Value Co-creation and Appropriation of Platform Alliances in Cooperative Advertising

Abstract: Digital platforms help develop the open value co-creation strategic alliances, reshape traditional B2B relationships, and promote inclusive social innovation. This research explores the nature of coopetition between the digital platform owner and the participants. The focus is on the alliance balancing the contradiction between value creation and appropriation in the platform-based value co-creation alliance with supporting evidence from a retailer-dominated Stackelberg game in the context of cooperative advertising. The game illustrates the significance of cooperative relationships to co-create a larger total value and the existence ofan unequal win-win relationship in the value co-creation strategic alliance. The dominant platform may motivate the manufacturer to fully support the advertising by providing 'rebate bait' based on the latter's different bargaining power. However, once the manufacturer is 'hooked' and joins the game, the platform primarily absorbs the increased profits. This study reveals that the contradictory logics of cooperation and competition, or coopetition, can be accommodated in the platform-based alliance co-creating overall value. The dynamic coopetition is involved in a partially convergent interest structure and impacted by power asymmetry. The results highlight the balance between the tensions and harmonies in value creation and appropriation processes.

Keywords: Platform-based Alliance; Coopetition; Value Co-creation; Value Appropriation; Cooperative Advertising; Power Asymmetry

1. Introduction

Digital platforms such as Alibaba, Uber, and Airbnb promote open and innovative business models to help develop value co-creation alliances. As they trigger network effects between the demand and supply side, they are particularly associated with rapid growth and the potential to dominate a market due to winner-take-all dynamics (Hagiu & Wright, 2015). The value co-creation alliances formed by platform owners and participants reshape the logic of social and business value creation by accommodating multiple participants, breaking through geographical restrictions and information asymmetry, rebuilding diverse resources portfolios and creating novel opportunities (Täuscher & Laudien, 2018; Parker et al., 2016). This allows products, services, information and opportunities to be available to a large population and innovates a more efficient and sustainable business model (Kirzner, 2015; Wilson & Millman, 2003). For instance, Alibaba provides a service ecosystem developed around digital platforms that include a variety of elements such as consumers, merchants, brands, retailers, third-party service providers and other businesses**.** Uber offers a green business model of ridesharing and implements the goal of 'You've got drive. We've got jobs', which provides viable employment opportunities for the unemployed and underemployed and simultaneously benefits consumers. Thus, the platform alliance between the platform and its participant facilitates the emergence, engagement and evolution of the intertwined social and commercial value through sustainable value co-creation. This provides a new insight for exploring social innovation through the platform-based value co-creation strategic alliance.

Although the benefits of digital platforms have been extensively discussed (Wen & Zhu, 2019; Nambisan, Siegel, & Kenney, 2018; McIntyre & Srinivasan, 2017), knowledge related to how the value co-creation alliance performs value creation and appropriation and how the specific coopetitive relationship in the platform alliance still needs a more in-depth contextualized analysis(Cenamor, Parida, & Wincent, 2019; Täuscher & Laudien, 2018). Empirical evidence has supported that platform alliances tend to generate business and social value and confirmed the necessity of partnerships in alliances rather than an independent venture (Crisafulli, Dimitriu & Singh, 2020; Täuscher & Laudien, 2018). However, different voices call for attention to the tensions and conflicts in the value co-creation alliances as the goals and interests of actors in alliances only partially converge (Chou & Zolkiewski, 2018). A common but paradoxical situation is that the joint and collective cooperative efforts which create a larger pie are countervailed by individuals' attempts to get a bigger portion of the pie (Brandenburger & Nalebuff, 1996). For example, suppliers on the Alibaba platform could obtain more market opportunities and larger potential customers. Still, they do not want to be constrained by excessive rules or charged by excessive commissions from the platform owners. For Alibaba, it hopes that suppliers can reach more deals to enlarge the total benefit through value co-creation, but its for-profit nature orients it to purchase a higher private share of the created benefit. The same is true for the relationship between the suppliers and platforms such as Amazon, Uber, Airbnb. Cooperation and competition merge to form a strategic interdependence, giving rise to coopetition in the value co-creation alliance. Therefore, balancing the contradictory logic of the interaction between cooperation and competition within alliance relationships has become crucial (Gnyawali, Madhavan, He, & Bengtsson, 2016; Karray & Zaccour, 2006)

The B2B cooperative advertising research has given us some inspiration to explore this issue. On the one hand, cooperative advertising has been proved an effective means of increasing overall value and achieving a 'win-win situation' (Amrouche & Yan, 2017). It can stimulate total product sales, improve the entire supply chain performance, and facilitate the construction of long-term B2B relationships (Mora Cortez, Gilliland, & Johnston, 2020). On the other hand, value appropriation may lead to cost-sharing and profit distribution in the process of value co-creation through cooperative advertising. The most frequently discussed is advertising cost-sharing of dominant manufacturers, including the cost rates (Bergen & John, 1997)， the wholesale contracts characterized by discounted prices (Sluis & De Giovanni, 2016) and other mechanisms (Sarkar, Omair, & Kim, 2020; Kim, Jung, & Park, 2015; Kunter, 2012). However, this situation has changed in the value co-creation platform alliance. The dominant platform may take the initiative to share benefits to attract sustainable cooperation with its participant. Thus, this research constructs an action context in which the platform (acting as the dominant retailer) and the platform participant (acting as the manufacture) cooperate in advertising and then attempts to explore how the platform-

based B2B alliance simultaneously and paradoxically engages in the contradictory logic of cooperation and competition.

We propose a retailer-dominated Stackelberg game framework to analyze value creation and value appropriation in the context of advertising cooperation. We assume that the platform provides its own branded products or services (i.e., the private brand, PL) that could substitute the manufacturer's brand on the platform (i.e., the national brand, NB) thereby reflecting the tensions in the B2B relationship. Four specific scenarios are compared respectively to explore the NB advertising coopetition between the platform retailer and the manufacturer: 1/ the retailer sells the NB and the PL without advertising (Scenario 0); 2/the retailer fully supports NB advertising (Scenario 1); 3/the manufacturer fully supports NB advertising (Scenario 2); 4/ the retailer proposes a 'rebate bait' as an incentive mechanism, thus motivating the manufacturer to boost its level of advertising support.

We find that both players can improve their profits to achieve value co-creation, regardless of whether the manufacturer or the retailer absorbs the cost of advertising NB products. But an unequal win-win situation exists in the alliance as the dominant retailer receives a 'free-ride' and appropriates more value from the manufacturer's full support for NB advertising. Therefore, the dominant platform may set up 'rebate bait' as an incentive to lure the manufacturer's NB advertising investment and promote the positive interdependence between the platform and its participant. The effectiveness and cost of the 'rebate bait' are affected by a manufacturer's different bargaining power compared to a dominant retailer in the supply chain. This provides a new perspective for investigating the coopetitve relationship between the platform retailer and the manufacturer through value creation and value appropriation.

This research contributes to the research on social innovation through platform value co-creation alliances in the context of B2B advertising cooperative relationships. We highlight the significance of the digital platform in the simultaneous creation of dual value and analyse the mechanisms of value creation and value appropriation behind the platform alliances from coopetition. In advertising cooperation, the digital platform tends to cooperate with its participant to co-create a larger pie. It may also compete with its participant to get a bigger portion of the pie. This reveals the contradictory logic of cooperation and competition in the B2B strategic alliance. After comparing four specific scenarios, we find that a fair benefit-sharing mechanism contributes to a sustainable value co-creation alliance.

The remainder of this article is structured as follows. The second section introduces relevant theoretical development and reviews the literature on the digital platform's strategic alliance and value creation and appropriation from a B2B advertising context. The third section develops the relevant models, describes different scenarios and provides a comparative analysis. After analyzing the different scenarios mentioned above, the key research findings are integrated into Section 4. Finally, we draw conclusions provide a summative discussion of the research results, identify study limitations, and propose future research extensions.

2. Literature review

2.1. Strategic alliance in the digital platform

Rapidly emerging digital platforms supported by new-age digital technologies enable and support open product/service transactions between independent supply- and demand-side participants through value co-creation alliances (Täuscher & Laudien, 2018). Specifically, digital platforms attract multiple participants (including profit-making or non-profit individuals, enterprises, organizations, institutions, etc.) to shape a dynamic network and promote open strategic alliances that jointly carry out opportunity development and resource reorganization, thus realizing the dual value of business and society (Evans & Gawer, 2016; Gupta et al., 2020). Unlike traditional social enterprises that are motivated by the goal of meeting social needs or for-profit enterprises that are oriented towards business value, digital platforms have innovated the business operation model of 'doing well by doing good' (Varadarajan & Kaul, 2018) and provided a new value creation mechanism that innovatively integrates social and business missions (Battilana & Lee, 2014; Ebrahim, Battilana, & Mair, 2014; McMullen, 2018; Pache & Santos, 2013; De Silva, Khan, Vorley, & Zeng, 2020). Therefore, platform-based strategic alliances' value sheds new insight into

sustainable value co-creation alliances geared to generate both social and business value simultaneously.

The platform-based strategic alliance analysis includes at least two aspects: one is how the digital platform promotes and sustains value co-creation alliances, and the other is how the B2B alliance in the digital platform can sustainably create dual value. Regarding the first question, existing studies have fully explored the digital platform's benefits as an anchor for connecting demand-side and supply-side participants by providing transaction information, employment opportunities, and fair trade (Täuscher & Laudien, 2018). The hyper connecting feature of the platform(Swaminathan, Sorescu, Steenkamp, O Guinn, & Schmitt, 2020) surpasses the linear interaction between traditional B2B parties and connects a number of external actors by creating or expanding market segments based on previously untapped resources(West, Salter, Vanhaverbeke, & Chesbrough, 2014) These positive results illustrate the necessity of forming platform alliances and establishing value co-creation networks between platform owners and platform participants.

However, some scholars also argue that the possible tensions and conflicts that arise in co-creation alliances stem from the different or conflicting goals/interests of the actors that result in negative interdependencies in alliance relationships and affect the continuous development of the alliances (Crisafulli, Dimitriu, & Singh, 2020; Tura, Keränen, & Patala, 2019; Doganova & Karnøe, 2015). The conflicts can be embodied in the resource input, cost sharing, and benefit distribution in solving common problems or co-creating value (Chou & Zolkiewski, 2018; Phillips, Lee, Ghobadian, O Regan, & James, 2014). This also suggests that the digital platform is not a link tool, but a key actor leading the alliance relationship; value co-creation does not always bring positive results but may lead to worsening, destructive and negative results (Echeverri & Skålén, 2011; Prior & Marcos-Cuevas, 2016; Willy et al., 2017; Tura, Keränen, Patala, 2019). Therefore, when discussing how platforms can promote and maintain value co-creation alliances, it is necessary to explore how platform owners and platform participants as actors deal with the contradictory logic of cooperation and competition and balance the conflict between value creation and value appropriation in the process of value co-creation.

The second question is an extension of the first question. The sustainable creation of social and business value in platform alliances is mainly based on two innovative alliance mechanisms: one is to develop opportunities or capabilities to achieve the empowerment of participants; the other is to covering broad and diverse beneficiaries (Crisafulli, Dimitriu, & Singh, 2020; Babu et al., 2020). While these two mechanisms create business value, they also directly or indirectly generate social value. This innovative mechanism interprets how platform-based alliances simultaneously achieve dual value. However, this has been rarely discussed in existing social innovation research that often distinguishes social value from business value (Watson, Wilson, Smart, & Macdonald, 2018; Gemser & Perks, 2015). Previous literature on social innovation mainly focuses on the business model innovation of social enterprises or the corporate social responsibility of profitable enterprises (Foroudi, Akarsu, Marvi, & Balakrishnan, 2021; De Silva, Khan, Vorley, & Zeng, 2020; Varadarajan & Kaul, 2018) and emphasizes the realization of social goals such as poverty alleviation, education, or environmental protection through innovative activities or services (Dwivedi & Weerawardena, 2018; Mulgan, 2006). However, the existing research ignores how inclusive social innovations that integrate with commercial values can be realized, especially in the digital economy era when digital technology innovation promotes organizational innovation (Gupta, Kumar, & Karam; 2020). Digital platforms such as Uber, Alibaba, and Airbnb have innovated the business model of value co-creation and commercialized the logic of ‘doing well by doing good’. For example, the self-publishing platform Sellfy enables creators of various digital content (e.g., e-books, music, videos, and software) to commercialize through the platform business model. The retail platform Taobao has incubated some phenomenon-level individual merchants and stimulated new sales models such as e-commerce live streaming. This new type of retailer contributes to serving under-served segments, connecting disadvantaged groups, promoting employment, improving resource efficiency, and achieving other social values that are closely integrated with commercial value.

Therefore, platform alliances provide innovative co-creation alliance mechanisms to investigate the intertwined social and commercial value, but this topic has rarely been paid attention to (Watson, Wilson, Smart, & Macdonald, 2018; Gemser & Perks, 2015). The simultaneous creation of dual value also suggests that the tensions in platform alliances may not originate from the conflicts between social and business value but may exist in the conflicts of interests between

different players, thereby affecting actors' consideration of whether to form alliances to create a larger pie and how to get a bigger portion (Chou & Zolkiewski, 2018).

In conclusion, the generation of social and business value involves the co-creation of the platform and its participant. The paper focuses on the strategic alliance based on value co-creation in the digital platform. It explores a common but paradoxical situation between value creation (enlarging the total benefits) and value capture/appropriation (a private share of the created benefit) in the alliance relationship (Ritala & Tidström, 2014). Specifically, this study further investigates the balance of the contradictory logic of cooperation and competition. It deepens the understanding of the B2B co-creation alliance development in the context of the digital platform.

2.2. Value co-creation and appropriation from a B2B advertising context

Digital platforms have created a hyper-connected world and improved consumers' information availability (Swaminathan, Sorescu, Steenkamp, O Guinn, & Schmitt, 2020). Modern buyers are exposed to multiple and competitive advertising messages per day, affecting their rational and systematic decision-making in different brands (Belch & Belch, 2017)) This stimulates brand suppliers to cooperate with platforms through value co-creation and form B2B advertising alliances to enhance the overall brand experience and gain brand legitimacy in the highly connected platform ecosystem (Gustafson & Pomirleanu, 2021). It has been widely argued that advertising cooperation can increase product sales, improve resource utilization, and promote supply chain performance (Mora Cortez, Gilliland, & Johnston, 2020; Amrouche & Yan, 2017; Aust & Buscher, 2014). However, cost sharing and profit distribution in the process of value co-creation may stimulate the inherent competitive pressures in the B2B strategic alliances (Sluis & De Giovanni, 2016; Liu, Du, Li, & Hong, 2013), leading to the conflicts and tensions that arise in coopetitive relationships. Therefore, from the research of cooperative advertising, we can get some inspiration to investigate the factors that affect value creation and appropriation of strategic alliances as follows:

***Who is the leader in the competitive structure*?** The competitive situation and negotiation ability of the players in the game tend to determine the cooperative advertising approach (Zhang, Guo, Hu, & Wang, 2020). Numerous previous studies are limited to situations in which a manufacturer dominates the supply chain, attempted to explore the best couponing strategies (Bauner, Jaenicke, Wang, & Wu, 2019), quality improvement strategies (De Giovanni, 2011), and conditions under which leading manufacturers supply retailers' private brands (Milberg, Cuneo, & Langlois, 2019). However, the situation may change when digital platforms such as Taobao and Airbnb pioneer new open business models in their industry and grow as a new type of retailer. The platform's hyper-connecting capabilities overturn the huge influence of traditional retail giants like Walmart and Carrefour and change the competitive landscape in traditional B2B relationships (Wang, Tang, & Zhao, 2019). The era in which brand manufacturers dictate the game to compliant retailers has long since concluded. Therefore, digital platforms' rapid growth has shaped a new retailer-dominated market structure in B2B alliances.

***Advertising on a single brand or competing brands*.** Since the traditional retailer only sells the NB provided by the manufacturer, a simple vertical competition exists in the supply chain. Therefore, an increase or decrease in performance is simply caused by the advertising effect of the NB (Li, Zhang, & Liu, 2018). The focus of cooperation negotiation tends to be emphasised bysharing advertising costs and profit sharing (Huang, Li, & Mahajan, 2002). However, as the situation of a PL offered by the platform retailer competing against an NB supplied by its participant is widespread in the digital platform, there is not only vertical but also horizontal competition in the supply chain between NB and PL products (Aust & Buscher, 2014). Therefore, advertising on the NB may cause changes in profits for both NB and PL products based on the effectiveness of NB advertising and product competitiveness (Amrouche & Yan, 2017; Karray & Zaccour, 2006;). This has led to discussion toward dynamic and complicated situations instead of those that are simpler and more static through value creation (i.e., how to generate a higher total profit of the supply chain) and value appropriation (i.e., how to distribute the cost or share the joint optimal profit) (Amrouche & Yan, 2017; Liu, Du, Li, & Hong, 2013; Kunter, 2012).

The incentive mechanisms for cooperative advertising. Regarding value appropriation among different players under different cooperative modes, related studies have included various factors,

such as the retail price, wholesale price, expenditures, and the profit-sharing of players in the same or different games (Aust & Buscher, 2012; Huang, Li, & Mahajan, 2002; Huang & Li, 2001). Some actors may adopt initiative mechanisms to induce other players to participate in or strengthen a given motivator's preferred cooperation game (Amrouche & Yan, 2017). The cost sharing and profit distribution mechanism in the advertising cooperation process may lead to different incentive mechanisms for cooperative advertising. In the traditional manufacturer-dominated game, since retailer advertising is critical to stimulating consumer product demand and subsequent purchasing behaviour (Huang & Li, 2001; Zhang, Gou, Liang, & Huang, 2013), manufacturers, often as the initiators of incentives, accept wholesale contracts characterized by discounted prices (Sluis & De Giovanni, 2016) or cooperative advertising participation rates (Bergen & John, 1997) as incentive mechanisms. However, the platform B2B alliance is different from the previous cooperation form of advertising cost-sharing from the manufacturer (Kim, Jung, & Park, 2015; Kunter, 2012). As a powerful leader of the B2B alliance, the platform may provide an incentive mechanism to attract manufacturers' participation to generate social and business value, thus forming a symbiotic relationship of co-creating value in a dynamic balance coopetition.

3. Model framework

Digital platforms, such as Airbnb, Uber, and Amazon, serving as new-age retailers, tend to attract and support a large number of manufactures, especially small and medium enterprises (SMEs), through strategic alliances, which lead to value co-creation and give rise to social innovations (Täuscher & Laudien, 2018). As digital platforms could simultaneously allow manufactures and themselves to provide substitutable offerings, our work focuses on the NB advertising strategic alliances in a context of brand competition (i.e., the PL offered by the retailer against the NB offered by the manufacturer). It explores the dynamic process of coopetitive relationships between B2B strategic alliances and inter-firm interdependencies, which determine the involved firms' value creation (enlarging the total benefits) and appropriation actions (a private share of the created benefit) (Chou & Zolkiewski, 2018).

The alliance actors have both a positive-sum game structure based on complementarity and a zero-sum game structure based on conflicts of goals/interests. We utilize a game model to analyse the partially convergent interest structure in the alliance that results in coopetition in value creation and appropriation and explore how actors deal with tensions and harmonies that drive and balance coopetition to promote and maintain sustainable alliances. In alignment with previous papers (Buratto, Grosset, & Viscolani, 2007; Xie & Wei, 2009; Esmaeili & Zeephongsekul, 2010; SeyedEsfahani, Biazaran, & Gharakhani, 2011; Aust & Buscher, 2012; Guceri-Ucar & Koch, 2012; Karray, 2013; Zhang, Gou, Liang, & Huang, 2013), the platform retailer acts as the leader and the manufacturer acts as the follower in a retailer-dominated Stackelberg game.

Based on the previous literature regarding cooperative advertising (Aust & Buscher, 2014; Amrouche & Yan, 2017; Li, Zhang, & Liu, 2018; Zhang, Guo, Hu, & Wang, 2020), we compared four scenarios: 1/ the retailer sells the NB and the PL without advertising (Scenario 0), 2/the retailer fully supports NB advertising (Scenario 1), 3/the manufacturer fully supports NB advertising (Scenario 2), and 4/the retailer proposes a 'rebate bait' as an incentive mechanism, motivating the manufacturer to boost its advertising support level. We explain and compare each scenario below. All parameters, strategies, and functions that appear in our research are demonstrated in table 1.

Table 1. Descriptions of parameters, strategies, and functions.

Parameters	Interpretation
β	The competitiveness coefficient of the PL and the NB
ε	The effectiveness of NB advertising
Strategies	
w	NB wholesale price
p_N	NB retail price
P_P	PL retail price
A_1	NB advertising supported by the retailer
A_2	NB advertising supported by the manufacturer
α	Proportion of the manufacturer's profit with 'rebate bait'
Functions	
$D_N^{(i)}$	NB demand in Scenario i $(i = 0,1,2,3)$
$D_P^{(i)}$	PL demand in Scenario i $(i = 0,1,2,3)$
$\Pi_M^{(i)}$	Manufacturer profit in Scenario i $(i = 0,1,2,3)$
$\Pi_R^{(i)}$	Retailer profit in Scenario i $(i = 0,1,2,3)$
$\Pi_C^{(i)}$	Total supply chain profit in Scenario $i(i = 0,1,2,3)$

3.1. Scenario 0: selling the PL and NB without NB advertising

In Scenario 0, the manufacturer provides the NB for the dominant retailer at the wholesale price of w, and the dominant retailer sells the NB and the PL at the retail prices of P_N and P_P, respectively. Similar to the research of Amrouch & Yan (2017), consumers are indifferent to buy these two competitive brands (i.e., the NB and the PL). There is no difference for the retailer in terms of product promotion, after-sales service, and product assurance during the NB and PL sales.

According to the above assumptions, without NB advertising, the product demand primarily depends on the two brands' prices and product competitiveness. Let D_N and D_P denote the demands of the NB and PL respectively, and then we propose the linear demand functions (Shubik & Levitan, 2013) for the NB and the PL as follows:

$$D_N = 1 - P_N + \beta P_P \quad (1)$$

$$D_P = 1 - P_P + \beta P_N \quad (2)$$

The parameter β is the competitiveness of the two brands. When $\beta \to 0$, no competitive relationship between the NB and the PL exists. Conversely, when $\beta \to 1$, the competition between the two types of products is very high.

To simplify the calculations, we assume that the production costs of the two types of products are equal to 0, that is, $C_M = C_R = 0$. The manufacturer and the retailer are both risk-neutral. Therefore, we propose the decision objective functions based on the premise that both the manufacturer and the retailer attempt to maximize their profit expectations. As a result, the corresponding profit for the retailer and the manufacturer can be captured in the following functions:

$$\underset{P_N,P_P}{Max}\Pi_R = D_N(P_N - w) + D_P P_P \quad (3)$$

$$\underset{w}{Max}\Pi_M = D_N w \quad (4)$$

The retailer-dominated Stackelberg strategies are as follows:

$$P_P = -\frac{1}{2(\beta-1)}, P_N = \frac{\beta-3}{4(\beta-1)} \quad (5)$$

$$w = \frac{1}{4} \quad (6)$$

The calculation result of w, is equal to constant. Since we utilize a simplified form of the demand function, the absolute value of the research result is meaningless. This means that under the retailer-dominated Stackelberg equilibrium, the product competitiveness does not affect the wholesale price. The research also shows that the retail prices of the NB and the PL change positively with product competitiveness.

3.2. Scenario 1: NB advertising fully supported by the retailer

In Scenario 1, the dominant retailer fully supports the NB advertising. As the PL and the NB are competitive, the two brands' demands are affected by advertising on NB (Xie & Ai, 2006). We assume that brand competitiveness and advertising effectiveness have some effects on the optimal profit of the manufacturer, the retailer, and the entire supply chain. When the retailer spends A_1 for NB advertising, the advertising is positively related to the NB demand but negatively associated with the PL demand. According to the previous literature (e.g., Zaccour, 2008), we assume a linear relationship between advertising and sales. The demand functions for the NB and the PL are as follows:

$$D_N = 1 - P_N + \beta P_P + \varepsilon A_1 \quad (7)$$

$$D_P = 1 - P_P + \beta P_N - \beta\varepsilon A_1 \quad (8)$$

As defined in Table 1, the parameter β $(0 < \beta < 1)$ is brand competitiveness, and the parameter ε $(0 < \varepsilon < 1)$ is advertising effectiveness on the NB. The parameter $\beta\varepsilon$ is the coefficient of advertising competition effect (Karray & Amin, 2015; Karray & Zaccour, 2006). Following Roberts and Samuelson (1988), Sorger (1989), and Espinosa and Mariel (2001), we introduce a convex advertising cost $\frac{{A_1}^2}{2}$ and the variable A_1 as the retailer advertising input. Therefore, the profit functions that are maximized for the supply chain players are as follows:

$$\underset{P_N,P_P,A_1}{Max}\ \Pi_R = D_N(P_N - w) + D_P P_P - \frac{1}{2}{A_1}^2 \quad (9)$$

$$\underset{w}{Max}\Pi_M = D_N w \quad (10)$$

The retailer-dominated Stackelberg strategies are as follows:

$$P_N = -\frac{\beta\varepsilon^2+2\beta-6}{2(\varepsilon^2-4)(\beta-1)}, P_P = -\frac{1}{2(\beta-1)}, A_1 = -\frac{\varepsilon}{(\varepsilon^2-4)} \quad (11)$$

$$w = -\frac{1}{(\varepsilon^2-4)} \quad (12)$$

Proof: See Appendix A.1.

Our results reveal that advertising effectiveness impacts decision-making variables other than the price of the PL. At the same time, product competitiveness only affects retailers' decision-making (i.e., P_N and P_P). Through sensitivity analysis shown in Table 2, we can further understand the two parameters' impact on the decision variables. When the retailer fully invests in NB

advertising, a higher competition coefficient positively influences the NB and the PL's retail prices. Advertising effectiveness has a positive influence on all strategies except the PL retail price.

Table. 2. Sensitivity analysis for Scenario 1 strategies

Strategies	$\frac{d}{d\beta}$	$\frac{d}{d\varepsilon}$
P_N	+	+
P_P	+	NA
A_1	NA	+
W	NA	+

NA: means not applicable

Proof: See Appendix A.2.

As shown in Table 2, when brand competitiveness is high, the retailer tends to increase the prices of both products (i.e., the NB and the PL). Specifically, the retailer is likely to reduce the price gap between the NB and the PL and increase the sum of the two products' prices (Proof: See Appendix A.3.). Advertising investment increases with the improvement of advertising effectiveness and then drives an increase in NB sales. To achieve optimal profits, the dominant retailer tends to increase the retail price of the NB. As the retailer's demand for the NB increases, the manufacturer may increase the NB's wholesale price to the retailer.

3.3. Scenario 2: NB advertising fully supported by the manufacturer

In Scenario 2, the manufacturer invests in all NB advertising A_2 to promote the NB demand to counter the PL's sales. The other assumptions are the same as those in Scenario 1. As the competition between the two brands ($\beta > 0$), NB advertising tends to increase the demand of the NB and decrease that of the PL. Therefore, we assume a linear relationship between advertising and sales. The demand functions for the NB and the PL are then:

$$D_N = 1 - P_N + \beta P_P + \varepsilon A_2 \quad (13)$$

$$D_P = 1 - P_P + \beta P_N - \beta\varepsilon A_2 \quad (14)$$

The profit functions to be maximized for the supply chain players are given as:

$$\underset{P_N,P_P}{Max}\Pi_R = D_N(P_N - w) + D_P P_P \quad (15)$$

$$\underset{w,A_2}{Max}\Pi_M = D_N w - \frac{1}{2}{A_2}^2 \quad (16)$$

The retailer-dominated Stackelberg strategies are as follows:

$$P_N = -\frac{\varepsilon^2+\beta-3}{2(\varepsilon^2-2)(\beta-1)},\ P_P = -\frac{1}{2(\beta-1)} \quad (17)$$

$$A_2 = -\frac{\varepsilon}{2(\varepsilon^2-2)},\ w = -\frac{1}{2(\varepsilon^2-2)} \quad (18)$$

Proof: See Appendix A.4.

The results show that advertising effectiveness tends to affect all decision-making variables except P_P, and product competitiveness only affects the retailer's decisions instead of the manufacturer. Through the sensitivity analysis shown in Table 3, we can further understand these two parameters' impact on decision variables.

Table. 3. Sensitivity analysis for Scenario 2 strategies

Strategies	$\frac{d}{d\beta}$	$\frac{d}{d\varepsilon}$
P_N	+	+
P_P	+	Na
A_2	Na	+
w	Na	+

NA: means not applicable

When the manufacturer fully invests in NB advertising, the NB and the PL's retail prices are positively correlated with brand competitiveness. The PL retail price, the advertising cost, and the NB wholesale price are positively linked to advertising effectiveness.

3.4. Comparing Scenario 0, Scenario 1 and Scenario 2

Table. 4. presents a comparison of profits to investigate the impact of NB advertising on those of the supply chain players and examine whether it is beneficial for the platform retailer (Scenario 1) or the manufacturer (Scenario 2) to fully support the NB local advertising compared to the situation in which no advertising is invested (Scenario 0).

Table 4. Comparison of profits in Scenarios 2, 1 and 0

Profit	Scenario1- Scenarios 0	Scenario 2- Scenario 0	Scenario 2- Scenario 1
Π_R	>0	>0	>0
Π_M	>0	>0	>0
Π_C	>0	>0	>0

In Scenario 2: the M advertises the NB – in Scenario 1: the R advertises the NB – In Scenario 0: no advertising.

Proof: See Appendix A.5.

By comparing profits in Scenarios 0, 1 and 2 in Table. 4, we obtain the following propositions:

Proposition 1. If either the manufacturer or the retailer fully supports NB advertising, all supply chain players can achieve Pareto improvement compared to the situation where no advertising occurs.

Proposition 2. All supply chain players can benefit more from the manufacturer's full support for NB advertising than the retailer's full support.

The results show that when the manufacturer undertakes all advertising costs, the retailer can achieve higher profits. Furthermore, under the feasible regions of β $(0 < \beta < 1)$and ε $(0 < \varepsilon < 1)$, we find:

$$\Pi_R{}^{(2-1)} - \Pi_M{}^{(2-1)} > 0 \quad (19)$$

$$\Pi_R{}^{(2)\prime}(A_2) - \Pi_R{}^{(1)\prime}(A_1) > 0 \quad (20)$$

Proof: See Appendix A.6.

Eq. (19) shows that the platform retailer captures more incremental profit than the manufacturer between Scenarios 1 and Scenario 2. Eq. (20) shows that the marginal profit resulting from itmanufacturer's full NB advertising is greater than that from its own advertising investment. Furthermore, the retail price of NB in Scenario 2 is lower than that in Scenario 1 (Proof: See Appendix A.7.). This means that the manufacturer's full support for NB advertising can bring social value to customers by providing lower-priced NB products. Based on the above analysis, we make the below proposition:

Proposition 3. The dominant retailer may prefer to motivate the manufacturer to invest in NB advertising because an incentive helps to promote value co-creation for the platform and its participant.

3.5. Scenario 3: the retailer sets up 'rebate bait'

Through the above analysis, the manufacturer's full support is preferred over that of the retailer as it generates higher social and business value. However, the increased profit created by the manufacturer is mainly captured by the dominant retailer. Specifically, Fig. 1. shows that when the manufacturer invests in NB advertising, the increase in its profit comprises a maximum of 14.29% of the total increase in the supply chain profit, which is far lower than that obtained by the retailer. As a gesture of reciprocity, the retailer tends to propose a rebate incentive to share the increased profit with the manufacturer, which in turn encourages the latter to fully advertise the NB.

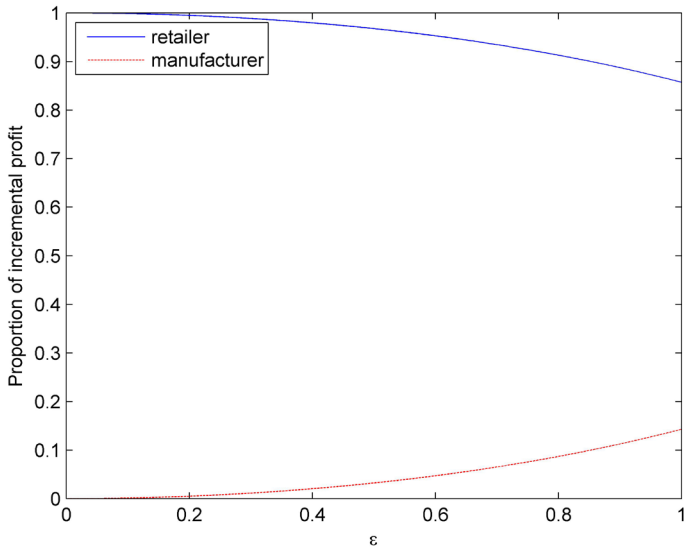

Fig. 1. The increased profit distribution in Scenario 2

3.5.1. For the manufacturer with high bargaining power

For the strong manufacturer, the NB has some unique advantages, such as high brand awareness, which may help the platform retailer attract customers and increase customer stickiness (Dawar & Stornelli, 2013). Therefore, under the situation where the strong manufacturer absorbs all advertising costs when the Nash equilibrium is reached, its profit is then:

$$\Pi^{(N)}{}_M = -\frac{\varepsilon^2-2}{2(\varepsilon^2-3)^2} \tag{21}$$

Compared to the manufacturer profit in Scenario 2, we find:

$$\Pi^{(N)}{}_M > \Pi^{(2)}{}_M \tag{22}$$

Proof: See Appendix A.8.

This means that a strong manufacturer may tend to bargain with the platform retailer to infinitely approach the optimal profit in the Nash equilibrium game. Therefore, the strong manufacturer might attempt to uncover opportunities to negotiate with the dominant retailer for an extra rebate incentive. As stated in Proposition 3, the dominant retailer tends to put forward a rebate inventive to motivate the manufacturer to fully support the NB advertising investment and consolidate the B2B relationship, thus achieving a win-win situation.

Achieving advertising cooperation between the dominant retailer and the strong manufacturer depends on two conditions in profit distribution:

Condition 1. the dominant retailer's profit under incentive cooperation is higher than that of Scenario 1, in which the retailer fully supports NB advertising.

Condition 2. the strong manufacturer's profit under incentive cooperation is higher than Scenario 2, where the manufacturer fully supports NB advertising.

Suppose the strong manufacturer finally obtains a share of the entire supply chain profit, $\alpha(0 \le \alpha \le 1)$:

$$\Pi_M^{(3)} = \alpha\Pi_C^{(2)}, \Pi_R^{(3)} = (1-\alpha)\Pi_C^{(2)} \tag{23}$$

From the above two conditions, the inequalities can be established:

$$\begin{cases} \Pi_M^{(3)} > \Pi_M^{(2)} & (24) \\ \Pi_R^{(3)} > \Pi_R^{(1)} & (25) \end{cases}$$

The value range of α is $(\alpha_{inf}, \alpha_{sup})$ when the cooperation is reached, where

$$\alpha_{inf} = \frac{\beta-1}{2(\beta+1)\varepsilon^2-\beta-7} \quad (26)$$

$$\alpha_{sup} = -\frac{(\beta-1)(\varepsilon^2+4)}{(\varepsilon^2-4)(2(\beta+1)\varepsilon^2-\beta-7)} \quad (27)$$

For β and ε in given feasible regions, if $\alpha_{inf} < \alpha_{sup}$, it means that there is bargaining space between the dominant retailer and the manufacturer and the parameter α within $(\alpha_{inf}, \alpha_{sup})$can ensure the establishment of cooperation between two players. If$\alpha_{inf} \geq \alpha_{sup}$, regardless of how the increased profit is distributed, the retailer and the manufacturer cannot be simultaneously satisfied and achieve cooperation. That is, the retailer and the manufacturer cannot obtain Pareto improving through cooperation.

We define the variable: $\Delta\alpha = \alpha_{sup} - \alpha_{inf}$ to measure the bargaining space between the dominant retailer and the manufacturer. The feasible regions of β and ε are as follows respectively:

$$\Delta\alpha'(\beta) < 0, \ \Delta\alpha'(\varepsilon) > 0 \quad (28)$$

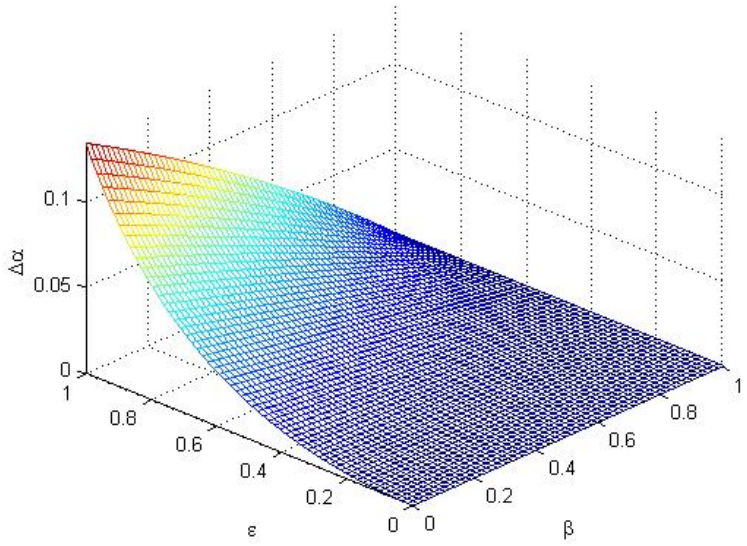

Fig. 2. Bargaining space $\Delta\alpha$

As shown in Fig. 2., the finding indicates that when product competitiveness is higher, the bargaining space between two players is smaller; when NB advertising effectiveness is greater, the bargaining space between two players is greater. However, although the dominant retailer may offer an incentive to the strong manufacturer, it still receives most of the increased profit as it tends to have the priority to adjust the the rebate's scope.

Proposition 4. When the bargaining space between two players $\Delta\alpha > 0$, $\alpha \in (\alpha_{inf}, \alpha_{sup})$, the dominant retailer tends to provide 'rebate bait' for the strong manufacturer based on proportion α and can still obtain a greater share of the increased profit than the manufacturer.

3.5.2. For the manufacturer with low bargaining power

For the weak manufacturer, its bargaining power is relatively lower than the dominant retailer. Therefore, it can only make decisions under the leadership of the dominant retailer. Specifically, in a retailer-led market, the weak manufacturer could optimize its profit by fully investing in NB advertising. As a result, the dominant retailer does not need to take incentive measures.

When the manufacturer's bargaining power is low, the bargaining space for both players is:

$$\Delta\alpha \in (0, \alpha_{sup}) \quad (29)$$

Proposition 5. The dominant retailer does not have to motivate the weak manufacturer through rebate incentives because the latter is willing to pay for all NB advertising.

4. Results

Based on the above analysis, we summarize the main research results. As presented in Fig. 3 and Table 5, the paper presents the overall game and the platform retailer's profits and the manufacturer in all scenarios to explore the coopetition in the B2B relationship through value creation and appropriation. To be specific, we obtain the following results:

From our comparison of Scenario 0, Scenario 1, and Scenario 2, we find that the NB advertising investment fully paid by either the retailer (Scenario 1) or the manufacturer (Scenario 2) can prompt profit improvement for both players and a Pareto improvement for the entire supply chain compared to Scenario 0 where no NB advertising occurs (Mora Cortez, Gilliland, & Johnston, 2020; Dant & Berger, 1996; Huang, Li, & Mahajan, 2002; Yan, 2010; Aust & Buscher, 2012). Therefore, NB advertising allows the retailer and the manufacturer to co-create value and expands the existing product market.

Considering the comparison of Scenario 1 and Scenario 2, it is better for the manufacturer to absorb the full expense of NB advertising as Scenario 2 generates a higher surplus of profit for the retailer and the manufacturer and a lower price for customers. This finding differs from those of the prior literature, which focuses on NB advertising that the retailer mainly supports (compared to Amrouche & Yan, 2017; Alaei, Alaei, & Salimi, 2014). The manufacturer's full support for NB advertising can generate higher social and business value in the platform alliance.

As the increased profit created by the manufacturer's support for NB advertising is mainly captured by the dominant retailer, the platform retailer may set 'rebate bait' to effectively stimulate the manufacturer to invest in advertising and promote the B2B relationship. Rebate bait promotes positive interdependencies between the platform retailer and the manufacturer and the formation of sustainable strategic alliances, bringing satisfactory performance for all supply chain players (Amrouche and Yan, 2017).

For the strong manufacturer, the competitive situation, advertising effectiveness, and negotiation ability of the game players tend to determine the cooperative advertising approach (as Zhang, Guo, Hu, & Wang, 2020). Specifically, the lower the product competitiveness and the greater the advertising effectiveness, the higher the bargaining space between the two players. On the contrary, the weak manufacturer is likely to bear all the advertising costs and accept profit appropriation by the dominant retailer because it can still receive more profits than those received under a scenario in which no entity invests in NB advertising and also share the retailer's contribution channel to accumulate its NB reputation in a platform provided by the retailer.

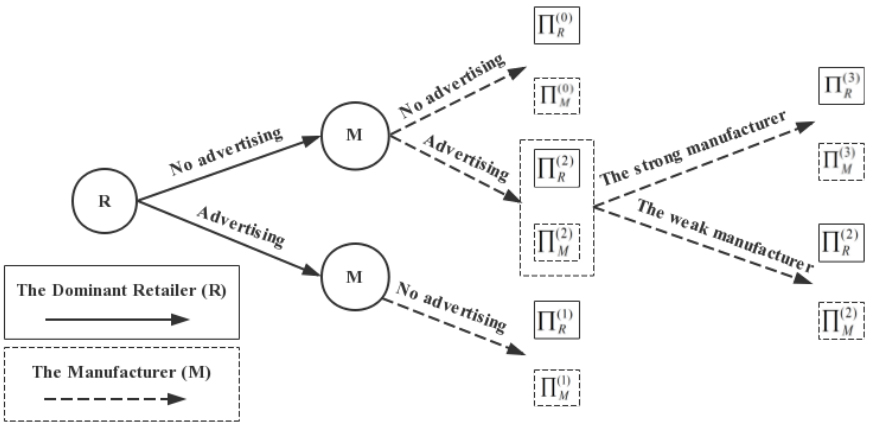

Fig. 3. The overall game

Table 5. Order of profits for all scenarios

	Order of profits
Retailer profit	$\Pi_R^{(2)} > \Pi_R^{(3)} > \Pi_R^{(1)} > \Pi_R^{(0)}$
Manufacturer profit	$\Pi_M^{(3)} > \Pi_M^{(2)} > \Pi_M^{(1)} > \Pi_M^{(0)}$
Supply chain profit	$\Pi_C^{(3)} = \Pi_C^{(2)} > \Pi_C^{(1)} > \Pi_C^{(0)}$

5. Conclusion

This paper aims to examine whether and how the B2B strategic alliance between the platform retailer and the manufacturer could achieve social and business value through value co-creation. Our work explores the coopetitive dynamics between B2B advertising strategic alliances through value creation and value appropriation. We provide a retailer-dominated Stackelberg game framework to examine the dominant retailer and manufacturer's role in the game of the NB advertising strategy. Below we outline the main research findings.

a) Compared to the situation where no advertising occurs, either the retailer or the manufacturer supporting NB advertising in the platform strategic alliance prompts a Pareto improvement of both players and generates higher social and business value in the process of value co-creation.

b) The manufacturer's full support is preferred over that of the retailer as it achieves a higher surplus of profits for all parties and the entire supply chain. However, the increased profit would be mainly occupied by the dominant retailer. This shows that the B2B advertising cooperation in the platform alliance leads to an unequal win-win result.

c) The dominant retailer may take an incentive mechanism of 'rebate bait' determined by manufacturers' different power structures to motivate the latter's fully support advertising on the NB and consolidate the platform B2B alliance. The dominant retailer can stimulate it to invest in NB advertising through small or even zero rebates for the weak manufacturer with low bargaining power. For the strong manufacturer with high bargaining power, the bargaining space between two players is negatively related to brand competitiveness and positively related to advertising effectiveness.

The paper has theoretical contributions in two main dimensions. First, from the perspective of value co-creation, the paper enriches the path explanation of social innovation. Previous studies have mainly focused on how not-for-profit organizations achieve social value through innovative products or services and how to serve specific recipients and solve social problems (De Silva et al., 2020; Defourny & Nyssens, 2010; Mulgan, 2006). However, in an era where technological innovation brings innovative business models and stimulates disruptive innovation, we attempt to explore the dual value realized by emerging digital business practices such as platform economy and broaden our understanding of inclusive social innovation through platform alliances. Second, from the perspective of dynamic coopetition, this paper reveals the coopetitive relationships of platform strategic alliances in the process of value co-creation. We explain the partially convergent interest structure in the alliance and reveal the existence of unequal win-win result in the alliance relationship. Our study discusses how to balance the contradiction between value creation and value appropriation and how to deal with the contradictory logic of cooperation and competition in the value co-creation process, instead of treating cooperation and competition as independent and opposing forces (Gnyawali et al. 2016). The balance of the coopetitve relationship through the value co-creation alliance tends to be complicated and dynamic (Babu, Dey, Rahman, Roy & Kamal, 2020; Silvaa, Khanb, Vorleyc, Zeng, 2019; Chou & Zolkiewski, 2018).

The findings of this study generate several practical implications for the platform-based value co-creation alliance. First, we provide a new perspective of social innovation through the B2B value co-creation relationship between the platform retailer and the manufacturer. We attach importance to the destructive innovation power of digital technologies that innovate value creation and appropriation and cultivate open business systems that accommodate multiple participants and create a wider social and business value range. Second, the paper suggests that the B2B relationship between the platform and the manufacturer becomes an unequal win-win relationship. Although value is delivered through cooperation for both players, all actors' benefits may not be equally enjoyed (Babu, Dey, Rahman, Roy & Kamal, 2020). Therefore, the dominant platform may tend to set 'rebate bait' as an incentive to motivate the manufacturer to afford NB advertising investment fully. Furthermore, this finding also reminds regulators to be wary of participants' profit exploitation by the powerful platform and carry out regulatory guidelines to promote fairer value co-creation and the sustainable development of the platform economy.

Our study has limitations, and future research can be extended in several directions. First, this paper offers a unique insight to research social innovation by analysing value co-creation through

cooperative advertising alliance. Future papers can further explore the value of new-age platforms through various B2B relationships in social innovation by considering multiple actors (e.g., a three-echelon supply chain comprising the supplier, the manufacturer, and the retailer, or the coopetitive relationships between for-profit and not-for-profit organizations) and different strategic alliances (e.g., vertical and horizontal social innovation alliances or traditional contract form and trust form of B2B alliances). Second, the game process elaborated in this paper is discussed as a static game; thus, repeated games may be further analysed in future research. The analysis of empirical models that incorporate various decision variables and that influence the purchasing decision process seems to be an interesting area of future research pertaining to the digital platform's advertising strategy.

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Appendix

A.1. Proof of the optimal prices of the PL and the NB in Scenario 1

The corresponding profit functions that are maximized for the retailer and the manufacturer can be written as follows:

$$\underset{P_N,P_P,A_1}{Max}\ \Pi_R = (1 - P_N + \beta P_P + \varepsilon A_1)(P_N - w) + (1 - P_P + \beta P_N - \beta\varepsilon A_1)P_P - \frac{1}{2}{A_1}^2 \quad (30)$$

$$\underset{w}{Max}\Pi_M = (1 - P_N + \beta P_P + \varepsilon A_1)w \quad (31)$$

We assume $\mathrm{P_N} = \mathrm{P_i} + \mathrm{w}$, in which the variable $\mathrm{P_i}$ represents the unit profit obtained by the retailer from the NB sales. We utilize this equation in Eq. (31) and find the first derivative of Eq. (31) for variable w. We then obtain:

$$\frac{d\Pi_M}{dw} = 1 - (P_N - w) - 2w + \beta P_P + \varepsilon A_1 \quad (32)$$

When Eq. (32) is set to 0, the manufacturer's response function to the retailer's decision is obtained as follows:

$$w = 1 - P_N + \beta P_P + \varepsilon A_1 \quad (33)$$

When we substitute Eq. (33) into Eq. (30), we find the first-order partial derivatives for A_1, P_N, and P_P, respectively:

$$\begin{cases} \dfrac{\partial \Pi_R}{\partial A_1} = 3\varepsilon P_N - 3\beta\varepsilon P_P - 2(\varepsilon^2 + 1)A_1 - 2\varepsilon & (34) \\ \dfrac{\partial \Pi_R}{\partial P_N} = 3 - 4P_N + 4\beta P_P + 3\varepsilon A_1 & (35) \\ \dfrac{\partial \Pi_R}{\partial P_P} = 1 - 2(\beta^2 + 1)P_P + 4\beta P_N - 3\beta\varepsilon A_1 - 2\beta & (36) \end{cases}$$

When Eq. (34), Eq. (35) and Eq. (36) are set to 0, the optimal retail prices of the PL and the NB are obtained as follows:

$$P_N = -\frac{\beta\varepsilon^2 + 2\beta - 6}{2(\varepsilon^2 - 4)(\beta - 1)},\ P_P = -\frac{1}{2(\beta - 1)},\ A_1 = -\frac{\varepsilon}{(\varepsilon^2 - 4)} \quad (37)$$

$$w = -\frac{1}{(\varepsilon^2 - 4)} \quad (38)$$

A.2. Proof of sensitivity analysis for Scenario 1 strategies

The corresponding partial derivatives of the strategies regarding the parameters can be written as follows:

$$\begin{cases} \frac{\partial P_N}{\partial \beta} = \frac{1}{2(\beta-1)^2} & (39) \\ \frac{\partial P_P}{\partial \beta} = \frac{1}{2(\beta-1)^2} & (40) \\ \frac{\partial A_1}{\partial \beta} = 0 & (41) \\ \frac{\partial w}{\partial \beta} = 0 & (42) \end{cases}$$

$$\begin{cases} \frac{\partial P_N}{\partial \varepsilon} = \frac{6\varepsilon}{(\varepsilon^2-4)^2} & (43) \\ \frac{\partial P_P}{\partial \varepsilon} = 0 & (44) \\ \frac{\partial A_1}{\partial \varepsilon} = \frac{(\varepsilon^2+4)}{(\varepsilon^2-4)^2} & (45) \\ \frac{\partial w}{\partial \varepsilon} = \frac{2\varepsilon}{(\varepsilon^2-4)^2} & (46) \end{cases}$$

As parameters β and ε are more than 0 and less than 1, and the square terms are greater than 0, we obtain a result in which Eq. (39), Eq. (40), Eq. (43), Eq. (45) and Eq. (46) are all greater than 0.

A.3. Proof of the strategies in which the retailer increases prices

We establish a function for product sales as follows:

$$\begin{aligned} \Pi_{sale} &= (1 - P_N + \beta P_P)P_N + (1 - P_P + \beta P_N)P_P \\ &= (P_N + P_P) - (P_N - P_P)^2 - 2(1-\beta)P_N P_P \end{aligned} \quad (47)$$

From Eq. (47), it can be seen that the more intense the product competition, the less attention will be paid to the item $-2(1-\beta)P_N P_P$. Therefore, the retailer tends to consider the item $(P_N + P_P)$ and the item$-(P_N - P_P)^2$. To obtain more profits, the retailer is likely to reduce the price gap between the NB and the PL and increase the sum of the prices of the two products.

A.4. Proof of the optimal prices of the PL and the NB in Scenario 2

The corresponding profit functions that are maximized for the retailer and the manufacturer can be written as follows:

$$\begin{aligned} \underset{P_N, P_P, A_1}{Max}\ \Pi_R &= (1 - P_N + \beta P_P + \varepsilon A_2)(P_N - w) \\ &\quad + (1 - P_P + \beta P_N - \beta\varepsilon A_2)P_P \end{aligned} \quad (48)$$

$$\underset{w}{Max}\Pi_M = (1 - P_N + \beta P_P + \varepsilon A_2)w - \frac{1}{2}{A_2}^2 \quad (49)$$

Assuming $P_N = P_i + w$, in which the variable P_i represents the unit profit obtained by the retailer from the NB sales, the first derivative of Eq. (49) for variables w and A_2 as follows:

$$\frac{d\Pi_M}{dw} = 1 - (P_N - w) - 2w + \beta P_P + \varepsilon A_2 \quad (50)$$

$$\frac{d\Pi_M}{dA_2} = \varepsilon w - A_2 \quad (51)$$

When Eq. (50) and Eq. (51) are set to 0, the manufacturer's response function to the retailer's decision is obtained as follows:

$$w = -\frac{1-P_N+\beta P_P}{(\varepsilon^2-1)} \tag{52}$$

$$A_2 = -\frac{\varepsilon(1-P_N+\beta P_P)}{(\varepsilon^2-1)} \tag{53}$$

When we substitute Eq. (52) and Eq. (53) into Eq. (48), we find the first-order partial derivatives for P_N and P_P, respectively:

$$\begin{cases} \dfrac{\partial \Pi_R}{\partial P_N} = \dfrac{3-\varepsilon^2+2(\varepsilon^2-2)P_N+2\beta(2-\varepsilon^2)P_P}{(\varepsilon^2-1)^2} & (54) \\ \dfrac{\partial \Pi_R}{\partial P_P} = \dfrac{1+\varepsilon^4-2\varepsilon^2+\beta\varepsilon^4-\beta\varepsilon^2-2\beta+2\beta(2-\varepsilon^2)P_N+C_1P_P}{(\varepsilon^2-1)^2} & (55) \end{cases}$$

Where $C_1 = 2\beta^2\varepsilon^4 - 2\beta^2\varepsilon^2 - 2\beta^2 - 2\varepsilon^4 + 4\varepsilon^2 - 2$.

When Eq. (54) and Eq. (55) are set to 0, the optimal retail prices of the PL and the NB are obtained:

$$P_N = -\frac{\varepsilon^2+\beta-3}{2(\varepsilon^2-2)(\beta-1)}\ ,\ P_P = -\frac{1}{2(\beta-1)}, \tag{56}$$

$$w = -\frac{1}{2(\varepsilon^2-2)}\ ,\ A_2 = -\frac{\varepsilon}{2(\varepsilon^2-2)} \tag{57}$$

A.5. Proof of Table 4

The expressions of the supply chain players' profits in Scenarios 0, 1 and 2 are shown in Table 5:

Table 5. Profits of the retailer, the manufacturer, and the supply chain in Scenarios 2, 1 and 0

Item	Scenario 0	Scenario 1	Scenario 2
Π_M	$\frac{1}{16}$	$\frac{1}{(\varepsilon^2-4)^2}$	$-\frac{1}{8(\varepsilon^2-2)}$
Π_R	$\frac{-(\beta+3)}{8(\beta-1)}$	$\frac{(-\beta-1)\varepsilon^2+2\beta+6}{4(\beta-1)(\varepsilon^2-4)}$	$\frac{(-\beta-1)\varepsilon^2+\beta+3}{4(\beta-1)(\varepsilon^2-2)}$
Π_C	$-\frac{\beta+7}{16(\beta-1)}$	$\frac{(-\beta-1)\varepsilon^4+(6\beta+10)\varepsilon^2-4\beta-28}{4(\beta-1)(\varepsilon^2-4)^2}$	$\frac{2(-\beta-1)\varepsilon^2+\beta+7}{8(\beta-1)(\varepsilon^2-2)}$

Comparison of the optimal profits of the retailer, the manufacturer, and the supply chain in Scenario 0, Scenario 1, and Scenario 2 is as follows:

① $\Pi_R^{(2)} - \Pi_R^{(0)} = -\frac{\varepsilon^2}{8(\varepsilon^2-2)} > 0$ (58)

② $\Pi_R^{(1)} - \Pi_R^{(0)} = -\frac{\varepsilon^2}{8(\varepsilon^2-4)} > 0$ (59)

③ $\Pi_R^{(2)} - \Pi_R^{(1)} = \frac{\varepsilon^2}{4(\varepsilon^4-6\varepsilon^2+8)} = \frac{\varepsilon^2}{4(\varepsilon^2-2)(\varepsilon^2-4)} > 0$ (60)

④ $\Pi_M^{(2)} - \Pi_M^{(0)} = -\frac{1}{8(\varepsilon^2-2)} - \frac{1}{16} > 0$ (61)

⑤ $\Pi_M^{(1)} - \Pi_M^{(0)} = \frac{1}{(\varepsilon^2-4)^2} - \frac{1}{16} > 0$ (62)

⑥ $\Pi_M^{(2)} - \Pi_M^{(1)} = -\frac{1}{8(\varepsilon^2-2)} - \frac{1}{(\varepsilon^2-4)^2} = -\frac{\varepsilon^4}{8(\varepsilon^2-2)(\varepsilon^2-4)^2} > 0$ (63)

⑦ $\Pi_C^{(2)} - \Pi_C^{(0)} = -\frac{3\varepsilon^2}{16(\varepsilon^2-2)} > 0$ (64)

⑧ $\Pi_C^{(1)} - \Pi_C^{(0)} = -\frac{\varepsilon^2(3\varepsilon^2-16)}{16(\varepsilon^2-4)^2} > 0$ (65)

⑨ $\Pi_C^{(2)} - \Pi_C^{(1)} = \frac{\varepsilon^2(\varepsilon^2-8)}{8(\varepsilon^2-2)(\varepsilon^2-4)^2} > 0$ (66)

A.6. Proof of the incremental profits of the retailer and the manufacturer between Scenarios 1 and Scenario 2

$$\Pi_R{}^{(2-1)} = \Pi_R{}^{(2)} - \Pi_R{}^{(1)} = \frac{\varepsilon^2}{4(\varepsilon^4-6\varepsilon^2+8)} \quad (67)$$

$$\Pi_M{}^{(2-1)} = \Pi_M{}^{(2)} - \Pi_M{}^{(1)} = -\frac{\varepsilon^2}{8\varepsilon^6-80\varepsilon^4+256\varepsilon^2-256} \quad (68)$$

$$\Pi_R{}^{(2-1)} - \Pi_M{}^{(2-1)} = \frac{\varepsilon^2(3\varepsilon^2-8)}{8\varepsilon^6-80\varepsilon^4+256\varepsilon^2-256} \quad (69)$$

In Eq. (69), the numerator and the denominator are both less than 0, so we then have:

$$\Pi_R{}^{(2-1)} - \Pi_M{}^{(2-1)} > 0 \quad (70)$$

The functions of the retailer's profits in Scenarios 1 and Scenario 2 regarding advertising inputs A_2 and A_1 are as follows:

$$\Pi_R{}^{(2)}(A_2) = \frac{16(\beta-1){A_2}^2-2(\beta+1)\left(32{A_2}^2+1\right)^{\frac{1}{2}}+2(\beta+1)}{8(\beta-1)\left(\left(32{A_2}^2+1\right)^{\frac{1}{2}}-1\right)} \quad (71)$$

$$\Pi_R{}^{(1)}(A_1) = \frac{\mp 8(\beta-1){A_1}^2-2(\beta+1)\left(16{A_1}^2+1\right)^{\frac{1}{2}}+2(\beta+1)}{8(\beta-1)\left(\left(16{A_1}^2+1\right)^{\frac{1}{2}}-1\right)} \quad (72)$$

The first-order partial derivatives for A_2 and A_1 are as follows:

$$\Pi_R{}^{(2)\prime(A_2)} = \frac{2A_2}{\left(32A_2^2+1\right)^{\frac{1}{2}}} \quad (73)$$

$$\Pi_R{}^{(1)\prime}(A_1) = \frac{A_1}{\left(16A_1^2+1\right)^{\frac{1}{2}}} \quad (74)$$

Assuming both advertising inputs A_2 and A_1 equal A, then:

$$\Pi_R{}^{(1)\prime}(A) = \frac{A}{\left(16A^2+1\right)^{\frac{1}{2}}} = \frac{2A}{2\left(16A^2+1\right)^{\frac{1}{2}}} = \frac{2A}{\left(64A^2+4\right)^{\frac{1}{2}}} = \frac{2A}{\left(32A^2+1+32A^2+3\right)^{\frac{1}{2}}} < \frac{2A}{\left(32A^2+1\right)^{\frac{1}{2}}} = \Pi_R{}^{(2)\prime}(A) \Rightarrow$$

$$\Pi_R{}^{(2)\prime(A_2)} - \Pi_R{}^{(1)\prime(A_1)} > 0 \quad (75)$$

The simulation result is shown in Fig. 4.

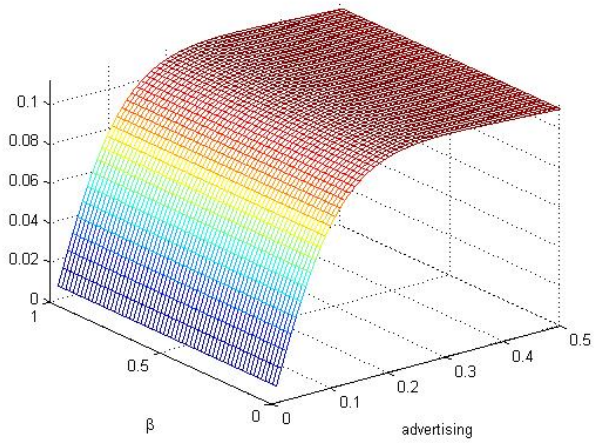

Fig. 4. Numerical simulation of the marginal profit

A.7. Comparison of prices:

Comparison of the NB prices in Scenario 0, Scenario 1, and Scenario 2 is as follows:

$$P_N^{(1)} - P_N^{(0)} = -\frac{3\varepsilon^2}{4(\varepsilon^2-4)} > 0 \tag{76}$$

$$P_N^{(2)} - P_N^{(0)} = -\frac{\varepsilon^2}{4(\varepsilon^2-2)} > 0 \tag{77}$$

$$P_N^{(2)} - P_N^{(1)} = \frac{\varepsilon^2(\varepsilon^2-1)}{2(\varepsilon^4-6\varepsilon^2+8)} < 0 \tag{78}$$

A.8. Profit derivation under Nash equilibrium:

The corresponding profit functions that are maximized for the retailer and the manufacturer can be written as follows:

$$\underset{P_N,P_P,A_1}{Max}\ \Pi_R = (1 - P_N + \beta P_P + \varepsilon A_2)(P_N - w) + (1 - P_P + \beta P_N - \beta\varepsilon A_2)P_P \tag{79}$$

$$\underset{w}{Max}\Pi_M = (1 - P_N + \beta P_P + \varepsilon A_2)w - \frac{1}{2}{A_2}^2 \tag{80}$$

Assuming $P_N = P_i + w$, in which the variable P_i represents the unit profit obtained by the retailer from the NB sales. We utilize this equation in Eq. (80). The first-order conditions for Nash equilibrium are as follows:

$$\begin{cases} \dfrac{\partial \Pi_M}{\partial w} = 1 - (P_N - w) - 2w + \beta P_P + \varepsilon A_2 & (81) \\ \dfrac{\partial \Pi_M}{\partial A_2} = \varepsilon w - A_2 & (82) \\ \dfrac{\partial \Pi_R}{\partial P_N} = w - 2P_N + A_2\varepsilon + 2\beta P_P + 1 & (83) \\ \dfrac{\partial \Pi_R}{\partial P_P} = \beta P_N - 2P_P + \beta(P_N - w) - A_2\beta\varepsilon + 1 & (84) \end{cases}$$

When Eq. (81), Eq. (82), Eq. (83) and Eq. (84) are set to 0, the optimal retail prices of the PL and the NB are obtained:

$$P_N = -\frac{\beta\varepsilon^2+\beta-4}{2(\varepsilon^2-3)(\beta-1)}\ ,\ P_P = -\frac{1}{2(\beta-1)}\ , \tag{85}$$

$$w = -\frac{1}{\varepsilon^2-3},\ A_2 = -\frac{\varepsilon}{\varepsilon^2-3} \tag{86}$$

The optimal profit under Nash equilibrium for the manufacturer is given by:

$$\Pi^{(N)}{}_M = -\frac{\varepsilon^2-2}{2(\varepsilon^2-3)^2} \tag{87}$$

$$\Pi^{(N)}{}_M - \Pi^{(2)}{}_M = -\frac{\varepsilon^2-2}{2(\varepsilon^2-3)^2} - \left(-\frac{1}{8(\varepsilon^2-2)}\right) = \frac{-3\varepsilon^4+10\varepsilon^2-7}{8(\varepsilon^2-2)(\varepsilon^2-3)^2}$$

$$= \frac{(-3\varepsilon+7)(\varepsilon-1)}{8(\varepsilon^2-2)(\varepsilon^2-3)^2} > 0 \tag{88}$$