Fig. 2, the following constraints need to be satisfied to ensure that there is demand for each channel: $0 < \frac{h_0 + (1-\lambda)t_o}{1-\alpha} < \frac{(1-\lambda)p + h_1}{\alpha} < 1$, $0 < p < p + \frac{h_{s_2}}{\lambda} < p + \frac{(1-\alpha)h_{s_2} + \alpha h_{s_3}}{\lambda} < 1$, respectively:

$$D_s^2 = (1 - p - \frac{h_{s_2}}{2\lambda}) * h_{s_2} \quad (6)$$

$$D_o^2 = (1 - p - \frac{(1-\alpha)h_{s_2} + \alpha h_{s_3}}{\lambda}) * (1 - h_{s_3}) \quad (7)$$

$$D_b^2 = (1 - p - \frac{\alpha h_{s_3} - \alpha h_{s_2}}{2\lambda}) * (h_{s_3} - h_{s_2}) \quad (8)$$

Total demand is:

$$D^2 = D_s^2 + D_o^2 + D_b^2 \quad (9)$$

The total profit of the model is:

$$\pi^2 = (p - c) * D_o^2 + (1 - \lambda)(r - p - c_o) * D_o^2 + (w - c) * D_s^2 + (p - c) * D_b^2 + (1 - \lambda)(r - p - c_o) * D_b^2 + \lambda * p * D_s^2 - w * D_s^2 + (e - w) * D_b^2 \quad (10)$$

Substituting the demand function equation for each channel into the profit function, the second order derivative of the retailer's profit π^2 with respect to the price **p** is less than zero, so there exists an optimal solution to the function, and the optimal price p^{2^*} is obtained by using backward induction:

$$p^{2^*} = \left[e - w + \alpha - \frac{\alpha}{2}(h_{s_2} + h_{s_3}) - h_{s_2}\right](h_{s_3} - h_{s_2}) - (1 - \lambda)(h_{s_2} - 1)(c_o - h_{s_2} - r) + \lambda\left[(h_{s_2} - 1)^2 + h_{s_2}\right] - \frac{{h_{s_2}}^2}{2} + c \quad (11)$$

Substituting optimal pricing into each equation yields the optimal solution for each channel's demand, the retailer's total demand, and the retailer's profit.

3.3 Cross-Channel Return Strategy Model In Omni-Channel Mode

In this model, the manufacturer allows cross-channel returns, so consumers can buy online and return offline, or pick up the goods offline and try them out at home and then return them online. Borrowing the consumer utility function to build Stackelberg game model, the consumer utility function of each channel is: $U_s^3 = \lambda(v - p) - h_s$, $U_o^3 = \lambda v - p - h_0 - h_1 - (1 - \lambda)(\beta t_s + (1 - \beta)t_o)$, $U_b^3 = \lambda(v - p) - \alpha h_s - h_0 - (1 - \lambda)(1 - \gamma)t_o$. When $U_s^3>0$ and $U_s^3>U_o^3, U_b^3$, consumers choose offline channels to buy; when $U_o^3>0$ and $U_o^3>U_s^3, U_b^3$, choose online channels to buy; when $U_b^3>0$ and $U_b^3>U_s^3, U_o^3$, choose BOPS channels to buy, which can be obtained from the distribution of demand for each channel, as shown in Fig. 3.

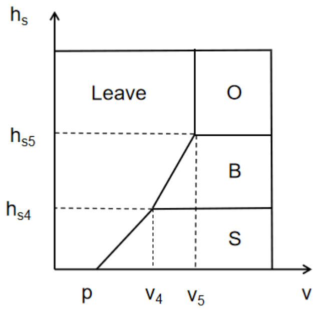

Fig. 3. Distribution of demand by channel in the case of allowing cross-channel returns

Of these, $h_{s_4} = \frac{h_0 + (1-\lambda)B}{1-\alpha}$, $h_{s_3} = \frac{(1-\lambda)p + h_1 + (1-\lambda)A - (1-\lambda)B}{\alpha}$, $v_4 = p + \frac{h_{s_4}}{\lambda}$, $v_5 = \frac{(1-\alpha)h_{s_2} + \alpha h_{s_3}}{\lambda} + p$. From Fig. 3, the following constraints need to be satisfied in order to ensure that there is demand for each channel: $0 < \frac{h_0 + (1-\lambda)B}{1-\alpha} < \frac{(1-\lambda)p + h_1 + (1-\lambda)A - (1-\lambda)B}{\alpha} < 1$, $0 < p < p + \frac{h_{s_4}}{\lambda} < \frac{(1-\alpha)h_{s_2} + \alpha h_{s_3}}{\lambda} + p$, respectively:

$$D_s^3 = (1 - p - \frac{h_{s_4}}{2\lambda}) * h_{s_4} \quad (12)$$

$$D_o^3 = (1 - p - \frac{(1-\alpha)h_{s_4} + \alpha h_{s_5}}{\lambda}) * (1 - h_{s_5}) \quad (13)$$

$$D_b^3 = (1 - p - \frac{\alpha h_{s_5} - \alpha h_{s_4}}{2\lambda}) * (h_{s_5} - h_{s_4}) \quad (14)$$

Total demand is:

$$D^3 = D_s^3 + D_o^3 + D_b^3 \quad (15)$$

The total profit of the model is:

$$\pi^3 = (p - c) * D_o^3 + (1 - \lambda)(r - c_o)(1 - \beta) * D_o^3 - (1 - \lambda) * p * D_o^3 + (w - c) * D_s^3 + (p - c) * D_b^3 + (1 - \lambda)(r - c_o)(1 - \gamma) * D_b^3 - (1 - \lambda) * p * D_b^3 + \lambda * p * D_s^3 - w * D_s^3 + (e - w) * D_b^3 + \beta(1 - \lambda)(r - c_b) * D_o^3 + \gamma(1 - \lambda)(r - c_b) * D_b^3 \quad (16)$$

Substituting the demand function equation for each channel into the profit function, the second order derivative of the retailer's profit π^3 with respect to the price **p** is less than zero, so there exists an optimal solution to the function, and the optimal price p^{3^*} is obtained by using backward induction:

$$p^{3^*} = (c_o - h_{s_4} - r)(1 - h_{s_4})(1 - \lambda) + (h_{s_4} - h_{s_5})\left[e - h_{s_4} + \alpha - w - \frac{\alpha}{2}(h_{s_4} + h_{s_5})\right] + (c_o - c_b)(1 - \lambda)\left[\gamma(h_{s_4} - h_{s_5}) + \beta h_{s_5} - \beta\right] + \lambda\left[(h_{s_4} - 1)^2 + h_{s_4}\right] + c - \frac{{h_{s_4}}^2}{2} \quad (17)$$

Substituting optimal pricing into each equation yields the optimal solution for each channel's demand, the retailer's total demand, and the retailer's profit.

4. Omni-Channel Returns Strategy Analysis

Based on the above model, this paper uses MATLAB to carry out numerical simulation, and analyzes the effects of before and after allowing cross-channel returns on the changes of demand and profit in each channel as well as the manufacturer's choice of return strategy by means of an arithmetic case analysis, all of which use the equilibrium solution obtained above and take the values of the parameters according to the constraints and with reference to the literature [4,7], which are as follows: β=0.8, γ=0.7, t_s=0.15, c_b=0.15, v=1, c=0.2, p=0.5, λ=0.7, h_0=0.05, h_1=0.1, α=0.5, t_o=0.2, c_o=0.1, e=0.35, r=0.05, w=0.3, μ=0.05

4.1 The Impact of Product Match Ratio on Demand and Profit

To satisfy the constraints, the value range of the product matching rate λ is set between [0.65,1]. The results of data simulation using MATLAB are shown in Fig. 4, where D1, D2 and D3 denote the total demand for dual-channel, omni-channel with no cross-channel returns allowed and omni-channel with cross-channel returns allowed respectively. When λ increases, the total demand increases in all three models, but the growth rate is gradually slowing down in all of them. After the implementation of BOPS, the total demand is larger than the total demand in the dual-channel model in all scenarios; and the total demand is larger after allowing cross-channel returns. As shown in Fig. 5. π1, π2, and π3 denote the total profit under the three scenarios. In all three scenarios, the total profit grows when λ is increasing, and the growth rate is gradual. Compared to the total profit in the dual-channel model, the profit is increasing in all cases after the implementation of the BOPS strategy, and the profit value is maximized in the case where cross-channel returns are allowed.

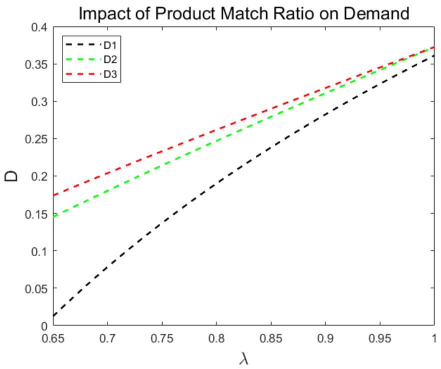

Fig. 4. Impact of Product Matching Ratio on Demand

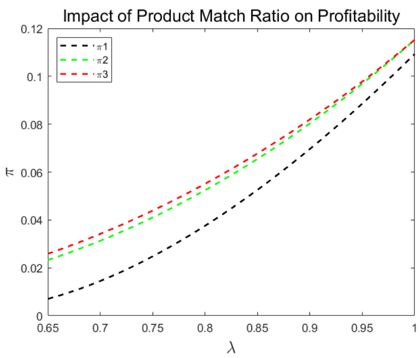

Fig. 5. Impact of Product Matching Ratio on Profit

4.2 The impact of online return costs on demand and profitability

To satisfy the constraints, the value range of online return cost to is set at [0, 0.5]. From Fig. 6, it can be seen that the total demand is increased after the implementation of BOPS strategy compared to the total demand of the dual-channel model. When $t_o<0.091$, the total demand in the case of disallowing cross-channel returns is the largest, but the total demand in the case of allowing cross-channel returns rises slowly; when $t_o>0.091$, the total demand in the case of allowing cross-channel returns is the largest, and at this time, the total demand in the three channels is decreasing, and consumers are more willing to go to the offline returns, which is also consistent with the actual reality.When the online return cost increases, consumers are not willing to bear the higher cost, and are more likely to choose to go to the offline return. As can be seen from Fig. 7, when $t_o<0.11$, the profit in the case of disallowing cross-channel returns is the largest, but the total profit in the case of allowing cross-channel returns is slowly increasing; when $t_o>0.11$, the total profit in the case of allowing cross-channel returns is the largest, and the profit in all three cases decreases with the increase of t_o.

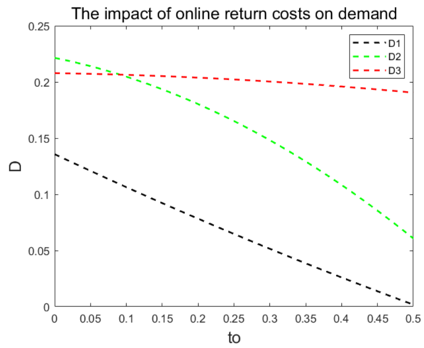

Fig. 6. Impact of Online Return Costs on Demand

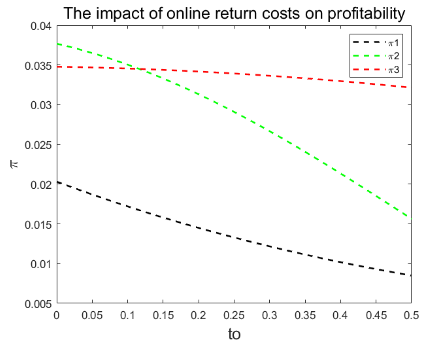

Fig. 7. Impact of online return costs on profitability

4.3 The Impact of Cross-Channel Return Probability on Demand and Profit

As shown in Fig. 8, where Ds3-Ds2, Do3-Do2 and Db3-Db2 are denoted as the demand difference of the three channels that allow cross-channel returns to be signed after the implementation of the BOPS strategy. As can be seen from the figure, when β is constant, the demand difference of both online as well as BOPS channels is increasing as γ keeps increasing and the BOPS channel is growing faster. This indicates that after the implementation of cross-channel returns, consumers may be more willing to go offline to return goods because of the higher cost of online returns or the lower cost of the trouble of offline returns. In the BOPS channel consumers can return goods directly if they are not satisfied with the product after picking up the goods offline, which largely reduces the cost of the trouble of returning goods and this is consistent with the actual situation. As shown in Fig. 9, when β is unchanged, with γ increasing the total profit margin is decreasing; when γ is unchanged, with β increasing the total profit margin slowly decreases.

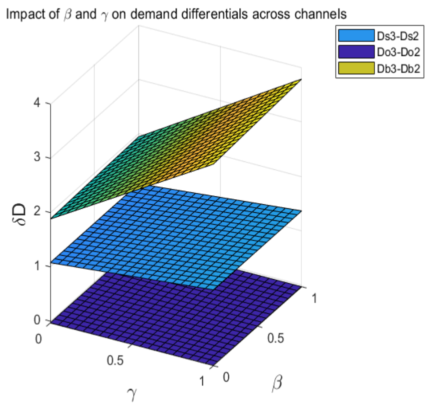

Fig. 8. Effect of β and γ on the demand differential across channels

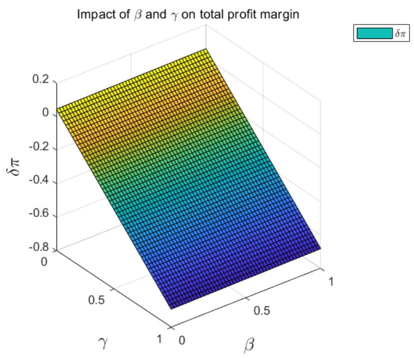

Fig. 9. Effect of β and γ on the total profit margin

5. Manufacturer's Return Strategy Options in the BOPS Model

5.1 The Impact of Cross-Earning and Cross-Channel Returns Processing Costs on Returns Strategy Selection

This section analyzes the impact of Cross-Earning and Cross-Channel Returns Processing Costs on the overall profit differential of the supply chain and investigates how manufacturers should make return strategy choices. Fig. 10 shows an arithmetic plot of the increase in total profit before and after allowing cross-channel returns, as the cross-earning **e** and cross-channel return processing costs **c_b** vary in the range of [0,1]. From Fig. 10, it can be seen that when the cross-channel returns processing cost is small and the cross-earning is large, the manufacturer can realize higher profits by choosing to implement the cross-channel returns strategy.

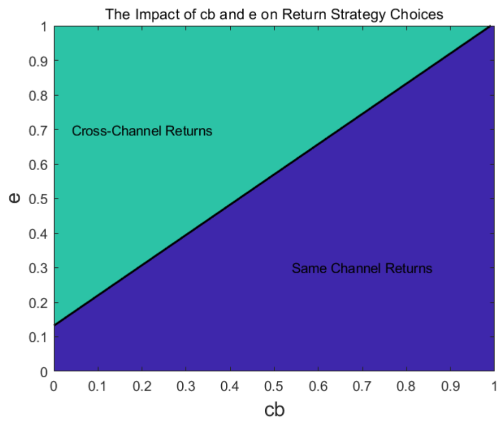

Fig. 10. Impact of cb and e on manufacturers' return strategy choices

5.2 The Effect of Product Matching Ratio on Manufacturers' Return Strategy Choices

To satisfy the constraints, the value range of the product matching rate is set between [0.65,1] and δπ is the profit difference before and after allowing cross-channel returns after implementing the BOPS strategy. As shown in Fig. 11, the profit difference after allowing cross-channel returns is positive, indicating that the profit after allowing cross-channel returns is always greater than the profit without allowing cross-channel returns. Therefore, it is more favorable for manufacturers to choose the strategy of allowing cross-channel returns.

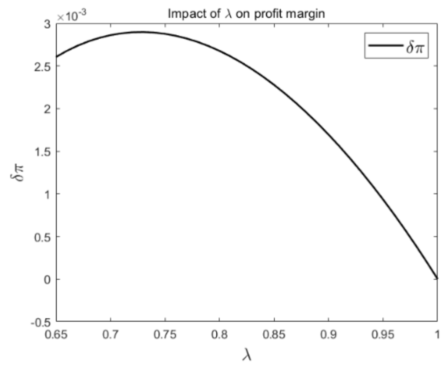

Fig. 11. Selection of Product Matching Ratio on Manufacturer's Return Strategy

6. Conclusion

As channel convergence rapidly advances, retailers have started to enable online ordering with offline pickup and have introduced a cross-channel return strategy. Unlike a same-channel return strategy, this new approach allows consumers to return products purchased online at physical store locations and the ability to return goods purchased in the BOPS channel, offering customers greater flexibility and more options for returning their purchases. (1) The above results show that the total profit of the supply chain increases with the product matching rate. Compared to the profit in the dual-channel model, the overall profit of the supply chain increases significantly regardless of whether cross-channel returns are allowed or not. In addition, whether cross-channel returns are allowed or not affects the demand in the dual-channel model, so it is more effective for manufacturers to implement the BOPS strategy compared to the dual-channel model.

(2) Manufacturers are suited to implement cross-channel returns strategy when the Cross-Channel Returns Processing Costs are small and the Cross-Earning obtained after implementing BOPS strategy is large. When the cross-channel returns processing cost is large, the manufacturer needs to pay a larger hassle cost, so it is more suitable to implement the same-channel returns strategy.

(3) With the increasing of γ, demand difference of online and BOPS channel are increasing, consumers are more willing to go to the offline return due to the higher online return cost or the lower offline return trouble cost. In the BOPS channel ,consumers can pick up the goods offline if the product is not satisfied with the product can be returned directly, which largely reduces the return of the trouble cost.

The research in this paper is based on the same price situation, and does not take into account the different price, the inventory costs incurred after the return of goods, etc.; in addition, this paper only considers the return of goods when the consumer needs to bear the shipping costs, and does not consider how the consumer will choose to return goods if there is a return freight insurance

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