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RESEARCH ARTICLE

Cooperate or Not? A Service Cooperation Strategy for Products With Service Attributes Considering Showrooming Behavior

JIQIONG LIU AND SHUAI FENG
School of Business, Fuyang Normal University, Fuyang 236037, China
Anhui Provincial Key Laboratory of Regional Logistics Planning and Modern Logistics Engineering, Fuyang 236037, China

Corresponding author: Shuai Feng (fengshuai@mail.hfut.edu.cn)

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ABSTRACT In the face of competitive pricing pressure from online retailers and high-quality service pressure from physical retailers, are retailers in these two channels willing to establish a service cooperation (SC) strategy? If so, then will they support or avoid consumer showrooming behavior? To address these questions, we use a game theoretic model to examine three strategic configurations: nonservice cooperation (SN), SC, and nonshowroom cooperation (NC). We recommend the optimal strategy based on factors influencing the service-level threshold, such as market information coverage factors and service characteristics. Our results show that the SC strategy is the best for physical retailers when their market coverage is low or the threshold requirement for service is high; however, when the service level is low, physical retailers should avoid supporting consumer showrooming behavior; that is, the NC strategy is their best choice. In contrast, online retailers are always willing to choose the SC strategy and support showrooming to reflect their lower price advantage. Finally, we explore the optimal strategies of the two retailers in the endogenous service-level scenario. The optimal strategy selection of online retailers remains unchanged. However, physical retailers prefer the SN strategy because of their dominance in service; these retailers have the incentive to choose the NC strategy when their markets have a high degree of information coverage.

INDEX TERMS Showrooming, cooperation strategy, consumer behavior.

I. INTRODUCTION

The growth of multichannel retail has increased competition among retailers operating in multiple channels [1]. Simultaneously, a retail phenomenon called ''showrooming'' has emerged. Showrooming refers to the phenomenon when a consumer first visits a physical channel (physical store) to evaluate a product and, if satisfied with the product, purchases it via the online channel (online store) at a lower price. In the face of low-price competition pressure from online retailers based on showrooming, physical retailers (such as Walmart, Best Buy, Macy's Target and Toys ''R Us'') lose potential customers and face unprecedented challenges and threats. Moreover, showrooming is becoming a worldwide trend [2] and is even still on the rise. Comscore's report showed that at least 36% of consumers exhibited showrooming behavior in the US during the fourth quarter of 2017, an increase of 5% from 2013 [3]. In addition, according to a market survey, furniture products are more likely to induce consumer showrooming behavior; approximately 84.47% of consumers

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who purchase furniture products have a great willingness to engage in showrooming [4]. This preference is due to the fact that furniture products have more nondigital attributes that are difficult to evaluate online. The above facts indicate that physical retailers are willing and motivated to explore some strategies or collaborate with online retailers to offset or reduce the negative effects of showrooming.

Given the development of e-commerce and new retail, many online retailers have begun recognizing their shortcomings. That is, constrained by geographical differences, complete online and offline interaction is complicated, especially for products with service attributes. For this reason, some consumers turn to the physical channel to make purchases, even if online prices are often lower than those of the physical channel. Therefore, most online retailers have started to actively explore cooperation with offline retailers to deepen integration and enhance consumers' online and offline multidimensional experience and service perception.

Faced with price competition from online retailers and high-quality service pressure from physical retailers, online and physical retailers have begun to test some collaboration channel strategies. In one such strategy, service cooperation (SC), online retailers pay a service fee to offline physical retailers and transfer offline services from their online channels to physical retailers. SC is widespread in commercial practice. For example, online furniture retailers often use the SC strategy to collaborate with offline physical retailers and submit housing measurements, furniture solution designs, and installations to physical retailers; those retailers using this strategy include Sofia, Oppein and many online furniture retailers. It is important note that a given SC strategy may produce different results in different situations. In 2012, Red Star Macalline attempted to operate its online furniture retail business through the SC strategy, but it resulted in poor performance and increased operating costs. However, in 2018, the company integrated both online and physical channels again, partnered with Tencent, and launched a global home intelligent marketing platform. In that same year, a trial operation was conducted during the Double Eleven event to test the company's SC strategy. The strategy proved to be successful, generating over 16 billion RMB in revenue and benefiting both online and offline channels.

Showrooming and SC have attracted significant attention in management research. The following issues are of great practical significance:

(1) For products with service attributes, under the pressure of showrooming and service competition, will physical and online retailers take the initiative to adopt a SC strategy with each other?

(2) When or under what conditions will the two retailers cooperate in terms of service? What are the key factors of an effective SC strategy?

(3) Under the premise of SC, will the decision of the two retailers to support or avoid consumer showrooming behavior change?

To answer these questions, we construct a game theoretic model to analyze three strategies (nonservice cooperation (SN), SC, and nonshowroom cooperation (NC)). In addition to equilibrium analysis, we examine the optimal strategy selection of the physical retailer and the online retailer. Finally, we extend the endogenous service-level scenario to compare the change in strategy selection of the two retailers under exogenous and endogenous service levels. Below, we present the main contributions and results of this paper.

Our study contributes to the literature and practice in three ways. First, we expand the existing studies on consumer showrooming behavior and SC between online and offline channels. Our research is different from previous studies in that the latter focused on exploring how to use various strategies to counter the occurrence of consumer showrooming behavior. In contrast, our research considers a strategy that encourages physical retailers to support consumers' showrooming needs and collaborate with online retailers with a competitive advantage in high-quality services. Second, we introduce the sensitivity of consumers to different channels of service to characterize their expected purchasing utility. This extension not only makes our work more realistic but also enriches the literature. Third, we provide the best strategy selection results, corresponding applicable conditions and managerial insights for both physical and online retailers, which can advise retailers on adopting SC and whether to support or avoid consumer showrooming behavior to help them achieve more remarkable performance.

Several important results emerge from our work. First, in the exogenous service-level scenario, the service level is critical to a physical retailer's strategy selection, and market information coverage factors and service characteristics determine the threshold of the service level. Specifically, the lower the market information coverage or the higher the service revenue is, the more incentive the physical retailer has to cooperate with the online retailer. The reason for this is that SC increases the information coverage of a physical retailer who can provide quality service, which in turn increases sales and profits. Interestingly, the higher the threshold for service is, the more motivated the physical retailer will be to partner with the online retailer rather than to create silos against the online retailer. This outcome may result because the physical retailer is typically perceived as a service provider who can generate more service profits through SC. However, when the service level is low, the physical retailer should avoid supporting consumer showrooming behavior, regardless of how much revenue it can gain from SC.

Second, regardless of the service level, an online retailer should choose the SC strategy and support consumer showrooming behavior to demonstrate the low-price advantage and reduce the costs associated with online consumer returns.

Finally, in the endogenous service-level scenario, where it has service dominance, the physical retailer is more inclined to use the SN strategy. Moreover, with high information coverage in its market, the physical retailer is always incentivized

to avoid consumer showrooming behavior. However, similar to the exogenous service-level scenario, the online retailer is inclined toward the SC strategy and supports showrooming. These results can provide retailers with advice on whether to support SC and consumer showrooming behavior to help them achieve better performance.

The remainder of the paper is organized as follows. Section II provides a review of the relevant literature. A description of the three models is provided in Section III. Section IV presents the equilibrium analysis of the three models in the exogenous service-level scenario. Section V highlights some managerial implications through a comparison of strategy selections. Section VI extends the three models in the endogenous service-level scenario. Finally, the main conclusions of the study and directions for future work are presented in Section VII. All proofs are provided in Appendix A.

II. LITERATURE REVIEW

Our research is associated with two strands of literature: the first concerns consumer free-riding showrooming behavior, and the second addresses competition and cooperation in dual channels.

A. CONSUMER FREE-RIDING SHOWROOMING BEHAVIOR

Our research is related to showrooming, a type of consumer free-riding behavior in the multichannel retail industry. Most researchers studying consumer free-riding behavior believe that it has a negative impact on physical retailers' market share and profitability, thereby affecting their incentive to provide pre- and after-sales service [2], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14]. Therefore, these researchers have investigated various strategies to counteract free-riding showrooming behavior and internalize channel conflicts. For example, with the intensification of market competition for information services caused by consumer showrooming behavior, retailers have become less motivated to provide information services [6]. The growth of multichannel retail has allowed consumers to switch purchase channels at will. Showrooming behavior has gradually become popular among consumers; however, showrooming negatively affects the profitability of physical retailers [14]. To counter the adverse impact of showrooming, Xing and Liu [7] proposed a price-matching strategy and an optional compensation rebate contract to coordinate physical retailers' sales efforts and compensate them. Mehra et al. [12] studied two strategies to combat showrooming behavior—a price-matching strategy as a short-term plan and an exclusive product or brand strategy as a long-term plan—showing that as showrooming becomes more common, the price-matching strategy becomes less effective, while the effectiveness of the exclusive strategy is more durable. Physical retailers can also establish alliances with manufacturers to provide them with enough inventory to sell, thereby generating higher demand and specialized consumer groups [15]. Moreover, with the intensification of showrooming, webrooming by physical retailers can increase consumer visits to physical stores under certain conditions. The return policy of online retailers can also ease the pressure of showrooming, thereby increasing the profits of retailers in both channels [11]. Through showrooming and webrooming, channel integration can significantly affect consumer channel preferences [16].

However, interestingly, some researchers argue that the profitability of physical retailers has increased due to showrooming. For example, Zhang et al. [17] asserted that free riding benefits not only free riders but also service providers. Although competition from online retailers may be detrimental to physical retailers, the showrooming effect of technological progress may increase the profitability of physical retailers [18]. Showrooming behavior may also benefit manufacturers that own offline stores; however, it negatively affects online retailers [19].

In addition, some research shows that showrooming behavior in omnichannel retail differs from that in multichannel retail. In omnichannel retail, consumers examine products in a seller's (company's) physical stores and purchase from the same seller's (company's) online store [4]. Therefore, for omnichannel retailers, various methods (e.g., optimizing the product mix and quick response (QR) codes in showrooms) are commonly used to encourage and guide consumers in engaging in showrooming behaviors to fulfill the promise of higher omnichannel operational efficiency [20]. To enhance customer participation, Konur [21] proposed the concept of shared showrooms and introduced a cost-sharing contract for these showrooms. Furthermore, Li et al. [4] studied how showrooms can be deployed to reduce consumer uncertainty.

Although our study examines showrooming in multichannel retail, it differs from previous studies and contributes to understanding consumer showrooming behavior. On the one hand, previous research has focused on how physical retailers can use various strategies to counter the showrooming effect created by online retailers that effectively use the former's physical stores as accessible showrooms. In contrast, our research highlights the service advantages of physical retailers, enabling collaboration between the two channels through online and offline service partnerships. The purpose is not to weaken the free-riding behavior of online retailers in showrooming but to leverage the effect of showrooming to achieve a win-win result for physical and online retailers. In other words, few studies have considered both showrooming and SC, whereas our research considers both. On the other hand, we introduce consumers' sensitivity to service to depict the expected consumer purchasing utility of different channels, which provides a novel way to describe the uncertainty of consumer purchases.

B. COMPETITION AND COOPERATION IN DUAL CHANNELS

The second relevant stream of literature examines competition and cooperation in dual channels.

Most competition between online and offline channels is focused on pricing decisions. Most researchers believe that in a competitive environment, the sales prices in the two channels would be different [22], [23], [24], [25], [26], [27], [28], [29]. Some researchers have contended that physical sales prices tend to be higher than online sales prices because of the former's higher operating costs [26], [27]. However, other researchers have argued that online retailers will sell at higher prices than will physical retailers when most consumers prefer to purchase online [22]. In addition, to alleviate channel conflicts and maintain brand consistency, some researchers have proposed that the prices in the two channels should be the same [30], [31], [32], [33], [34], [35], [36]. Some studies have considered the showrooming effect in their analyses of pricing decisions under competition between dual channels [2], [8], [9], [11], [12], [13], [14], [18]. Ting et al. [13] studied price competition between online and offline channels in the presence of showrooming and a payment cost effect and found that when the payment cost effect changes, the prices and profits of both channels change accordingly and that the showrooming effect may exacerbate price competition. Wang and Wang [14] proposed in-store services to counteract showrooming.

Studies on cooperation in dual channels aim to explore effective cooperative strategies and coordination mechanisms to resolve channel conflicts. As mentioned, physical prices tend to be higher than online prices. Moreover, dual-channel environments are conducive to free riding, which is detrimental to the profitability of physical retailers, leading to channel conflict. To resolve this conflict, retailers in dual-channel environments should adopt appropriate cooperation and coordination strategies or mechanisms. Bell et al. [37] and He et al. [38] proposed a comprehensive approach to operating both physical and online channels. Dual-channel cooperation strategies based on buying online, picking up in-store (BOPS), preordering online, picking up in-store (POPU), or shipping to store (STS) have been proposed to integrate and coordinate online and offline channels [32], [39], [40], [41]. Kusuda [41] found that retailers can identify their optimal store inventory levels with information about customer behavior, hassle, and delivery costs when using BOPS strategies. The information-sharing strategy [42] and the cooperative advertising strategy [43], [44] have been examined to coordinate between dual channels. In addition, Yang et al. [45], He et al. [46] and Bayram and Cesaret [47] proposed horizontal transfer strategies, that is, establishing a relationship between the online and physical channels whereby the two channels transfer excess inventories to meet each other's needs. However, some scholars have proposed that cumulative advantage is a double-edged sword of cooperation [48], [49], [50], [51]. Therefore, cooperation between physical and online retailers remains an unresolved matter that requires attention.

Our study also focuses on cooperation in dual channels and the showrooming phenomenon. On the one hand, in contrast to previous studies on competitive price decision making based on showrooming, we explore not only the competitive pricing decision but also the cooperative pricing decision. That is, we discuss the competitive and cooperative pricing decisions of retailers operating in two channels based on showrooming and SC. On the other hand, our study contributes to the literature and business practice in general by addressing the negative effects of showrooming through the SC strategy. In this process, we consider the dual nature of the role of physical retailers, not only as sellers but also as service providers.

III. MODEL

Our model considers two retailers: a physical retailer (hereafter addressed as he) that operates in the physical channel (physical store) and an online retailer (hereafter addressed as she) that operates in the online channel (online store). Subscript p represents the physical channel, and subscript o represents the online channel. Both retailers sell the same durable products with service. This paper takes furniture products that require service as an example. We develop models to analyze the different purchase behaviors of consumers and the respective strategic choices of physical and online retailers. The notations used in this paper are defined in Table 1.

TABLE 1. Notations.

Notations	Description
v	Consumer reservation value from a best-fit product
p_p	Price per unit of product sold by the physical retailer in the physical store
p_o	Price per unit of product sold by the online retailer in the online store
x	Consumer sensitivity to service, $x \sim U[0,1]$
s	Service level perceived by a consumer from purchasing through the offline physical channel
$s-\varepsilon$	Service level perceived by a consumer from purchasing through the online channel, where the value of ε is known to both consumers and retailers
k	Probability of a consumer correctly selecting the best-fit product by evaluating only through the online channel
Δ	Loss of consumer utility in a consumer's selection of an unsuitable product
δ	Expected loss of consumer utility, $\delta = (1-k)\Delta$
λ	Proportion of low-type consumers who are closer to physical stores
t	Cost of visiting the physical store for high-type consumers
w	Consumer inconvenience cost of service provided by the online channel before SC
η	Service cost coefficient of the physical retailer
h	Unit variable service cost coefficient of the online retailer

A. PRODUCT WITH SERVICE ATTRIBUTES

A product consists of digital and nondigital attributes [12]. If consumers choose to purchase a product only after evaluating it through the online channel, then they may not select the most suitable product because they cannot touch and experience the product to evaluate its nondigital attributes. Consumers can choose to visit offline physical stores to evaluate nondigital attributes. However, after visiting and

evaluating in the offline channel, consumers will choose to engage in showrooming behavior by purchasing online.

The furniture products we study include not only physical objects but also related services. The services here include only the front-end store image and professional furniture consulting service, professional measurement and design service in the middle, and the last loop of installation and after-sales service as well as additional value-added services (such as furniture maintenance and cleaning services). Because each consumer has a different sensitivity to service, we assume that consumers are heterogeneous in their sensitivity x to service and that x is uniformly distributed over [0,1]. When $x = 1$, the consumer is extremely sensitive to service. When $x = 0$, the consumer is extremely insensitive to service. Then, for a consumer whose service sensitivity is x, if he or she chooses to purchase from an offline physical store with service level s, then the perceived value of the service he or she obtains is xs.

However, although online stores also provide consulting, design and after-sales installation services, it is difficult for consumers to experience and touch actual products through these channels because of the remote relationship between online and offline. It is also challenging to carry out subsequent value-added services, and thus, the level of service provided by the online channel is lower than that provided by the offline channel. To characterize the difference in consumers' perceived value of services, we set consumers' perceived reduction in the level of service provided by the online channel compared with service in the offline physical channel as ε. The reduction in service perception is consistent with practice in which the online retailer's online channel does not necessarily have a service advantage, especially in after-sales and value-added services. Then, if a consumer whose service sensitivity is x chooses to purchase online, then the perceived service level is $(s - \varepsilon)$, and the perceived value of online services received is $x(s - \varepsilon)$.

Therefore, the physical retailer sells products at a unit price p_p in his physical store and provides a full range of services, and the perceived value of services by offline consumers is xs, while the online retailer sells products at a unit price p_o in her online store, while the corresponding service perceived value is $x(s - \varepsilon)$.

B. CONSUMER BEHAVIOR

In addition to service perception, consumer utility is affected by product utility, price and purchase cost. All customers receive a reservation value, v, from their best-fit product [12], [52]. Consumers can evaluate and experience products (including digital and nondigital attributes) in a physical store and choose the best-fit products to obtain reservation value v. However, consumers who directly evaluate the product assortment only through the online channel cannot accurately assess whether a product is the best fit because they cannot experience the nondigital product attributes. Assume that the probability of a consumer selecting a best-fit product correctly by evaluating only through the online channel is k, where $0 < k < 1$. If a consumer purchases a product that is not the best-fit product, then the consumer's reservation value is $v - \Delta$, where $0 < \Delta < v$. Therefore, for the consumer who directly evaluates and purchases a product online, the expected reservation value is $kv+(1-k)(v-\Delta) = v - (1 - k)\Delta$. Let $(1 - k)\Delta = \delta$; then, the consumer directly evaluates and purchases a product online, and his or her expected reservation value is $v - \delta$. It is assumed that v and Δ obtained by consumers after purchasing are known. We use k to capture the information coverage of the online channel or the online retailer's ability to provide online information. Online retailers can increase the information available through their online channel by increasing the number of online advertisements and setting up virtual showrooms (such as virtual reality and webcasts).

Consumers incur different travel costs and service inconvenience costs according to their purchase preference behavior. First, following Mehra et al. [12], we assume that travel costs for consumers to visit a physical store (showroom) are divided into the following two-segment structures:

(1) Low travel cost t_L for low-type consumers who are closer to the physical store. The proportion of low-type consumers is λ. For ease of processing, t_L is normalized to zero.

(2) High travel cost $t_H = t$ for high-type consumers who are far from the physical store. The proportion of high-type consumers is $1-\lambda$. To ensure a balanced market distribution, we assume that t is high enough and that $t > \Delta > \delta$; thus, high-type consumers cannot ignore their travel cost and are more inclined to evaluate and purchase directly online.

The parameter λ reflects the physical retailer's ability to provide information through physical stores (showrooms), which can be used to measure the information coverage of the physical channel. The physical retailer can increase demographic information coverage by increasing the number of physical stores, installing showrooms in shopping centers, or providing subsidies to consumers who visit showrooms. The more a physical retailer invests in physical stores/showrooms, the higher the percentage of consumers that will eliminate high travel costs for offline consumers.

If consumers purchase products online, then there will be inconvenience costs for online services. This fact is reflected in the inconvenience cost incurred when online consumers experience off-site service communication, including the need for online consumers to confirm tedious professional measurement data and schedule appointments for installation in advance with online retailers and to schedule additional appointments for paint repair and other services if products are damaged due to transportation or delivery. We consider the inconvenience costs of online services caused by consumers' online purchases in the following two stages:

(1) Before online and offline SC, that is, when the online channel and the physical channel have not reached SC, online consumers perceive the inconvenience cost $w_B = w$ of online services.

(2) After online and offline SC, the online channel and the physical channel have reached SC. The offline services for the online channel are left to the physical retailer. In this case, consumers no longer need to repeatedly confirm tedious professional measurement data with online retailers. Other installations and services required to repair damage are also completed by the physical retailer. In this case, off-site communication between consumers and the online retailer is transformed into communication between the physical retailer and the online retailer. The inconvenience and cost perceived by online consumers are also reduced. After SC, the service inconvenience cost of online consumers is reduced to w_A, where w_A is normalized to zero for simplicity.

In summary, in the first phase of consumer shopping, a consumer first decides whether to visit an offline physical store, go directly online to evaluate and purchase a product, or even engage in showrooming behavior. Therefore, there are three types of consumer purchasing behavior: (1) that of consumers who evaluate and purchase in the physical store (P type), (2) that of consumers who evaluate and purchase directly online (O type), and (3) that of consumers who purchase online after showrooming (S type). Given that $T = p,\ o,\ s$, let U_T denote the expected utility if consumers engage in T-type purchase behavior.

$$U_p = v + xs - p_p - t_j \quad (j = L,\ H) \tag{1}$$

$$U_o = (v - \delta) + x(s - \varepsilon) - p_o - w_i \quad (i = B,\ A) \tag{2}$$

$$U_s = v + x(s - \varepsilon) - p_o - t_j - w_i \quad (j = L,\ H;\ i = B,\ A) \tag{3}$$

Based on expected utilities, consumers with low travel costs (low-type consumers) tend to visit the physical store because the information they collect there is cost-free, and based on their evaluation, they can determine whether the product is suitable for them, thereby reducing the possibility of making a suboptimal choice. For consumers with high travel costs (high-type consumers), it is futile to visit the physical store because the cost of visiting is high, although it is possible to determine whether the choice is optimal.

C. PROFITS OF RETAILERS

According to the expected utilities of consumers, the demand of low-type and high-type consumers can be determined, and the market share of the physical channel and the online channel can be obtained as D_{pj} and D_{oj}, respectively; $j \in \{L, H\}$.

The physical retailer and the online retailer must determine in advance whether to cooperate in terms of partial service (measurement and design in the middle phase, after-sales distribution and installation), which determines not only whether consumers will incur the inconvenience cost of online services when purchasing products online but also the profit function of each retailer. Furthermore, we assume that the service level is determined by long-term competition or market guidance and is exogenous (we extend the endogenous service-level scenario in Section VI). The corresponding operating costs for retailers are normalized to zero.

Here, partial service refers only to the measurement and design in the middle phase, after-sales distribution and installation. For later value-added service, the physical retailer will not consider whether to cooperate with the online retailer for two reasons. On the one hand, value-added services (such as repair and maintenance) have a relatively long duration, and the difficulty and cost of such services increases over time, which makes the physical retailer reluctant to accept full-service cooperation. On the other hand, if conducting full-service cooperation between the online and offline channels, the physical retailer will lose a competitive advantage in offline services. Moreover, because online prices are often lower than offline prices, the physical retailer will lose most of the consumer market, which will be extremely detrimental to him. Consequently, the physical retailer will never choose full-service cooperation.

The profit of the physical retailer is expressed by Π_p.

$$\Pi_p = \sum_{j \in \{L,H\}} (D_{pj} p_p) - \frac{1}{2}\eta s^2 + \pi_c \tag{4}$$

The first item represents the revenue generated by the physical retailer selling products to low- and high-type consumers. The second item represents the fixed service costs of the physical retailer, which include the costs of facilities, equipment, and venues used to implement the service and the salary and training costs of the personnel hired to perform design, after-sales installation, and maintenance services. According to Ofek et al. [33], Cachon and Kök [53], the fixed service cost in this paper is expressed as a quadratic cost function, $f(s) = \frac{1}{2}\eta s^2$, and its attributes follow $f(0) = 0$, $f'(s) > 0$ and $f''(s) > 0$, where η represents the fixed service cost coefficient of the physical retailer. The third item represents the SC fee charged by the physical retailer to the online retailer. When SC exists, $\pi_c = \sum_{j \in \{L,H\}} (D_{oj} h(s - \varepsilon))$, and when SC does not exist, $\pi_c = 0$; h is the unit variable service cost coefficient of the online retailer.

The profit of the online retailer is expressed by Π_o.

$$\Pi_o = \sum_{j \in \{L,H\}} (D_{oj} p_o) - \sum_{j \in \{L,H\}} [D_{oj} h(s - \varepsilon)] \tag{5}$$

The first item represents the sales revenue of the online retailer. The second item represents the variable service cost of the online retailer. Thus, for the online retailer, there is no fixed service cost, but there is a corresponding variable service cost. The variable service cost of the online retailer is as follows:

(1) If there is no SC with the physical retailer, then the online retailer will require consumers to measure some dimensional data (such as the length, width and height of doors or windows) and designate only some third-party service personnel to help consumers complete the corresponding installation and other after-sales services. After completing the services, the online retailer pays a variable fee to the

third-party personnel. The different types and discontinuities of services force consumers to repeatedly confirm the corresponding appointment with the online retailer. Due to service inconsistencies and the difficulty of communicating back and forth in different places, online consumers perceive the inconvenience of the services provided by the online retailer, and the inconvenience cost is $w_B = w$.

(2) If there is SC with the physical retailer, then the online retailer's variable service fee is paid to the physical retailer, and online consumers will no longer perceive the inconvenience of the services; i.e., $w_A = 0$. After SC, the online retailer transfers the measurement, installation and other after-sales services to the physical retailer, and there is continuity between these services. In the process, communication between consumers and the online retailer transforms into communication between the physical retailer and the online retailer. However, to maintain the service competitiveness of the physical channel, the physical retailer provides the online retailer with only measurement, distribution and installation services, even if they cooperate on services and not on more competitive maintenance services, as mentioned above, such as mattress mite removal, sofa cleaning and furniture maintenance services.

In this paper, because the product we study is furniture, hypotheses $\varepsilon > h$ and $\varepsilon > \delta$ are held constant. $\varepsilon > h$ means that if the consumer is extremely sensitive to service, then the service gap between online and offline channels perceived by the consumer is greater than the unit cost of the online retailer to improve the service level. This fact also means that if the consumer is extremely sensitive to service, then the unit service cost of the online retailer is insufficient to retain the consumer. $\varepsilon > \delta$ means that when the consumer is extremely sensitive to service, the service gap between online and offline channels perceived by the consumer is greater than the utility loss caused by the inability to evaluate online accurately. This fact also means that when the consumer is extremely sensitive to service, the he or she values the service quality more than the utility loss caused by inaccurate evaluation.

D. TIMING

The game sequence is as follows. In the first stage, two retailers decide whether to engage in SC. If the two retailers cooperate on services, then the physical retailer should decide whether to support or avoid consumer showrooming behavior in the second stage. In the third stage, the physical retailer sets the selling price for the offline channel, and the online retailer sets the selling price for the online channel simultaneously. The third stage is consistent with practice, in which the physical retailer does not necessarily have the first-mover advantage for his offline channel, especially in competition with the online retailer. In the fourth stage, consumers strategically choose channels to understand product information and then make a purchase decision.

In view of the above game selection, we consider three strategies for retailers: SN for the nonservice cooperation strategy, SC for the SC strategy, and NC for the NC strategy.

IV. EQUILIBRIUM ANALYSIS

In this section, we first analyze equilibrium solutions in various strategy scenarios.

A. SN STRATEGY

In the SN strategy scenario, the two retailers choose not to cooperate on services. The correlation function is represented by superscript SN. In the SN strategy scenario, we reconstruct the expected utilities of consumers, as depicted in Figure 1.

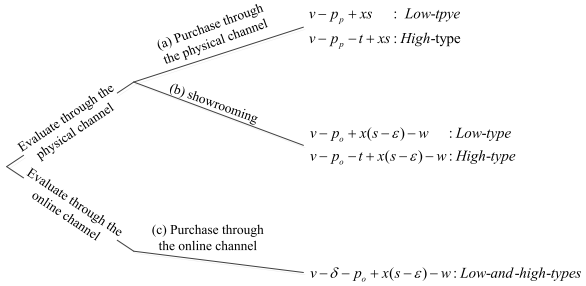


FIGURE 1. Consumer purchase behaviors and their expected utilities under the SN strategy.

As mentioned above, low-type consumers always tend to visit the physical store, which means that they always prefer option (b) over option (c). High-type consumers always tend to evaluate and purchase directly online, which means that they tend to choose option (c) over option (c). Thus, for low-type consumers, we can solve for the difference point between options (a) and (b); that is, $x_L^{SN} = \frac{p_p - p_o - w}{\varepsilon}$. Similarly, for high-type consumers, the indifference point between options (a) and (b) is $x_H^{SN} = \frac{p_p - p_o - w + t - \delta}{\varepsilon}$. Consequently, in the case of the SN strategy, the market shares of the two retail channels are expressed as follows:

$$D_p^{SN} = D_{pL}^{SN} + D_{pH}^{SN} = \lambda(1 - x_L^{SN}) + (1 - \lambda)(1 - x_H^{SN}) \quad (6)$$

$$D_o^{SN} = D_{oL}^{SN} + D_{oH}^{SN} = \lambda x_L^{SN} + (1 - \lambda) x_H^{SN} \quad (7)$$

The profits of the two retailers are reformulated as follows:

$$\prod_p^{SN} = p_p D_p^{SN} - \frac{1}{2}\eta s^2 \quad (8)$$

$$\prod_o^{SN} = [p_o - h(s - \varepsilon)] D_o^{SN} \quad (9)$$

Through the first-order solution, we can obtain Proposition 1, that is, that related to equilibrium prices in the case of the SN strategy. All proofs are provided in Appendix A.

Proposition 1: In the SN strategy scenario, the equilibrium prices of the physical retailer and the online retailer are as follows:

$$p_p^{SN} = \frac{1}{3}[2\varepsilon + w + h(s - \varepsilon) - (1 - \lambda)(t - \delta)] \quad (10)$$

$$p_o^{SN} = \frac{1}{3}[\varepsilon - w + 2h(s - \varepsilon) + (1 - \lambda)(t - \delta)] \quad (11)$$

Recall that $\delta = (1-k)\Delta$, where k reflects the information parameter of the online channel and λ reflects the ability of the physical retailer to provide information through his physical store. Proposition 1 shows that the greater the information provided by the physical retailer is—meaning that the physical retailer invests more in the physical store—the higher the price that will be charged. The more information the online retailer provides, the more she will invest in the online website and thus charge higher prices. In addition, if the inconvenience cost w of online consumer services is higher, then the physical retailer will raise its price, and the online retailer will reduce its price to offset the inconvenience of online services. $(t-\delta)$ is the net travel cost paid by a high-type consumer to eliminate the expected perceived value (δ) of a product that is not the best choice. Obviously, the higher the cost is, the more likely the physical retailer will be to lower his offline price to attract more high-type consumers to visit a physical store, thereby gaining a larger market share and increasing profitability. In contrast, the higher $(t-\delta)$ is, the higher the costs will be for high-type consumers who visit the physical store to eliminate the possibility that the product is not the best choice. Therefore, the higher the cost is, the more inclined high-type consumers will be to shop directly online. In that case, the online retailer should increase the online price to increase profitability.

B. SC STRATEGY

Next, we consider a strategy in which two retailers can choose whether to support SC. The decision of the physical retailer to cooperate with the online retailer is defined as the SC strategy, and the correlation function is represented by superscript SC. In the SC strategy scenario, the services of measurement, distribution and installation through the online channel are fulfilled by the physical retailer, which eliminates the service inconvenience for online consumers. In the SC strategy scenario, we reconstruct the expected utilities of consumers, as depicted in Figure 2.

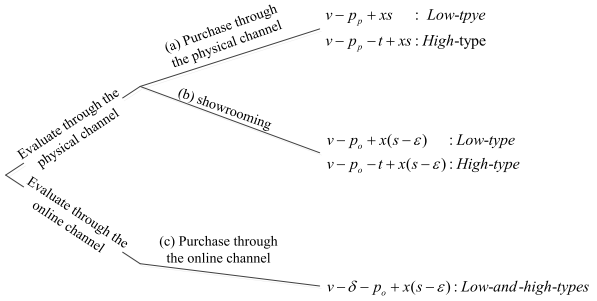


FIGURE 2. Consumer purchase behaviors and their expected utilities under the SC strategy.

Similarly, low-type consumers always tend to visit the physical store, while high-type consumers always tend to evaluate and purchase directly online. Then, low-type consumers choose only between options (a) and (b), and the indifference is $x_L^{SC} = \frac{p_p - p_o}{\varepsilon}$. High-type consumers choose only between options (a) and (c), and the indifference is $x_H^{SC} = \frac{p_p - p_o + t - \delta}{\varepsilon}$. Consequently, under the SC strategy, the market shares of the two retail channels are as follows:

$$D_p^{SC} = D_{pL}^{SC} + D_{pH}^{SC} = \lambda(1 - x_L^{SC}) + (1-\lambda)(1 - x_H^{SC}) \tag{12}$$

$$D_o^{SC} = D_{oL}^{SC} + D_{oH}^{SC} = \lambda x_L^{SC} + (1-\lambda) x_H^{SC} \tag{13}$$

The profits of the two retailers are reformulated as follows:

$$\prod\nolimits_p^{SC} = p_p D_p^{SC} - \frac{1}{2}\eta s^2 + h(s-\varepsilon) D_o^{SC} \tag{14}$$

$$\prod\nolimits_o^{SC} = [p_o - h(s-\varepsilon)] D_o^{SC} \tag{15}$$

Through the first-order solution, we can obtain Proposition 2.

Proposition 2: In the SC strategy scenario, the equilibrium prices of the physical retailer and online retailer are as follows:

$$p_p^{SC} = \frac{1}{3}[2\varepsilon + 2hs + h(s-\varepsilon) - (1-\lambda)(t-\delta)] \tag{16}$$

$$p_o^{SC} = \frac{1}{3}[\varepsilon + hs + 2h(s-\varepsilon) + (1-\lambda)(t-\delta)] \tag{17}$$

The meaning of Proposition 2 is approximately the same as that of Proposition 1. If the channel retailer provides more information, then a higher channel price will be charged. In the SC strategy, the service inconvenience for online consumers is eliminated, and thus, the online price is not affected by service inconvenience.

C. NC STRATEGY

In this section, we consider a strategy (defined as the NC strategy) where retailers avoid consumer showrooming behavior. To determine how retailers avoid consumer showrooming behavior, they can segment their products into online and offline channel brands. For example, physical retailers and online retailers sell different product assortments in different channels, which is commonly referred to in the literature as an exclusive product strategy [12]. This situation also means that products sold online are different from those sold through the offline channel, which is a very common practice. The correlation function is represented by superscript NC. In the NC strategy scenario, we reconstruct the expected utilities of consumers, as depicted in Figure 3.

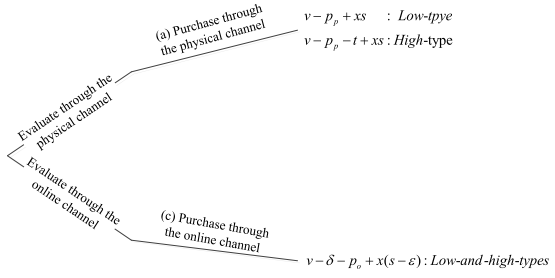


FIGURE 3. Consumer purchase behaviors and their expected utilities under the NC strategy.

The indifference point of low-type consumers for options (a) and (c) is $x_L^{NC} = \frac{p_p - p_o - \delta}{\varepsilon}$. High-type consumers choose between options (a) and (c), and the point of indifference between them is $x_H^{NC} = \frac{p_p - p_o + t - \delta}{\varepsilon}$. Consequently, in the NC strategy, the market shares of the two retail channels are as follows:

$$D_p^{NC} = D_{pL}^{NC} + D_{pH}^{NC} = \lambda(1 - x_L^{NC}) + (1 - \lambda)(1 - x_H^{NC}) \tag{18}$$

$$D_o^{NC} = D_{oL}^{NC} + D_{oH}^{NC} = \lambda x_L^{NC} + (1 - \lambda)x_H^{NC} \tag{19}$$

The profits of the two retailers are reformulated as follows:

$$\prod_p^{NC} = p_p D_p^{NC} - \frac{1}{2}\eta s^2 + h(s - \varepsilon)D_o^{NC} \tag{20}$$

$$\prod_o^{NC} = [p_o - h(s - \varepsilon)]D_o^{NC} \tag{21}$$

Through the first-order solution, we can obtain Proposition 3.

Proposition 3: Under the NC strategy, the equilibrium prices of the physical retailer and the online retailer are as follows:

$$p_p^{NC} = \frac{1}{3}[2\varepsilon + h(s - \varepsilon) - (1 - \lambda)t + \delta] \tag{22}$$

$$p_o^{NC} = \frac{1}{3}[\varepsilon + 2h(s - \varepsilon) + (1 - \lambda)t - \delta] \tag{23}$$

Proposition 3 also shows that the more abundant the information provided by the channel retailer for products is, the higher the price that is charged to compensate for the increased operating costs.

V. STRATEGY COMPARISON

In this section, we examine various strategies to address whether two retailers will consider collaboration on services in response to consumer showrooming behavior and whether they will support or avoid showrooming thereafter.

A. STRATEGY COMPARISON OF COOPERATION

Whether SC between physical and online retailers is beneficial is determined by comparing the profits of the two parties under the SN and SC strategies.

Proposition 4: Comparing the SN strategy with the SC strategy, we obtain the following:

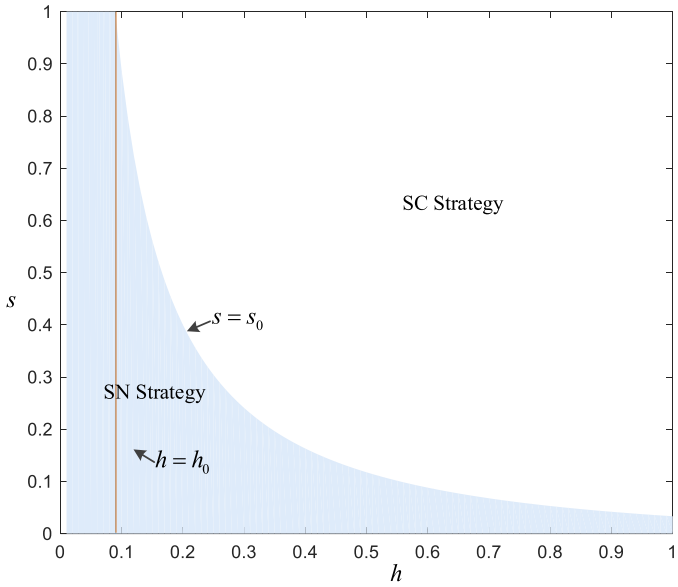
(1) When $s > s_0$ and $h > h_0$, the physical retailer choosing the SC strategy is better off; i.e., $\Pi_p^{SC} > \Pi_p^{SN}$. When $s \le s_0$, the physical retailer choosing the SN strategy is better off; i.e., $\prod_p^{SC} \le \prod_p^{SN}$.

(2) The online retailer choosing the SC strategy is better off than when choosing the SN strategy; i.e., $\prod_o^{SC} \le \prod_o^{SN}$.

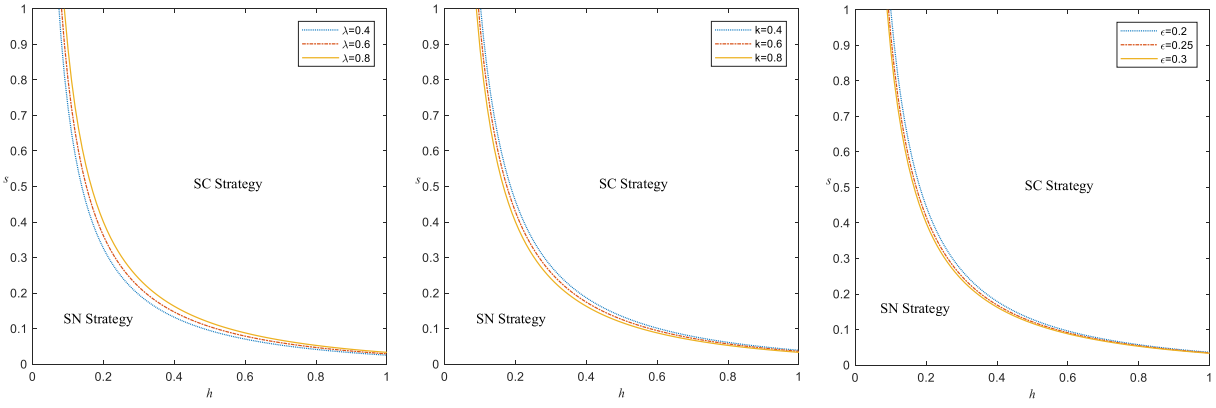
Note that $s_0 = \frac{A_1 - \sqrt{A_1^2 + 4h^2 A_2}}{2h^2}$ and $h_0 = \frac{-A_4 + \sqrt{A_4^2 - 4A_3 A_5}}{2A_3}$, where $A_1 = 2h(1 - \lambda)(t - \delta) - 2hw + 5\varepsilon h + 2\varepsilon h^2$, $A_2 = 2w(1 - \lambda)(t - \delta) - 2\varepsilon w(2 - h) - w^2$, $A_3 = 2\varepsilon - 1$, $A_4 = 5\varepsilon + 2(1 - \lambda)(t - \delta) - 2w + 2\varepsilon w$, and $A_5 = w[2(1 - \lambda)(t - \delta) - w - 4\varepsilon]$.

Proposition 4 shows how the physical retailer and online retailer choose between the SN strategy and the SC strategy. If and only if the physical retailer has a significant competitive advantage in terms of service ($s > s_0$) and can obtain relatively high revenue from such service ($h > h_0$) can the profit obtained by the physical retailer under the SC strategy be higher than that under the SN strategy. This finding indicates that the level of service that the product requires is critical to the choice of SC strategy for a physical retailer. In Figure 4(a), we provide a graphical illustration of the SC willingness of a physical retailer. The values of the parameters in the figures follow the following basic settings. First, we set the proportion of low-type consumers λ at three different levels—low (0.4), medium (0.6), and high (0.8)—to reflect the different levels of market information coverage of the physical retailer. Second, we set three different levels of probability k to reflect the probability that consumers directly evaluate and purchase the best-fit product through the online channel and can correlate the market information coverage of the online retailer at different levels, with the same settings of 0.4, 06, and 0.8. To ensure that high-type consumers cannot ignore their travel costs and that the previous assumption $t > \delta$ holds, $t = 0.25$ and $\delta = 0.1$ are set. Finally, we should reflect the service-level gap between online and offline, and thus, we set $\varepsilon = 0.3$, $w = 0.1$ and $\eta = 0.125$. Unless otherwise specified, the above parameter values will follow this basic setting.

The lower-left corner of Figure 4(a) indicates that the SN strategy is the optimal strategy for the physical retailer, while the upper-right corner of Figure 4(a) indicates that the SC strategy is the optimal strategy for the physical retailer. That is, when the product requires a lower service level, the physical retailer should consider not cooperating with the online retailer on services; however, when the product requires a higher service level, the physical retailer should consider cooperating with the online retailer on services. The threshold (s_0) of the service level is determined by the market information coverage factors (λ and k) and service features (h and ε). Figures 4(b) and 4(c) show the market information coverage factors (λ and k) and their impact on the strategic choices of the physical retailer, respectively. As mentioned earlier, λ can reflect the ability of the physical retailer to provide information through showrooms, and thus, it can be used to measure the physical market information coverage of the physical retailer. Moreover, k is the probability that consumers directly evaluate and purchase the best-fit product, and thus, it can be used to measure the online market information coverage of the online retailer. As shown in Figures 4(b) and 4(c), as λ decreases or k increases, the scope for the physical retailer to adopt the SC strategy expands, while the scope for him to adopt the SN strategy decreases. This finding suggests that as λ becomes lower or k becomes higher, physical retailers are more likely to use the SC strategy, which means that their willingness to cooperate in terms of service is greater. This result occurs because the lower informational ability (λ) provided by the physical retailer means less market coverage. Physical retailers can consider collaborating with online retailers to earn



(a) Comparison of the SN and SC strategies



(b) Impact of λ (c) Impact of k (d) Impact of ε

FIGURE 4. Selection of SN and SC strategies for the physical retailer ($t = 0.25$, $\delta = 0.1$, $\lambda = 0.8$, $\varepsilon = 0.3$, $w = 0.1$, $\eta = 0.125$).

additional revenue from their sales service to compensate for the disadvantage of their low market coverage rate. On the other hand, the higher the ability k of online stores to provide information is, the more likely that consumers will purchase products online to match their best-fit products. Moreover, online stores have an advantage over offline physical stores in terms of lower prices, meaning that consumers have fewer incentives to visit physical stores (showrooms) or even obtain best-fit products by visiting them. The direct result is that the demand for the physical channel decreases. Therefore, similar to the above findings, the greater the value of k is, the greater the willingness of the physical retailer to collaborate with the online retailer to improve profitability.

In addition, Figure 4(d) shows the influence of service features (the effort h of online retailers to eliminate the inconvenience of online services and the perception difference ε on the willingness of the physical retailer to collaborate on services). As consumers have increasing requirements for furniture products with service features, that is, as h and ε increase, the scope of the SC strategy adopted by the physical retailer expands, whereas the scope of the SN strategy shrinks. A higher h value means that the online retailer bears higher service costs for providing services. For the online retailer, whether she adopts the SC or SN strategy, the service cost is inevitable. However, under the SC strategy, this cost turns into an additional benefit for the physical retailer. Therefore, the larger the value of h is, the greater the benefit that the physical retailer can obtain from the SC strategy and the more inclined he will be to choose the SC strategy. Furthermore, the greater the value of ε is, the more obvious the difference in consumer perception of offline and online services will be, and the less competitive advantage the online retailer will

have in providing services. From another perspective, this result indicates that the physical retailer has a more significant competitive advantage in providing services. In this case, on the one hand, the online retailer has full incentives to cooperate with the physical retailer to eliminate the inconvenience of online shopping for consumers and thus compensate for the reduction in consumers' online purchase utility caused by large differences in service perception, thereby increasing sales and profitability. On the other hand, the physical retailer should seize the opportunity presented by large differences in service perceptions and achieve profitability in both products and services by adopting the SC strategy to further increase profits.

In summary, under certain conditions, the SC strategy can achieve simultaneous improvements in the profits of the physical retailer and the online retailer, thereby enabling both parties to cooperate. Especially for the physical retailer, when his market coverage is low and providing service is competitive, he prefers to cooperate with the online retailer so that more consumers will perceive service advantages in the physical channel and then increase their future willingness to purchase through the physical channel. For example, compared with furniture without service attributes, furniture with service attributes has higher service requirements on the consumer and retailer sides, indicating that the threshold for cross-channel services for consumers in the furniture industry with service attributes may be high. When the service threshold is high, the physical retailer can consider cooperating with the online retailer to increase the exposure rate of its channel service features. According to our results, the threshold s_0 of the service level can be calculated to better determine the strategic service-cooperation choice.

According to Proposition 4, we also know that an online retailer, regardless of the service level, will choose the SC strategy. The reason for this choice is that SC with the physical channel will eliminate the inconvenience of service provision by the online channel for consumers, which will indirectly improve the service perception of consumers using the online channel. Therefore, when comparing cooperation or noncooperation strategies, the online retailer will choose the SC strategy.

B. STRATEGY COMPARISON OF SHOWROOMING BEHAVIOR AVOIDANCE

Under the premise of SC, the online retailer and the physical retailer can also consider whether to support or avoid consumer showrooming behavior. To avoid consumer showrooming behavior, retailers can sell different product assortments through different channels (i.e., an exclusive product strategy). To obtain more managerial insights, we analyze and compare retailers' profits under the SC strategy with those under the NC strategy.

Proposition 5: In comparing the SC strategy and the NC strategy, we obtain the following:

(1) The physical retailer choosing the NC strategy will be better off when s is low, which is expressed as follows: if $0 \le s \le s_1$, then $\prod_p^{NC} \ge \prod_p^{SC}$. The physical retailer choosing the SC strategy will be better off when s is high, which is expressed as follows: if $s_1 < s < 1$, $\varepsilon > \varepsilon_1$ and $h > \delta$, then $\prod_p^{NC} \le \prod_p^{SC}$.

(2) The online retailer choosing the SC strategy is better off than when choosing the NC strategy as follows: $\prod_o^{SC} > \prod_o^{NC}$.

Note that $s_1 = \frac{-B_1 - \sqrt{B_1^2 - 8h^2 B_2}}{2h^2}$ and $\varepsilon_1 = \frac{(\delta+h)^2}{2h^2+5h+2\delta h-4\delta}$, where $B_1 = h(2\delta - 5\varepsilon - 2t + 2\lambda t - 2\varepsilon h)$ and $B_2 = -\lambda^2\delta^2 + 2\lambda^2\delta t + 2\lambda\delta^2 + 4\lambda\varepsilon\delta - 2\lambda\delta t - 2\lambda\varepsilon\delta h$.

Proposition 5 first shows that under the premise of SC, the online retailer always chooses to support consumer showrooming behavior. This choice is obvious because consumers deepen their understanding of products through showrooming behavior. Choosing a lower-priced online purchase will undoubtedly lead to a greater utility surplus. The direct result will be an increase in sales and profits for online retailers.

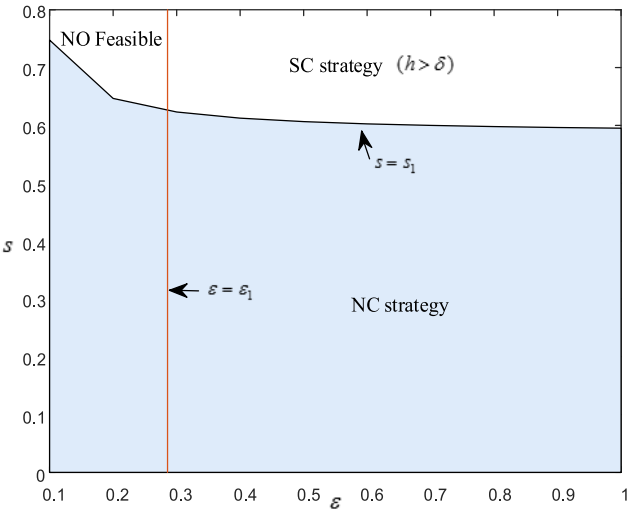


FIGURE 5. Selection of SC and NC strategies by the physical retailer ($t = 0.25$, $\delta = 0.1$, $\lambda = 0.8$, $\varepsilon = 0.3$, $w = 0.1$, $\eta = 0.125$).

For the physical retailer, according to Proposition 5, we know that when the service level is relatively high, the physical retailer has a significant competitive advantage with regard to his services ($\varepsilon > \varepsilon_1$), and the unit service revenue collected from the online retailer is sufficient to compensate for the negative impact of consumer showrooming behavior ($h > \delta$). The SC strategy is more beneficial for the physical retailer than is the NC strategy when the service level is relatively high. We use Figure 5 to visually illustrate the changes in the strategy selection of the physical retailer. The upper part of Figure 5 shows that the SC strategy is the optimal strategy for the physical retailer, while the lower part shows that the NC strategy is the best choice. This finding confirms the conclusion of Proposition 5 and suggests that a physical retailer should consider choosing a higher service level to support consumer showrooming behavior if his competitive

advantage in terms of service is significant and the benefits gained from SC are relatively substantial.

For example, Red Star Macalline's high-quality furniture products have adopted a high service-level strategy and begun to display more implementable service attributes in the physical store (showroom). The rationale for this strategy is that if a consumer finds high-quality furniture to be unsuitable, then it usually results in considerable return costs (including reprocessing costs) for both retailers and consumers. Therefore, retailers who provide high-quality furniture tend to improve their service level (for example, by hiring more advanced product customization design assistants, providing installation training and hiring after-sales maintenance professionals to better serve customers). Despite the higher cost of an enhanced service level, increased market demand still provides retailers with the opportunity to obtain higher profits.

However, Proposition 5 also indicates that if a product's service level is low, then the physical retailer has no obvious competitive advantage, regardless of how much he can obtain from SC, and the physical retailer should avoid supporting showrooming behavior. The reason for this is that when the level of service required by a product is low, consumers will perceive less of a difference between online and offline services. In that case, the physical retailer will lose its competitive advantage in terms of services, which may cause some consumers who originally purchased through the physical channel to purchase online, especially those who are less sensitive to service. This change in turn will decrease the physical retailer's sales volume. Therefore, supporting showrooming will undoubtedly further reduce the market share of the physical channel. Although the physical retailer can still obtain an additional benefit from the SC strategy, the benefit will no longer be enough to compensate for the loss from reduced sales, and avoiding consumer showrooming can alleviate these disadvantages. Therefore, whether a physical retailer supports or avoids consumer showrooming depends on the product characteristics, that is, the product's service level or the physical retailer's competitive advantage in product services.

Practical examples demonstrate that physical retailers can mitigate the negative effects of consumer showrooming behavior by offering quick sales [54] and presales [55], [56], [57], hiding barcodes [58], engaging in price matching [11], and adopting an exclusive product strategy [12].

There are two ways in which physical retailers can take indirect measures to prevent the negative effects of consumer showrooming. On the one hand, consumer showrooming allows online retailers to free ride in offline physical stores because after consumers touch and experience the products of physical stores, they may switch to online stores to make purchases. Consequently, some potential offline consumers may not be convinced that the product will meet their expectations, and they may choose to experience the product in an offline physical store (showroom) to decide whether and where to purchase the product. In this case, potential offline consumers who are satisfied with the product but are not sensitive to product-related services may purchase online at a lower price, causing physical retailers to lose potential consumers. According to a Comscore report [3], as many as 36% of consumers engage in showrooming. Therefore, physical retailers can use SN strategies of fee-based membership [19], [59], price matching [11], and exclusive products [12] to prevent consumers from turning to online channels. On the other hand, consumer showrooming will lead to fierce service competition. According to Proposition 5, only when the service level is high will the physical retailer's profit under the SC strategy be higher than that under the NC strategy. Thus, physical retailers may prefer strategies that do not directly target consumer showrooming behavior but increase their service level. For example, in addition to professional delivery and installation, the physical retailers of Red Star Macalline provide free follow-up value-added services such as mattress mite removal, sofa maintenance, floor maintenance, and furniture lacquering to consumers.

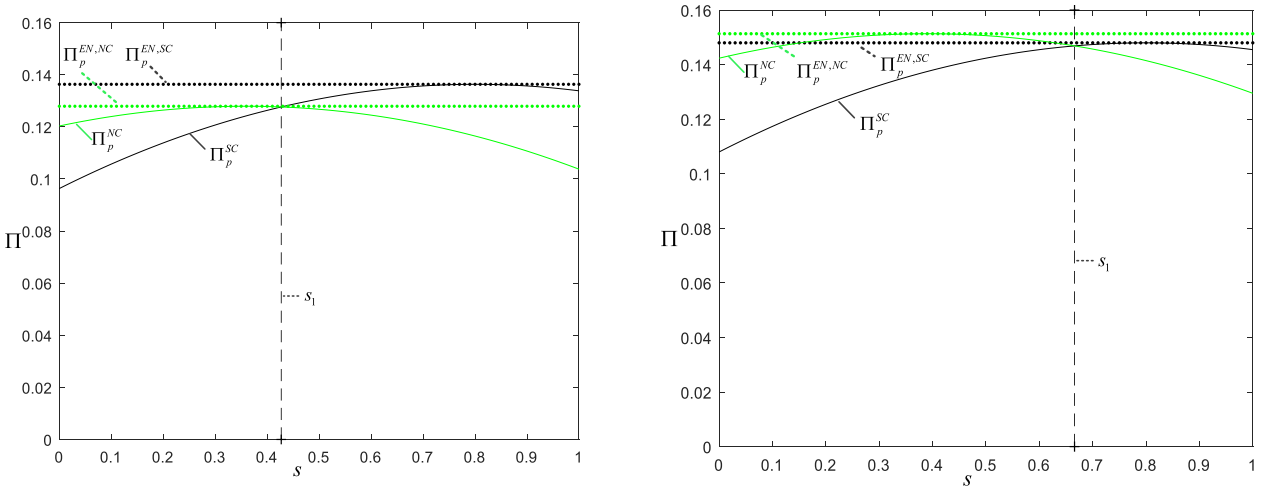
Proposition 5 also indicates that online retailers always choose to support consumer showrooming and that avoiding showrooming will be unfavorable for them. For example, Li et al. [4] analyzed how online retailers use QR codes to inform consumers that online products and services are the same as those available offline. In practice, more online retailers have transformed and upgraded to omnichannel retailers. For example, Lin's Wood in China, which was originally an online retailer, opened its first offline online-to-offline (O2O) experience showroom in Foshan in August 2014. By October 2019, the company had opened 252 offline stores around the world, including in regions such as China, Singapore and Malaysia. The company is committed to improving consumer service and experience perception and plans to add 1,000 offline stores within three years, believing that it is necessary to support consumer showrooming and conduct online and offline SC, which is also in line with Proposition 4.

VI. EXTENSION: ENDOGENOUS SERVICE LEVEL

Compared with the exogenous service-level scenario, we propose Propositions 6 and 7.

Next, we extend the scenario where the service level is endogenous. We assume that the service level s is determined by the physical retailer because he has more service dominance than does the online retailer. The service level is determined first, and the other game processes are set in the same order as the external service-level scenario. We use s^{EN} to denote the endogenous service-level scenario. Similarly, in the endogenous service-level scenario, other symbols also use superscript *EN*. The corresponding equilibrium solutions are provided in Table 2.

Proposition 6: Comparing the profits of the physical retailer under scenarios of exogenous and endogenous service levels, we obtain the following:



(a) $\lambda \le \arg(\Pi_p^{EN,SC} = \Pi_p^{EN,NC})$ (b) $\lambda > \arg(\Pi_p^{EN,SC} = \Pi_p^{EN,NC})$

FIGURE 6. Changes in the selection of the SC and NC strategies in the endogenous service-level scenario ($t = 0.25$, $\delta = 0.1$, (a)$\lambda = 0.8$, (b)$\lambda = 0.6$, $\varepsilon = 0.3$, $w = 0.1$, $\eta = 0.125$).

TABLE 2. Equilibrium service levels and prices.

Case	Equilibrium service levels and prices
	$s^{EN,SN} = \frac{2h[w+2\varepsilon(1-h/2)-(1-\lambda)(t-\delta)]}{9\eta\varepsilon-2h^2}$
SN strategy	$p_p^{EN,SN} = \frac{1}{3}[2\varepsilon+w+h(s^{EN,SN}-\varepsilon)-(1-\lambda)(t-\delta)]$
	$p_o^{EN,SN} = \frac{1}{3}[\varepsilon-w+2h(s^{EN,SN}-\varepsilon)+(1-\lambda)(t-\delta)]$
	$s^{EN,SC} = \frac{h}{\eta}$
SC strategy	$p_p^{EN,SC} = \frac{1}{3}[2\varepsilon+2hs+h(s^{EN,SC}-\varepsilon)-(1-\lambda)(t-\delta)]$
	$p_o^{EN,SC} = \frac{1}{3}[\varepsilon+hs+2h(s^{EN,SC}-\varepsilon)+(1-\lambda)(t-\delta)]$
	$s^{EN,NC} = \frac{2h[2\varepsilon(1-h/2)+\delta-(1-\lambda)t]}{9\eta\varepsilon-2h^2}$
NC strategy	$p_p^{EN,NC} = \frac{1}{3}[2\varepsilon+h(s^{EN,NC}-\varepsilon)-(1-\lambda)t+\delta]$
	$p_o^{EN,NC} = \frac{1}{3}[\varepsilon+2h(s^{EN,NC}-\varepsilon)+(1-\lambda)t-\delta]$

(1) The physical retailer's choice of SC will change as follows: when $s > s_0$, with the endogenous service level, he will shift from the cooperation strategy to the noncooperation strategy; conversely, when $s \le s_0$, he will still choose the noncooperation strategy.

(2) The showroom avoidance/support choice of the physical retailer will change as follows:

i) when $\lambda \le \lambda^*$ and $s \le s_1$, $\Pi_p^{EN,SC} \ge \Pi_p^{EN,NC}$, i.e., with the endogenous service level, he will change from avoiding to supporting consumer showrooming behavior. When $\lambda \le \lambda^*$ and $s > s_1$, $\Pi_p^{EN,SC} \ge \Pi_p^{EN,NC}$; i.e., his choice remains unchanged, and he still supports showrooming.

ii) when $\lambda > \lambda^*$ and $s \le s_1$, $\Pi_p^{EN,SC} < \Pi_p^{EN,NC}$; i.e., with the endogenous service level, his choice remains unchanged, and he continues to avoid consumer showrooming behavior. When $\lambda > \lambda^*$ and $s > s_1$, $\Pi_p^{EN,SC} < \Pi_p^{EN,NC}$; i.e., he will switch from supporting to avoiding consumer showrooming behavior.

In these cases, $\lambda^* = \frac{-C_2-\sqrt{C_2^2-4C_1C_3}}{2C_1}$. ($C_1 = -2\eta[(9\varepsilon\eta - 2h^2)\delta(2t - \delta) + 2h^2t^2]$, $C_2 = -4\eta[2h(t - \delta) + 9\delta\varepsilon\eta][\delta + (\varepsilon - t) + (\varepsilon - h)]$, $C_3 = h^2[\eta(2h + 5)(13 - 2h)\varepsilon^2 + 2(8\eta(t - \delta) - 9h^2 - 4\eta h(t - \delta))\varepsilon - 4\eta(t - \delta)^2]$)

When the service level is endogenous, it is more beneficial for the physical retailer to choose noncooperation. In this case, the choice regarding whether to support or avoid consumer showrooming behavior depends on his ability λ to provide information through the physical channel or market coverage (as shown in Figure 6). The reason for this is that the physical retailer can use his service-level decision-making power to achieve two effects. On the one hand, he can maximize the use of service competitiveness, in which case he will choose a noncooperation strategy. On the other hand, avoiding showrooming can weaken service competition between online and offline channels, further reducing service costs and increasing revenue. Therefore, when the physical retailer has the ability to provide information, which means that his market coverage is high enough, he will always be motivated to avoid showrooming.

Proposition 7: Comparing the profits of the online retailer under scenarios of exogenous and endogenous service levels, we obtain the following:

(1) There is no change in the SC choice of the online retailer, and she is always willing to choose SC.

(2) Supporting showrooming always benefits the online retailer.

Proposition 7 shows that online retailers always benefit from SC and showrooming support. Thus, online retailers should consider signing long-term SC agreements with

physical retailers and try to narrow the gap between online and offline service levels, thus forming a long-term cooperation strategy and guiding physical retailers to give up service dominance.

VII. CONCLUSION

With the intensification of multichannel retail competition, the market share of the physical channel is shrinking, and its profitability is declining; online retailers have been using the physical channel as a free showroom. Popular media describe online retailers as ''eating physical retailers' lunch'' [18]. However, consumer demand for showrooms is an important reason for the emergence of physical retailers and their physical channel in the first place, and showrooming can be used to drive profitability. Consumers increasingly value service quality; consumer demand for services in the physical channel has always been one of the main reasons for the existence of the physical channel, and it is a major driving force for two retailers in dual channels to enter into SC.

Most studies on consumer showrooming ignore the impact of service. To address this oversight, in this paper, we study how and when facing competitive pressure from the online channel and the use of physical stores as free showrooms can physical retailers exploit their service advantage to address the consumer showrooming effect in a dual-channel environment. Online retailers face pressure in the form of service competition, and we examine the conditions under which they will agree to SC with physical retailers. We examine a SC strategy and find that under certain conditions, such as high service threshold requirements or high service requirements, SC can enable both retailers in the two channels to achieve a win-win outcome. The following conclusions can be obtained from our study.

First, in the exogenous service-level scenario, physical retailers earn higher profits under the SC strategy than under the SN strategy when and only when they have a significant competitive advantage in terms of their service ($s > s_0$) and can obtain relatively high returns from service revenue ($h > h_0$). However, online retailers always earn higher profits under the SC strategy than under the SN strategy, which means that online retailers always have the willingness to participate in the SC. The service level plays a crucial role in the willingness of physical retailers to participate in the SC, and market information coverages (λ, k) and service characteristics (h, ε) influence the service level. On the one hand, when the physical market information coverage λ is lower or the online market coverage is higher, the willingness of physical retailers to adopt the SC strategy is greater. This means that physical retailers attempt to increase their market coverage through the SC strategy. On the other hand, service characteristics include the service cost factor h and the service threshold factor ε. The willingness of physical retailers to adopt the SC strategy increases as consumers demand higher service levels for products, with an increase in response to h and ε.

Second, regarding the decision of whether to still support consumer showrooming after SC, we find that online retailers always tend to support it because they are the beneficiaries of consumer showrooming behavior. Only when physical retailers have a significant competitive advantage in their services ($s > s_1$, $\varepsilon > \varepsilon_1$) and the revenue generated from SC is relatively high ($h > \delta$) can they consider choosing a higher service level to support consumer showrooming behavior.

Third, in the endogenous service-level scenario, since physical retailers have service-leading decision-making power, they will be more inclined toward the SN strategy. However, similar to the exogenous service-level scenario, online retailers lean toward the SC strategy and support consumer showrooming behavior.

Some useful managerial enlightenments are as follows. To strengthen the reliability of SC, online retailers should guide physical retailers in signing long-term SC strategic contracts and thus preventing physical retailers from widening the gap between online and offline services. Moreover, with the development of the multichannel retail industry and technological progress, the consumer showrooming phenomenon is irresistible, and thus, we cannot blindly resist it. To respond to consumer demand for showrooms, physical retailers should provide consumers with convenient options for showrooming. For example, physical shops (such as Barnes & Noble, Best Buy, Macy's, and Nordstrom) should provide free wireless internet instead of covering the ceiling with wire to prevent consumers from accessing the internet via smartphones. Of course, we do not discount the negative effects that consumer showrooming has had on physical retailers. Physical retailers should fully exploit their channel advantages, such as the SC strategy proposed in this paper, the price confusion strategy (such as bundling, discounts, and loyalty integration) and the exclusive product strategy proposed by other researchers. Regardless of whether consumers need a showroom, the strategy used by physical retailers should be used to enhance their core competitiveness in services rather than seeking to eliminate showrooming directly.

The current analysis considers only the competition and cooperation decisions of retailers in the two channels in the presence of consumer showrooming in a dual-channel environment. However, in the presence of consumer showrooming, the manufacturer not only benefits from the increase in the market share of the online channel but is also negatively affected by the decreased market share of the physical channel. One extension of this paper would be to consider whether the manufacturer can provide a contract to coordinate the tradeoff between the showrooming effect and service competition. Another extension would be to examine whether the online retailer allowing returns might weaken consumer demand for the use of the physical channel as a showroom. How should the physical retailer and the online retailer formulate their channel pricing strategy, service strategy, optimal return strategy (full refund, partial refund or nonrefund policy), and optimal refund price under a partial return policy?

APPENDIX A
ALL PROOFS

Proof of Proposition 1: From the second derivative $\frac{\partial^2 \Pi_p^{SN}}{\partial p_p^2} = \frac{-2}{\varepsilon} < 0$, it can be seen that Π_p^{SN} is a concave function w.r.t. p_p. The second derivative $\frac{\partial^2 \Pi_o^{SN}}{\partial p_o^2} = \frac{-2}{\varepsilon} < 0$ shows that Π_o^{SN} is a concave function w.r.t. p_o. From $\partial \Pi_p^{SN}/\partial p_p = 0$ and $\partial \Pi_o^{SN}/\partial p_o = 0$, the optimal prices p_p^{SN} and p_o^{SN} can be obtained in the case of SN.

Proof of Proposition 2: From the second derivative $\frac{\partial^2 \Pi_p^{SC}}{\partial p_p^2} = \frac{-2}{\varepsilon} < 0$, it can be seen that Π_p^{SC} is a concave function w.r.t. p_p. The second derivative $\frac{\partial^2 \Pi_o^{SC}}{\partial p_o^2} = \frac{-2}{\varepsilon} < 0$ shows that Π_o^{SC} is a concave function w.r.t. p_o. From $\partial \Pi_p^{SC}/\partial p_p = 0$ and $\partial \Pi_o^{SC}/\partial p_o = 0$, the optimal prices p_p^{SC} and p_o^{SC} of the two retailers can be obtained in the case of SC.

Proof of Proposition 3: From the second derivative $\frac{\partial^2 \Pi_p^{NC}}{\partial p_p^2} = \frac{-2}{\varepsilon} < 0$, it can be seen that Π_p^{NC} is a concave function w.r.t. p_p. The second derivative $\frac{\partial^2 \Pi_o^{NC}}{\partial p_o^2} = \frac{-2}{\varepsilon} < 0$ shows that Π_o^{NC} is a concave function w.r.t. p_o. From $\partial \Pi_p^{NC}/\partial p_p = 0$ and $\partial \Pi_o^{NC}/\partial p_o = 0$, the optimal prices p_p^{NC} and p_o^{NC} of the two retailers can be obtained in the case of NC.

Proof of Proposition 4: (1) $\prod_p^{SC} - \prod_p^{SN} = \frac{1}{9\varepsilon}[-h^2 s^2 + A_1 s + A_2]$, where $A_1 = 2h(1-\lambda)(t-\delta) - 2hw + 5\varepsilon h + 2\varepsilon h^2$ and $A_2 = 2w(1-\lambda)(t-\delta) - 2\varepsilon w(2-h) - w^2$. $\frac{\partial^2(\prod_p^{SC} - \prod_p^{SN})}{\partial s^2} = -\frac{2h^2}{9\varepsilon} > 0$; therefore $\prod_p^{SC} - \prod_p^{SN}$ is a concave function with respect to (w.r.t.) s. The symmetry axis of the function of $\prod_p^{SC} - \prod_p^{SN}$ is $\frac{1}{2h}[2(1-\lambda)(t-\delta) - 2w + 3\varepsilon + 2\varepsilon(1+h)]$. With $x_L^{SN} \geq 0$, we can obtain $\varepsilon \geq \frac{1}{1+h}[w + hs + 2(1-\lambda)(t-\delta)]$. Then, the symmetry axis $\geq \frac{1}{2h}[3\varepsilon + 2hs + 6(1-\lambda)(t-\delta)] > 1$ because $\varepsilon > h$.

When $s = 0$, $\prod_p^{SC} - \prod_p^{SN}|_{s=0} = -\frac{w}{9\varepsilon}[2\varepsilon(1-h) + 2(\varepsilon - (1-\lambda)(t-\delta)) + w]$. Because $x_L^{SN} \geq 0$, we can obtain $\varepsilon \geq \frac{1}{1+h}[w + hs + 2(1-\lambda)(t-\delta)] > (1-\lambda)(t-\delta)$, and then, $\prod_p^{SC} - \prod_p^{SN}|_{s=0} < 0$.

When $s = 1$, $\prod_p^{SC} - \prod_p^{SN}|_{s=1} = \mu(h) = \frac{1}{9\varepsilon}[A_3 h^2 + A_4 h + A_5]$, where $A_3 = 2\varepsilon - 1$, $A_4 = 5\varepsilon + 2(1-\lambda)(t-\delta) - 2w + 2\varepsilon w$, and $A_5 = w[2(1-\lambda)(t-\delta) - w - 4\varepsilon]$. Obviously, $\varepsilon < \frac{1}{2}$, and thus, $\mu(h)$ is a concave function w.r.t. h.

When $h = 0$, $\mu(h=0) = -\frac{w}{9\varepsilon}[2(1-\lambda)(t-\delta) + 4\varepsilon + w] < 0$; when $h = 1$, $\mu(h=1) = \frac{1}{9\varepsilon}[7\varepsilon + 2(1-\lambda)(t-\delta)(1+w) + 2\varepsilon w - (1+w)^2]$. When $s = 1$ and $h = 1$, $\varepsilon \geq \frac{1}{2}[w + 1 + 2(1-\lambda)(t-\delta)]$. Therefore,

$$\begin{aligned}\mu(h=1) &> \frac{1}{9\varepsilon}[5\varepsilon + 2(1-\lambda)(t-\delta)(1+w) + 2\varepsilon w \\ &\quad + 2(1-\lambda)(t-\delta) - (1+w)w] \\ &> \frac{1}{9\varepsilon}[3\varepsilon + 2(1-\lambda)(t-\delta)(1+w) \\ &\quad + 2\varepsilon w + 4(1-\lambda)(t-\delta) + (1+w)(1-w)] > 0.\end{aligned}$$

Solving the quadratic equation $\mu(h) = 0$ w.r.t. h shows that the smaller real root is $h_0 = \frac{-A_4 + \sqrt{A_4^2 - 4A_3A_5}}{2A_3}$. Therefore, when $h > h_0$, $s \leq s_0$, $\prod_p^{SC} \leq \prod_p^{SN}$.

Solving the quadratic equation $\prod_p^{SC} - \prod_p^{NC} = 0$ w.r.t. s shows that the smaller real root is $s_0 = \frac{A_1 - \sqrt{A_1^2 + 4h^2 A_2}}{2h^2}$. Therefore, when $s > s_0$ and $h > h_0$, $\prod_p^{SC} > \prod_p^{SN}$, and when $s \leq s_0$, $\prod_p^{SC} - \prod_p^{SN}$.

(2) $\prod_o^{SC} - \prod_o^{SN} = \frac{w+hs}{9\varepsilon}[2\varepsilon(1+h) - w - hs + 2(1-\lambda)(t-\delta)]$. Because $x_L^{SN} \geq 0$, we can obtain $\varepsilon \geq \frac{1}{1+h}[w + hs + 2(1-\lambda)(t-\delta)]$. Therefore,

$$\begin{aligned}\prod_o^{SC} - \prod_o^{SN} &\geq \frac{w+hs}{9\varepsilon}[2(w + hs + 2(1-\lambda)(t-\delta)) \\ &\quad - w - hs + 2(1-\lambda)(t-\delta)] \\ &= \frac{w+hs}{9\varepsilon}[w + hs + 6(1+\lambda)(t-\delta)] > 0.\end{aligned}$$

Proof of Proposition 5: (1) $\prod_p^{NC} - \prod_p^{SC} = \frac{1}{9\varepsilon}[h^2 s^2 + B_1 s + B_2]$, where $B_1 = h(2\delta - 5\varepsilon - 2t + 2\lambda t - 2\varepsilon h)$ and $B_2 = -\lambda^2\delta^2 + 2\lambda^2\delta t + 2\lambda\delta^2 + 4\lambda\varepsilon\delta - 2\lambda\delta t - 2\lambda\varepsilon\delta h$. $\frac{\partial^2(\prod_p^{NC} - \prod_p^{SC})}{\partial s^2} = \frac{2h^2}{9\varepsilon} > 0$; therefore, $\prod_p^{NC} - \prod_p^{SC}$ is a concave function w.r.t. s.

When $s = 0$, $\prod_p^{NC} - \prod_p^{SC}|_{s=0} = \frac{\lambda\delta}{9\varepsilon}[2(1-\lambda)(t-\delta) + \lambda\delta + 2\varepsilon(2-h)] > 0$.

When $s = 1$, $\prod_p^{NC} - \prod_p^{SC}|_{s=1} = g(\lambda) = B_3\lambda^2 + B_4\lambda + B_5$, where $B_3 = (2t-\delta)\delta$, $B_4 = 2(\delta^2 + 2\delta\varepsilon - \delta t - \delta\varepsilon h + ht)$ and $B_5 = h^2 - 2\varepsilon h^2 + 2\delta h - 5\varepsilon h - 2ht$. The symmetry axis of $g(\lambda)$ is $-\frac{B_4}{2B_3} = -\frac{\delta^2 + \delta\varepsilon(2-h) + (h-\delta)t}{(2t-\delta)\delta}$. When $h > \delta$, the symmetry axis of $g(\lambda)$ is less than zero. When $\lambda = 0$, $g(\lambda=0) = h^2 - 2\varepsilon h^2 - 2h(t-\delta) - 5\varepsilon h$; due to $\varepsilon > h$, $g(\lambda=0) < h^2 - 2\varepsilon h^2 - 2h(t-\delta) - 5h^2 = -4h^2 - 2\varepsilon h^2 - 2h(t-\delta) < 0$. When λ=1, $g(\lambda=1) = -\varepsilon(2h^2 + 5h + 2\delta h - 4\delta) + (\delta + h)^2$. Therefore, when $\varepsilon > \frac{(\delta+h)^2}{2h^2+5h+2\delta h-4\delta}$ and $h > \delta$, $g(\lambda=1) < 0$. That is, when $\varepsilon > \frac{(\delta+h)^2}{2h^2+5h+2\delta h-4\delta}$ and $h > \delta$, $\prod_p^{NC} - \prod_p^{SC}|_{s=1} < 0$.

Solving the quadratic equation $\prod_p^{NC} - \prod_p^{SC} = 0$ w.r.t. s shows that the smaller real root is $s_1 = \frac{-B_1 - \sqrt{B_1^2 - 4h^2 B_2}}{2h^2}$. Comprehensively, when $s_1 < s < 1$, $\varepsilon > \frac{(\varepsilon+h)^2}{2h^2+5h+2\delta h-4\delta} = \varepsilon_1$, and when $h > \delta$, $\prod_p^{NC} < \prod_p^{SC}$; when $0 \leq s \leq s_1$, $\prod_p^{NC} \geq \prod_p^{SC}$.

(2) $\prod_o^{NC} - \prod_o^{SC} = -\frac{\lambda\delta + hs}{9\varepsilon}[2(1-\lambda)(t-\delta) + (\varepsilon - \lambda\delta)] + (\varepsilon - hs) + 2\varepsilon h]$. Because $\varepsilon > \delta$ and $\varepsilon > h$, $\prod_o^{NC} - \prod_o^{SC} < 0$; i.e., $\prod_o^{SC} > \prod_o^{NC}$.

Proof of Proposition 6: The equilibrium price and service level under the endogenous service-level scenario can be obtained by standard backward induction. The solution method is approximately the same as when the service level is exogenous. For convenience, we omit a similar solution process.

The equilibrium price and endogenous service level are shown in Table 1.

We then compare the profits of the physical retailer under the endogenous service-level scenario and the exogenous service-level scenario. We find that $\Pi_p^{EN,SN} > \Pi_p^{SN}$, $\Pi_p^{EN,SC} > \Pi_p^{SC}$ and $\Pi_p^{EN,SN} > \Pi_p^{EN,SC}$. Recalling the exogenous service-level scenario, when $s \le s_0$, $\prod_p^{SN} \ge \prod_p^{SC}$; when $s > s_0$, $\prod_p^{SN} < \prod_p^{SC}$. Therefore, when $s > s_0$, under the endogenous service-level scenario, the physical retailer will change from a cooperative strategy to a noncooperative strategy. In contrast, when $s \le s_0$, he will still choose a noncooperative strategy.

By comparing profits, we also find that $\Pi_p^{EN,SC} > \Pi_p^{SC}$ and $\Pi_p^{EN,NC} > \Pi_p^{NC}$. Moreover, $\Pi_p^{EN,SC} - \Pi_p^{EN,NC} = \frac{1}{18\varepsilon\eta(9\varepsilon\eta-2h^2)}(C_1\lambda^2 + C_2\lambda + C_3)$, in which $C_1 = -2\eta[(9\varepsilon\eta - 2h^2)\delta(2t - \delta) + 2h^2t^2]$, $C_2 = -4\eta[2h(t - \delta) + 9\delta\varepsilon\eta][\delta+(\varepsilon-t)+(\varepsilon-h)]$, and $C_3 = h^2[\eta(2h+5)(13-2h)\varepsilon^2+2(8\eta(t-\delta)-9h^2-4\eta h(t-\delta))\varepsilon-4\eta(t-\delta)^2]$. Obviously, $C_1 < 0$, $C_2 < 0$, and $C_3 > 0$. Therefore, there exists a larger root, $\lambda^* = \frac{-C_2-\sqrt{C_2^2-4C_1C_3}}{2C_1}$; when $\lambda \le \lambda^*$, $\Pi_p^{EN,SC} \ge \Pi_p^{EN,NC}$; conversely, $\Pi_p^{EN,SC} < \Pi_p^{EN,NC}$. Recalling the exogenous service-level scenario, when $s \le s_1$, $\prod_p^{NC} \ge \prod_p^{SC}$, and when $s > s_1$, $\prod_p^{NC} < \prod_p^{SC}$. Therefore,

(i) When $\lambda \le \lambda^*$ and $s \le s_1$, $\Pi_p^{EN,SC} \ge \Pi_p^{EN,NC}$; that is, in the endogenous service-level scenario, the physical retailer will switch from avoiding to supporting consumer showrooming behavior. When $\lambda \le \lambda^*$ and $s > s_1$, $\Pi_p^{EN,SC} \ge \Pi_p^{EN,NC}$; that is, the physical retailer will still support showrooming behavior.

(ii) When $\lambda > \lambda^*$ and $s \le s_1$, $\Pi_p^{EN,SC} < \Pi_p^{EN,NC}$; that is, his choice will remain the same, and he will still avoid showrooming. When $\lambda > \lambda^*$ and $s > s_1$, $\Pi_p^{EN,SC} > \Pi_p^{EN,NC}$, and he will switch from supporting to avoiding showrooming.

Proof of Proposition 7: Comparing the profits of the physical retailer under the endogenous service-level scenario with those under the exogenous service-level scenario, we obtain $\Pi_o^{EN,SC} = \Pi_p^{SC}$, $\Pi_o^{EN,SC} > \Pi_o^{EN,SN}$ and $\Pi_o^{EN,SC} > \Pi_o^{EN,NC}$. Recalling the exogenous service-level scenario, $\prod_o^{SC} > \prod_o^{SN}$ and $\prod_o^{SC} > \prod_o^{NC}$ are obtained. Therefore, the online retailer's choice has not changed, and the online retailer is always willing to choose the SC strategy and support consumer showrooming behavior.

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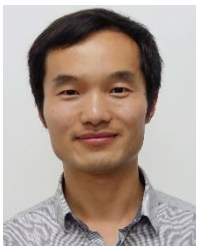
JIQIONG LIU was born in Haikou, Hainan, China, in 1984. She received the bachelor's and master's degrees in management and the Ph.D. degree in management science and engineering from the Hefei University of Technology, Anhui, China, in 2007, 2010, and 2021, respectively.

She is currently an Associate Professor with the Business School, Fuyang Normal University, Anhui, in 2010. Her current research interests lie in marketing pattern choosing and product pricing based on consumer behavior, marketing, and operation under omni-channel. Her articles have appeared in journals, such as *Journal of Retailing and Consumer Services*.



SHUAI FENG was born in Dangshan, Anhui, China, in 1983. He received the bachelor's and master's degrees in management and the Ph.D. degree in management science and engineering from the Hefei University of Technology, Anhui, China, in 2007, 2010, and 2021, respectively.

Since 2010, he has been a full-time Teacher with the Business School, Fuyang Normal University, Anhui. He is currently an Associate Professor and his research areas include behavioral modeling in marketing, competitive and cooperative strategies, distribution channels, and pricing. His articles have appeared in journals, such as IEEE Access. He serves as a Reviewer for the *Journal of the Operational Research Society*.