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Decision support

Competition or cooperation: Strategy analysis for a social commerce platform

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ABSTRACT

Consider a market where identical products are sold to consumers via two competing platforms: one traditional and the other social-commerce-based. The social commerce platform operates a virtual community using two strategies: a competition strategy whereby the social commerce platform attracts and engages consumers through its virtual community, leading them to directly purchase products from its e-commerce channel, and a cooperation strategy whereby the social commerce platform integrates links to the traditional platform's online channel within its community. We fully characterize the optimal decisions and corresponding profits and consumer surplus under each strategy. Our findings indicate that while platforms increase prices in a market with full coverage, they (weakly) decrease them in a market with partial coverage if consumer unit travel costs increase. Additionally, we explain how the revenue-sharing rate and spillover effect of a virtual community affect the cooperation strategy and discover that they have a nonmonotonic impact on the effort level of the social commerce platform. Importantly, we show that when the downstream market is partially covered, the cooperation strategy could result in a win-win-win situation for platforms, consumers, and social welfare. When the downstream market is fully covered, however, the cooperation strategy may result in a lose-win-lose, lose-win-win, or lose-lose-win situation for the social commerce platform, traditional platform, and consumers. Implementing the cooperation strategy might reduce social welfare. We also consider three extensions – sequential pricing, the traditional platform investing in its own virtual community, and a cooperation strategy with cost sharing – to check the robustness of the main results.

1. Introduction

The expansion of social commerce platforms has been impressive. In China, sales from social commerce platforms such as Douyin and RED (Wan, 2022, also known as Xiaohongshu) exceeded $365 billion in 2021, according to a McKinsey report (Amed et al., 2021). RED, one of the most famous social commerce platforms, had 200 million monthly active users by October 2021 and is still expanding quickly.[1] In the US, transactions on social commerce platforms amounted to $51.8 billion in 2022, and they are predicted to reach $145.2 billion by 2028 (Becdach et al., 2022). A social commerce platform called Lemon8 has recently surged in popularity in the United States. After being released in April 2023, the Lemon8 app was installed more than 650,000 times nationwide in just ten days (Fischer, 2023).

The rapid growth of social commerce platforms is due to their integration of social media and online shopping (Jin et al., 2022; Zheng et al., 2020). Social commerce platforms distinguish themselves from traditional platforms (e.g., Taobao, JD, Amazon) by fostering the growth of *a virtual community*, which offers the following benefits. First, the virtual community allows users to interact socially with others while experiencing a variety of lifestyles that are shared by others, covering subjects such as food, fitness, and clothing. This improves the shopping experience for customers and raises their confidence in brands and platforms (Lin et al., 2019). Second, the community supports the e-commerce component of the social commerce platform by effectively gathering and analyzing user consumption data, which leads to more accurate product recommendations and eventually increases sales (Fu et al., 2020). Moreover, the virtual community sets social commerce platforms apart from traditional platforms and provides opportunities for cooperation. As an example, Taobao recognized the power of RED's virtual community and decided to collaborate with RED in 2020 (Feed, 2021). This helped RED expand its visibility. Last, the virtual community can play a key role in expanding a product's market coverage. Using the cosmetics industry as an example, RED designed a special algorithm that analyzes the preferences of female consumers to encourage them to make purchases and share their product experiences (Lin & Shen, 2023). As a result, a positive feedback loop begins in which an increasing number of female consumers interact with the platform through the virtual community (Ecommerce in China, 2023).

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[1] https://www.xiaohongshu.com/en?source=official

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The platform successfully attracts female users by utilizing the virtual community, leading to a noticeable expansion of the cosmetics market. The proportion of female consumers on RED surged from roughly 70% in 2020 to nearly 90% in 2021, as shown by Verot (2023).

The establishment of the virtual community is a double-edged sword for a social commerce platform. On the positive side, the virtual community can help to attract new customers and promote direct transactions within a social commerce platform's own online marketplace. On the other hand, fostering the virtual community requires substantial financial investment that also carries the risk of losing consumers who interact with the virtual community to traditional platforms. For example, RED had raised $917.7 million in funding through 7 rounds of financing as of November 2021 (Crunchbase, 2021). The majority of these funds are used to enhance the virtual community, such as by utilizing AI technologies to expand the scope of content.[2] Although RED had a user base of more than 300 million in 2020, only 15% to 20% of its total revenue came from online sales. In reality, after exploring RED's virtual community, many users move on to traditional platforms such as Taobao to make orders.

To lessen the negative impact caused by transferred purchase behavior, some social commerce platforms choose to collaborate with traditional platforms. For instance, Weibo has formed alliances with well-known platforms such as Taobao and JD, earning part of its profits as commission fees (Chernavina, 2020). Similarly, in 2020, RED elected to collaborate with Taobao, allowing links to Taobao's products within its virtual community. In exchange, RED received a share of the sales revenue generated by these links. However, due to unmet expectations, the RED and Taobao partnership was terminated in 2021 (Feed, 2021).

In light of the aforementioned industries, we are interested in the operational approach that a social commerce platform controlling a virtual community should adopt when competing with a traditional platform. In particular, we consider two operational strategies adopted by a social commerce platform. One is the *competition strategy*, wherein the social commerce platform leverages its virtual community to attract and engage users, encouraging them to buy products directly from the social commerce platform. The second strategy is a *cooperation strategy*, whereby the social commerce platform incorporates links to the traditional platform's products into its virtual community and receives commission payments from the traditional platform for any additional sales generated by the online virtual community. We are interested in addressing the following research questions:

1. What impact does the particular operational strategy have on the optimal effort level in the virtual community created by the social commerce platform and the optimal pricing choices for the two platforms?
2. Which operational strategy should the social commerce platform adopt?
3. Using the chosen approach, is it possible to produce a win-win outcome for platforms, consumers, and social welfare?

To address these questions, we consider a market with two distinct platforms that sell the same product to consumers along a Hotelling line: a social commerce platform (such as RED) and a traditional platform (such as Taobao). The platforms compete on price, and the social commerce platform chooses how much it will invest in a virtual community on its own platform. Two operational strategies for the social commerce platform are examined: a *competition strategy* and a *cooperation strategy*. The virtual community benefits itself only when the social commerce platform uses a competition strategy. However, the traditional platform can also benefit from the virtual community when the cooperation strategy is used. We characterize the equilibrium results when the social commerce platform uses various operational strategies and contrast the corresponding outcomes to examine the effects of various strategies. Our main findings are as follows.

First, we discover that, depending on consumers' base valuation of the product, the downstream market may be partially or fully covered. The two platforms (do not) actively compete when consumers place a high (low) value on the product. This result holds for both the competition and cooperation strategies. Under the competition strategy, in the partial coverage market where two platforms behave like monopolies, an increase in consumer unit travel costs would result in (weakly) lower retail prices for both platforms. However, in the full coverage market with active competition, an increase in the unit travel cost results in higher retail prices for them. Notably, we show that the social commerce platform tends to reduce its effort in the virtual community as the consumer unit travel cost rises. Despite different underlying causes, this result holds in both partial and full coverage markets. Last, our results imply that an increase in unit travel costs results in lower profits for both platforms in a partially covered market but higher profits for them in a fully covered market. Consumers always become worse off as the consumer unit travel cost rises.

Second, under the cooperation strategy, we capture the spillover effect, where users of the traditional platform can also gain additional benefits from the social commerce platform's virtual community. In this case, the traditional platform shares a portion of the incremental revenue generated by the virtual community as a commission with the social commerce platform, which is determined by the revenue-sharing rate. We then examine how the platform decisions are influenced by the consumer unit travel cost, the spillover effect, and the revenue-sharing rate. (1) Regarding the role of the unit travel cost, we show that its effect on the retail prices of the two platforms is identical to that of the competition strategy. The social commerce platform might increase its effort level in the virtual community as the unit travel cost rises. (2) An increase in the spillover effect allows both platforms to increase retail prices in a partially covered market but encourages both to decrease the retail prices in a fully covered market. Interestingly, the spillover effect plays opposite roles in affecting the social commerce platform's optimal effort level devoted to the virtual community in partial and full coverage markets. (3) We demonstrate that in a partially covered market, the traditional platform, aiming to reduce demand from the virtual community and thus reduced commission sharing, sets a higher retail price as the revenue-sharing rate rises. On the other hand, in a fully covered market, the traditional platform sets a lower price, anticipating that the decreased level of competition induced by the revenue-sharing effect outweighs higher commission losses. The social commerce platform decreases its retail price as the revenue-sharing rate increases in a fully covered market, but in a partially covered market, it may set a higher retail price when the traditional platform benefits less from cooperation. Finally, the revenue-sharing rate affects the optimal effort invested in the virtual community in a nonmonotonic manner.

By comparing the equilibrium outcomes of different operational strategies, we discover that in a partially covered market, the social commerce platform should adopt a cooperation strategy because it can expand the market for both platforms by investing more in the virtual community to increase the overall consumer utility. Ultimately, this results in a situation where everyone wins—consumers, the traditional platform, the social commerce platform, and social welfare. In the fully covered market, it is advisable for the social commerce platform to adopt a competition strategy. Moreover, the adoption of a cooperation strategy can result in various outcomes for the social commerce platform, the traditional platform, and consumers, including lose-win-lose, lose-win-win, or lose-lose-win outcomes. Our findings align with the narrative surrounding RED and Taobao mentioned above and partially explain why their partnership terminated in 2021. According to our results, when platforms actively compete in the downstream market, a cooperation relationship proves detrimental to the social commerce platform and may even also harm the traditional platform. Finally, the

[2] https://www.xiaohongshu.com/en

overall social welfare may suffer as a result of the adoption of the cooperation strategy.

Our contributions come primarily from two aspects. First, our study addresses the operational strategies that the social commerce platform should use to compete with the traditional platform. These strategies have been observed in practice but have not been fully explored in the literature. Our model specifically captures the feature of a cooperation strategy whereby the social commerce platform's effort in the virtual community can benefit its rival through a spillover effect. Second, our findings provide managerial guidance for a social commerce platform in markets with various competitive environments as well as theoretical justifications for the changing relationship between a social-commerce-based platform and a traditional platform.

The remainder of the paper is organized as follows. In Section 2, we provide a relevant literature review. Section 3 presents the model. The equilibrium outcomes of the two operational strategies and the sensitivity analysis for key parameters are derived in Section 4. Section 5 compares the equilibrium results of the two strategies and examines the effect of various strategies. Section 6 examines how the key parameters influence the change in profits, consumer surplus, and social welfare before and after implementing a cooperation strategy and explores three extensions as robustness checks of our main results. Section 7 concludes the paper by outlining the main findings, limitations, and future research directions. Proofs and supplementary analysis are provided in the Online Appendices.

2. Literature review

Our work relates to the research on social commerce, especially regarding social commerce platform operations. Social commerce, such as live streaming and augmented reality shopping, has attracted attention from academics in recent years (Arghashi, 2022; Chen et al., 2019; Hao & Yang, 2023; Hollebeek & Macky, 2019; Hu et al., 2019; Lam et al., 2019; Niu et al., 2023; Pan et al., 2022; Xu et al., 2023; Zhang et al., 2023; Zhao et al., 2023). As a prime instance of social commerce, social commerce platforms run a virtual community for the benefit of their own online marketplaces while fusing social media and online shopping. Jain and Qian (2021) investigate a social commerce platform's revenue-sharing mechanism design for content creators to promote high-quality content. Bhargava (2022) studies revenue sharing between heterogeneous content creators and a three-sided social commerce platform consisting of consumers, content creators, and advertisers and finds that a moderate sharing method improves the profits of all parties on the platform. Wei et al. (2023) consider the effects of various advertising formats on the revenue sharing of the social commerce platform and suggest that a new ad format may make the social commerce platform, content creators, and consumers worse off. Jiang et al. (2023) focus on the contract selection of video platforms and how specific contracts affect the incentives for content creators to combat copyright infringement. In contrast to the aforementioned literature, the aim of our paper is to investigate the preferred strategy used by the social commerce platform when it competes with a traditional platform in the downstream market. We fully describe the conditions under which a win-win outcome for platforms and customers may be achieved when the social commerce platform adopts the cooperation strategy.

Moreover, our research contributes to the literature on product information revelation/disclosure. Numerous studies in this field examine the ways in which platforms use various types of product information to influence both consumers (Lin et al., 2020; Markopoulos & Hosanagar, 2018; Zhang et al., 2024) and sellers (Bimpikis & Mantegazza, 2023; Lam & Liu, 2023). In our paper, we show that the virtual community that the social commerce platform invests in helps to collect and analyze user consumption data, offering certain kinds of information such as shopping experiences and recommendations, increasing consumers' utility and the corresponding purchase incentives. The social commerce platform can set itself apart from traditional platforms through the virtual community. However, the value of such a virtual community has not been thoroughly explored in the literature.

Our paper is also related to the topic of coopetition strategy. The concept of coopetition, as introduced by Nalebuff et al. (1996), illustrates when competing platforms have cooperative relationships, leveraging the interplay between competitive and collaborative mechanisms to maximize individual profits. There is extensive literature on coopetition strategies in supply chain management (Chen et al., 2019a, 2019b; Deng & Xu, 2023; Mao et al., 2023; Pun & Hou, 2022). For example, Chen et al. (2019a) investigate the strategic choices made by two competing firms regarding cooperation or competition, and they discover that the cooperation strategy may lessen the level of competition (cooperation) within the cooperation (competition) area. Mao et al. (2023) consider a three-tier supply chain consisting of a manufacturer, an e-retailer, and a third-party platform and focus on the e-retailer's choice of cooperation strategies and their impact on the members of the supply chain. Furthermore, research on how various factors influence the operational strategies of platforms engaged in coopetition is rapidly expanding. These factors include the adoption of logistics service (Cao et al., 2023; Huang et al., 2020; Lai et al., 2022; Liu et al., 2023), consumer homing choices (Lin et al., 2020; Wu & Chiu, 2023), contract design (Cohen & Zhang, 2022), and channel structures (Qiu et al., 2023). For example, Lai et al. (2022) investigate how the fulfillment services offered by Amazon influence the coopetition relationship between Amazon as an e-commerce platform and third-party sellers on the platform. Cao et al. (2023) study whether adopting the platform's logistics services influences a brand's decision to establish a flagship store on a platform that currently operates a "self-run (SR)" store. Wu and Chiu (2023) consider the impact of consumers' homing choices on pricing decisions for two competing online media platforms that any platform can choose whether to develop and share exclusive content to charge a licensing fee to another platform. Qiu et al. (2023) investigate whether a recycling platform and an online secondhand platform can integrate to compete against an online retail platform. Cohen and Zhang (2022) consider the situation where two-sided platforms not only compete with one another on both sides of the market by simultaneously setting prices and wages but also collaborate to provide a single service. They demonstrate how a well-designed profit-sharing contract can result in a win-win scenario for all parties involved in the platform. Our study contributes to the literature on platforms' coopetition strategies. In the cooperation strategy that we consider, the social commerce platform competes with the traditional platform while also using its virtual community to attract more customers to the traditional platform by charging commission fees based on incremental revenue, a situation that is observed in practice but has received less attention in the literature.

Last, our work is related to studies investigating platform/firm operations (Bakos & Halaburda, 2020; Chellappa & Mukherjee, 2021; Despotakis et al., 2021; Shi et al., 2022; Sui et al., 2023; Zhang et al., 2023), especially concerning competition among players (Chen et al., 2022; Choe et al., 2024; Sun et al., 2022) that use the Hotelling model. For instance, Bakos and Halaburda (2020) focus on the issue of two-sided platforms competing under multihoming and adopt the Hotelling model to capture the difference between the two-sided platforms. Similarly, Sui et al. (2023) study how two competing two-sided platforms make decisions on pricing and bilateral value-added service investment. Despotakis et al. (2021) model two platforms located at the two ends of a Hotelling line and consider the limitations of ad blockers when analyzing the competition between two social commerce platforms. Zhang et al. (2023) examine how a blockchain-technology-supported platform and a traditional platform decide on pricing when they compete with each other in a multiperiod setting. They use the Hotelling line to depict consumers' heterogeneous preference for the products or services provided by the two platforms. Sun et al. (2022)

study how official prices and channel pricing order influence the pricing decision of a manufacturer with dual channels. The dual channel consists of a direct sales channel and a third-party retail channel located at opposite ends of the Hotelling line. Zhang et al. (2024) study how consumers' social comparison influences competing firms to make pricing and product-line decisions. Chen et al. (2022) study the competition between a supplier with a direct channel and a retailer. The supplier and retailer have the option to utilize either instant discounts or gift cards as promotions to boost sales. They use the Hotelling model to describe consumer preferences between the two channels and analyze the equilibrium outcomes in a partially or fully covered market. Similarly, Choe et al. (2024) also consider partial and full coverage within the Hotelling model. They explore how a data-rich firm benefits by sharing consumer data with a data-poor competitor. The two firms are located at opposite ends of the Hotelling line. Despite focusing on different issues, Pei et al. (2023) adopt the Hotelling model to capture consumers' heterogeneous preferences for various firms. Based on the above literature, in our paper, we also use the Hotelling model to depict consumers' heterogeneous preference between the social commerce platform and the traditional platform. The consumers located on the Hotelling line incorporate the preferences, prices, and attractiveness generated by the virtual community to make purchase decisions from the two platforms.

3. Model setup

Consider a market where the same products are sold to consumers on two different platforms, one of which is traditional (such as Taobao), and the other is social-commerce-based (such as RED). The two firms engage in price competition and are located at the two ends of a unit Hotelling line [0,1] (Bae et al., 2022; Bagchi et al., 2020; Kim & Balachander, 2023; Pei et al., 2023). Without loss of generality, we assume that the social commerce platform is located at 0 and the traditional platform is located at 1. Throughout the paper, we use subscript "c" to represent the results of the social *commerce* platform, and subscript "t" to denote the results of the *traditional* platform. The retail prices set by the traditional and social commerce platforms are denoted by p_t and p_c, respectively. Consumers are uniformly distributed along the line and have heterogeneous preferences[3] for each platform, which can be captured by the distance of a consumer from each platform. Denote the distance from the social commerce platform by x, where $x \in (0,1)$. As a result, the distance from the traditional platform is $1-x$. Following Bae et al. (2022) and Zhang et al. (2023), the consumer located at x incurs a disutility mx, where m measures the marginal disutility. A *higher* m suggests that consumers find it more undesirable to stray from their preferred platform and thus reflects *a greater degree of platform difference* (Zhang et al., 2023). Without loss of generality, we normalize the total number of consumers to 1. Each consumer requires only a single unit of the product and receives a base value v from the product (Bae et al., 2022; Lin et al., 2018). Before deciding whether to purchase the product and from which platform, consumers compare the utility derived from each platform.

The social commerce platform invests in a virtual community by increasing the quality of generated content in addition to the regular operating costs of the community. To reflect the benefit of the virtual community, we follow Jain and Qian (2021) and assume that a consumer who chooses the social commerce platform receives a base value of v plus an additional benefit of e, where $e \in (0,1)$ represents the effort invested by the social commerce platform in the virtual community and can measure the level of influence that the community has on consumers. A higher e indicates that the virtual community is more attractive. A community typically necessitates an investment cost, which is given by $C(e) = e^2/2$. This cost function has the same spirit as those found in the literature (Ha et al., 2022; Sun et al., 2020; Yu et al., 2021) and highlights the need for the social commerce platform to strike a balance between investment and the benefits of attracting consumers.

Inspired by the practice of RED and Taobao, we consider two operational strategies for the social commerce platform. The first strategy is a *competition strategy*, in which the social commerce platform attracts and engages consumers through its virtual community, leading them to purchase products directly from the social commerce platform. The second is a *cooperation strategy*, in which the social commerce platform integrates links to Taobao's products within its virtual community, resulting in a mutually beneficial relationship. Specifically, in this scenario, the social commerce platform utilizes its community to benefit the competitor (i.e., the traditional platform) in that the integrated links increase consumers' purchasing incentives for the traditional platform. Simultaneously, the social commerce platform can receive some commission-based transaction fees from the traditional platform's increased demand (Chernavina, 2019, 2020). Fig. 1 depicts these two strategies.

In the *competition strategy*, the social commerce platform privately uses its virtual community to benefit itself. Accordingly, we can define the consumer's utility at location x with different platform choices as follows:

$$U_c = v + e - mx - p_c, \tag{1}$$

$$U_t = v - m(1-x) - p_t, \tag{2}$$

where U_c and U_t represent a consumer's utility from the social commerce platform and traditional platform, respectively. Denote D_t as the demand for the traditional platform and D_c as the demand from the social commerce platform in the competition strategy. They can be derived based on the utility functions (1) and (2) shown above. The two platforms' profits are as follows:

$$\pi_c = p_c D_c - \frac{e^2}{2}, \tag{3}$$

$$\pi_t = p_t D_t. \tag{4}$$

In the *cooperation strategy*, integrated links to the traditional platform increase consumers' purchasing incentives for the traditional platform because the links help to reduce consumer search costs, and those consumers can also participate in social activities in the virtual community. Given this, the traditional platform benefits in part from the social commerce platform's effort e. Consumers who purchase products from the traditional platform now gain additional utility βe from the virtual community, where $\beta \in (0,1)$ represents the spillover effect of the virtual community (Niu et al., 2023; Wu et al., 2022; Zhen et al., 2022). Specifically, in the cooperation strategy, a consumer receives the following utility if buying from the traditional platform.

$$U_t = v + \beta e - m(1-x) - p_t. \tag{5}$$

Denote $\widehat{D}_t$ as the demand of the traditional platform and $\widehat{D}_c$ as the demand from the social commerce platform under the cooperation strategy. They can be derived based on the utility functions (1) and (5).

The traditional platform must share a portion of the revenue generated by integrated links with the social commerce platform. Denote the revenue-sharing rate by α. To measure the demand fluctuation of the traditional platform before and after the social commerce platform allows integrated links, we denote the change in demand by ΔD, where $\Delta D = \widehat{D}_t - D_t$. Note that in $\widehat{D}_t$, the parameter β is very important and represents the virtual community's spillover effect on the traditional

[3] Consumer preferences vary depending on the particular features of a platform. While traditional platforms such as Taobao concentrate on factors such as logistics and after-sales services (Liu et al., 2023), social commerce platforms such as RED use virtual communities to affect consumer perceptions of products (Zhao et al., 2023). Customers' diverse product preferences are shaped by these unique platform features.

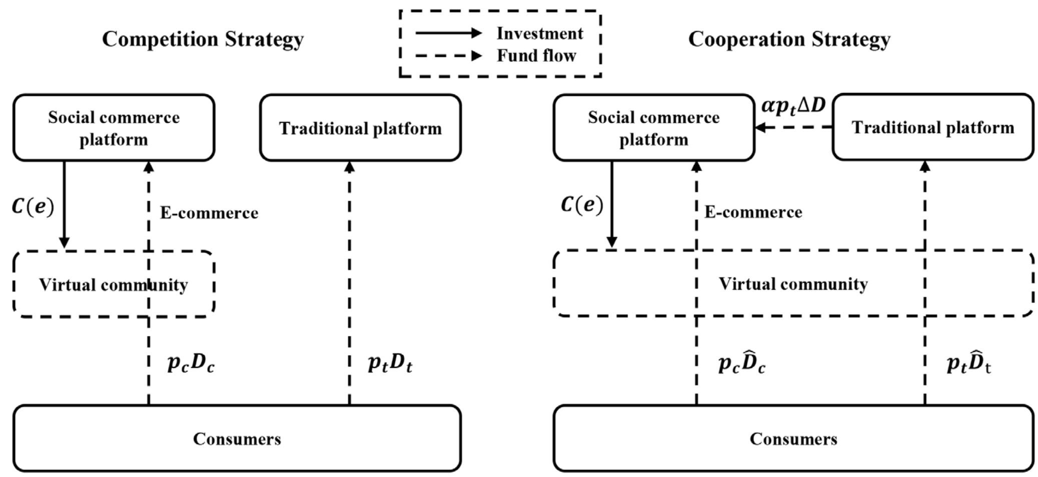

Fig. 1. Competition strategy vs. cooperation strategy.

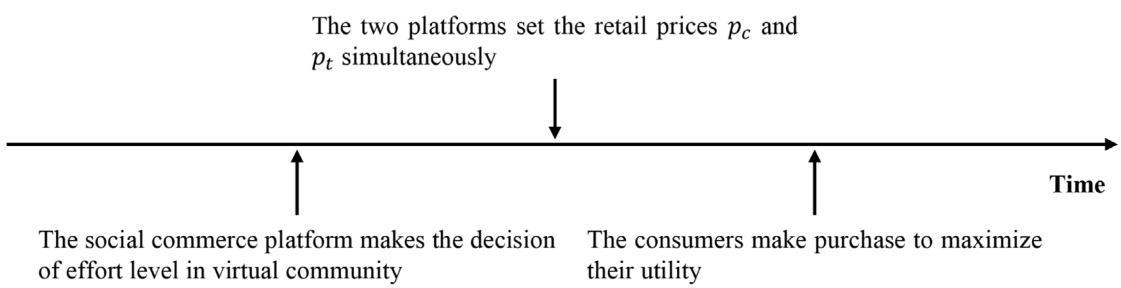

Fig. 2. The sequence of events.

platform. In D_t, however, the parameter β essentially equals zero, indicating no spillover effect and a pure competition relationship between the two platforms. The difference between these two demands (ΔD) represents the incremental demand after implementing the cooperation strategy by allowing the traditional platform's purchase links in the virtual community of the social commerce platform. In reality, the social commerce platform charges a commission based on the revenue from incremental demand. Accordingly, under the cooperation strategy, the platforms' profits are:

$$\pi_c = p_c \hat{D}_c + \alpha p_t \Delta D - \frac{e^2}{2}, \tag{6}$$

$$\pi_t = p_t \hat{D}_t - \alpha p_t \Delta D. \tag{7}$$

To ensure the positivity of the equilibrium results, we focus on the case where $m > \underline{m} \triangleq \frac{1+2(1-\alpha)\alpha\beta^2}{2}$ (see the proof of Lemma 2 for details) throughout the paper. The sequence of events is as follows (Fig. 2). First, the social commerce platform determines the effort invested in the virtual community. Second, the two platforms simultaneously set retail prices p_c and p_t. Finally, consumers make purchases to maximize their utility. The sequence is the same under the competition and cooperation strategies.

Table 1 summarizes the key notation used throughout the paper.

4. Equilibrium analysis

In this section, we solve the game by backward induction. We first analyze the competition strategy in Section 4.1 and then analyze the cooperation strategy in Section 4.2.

4.1. Competition strategy

For any given p_t and p_c, we first derive the demands for the two platforms. Based on utility functions (1) and (2), one can easily conclude that if a consumer purchases from the social commerce platform, it should have $v + e - mx - p_c \geq v - m(1 - x) - p_t$ and $v + e - mx - p_c \geq 0$. Consequently, a consumer whose type x satisfies $0 < x < \min\{\frac{v+e-p_c}{m}, \frac{m+e+p_t-p_c}{2m}\}$ prefers the social commerce platform. Similarly, if $v + e - mx - p_c < v - m(1 - x) - p_t$ and $v - m(1 - x) - p_t \geq 0$, or equivalently, $\max\{\frac{m+e+p_t-p_c}{2m}, \frac{m+p_t-v}{m}\} < x < 1$, then a type-$x$ consumer purchases from the traditional platform. We then can obtain that when the base valuation is low, i.e., $v \leq \frac{m+p_t+p_c-e}{2}$, $\min\{\frac{v+e-p_c}{m}, \frac{m+e+p_t-p_c}{2m}\} = \frac{v+e-p_c}{m}$ and $\max\{\frac{m+e+p_t-p_c}{2m}, \frac{m+p_t-v}{m}\} = \frac{m+p_t-v}{m}$. It can easily be shown that the demands of the social commerce platform and traditional platform are $D_c = \frac{v+e-p_c}{m}$ and $D_t = 1 - \frac{m+p_t-v}{m}$, respectively, where $D_t + D_c < 1$. In this situation, we say that the downstream market is *partially* covered. At this point, the consumer surplus is defined as $CS = \int_0^{\frac{v+e-p_c}{m}} (v + e - mx - p_c)\, dx + \int_{\frac{m+p_t-v}{m}}^{1} (v - m(1 - x) - p_t)\, dx$ based on utility functions (1) and (2). When $v > \frac{m+p_t+p_c-e}{2}$, $\min\{\frac{v+e-p_c}{m}, \frac{m+e+p_t-p_c}{2m}\} = \max\{\frac{m+e+p_t-p_c}{2m}, \frac{m+p_t-v}{m}\} = \frac{m+e+p_t-p_c}{2m}$. Clearly, now we have $D_c = \frac{m+e+p_t-p_c}{2m}$ and $D_t = 1 - \frac{m+e+p_t-p_c}{2m}$. The downstream market is now *fully* covered (i.e., $D_c + D_t = 1$). The consumer surplus is calculated as $CS = \int_0^{\frac{m+e+p_t-p_c}{2m}} (v + e - mx - p_c)\, dx + \int_{\frac{m+e+p_t-p_c}{2m}}^{1} (v - m(1 - x) - p_t)\, dx$.

After obtaining the specific demands of the two platforms, we substitute D_t and D_c into their profit functions (3) and (4). We then derive the best-response functions of the two platforms regarding the optimal price decisions p_t and p_c. By simultaneously solving the best-response functions, we can derive the optimal price decisions in equilibrium. The following lemma characterizes the platforms' optimal retail price decisions and the corresponding equilibrium outcomes under the competition strategy.

Lemma 1. *Under the competition strategy, the optimal equilibrium decisions depend on whether the downstream market is partially ($D_c^* + D_t^* < 1$) or fully ($D_c^* + D_t^* = 1$) covered. The expressions for the optimal*

Table 1
Key notation.

Symbol	Description
$i \in \{c, t\}$	c denotes the social commerce platform; t denotes the traditional platform
e	Social commerce platform's effort invested in the virtual community, decision variable
$\hat{e}$	Social commerce platform's effort under the cooperation strategy, decision variable
p_i	Platform i's retail price under the competition strategy, decision variable
$\hat{p}_i$	Platform i's retail price under the cooperation strategy, decision variable
α	Revenue-sharing rate under the cooperation strategy
v	Consumers' base value for the product
m	Unit travel cost
x	Consumers' location on the unit line, representing their types
β	Spillover effect of the virtual community on the traditional platform
U_i	Consumer's utility from platform i
D_i	The demand of platform i under the competition strategy
$\hat{D}_i$	The demand of platform i under the cooperation strategy
π_i	The profit of platform i under the competition strategy
$\hat{\pi}_i$	The profit of platform i under the cooperation strategy
CS	Consumer surplus under the competition strategy
$\widehat{CS}$	Consumer surplus under the cooperation strategy
SW	Social welfare under the competition strategy
$\widehat{SW}$	Social welfare under the cooperation strategy

Table 2
Equilibrium outcomes under competition strategy.

	Partial coverage	Full coverage
Demands	$D_c^* = \frac{v}{2m-1}, D_t^* = \frac{v}{2m}$	$D_c^* = \frac{9m}{2(9m-1)}, D_t^* = \frac{9m-2}{2(9m-1)}$
Optimal Decisions	$e^* = \frac{v}{2m-1}, p_c^* = \frac{vm}{2m-1}, p_t^* = \frac{v}{2}$	$e^* = \frac{3m}{9m-1}, p_c^* = \frac{9m^2}{9m-1}, p_t^* = \frac{m(9m-2)}{9m-1}$
Optimal Profits	$\pi_c^* = \frac{v^2}{4m-2}, \pi_t^* = \frac{v^2}{4m}$	$\pi_c^* = \frac{9m^2}{2(9m-1)}, \pi_t^* = \frac{m(9m-2)^2}{2(9m-1)^2}$
Consumer Surplus	$CS^* = \frac{v^2(8m^2-4m+1)}{8m(2m-1)^2}$	$CS^* = v + \frac{m(144m-405m^2-10)}{4(9m-1)^2}$

decisions (e^*, p_i^*), profits of platforms (π_i^*), and consumer surplus (CS^*) are summarized in Table 2.

The aforementioned discussions and Lemma 1 imply that how the two platforms share the downstream market depends significantly on how much the consumer values the product. Clearly, there is no direct competition between the two platforms when the base value of consumers is low. Both platforms are motivated to raise the retail price and the corresponding results by a higher base value. In contrast, when consumers value a product excessively, all types of consumer demands are met. The two platforms are now *actively competing* for consumers. These findings are in line with the existing literature on the Hotelling model and price competition (Chen et al., 2022; Choe et al., 2024; Pei et al., 2023).

Based on Lemma 1, we next analyze the impact of travel cost m, which measures the difference between the two platforms, on the optimal decisions and corresponding equilibrium results.

Proposition 1. *Under the competition strategy, the unit travel cost (m) affects the equilibrium results in the following way:*

1. *When the downstream market is partially covered:* $\frac{\partial e^*}{\partial m} < 0$, $\frac{\partial p_c^*}{\partial m} < 0$, $\frac{\partial D_c^*}{\partial m} < 0$, $\frac{\partial D_t^*}{\partial m} < 0$, $\frac{\partial \pi_c^*}{\partial m} < 0$, $\frac{\partial \pi_t^*}{\partial m} < 0$, *and* $\frac{\partial CS^*}{\partial m} < 0$.
2. *When the downstream market is fully covered:* $\frac{\partial e^*}{\partial m} < 0$, $\frac{\partial p_c^*}{\partial m} > 0$, $\frac{\partial p_t^*}{\partial m} > 0$, $\frac{\partial D_c^*}{\partial m} < 0$, $\frac{\partial D_t^*}{\partial m} > 0$, $\frac{\partial \pi_c^*}{\partial m} > 0$, $\frac{\partial \pi_t^*}{\partial m} > 0$, *and* $\frac{\partial CS^*}{\partial m} < 0$.

According to Proposition 1, when the downstream market coverage is different, the impact of m on the retail prices of the platforms, the demand for the traditional platform, and the platforms' profits all change. First, the social commerce platform's optimal retail price decreases in the unit travel cost when the market features partial coverage in equilibrium, where both platforms behave like local monopolies. Note that a higher unit travel cost represents greater disutility, so the social commerce platform must lower its price to maintain demand. Furthermore, the traditional platform's retail price is independent of m and affected by only consumers' base value. Interestingly, we show that both platforms aggressively set retail prices when m increases and the market features full coverage in equilibrium. Assume that a higher unit travel cost indicates a greater disparity between the two platforms and a stronger consumer preference for sticking with the ideal platform. As m rises, consumers bear a higher cost when switching to the alternative choice. Anticipating this, the two platforms each set a higher retail price without worrying about losing consumers. Second, a higher m results in lower profits for the platforms when the market is only partially covered, whereas it results in higher profits for them when the market is fully covered. Under partial coverage, both platforms' demands and retail prices (weakly) decline in m, which changes both platforms' profits. Since both platforms can set a higher price for a higher m under full coverage, they both make greater profits. Finally, under partial coverage, demand for the traditional platform declines when the consumer unit travel cost increases. In contrast, the traditional platform is more in demand in the fully covered market because its rival raises the retail price while simultaneously lowering its effort in the virtual community.

When the marginal disutility m increases, it is intuitive that consumers become worse off and the demand for the social commerce platform decreases. Importantly, Proposition 1 demonstrates that a higher unit travel cost (m) always results in a lower optimal effort level (i.e., $\frac{\partial e^*}{\partial m} < 0$), regardless of whether the downstream market is fully or partially covered. However, we would like to emphasize that, for various market coverage states, the causes of that result differ. When the downstream market features partial coverage, the social commerce platform is forced to lower the retail price under a larger marginal disutility m ($\frac{\partial p_c^*}{\partial m} < 0$). The lower price enables the social commerce platform appropriately to reduce the effort level without losing consumers (refer to Eq. (1)). Nevertheless, if the downstream market is fully covered, this logic is invalid. As noted above, a higher m indicates a greater difference between the two platforms and thus weaker competition between them, which motivates both platforms to increase their retail prices. Note that the social commerce platform may employ a virtual community as a tool to compete with the traditional platform by attracting more customers. Because of the competitor's increased retail price, the social commerce platform can reduce its investment in the online community and need not be concerned about suffering further losses in the competitive market.

4.2. Cooperation strategy

Similar to the analysis in Section 4.1, we first determine the platforms' individual demands for any given p_t and p_c based on utility functions (1) and (5). A consumer prefers the social commerce platform when $v+e-mx-p_c \geq v+\beta e-m(1-x)-p_t$ and $v+e-mx-p_c \geq 0$. That is, a consumer of type x, where $0 < x < \min\{\frac{v+e-p_c}{m}, \frac{m+(1-\beta)e+p_t-p_c}{2m}\}$, purchases from the social commerce platform. Analogously, we can easily derive that when $\max\{\frac{m+(1-\beta)e+p_t-p_c}{2m}, \frac{m+p_t-\beta e-v}{m}\} < x < 1$, the consumer selects the traditional platform. We use "$\hat{}$" to denote the results associated with the cooperation strategy.

When $v \leq \frac{m+p_t+p_c-(1-\beta)e}{2}$, the demands of the platforms are $\hat{D}_c = \frac{v+e-p_c}{m}$ and $\hat{D}_t = 1-\frac{m+p_t-\beta e-v}{m}$, where $\hat{D}_c+\hat{D}_t < 1$ (a partially covered market). Recall that the demand for the traditional platform under the competition strategy with a partially covered market is $D_t = 1-\frac{m+p_t-v}{m}$; the additional demand as a result of the social commerce platform's allowing integrated links in its virtual community is $\Delta D = \hat{D}_t - D_t = \frac{\beta e}{m}$. The consumer surplus is defined as $\widehat{CS} = \int_0^{\frac{v+e-p_c}{m}} \left(v+e-mx-p_c\right)\, dx + \int_{\frac{m+p_t-\beta e-v}{m}}^{1} \left(v+\beta e-m(1-x)-p_t\right)\, dx$ based on utility functions (1) and (5). When $v > \frac{m+p_t+p_c-(1-\beta)e}{2}$, we now have $\hat{D}_c = \frac{m+(1-\beta)e+p_t-p_c}{2m}$ and $\hat{D}_t = 1-\frac{m+(1-\beta)e+p_t-p_c}{2m}$. The downstream market is now *fully* covered (i.e., $\hat{D}_c+\hat{D}_t = 1$). The demand for the traditional platform under the competition strategy with a fully covered market is $D_t = 1-\frac{m+e+p_t-p_c}{m}$. Thus, the demand change becomes $\Delta D = \hat{D}_t - D_t = \frac{\beta e}{2m}$. The consumer surplus is defined as $\widehat{CS} = \int_0^{\frac{m+(1-\beta)e+p_t-p_c}{2m}} \left(v+e-mx-p_c\right)\, dx + \int_{\frac{m+(1-\beta)e+p_t-p_c}{2m}}^{1} \left(v+\beta e-m(1-x)-p_t\right)\, dx$ based on utility functions (1) and (5).

Next, we substitute the demands of the two platforms $\hat{D}_c$, $\hat{D}_t$ and ΔD into profit functions (6) and (7), respectively. Then, we derive the best-response functions for the two platforms in relation to retail prices p_c and p_t. By simultaneously solving the best-response functions, we obtain the optimal retail prices for any given e. Substituting them into (6), we solve for the optimal effort level under the cooperation strategy. We summarize the optimal decisions of the two platforms and the corresponding profits and consumer surplus in equilibrium in the following result.

Lemma 2. *Under the cooperation strategy, the optimal equilibrium decisions depend on whether the downstream market is partially ($\hat{D}_c^*+\hat{D}_t^* < 1$) or fully ($\hat{D}_c^*+\hat{D}_t^* = 1$) covered. The expressions for the optimal decisions ($\hat{e}^*$, $\hat{p}_i^*$), profits of platforms ($\hat{\pi}_i^*$), and consumer surplus ($\widehat{CS}^*$) are summarized in Table 3.*

Lemma 2 reveals that the optimal decisions become more complicated if the two platforms cooperate. However, it remains true that when consumer base valuation is high, the two platforms actively compete, allowing for the fulfillment of all market demand, whereas when consumer base valuation is low, only a small proportion of consumers purchase products. This is consistent with the finding in Lemma 1.

Proposition 2. *Under the cooperation strategy, the unit travel cost (m) affects the equilibrium results in the following way:*

1. *When the downstream market is partially covered, $\frac{\partial \hat{e}^*}{\partial m} < 0$, $\frac{\partial \hat{p}_c^*}{\partial m} < 0$, and $\frac{\partial \hat{p}_t^*}{\partial m} < 0$.*
2. *When the downstream market is fully covered, $\frac{\partial \hat{e}^*}{\partial m} < 0$ when $\beta < \beta_1$, and $\frac{\partial \hat{e}^*}{\partial m} \geq 0$ otherwise, where β_1 is given by (A.11) in the Online Appendix A. Moreover, $\frac{\partial \hat{p}_c^*}{\partial m} > 0$, $\frac{\partial \hat{p}_t^*}{\partial m} > 0$.*

Proposition 2 implies that the effects of unit travel cost m on the retail prices of the social commerce platform ($\hat{p}_c^*$) and the traditional platform ($\hat{p}_t^*$) under the cooperation strategy are identical to those under the competition strategy (Proposition 1), as are the underlying causes. Our findings also suggest that, in contrast to the results of Proposition 1, the optimal effort level still declines in m under partial coverage, but it may increase in m under full coverage. Specifically, the social commerce platform may raise its effort ($\frac{\partial \hat{e}^*}{\partial m} \geq 0$) when the spillover effect is high ($\beta \geq \beta_1$) and the two platforms cooperate. One might anticipate that the social commerce platform has incentives to lower e because the competition between the two platforms becomes less intense when m increases. However, a significant spillover effect encourages the social commerce platform to increase its effort in light of the rising m because that platform could profit more from the traditional platform's increased revenue, enjoying the commission-based revenue as a result of the cooperative relationship.

Proposition 3. *Under the cooperation strategy, the revenue-sharing rate (α) affects the equilibrium results in the following way.*

1. *When the downstream market is partially covered: (1) If $m \leq \frac{5}{2}$ and $\beta_2 < \beta \leq 1$, $\hat{e}^*$ and $\hat{p}_c^*$ both first increase and then decrease with α, and both obtain the maximum value at $\alpha = \alpha_1$. In other cases, $\frac{\partial \hat{e}^*}{\partial \alpha} \geq 0$ and $\frac{\partial \hat{p}_c^*}{\partial \alpha} \geq 0$. (2) $\frac{\partial \hat{p}_t^*}{\partial \alpha} > 0$.*
2. *When the downstream market is fully covered: (1) The change in $\hat{e}^*$ is summarized as follows. (1a) If $m \leq \frac{11}{9}$ and $0 < \beta \leq \beta_3$, $\frac{\partial \hat{e}^*}{\partial \alpha} < 0$. (1b) If $m \leq \frac{11}{9}$ and $\beta_3 < \beta \leq \beta_4$, $\hat{e}^*$ first increases and then decreases in α with threshold α_2. (1c) Otherwise, $\frac{\partial \hat{e}^*}{\partial \alpha} \geq 0$. (2) $\frac{\partial \hat{p}_c^*}{\partial \alpha} < 0$, and $\frac{\partial \hat{p}_t^*}{\partial \alpha} < 0$.*

Above, β_2, α_1, β_3, β_4, and α_2 are given by (A.13), (A.14), (A.15), (A.16), and (A.17) in the Online Appendix A, respectively.

The retail price of the traditional platform increases with the revenue-sharing rate α when the downstream market features partial coverage, while it decreases with α when the downstream market exhibits full coverage, as shown by Proposition 3. In the former case, there is no direct rivalry between the two platforms, and a higher revenue-sharing rate drives the traditional platform to price aggressively. By doing so, the traditional platform can help to lower the incremental demand ΔD under cooperation, which further decreases the commission revenue paid to the social commerce platform. In the latter scenario, when α increases, the traditional platform is willing to lower the retail price to attract more customers to directly compete with the social commerce platform, despite the fact that doing so results in a loss of some revenue-sharing-based commission fees. In this case, our results imply that the competitive effect outweighs the concerns about higher commission losses.

Regarding the social commerce platform's optimal retail price, we find that it decreases in α in a fully covered market but may increase in α in a partially covered market. When the two platforms are engaged in fierce competition, the social commerce platform is willing to reduce the retail price to temper the competition and allow the traditional platform to make a larger additional profit if it can obtain more (i.e., under a higher α) revenue-sharing-based profit from the traditional platform. In other words, the cooperation effect weakens the rivalry between the two platforms. This effect disappears, however, if there is no direct competition between the two platforms (when the market is partially covered). Instead, our findings suggest that the social commerce platform has incentives to raise its retail price for a greater α when the spillover effect β is low. This is because, in these circumstances, the traditional platform receives only a small benefit from the virtual community but still needs to pay the social commerce platform commission fees, which enables the social commerce platform to set more aggressive prices.

One might anticipate that a higher revenue-sharing rate would increase the social commerce platform's revenue-sharing fees, motivating

Table 3
Equilibrium outcomes under cooperation strategy.

	Partial coverage	Full coverage
Demands	$\widehat{D}_c^* = \frac{v\left(2m+\alpha\beta-2(1-\alpha)\alpha\beta^2\right)}{m\left(4m-4(1-\alpha)\alpha\beta^2-2\right)}$	$\widehat{D}_c^* = \frac{9\left(2m+\alpha\beta-(1-\alpha)\alpha\beta^2\right)}{4\left(9m+\left(5\alpha^2-5\alpha-1\right)\beta^2+(5\alpha+2)\beta-1\right)}$
	$\widehat{D}_t^* = \frac{v\left(2m+(\alpha+1)\beta-\alpha(1-3\alpha)\beta^2-1\right)}{m\left(4m-4(1-\alpha)\alpha\beta^2-2\right)}$	$\widehat{D}_t^* = \frac{18m+(11\alpha^2-11\alpha-4)\beta^2+(11\alpha+8)\beta-4}{4\left(9m+(5\alpha^2-5\alpha-1)\beta^2+(5\alpha+2)\beta-1\right)}$
Optimal Decisions	$\widehat{e}^* = \frac{v(\alpha\beta+1)}{2m-2(1-\alpha)\alpha\beta^2-1}$	$\widehat{e}^* = \frac{3m(2+(\alpha-2)\beta)}{2(9m+(5\alpha^2-5\alpha-1)\beta^2+(5\alpha+2)\beta-1)}$
	$\widehat{p}_c^* = \frac{v\left(2m+\alpha\beta-2(1-\alpha)\alpha\beta^2\right)}{4m-4(1-\alpha)\alpha\beta^2-2}$	$\widehat{p}_c^* = \frac{9m(2m+\alpha\beta-(1-\alpha)\alpha\beta^2)}{2(9m+(5\alpha^2-5\alpha-1)\beta^2+(5\alpha+2)\beta-1)}$
	$\widehat{p}_t^* = \frac{v\left(2m+(1-\alpha)\beta-(1-\alpha)\alpha\beta^2-1\right)}{4m-4(1-\alpha)\alpha\beta^2-2}$	$\widehat{p}_t^* = \frac{m(18m+(8\alpha^2-5\alpha-4)\beta^2+(5\alpha+8)\beta-4)}{2(9m+(5\alpha^2-5\alpha-1)\beta^2+(5\alpha+2)\beta-1)}$
Optimal Profits	$\widehat{\pi}_c^* = \frac{v^2\left(2m+2\alpha\beta-\alpha(2-3\alpha)\beta^2\right)}{4m\left(2m-2(1-\alpha)\alpha\beta^2-1\right)}$	$\widehat{\pi}_c^* = \frac{3m(12m+8\alpha\beta-\alpha(8-7\alpha)\beta^2)}{8(9m+(5\alpha^2-5\alpha-1)\beta^2+(5\alpha+2)\beta-1)}$
	$\widehat{\pi}_t^* = \frac{v^2\left(2m+(1-\alpha)\beta-(1-\alpha)\alpha\beta^2-1\right)^2}{4m\left(2m-2(1-\alpha)\alpha\beta^2-1\right)^2}$	$\widehat{\pi}_t^* = \frac{m(18m+(8\alpha^2-5\alpha-4)\beta^2+(5\alpha+8)\beta-4)^2}{8(9m+(5\alpha^2-5\alpha-1)\beta^2+(5\alpha+2)\beta-1)^2})$
Consumer Surplus	$\widehat{CS}^* = \frac{v^2\left(\alpha^2\left(13\alpha^2-14\alpha+5\right)\beta^4+2\alpha\left(5\alpha^2-1\right)\beta^3\right)}{8m\left(2m-2(1-\alpha)\alpha\beta^2-1\right)^2}$	$\widehat{CS}^* = v + \frac{m(8-439\alpha^4+878\alpha^3-375\alpha^2-64\alpha)\beta^4}{16(9m+(5\alpha^2-5\alpha-1)\beta^2+(5\alpha+2)\beta-1)^2}$
	$+\frac{v^2\left(\left(\alpha^2(20m-4)+\alpha(4-12\ m)+1\right)\beta^2\right)}{8m\left(2m-2(1-\alpha)\alpha\beta^2-1\right)^2}$	$+\frac{m(16-758\alpha^3+390\alpha^2+408\alpha)\beta^3}{16(9m+(5\alpha^2-5\alpha-1)\beta^2+(5\alpha+2)\beta-1)^2}$
	$+\frac{v^2\left((\alpha(8m-2)+4m-2)\beta+8m^2-4m+1\right)}{8m\left(2m-2(1-\alpha)\alpha\beta^2-1\right)^2}$	$+\frac{m(3\alpha(564m-208)+3(48m-32)-3\alpha^2(564m+5))\beta^2}{16(9m+(5\alpha^2-5\alpha-1)\beta^2+(5\alpha+2)\beta-1)^2}$
		$+\frac{m((4\alpha(70-369\ m)+16(7-45\ m))\beta+36m(16-45\ m)-40)}{16(9m+(5\alpha^2-5\alpha-1)\beta^2+(5\alpha+2)\beta-1)^2}$

it to increase effort in the virtual community. However, Proposition 3 (statements 1(1) and 2(1)) shows that a higher revenue-sharing rate might lead to a lower optimal effort level, regardless of whether the downstream market is fully or partially covered. Specifically, when the unit travel cost is moderate and the spillover effect (measured by β) and revenue-sharing rate are high, the social commerce platform decreases its effort $\widehat{e}^*$ for a larger α. The cooperation and competition between the two platforms continue to impact the result in a fully covered market. The social commerce platform would receive more revenue-based fees as a result of increased effort, but the spillover effect would also increase competition between the two platforms. A nonmonotonic effort level in terms of α is produced by balancing these two effects. Again, in a market with partial coverage, increasing effort would help the social commerce platform earn more revenue-based fees; however, as the retail price of the traditional platform rises, although the social commerce platform reduces its effort, it still can maintain consumer demand for its own platform. These two effects induce the nonmonotonic impact regarding α.

Proposition 4. *Under the cooperation strategy, the spillover effect (β) influences the equilibrium results in the following way.*

1. *When the downstream market is partially covered:* $\frac{\partial \widehat{e}^*}{\partial \beta} > 0$, $\frac{\partial \widehat{p}_c^*}{\partial \beta} > 0$, *and* $\frac{\partial \widehat{p}_t^*}{\partial \beta} > 0$.
2. *When the downstream market is fully covered: (1)* $\frac{\partial \widehat{e}^*}{\partial \beta} < 0$. *(2) If* $0 < \alpha < \frac{1}{2}$, $\widehat{p}_c^*$ *first decreases and then increases in* β *with threshold* β_5; *otherwise,* $\frac{\partial \widehat{p}_c^*}{\partial \beta} \leq 0$. *(3) If* $m > \frac{5}{3}$ *and* $\alpha_5 < \alpha \leq 1$, $\widehat{p}_t^*$ *first decreases and then increases in* β *with threshold* β_6; *otherwise,* $\frac{\partial \widehat{p}_t^*}{\partial \beta} > 0$.

In the above, β_5, α_5 *and* β_6 *are given by (A.19), (A.21) and (A.22) in the Online Appendix A.*

Proposition 4 indicates that the coverage of the downstream market influences how the spillover effect influences the optimal effort level and retail prices of the platforms. The social commerce platform is motivated to increase its effort because it can earn more from the traditional platform's revenue sharing under partial coverage. In contrast, in the case of full coverage, an increase in the spillover effect has negative effects on the social commerce platform due to the fierce competition between the two platforms. To reduce competition with the traditional platform as the spillover effect increases, the social commerce platform reduces its effort under a larger β.

We also demonstrate that, in the partial coverage case, both platforms increase retail prices when β rises, but both may decrease prices in the full coverage case. Recall that a higher spillover effect implies a higher level of consumer utility from the traditional platform. Thus, with a larger β, the traditional platform raises its price, which results in increased revenue-based commission fees paid to the social commerce platform. Anticipating this, the social commerce platform also raises its retail price without worrying about the impact on its overall profit. In the full coverage market, the two platforms compete directly, which lessens their incentives to raise retail prices because they fear losing more profit by doing so. This is analogous to the explanation for changes in the effort level.

5. Competition vs. Cooperation

In this section, we compare the equilibrium results under the competition and cooperation strategies based on Sections 4.1 and 4.2. We are interested in determining how specific operational strategies affect the decisions made by platforms and exploring whether a cooperation strategy might produce a win-win situation for both platforms and customers.

Proposition 5. *The comparisons between the optimal decisions under the competition and cooperation strategies are summarized as follows:*

1. *When the market features partial coverage,* $\widehat{e}^* > e^*$, $\widehat{p}_c^* > p_c^*$ *and* $\widehat{p}_t^* > p_t^*$.
2. *When the market features full coverage, (1)* $\widehat{e}^* < e^*$ *and* $\widehat{p}_c^* < p_c^*$, *(2) If* $m > \frac{5}{3}$, $\alpha_5 < \alpha \leq 1$ *and* $0 < \beta \leq \beta_7$, $\widehat{p}_t^* \leq p_t^*$; *otherwise, it has* $\widehat{p}_t^* > p_t^*$.

In the above, α_5 *and* β_7 *are given by (A.21) and (A.25) in the Online Appendix A.*

Proposition 5 describes the relationship between the optimal decisions made in equilibrium when the social commerce platform employs various strategies. We demonstrate that if consumers' basic valuation of the product is low and hence the downstream market features partial coverage (refer to the proof of Proposition 5), the optimal effort level and retail prices under the cooperation strategy are consistently higher than those under the competition strategy. Notably, these results may be reversed when consumers' base value is high (in which case all demands are satisfied in equilibrium). In the former case, there is no direct competition between the platforms, and both platforms act as local monopolists. The cooperation strategy motivates the social commerce platform to increase its effort to benefit from the increased revenue shared by the traditional platform, which results in a market expansion for the two platforms (see the proof of Proposition 5). Consequently, they both charge a higher retail price under the cooperation strategy.

In the latter case, the two platforms compete directly for consumers. Utilizing a cooperation strategy yields a lower effort level and retail price for the social commerce platform than that obtained under a pure competition strategy (i.e., $\widehat{e}^* < e^*$ and $\widehat{p}_c^* < p_c^*$). This is because the revenue sharing that the social commerce platform receives from the traditional platform is insufficient to offset the losses generated by heightened market competition. Instead of growing the downstream market, the cooperation strategy leads to a redistribution of market share and profits between the two platforms. We also show that given a small spillover effect, a high revenue-sharing rate, and a high unit travel cost, the traditional platform sets a lower retail price under the cooperation strategy than under the competition strategy. Although the cooperation strategy can enhance the potential demand of the traditional platform through the spillover effect, the high revenue-sharing rate necessitates a reduction in the retail price to attract more consumers and offset the loss incurred through revenue-based commission fees. However, in situations where the spillover effect is high and the revenue-sharing rate is low, the traditional platform continues to maintain a higher price under the cooperation strategy, similar to the scenario where both platforms operate as separate monopolists.

Proposition 6. *The relationships between the profits of the platforms under the cooperation and competition strategies are summarized as follows:*

1. *When the market features partial coverage, the profit for both platforms is higher when the social commerce platform adopts the cooperation strategy (i.e., $\widehat{\pi}_c^* > \pi_c^*$ and $\widehat{\pi}_t^* > \pi_t^*$).*
2. *When the market features full coverage: (1) The profit for the social commerce platform under the cooperation strategy is always lower (i.e., $\widehat{\pi}_c^* < \pi_c^*$). (2) If $m > \frac{5}{3}$, $\alpha_5 < \alpha \le 1$ and $0 < \beta \le \beta_7$, the profit for the traditional platform under the cooperation strategy is lower than that under the competition strategy (i.e., $\widehat{\pi}_t^* \le \pi_t^*$) and higher otherwise.*

In the above, α_5 and β_7 are given by (A.21) and (A.25) in the Online Appendix A.

Proposition 6 illustrates a crucial insight: in the absence of direct rivalry, the cooperation strategy can result in a win-win situation for both platforms. Interestingly, using the cooperation strategy in a market with full coverage could lead to a lose-lose situation. Furthermore, practically, our finding might offer a fundamental explanation for how RED and Taobao's relationship developed. When the competition between these two platforms was relatively mild (like in the partial coverage market), RED was willing to cooperate with Taobao by integrating links in the virtual community in 2020. During the initial cooperation phase, RED's community-driven features complemented Taobao's aim of expanding its consumer base and exploring social channels (Desk, 2020). This collaboration significantly boosted demand for both platforms ($\widehat{D}_c^* > D_c^*$ and $\widehat{D}_t^* > D_t^*$; see the proof of Proposition 5), in line with our theoretical findings, resulting in higher profits for both platforms ($\widehat{\pi}_c^* > \pi_c^*$ and $\widehat{\pi}_t^* > \pi_t^*$). The cooperation strategy facilitated Taobao in drawing more traffic from RED through the spillover effect. Over time, this intensified the competition between the two platforms. According to Goldman Sachs Research, such competition resulted in a decline in Taobao's market share in 2021 (Keung et al., 2022), indicating that the partnership did not yield sufficient benefits for Taobao. RED also observed that the collaboration did not significantly boost its own product sales (Song, 2022). Consequently, we conclude that the face-to-face competition (like in the full coverage market scenario) drove RED to terminate its collaboration with Taobao in 2021 and shifted its focus toward developing its own e-commerce platform.

Our result further illustrates that in a fully covered market, employing a cooperation strategy with a high revenue-sharing rate ($\alpha > \alpha_5$) and a high spillover effect ($\beta > \beta_7$) can lead to a lose-win outcome for social-commerce-based and traditional platforms, respectively. This can be attributed to the following reasons. Recall that the traditional platform imposes a higher retail price under the cooperation strategy (Proposition 5). This, along with the fact that the cooperation strategy increases demand for the traditional platform as a result of the significant spillover effect (refer to the proof of Proposition 6), makes the traditional platform better off. In contrast, as demonstrated by the proof of Proposition 6, the demand for the social commerce platform under the cooperation strategy is always lower than that under the competition strategy. The social commerce platform competes by lowering its retail price (see the proof of Proposition 5) to retain customers. Although the social commerce platform receives a high commission from the traditional platform, it is insufficient to compensate for the loss from its own channel. The social commerce platform's revenue declines as a result of the negative competition effect outweighing the positive cooperation effect.

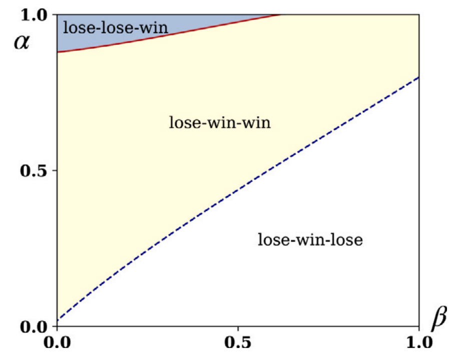

Fig. 3. Changes in profits and consumer surplus in a full coverage market ($\upsilon = 6, m = 4$).

Proposition 7. *When the downstream market is partially covered, the consumer surplus under the cooperation strategy is always higher than that under the competition strategy (i.e., $\widehat{CS}^* > CS^*$). The cooperation strategy results in a win-win-win outcome for the social commerce platform, traditional platform, and consumers.*

Proposition 7 demonstrates that the cooperation strategy proves advantageous for consumers in a partially covered market. Although consumers face higher prices on the platforms under the cooperation strategy ($\widehat{p}_c^* > p_c^*$ and $\widehat{p}_t^* > p_t^*$), they obtain more utility from the virtual community ($\widehat{e}^* > e^*$), as shown in Proposition 5. Therefore, total consumer surplus rises.

It is difficult to analytically explore the impact of the cooperation strategy in the fully covered market because the expression for consumer surplus in this situation is so complex. Hence, to perform the analysis, we conduct a numerical study. Fig. 3 shows how the outcomes (profit of the social commerce platform, profit of the traditional platform, and consumer surplus) vary before (i.e., using competition strategy) and after adopting the cooperation strategy in a *full* coverage market. In particular, we define the cooperation strategy as having a *lose-win-win* outcome if it results in the *social commerce* platform making *less profit*, the *traditional* platform making *more profit*, and *consumers* being *better off* than they would be under the competition strategy. The other situations (such as lose-win-lose and lose-lose-win) have similar explanations.

First, we observe that consumers are more likely to benefit from the cooperation strategy if the spillover effect is low or the revenue-sharing rate is high. A large spillover effect implies a low effort level in the virtual community (as mentioned in Proposition 4), which is detrimental to consumers. Additionally, a high revenue-sharing rate makes both platforms decrease their retail prices (refer to Proposition 3), which benefits consumers. Second, we find that a lose-win-win outcome can occur in equilibrium under the cooperation strategy. This result, along with Proposition 6, may help to explain why RED's popularity increased

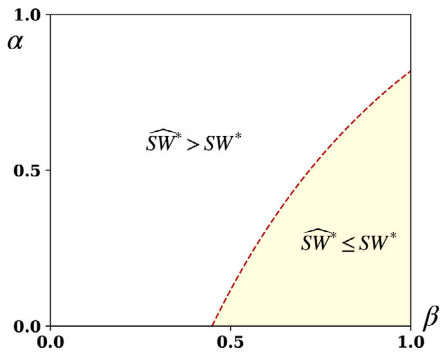

Fig. 4. Change in social welfare in a full coverage market ($v = 6$, $m = 4$).

despite the end of its partnership with Taobao. This is precisely the case where the cooperation strategy benefits both the traditional platform and consumers, allowing RED's brand to spread.

Next, we examine whether implementing the cooperation strategy will improve overall social welfare. Denote $SW(= CS + \pi_c + \pi_t)$ and $\widehat{SW}(= \widehat{CS} + \hat{\pi}_c + \hat{\pi}_t)$ as the social welfare under competition and cooperation strategies, respectively; we have the following result.

Corollary 1. *When the downstream market is partially covered, social welfare under the cooperation strategy is always higher than that under the competition strategy (i.e., $\widehat{SW}^* > SW^*$).*

Corollary 1 shows that when the market features *partial coverage*, the performance of social welfare aligns with that of both the social commerce platform and the traditional platforms' profit, as well as that of consumer surplus. Due to the lack of competition, the adoption of a cooperation strategy amplifies the profitability of both platforms (Proposition 6). Moreover, the strategy results in consumers deriving greater additional utility from the virtual community (Proposition 7), thereby leading to an increase in overall social welfare.

Examining the influence of the cooperation strategy on social welfare analytically in a *fully covered market* is difficult due to the complexities of the social welfare expression. As a result, we conduct a numerical study for this analysis. Specifically, we set $v = 6$ and $m = 4$ to compare the social benefits of the two strategies in the full coverage market, as shown in Fig. 4. We find that when the spillover effect is high, adopting a cooperation strategy is harmful to social welfare. This is because a large β expands the traditional platform's demand, allowing it to raise the retail price and benefit from the cooperation strategy (see Proposition 6). Simultaneously, the social commerce platform's demand shrinks, forcing it to embrace a low-price strategy that reduces its profit (Proposition 6). Consequently, the overall consumer surplus decreases, leading to an ultimate reduction in overall social welfare.

6. Discussion

In this section, we first investigate how the consumer unit travel cost, spillover effect, and revenue-sharing rate affect the optimal outcomes in the two strategies (Section 6.1). To assess the robustness of the main insights, we then discuss three variations of our main model: sequential pricing (Section 6.2), expansion strategy of the traditional platform (Section 6.3), and cost sharing (Section 6.4).

6.1. Effects of key parameters

We numerically investigate how crucial parameters (specifically, consumer unit travel cost, spillover effect, and revenue-sharing rate) affect the performance of the market. In particular, we calculate the additional demand under the cooperation strategy (i.e., ΔD defined in Section 4.2), the change in profit of the two platforms in the two strategies, calculated by $\Delta\pi_c = \hat{\pi}_c^* - \pi_c^*$ and $\Delta\pi_t = \hat{\pi}_t^* - \pi_c^*$, and the change in consumer surplus and social welfare, defined as $\Delta CS = \widehat{CS}^* - CS^*$ and $\Delta SW = \widehat{SW}^* - SW^*$.

First, we discover that when the downstream market is partially covered, the changes in the performance of the measures of interest ΔD, $\Delta\pi_c$, $\Delta\pi_t$, ΔCS and ΔSW show the same pattern. Particularly, they all decrease in the unit travel cost and increase in the spillover effect. Furthermore, the revenue-sharing rate has a nonmonotonic impact on them. Interested readers can refer to Online Appendix B.1 for details.

In the subsequent analysis in this section, we focus on the full coverage market. Fig. 5 illustrates the impact of unit travel cost on ΔD, $\Delta\pi_c$, $\Delta\pi_t$, ΔCS and ΔSW. Recall that the cooperation strategy brings additional demand to the traditional platform, and we find that the demand decreases as the unit travel cost increases. As the spillover effect becomes stronger, the impact of the cooperation strategy on additional demand becomes more apparent. Second, the change in profit of the social commerce (traditional) platform slightly increases (decreases) as the unit travel cost increases. Third, the variations in consumer surplus and social welfare both increase with the unit travel cost. Furthermore, when the spillover effect is low, consumers tend to benefit more from a cooperation strategy, aligning with our findings in Section 5.

Fig. 6 shows that a higher spillover effect does not necessarily generate more additional demand for the traditional platform, which is somewhat surprising. When the spillover effect is low, competition between platforms is relatively mild, making the impact of the cooperation strategy more significant in increasing additional demand. However, as the spillover effect increases further, the social commerce platform is compelled to lower prices to retain demand, resulting in less additional demand for the traditional platform. Moreover, the change in profit for the social commerce (traditional) platform decreases (increases) in β and the consumer surplus and social welfare induced by the cooperation strategy may benefit or be harmed by a stronger spillover effect. An increased spillover effect triggers a reduction in the social commerce platform's effort in the virtual community under the cooperation strategy (refer to Proposition 4), which has a negative effect on consumer surplus and social welfare.

Fig. 7 depicts the impact of the revenue-sharing rate. As the revenue-sharing rate rises, so does the additional demand generated by the cooperation strategy. Furthermore, a greater spillover effect steepens the growth curve of additional demand. When the revenue-sharing rate rises, the cooperation strategy induces a higher (lower) profit for the social commerce (traditional) platform. Furthermore, when the spillover effect is low and the revenue-sharing rate is high, the adoption of a cooperation strategy negatively affects the traditional platform (as indicated in Proposition 6). Last, both consumer surplus and social welfare increase with a larger revenue-sharing rate. This implies that the social commerce platform can help to improve consumer surplus and social welfare in the cooperation strategy by adjusting α. This is a result of the strengthened competition effect between the two platforms that the two platforms reduce their prices (see Proposition 3).

6.2. Sequential pricing

In practice, some social commerce platforms may incorporate e-commerce features later than traditional platforms. For example, RED initially focused on building its online community before moving on to e-commerce development in 2019.[4] Therefore, in a *competitive* scenario between two platforms, pricing would occur *sequentially* rather than simultaneously. Accordingly, we examine an extended model in which the social commerce platform sets the retail price after the traditional platform in the competition strategy to see how this affects the results (all other decision timings are consistent with those illustrated in

[4] https://www.xiaohongshu.com/en#investors.

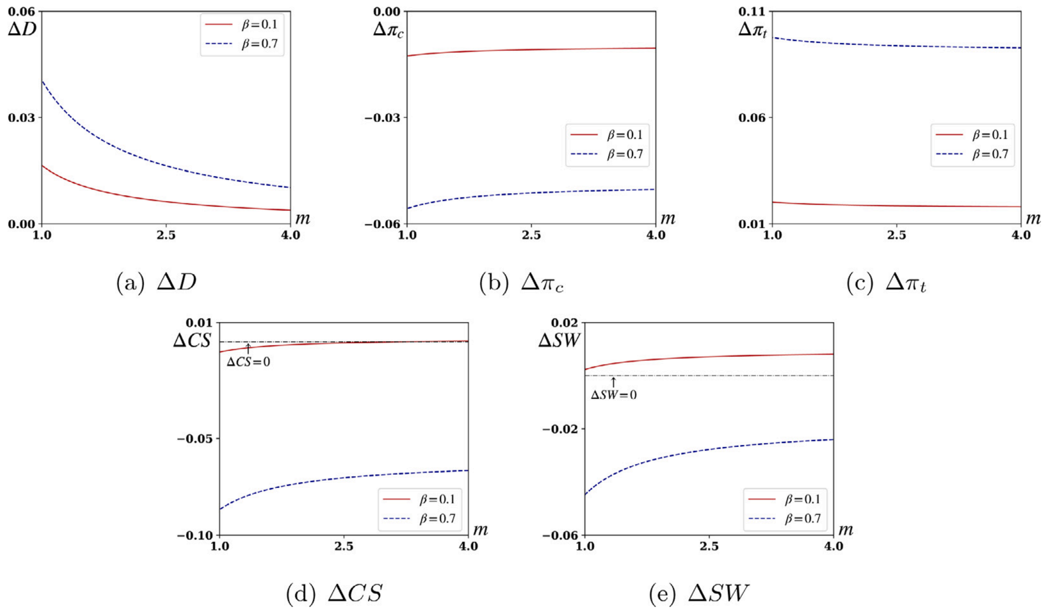

Fig. 5. Effects of unit travel cost m in a full coverage market ($v = 6$, $\alpha = 0.15$).

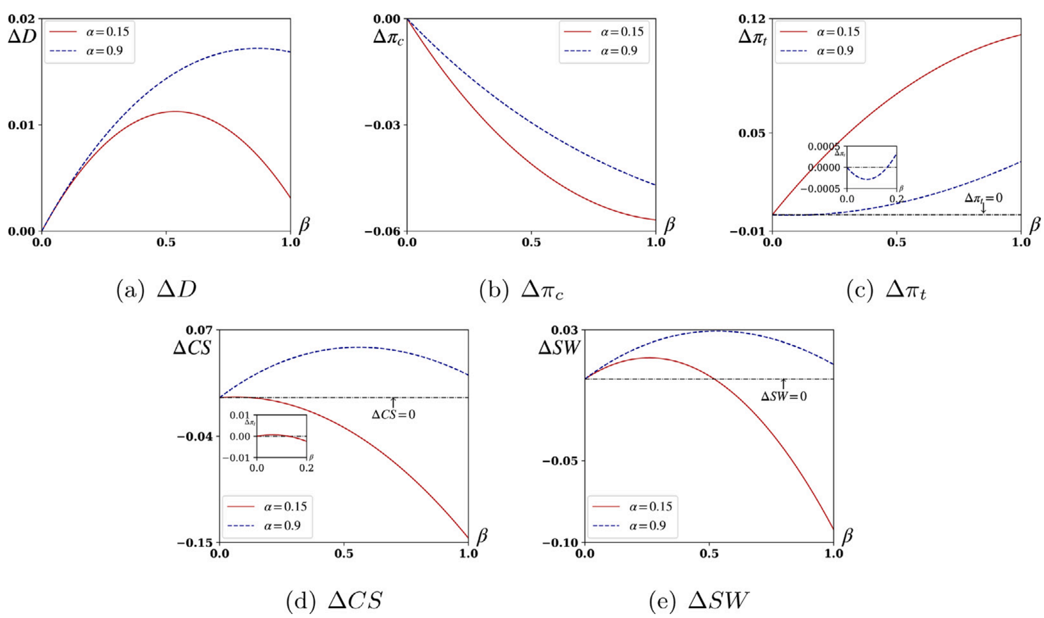

Fig. 6. Effects of spillover effect β in a full coverage market ($v = 6$, $m = 4$).

Fig. 2). The game is solved by backward induction, and the results are summarized in Online Appendix B.2. In addition, we obtain the following result.

Proposition 8. *When the market features full coverage, the comparison of optimal decisions under the cooperation strategy and competition strategy with sequential pricing is summarized as follows: (1) If $0 < \beta \leq \beta_8$, $\hat{e}^* \geq e^*$; otherwise, it has $\hat{e}^* < e^*$. (2) $\hat{p}_c^* < p_c^*$ and $\hat{p}_t^* < p_t^*$. Here, β_8 is given by (A.31) in the Online Appendix A.*

Proposition 8 conveys the following information. In a full coverage market, when the spillover effect is low ($\beta \leq \beta_8$), the cooperation strategy motivates the social commerce platform to increase its effort ($\hat{e}^* \geq e^*$). The retail price of the social commerce platform is lower under the cooperation strategy ($\hat{p}_c^* < p_c^*$), aligning with the findings in Proposition 5. However, if the two platforms execute sequential pricing, the traditional platform always sets a higher retail price than that in a cooperation strategy ($\hat{p}_t^* < p_t^*$), in contrast to the result obtained under the competition strategy with simultaneous pricing (refer to 2(2) in Proposition 5). This suggests that the traditional platform pricing becomes more aggressive in the competition strategy when it acts as a price leader.

Proposition 9. *When the market features full coverage, the profit relationships of the platforms under the cooperation strategy and competition strategy with sequential pricing are as follows:*

1. *The profit for the social commerce platform under the cooperation strategy is always lower (i.e., $\hat{\pi}_c^* < \pi_c^*$).*
2. *When $\underline{m} < m \leq \widetilde{m}$ and $0 < \beta < \beta_9$, or when $\underline{m} < m \leq \widetilde{m}$, $\beta_9 \leq \beta \leq \min\{\beta_{10}, 1\}$, and $\alpha_6 < \alpha \leq 1$, when $m > \widetilde{m}$, the profit for the traditional platform under cooperation strategy is lower than that under competition strategy with sequential pricing (i.e., $\hat{\pi}_t^* < \pi_t^*$) and higher otherwise.*

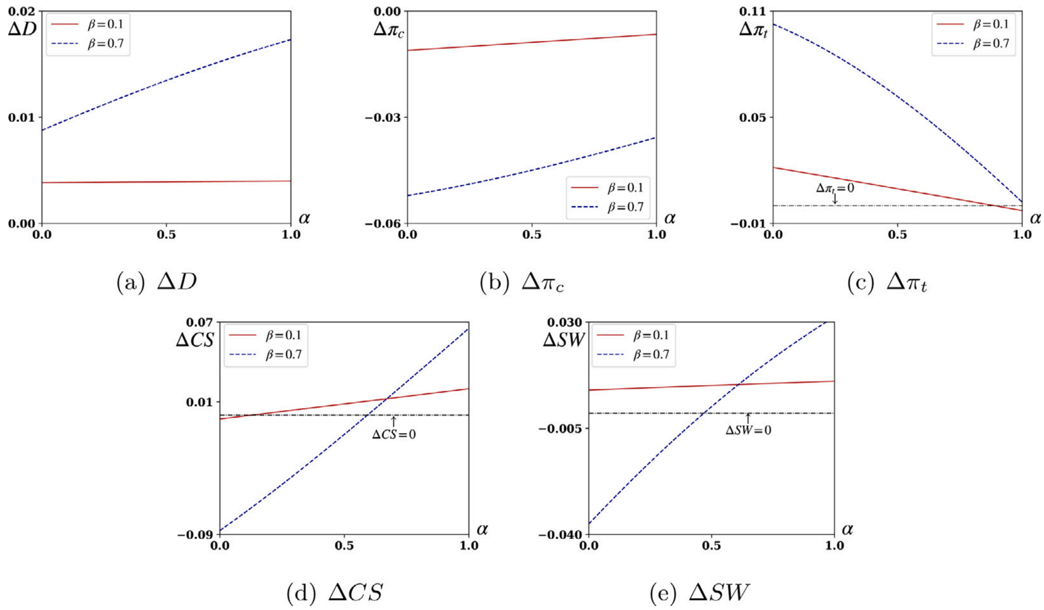

Fig. 7. Effects of revenue-sharing rate α in a full coverage market ($\upsilon = 6$, $m = 4$).

In the above, $\underline{m}$, β_9, β_{10}, α_6 and $\widetilde{m}$ are given by (A.7), (A.34), (A.36), (A.37) and (A.38) in the Online Appendix A.

Proposition 9 mirrors the conclusions drawn in Proposition 6. When the market is fully covered, the lose-lose and lose-win outcomes for the social commerce platform and traditional platform persist. Compared with the competition strategy with simultaneous pricing, changing the game sequence mitigates the competition between platforms. This leads to increased profitability for the traditional platform under the competition strategy with sequential pricing. Furthermore, we conduct a numerical study to investigate the impact of the cooperation strategy on the two platforms alongside with consumer surplus (see Figure B.2.1). We discover that the cooperation strategy always harms the social commerce platform, even in the case of sequential pricing, but it may also help the traditional platform and customers (as shown in Fig. 3). Interested readers can explore Online Appendix B.2 for detailed information.

6.3. Expansion strategy of the traditional platform

In this section, we examine a scenario where the traditional platform, rather than collaborating with the social commerce platform through a cooperation strategy (Alizila, 2016), runs its own virtual community. We refer to this as the traditional platform's *expansion strategy* for ease of exposition. Thereafter, we compare the equilibrium outcomes with those in a competition strategy to investigate the impact of the expansion strategy on the market participants' performances.

In this new model, the traditional platform simultaneously determines the effort level with the social commerce platform in the first stage of the game, and all the subsequent decision timings are consistent with those illustrated in Fig. 2. Under the *expansion strategy*, a consumer choosing the traditional platform receives a base value of υ coupled with an extra benefit of e_t, where $e_t \in (0,1)$ is the traditional platform's effort invested in its virtual community. The effort incurs an investment cost of $C(e_t) = e_t^2/2$. The consumer's utility in Eq. (2) is rewritten as $U_t = \upsilon + e_t - m(1-x) - p_t$. Denote $\widetilde{D}_t$ as the demand of traditional platform and $\widetilde{D}_c$ as the demand of the social commerce platform under the expansion strategy. Accordingly, under the expansion strategy, the traditional platform's profit is given by $\pi_t = p_t\widetilde{D}_t - \frac{e_t^2}{2}$. We solve the game by backward induction; the outcomes are summarized in Online Appendix B.3, and the results corresponding to the expansion strategy are denoted by the notation $\widetilde{\cdot}$.

Proposition 10. *Comparing the outcomes in the competition and expansion strategies results in:*

1. *When the market features partial coverage, $\widetilde{e}^* = e^*$, $\widetilde{p}_c^* = p_c^*$ and $\widetilde{p}_t^* > p_t^*$.*
2. *When the market features full coverage, $\widetilde{e}^* < e^*$, $\widetilde{p}_c^* < p_c^*$ and $\widetilde{p}_t^* > p_t^*$.*

Proposition 10 outlines the relationships of the optimal equilibrium decisions between the expansion and competition strategies. When the market is partially covered, both platforms behave as local monopolists due to the absence of direct competition between them. Consequently, the social commerce platform maintains an unchanged optimal effort level and retail price under the expansion strategy (i.e., $\widetilde{e}^* = e^*$ and $\widetilde{p}_c^* = p_c^*$). Under full market coverage, the expansion strategy results in a reduced effort level and lower retail price for the social commerce platform compared to those of the competition strategy (i.e., $\widetilde{e}^* < e^*$ and $\widetilde{p}_c^* < p_c^*$). This shift occurs because the virtual community invested in by the traditional platform intensifies competition, prompting the social commerce platform to lower effort to mitigate losses from heightened rivalry and lower its retail price to retain demand. The traditional platform, regardless of whether in a partial or full coverage market, always sets a higher retail price under the expansion strategy than that under the competition strategy (i.e., $\widetilde{p}_t^* > p_t^*$). This is because the expansion strategy strengthens the traditional platform's competitiveness due to the investment in the virtual community.

Proposition 11. *Compared to the competition strategy, the impact of the expansion strategy on the profit of the social commerce platform, profit of the traditional platform, and consumer surplus is summarized as follows:*

1. *When the market features partial coverage, utilizing the expansion strategy leads to a (weakly) win-win-win outcome (i.e., $\widetilde{\pi}_c^* = \pi_c^*$, $\widetilde{\pi}_t^* > \pi_t^*$ and $\widetilde{CS}^* > CS^*$).*
2. *When the market features full coverage, utilizing the expansion strategy leads to a lose-win-win outcome (i.e., $\widetilde{\pi}_c^* < \pi_c^*$, $\widetilde{\pi}_t^* > \pi_t^*$ and $\widetilde{CS}^* > CS^*$).*

Proposition 11 indicates that despite the traditional platform also implementing a virtual community (i.e., the expansion strategy), the key insights derived from the main model remain valid. Specifically, following the adoption of the expansion strategy, in a partially covered market, the win-win-win situation for the social commerce platform, traditional platform, and consumer surplus still holds. In a fully covered market, the lose-win-win outcome persists for the social commerce platform, traditional platform, and consumer surplus. Nevertheless, the lose-win-lose and lose-lose-win outcomes vanish in the expansion strategy. This reveals that from the perspective of the traditional platform and consumers, it is preferable for the traditional platform to promote its own virtual community rather than participate in the social commerce platform's cooperation strategy.

6.4. Cost sharing

In the cooperation strategy, the social commerce platform may request the traditional platform to share a fraction of the investment cost of the virtual community. Denote γ ($\gamma \in [0,1]$) as the cost-sharing rate. Under the cooperation strategy with cost sharing, the platforms' profits are rewritten as $\pi_c = p_c \widehat{D}_c + \alpha p_t \Delta D - \frac{\gamma e^2}{2}$ and $\pi_t = p_t \widehat{D}_t - \alpha p_t \Delta D - \frac{(1-\gamma)e^2}{2}$, respectively. A larger γ value suggests that the social commerce platform is responsible for more virtual community investment costs. Based on this new model, we solve the game again. The results are summarized in Online Appendix B.4. Then, we investigate whether the cooperation strategy with cost sharing could lead to a win-win outcome for both platforms.

Proposition 12. *When the market features partial coverage, the relationships between the profits of the platforms under the competition strategy and cooperation strategy with cost sharing are:*

1. *The profit for the social commerce platform under the cooperation strategy with cost sharing is always higher (i.e., $\hat{\pi}_c^* > \pi_c^*$).*
2. *If $\gamma < \gamma_1$, the profit for the traditional platform under the cooperation strategy with cost sharing is lower than that under the competition strategy (i.e., $\hat{\pi}_t^* < \pi_t^*$) and higher otherwise.*

In the above, γ_1 is given by (A.40) in the Online Appendix A.

Proposition 12 demonstrates that in the absence of direct competition between platforms, a win-win situation still occurs under the cooperation strategy with cost sharing when the cost-sharing rate is high (i.e., $\gamma \geq \gamma_1$). However, if the cost-sharing rate is low, indicating a relatively high investment cost borne by the traditional platform, the cooperation strategy with cost sharing will diminish the profit of the traditional platform ($\hat{\pi}_t^* < \pi_t^*$). This leads to a win-lose outcome for the social commerce platform and the traditional platform.

In the case of a fully covered market, we cannot conduct analytic comparisons of the competition and cooperation strategies due to the complicated expressions for the equilibrium outcomes. We thus conduct extensive numerical experiments by considering $144,780,372$ combinations of parameter values of the unit travel cost m, the cost-sharing rate γ, the revenue-sharing rate α, and the spillover effect β. In the experiments, α, β change within $(0,1)$ with a minimum value of 0.01, maximum value of 0.99, and step size of 0.01; m changes within $[2,4]$ with a step size of 0.01, and γ changes within $(\gamma_0, 1)$ with a step size of 0.01, where $\gamma_0 = \frac{1+2(1-\alpha)\alpha\beta^2}{2m}$.[5] Table 4 summarizes the comparison outcomes for these numerical experiments. We say the cooperation strategy achieves a win-win-win outcome when it leads to the social commerce platform earning higher profit, the traditional platform earning higher profit, and consumers benefiting more compared to the competition strategy. Our results show that the win-win-win outcome induced by the cooperation strategy disappears in a full coverage market, which is in line with the results in the main model without cost sharing. Importantly, the social commerce platform can profit from the cooperation strategy in 26.2% of all cases if the traditional platform is prepared to split the expenses incurred in the virtual community. However, because of the large percentage of investment costs it carries, this harms the traditional platform. We thus conclude that even considering a cooperation strategy with cost sharing, the two platforms cannot achieve a win-win outcome from cooperation. This further shows the robustness of our result in the main model. Our results also indicate that adopting a cooperation strategy may benefit consumers in the majority of cases (roughly 83.7% of all numerical instances).

7. Conclusion

Social commerce platforms have significantly increased in popularity both in China and globally in the vibrant contemporary digital landscape. In contrast to traditional platforms, social commerce platforms distinguish themselves by creating a virtual community that enables consumers to share their experiences and interact with other users, ultimately leading to increased sales. In actuality, however, there are instances where users explore virtual communities but then switch to traditional platforms. Consequently, social commerce platforms often opt to collaborate with traditional platforms, allowing links to traditional platforms' products within their virtual communities. In return, the social commerce platform receives a portion of the revenue generated by these links. Driven by the observed phenomenon of RED partnering with Taobao in 2020 but terminating the partnership in the following year, we focus on how cooperation and competition strategies affect the operational decisions of social commerce and traditional platforms, as well as the consumers in the downstream market, to provide insights into the motivations of a social commerce platform for choosing different operational strategies.

We summarize the key results of this paper in Table 5. Among the key results, importantly, we show that when the social commerce platform adopts the competition strategy, it tends to decrease its effort in the virtual community as the consumer unit travel cost increases. We further clarify that under partially and fully covered markets, the underlying driving forces for this result differ. The spillover effect of the virtual community and the revenue-sharing rate are two key factors in the cooperation strategy. We demonstrate that the social commerce platform tends to increase effort in the virtual community as the consumer unit travel cost increases when the spillover effect is significant (where the social commerce platform has the potential to earn substantial commission-based revenue from the traditional platform). Furthermore, our findings suggest that the revenue-sharing rate has a nonmonotonic impact on the social commerce platform's optimal effort level.

By comparing the performance of the two platforms, consumer surplus, and social welfare, we conclude that the social commerce platform should always adopt the cooperation strategy in a partially covered market, which results in a win-win-win outcome for the aforementioned parties. However, the social commerce platform is always worse off if it adopts the cooperation strategy in a fully covered market. Insufficient revenue sharing makes the social commerce platform fail to offset losses from intensified market competition. We find that the traditional platform might also be worse off when competition is extremely fierce. That is, a lose-lose outcome for the two platforms may arise in equilibrium under the cooperation strategy. Depending on the magnitude of the revenue-sharing rate and the degree of the spillover effect, the cooperation strategy may benefit or harm consumers. In conclusion, lose-win-lose, lose-win-win, and lose-lose-win outcomes are all possible (for the social commerce platform, the traditional platform, and consumers) under the cooperation strategy in a scenario where the two platforms actively compete in the market. Our findings offer potential justifications for the shifts in operational strategy between RED and Taobao. Our numerical studies further show that social welfare might also be harmed if the social commerce platform implements the cooperation strategy. We also consider three variations of our main

[5] $\gamma > \gamma_0 \triangleq \frac{1+2(1-\alpha)\alpha\beta^2}{2m}$ is requested to ensure the positivity of the equilibrium results. Please see the proof of Lemma B.4.1 in Online Appendix B.

Table 4
Summary of numerical experiments: Model of cost sharing in full coverage market.

	Comparisons (Cooperation Strategy vs. Competition Strategy)			
	win-lose-win	lose-win-win	lose-win-lose	lose-lose-win
Occurrences	37,881,041	40,801,444	23,615,825	42,482,062
Percentage	26.2%	28.2%	16.3%	29.3%

Table 5
Summary of main results.

	Competition Strategy		Cooperation Strategy	
	Partial coverage	Full coverage	Partial coverage	Full coverage
$\uparrow m$ (unit travel cost)	$\downarrow e^* \downarrow p_c^*$	$\downarrow e^* \uparrow p_c^* \uparrow p_t^*$	$\downarrow \hat{e}^* \downarrow \hat{p}_c^* \downarrow \hat{p}_t^*$	$\downarrow$ *or* $\uparrow \hat{e}^*$ (Proposition 2) $\uparrow \hat{p}_c^* \uparrow \hat{p}_t^*$
$\uparrow \alpha$ (revenue-sharing rate)	/		first $\uparrow$ then $\downarrow$ or $\uparrow \hat{e}^*$ (Proposition 3) first $\uparrow$ then $\downarrow$ or $\uparrow \hat{p}_c^*$ (Proposition 3) $\uparrow \hat{p}_t^*$	$\downarrow \hat{e}^*$ (Proposition 3) first $\uparrow$ then $\downarrow \hat{e}^*$ (Proposition 3) $\uparrow \hat{e}^*$(Proposition 3) $\downarrow \hat{p}_c^* \downarrow \hat{p}_t^*$
$\uparrow \beta$ (spillover effect)	/		$\uparrow \hat{e}^* \uparrow \hat{p}_c^* \uparrow \hat{p}_t^*$	$\downarrow \hat{e}^*$ first $\downarrow$ then $\uparrow$ or $\downarrow \hat{p}_c^*$ (Proposition 4) first $\downarrow$ then $\uparrow$ or $\uparrow \hat{p}_t^*$ (Proposition 4)

	Comparisons (Competition vs. Cooperation)	
	Partial coverage	Full coverage
SC platform's effort	$e^* < \hat{e}^*$	$e^* > \hat{e}^*$
SC platform's retail price	$p_c^* < \hat{p}_c^*$	$p_c^* > \hat{p}_c^*$
T platform's retail price	$p_t^* < \hat{p}_t^*$	$p_t^* \geq \hat{p}_t^*$ or $p_t^* < \hat{p}_t^*$ (Proposition 5)
SC platform's profit	$\pi_c^* < \hat{\pi}_c^*$	$\pi_c^* > \hat{\pi}_c^*$
T platform's profit	$\pi_t^* < \hat{\pi}_t^*$	$\pi_t^* \geq \hat{\pi}_t^*$ or $\pi_t^* < \hat{\pi}_t^*$ (Proposition 6)
Consumer surplus	$CS^* < \widehat{CS}^*$	$CS^* < \widehat{CS}^*$ or $CS^* > \widehat{CS}^*$
Social Welfare	$SW^* < \widehat{SW}^*$	$SW^* < \widehat{SW}^*$ or $SW^* > \widehat{SW}^*$

Notes. In the above, "SC" represents "Social commerce", and "T" represents "Traditional".

model: sequential pricing, a traditional platform investing in its own virtual community, and cost sharing in the cooperation strategy. Our analysis demonstrates that these model variations have no effect on the primary insights.

The paper has limitations and offers potential directions for future research. First, how well consumers comprehend products and make purchases is significantly influenced by the quality of content produced by content creators. In future studies, it would be worthwhile to include content creators in the game. Second, if both platforms are operated by a single retailer, there would be a cross-channel effect between the two platforms. This would certainly affect the specific operational strategy of the retailer. Exploring this situation is also attractive. Additionally, RED used a variety of techniques to improve brand promotion. Future research should focus on the social commerce platform's collaboration with the brand. Finally, in real-world situations, some consumers might be devoted to a particular platform while others might be considering switching to another platform. As a result, it might be worthwhile to further investigate consumer loyalty and switching behavior.

CRediT authorship contribution statement

Haiqing Song: Methodology, Validation, Conceptualization, Supervision. **Rui Wang:** Validation, Visualization, Formal analysis, Methodology, Software, Writing – original draft. **Yanli Tang:** Formal analysis, Supervision, Validation, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.ejor.2024.05.014.

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